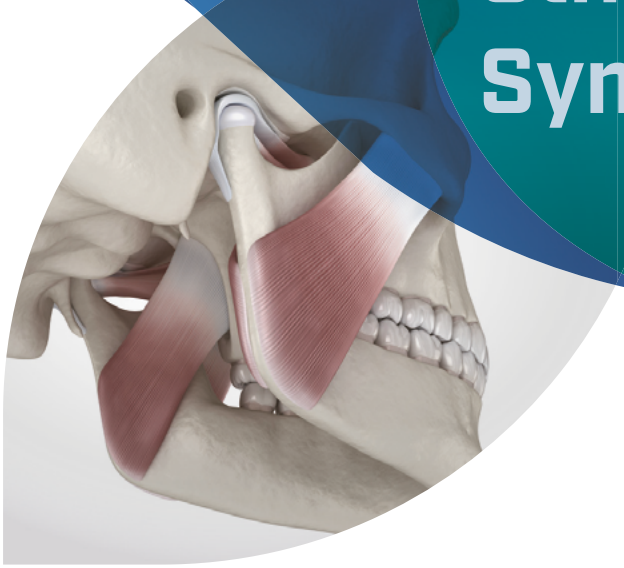
Proceedings of the 5th Sino-German Symposium



14th-15th October | Münster Germany

TMJ and Related Skeleton Surgical Treatments

17th-18th October | Innsbruck Austria

Cadaver Training Course for Yang's TMJ Surgical Techniques

Arthroscopic Discopexy, Open Discopexy, Total Joint Replacement

Host

Duisburg-Essen University IMC International Medical College, Germany
Shanghai Jiao Tong University, School of Medicine, College of Stomatology, China

Scientific Endorsement

European Association for Cranio-Maxillo-Facial Surgery, Europe
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German Surgical Foundation, Germany
National Clinical Research Center for Oral Diseases(Shanghai), China

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TMJ and Related Skeleton Surgical Treatments: Proceedings of the 5th Sino-German Symposium 2024

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Abstract

The 5th Sino-German Symposium 2024 convened leading experts in temporomandibular joint (TMJ) disorders, hosted by Duisburg-Essen University and Shanghai Jiao Tong University. The symposium aimed to enhance collaboration and knowledge exchange between scholars from Germany and China. Attendees explored a variety of topics, including anterior disc displacement, condylar resorption, and advanced surgical techniques for TMJ.

Session I addressed anterior disc displacement and condylar resorption, highlighting both surgical and conservative treatment options alongside the utility of MRI for radiological diagnoses. Session II focused on the complexities of condylar fractures and ankylosis, discussing treatment protocols and soft tissue management, with considerable dialogue surrounding the Shanghai protocol for ankylosis. Session III examined TMJ reconstruction methods, including costochondral grafts and alloplastic replacements, emphasizing the need to balance innovative approaches with established surgical practices. Finally, Session IV tackled clinical issues related to TMJ and cranio-jaw interactions, including complications from TMJ prostheses and multidisciplinary approaches to complex cases.

The symposium was co-organized by key organizations such as German Surgical Foundation, Chinese Stomatological Association, Chinese Society of Oral and Maxillofacial Surgery and the National Clinical Research Center for Oral Diseases (Shanghai), China, highlighting its collaborative nature. The proceedings aim to advance the understanding and treatment of TMJ disorders, ultimately benefiting both practitioners and patients in the field.

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Archive of Orofacial Data Science

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Contents

Table 1. Speakers at the 5th Sino-German Symposium 2024, in alphabetical order.

NAME	POSITION	INSTITUTION
Dr. Guo Bai	Oral maxillofacial surgeon	Attending doctor, Department of Oral Surgery, Shanghai Ninth People's Hospital, China
Prof. Minjie Chen	Oral maxillofacial surgeon	Professor, Department of Oral Surgery, Shanghai Ninth People's Hospital, China
Prof. Joel Ferri	Maxillofacial surgeon	Director and Chairman, Maxillo-Facial Department, University Hospital Lille, France
Prof. Thomas Fillies	Maxillofacial surgeon	Director, Maxillo-Facial Department, Marienhospital Stuttgart, Germany
Prof. Dongmei He	Oral maxillofacial surgeon	Professor, Department of Oral Surgery, Shanghai Ninth People's Hospital, China
Dr. Zixian Jiao	Oral maxillofacial surgeon	Attending doctor, Department of Oral Surgery, Shanghai Ninth People's Hospital, China
Prof. Ulrich Joos	Maxillofacial surgeon	Director and Chairman em. Maxillo-Facial Department, University Hospital Münster, Germany International Medical College University Duisburg-Essen, Germany
Prof. Gero Kinzinger	Orthodontist	Professor, IMC University Duisburg-Essen, Germany
Prof. Günter Lauer	Maxillofacial surgeon	Director and Chairman, Department of Oral and Maxillofacial Surgery, University Hospital Carl-Gustav-Carus Technische Universität Dresden, Germany
Dr. Xiaohan Liu	Oral maxillofacial surgeon	Attending doctor, Department of Oral Surgery, Shanghai Ninth People's Hospital, China
Prof. Florencio Monje	Oral maxillofacial surgeon	Director, Department of Oral and Maxillofacial Surgery, Medical School Extremadura University, Badajoz, Spain
Prof. Leonard Duarte Moreira	Oral maxillofacial surgeon	Associate Professor, Department of Oral and Maxillofacial Surgery and Traumatology (OMFST), Medical Center, Hospital Vivalle São José dos Campos, São Jose dos Campos, SP, Brazil
Prof. Andreas Neff	Maxillofacial surgeon	Director and Chairman, Maxillofacial Department, University Hospital Marburg, Germany
Prof. Jozsef Piffko	Maxillofacial surgeon	Director and Chairman, Maxillofacial Department, University Hospital Szeged, Hungary
Dr. Robert Schuon	ENT Surgeon	Senior Lecturer, Medical University Hannover, Germany International Medical College University Duisburg Essen, Germany
Dr. Pei Shen	Orthodontist	Attending doctor, Department of Oral Surgery, Shanghai Ninth People's Hospital, China
Prof. Andrew Sidebottom	Oral maxillofacial surgeon	Director and Chairman, Maxillofacial Department, Nottingham University Hospital, Nottingham, UK
Prof. Paulo Alexandre da Silva	Oral maxillofacial surgeon	Surgeon and Medical Doctor, Department of Oral and Maxillofacial Surgery and Traumatology (OMFST), Medical Center, Hospital Vivalle São José dos Campos, São Jose dos Campos, SP, Brazil
Prof. Thomas Stamm	Orthodontist	Associate Professor, Orthodontic Department, University Hospital Münster, Germany
Prof. Ulrich Sure	Neurosurgeon	Director and Chairman, Neurosurgical Department, University Hospital Essen, Germany
Dr. Bernhard Weiland	Maxillofacial surgeon	Surgeon and Medical Doctor, Department of Oral and Maxillofacial Surgery, University Hospital Carl-Gustav-Carus Technische Universität Dresden, Germany
Dr. Qianyang Xie	Orthodontist	Attending doctor, Department of Oral Surgery, Shanghai Ninth People's Hospital, China
Prof. Chi Yang	Oral maxillofacial surgeon	Vice Dean, Shanghai Jiao Tong University, School of Medicine, College of Stomatology. Department of Oral Surgery, Shanghai Ninth People's Hospital, China
Prof. Shanyong Zhang	Oral maxillofacial surgeon	Professor, Department of Oral Surgery, Shanghai Ninth People's Hospital, China
Dr. Jisi Zheng	Oral maxillofacial surgeon	Attending doctor, Department of Oral Surgery, Shanghai Ninth People's Hospital, China
Prof. Songsong Zhu	Oral maxillofacial surgeon	Chairman, Department of Orthognathic and TMJ Surgery, West China Hospital of Stomatology, Sichuan University, Chengdu, China

Introduction

The 5th Sino-German Symposium 2024 marked a significant gathering of leading experts and practitioners in the field of temporomandibular joint (TMJ) disorders and associated surgical interventions. Hosted by the Duisburg-Essen University, IMC International Medical College in Germany, and Shanghai Jiao Tong University School of Medicine, College of Stomatology in China, this symposium aimed to foster collaboration and knowledge exchange between scholars from both nations.

During the course of the symposium, a diverse range of topics was explored, covering the complexities of anterior disc displacement and condylar resorption, the intricate management of condylar fractures and ankylosis, and advanced reconstruction techniques for TMJ. The program featured esteemed speakers and numerous prominent personalities in this field. Their research, which spans decades of surgical data, innovative treatment protocols, and the latest technological advances, provided invaluable information on TMJ-related surgical practices.

Session I discussed anterior disc displacement and condylar resorption, discussing surgical and conservative treatment options. The presentations included critical evaluations of radiological diagnoses by MRI and the biomechanics of jaw disorders, thereby setting the stage for the multifaceted discussions that followed.

In session II, the focus was on the intricacies of condylar fractures and ankylosis. Key topics such as treatment protocols, soft tissue management during operations, and the Shanghai protocol for ankylosis generated notably engaging discourse among participants.

Session III covered various methods of TMJ reconstruction, including costochondral grafts and alloplastic replacements, with an emphasis on outcomes and practical techniques in surgery. This session proved crucial to understanding the balance between innovative approaches and established surgical practices that underpin oral and maxillofacial surgery.

Lastly, session IV addressed clinical concerns related to TMJ and cranio-jaw interactions, with pertinent discussions on complications arising from TMJ prostheses and the integration of various surgical disciplines in treating complex cases.

This symposium was scientifically co-organized by significant organisations such as the European Association for Cranio-Maxillo-Facial Surgery and the Chinese Stomatological Association, reflecting the collaborative spirit that pervaded the event. By bringing together experts from diverse backgrounds, the symposium enhanced knowledge and developed new perspectives in TMJ surgical treatments.

We invite you to engage with the proceedings of this symposium in the hope that the presented research and discussions inspired further advancements in the understanding and management of TMJ disorders, ultimately benefitting both practitioners and patients alike.

Session I - Anterior Disc Displacement and Condylar Resorption

I.1 Twenty-three years' surgery data and TMJ originated dentomaxillofacial deformities

Chi Yang. In the lecture on the developments in temporomandibular joint (TMJ) surgery, Prof. Yang provided a detailed overview of how this field has evolved significantly over the years. It was highlighted that back in 2001, only about 70 TMJ surgeries were performed annually. However, this number saw a dramatic increase, reaching over 500 surgeries just four years later. Fast forward another decade, and the annual figure hit the 1,000 mark, subsequently climbing further to more than 2,000 within the next four years, and surpassing 3,000 surgeries per year shortly thereafter. This trend not only indicates improvements in surgical techniques but also the growing need for effective treatments for TMJ issues.

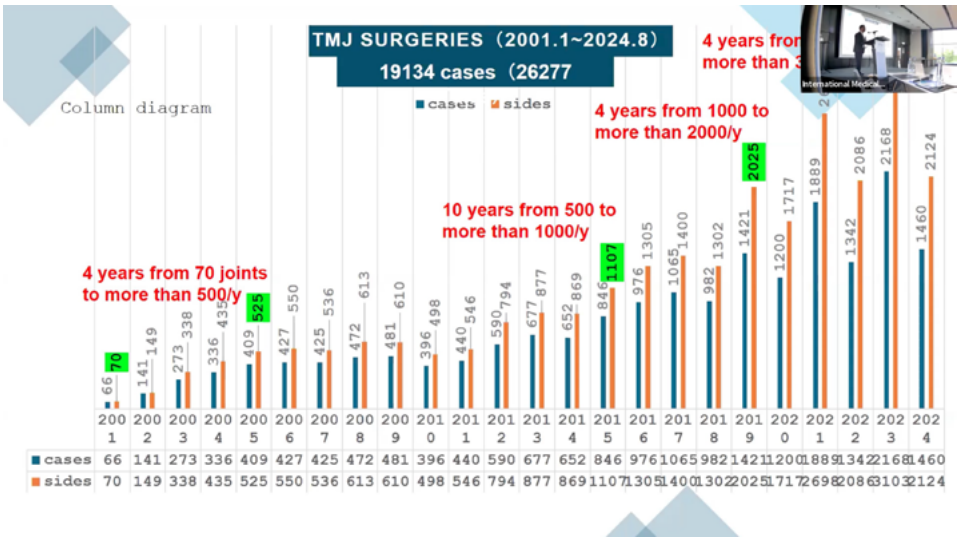


Figure 1. Dramatic increase of TMJ surgeries at the Department of Oral Surgery, Shanghai Ninth People's Hospital, China. In total 19,134 cases with 26,722 joints were operated between 2001 and 2024.

The speaker encouraged those interested in this field to consider establishing their own TMJ surgery departments, making it clear that such efforts are entirely achievable. In terms of surgical methods, a variety of essential techniques are employed in TMJ surgery. For instance, management of disc displacement can be approached through either arthroscopic surgery or open reduction techniques, with more detailed explanations promised in following presentations by Dr. Liu and Prof. He.

Joint replacement surgery encompasses several approaches. One technique involves using rib grafts, which are particularly useful for adolescent patients, while another utilises the pedicled hemi-sternalclavicular joint, ideal for cases of joint infection due to its dependable blood supply. Further insights into the use of both standard and customised prosthetics will be provided by Dr. Bai and Dr. Zheng in their upcoming talks. The fixation of condylar fractures, especially in intra-capsular cases, presents notable challenges and will be thoroughly discussed in an upcoming lecture by Prof. He.

For patients with ankylosis, lateral arthroplasty is the treatment of choice. During

exposure surgery, the visibility of bony fusion allows for a clear view of normal anatomical structures. Once the bony fusion is removed, the resulting space is filled with adipose tissue to prevent the recurrence of the condition.

The merging of orthodontic surgery with TMJ interventions has been shown to significantly improve treatment outcomes, particularly in cases where joints are deemed non-salvageable. The combination of total joint replacement and orthodontic procedures appears to greatly enhance both jaw functionality and overall facial aesthetics, as demonstrated by pre- and post-operative comparisons.

In terms of tumour management within TMJ surgery, over 1,200 cases have been documented. The most common tumours affecting the TMJ have been categorised into types such as synovial lesions, cartilage lesions, and those related to genetic anomalies. Tumours have been further classified into ten types based on radiographic findings, necessitating a range of surgical interventions, including autogenous bone grafting and prosthetic placements.

Furthermore, recent advancements have introduced innovative surgical techniques aimed at addressing anterior disc displacement and condylar resorption. A new treatment protocol has been proposed which aims to improve surgical outcomes. Modifications to the classification of intracapsular fractures and more comprehensive strategies for managing ankylosis have been developed, greatly enhancing treatment effectiveness.

In conclusion, the ongoing advancements in TMJ surgery signify a dedicated effort towards refining methods and improving patient outcomes through both innovation and collaborative research. The creation of a comprehensive cranial jaw prosthesis system exemplifies how digital technology is being integrated into surgical planning and execution. Overall, it was a remarkably enlightening discussion about the future of TMJ surgical procedures.

I.2 Radiological diagnosis of the TMJ in MRI

Gero Kinzinger, Robert Schuon. The topic of functional orthodontics was addressed, referencing a publication by Gerda Komposch from 42 years ago. In her work, it was established that bone remodelling processes occur in relation to specific applications aimed at treating an Angle Class II malocclusion. Gerda Komposch proposed a theory suggesting that bone acquisition at the posterior margin of the condyle and the posterior edge of the glenoid fossa results in a forward positioning of the mandible, thereby addressing Class II malocclusion. Conversely, it was noted that there is bone resorption in the anterior condyle region, accompanied by posterior curvature of the post-glenoid process. Ultimately, these changes contribute to a mesial drift, characterised by a downward and forward displacement of the glenoid fossa and a distal cranial translation of the condyle. Such findings are noteworthy, albeit not universally acknowledged, given that treatment via fixed orthodontic methods is well-documented and established, with initial procedures dating back over 90 years.

In this context Prof. Kinzinger presented a specific case involving a young male patient exhibiting Class II malocclusion, treated over a duration of approximately seven months. Initially, there was a pronounced overjet and molar occlusion. Following treatment, improvements were observed, and the patient was assessed at 14 years of age, revealing a significant enhancement in occlusion. Analysis of this case indicated a therapeutic effect from the fixed mechanism, with measurable improvement in overjet attributed to both skeletal and dental advancements.

Magnetic Resonance Imaging (MRI) was employed to observe the condylar position. The

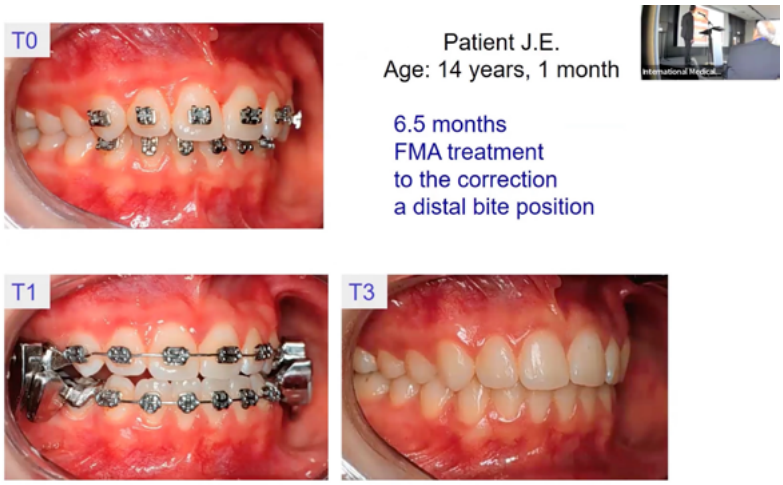


Figure 2. Intraoral situation of a Angle Class II malocclusion pretreatment, during the fixed functional phase and posttreatment.

images illustrated the initial condylar placement, the subsequent advancement, and final repositioning in the glenoid fossa after three months of treatment. Subsequent imaging indicated a return to a centric position of the condyle within the fossa.

Another case involving a functional mandibular advancer over 7.5 months similarly demonstrated a therapeutic effect, with a notable improvement in overjet and molar relations observed. The MRI data corroborated these clinical findings, visualising the positional changes of the condyle relative to anatomical landmarks.

Historically, Komposch's initial findings arose from animal studies using rubber bands to simulate mandible advancement, which ultimately resulted in the creation of a Class III malocclusion in subjects originally exhibiting good occlusion. Her discoveries in bone remodelling processes in both condyle and fossa hold relevance even today, facilitated by the non-invasive nature of MRI, allowing for careful evaluations, including in paediatric populations.

The analysis encompassed longitudinal assessments of the disc and condyle relationships, considering metrics such as the disc angle over various time points before and after treatment. The study confirmed that while ongoing changes were noted, the duration of treatment was carefully managed, with optimal treatment lengths documented between six to nine months.

Through metric evaluations, significant changes in anatomical dimensions of the condyle and its relation to the fossa were investigated across participant groups. However, overall results indicated minimal alterations in the dimensions of the condyle post-treatment.

In conclusion, the discourse surrounding fixed functional appliances has revealed detectable remodelling processes in both condyle and fossa, although these appear less extensive than previously anticipated based on Komposch's initial findings. Current recommendations suggest such treatment modalities may be most beneficial for patients with moderately pronounced Class II anomalies. For adult patients, fixed functional orthodontic devices are presented as a therapeutic alternative to tooth extractions, particularly among those seeking to avoid more invasive surgical interventions.

I.3 TMJ ADD: Disc repositioning or not? A RCT study

Pei Shen. Dr. Shen began her lecture with a case of an open bite that developed after orthodontic treatment. She pointed out that relapses of this nature was frequently observed in their TMJ clinic. To address these occurrences, systematic studies were performed, aimed at collecting and analysing data from consecutive patients. Through this research, three significant observations were established.

Firstly, it was observed that symptoms associated with TMJ, including clicking, limited mouth opening, and pain, are not particularly prevalent among younger patients. It was noted that a considerable number of adolescents either experience transient symptoms or report a complete absence of symptoms.

Secondly, it was found that approximately 35% of patients present with primary concerns that are unrelated to their TMJ condition, with issues such as malocclusion or jaw deformities being cited instead. Lastly, it was established that nearly 17% of the patients involved have a documented history of prior orthodontic treatment.

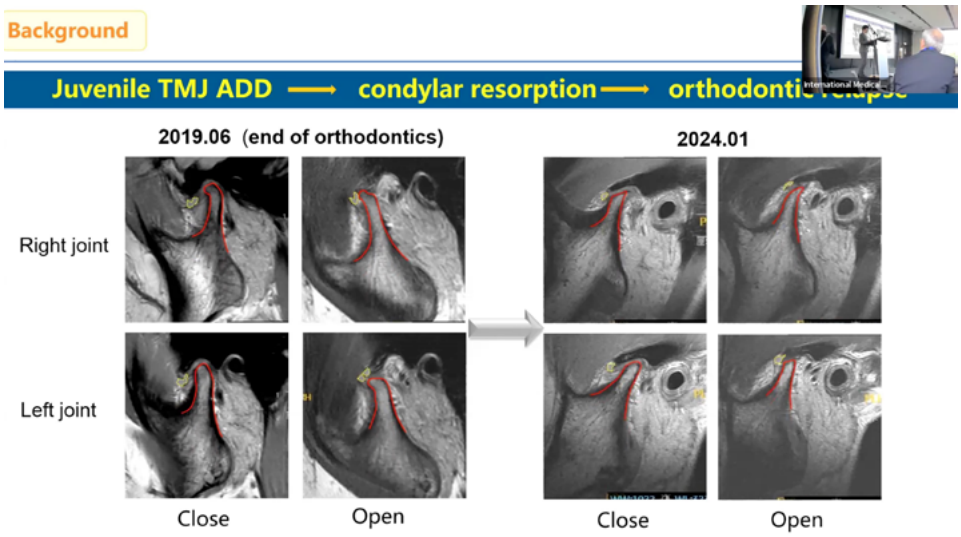


Figure 3. MRI images explaining juvenile TMJ anterior disc displacement with the development of condylar resorption.

These findings underline the importance of developing strategies to prevent condylar resorption, stimulate healthy condylar growth, and ultimately reduce the recurrence rate of orthodontic treatment failures attributed to TMJ disorders. These challenges were deemed urgent and warranted immediate intervention. Consequently, it was stated that three central questions would be addressed in this presentation:

1. What is the natural progression and outcome associated with juvenile TMJ internal derangement (ADD)?
2. What changes occur following disc repositioning procedures?
3. Can functional appliances effectively promote condylar growth and correct such deformities?

In addressing these questions, two clinical studies were utilised for analysis. The first study comprised a retrospective, self-controlled case series designed to evaluate both the

natural progression of TMJ disorder and the outcomes following disc repositioning in juvenile patients diagnosed with TMJ ADD. Participants were selected from individuals aged between 10 and 20 years, diagnosed with TMJ ADD without reduction based on magnetic resonance imaging (MRI) findings. Each participant was required to provide at least three sets of MRI scans along with lateral and postero-anterior cephalometric radiographs taken at different intervals, including an initial visit a week before surgery and subsequent follow-up appointments post-surgery. It was mandated that both the pre-surgical and post-surgical observation periods be a minimum of six months in length.

During the pre-surgical phase, only supportive treatments, such as education about their condition, were provided to the patients. As a result, this timeframe was regarded as indicative of the condition's natural course. The outcomes of the study were evaluated through two primary dimensions: The TMJ itself and the associated skeletal structures. For the TMJ aspect, alterations in condylar height were monitored during both the natural progression of the condition and the follow-up period following disc repositioning. In assessing skeletal measurements, particular attention was given to changes in parameters such as SNA, SNB, ANB, Pogonion perpendicular measurements, and the distance from the midline to the mandible.

Upon examination of the results, it was determined that during the natural progression, condylar height diminished by one millimetre. In contrast, following surgical intervention for disc repositioning, an improvement of 2.57 millimetres in condylar height was observed. These alterations in condylar height corresponded with observed changes in bone landmarks.

Throughout the natural course, progressive retrusion of the mandible was noted, along with a corresponding worsening of deviation. However, post-disc repositioning surgery, significant improvement in both mandibular retrusion and deviation was documented.

An illustrative case involving a 14-year-old female, who presented with a subtle chin deviation that deteriorated over a period of one and a half years, was discussed. Remarkably, a mere eight months following disc repositioning, considerable improvement in her chin deviation was demonstrated, as dramatically illustrated in her post-ontariocephalometric radiographs. During follow-up, a noted left-side rotation of her mandible occurred; however, it was reported that after the intervention, her mandible gradually returned to the right side, showcasing significant correction of her mandibular deviation. The principal catalyst for these changes was attributed to modifications within the joint structures. Notably, while the disc's condylar position on the right side remained stable throughout, anterior displacement was initially exhibited on the left side. During the natural progression, a decline in condylar height on the left side was noted, but post-surgery, new bone formation at the condyle became evident. Thus, it can be inferred that condylar resorption and regeneration are pivotal to the alteration of jaw deformities.

In conclusion, the findings from this study indicate that for juvenile patients with TMJ ADD, failure to reposition the disc may lead to condylar resorption, resulting in decreased condylar height and exacerbated jaw deformities. In contrast, successful disc repositioning facilitates condylar remodelling, leading to an increase in condylar height and subsequent correction of jaw deformities.

To further explore these concepts, a randomised controlled trial was conducted to investigate whether functional appliances could stimulate condylar growth and effectively address jaw deformities. This multi-centre clinical trial involved a cohort of 240 juvenile patients presenting with TMJ ADD and jaw deformities, all of whom were treated with functional appliances post-recruitment. Two groups were established based on treatment protocols: participants in the *'joint occlusal group'* underwent arthroscopic disc repositioning surgery

prior to functional appliance application, while those in the *'occlusal group'* did not.

Outcomes were assessed at baseline and at 8 and 14 months, with data collection focusing on similar outcome measures as those employed in the retrospective study. Comparative analysis revealed that baseline characteristics between the two treatment groups were analogous; however, significant divergence in condylar height emerged. At the 8-month mark, the occlusal group presented an increase of 1.57 millimetres in condylar height, whereas the joint occlusal group exhibited a decrease of 0.75 millimetres. This trend continued to diverge at the 14-month follow-up, with the joint occlusal group showcasing further increases in condylar height, while the occlusal group experienced a continued decline, resulting in a total difference of 3.67 millimetres.

Changes in established bony landmarks corresponded with variations in condylar height. Within the occlusal group, worsening retrusion and deviation of the mandible were noted, whereas improvements were documented in the joint occlusal group, with effective correction of both retrusion and deviation. Illustrative case studies from each group further elucidated these findings.

Thus, it was substantiated through the clinical trial that for juvenile patients with TMJ ADD and jaw deformities, advancing with orthodontic treatment without prior disc repositioning surgery risks inducing condylar resorption, exacerbating deformities, and potentially resulting in relapse. In contrast, performing disc repositioning prior to orthodontic intervention fosters condylar regeneration, thereby improving deformities and enhancing treatment stability.

The underlying mechanisms driving these observations were illustrated further through the case of a 14-year-old female with TMJ ADD, whose treatment initially involved disc repositioning via splint application. Upon restoration of normal disc position, significant increases in condylar height were noted. However, a relapse of disc displacement resulted in the loss of the newly formed bone. Ultimately, a subsequent arthroscopic procedure reinstated bone regeneration.

Consequently, it becomes evident that the positional relationship between the disc and condyle plays a crucial role in determining condylar regeneration or resorption.

Based on these research outcomes, it is clear how best to approach juvenile TMJ ADD. It is recommended that treatment commence with addressing disc displacement through successful repositioning, followed by a comprehensive examination of jaw and occlusal concerns using functional appliances or orthodontic interventions, especially for cases with mild to moderate deformities. The resultant regenerative and remodelling processes of the condyle post-disc repositioning can effectively rectify deformities, ultimately aiding in achieving stable treatment outcomes.

I.4 Characteristics and morphology of the roof of the glenoid fossa in patients with and without headache symptoms

Thomas Stamm. Headaches are characteristically reported as sensations of pain occurring above the orbitomeatal line, which extends approximately from the upper regions of the eyes to the posterior aspect of the skull. This anatomical line serves a crucial role in contemporary headache research. The orbitomeatal line itself is defined by a path that runs from the outer canthus of the eyes to a midpoint located at the external acoustic meatus. It is noteworthy that this line intersects the TMJ, suggesting that structures within the TMJ may play a role as a potential cofactor in the etiology of headaches.

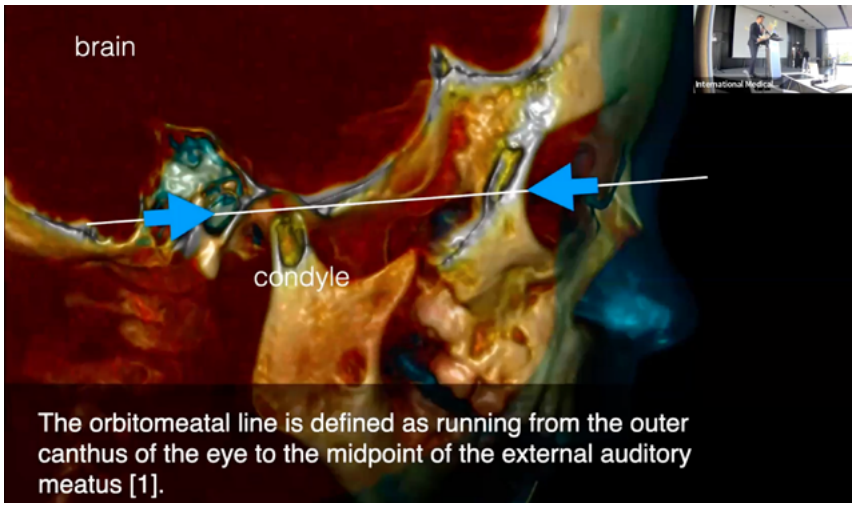


Figure 4. The orbitomeatal line passes through the upper part of the TMJ.

The classification of headache disorders has identified over 360 distinct types, as delineated by the International Classification of Headache Disorders. These headaches are categorised into three primary domains: primary headaches, secondary headaches, and neuropathic facial pains. Primary headaches are defined as independent disorders with their own pathophysiological mechanisms, occurring without the influence of other disorders. In contrast, secondary headaches arise as a result of an underlying condition such as bacterial meningitis, trauma, or medication overuse.

Given this context, it becomes imperative to explore which anatomical variations or pathologies within the TMJ may contribute to headache development. A retrospective analysis was conducted using cone-beam computed tomographies (CBCTs), which had been collected for various dental and surgical purposes, but not specifically for this study. The primary inclusion criterion mandated that the imaging must encompass the roof of the TMJ, with anatomical assessments conducted by two independent investigators. In the event of notable findings, patients were administered a tailored questionnaire to evaluate these observations.

Utilising two-dimensional multiplanar reconstruction techniques in a DICOM image viewer, various structural elements were examined in all three spatial planes - axial, coronal, and sagittal. Notably, any abnormalities such as bony discontinuities or cavities connecting the TMJ to adjacent cranial structures were identified. These discontinuities, termed 'roof perforations,' can house various substrate tissues that are indeterminate on CBCT imaging.

It was hypothesised that, in cases where only soft tissue is present in the roof perforation, activities such as chewing or grinding could cause pressure waves to transmit more efficiently through soft tissue compared to bone, possibly contributing to headache sensations. The investigation revealed that roof perforations could appear in varying configurations, including channels connecting the middle cranial fossa to the TMJ area. Additional observations included the identification of thin bony lamellae separating the TMJ from the cranial cavity, which produced a spectrum of findings ranging from clear perforations to uncertain structural integrity.

The study categorised participants into three groups based on the findings: those with roof perforations (including holes and channels), those with a thin bony roof, and a control group comprising individuals without any notable findings. Following this categorisation, a headache diagnostic screening questionnaire was utilised to differentiate between primary

and secondary headache types in the patient cohort.

Results indicated that out of 270 screened CBCTs, 101 met the inclusion criteria, with 47 exhibiting TMJ-related findings and 45 serving as controls. Notably, nearly 50% of patients reported primary headache types, with a significant number also displaying mixed headache forms. Additionally, it was observed that headaches became less prevalent with advancing age, particularly after the age of 50.

The findings imply a relationship between TMJ structural abnormalities and the occurrence of primary headaches, specifically highlighting that perforations and thin bony layers at the TMJ roof were more frequently associated with these headache types. Furthermore, these unilateral perforations may serve as a diagnostic criterion for primary headache classifications, particularly in migraine without aura.

In conclusion, while this study does not definitively establish the TMJ as a causal factor in headache pathophysiology, it does suggest a complex interplay that warrants further investigation to ascertain the potential contributions of TMJ abnormalities to headache disorders.

I.5 Surgical and arthroscopic anatomy of TMJ

Paulo Alexandre da Silva. Unfortunately the presentation was canceled.

I.6 Surgical procedures for arthroscopic surgery

Xiaohan Liu. In this lecture, Dr. Liu, a member of Prof. Yang's team, provided an overview of the arthroscopic technique, which is recognised as an effective yet minimally invasive approach for the diagnosis and treatment of TMJ conditions. The origins of this technique can be traced back to 1975, when Onishi was the first to document its application for diagnosing TMJ disorders. Subsequently, McCain advanced the technique by incorporating it into disc reduction procedures.

However, it was noted that many of the earlier reports regarding the arthroscopic technique were characterised by a limited number of cases and relatively low success rates. Furthermore, these studies predominantly concentrated on clinical symptoms without the inclusion of MRI evaluations. In 2001, Prof. Yang enhanced the arthroscopic technique by designing specialised instrument sets, leading to a structured process that has since yielded significant improvements in outcomes and high success rates during prolonged follow-up periods. All findings were based on comprehensive evaluations combining both MRI and clinical assessments.

From 2001 to 2024, a remarkable total of 6,453 patients with 8,758 joints have undergone treatment using Yang's technique in their department, with a notable increase in the number of procedures observed since 2023. This surge has been attributed to the growing proficiency of surgeons within Yang's team who are becoming adept at employing this technique. For those interested in furthering their understanding, opportunities to observe live demonstrations and participate in hands-on cadaver courses will be available shortly.

The Yang's technique has been disseminated internationally, having been showcased across nine countries through live surgeries and training sessions on 15 separate occasions. More than 90 visiting scholars from 29 different nations have visited the department with a specific interest in this technique.

A key aspect of Dr. Liu's presentation was the discussion of the indications and contraindications associated with Yang's arthroscopic discopathy technique. The indications for this technique are becoming increasingly tangible, with advancements in surgical techniques

allowing for broader applicability. Prof. Yang identified several conditions suitable for treatment, such as anterior disc displacement (ADD) with or without reduction, particularly in patients exhibiting clinical symptoms such as pain and limited mouth opening, as well as in young adolescents where early disc repositioning is crucial.

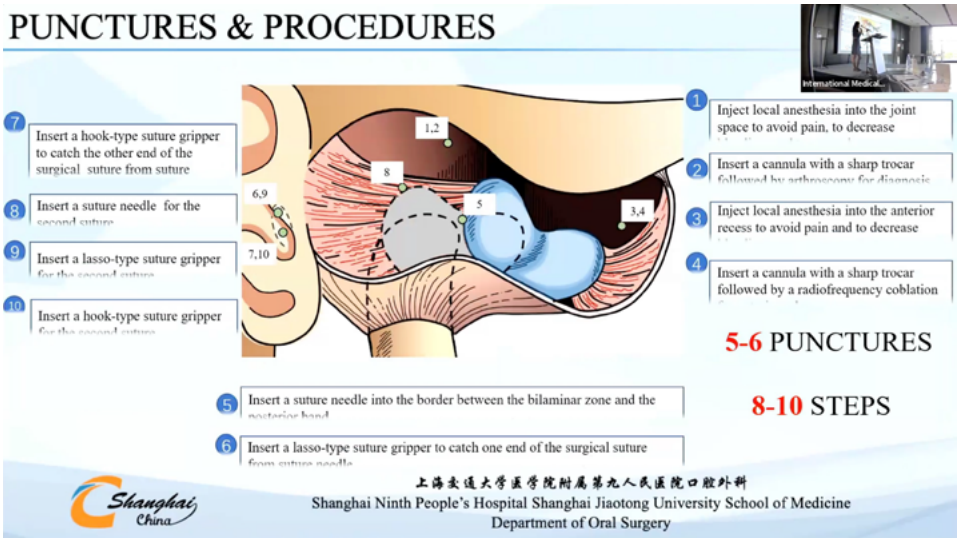


Figure 5. Prof. Yang's specific surgical procedure typically involves five to six punctures, accompanied by eight to ten detailed steps.

When discussing the disc itself, it was emphasised that severe twisting or significant displacement of the disc may render arthroscopic surgery impractical due to the diminished ability of the disc to properly cover the condyle. If the disc exhibits a significant tear, particularly within the intermediate zone, it may represent an absolute contraindication to the procedure due to potential functional impairment.

Regarding perforations in the disc, if the defect is smaller than half the disc's surface area, surgical intervention may still be feasible to reposition the disc. In instances where the perforation exceeds half of the disc's area, but the overall dimensions and configuration of the disc are favourable, successful repositioning remains possible, contingent upon the surgeon's expertise.

Furthermore, the surrounding tissues must be considered. Instances where the retrodiscal tissues are excessively thick or hardened, termed as 'soda disc', pose challenges to repositioning. Similarly, if the articular eminence exhibits a steep slope or an obstructive curtain-like structure, this could impede access to the anterior aspect of the joint cavity and serve as an absolute contraindication to the procedure. In cases where significant adhesions are present, open surgical intervention might be deemed the preferable option.

Finally, attention must be given to condylar movement during procedures performed under local anaesthesia. Observations from MRI scans regarding the condylar position during mouth opening can offer valuable insights, supported by clinical assessments ensuring that maximum inter-incisal opening remains within appropriate limits.

With regard to Yang's technique itself, it comprises three fundamental steps which were also highlighted during the session. The anterior release, disc reduction, and disc suture represent a specific surgical procedure. This intervention can be performed under either local or general anaesthesia and typically involves five to six punctures, accompanied by eight to ten detailed steps.

Initially, the procedure commences with the arthroscopic puncture. It is imperative that the patient is positioned with the mouth open during this phase. The posterior slope of the articular eminence and the condylar process is marked, with the desired intersection point being approximately 10 millimetres anterior to the tracking markers. Care must be taken to avoid damage to the superficial temporal vessels to prevent excessive bleeding. Subsequently, local anaesthesia is administered to alleviate pain, minimise bleeding, and most significantly, to enhance the operative space. The next step involves utilising the arthroscope for diagnostic purposes.

Following this, attention shifts to the coblation puncture. At this stage, the patient is transitioned to a closed mouth position. The anterior slope of the articular eminence is marked, and a second cannula is positioned parallel to the initial arthroscope. Radial coblation is employed for the anterior release at this juncture. The incision is generally made two to three millimetres anterior to the anterior edge of the disc. It is crucial to avoid excessive depth or anterior displacement of the incision to prevent injury to the mesenteric nerve and associated vessels.

The next step involves the suture needle puncture, which is indicative of positioning between the arthroscope and coblation punctures, usually around 10 millimetres anterior to the arthroscope puncture. Under the arthroscope, the suture needle is manipulated in and out between the 2-0 gauge suture and the posterior band of the disc. This is followed by retracting the disc for repositioning, necessitating a translateral approach, typically executed at the cartilage level of the external auditory canal.

During this section of the procedure, the Yang's arthroscopic discopaxy instrument set is utilised. Initially, a lasso-type suture gripper is employed to retrieve the suture from the needle, subsequently switching to a hook-type instrument to acquire the opposing end of the suture. In certain instances, a secondary suture may be utilised to facilitate minor overcorrection to mitigate the risk of disc displacement recurrence, positioned approximately five millimetres posterior to the first suture.

The procedure concludes with the retraction of the sutures, which are concealed at the cartilage level. It is noteworthy that the overall completion of the Yang's technique arthroscope surgery can typically be accomplished within a time frame of 15 to 20 minutes, involving a minimal incision of approximately three millimetres, and it exhibits a notably high success rate. The final steps include placing a suture into the suture needle and then utilising the vessel-type instrument to secure one end of the suture before employing the hoop-type instrument for the retrieval of the other end.

As the presentation progresses, it was indicated that participants seeking a more detailed understanding of a specific surgical technique would have the opportunity to engage directly with Prof. Yang during cadaver courses scheduled two days later.

The Yang's technique was presented as applicable for both rotational anterior disc displacement (ADD) and ADD accompanied by perforation, with the fundamental procedural steps remaining largely consistent across these variations. Notable modifications were introduced for the lateral ADD, where the cartilage puncture site is positioned slightly anteriorly, necessitating that the suture needle be directed both forwards and upwards. Ultimately, the sutures are drawn backwards and inwards.

Conversely, when performing medial ADD, the cartilage puncture is situated more posteriorly, requiring the suture needle to be oriented backwards and downwards, with the sutures being pulled backwards and outwards. For cases of perforation, it was emphasised that the arthroscope remains the standard tool for verifying both the size and the precise location of the perforation. During the procedure, the suture needle should be placed at the border

of the posterior band adjacent to the retro-discal region, with significant attention given to ensuring it is positioned anteriorly to the perforation to facilitate the backward repositioning of both the perforation and the disc.

From 2011 to 2019, a total of 1,518 ADD joints were treated using Yang's arthroscope surgery, and a follow-up period of at least 24 months indicated a success rate of 95%.

In discussing the complications and challenges associated with these surgical techniques, it was reported that the most frequently encountered issue was bleeding. This is often attributed to the puncture of the arthroscope or potential damage to the superficial temporal vessels and the masseter nerves and vessels during incision, which may lead to bleeding. Furthermore, injury to the masseter nerves could potentially result in long-term complications such as amyotrophy pain; ongoing research is being conducted into this matter.

Instrument failure was also discussed, specifically cases of broken instruments encountered during surgery, which are typically managed using forceps under the arthroscope. Reassurance was provided that current instruments have been significantly reinforced for improved reliability.

Several clinical cases were presented to illustrate the application of Yang's techniques. One patient, a 17-year-old female, presented with left-sided joint pain and jaw deviation. Preoperative MRI confirmed left-sided ADD without reduction. Following arthroscope surgery and an orthodontic regimen, there was notable improvement, with the disc successfully repositioned and significant new bone formation observed.

Additionally, an example of the lateral ADD was shared, highlighting the importance of sagittal and coronal repositioning, which resulted in satisfactory new bone formation. Another case involved ADD with perforation, where preoperative imaging indicated disc displacement. Post-surgery, after a slight overcorrection was noted, stability was observed, with the disc securely positioned over the canal.

In conclusion, the lecture provided valuable insights into the applicability and effectiveness of Yang's technique in treating various forms of ADD, along with associated challenges and successful patient outcomes. The importance of careful technique and instrument reliability was underlined, contributing to the overall success of these surgical interventions.

I.7 Open reduction of TMJ disc and outcome (discopexy)

Andrew Sidebottom. In this presentation on TMJ open surgery, Prof. Sidebottom commenced by expressing gratitude for the invitation to address the audience. The intention was to discuss TMJ open surgery over a 15 to 20-minute period, allowing time for questions at the conclusion. It was acknowledged that the preceding discussions had primarily concentrated on focal arthroscopic surgery, a method with which the speaker did not have direct training, as proficiency in more advanced levels of arthroscopic surgery had not been acquired due to the timing of their training.

The focus of the discourse was to present a structured management protocol for TMJ surgery, including the rationale behind pathology-based open surgery, the principles governing such approaches, considerations regarding interpositions, and the expected outcomes associated with this surgical modality. Emphasis was placed on open surgery rather than arthroscopic methods.

The staged approach to management was outlined, beginning with conservative measures followed by pre-arthroscopy treatment, arthroscopy, and arthrocentesis. Attention was directed towards the assessment of outcomes linked to findings and the accuracy of initial diagnoses, ultimately leading to the indications for open surgery and alternatives available,

alongside the rationale behind surgical interventions and their associated outcomes.

Initial patient examinations and accurate diagnoses were highlighted as critical components in managing cases of internal derangement, with around 80 to 90% of patients likely responding positively to conservative treatment strategies. The speaker advocated for offers of advice, reassurance, a soft diet, the elimination of wide jaw function, and the use of topical anti-inflammatories. The use of a soft bite splint was also noted, with a commitment to active treatment over an eight-week period. Moreover, emerging evidence pointed towards the efficacy of early arthrocentesis for long-term outcomes, as suggested by findings from a study conducted by Israeli researchers, which indicated that delayed arthroscopic interventions beyond one year correlated with poorer outcomes.

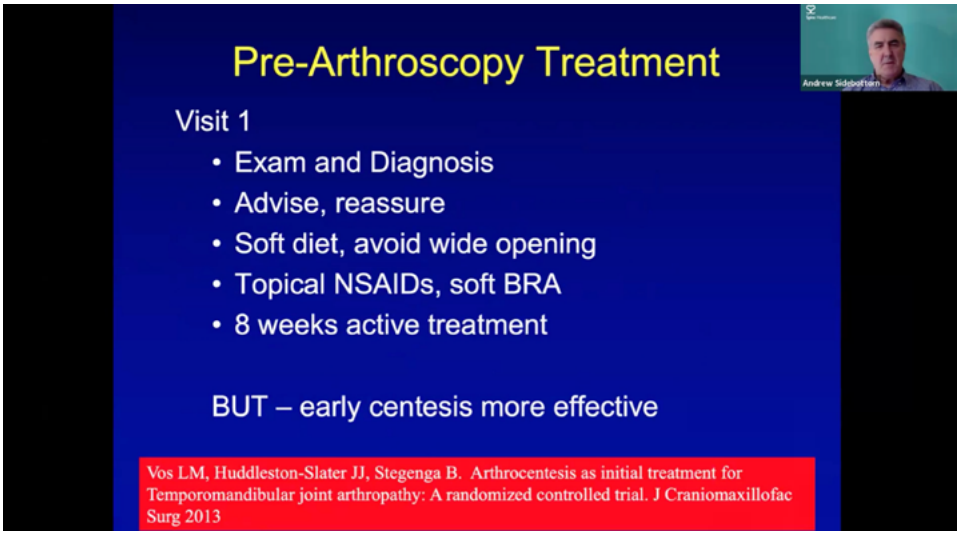


Figure 6. Staged approach, beginning with conservative measures followed by pre-arthroscopy treatment, arthroscopy, and arthrocentesis.

The utility of MRI scans was addressed, referring to an early series from Prof. Yang's unit that suggested MRI may serve as a supplementary tool to clinical examinations, with limited additional benefit for experienced surgeons. A discussion arose regarding the treatment necessity for the 30% of patients presenting with anterior disc displacement and whether all such patients required intervention.

Indications for arthroscopy were outlined as failing conservative treatment characterized by restricted jaw opening, persistent pain, or joint locking. Furthermore, it was advised that patients demonstrating an anterior open bite should generally avoid arthroscopy due to its association with significant joint collapse, while those suffering from ankylosis would be ineligible for such procedures.

Reflecting on the speaker's own initial series, which was noted as comparatively small to those from Prof. Yang's cohort, an approximate 80% success rate for level one arthroscopy was reported. However, it was observed that at six weeks post-treatment, this success rate diminished, raising questions regarding potential deterioration in technique. It was noted that a subset of patients continued to show improvement beyond the six-week mark, with about 10% of individuals experiencing ongoing benefits over the following months.

Longer-term data from a series examining 240 cases revealed significant pain relief and increased jaw opening, although these improvements seemed not to correlate directly with Wilkes stages, likely due to the limited statistical significance across the stages. There

appeared to be a trend suggesting better outcomes with lower Wilkes stages.

In considering arthroscopy followed by open surgery, the speaker affirmed that it is regarded as an accurate technique when executed by experienced surgeons. However, findings from Yang's study indicated a modest accuracy rate of 50 to 60% in diagnosing disc tears, a statistic acknowledged as dated at ten years old. It was also noted that a Japanese study indicated arthroscopy demonstrated greater accuracy in diagnosing osteoarthritis compared to previous assessments.

In the context of managing joint pathologies, particularly for patients lacking the requisite skills for arthroscopy placement, a discussion arose concerning the appropriateness of utilising solely arthroscopy or arthrocentesis. It was communicated that while both methods offer comparable therapeutic advantages, outcomes tend to be marginally superior when level one arthroscopy is employed after one year.

One notable benefit of arthroscopy is its diagnostic capability, which surpasses that of magnetic resonance imaging (MRI) and arthrocentesis independently. This modality not only facilitates the formulation of subsequent treatment plans but also serves to reassure patients regarding the normalcy of their joint condition, indicating that further surgical intervention may not be necessary. In instances where the procedure reveals no pathological findings, the recommendation is to refer the patient for pain management, thereby avoiding an overburdened clinic concentrating excessively on pain management when the source may be myofascial or functional in nature.

Additionally, findings from a study involving 427 patients who underwent 596 arthroscopies were reviewed, showing an average age of approximately 40 years, with a predominant number of female patients, a common demographic observed in TMJ series. Significantly, the majority of these patients exhibited positive arthroscopic results. It was noted that in the UK, disc tears typically manifest within the articular disc itself rather than in retrodiscal tissues. The investigation revealed that only 39% of patients with a disc tear proceeded to require further surgical intervention, with a mere 9% necessitating joint replacement. In contrast, patients without a disc tear demonstrated a markedly lower likelihood of needing additional joint surgery when compared with those exhibiting a disc tear.

Consequently, positive arthroscopic findings were associated with poorer outcomes; however, approximately 60% of patients presenting with disc tears ultimately stabilised following the procedure, suggesting a minimum observation period of three months before considering advanced interventional options.

The principles advocated by *primum non nocere* from the Hippocratic School of Epidemics were referenced, highlighting the imperative to either assist or refrain from causing harm to patients during medical treatment. Embedded within the Hippocratic Oath, which practitioners in the UK are bound to uphold, is the commitment to prevent patient harm in pursuit of any perceived benefits.

Thus, it was asserted that initial surgical intervention, specifically a straightforward level one arthroscopy involving lysis and lavage, is regarded as a superior diagnostic method compared to MRI. Therapeutically, over 80% of individuals improve following this approach, while over 50% of those with disc tears can be successfully discharged without further treatment or the need for additional medications.

The dialogue then transitioned towards open surgery, deemed a focal point of the presentation. Indications for such intervention encompass unsuccessful conservative management, a positive response to local anaesthetic administered within the joint—indicating the source of pain—or failed arthroscopy displaying affirmative findings on either imaging techniques or through the arthroscopic assessment itself. Moreover, conditions such as recurrent dis-

location and established surgical entities, including osteochondroma and synovial chondromatosis, are recognised as appropriate indications for open surgical intervention.

Contraindications are equally crucial to consider; unilateral progression to open surgery without exploring other viable options may stem from insufficient conservative management solutions. Controversies persist regarding the necessity of operating on asymptomatic contralateral joints that exhibit clicking. A parallel was drawn to orthopaedic procedures where it was suggested that if orthopaedic colleagues were advised to perform bilateral knee surgeries on all patients with clicking symptoms, the proposition would likely be dismissed immediately.

Prof. Sidebottom has underscored that in situations where no relief from local anaesthetic injections in the joint is observed, expectations for pain reduction through surgical cleansing are unwarranted. Therefore, prior to advancing to joint replacement procedures—indicated for conditions such as ankylosis, considerable joint collapse, or severe degenerative ailments—it is prudent to exhaust arthroscopic techniques or lesser invasive methods, keeping in mind the variable outcomes associated with anterior disc displacement.

In the field of TMJ surgery, various surgical alternatives have historically been explored, including eminence surgery, disc surgery, and condylar surgery, along with procedures located outside the joint such as coronoidectomy and condylotomy. A common misconception pertaining to TMJ surgery is the notion that if one possesses a surgical technique, it should be universally applicable regardless of the specific circumstances presented, akin to the adage about having a hammer and treating every problem as a nail.

Prior to the advent of arthroscopy, it was observed that approximately 80% of patients experienced improvement, whereas this success rate appears diminished following arthroscopic interventions. It is recognised that exposure of the joint to air results in changes that increase the risk of degenerative processes and remodelling, suggesting that such interventions should not be undertaken lightly and that alternative treatments should be thoroughly considered, in accordance with the principle of *primum non nocere*.

The discussion regarding the role of interposition after discectomy prompts the consideration of whether interposition should be performed. A review published in the Atlas of Oral and Maxillofacial Surgery Clinics explored the efficacy of interposition techniques, revealing that interpositions involving free fat or dermis yielded the most favourable outcomes in terms of initial pain relief, albeit with the acknowledgement of a secondary donor site and the potential risk of calcification within the joint. Conversely, not employing interposition resulted in improved mouth opening in the long term and pain levels similar to those with interposition after approximately six months. The underlying hypothesis is that such practices may facilitate the formation of a fibrous neodisc, thus enhancing functional recovery.

The examination of orthopaedic practices offers insights into effective management strategies; it is noted that these professionals focus on addressing the underlying pathology, preserving normal anatomical structures, or repairing or replacing abnormal anatomical features. A critical piece of advice is to refrain from performing surgery on asymptomatic joints and from solely treating clicking sounds, as these may often represent normal anatomical variations or a physiological response to increased mechanical stress.

It is emphasised that learning from experiences is crucial, as repeating the same approach and expecting different outcomes is deemed nonsensical. In managing the pathological conditions of the TMJ, the underlying issues must be addressed: if the eminence is enlarged or degenerated, or if lateral lipping is evident, a reduction of the eminence should be undertaken. Adhesions in both the upper and lower joint spaces should be broken down, and in

cases of stretched retrodiscal tissues, disc placation may be accomplished arthroscopically, potentially leading to reduced trauma compared to open techniques. If the disc exhibits irreparable damage, discectomy may be indicated; alternatively, a condylar shave may be performed to smoothen the condylar surface or eliminate erosions.

The outcomes of these interventions necessitate clear measurements of success, demanding the use of reproducible objective outcome measures. Parameters such as mouth opening, visual analogue scale (VAS) pain scores, and dietary scores must be assessed at each visit alongside subjective quality of life evaluations and patient-reported outcome measures. A proposed standard for acceptable function may be achieving a pain score lower than 2 on a scale of 10 and a mouth opening exceeding 3 centimetres, beyond which further surgical interventions are unlikely to yield significant improvements. This mandates a focus on effective patient management rather than tailoring treatments to personal or administrative preferences.

Importantly, practitioners should avoid promises of complete cure or total pain relief; instead, the aim is to manage the condition effectively to enhance quality of life, allowing patients to adapt to any persistent disabilities or challenges. A study conducted by Homland and Anders Homland from Sweden advocated for discectomy, revealing that amongst 11 patients who had failed to benefit from arthroscopic lysis and lavage, only 55% achieved success post-discectomy. When comparing these results to those of similar patients who had not undergone prior arthroscopic intervention, an 86% success rate was noted, thus highlighting the significant advantage that arthroscopy may confer to patient outcomes.

Furthermore, early outcomes from a personal practice involving techniques such as discectomy, aminectomy, or condylar shaving demonstrated a recovery rate of merely 61% at the one-year mark, underscoring the challenges faced in achieving optimal results in TMJ surgical interventions.

In a subsequent study conducted by a trainee at the time, 80 patients were examined, with a majority being female. The results indicated a gradual improvement in pain scores. The significance of these findings rests on the fact that, when performing a discectomy, no interposition is employed. Mobilising the patients is considered crucial, although it requires time for pain alleviation to occur.

The investigation demonstrated that outcomes from open surgery tend to improve more swiftly. A primary concern is to counteract the formation of fibrous tissue, which can lead to restricted mouth opening and potentially cause ankylosis. Encouraging movement is essential, as these patients will progressively improve over time, despite the pain they may experience.

A recently published study in a prominent journal presented the outcomes of 105 patients who underwent pathology-based surgery after one year. Of these, 91 patients achieved a mouth opening greater than 30 millimetres, while 15 experienced persistent joint pain and eight had chronic myofascial pain. Notably, symptom resolution was observed in 89 patients after one year, with two reporting improvements, whereas 16 required joint replacement. Thus, the success rate of open surgical interventions following failed arthroscopy was calculated to be 85%.

Long-term studies examining patients who underwent joint replacement suggest that, generally speaking, most of them experience improvements, as will be detailed in a presentation scheduled for tomorrow.

Success is defined as a patient being discharged, satisfied with the outcome, and maintaining persistent positive results over several years. Protocols for open joint surgery or the transition to joint replacement were also discussed.

Upon analysing predictors of success, it was noted that patients with a Wilks stage greater than three in the early series often proceeded to joint replacement. Those presenting with a pain score above nine out of ten warranted particular caution during surgical intervention, as a portion of the pain could be both psychological and functional. A mouth opening of less than 29 millimetres resulted in 50% progressing to joint replacement. In the early series, this figure was approximately 39%, contrasted with 16% in later series, highlighting the ongoing learning process within this field.

In cases where arthroscopy fails, a waiting period of at least three months is recommended. For patients exhibiting Wilks stages four and five, consideration should be given to whether to proceed directly to joint replacement. For those in Wilks stages two and three, an open exploration should be contemplated, addressing various pathological tissues, such as the eminence, disc, condyle, and intra-articular structures simultaneously, thereby attempting to rectify the condition in a single operation. Should this approach prove ineffective, a subsequent joint replacement may be necessary.

In summary, the current discourse indicates an increasing recognition of the benefits associated with arthroscopic intervention. Nonetheless, long-term outcomes for arthroscopic procedures remain to be fully realised, with forthcoming research, particularly from China, anticipated to shed light on this issue. Additionally, it is noted that a number of junior surgeons are opting to transition directly to joint replacement following failed arthroscopy. However, there continues to be a perceived role for open surgical interventions. A recent study published in the Journal Oral Rehabilitation indicated that, despite the absence of interposition after discectomy, patients continue to benefit even 30 years later, although significant radiological changes are observable. Nevertheless, clinically, these patients are reported to be doing well.

This reinforces the adage that emphasizes the importance of addressing the patient rather than merely the radiological findings. The proposed conservative protocol entails timely discharge, alongside a systematic approach encompassing conservative management, arthroscopy, open surgery, and, ultimately, joint replacement.

I.8 Open reduction of TMJ disc

Dongmei He. In a recent discourse regarding open disc surgery, the speaker conveyed insights derived from their clinical experiences. Citing Prof. Sidebottom, they affirmed the ethical principle of *do no harm* to patients, a sentiment that aligns with their own professional ethos.

It was noted that patient preferences often influence the choice of surgical interventions, particularly when alternative approaches are perceived to yield superior outcomes. This dynamic frequently prompts consideration of the adequacy of the surgical methods employed, particularly when postoperative results are suboptimal.

The discussion focused specifically on the open reduction of the TMJ disc, highlighting that open disc displacement is a prevalent clinical issue. Such displacement can lead to joint dysfunction and degenerative changes, including osteoarthritis. Notably, during periods of growth, a reduction in condylar height may precipitate dentofacial deformities, an association recognized by orthodontists since the 1990s.

The primary objectives of surgical disc reduction were articulated as the alleviation of symptoms, enhancement of TMJ functionality, stabilization of the joint, and the preservation of growth potential to prevent, mitigate, or rectify dentofacial deformities in adolescents.

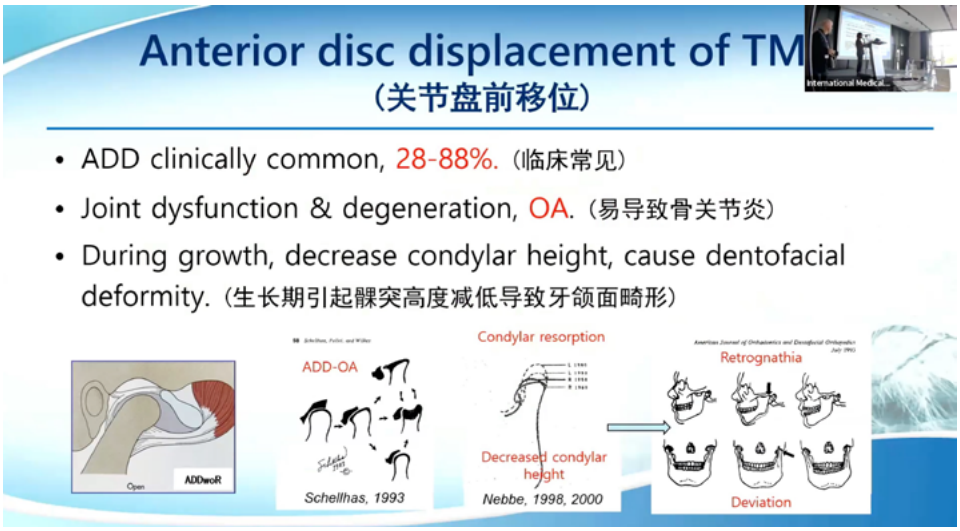


Figure 7. Anterior disc displacement of the TMJ, which is clinically common, occurring in 28-88% of cases and can lead to joint dysfunction and degeneration.

The indications for open reduction of the TMJ disc were outlined, specifying that patients should present with salvageable discs and condyles, classified within stages two to five. Importantly, the anatomical integrity, length, shape, and particularly the quality of the bone marrow within the joint, were cited as critical factors. It was suggested that patients should not have undergone multiple failed interventions; rather, ineffective conservative treatments should be the guiding rationale for surgical consideration.

The speaker further articulated the importance of addressing scenarios where joint deformities may arise during growth periods or where orthodontic treatment could potentially compromise joint stability. These circumstances warranted either open surgical or minimally invasive techniques, such as arthroscopic disc repositioning.

In detailing surgical methodologies, two predominant approaches to open surgery were delineated: the traditional anchorage of the TMJ disc and the suturing of the disc via open incision. The historical context of the anchorage technique was briefly reviewed, noting its initial description in 1887, further elaborated upon in the 1970s by Wilkers through arthrography, which subsequently led to gradual acceptance despite historically suboptimal outcomes.

Advancements in surgical techniques were highlighted, including Wolford's introduction in 2001 of a modified method aimed at enhancing success rates, particularly through the release of the anterior disc attachment. However, it was observed that success rates had diminished over time. In 2003, Prof. Yang contributed to the field by modifying surgical techniques and creating a specially designed mini-screw anchor that facilitates easy removal and insertion, which reportedly yielded a long-term success rate of 96%, as validated by MRI assessments.

In the current presentation, a novel surgical technique was presented, specifically a modified pre-auricular incision. The approach diverges from the traditional method of dissection along the external auditory canal; instead, dissection is performed anterior to the superficial temporal vessels. This alteration enables enhanced visibility of the TMJ capsule.

Following this initial step, a straight-bobbed retractor is strategically placed upon the sigmoid notch, facilitating the gentle depression of the ramus downwards, which in turn offers better access to the upper joint. Upon opening the joint, the visualisation of the

displaced disc, which appears white, and the retro-discal tissue, characterised by a reddish hue, becomes possible.

At this stage, the anterior disc attachment is released, with caution advised concerning the underlying masseter artery and nerve, as highlighted in Dr. Liu's previous lecture. The identification of these anatomical structures is critical for maintaining surgical integrity. A periosteal elevator is subsequently utilised to achieve passive reduction of the disc; this maneuver should be executed to ensure the disc is tension-free.

The procedure continues with the placement of a 2.0-millimetre self-drilling mini screw, upon which 3-0 or 2-0 non-resorbable polyester sutures are tied. Horizontal mattress sutures are then applied, followed by the creation of six knots to secure the disc in position. It is imperative to verify both the location and stability of the disc at this juncture. In cases where recurrence may be a concern, the introduction of subcutaneous fat within the gap is proposed.

The discussion also included a comparative analysis of pre-operative and post-disc repositioning states. Notably, the incision made is minimal and becomes inconspicuous over time. A video demonstration has been included to visually substantiate these techniques. It is essential to meticulously dissect around the superficial temporal vessels prior to accessing the upper joint space. The application of an epinephrine saline is recommended before proceeding with the dissection of the anterior disc attachment. Following this, the mini screw is installed, the sutures tied, and two horizontal mattress sutures are executed, concluding with six knots before the capsule is closed. A mini drain is routinely employed at the completion of the procedure.

Furthermore, several clinical cases were presented, including that of a 14-year-old female patient diagnosed with a Class II skeletal malocclusion accompanied by bilateral disc displacement. Post-disc repositioning, facilitated by the mini screw anchor and subsequent use of a splint to maintain the mandible's positioning, the patient exhibited substantial improvements over an 18-month follow-up period. Notable new bone formation occurred, resulting in enhanced counterline height, which effectively advanced the mandible and significantly reduced the overjet.

The post-orthodontic treatment outcomes were also evaluated, displaying considerable forward movement of the chin, as evidenced by the septum metric measurements recorded before and after orthodontic intervention.

The alternative technique discussed pertains to open suturing. To mitigate the disruption of the vascular supply when inserting bone anchors, a modified approach was developed. This method bears similarities to the arthroscopic procedure previously delineated by Dr. Liu.

It has been noted that this technique is particularly advantageous for patients presenting with small condyles, developmental issues, and osteoporosis. Additionally, it is characterised by its straightforward learning curve, requiring minimal equipment.

The procedural steps involve the utilisation of a 20-gauge needle for the insertion and extraction of sutures through the external auditory canal. A video demonstration was presented to elucidate the methodology involved. It was indicated that the sutures employed are devoid of a head, simplifying the process relative to procedures conducted under an arthroscope. Ultimately, six knots are tied before a small drain is introduced.

Visual comparisons were made of surgical conditions before and after the intervention, revealing obscured skull features in the post-operative imagery. A specific case was cited involving a 13-year-old patient, highlighting the prevalence of skeletal Class II cases in China. Following disk repositioning via open suturing, an increment of 2.6 millimetres in condylar growth was observed, resulting in a significantly improved profile post-orthodontic

treatment.

Sublimetric measurements taken before and after orthodontic intervention further supported these findings. In summarising the critical elements for successful open disk reduction, it was suggested that the procedures could be practised following a two-day cadaver course, with further instruction anticipated from Prof. Yang regarding surgical execution.

Key requisites identified included the complete release of the anterior disk attachment, preservation of the adjacent nerve and artery, tension-free disk repositioning, and an accurate suture placement on the posterior band of the disk. Overcorrection of the disk was underscored as crucial; research indicated that disks which were either normal or inadequately corrected were prone to relapse.

Follow-up results from a cohort of 2,741 joints treated using open surgery demonstrated that approximately 98% of disks remained in position, with condylar stability estimated at around 90%. Remarkably, the success rate remained consistent at about 98% even five years post-operation.

A specific examination of disk reduction techniques employing mini screw anchors in adolescent patients was conducted, involving MRI assessments and sublimetric measurements which illustrated increases in condylar height and alterations in dental-facial deformities. A follow-up study encompassing 317 joints operated on via open suturing within one month indicated stability in disk position and condylar bone of 98%.

Comparative analyses between arthroscopic and mini screw anchor techniques were noted, with findings suggesting that arthroscopic surgery facilitates quicker procedural times and enhanced clinical recovery, while also yielding minimal invasiveness and superior condylar remodelling. Conversely, research authored by Dr. Liu highlighted that open suturing resulted in improved condylar bone remodelling relative to mini screw anchors, particularly in adolescent patients, yielding greater new bone height accumulation.

The results of a study presented by Prof. Zhang illustrated three methods of disk repositioning alongside corresponding changes in condylar height and dental-facial deformities. Complications reported included hematoma, temporary facial nerve palsy, temporary malocclusion, bone resorption, suture reaction, and infection.

In conclusion, two distinct methods of open disk reduction were introduced, both demonstrating consistent outcomes. The fundamental aspects for successful disk repositioning were emphasised: these incorporate adequate exposure, comprehensive release of the anterior disk attachment, precise disk suturing and fixation, along with the overarching principle of disk overcorrection. Appreciation was expressed for the audience's attention throughout the presentation.

I.9 Staging and treatment protocols for ADD and CR

Pei Shen. During this lecture, it was explained that a staging system and corresponding treatment protocols for juvenile TMJ anterior disc displacement (ADD) and condylar resorption (CR) would be presented. The prevalence of juvenile TMJ-ADD was highlighted as being particularly significant among young adults, with an increase in occurrence noted as they age. The lecturer remarked on the multifaceted influence of ADD on various aspects, including occlusion, skeletal structure, muscle function, and airway dynamics.

Nevertheless, it was pointed out that the existing treatment protocols for juvenile TMJ-ADD show considerable variability and that there is a notable absence of a widely accepted standardised treatment approach. Recent advancements in understanding the pathophysiology of TMJ-ADD were acknowledged, yet it was noted that diagnostic and therapeutic

developments have not progressed in tandem.

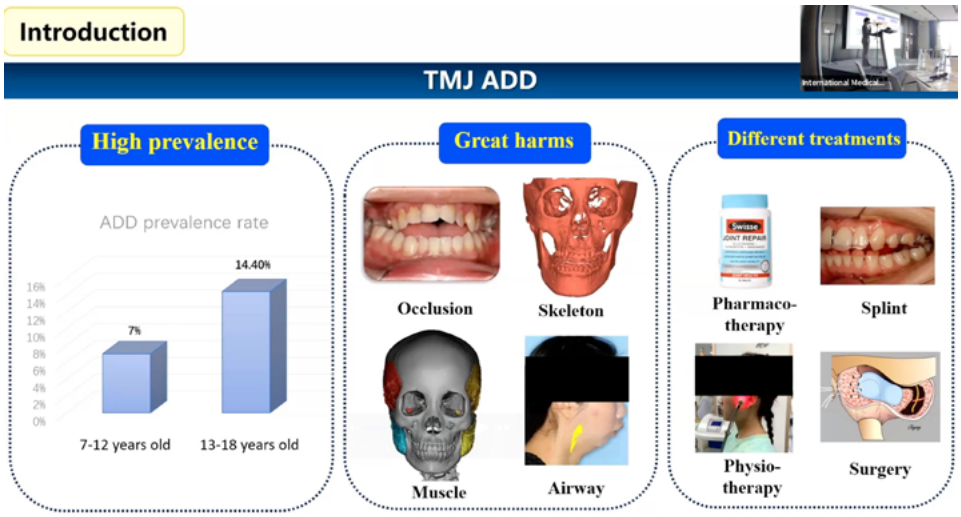


Figure 8. The multifaceted influence of TMJ-ADD on various aspects.

The need for further research to delineate and formulate specific therapeutic interventions for diverse TMJ-related diagnostic conditions was reiterated, reflecting the sentiments expressed by Dovick in his previous study. The discussion introduced the Wilkes classification, which is currently the predominant staging system utilised for TMJ-ADD. This classification encompasses five stages, progressing from stage 1 to stage 5, the latter indicating chronic TMJ pain. The lecturer summarised that this system relies on observable bone changes and clinical symptoms; however, it was also critiqued for its limitations.

Primary drawbacks of the Wilkes classification include its failure to assess disc morphology, lack of clarity regarding the salvability of the disc and condyle at various stages, and the absence of tailored treatment recommendations corresponding to each stage. As emphasised by numerous clinicians, there is a pressing need for a more pragmatic classification that offers specific treatment options for each category of the disorder.

In light of these issues, a new staging system, named Yang's classification, was proposed. To develop this system, an extensive collection of juvenile patients diagnosed with TMJ-ADD was compiled from 2009 to 2012, ensuring that all participants had undergone at least one follow-up and excluding those with congenital deformities, systemic diseases, or other pathologies impacting condylar growth. With over thirty years of clinical experience, Prof. Yang and his team established this classification system, focusing on conditions pertaining to the disc, condyle, and underlying bone marrow.

A detailed outline of each stage within this new classification was provided. In stage 0, normal MRI imaging reveals a disc maintaining its typical shape, alongside a condyle exhibiting normal shape and height with no evidence of bone resorption. Furthermore, both the volume and quality of the underlying bone marrow were deemed normal.

Progressing to stage 1, MRI imaging again shows a disc retaining its original form, with the condyle demonstrating minor or localised resorption while maintaining normal height. There is also partial reduction observed in the bone structure at the condyle's apex. At stage 2, the disc still appears morphologically stable, but moderate resorption of the condyle is evident, accompanied by a discernible decrease in height and minor signs of bone marrow reduction.

Stage 3 is further subdivided into stages 3A and 3B. In stage 3A, the disc is noted to

be either in its standard form or slightly deformed, positioning itself barely over the top of a severely resorbed condyle. The principal distinction between stages 3A and 3B is the disc's length; in 3B, the disc is markedly shortened, rendering it unable to adequately cover the condyle even after repositioning procedures. The conditions of the bone and marrow in stage 3B are comparable to those observed in stage 3.

In stage 4, subdivisions 4A and 4B are indicated, where MRI imaging reveals a disc similar to that of stage 3A but shows a condyle suffering severe resorption with compromised structural integrity. In 4B, the disc remains unchanged, but the condyle may experience complete resorption with significant loss of the underlying bone structure.

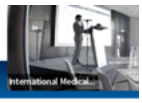
According to this new classification system, stages 3 and 4 are categorised as idiopathic condylar resorption. The proposed treatment protocols specify that for stages 0, 1, 2, and 3A, disc repositioning techniques are recommended, given that the disc's shape and length remain acceptable for intervention. The specific method for repositioning—whether through functional application, splinting, arthroscopy, or open surgery—should be determined based on individual cases, with the overarching objective being the restoration of the displaced disc to its anatomical position.

For patients classified in stage 3B, due to the disc being inadequate in length to cover the condyle, a follow-up MRI is advised after six to twelve months. If condylar resorption halts, unloading orthodontics is proposed as a treatment option; however, persistent resorption necessitates transitioning treatment to manage stage 4. In this advanced stage, condylar resection and replacement are typically indicated.

In conclusion, joints classified as stage 0, 1, 2, and 3A are presumed salvageable, whereas those in stage 4 are recognised as unsalvageable. Stage 3B presents a unique challenge, falling into a grey area where the potential for salvageability is contingent upon the observed progression of the condition.

Methods

Yang' s staging system



stage	Disc	Condyle	Marrow
Stage 0	Basic shape	normal condylar shape and height	Normal volume and quality
Stage 1	Basic shape	Mild and local condylar resorption, but normal condylar height	Partially reduced on the top
Stage 2	Basic shape	Moderate condylar resorption, reduced condylar height.	Mildly reduced
Stage 3	Basic shape or distorted	Severe condylar resorption	Moderately reduced
3A	Basic shape remains, or mildly distorted and shortened	Small, but basic shape is present	Moderately reduced
3B	Severely distorted and shortened	Small, but basic shape is present	Moderately reduced
Stage 4	Basic shape or distorted	Severe condylar resorption	oderately reduced with inflammatory changes, or severe reduced, or absent
4A	Basic shape remains or distorted. Perforation is common	Severe resorption, loss of integrity of cortical bone.	Moderately reduced with severe inflammatory changes
4B	Basic shape remains or distorted. Perforation is common	Severe resorption, or complete resorption	Severe reduced, or absent

Figure 9. Prof. Yang's classification system, focusing on conditions pertaining to the disc, condyle, and underlying bone marrow.

The criteria established for assessing the efficacy of treatment in juvenile Anterior Disc Displacement (ADD) are delineated as follows.

In cases of disc repositioning, a normal disc position accompanied by condyle regeneration is classified as excellent. Conversely, a scenario where the disc position remains normal, yet

shows minimal to no condyle regeneration or evidence of progression in condyle resorption, is rated as good. If, however, a recurrence of disc displacement occurs, or if there is a progression in condyle resorption, the outcome is categorised as poor.

In the context of joint reconstruction, successful integration of the graft with minimal to no resorption is considered a good outcome, while the presence of significant graft resorption is classified as poor. Outcomes deemed excellent and good are interpreted as ameliorated, while those assessed as poor are regarded as aggravated.

The study included a total of 780 joints, with an average follow-up period of 20 months. The joints were classified according to both Yang's and Wilkes' classification systems. Yang's classification particularly provided further distinction within stages 4 and 5 of the Wilkes system, thereby clarifying the suitability of the joints for treatment.

Kaplan-Meier survival curves were employed to contrast the prognostic evaluation efficiency between the Wilkes' and Yang's classification systems. The findings indicated that Yang's classification facilitated a significant stratification among different subgroups. Following this, both univariate and multivariate analyses were performed to ascertain the variables affecting treatment efficacy. It was revealed that a noteworthy interaction exists between the stratification provided by Yang's classification and the selected treatment modalities. Specifically, in salvageable joints, disc repositioning resulted in favourable outcomes, whereas joint replacement emerged as the more effective choice for unsalvageable joints. This underscores the utility of Yang's classification in guiding treatment decisions for juvenile TMJ ADD.

The predictive model was subsequently validated using the collected dataset. Analysis from the Cox model indicated that treatment strategies aligned with Yang's classification demonstrate a high degree of predictive reliability.

Several cases were presented to illustrate these findings. One case involved a young girl whose initial MRI depicted ADD without reduction on the right side, with the condyle height on that side shorter than on the left. The joint was designated as stage 2, warranting disc repositioning surgery. Postoperatively, new bone formation was observed atop the condyle, culminating in complete integration after three years. This intervention resulted in marked changes in her facial structure—initially, her chin deviated to the left, but after the treatment period, the mandibular asymmetry showed significant correction. X-ray evaluation demonstrated that the height of the right mandibular ramus, which was previously shorter, was nearly equal to that of the left post-treatment. Furthermore, occlusal observations revealed that her lower dental midline, once deviated to the right, was entirely corrected following the growth of the right condyle.

From these cases and findings, several conclusions can be drawn. Firstly, Yang's classification effectively differentiates the severity of juvenile TMJ-ADD, offering substantial stratification across distinct subgroups, thereby affirming its practical application. Secondly, this classification allows for the identification of salvageable and unsalvageable joints, indicating its reliability. Lastly, with respect to treatment efficacy, condyle remodelling and regeneration were predominantly observed in stage 1, 2, and 3A cases, suggesting that treatment outcomes for juvenile TMJ-ADD, based on this classification, are highly predictable.

I.10 Complications of TMJ open and minimally invasive surgery

Florencio Monje. In this oral presentation on complications associated with open and minimally invasive TMJ surgery, it was conveyed that complications serve as a humbling reminder for all surgeons, highlighting the less desirable aspects of surgical practice. It was suggested that these complications, akin to a carbon footprint, merit discussion and analysis

to facilitate a reduction in their occurrence following surgical procedures. While engaging in dialogue regarding complications may present a somewhat somber tone, it was argued that such discussions are ultimately honest, constructive, and beneficial, serving to prevent future complications in both the lecturer's and the audience's clinical practices.

Drawing parallels with life, complications within the realm of radiosurgery were categorised into unavoidable and avoidable types. Fundamental knowledge of the anatomy of the TMJ was deemed essential for understanding the potential complications that may arise. The joint is encircled by various neurological structures, principally originating from the fifth and seventh cranial nerves, along with blood vessels, primarily branches of the internal maxillary and superficial temporal arteries. Furthermore, the TMJ's close anatomical relationship with the base of the skull, along with its proximity to the ear, increases the risk of damaging the external auditory canal or the middle ear. The position of the parotid gland, which lies inferior yet adjacent to the joint, also contributes to the complexity of surgical intervention.

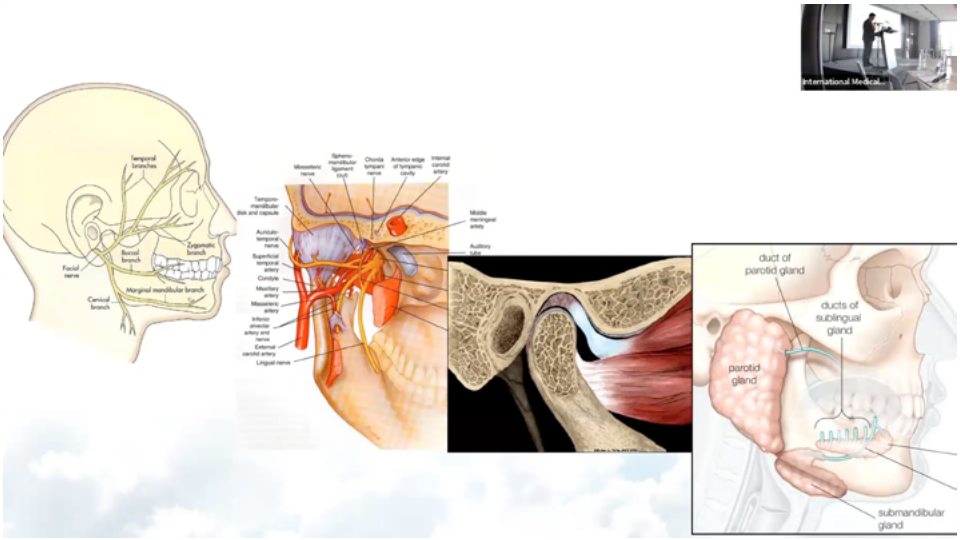


Figure 10. The TMJ is encircled by various neurological structures, principally originating from the fifth and seventh cranial nerves, along with blood vessels.

When considering complications associated with minimally invasive surgery, it was noted that while literature on this subject is limited, high-quality studies do exist. Prof. Monje emphasized that a comprehensive review of all joint surgeries indicated that the complication rates observed in TMJ procedures are strikingly comparable to those reported in hip or knee arthroscopy. A recent publication referenced by the lecturer, highlighted that the complication rate within the literature for TMJ arthroscopy stands at approximately 8%, underscoring the procedure's overall safety.

It was remarked that the likelihood of complications is inversely proportional to the surgeon's experience; increasing surgical proficiency correlates with a reduced probability of encountering complications. Conversely, the complexity of the procedure appears to heighten this risk. Notably, the complications associated with local anaesthesia were mentioned, along with the importance of accurately detecting interoperative complications. The speaker asserted the practice of limiting the number of punctures to no more than three during procedural interventions to mitigate risks.

Prof. Monje identified a total of twelve classes of complications, with the foremost

being damage inflicted upon the fibrocartilage or the articular eminence and fossa, particularly prevalent among less experienced surgeons. The various manoeuvres intrinsic to TMJ surgery may inadvertently lead to tearing within the inter-articular tissues, which can result in the underdiagnosis of differing grades of contrabalance—this differential diagnosis between contrabalance and iatrogenic damage to the TMJ surface was underscored as critical.

Additionally, the lecture addressed the potential for irrigation fluid extravasation into the temporal and parietal regions, along with the vascular region, emphasising the necessity of diligent monitoring of the irrigation circuit to prevent obstruction. Instances of fluid leakage might lead to palatal or parapharyngeal edema, which necessitates careful exploration of the oropharyngeal area prior to patient extubation when such complications are suspected. It was stated that lateral parapharyngeal edema typically manifests within two to four hours and can be managed effectively with corticosteroid therapy. Neurological complications observed in these procedures exhibit an incidence rate ranging from 0.75% to 3.9%.

During his presentation Prof. Monje discussed five potential complications associated with surgical procedures.

Firstly, the phenomenon of dilated damage to the central nervous system was highlighted. Such damage can result from punctures or improper entry through the temporal fossa, which may lead to observable perforations in the roof of the glenoid fossa. It was noted that brain structures could be visualised endoscopically through arthroscopy, necessitating caution, particularly in instances where pneumatization of the thin temporal fossa is evident.

The second potential issue pertains to the peripheral nervous system, specifically the risk of injury to branches of the facial nerve. This type of injury may occur as a consequence of anaesthetic administration or direct trauma stemming from excessive instrumentation, repeated punctures, or the use of an electrical scalpel. An illustrative case was presented involving a patient classified as level two arthroscopy, who experienced paralysis of the upper branch of the facial nerve for six weeks post-operation. Remarkably, it was reported that the patient regained full function of the affected nerve branch ten weeks after the procedure. Furthermore, the proximity of the masseteric nerve to the site of myotomy—specifically, in relation to the lateral pterygoid muscle—was emphasised. To mitigate the risk of damaging the masseteric nerve, it is recommended to perform a superficial myotomy to a maximum depth of five millimetres. A plasma sprayer, which utilises a specific form of radiofrequency, was proposed as a technique for facilitating conservative myotomy.

The third discussed possibility pertained to the astralisation of fluid, which could exert pressure on nerves such as the infraorbital, lingual, or inferior alveolar nerves when compression occurs in the parapharyngeal space. It was suggested that maintaining a continuous flow of irrigation saline during procedures could diminish fluid accumulation, thereby reducing the risk of neuroplexia.

The fourth complication identified was Frey's syndrome, characterised by gustatory sweating. The prevailing hypothesis regarding its etiology revolves around aberrant regeneration of parasympathetic fibres.

The presentation also addressed vascular complications, beginning with the observation that interarticular bleeding is typically not severe but can pose challenges in terms of visibility within the superior joint space. To enhance visibility, high-flow cold irrigation may be employed, and in certain cases, it may be necessary to occlude vessels or utilise radiofrequency for coagulation of terminal vessels. The use of a posterolateral approach was discussed as a strategy to avoid damaging the major superficial temporal vessels or the facial nerve, with the consensus indicating that this technique is largely effective.

Additionally, concerns were raised regarding potential vascular complications associated

with the inner structures of the TMJ, particularly the meningeal arteries. The importance of recognising the distance between the skin and the centre of the TMJ was underscored, with caution advised if this distance exceeds 25 millimetres without a visual reference to the joint.

Lastly, inflammatory complications were addressed, wherein the emergence of a severe inflammatory process immediately following TMJ surgery could often be traced back to excessive instrumentation or repeated punctures. It was noted, however, that most inflammatory conditions are generally amenable to medical treatment, and participants were advised to avoid repeated punctures in practice.

The patient in question had been referred to the hospital following a suturing discopexy procedure, which had unfortunately resulted in a four-hour operation. An MRI revealed notable inflammation in the soft tissue of the sternal aspect of the joint. There appeared to be a potential association with the development of otitis externa, which seemed to stem from the accumulation of irrigation fluid and debris in the external auditory canal during the procedure. Consequently, this could lead to perforation of the tympanic membrane.

One month post-arthroscopy, the patient reported experiencing hearing loss and discomfort while drinking. The underlying cause, as identified, was the presence of residual debris and fluid situated in the deeper sections of the external auditory canal. In cases of straightforward arthroscopy, the removal of this debris is standard practice.

An alternative consideration involved manipulation of the joint leading to the middle ear. A resident performed a commendable arthroscopy, approaching the middle ear despite believing that the symptoms resulted from a degenerative joint disease. This aligns with a principle articulated by McCain: if one encounters a familiar situation, it is advisable to refrain from intervention and seek clarification later.

Another possible explanation for the observed hearing loss might be excessive mobilization and damage to the TMJ due to a systemic reaction. This could manifest as distention of the sphenomandibular ligament and separation between the malleus and the anterior malleolar ligament, ultimately affecting the ossicular chain.

The literature reports a variation in infection rates, ranging from zero to 1% in arthritic patients; in the experience of the presenter, there were no instances of infectious complications, likely due to effective antibiotic prophylaxis, proper sterilization of instruments, and continuous irrigation of the joint. Cardiological complications, including arrhythmias, have been documented in relation to arthroscopy procedures aimed at distending the upper joint space. The use of certain anaesthetic solutions with epinephrine may lead to rapid absorption and the potential onset of ventricular ectopy.

Furthermore, the TMJ is known to have strong reflexogenic properties, making it susceptible to arrhythmias. Secondary occlusal changes following minimally invasive procedures are relatively common. The initial five to seven days post-surgery typically involve oedema, while in cases classified as level three, disc displacement may create a new positional arrangement, exacerbating the situation and potentially leading to an open bite.

A particular case was noted involving a patient who had undergone bilateral arthroscopy and was reportedly well ten years later. However, two years following the procedure, she developed an open bite, possibly due to lysis in the superior aspect of the condyle. Such movements and the resultant bony changes remain challenging to elucidate.

Complications relating to thermal damage within the joint, whether due to monopolar or bipolar energy sources, necessitate caution; it was noted that monopolar methods can elevate temperatures beyond 70 degrees Celsius in both the joint and surrounding soft tissues. Notably, there have been no documented cases of cutaneous complications arising from these

procedures.

Instances of semi-tosal lesions have been observed shortly after TMJ arthroscopy, potentially indicating allergic reactions to components of Ringer's lactate or disinfectants employed during the surgery. Equipment failure, particularly the breakage of instruments used in arthroscopic surgery, is of significant concern given their delicate nature. To mitigate this risk, it is recommended to use standardised instruments, verify structural integrity, avoid excessive force, and confirm the closure of instruments prior to their withdrawal through the cannula.

In the event of instrument breakage, the procedure should be halted immediately, and the instrument should be maintained in clear view while other surgical staff ascertains the functioning of the operative circuits. It is also essential to locate the fractured piece at its last known position, potentially necessitating conversion to open joint surgery.

Lastly, the procedure highlighted issues with sterilisation, as multiple fragments—both plastic and metallic—were discovered in the joint. The removal of these particles took nearly an hour of considerable effort.

In the second part of the presentation, the discussion transitioned to the topic of open joint surgery, identifying eleven classes of potential complications associated with these procedures.

The initial concern highlighted was related to scarring, particularly in the preauricular region. Various incision types, including preauricular and endoral approaches, were examined, with an emphasis on the preference for the endoral method to minimise the visibility of scars. It was noted, however, that complaints regarding preauricular scars are relatively infrequent, regardless of the incision type used. In contrast, scars resulting from mandibular or retromandibular incisions tend to be more conspicuous, which can pose challenges in certain cases.

Moreover, alterations in occlusion were discussed, attributed to three principal factors. Firstly, dyscopexia—where the positional relationship between the condyle and fossa is disrupted—was observed to cause malocclusion. Secondly, the use of muscular or temporal flaps was recognised as a potential contributor to such occlusal changes. Lastly, condylar hypoplasia, particularly following condylectomy, can lead to malocclusion as a secondary effect. Additionally, it was conveyed that the approach taken in treating TMJ injuries invariably alters the joint volume and surface, resulting in potential degeneration, adaptation, or remodelling, which may further lead to occlusal complications.

The phenomenon of Frey syndrome was also addressed, particularly concerning gustatory sweating associated with palatine gland surgery or TMJ interventions. The ear was identified as a particularly sensitive structure that could suffer severe repercussions if hearing impairment related to the joint occurs. It was advised that surgeons exercise caution to maintain a position anterior to the auditory canal while avoiding the use of heavy instrumentation, which risks damaging the middle ear or the ossicular chain.

Bleeding and nerve damage were acknowledged to frequently occur in conjunction; particular emphasis was placed on the maxillary artery, which poses significant risks that would be discussed in greater detail in subsequent lectures on total joint replacement complications. The incidence of infections post-arthroplasty was reported to range from one to two percent, with indications of swelling, lymphadenopathy, or edema in arthroplasty patients warranting consideration for possible infections. Acute infections may generally be managed with antibiotics and lavage, while subacute and chronic infections present more complex challenges. The theoretical framework proposed three distinct causes of infection: contamination during the surgical procedure by flora from adjacent structures, opportunistic infections in immuno-

compromised patients, and the presence of foreign bodies, particularly mitech bone anchors, which were mentioned to have no conclusive evidence linking them to higher infection rates in the literature.

Damage to the mandibular division of the fifth cranial nerve was deemed uncommon; however, reports of numbness in that region were noted, albeit typically not perceived as bothersome by patients. In contrast, the seventh cranial nerve may sustain either temporary or permanent damage due to stretching or transection during dissection, highlighting the importance of communicating with the anaesthesiologist to minimise the use of muscle relaxants if feasible. Furthermore, electrocautery was identified as a potential source of nerve injury due to electrical spread, particularly if bleeding control is attempted.

The incidence of facial nerve complications appeared more pronounced in patients with prior TMJ surgery, likely due to altered anatomy resulting from scarring. The development of parotid fistulas due to ductal sectioning was also addressed, with treatment recommendations including anti-cellulitis compression while emphasising the necessity to carefully close the parotid capsule before suturing the subcutaneous tissue and skin.

Ophthalmological complications were acknowledged as possible following open surgery, particularly during lengthy operative procedures, with corneal lesions being the most commonly reported issue. It was speculated that these ocular lesions might arise from contact with iodine solutions or inadvertent pressure during surgery, alongside hypotensive events during operations that could cause corneal ischemia and subsequent corneal edema. Preventative measures included ocular lubrication, taping, and the application of protective goggles.

Bone alterations following joint ankylosis, resulting from any technique employed, revealed that adaptation and remodelling processes could alter both the volume and surface of the joint. Historical practices involving the use of ear cartilage grafts resulted in varying outcomes, with some patients experiencing lysis while others developed ankylosis—likely influenced by the fragmentation of cartilage particles. Lastly, the topic of bone ankylosis following the use of temporal muscle flaps was revisited; while these flaps previously yielded favourable results, instances of heterotopic bone formation or ankylosis were recognised as possible complications.

Session II - Condylar Fracture and Ankylosis

II.1 Soft tissue management in ORIF of condylar head fractures – dos and don'ts

Andreas Neff. The primary focus of Prof. Neff's discourse was the critical aspect of soft tissue management. Upon reviewing the current literature, Prof. Neff identified a significant gap in the investigation of soft tissue conditions following trauma. He elaborated on the sequelae associated with such injuries, emphasising that soft tissues—such as contusions, distortions, and disc displacements—are profoundly affected, as are the surrounding structures of the TMJ. This distinction highlights the complexity of condylar fractures, as these cases involve not only bone but also intra-articular soft tissue, differentiating them from more standard fracture types.

The implications of surgical interventions on these soft tissues were a significant point of concern. Prof. Neff indicated that surgical procedures, including osteosynthesis, can induce iatrogenic trauma, which can result in complications such as scarring and the risk of fibrosacralculosis, alongside potential nerve damage and heterotopic ossification.

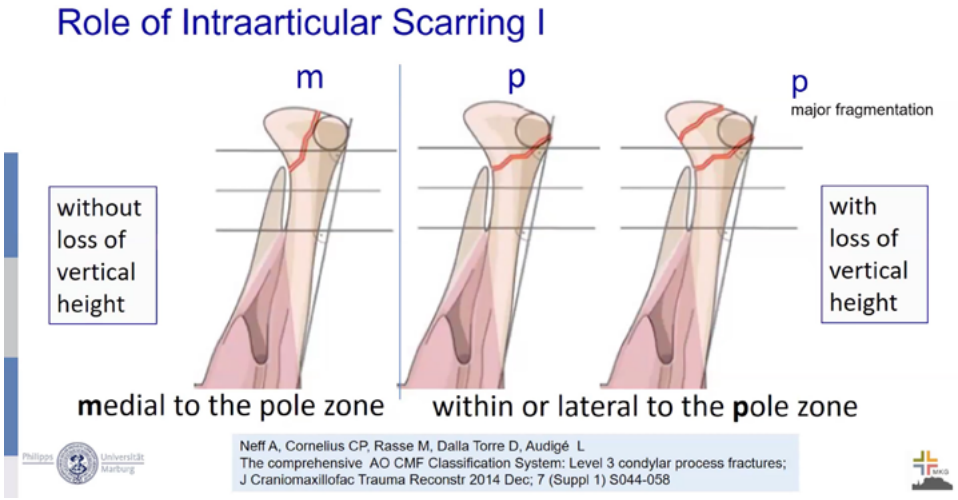


Figure 11. Role of intraarticular scarring.

It was noted that the discussion would extend to the long-term consequences of surgical management within the joint environment, which necessitates extreme caution to minimise any induced trauma. Prof. Neff expressed disappointment regarding the limited investigations performed in this field and pointed out the importance of occlusion in influencing treatment outcomes, suggesting that variations in dental support, particularly in younger patients, may yield differing results in recovery post-treatment of condylar head fractures. His remarks emphasised the necessity for a comprehensive understanding of both surgical techniques and patient-specific anatomical variances to optimise treatment efficacy.

The discussion later turned to specific complications such as hemarthrosis, with Prof. Neff referring to MRI studies indicating high rates of this condition in mandibular fractures. It was noted that the standard protocols for evaluating MRIs may require further scrutiny, especially concerning their applicability to specific clinical contexts.

A relevant publication authored in collaboration with colleagues in Bratislava was referenced, although it was acknowledged that the study sample consisted of only ten patients.

In this limited cohort, no significant instances of hemarthrosis were identified.

Following this, a video of an arthroscopic procedure conducted on a patient with a contralateral head fracture was examined. Observations revealed inflammation within the posterior band of the joint, with little to no evidence of hemarthrosis present. The literature frequently portrays cases involving rupture of the posterior band; however, the speaker noted that cases of lateral capsule perforation, where the condyle protrudes through the lateral capsular region, are more common when managing contralateral head fractures.

A sequence of images demonstrating the aftermath of osteosynthesis in a patient was illustrated. The development of scarring between the articular disc, the joint space, and the condylar surface was documented.

The presentation emphasised the necessity to differentiate the healing patterns and complications arising from various fracture types, particularly intra-articular and inter-capsular scarring, which may contribute to complications in joint function. It was evident that both soft tissue and osseous structures must be considered during treatment.

In comparative analyses of treatment effects on different fracture types, it was critical to ascertain the included patient demographics. Notably, a significant proportion of fractures—around 45%—in the condylar head area were multifragmented, which leads to varying clinical outcomes compared to medial fractures.

An MRI conducted following the application of resorbable materials revealed unsatisfactory results, prompting the discontinuation of such techniques. Initial attempts employing inadequate screws led to complications such as scarring, ultimately impairing the functionality of the TMJ. These findings underline the increased risk for soft tissue irritation associated with specific fracture patterns and treatment methodologies.

The discussion then shifted towards key takeaways pertinent to the osteosynthesis of condylar head fractures, highlighting the importance of preserving the integrity of the capsular area. The independent movement of the disc relative to the condyle is crucial; any scarring that hinders this movement poses a risk for significant limitations in joint mobility.

In the instances where detachment of the lateral pole from the condyle is unavoidable due to fracture extent, the associated outcomes tend to be poorer compared to fractures where preservation is achievable.

The retroauricular approach was proposed as a viable surgical technique. While not universally favoured, it offers several advantages, including improved access to the medial aspect of the fracture line, which remains relatively unchanged compared to the often fragmented lateral pole.

Further, the potential for scarring between the fracture line and the disc was reiterated, with the retroauricular approach facilitating access to less functionally critical regions of the joint. The use of previously inadequate materials such as lactosorb screws was critiqued, as their implementation has been associated with considerable limitations on both translatory and rotational movements within the joint.

Lastly, it was emphasised that the use of mini-plates or micro-plates in the context of conical head fractures is ill-advised, with recommended practice suggesting the incorporation of screws alongside these materials to mitigate the risk of joint scarring and subsequent mobility issues.

In the analysis of longitudinal follow-ups spanning a decade or more, certain complications have been identified, albeit infrequently. One such complication is heterotopic ossification, which appears to manifest predominantly among younger patients, specifically those aged 12 to 15 years. These younger individuals seem to exhibit an increased propensity for developing either heterotopic or hypertrophic ossification.

For instance, a case involving a 16-year-old presented severe heterotopic ossification, prompting further investigation into the possible relationship between the timing of joint mobilization and the occurrence of this complication. It has been noted that early implementation of mobility under full load may mitigate these adverse effects, particularly when patients adhere to prescribed rehabilitation exercises.

Statistical analyses have indicated that the incidence of complications is markedly higher in cases where osteosynthesis is delayed. The time frame identified in clinical experience suggests that intervention is most effective when performed within three weeks post-injury. Subsequent studies have documented deteriorating outcomes after this period. Despite some literature advocating for delayed osteosynthesis beyond months, the author cannot endorse such an approach, as it has not yielded positive results in practice. A timeframe of approximately 40 days has been identified as optimal; treatments conducted post this period tend to lead to poorer outcomes.

In Germany, there exists a protocol for the extraction of osteosynthesis materials, which diverges from international practices. This secondary intervention serves a dual purpose: it facilitates assessment of the surgical outcome and allows for evaluation of potential complications such as scarring and hardware placements. In roughly 25% of observed cases, screws intended to be flush with the bone surface were found to protrude post-operatively. While such findings do not typically correlate with functional deficits, the presence of external hardware may predispose patients to subsequent scarring and further complications.

Illustrative cases have shown that while screws may initially be positioned appropriately, significant resorption lacunae can develop post-removal of osteosynthesis materials. This resorption, manifesting close to the condylar surface, seems more likely a consequence of scarring linked to the fracture line rather than direct effect from the screws themselves.

It is imperative to recognise that currently employed osteosynthesis materials do not remain static; while they may retain their physical location, resorption and remodelling processes occur within the surrounding bone structure, influenced by varying loading conditions. Such factors inevitably impact the functionality and overall results of surgical interventions.

Ultimately, the desired outcome post-surgery is the restoration of healthy joint function, with a primary focus on achieving optimal disc mobility, indicative of healthy soft tissue dynamics. While patients may possess varied expectations and experiences post-procedure, monitoring clinical criteria reinforces the effectiveness of interventions.

II.2 Condylar fracture: treatment protocol and surgical techniques

Dongmei He. The lecture presented an overview encompassing four main topics: the classification system developed by Prof. Yang's research group, the treatment protocols employed, the surgical techniques utilized, and the outcomes observed during follow-up assessments.

It is widely acknowledged that intracapsular fractures are clinically prevalent, displaying characteristic clinical manifestations. However, the nuances of type C fractures are particularly noteworthy; despite the small size of the fracture fragment, it is often the case that the TMJ disc is positioned in association with this fragment. Conversely, types A and M are characterized by a decreased condylar height.

In the treatment of condylar fractures, several factors must be taken into account, including the specific type of fracture, the maximum interincisal opening (MIO), occlusion, and the age of the patient. The primary aims of surgical intervention for condylar fractures are to restore the anatomical height and occlusal relationships, as well as to prevent

complications such as ankylosis.

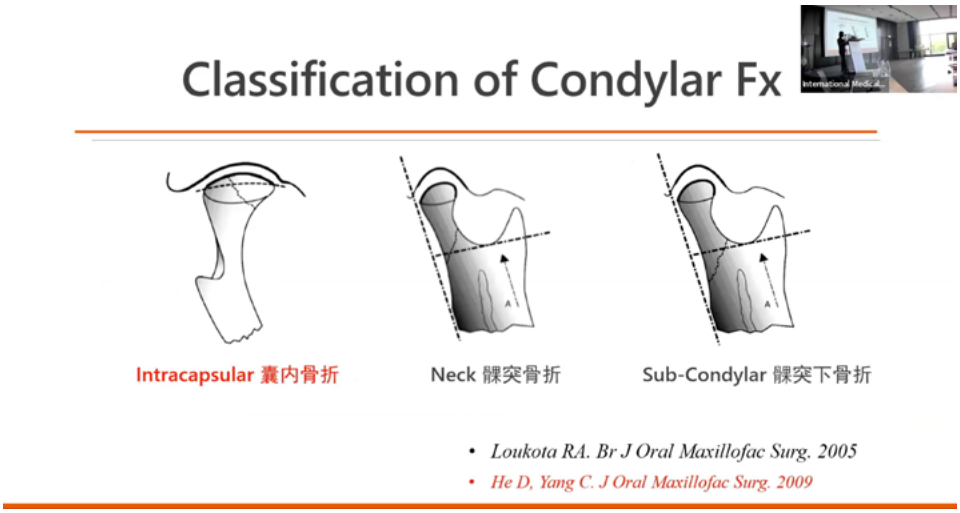


Figure 12. Classification of condylar fractures.

Indications for surgical intervention arise when fractures are likely to result in ankylosis, osteoarthritis, MIO impairment, or dental and facial deformities, conditions that may not be effectively addressed through conservative treatment methods. These indications can be classified as absolute or relative.

Dislocation of the ramus stump laterally within the fossa poses a significant risk for the development of ankylosis. Similarly, improper positioning of the ramus stump relative to the fossa can contribute to this complication. The surgical approach typically employs a preauricular incision, particularly for addressing intracapsular condylar fractures and neck fractures. Other incision techniques may also be employed.

The procedure commences with careful dissection anterior to the superficial temporal vessels, allowing direct visualisation of the facial nerve, which can be protected using a small hook. This approach facilitates easy exposure of condylar neck fractures while permitting assessment of the TMJ disc's status. In instances of displacement, repositioning of the disc is warranted.

Attention must be given to the lateral pterygoid muscle as it supplies blood to the condylar head, and the integrity of the cartilage is paramount to avoid complications such as ankylosis or growth disturbances, particularly in paediatric patients. Fixation of the fracture fragment is achieved using two screws or a mini plate, preferably bicortical screws, ensuring stability while maintaining proper disc position.

In cases of larger fracture fragments, two screws are typically sufficient, as reliance on a single screw increases the risk of fragment rotation. For neck and subcondylar fractures, the use of two mini plates is necessary to maintain stability and prevent dislocation induced by muscular pull. The plates should be positioned anteriorly and posteriorly along the condylar neck, while careful disc repositioning is critical to mitigate the risk of osteoarthritis or ankylosis.

Illustrating these principles, a case of a 15-year-old male patient presenting with bilateral condylar fractures was discussed. The patient exhibited significant facial and dental deformities, which correlated with a CT scan revealing a necessity for minimal surgical intervention to adequately expose the fracture line while preserving the facial nerve. Following fracture fixation and post-operative evaluation, satisfactory aesthetic and functional outcomes were

achieved.

The presentation reinforced that successful surgical outcomes hinge on adequate incision planning, meticulous reduction techniques that preserve surrounding anatomical structures, stable anatomic fixation, and the critical step of disc repositioning to prevent complications.

Notably, the presentation also addressed cases of failed surgical treatments resulting from inadequate reduction, overlooking TMJ disc positioning, and their long-term implications, such as osteoarthritis and fibrous ankylosis.

The optimal sequence of addressing combined condylar and mandibular fractures was also outlined, distinguishing between fresh and delayed fractures, necessitating different approaches in surgical management.

Cases involving paediatric patients with significant dislocations accentuated the need for prompt surgical intervention to prevent potential complications, including ankylosis and growth disturbances.

Lastly, the success criteria for the surgical management of condylar fractures were enumerated, including satisfactory mouth opening, absence of pain, unobstructed mandibular movement, stable occlusion, well-coordinated facial profiles, and the absence of surgical sequelae, particularly nerve injuries.

In summary, a comprehensive overview was provided based on Prof. Yang's classification system, indications for surgical management, and key considerations in achieving successful surgical outcomes while maintaining the potential for continued growth in paediatric patients. Related publications were also referenced to support the findings presented.

II.3 Endoscopic treatment of condyle fractures

Günter Lauer. The topic at hand concerns the endoscopic-assisted treatment for condylar fractures, an area of growing interest in maxillofacial surgery. It has been established through various studies that open reduction and internal fixation (ORIF) offers superior outcomes compared to a conservative management approach, often encapsulated in the phrase "wait-and-see" treatment. Highlights from important contributions in this field include work by Prof. Ekel from Dresden, known for the Ekel lag screw, which has facilitated the reduction and fixation of condylar fractures.

A significant milestone was achieved by the aforementioned Prof. Ekel, who conducted one of the first prospective, randomised multi-centre studies, demonstrating the efficacy of surgical intervention over conservative management. Furthermore, Matthias Schneider, a surgeon at the Department of Oral and Maxillofacial Surgery, Technical University of Dresden, has yielded a systematic review and meta-analysis, affirming the advantages of ORIF in terms of functional outcomes, pain reduction, and restoration of occlusion and jaw symmetry.

Despite the clear benefits associated with ORIF, the choice of surgical approach remains critical. The extraoral ORIF method, while effective, may lead to visible scarring and potential complications, such as facial nerve injury. Conversely, the intraoral approach is more familiar to maxillofacial surgeons, particularly regarding bilateral sagittal split osteotomy (BSSO) procedures.

The transoral approach has been documented as early as the 1980s within German literature. However, it suffers from limitations, including restricted visibility and an overall challenging working environment, akin to viewing through a tunnel. To overcome these issues, the endoscopic approach was introduced, enhancing visibility and facilitating the surgical process. Notably, this methodology was also recognised in American literature,

where early illustrations highlighted its clinical benefits.

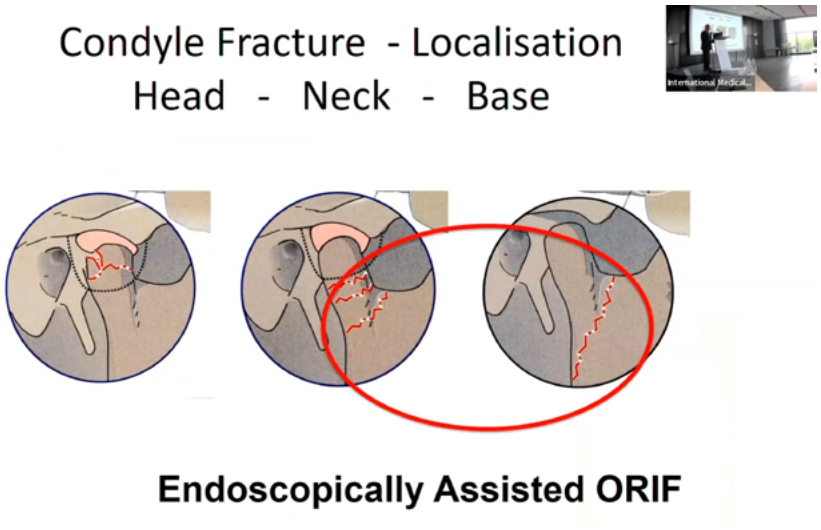


Figure 13. Base and neck fractures as indications for endoscopic treatment.

Performing the surgery necessitates a comprehensive set of specialised instruments, which include angeled drills, screwdrivers, and endoscopes, all of which are required for effective navigation through the confined intraoral space. The surgical technique typically involves an S-shaped incision to layer the muscles and extend the incision to the paramarginal region of the teeth. The surgeon must carefully dissect the tissue without damaging the buccal nerve, ensuring the muscle is preserved.

During the procedure, it is imperative to elevate the periosteum adequately to uncover the lateral aspect of the ramus leading to the condyle. The proximal fragment of the fracture may be obscured by muscle, requiring precise manipulation for exposure. Effective reduction hinges on optimal relaxation of the patient, calling for clear communication with the anaesthesia team during the procedure.

Different techniques for fracture reduction can be employed, including the use of clamps or the placement of screws accompanied by periosteal elevators. Following the reduction, the osteosynthesis begins by drilling proximal holes over the fracture line. Fixation of the plate should be immediately performed, with subsequent checks using an endoscope to ensure proper alignment before securing the screws fully.

The Vienna Group has contributed valuable insights regarding the stabilisation of fractured segments through these approaches, suggesting that while two plates provide greater stability, space considerations may restrict their use in certain cases. The biomechanics of the condyle must be taken into account, as evidenced by Maier and Wagner's developments of enhanced plates to achieve improved stability.

Biomechanical testing of these plates, including the Delta and Rhombic plates, demonstrates their robustness under varied clinical conditions. A clinical study involving 89 condylar fractures yielded promising results, indicating effective healing and restoration of function, including substantial mouth opening and lateral protrusion.

In summary, the endoscopic-assisted transoral approach emerges as a viable technique for treating condylar base and neck fractures. While the learning curve is steep, the introduction of 3D plates significantly aids the surgical process. Experience will determine the feasibility of addressing higher neck fractures and dislocated fractures; however, when intrao-

ral reduction proves inadequate, transitioning to an extraoral approach, typically through a retroauricular incision, may be warranted.

II.4 Post traumatic condylar fracture management

Andrew Sidebottom. In the subsequent 15 minutes, an exploration of the management strategies for post-traumatic complications associated with condylar fractures was presented, categorising the approaches into distinct methods.

The long-term complications typically encountered in these cases include malunion, nonunion, ankylosis, and growth abnormalities. Various management options are available, such as late reduction and fixation, condylar osteotomy, sagittal split osteotomy, inverted L osteotomy, distraction osteogenesis, 4-1 leveling osteotomy, lateral release of ankylosis, gap arthroplasty, costochondral grafts, and alloplastic replacement.

A series of pertinent questions must be addressed when assessing late complications of condylar fractures. These include: Is the joint function satisfactory? Is there any joint pain? Is the occlusion adequate? Is there a cant present? Has growth ceased? And is there a resultant facial anomaly? Each of these aspects will be examined in turn.

Commencing with joint function, it is essential to define what is deemed adequate. Typically, 98% of the population can achieve a mouth opening exceeding 35 millimetres, with lateral movements of approximately six millimetres, allowing for normal dietary capabilities. Critical concerns include the presence of fibrous or bony ankylosis.

The second aspect is joint pain. It was highlighted that undertaking surgery on a joint where the pain score is below two out of ten is unlikely to yield improvement. Nonetheless, significant pain during function can still be encountered.

Regarding occlusion, considerations must involve the presence of any open bites, either ipsilateral or contralateral, and particularly in bilateral cases, an anterior open bite. Moreover, any cant in occlusion needs to be evaluated, whether it is upward, downward, or absent altogether.

The issue of growth arrest must also be considered, particularly with respect to secondary presentations of conditions such as hemifacial microsomia. Importantly, the nature of joint fusion—bony or fibrous—should be assessed, alongside any resultant facial anomalies.

The underlying philosophy when addressing these conditions is succinct: either assist the patient or refrain from causing harm. Indications for early surgical intervention have been discussed in prior lectures, thus requiring no further elaboration. Effective fixation typically necessitates engagement of four cortices on either side of the fracture.

Contraindications for surgical intervention include insufficient conservative management, local infections, patient preference, inadequate surgical training for open procedures, and lack of appropriate instruments or plate systems tailored to the specific fracture characteristics.

The overarching goal within an orthopedic paradigm is to preserve normal anatomical structure, thereby minimising morbidity, enhancing functionality, and rectifying occlusion.

Moving on to late open reduction and internal fixation, an example was presented where conservative management for six weeks had taken place, although its actual nature remained somewhat ambiguous—possibly characterised by observation and inactivity. This resulted in a late change in occlusion, with the patient presenting with a contralateral open bite alongside an asymptomatic infected lower molar.

The proposed solution involved the opening of the fracture site, with potential options

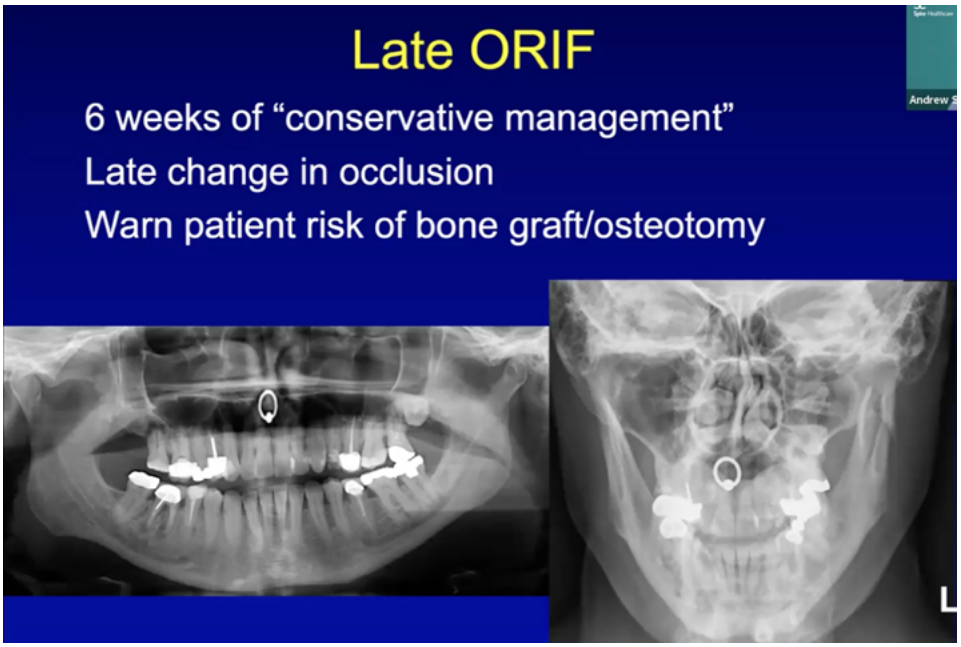


Figure 14. An example of late open reduction and internal fixation.

including osteotomising the bone or applying a bone graft to the defect. Ultimately, late open reduction allowed for joint mobilisation, revealing an oblique fracture. Fixation involved a bicortical screw complemented by two plates rather than two four-hole plates.

In the case of condylar osteotomy, indications for intervention typically include a notable shortening of the ramus, provided the condylar head and disc remain intact. The retromandibular approach is preferable in these instances. Utilising a piezo saw allows for greater precision during cutting, while minimising medial bleeding. Proximal fragment repositioning may be necessary, often necessitating interposition bone grafts from cancellous bone chips to facilitate lengthening.

Illustrations were shared regarding a patient with malunion or nonunion of proximal fragments. The surgical approach involved the removal of metalwork, osteotomising remaining fragments, and maintaining intermaxillary fixation while employing robust two-plate fixation alongside bone graft placement to address significant gaps.

The sagittal split osteotomy was indicated for a patient exhibiting considerable joint functionality despite poor radiological findings, as she demonstrated a 44-millimetre mouth opening. Thus, repositioning the occlusion through this technique yielded successful functional outcomes.

The inverted L osteotomy remains a viable method for lengthening the ramus in patients with intact TMJ functionality. A case was recounted involving a patient who experienced a prior malunion, which was subsequently managed through this technique with successful restoration of function.

Pediatric fractures necessitate additional considerations, specifically in terms of ankylosis. In patients exhibiting type three ankylosis, interventions could involve lateral release, disc interposition, or gap arthroplasty using autogenous grafts, among other options.

The discussion concluded with a summary of vital questions to consider when managing post-traumatic complications: Is joint function adequate? Is there joint pain? Is occlusion satisfactory? Is there a cant? Has growth termination occurred? And is any facial anomaly present? It is paramount to consider the patient as a whole rather than solely relying

on radiographic interpretations. Thus, effective management of condylar trauma requires proficiency in TMJ surgery, orthognathic surgery, and a comprehensive, multidisciplinary approach.

II.5 Surgical corrections of TMJ ankylosis with secondary dentofacial deformities

Songsong Zhu. Prof. Zhu, who is affiliated with the West China Hospital of Stomatology at Sichuan University, proceeded to dedicate a few minutes to provide an overview of their institution. It was stated that the West China Hospital of Stomatology is regarded as the birthplace of modern dentistry in China. The hospital is situated in Chengdu, within the Sichuan province of West China.

The facility comprises three main buildings: a teaching building, a laboratory building, and a clinical building. It was noted that the hospital is equipped with 500 dental chairs and 200 inpatient beds, facilitating the care of approximately 1.3 million outpatients and 9,000 inpatients annually.

The clinical structure of the hospital includes 16 outpatient clinical departments and four inpatient departments. Specifically highlighted was the speaker's department, which focuses on Orthognathic and TMJ surgery.

In the context of the Department of Orthognathic and TMJ Surgery, three primary categories of conditions were addressed. The first category pertains to orthognathic surgery, which focuses on the management of dental and facial deformities. The second category involves facial bone reconstructive surgeries, encompassing procedures such as scleromanial and ovident cheekbone surgeries. Notably, these facial plastic surgeries are particularly prevalent in East Asia. The final category discussed was TMJ surgery, which includes interventions for TMJ ankylosis, fractures, tumours, and arthroscopic procedures.

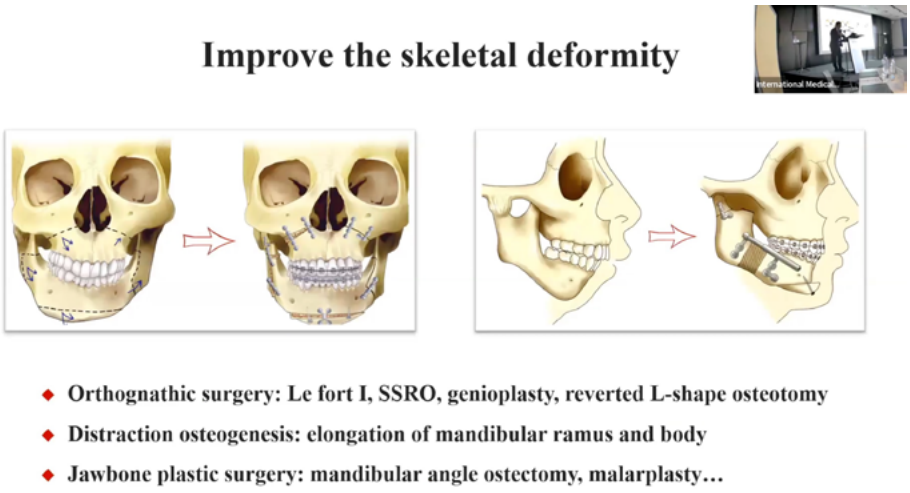


Figure 15. Methods to improve dentofacial deformity.

The session subsequently zeroed in on TMJ ankylosis in conjunction with dental facial deformities. TMJ ankylosis was defined as the presence of bony and fibrous adhesions within the joint, leading to a significant loss of TMJ function. It was noted that when TMJ ankylosis occurs in paediatric patients, it often results in secondary dental facial deformities, accompanied by both physical and psychological impairments. On average, the depart-

ment receives referrals for 30 to 40 patients suffering from TMJ ankylosis each year, with approximately half of these individuals being adults experiencing secondary dental facial deformities. The challenges associated with the treatment of TMJ ankylosis coupled with dental facial deformities in adult patients remain considerable for surgeons.

From January 2015 to January 2024, a total of 327 cases of TMJ ankylosis were recorded, with 58.7% of these cases involving adult patients, among whom 78.2% presented with secondary dental facial deformities. Approximately half of the TMJ ankylosis patients in this cohort were adults with accompanying deformities. For adult patients with TMJ ankylosis and dental facial deformities, specific treatment objectives were established. The foremost goal is the restoration of joint function, typically achieved through arthroplasty, which may include or exclude condyle reconstruction. The subsequent objective targets the enhancement of skeletal deformities, which may be addressed through orthognathic surgery, distraction osteogenesis, or facial bone reconstructive surgery. Lastly, the correction of critical deformities is emphasised, often necessitating orthognathic treatment.

With regard to arthroplasty, there are two principal types: arthroplasty without condyle reconstruction and arthroplasty with condyle reconstruction. The former is indicated for patients exhibiting minor skeletal deformities and is favoured for its simplicity and reduced operating duration; however, it carries potential drawbacks, such as a reduction in the height of the ramus. Conversely, arthroplasty with condyle reconstruction, which can utilise various techniques such as rib grafts, autogenous coronoid processes, distraction osteogenesis, or TMJ prosthetics, is more complex but allows for superior restoration of the ramus and functional joint capacity.

The fundamental procedures for arthroplasty typically involve exposure of the surgical field, with a specific focus on the ankylosed bone. The ankylosed bone is then excised, usually by approximately one centimetre. A temporal fascia flap may be employed to cover the bony surfaces, and a dark corvette might be introduced to fill the resulting void, thereby mitigating the risk of relapse. Should condyle reconstruction be required, popular techniques include rib grafting, autogenous coronoid processes, distraction osteogenesis, and the application of TMJ prosthetics.

In terms of skeletal deformity amelioration, orthognathic surgery techniques such as leptomastoidomy, sagittal split osteotomy, genioplasty, and L-shaped osteotomy may be utilised. Additionally, distraction osteogenesis serves to reconstruct cartilage and elongate the mandibular ramus. Jawbone reconstructive procedures, such as mandibular angular osteotomy and genioplasty, may also be considered as viable treatment options.

II.6 Treatment of TMJ ankylosis - Shanghai protocol

Dongmei He. The lecture on TMJ ankylosis, a particularly severe condition, emphasised the commendable contributions made by Prof. Zhu in understanding its complexities. Prof. He introduced Prof. Yang's classification system as well as the treatment protocol established in Shanghai. A focus was placed on the integration of surgical techniques facilitated by digital medicine, alongside a presentation of follow-up results from the associated procedures.

It was noted that the classification effort initiated by Sony in 1986 utilised X-ray technology to categorise TMJ ankylosis. Subsequently, in 2006, Prof. Yang refined this classification, drawing upon coronal CT scans to develop a more comprehensive treatment protocol.

Over the past 23 years, a total of 510 patients with 736 affected joints have been treated at the Ninth People's Hospital. A study conducted by Dres. Huang and Zhang delineated sub-classifications of ankylosis, revealing that more than fifty percent of cases retained a

residual condyle medially located to bony effusion.

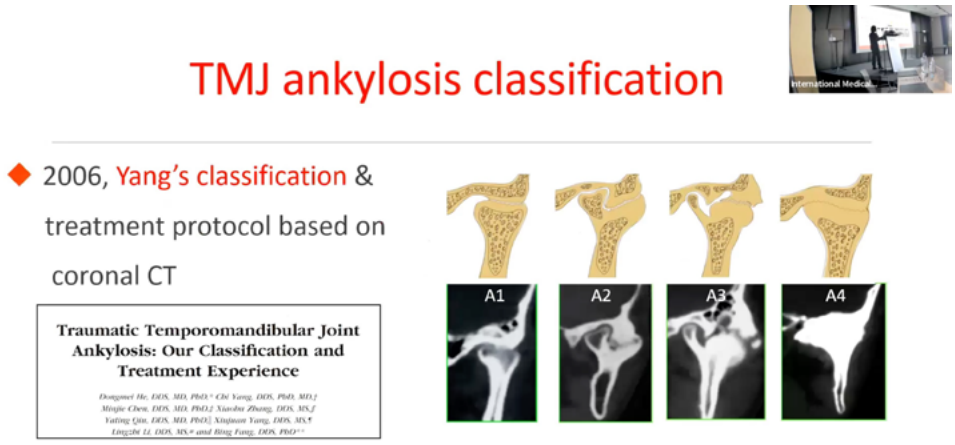


Figure 16. Professor Yang's classification on TMJ ankylosis, drawing upon coronal CT scans.

In 2008, Prof. Yang expanded the classification system further to encompass factors such as jaw deformities, maloclusion, and respiratory disturbances. Data presented indicated that over half of the patients exhibited jaw deformities, with severe maloclusion affecting approximately 25% of cases, and ulcers evident in 27% of the patients. Furthermore, findings from the hospital indicated that around 80% of the patients had experienced trauma. The treatment modalities included lateral gap arthroplasty (45%), costal chondrografts (30%), alloplastic total joint replacements (21%), in addition to combined orthognathic surgical interventions.

The following segment of the lecture addressed an investigative study regarding the traumatic origins of ankylosis. The classification indicated two primary categories: one without a condyle, which was believed to be closely associated with disc displacement, and another featuring residual condyles, potentially indicative of perilous condyle fractures.

Prof. Yang's research highlighted the mechanism of trauma, wherein displacement of the disc may occur anteriorly, resulting in damage to the posterior band, alongside corresponding condylar damage. An MRI example was cited, demonstrating a displaced disc that retained its general shape, whereas the condyle exhibited significant impairment. Notably, rapid degeneration of the condyle was observed within a mere two months post-injury.

An illustrative case of a 47-year-old female was discussed, who presented with a right-sided intracapsular condyle fracture. Two months following an open reduction and internal fixation, the patient suffered from restricted mouth opening and left joint pain. CT imaging revealed bone degeneration and MRI findings indicated a displaced disc and a damaged condyle. During the surgical operation, severe damage to the condyle was observable, characterised by fibrous ankylosis within the joint.

Ultimately, it was concluded that the traumatic factors leading to ankylosis in the absence of a condyle fracture are significantly associated with disc displacement, resulting in fibrous ankylosis, which may progress to bony ankylosis over time. Additionally, the presence of a residual condyle was acknowledged, although not all condyle fractures necessarily lead to ankylosis. Concerning the condyle fractures, it was highlighted that two types of fractures pose significant risks: those with the rib graft dislocated laterally to the fossa and those that maintain contact with the fossa. These fractures are notorious for their propensity to

result in ankylosis.

The discussion then transitioned to the management of ankylosis. In cases where the condyle is absent, joint reconstruction is undertaken either through the use of autogenous bone grafts or by employing a TMJ prosthesis, whilst utilising the residual condyle. Lateral gap arthroplasty is performed in these instances.

Indications for autogenous bone grafting, particularly for CCG, are primarily indicated in patients under 45 years of age exhibiting satisfactory bone quality. In paediatric patients, CCG is favoured due to its potential for growth, and it is additionally used in lieu of distraction osteogenesis to elongate the ribs, thereby concurrently rectifying joint deformities. Digital technology is employed to facilitate this surgical intervention.

An illustrative case was presented involving a three-year-old female diagnosed with left-sided TMJ ankylosis, accompanied by chin deviation and microsomia. Following the grafting of a rib and the use of a digital splint, as well as endoscopic assistance to reconstruct the shortened ramus, postoperative results showed significant improvement, with the ramus achieving nearly equal length to the contralateral side. The patient was provided with a splint postoperatively to encourage maxillary growth, with current practices involving a new digital occlusal splint. Notably, two years post-operation, the CCG demonstrated an increase in size by two centimetres, which was described as a case of overgrowth.

A subsequent case was detailed concerning another three-year-old patient with left-side ankylosis, who, following costal contour grafts from the ages of eight to fifteen, developed into a well-proportioned young man with excellent mouth opening and aesthetic appearance. A CT scan revealed notable rib growth.

The follow-up data regarding paediatric patients treated with CCG over a two-year period indicated that 70% exhibited growth in the ramus and improvement in jaw deformity. Critical factors for a successful operation were emphasised, asserting that the gap created must exceed 10 millimetres, particularly in the median region. Incomplete removal of this area could lead to re-ankylosis, thus necessitating the excision of the periosteum as well. The application of a fat graft to fill the dead space was recommended, as absence of such an intervention was associated with a significantly heightened relapse rate.

Over a span of 23 years, 150 rib joints had been operated on, with Prof. Chen expected to elaborate further on other autogenous bone graft techniques in the forthcoming session. Additionally, it was communicated that Dr. Zheng and Dr. Bai would address the topic of alloplastic total joint reconstruction in the next lecture. The advantages of alloplastic total joint replacement for TMJ ankylosis were deemed stark, particularly noting its low relapse rate and stable osteotomy gap. Post-operative application of fat greatly reduces the likelihood of relapse.

In the course of the last 18 years, a total of 420 standard TMJ prostheses have been implanted, alongside 157 prostheses addressing cases of ankylosis reconstruction.

A digital splint was employed to accurately direct both the orientation and depth of the osteotomy while ensuring the complete excision of the bone fusion. In a distinct case involving relapse, a rib graft was utilised for the reconstruction of the joint. Furthermore, the procedure involved lateral gap atheroplasty for patients presenting with a residual condyle that was of a larger size, as opposed to those with a smaller condylar structure. In instances where the condyle was deemed too small, a return to joint reconstruction was indicated.

An illustrative depiction by Dr. Liu was presented, demonstrating the operational techniques employed. In these procedures, a digital saw was utilised to excise the lateral bone fusion while simultaneously safeguarding the integrity of the condyle and the disc. To eliminate dead space, techniques involving either the tuberous femoral shaft blade or free fat

harvested from the abdomen were incorporated.

The advent of digital medicine has enabled the engineering of templates that effectively protect the medially displaced condyle during surgery. The advantages of lateral gap atheroplasty (LAP) include the restoration of TMJ function and the preservation of mandibular growth potential in paediatric patients. A case involving a seven-year-old boy diagnosed with right TMJ ankylosis illustrated these outcomes; post-LAP, notable mandibular growth and correction of deviation were observed, following the removal of the lateral bone fusion. After a ten-year follow-up, the patient had matured into a young man with commendable mouth opening capabilities. The LAP was performed without necessitating any jaw deformity corrections, which contributed to significant condylar growth, resulting in aspects similar to a normative structure after five years.

The results of a follow-up study from 2010 indicated that, when comparing the use of costochondral grafts to residual condyles, the latter exhibited enhanced growth capabilities. Additionally, follow-up results concerning LAP highlighted a considerable relapse rate when performed without fat grafting.

In addressing dental facial deformities in growing patients, LAP or joint reconstruction could be utilised, with a preference for costochondral grafting guided by digital medicine for pre-surgical design, operative guidance, and post-operative assessment. The protocols established for the management of combined dental facial deformities were noted, with Dr. Xie scheduled to elaborate on this topic in detail at a future session.

Lastly, the presentation included a complex case involving a 22-year-old female patient with a markedly small chin. Initial procedures aimed to lengthen the shortened mandible, followed by the application of a self-designed prosthesis for joint reconstruction, combined with level one osteotomy. This resulted in a significantly improved facial profile and enhanced mouth opening.

In conclusion, classifications of TMJ ankylosis were presented alongside coronal CT assessments, and traumatic factors contributing to TMJ ankylosis, particularly acute traumatic dislocation and perilous condylar fractures, were introduced. Through the discussion of treatment protocols for ankylosis and corresponding follow-up findings, the utility of digital medicine in guiding surgical interventions was underscored. A selection of related publications was also provided for further reference. The audience's attention was duly thanked at the end of the presentation.

II.7 Ruth Erwig Price, German Surgical Foundation; Real-time augmented reality annotation for surgical education during laparoscopic surgery: results from a single-center randomized controlled trial and future aspects

N. Erhard, Ulrich Joos, Florentine Hüttel. In the following honouring and award ceremony, it was reported that Ruth Erwig, a distinguished female surgeon, had previously been associated with the University Hospital Münster, Germany. Following her passing, it was noted that she had bequeathed a financial contribution to her former supervisor Prof. Joos, the former Head of the Department, who was initially uncertain about the appropriate use of these funds. As a result, an initiative between the estate of Ruth Erwig and the German Surgery Foundation was set up to regularly award a prize. In memory of Ruth Erwig the prize, which is valued at 5,000 Euros, is typically conferred during significant events, such as conferences, in a manner that reflects the foundation's objectives and ethos. This year, the prize was awarded to a working group dealing with the topic *Real-Time*

Augmented Reality Annotation for Surgical Education during Laparoscopic Surgery[1].

The content of this work can be summarised as follows. Surgical trainees rely heavily on their instructors to learn essential surgical techniques and identify anatomical structures. Laparoscopic surgery, in particular, introduces challenges such as the pivot point effect and the distance between instruments, the patient, and the monitor, complicating intraoperative communication and potentially leading to risks.

To address these issues, an interactive augmented reality tool, HoloPointer, was developed to provide real-time annotations on laparoscopic monitors, utilising verbal commands and head movements for a sterile workflow. A randomised controlled clinical trial evaluated its effectiveness during 32 elective laparoscopic cholecystectomies, involving 29 surgical teams consisting of 15 trainees and 13 instructors. The primary endpoint assessed the tool's impact on surgical performance through subjective evaluations and objective scoring metrics (GOALS and CVS).

Results showed a reduction in manual corrections of 59.4% and verbal corrections of 36.1%, with 84.6% of participants reporting improved subjective performance. However, no statistically significant differences were noted in objective parameters. The HoloPointer achieved a good usability score of 72.5, with 69.2% of participants expressing interest in its frequent use.

In summary, most trainees reported a subjective improvement in their performance with HoloPointer during laparoscopic cholecystectomies, alongside a decrease in reliance on traditional communication methods. This augmented reality tool is a promising aid for enhancing intraoperative communication and surgical training, with potential applications across various surgical disciplines.

[1]Huettl, Florentine MD; Heinrich, Florian PhD; Boedecker, Christian MD; Vradelis, Lukas MD; Ludt, Annekatrin; Kneist, Werner MD; Lang, Hauke MD, MA, FACS; Hansen, Christian PhD; Huber, Tobias MD, FEBS. Real-Time Augmented Reality Annotation for Surgical Education during Laparoscopic Surgery: Results from a Single-Center Randomized Controlled Trial and Future Aspects. Journal of the American College of Surgeons 237(2):p 292-300, August 2023. DOI: 10.1097/XCS.0000000000000712

Session III - TMJ Reconstruction

III.1 Costochondral graft in TMJ reconstruction

Florencio Monje. In the field of reconstructive surgery for children, particularly those experiencing congenital dysplasia, tumours, inflammatory diseases, ankylosis, or Class II malocclusions, costochondral grafts are frequently deemed a viable option. It is observed that these grafts exhibit both advantages and disadvantages that stem from similar characteristics. Proponents highlight benefits such as biological compatibility, minimal additional morbidity, adaptability through modified techniques— as illustrated in accompanying slides— as well as the absence of resorption. Conversely, detractors emphasise issues such as high morbidity, a risk of fracture, poor adaptability, inconsistent growth capacity, and the potential recurrence of ankylosis, particularly in cases where ankylosis is already present.

Figure 17. Advantages of costochondral grafts.

Regarding surgical protocols, it is common to employ preauricular incisions or various archaic modifications that depend on the specific pathology. In cases of ankylosis, certain archaic incisions may be preferred. Additional incision options include submandibular and preauricular approaches. Recent developments, as presented in a paper by Prof. Yang's team, have demonstrated that the traditional combination of preauricular and submandibular incisions in reconstructive procedures can be effectively superseded by a modified preauricular approach. This method utilises a three millimetre incision on the cheek, facilitating screw placement with the assistance of endoscopic technology and transoral devices.

The preparation of the joint space is a significant aspect of the protocol and introduces a critical concept known as the *critical size effect*. This phenomenon relates to bone gaps that cannot be bridged by normal callus formation and secondary healing, traditionally recognised in neurosurgery to be between 2.5 and 3.5 cm. Within the context of the TMJ, it has been established that when the gap between the bony stops measures less than 10 mm, the likelihood of ectopic bone formation increases. In contrast, larger bone defects inhibit the critical size defect process from occurring. Consequently, it is suggested that the critical size effect for the TMJ should be no less than 10 mm, with optimal measurements being 15 to 20 mm.

One relevant clinical case involved a patient suffering from post-traumatic ankylosis, in

whom reconstruction using a costochondral graft failed due to an inability to achieve the critical size effect. This resulted in the patient experiencing ectopic bone formation leading to re-ankylosis two years postoperatively. Maintaining the perichondrium at the junction is critical, with recommendations suggesting a layer of perichondrium of 4 to 6 mm and cartilage of 2 to 4 mm.

Furthermore, one notable complication associated with reconstructive interposition grafts (RIP) is adapting the graft to the remaining mandibular ramus due to the inherent curvature of the graft. Various techniques for optimising the adaptation of such grafts have been proposed. Notably, a technique developed years ago involved creating a green stick fracture of the costochondral graft, which allows for secure graft placement while minimising the space between the graft and the submandibular area, thereby facilitating accurate adaptation.

In terms of fixation, it has been observed that in a study conducted several years ago, healing of cortis to cortis after the placement of a costochondral graft spans approximately 20 weeks in monkeys, and possibly 25 weeks in humans. The exact duration of rigid fixation times remains a subject of debate; however, practical experience suggests a period of intermaxillary fixation lasting between two and three weeks is typical for costochondral grafts.

Complications associated with these procedures vary according to the surgical approach and may include facial paralysis and vascular complications. Among the most significant intraoperative or immediate postoperative complications is pneumothorax, along with fluctuating patient outcomes. A critical examination of a collective study involving 55 cases identified that nearly 60% of the complications were related to ankylosis. The findings suggest that patients with congenital TMJ conditions have better odds of being free from complications compared to those with acquired conditions.

Caution is warranted in cases involving patients with ankylosed TMJs, particularly those afflicted by dysankylosis secondary to infection—these patients tend to exhibit a higher likelihood of complications such as re-ankylosis. Another significant issue includes graft resorption, particularly in adult patients with large grafts; however, it is noted that some research teams have reported favourable outcomes with substantial reconstructions in adult populations. Finally, the phenomenon of overgrowth remains an additional challenge in postoperative management.

In a current meta-analysis, it was observed that while the literature generally indicates favourable outcomes concerning oral opening, it is noteworthy that assessment was conducted in only seven studies. The findings of the analysis indicated that overgrowth occurred in approximately 30% of the subjects investigated, whereas optimal growth was reported in about 55% of the cases.

Several factors were proposed as potential causes of overgrowth. It was suggested that advancing age of the patient correlates with an increased likelihood of overgrowth. Furthermore, it was hypothesised that greater thickness of the cartilage is associated with a higher probability of overgrowth. A third factor identified was the predominance of unilateral exercise patterns, which were seen to create additional stress on the graft, potentially leading to abnormal growth patterns.

One referenced study, conducted by the research team many years ago, involved a cohort of 30 patients presenting various pathologies such as condylar hypoplasia, ankylosis, and idiopathic condylar lysis. The purpose of the study was to evaluate the long-term outcomes for these patients following treatment.

One case presented involved a 30-year-old patient who had suffered untreated condylar trauma four years prior, resulting in ankylosis. It was reported that a critical-size graft was

implemented, using a corticone graft in conjunction with a temporal flap, and the adaptation of the graft to the external portion of the mandibular ramus was documented via computed tomography (CT). Oral opening was assessed at three months post-operation, and again, 26 years later, showing sustained function.

Another patient, treated for osteochondroma many years earlier, was presented as an adult who received grafting without the use of prosthetics. The 23-year follow-up revealed excellent adaptation of the graft, particularly on the left mandibular ramus, as evidenced by CT imaging. Additionally, insights regarding the relationship between the Hounsfield unit measurement and the costochondral graft in the contralateral condyle were deemed significant, with variations noted in different cases.

A further case highlighted involved a patient who had previously suffered from a malignant tumour, specifically a fibrosarcoma. The reconstruction undertaken for this patient was discussed, noting that the patient experienced a lapse six months post-surgery.

The presented research article discusses the long-term growth potential of costochondral grafts, specifically focusing on their use in six clinical cases characterised by growth capacity deficiencies and deviations in maxillofacial alignment. It reports on the findings that five out of the six patients demonstrated a capacity for growth, while all cases exhibited a decrease in alignment deviation.

In one notable instance, a patient who suffered a dog bite at the age of four received treatment solely aimed at soft tissue reconstruction. The condition of this patient was assessed two years post-treatment, followed by the application of a costochondral graft sixteen years later. The results showcased the outcomes of a woman who was subsequently observed twenty-four years after the initial graft application. Throughout her treatment, she undergone orthodontic intervention, and the adaptation of the costochondral graft to the position of the glenoid fossa was observed, likely influenced by ongoing growth.

The research also highlighted variability in the behavioural responses of individual patients to graft therapy. In one case involving a patient with developmental defects but no traumatic history, the formation of the condyle was examined alongside a significant reduction in alignment deviation following graft application. Notably, this patient relocated and returned two years after surgery without engaging in any orthodontic treatment, yet the symmetry of the mandible remained apparent upon re-evaluation.

Further observations were made regarding a control case of a 16-year-old patient, whose beard obscured underlying asymmetry, although an inclination of the occlusal plane was evident. A comparative analysis over a sixteen-year timeline illustrated the changes from initial treatment stages to final outcomes.

Moreover, the findings suggest a common protuberance observed in all cases, potentially correlated with the proximity to the internal aspect of the glenoid fossa. A particular patient with beneficial microsomia underwent a condylectomy reconstruction using a costochondral graft, with assessments conducted at the one- and three-year marks. Following orthodontic treatment, this patient was offered distraction osteogenesis, but disappeared from follow-up for six months. Ultimately, the final results indicated significant challenges in the removal of the metallic components associated with the distraction.

Another patient, similar in presentation, underwent a different intervention that commenced with a costochondral graft, leading to evaluations one and three years after the procedure. Eleven years post-surgery, the patient demonstrated good, albeit mild, symmetry, while a slight inclination of the occlusal plane was noted. The exceptional remodelling of the left costochondral graft was also observed.

A comprehensive approach combining orthodontic surgery, LeFort 1, genioplasty, and an

oblique subcondylar osteotomy on the contralateral side, while preserving the grafted side, culminated in a favourable outcome. The results after seventeen years illustrated noteworthy adaptation of the costochondral graft, affirming the long-term effectiveness of this grafting technique in the context of craniofacial reconstruction.

In the final case presented, the patient sustained chondylar trauma as a result of a bicycle accident. It was noted that many years prior, Prof. Robert from Switzerland introduced a method to reposition the condyle without employing any osteosynthesis techniques. This method was subsequently applied, accompanied by a certain degree of immobilisation.

Furthermore, a follow-up conducted five years later revealed significant degeneration and a reduction in the height of the condyle, likely attributable to vascular complications. Observations indicated a yearly deviation in the patient's condition, culminating in marked deformities, as evident when comparing the left condyle to the right.

To address these issues, a costochondral graft was utilised. When the patient returned for assessment after a 12-year interval, overall improvement in appearance was noted. However, there were concerns regarding decreased oral opening at this point, which necessitated a two-part treatment approach.

The initial part of the intervention involved arthroplasty, during which a transient silicone sheet was positioned in the temporal fossa, accompanied by rapidly assisted surgical expansion of the maxilla. This surgical strategy was deemed significant, as three cases underwent histological analysis, demonstrating the presence of highly active chondrocytes within the costochondral graft and regions of fibrosaccharosis.

The first stage of this treatment resulted in promising outcomes. Subsequently, in the second stage, the silicone sheet was removed, and a fat graft, genioplasty, and liposculpture were performed. The final results illustrated an effective integration of the costochondral graft.

In conclusion, it was emphasised that in cases of ankylosis, a critical size of the bed is necessary to accommodate any potential ankylosis. Additionally, the elevation of the ramus using a costochondral graft resulted in immediate correction of facial asymmetry, although it was acknowledged that a partial return to asymmetry may occur over the long term.

III.2 TMJ reconstruction in children

Joel Ferri. In a recent lecture on TMJ prostheses and head and neck malformations, an overview of the broad spectrum of pathologies associated with these areas was presented. It was noted that this category encompasses various rare diseases, underscoring the significant embryological diversity and complexity inherent in the head and neck region. Such intricacies in embryology likely contribute to the observed variety in clinical presentations.

The speaker drew attention to the unique characteristics of the TMJ, clarifying that it does not conform to the conventional understanding of joints. Rather than resembling typical joints such as the knee or hip, the TMJ originates from neural crest cells, which generate a cartilaginous structure. This distinction was emphasised, with the assertion that the TMJ possesses remarkable remodelling capabilities.

The definition of maxillofacial TMJ anomalies was provided, with the term *condylo-mandibular dysplasia* being suggested. This condition is characterised by an abnormality of the condyle and a corresponding deficit within the condylar unit, which can result in significant implications for the overall growth of the mandible and facial structure. The glenoid fossa remains relatively unaffected, as it is shaped primarily by the condyle of the mandible. Various clinical scenarios were presented, ranging from severe cases affecting the

ears and spine to milder forms.

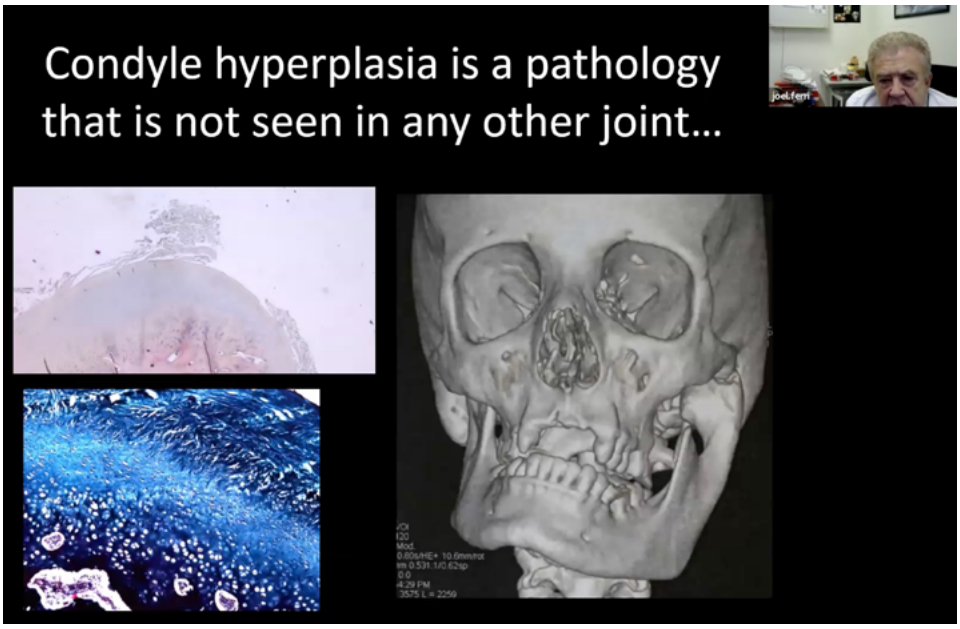


Figure 18. Condylomandibular dysplasia is characterised by an abnormality of the condyle and a corresponding deficit within the condylar unit.

Illustrative slides showcased examples of different clinical manifestations observed during the speaker's residency at Prof. Léa's department in Nantes. The presentations highlighted the intensive vascularisation and growth activity within the condylar region. Furthermore, bilateral and unilateral conditions, including hemifacial microsomia and Goldenhar syndrome, were detailed, along with instances of significant condylar deficits resembling condylar aplasia.

The extensive follow-up of over 400 syndromic and undiagnosed cases within the department was acknowledged, reflecting the vast array of clinical situations encountered. The panoramic radiographs presented further showcased this diversity, illustrating both bilateral and unilateral afflictions, alongside varying degrees of condylar remodelling.

Regarding treatment options, it was noted that while certain classical approaches, such as costo-chondral grafting and osteogenic distraction, have their respective advantages, they also necessitate careful monitoring for optimal outcomes. The speaker suggested that orthodontic treatments may yield variable results depending on the expertise of the practitioner and other influencing factors. Consequentially, it was suggested that the success of interventions like costo-chondral grafts may be compromised without stringent follow-up throughout the patient's growth period, often leading to issues of overgrowth or underdevelopment.

The discussion opened up considerations for managing more severe cases, which would be addressed with further insights in the future. Overall, the complexities and challenges associated with TMJ malformations and their management were thoroughly outlined, highlighting the intricacies of treatment planning in this field.

Osteogenic distraction is a technique that has been met with considerable scepticism due to various concerns. It was noted that the procedure presents specific indications, but the overall burden of the necessary interventions is significant, as multiple surgical procedures are often required for a single patient.

Particularly when addressing patients at or near adulthood, concerns regarding occlusal predictability following treatment with osteogenic distraction were highlighted. This method may lead to considerable fibrous tissue reaction post-distraction, raising concerns about potential complications if subsequent orthognathic surgery becomes necessary. The risk of substantial bone resorption was identified as a significant drawback of this technique, alongside the potential for inducing onculosis.

A few illustrative cases following distraction were presented to provide context. It was underscored that orthognathic surgery yields favourable outcomes; however, it is essential to target individuals who are at least very close to adulthood, as this procedure is not suitable for growing patients.

When summarising the challenges encountered in cases classified as Przanski class 2b or 3, the difficulty of graft positioning was emphasised. Specifically, in these cases, the absence of cranial-beige glenoid fossa complicates the determination of optimal graft placement. In the presence of significant defects, the expected orthopaedic effectiveness of interventions is markedly diminished.

Further emphasis was placed on the role of the condyle in mandibular growth and facial balance. Specific observations were made regarding a case exhibiting onculosis on the left side, attributed to recurrent ear infections, which ultimately affected the development of the mandible on that side. A clear asymmetry was observed, alongside a pronounced class 2 malocclusion; however, it was noted that the size of the corpus of the mandible appeared largely normal, even though its positional relationship within the skeletal framework was inadequate.

In highlighting the importance of motion in achieving normal jaw development, it was asserted that TMJ motion is essential. A retrospective case was referenced involving a patient suffering from bilateral ankylosis resulting from ear infections. The intervention involved the release of the joint using the conventional technique with a temporal flap. The postoperative results, observed approximately 8 to 9 months post-surgery, showcased rapid bone remodelling and stimulation of the jaw's corpus, illustrating significant improvement in the patient's condition.

In a recent evaluation of the same patient, it was acknowledged that while deficits in mandibular development remained and the individual presented with class 2 malocclusion, the overall situation was considerably better than at the outset. This enhancement in outcome was attributed to the restoration of motion in the joints, which played a crucial role in the progression towards improved mandibular function.

In the context of prosthetic dentistry, the issue of wear on prosthetic devices was underscored as a significant consideration, particularly when addressing the needs of children. It was noted that wear occurs in all prostheses used throughout the body. A review of two pertinent publications, notably one by Walford, revealed an unexpected finding regarding the prosthesis utilised for TMJ rehabilitation, which exhibited minimal wear. This phenomenon was attributed to the low-pressure environment within the joints, with the majority of pressure being concentrated on the molars. It was suggested that, with adequate occlusal control, wear on the TMJ prosthesis could be mitigated, although extreme scenarios presented unique challenges.

One such extreme case was discussed in relation to Goldenhar Syndrome, a complex condition characterised by the absence of the linoid fossa, cranial base anomalies, and the absence of condyles. Surgical placement of prosthetic grafts in such instances proved to be problematic, as the exact positioning of the grafts could not be confidently determined. It was conveyed that efforts to anchor the grafts to the cranial base faced difficulties, and the

uncertainty surrounding the surgical outcomes added to the complexity.

The significant issue of cranial base remodelling in patients afflicted with severe syndromes and rheumatic disorders was highlighted. Moreover, reference was made to previous distraction techniques, which had been shown to result in severe complications in specific patient cohorts. An illustrative case was presented of a female patient who, after a series of extractions elsewhere, exhibited bilateral ankylosis and a considerable airway obstruction. The implication was that the ramifications of such a complex medical history necessitated nuanced management strategies.

Turning to the current market for prostheses, the speaker expressed scepticism regarding the appropriateness of existing devices for paediatric patients. It was acknowledged that, in extreme cases, the implementation of a prosthesis remained a viable option. A case involving an 11-year-old boy, who also suffered from bilateral ankylosis following multiple extractions and faced breathing difficulties due to a fractured jaw, was discussed. It was concluded that the only feasible solution in this scenario was the use of a TMJ prosthesis.

The speaker reiterated a deliberate decision to avoid correcting malocclusion through the insertion of TMJ prostheses, emphasising the ongoing debate surrounding this approach. The primary objective of the surgical intervention was framed as the immobilisation of the joint, aimed at facilitating mandibular movement to stimulate growth in the jaw. The plan subsequently involved orthodontic treatment, followed by orthognathic surgery, to enhance occlusion and improve facial aesthetics.

In further discussion of Goldenhar Syndrome, another case was presented, involving a significant defect on the left side of a patient's jaw, who had also undergone numerous extraction procedures. Initially, a reconstruction technique employing a costochondral graft was implemented, followed by an established method of managing an open bite with a surgical wafer. It was reported that, while satisfactory growth of the graft was noted, considerable restrictions arose on the left side as a result of fibrous reactions. Ultimately, it was decided to proceed with the insertion of a TMJ prosthesis, which yielded positive results, culminating in stable occlusion. The speaker expressed regret for the absence of final occlusal images but maintained that the results were indeed promising.

In a recent lecture, it was reported on a young male patient diagnosed with Goldenhar syndrome who had previously undergone treatment in another department. This treatment involved a technique known as yo-mandibular pexy, which aimed to stabilise the zygomatic bone situated posterior to the symphysis to facilitate normal breathing patterns. Upon referral to this department, the patient sought solutions regarding both occlusion and facial aesthetics.

The surgical plan that was subsequently established included the insertion of a TMJ prosthesis during a single-step surgical procedure. The surgical approach involved the successful placement of a prosthesis on the right side, alongside a surgical split on the left side, which led to the additional decision to perform a genioplasty. However, initial reservations were expressed regarding the potential exposure of the posterior airways during the genioplasty, resulting in a more conservative execution of the procedure than originally intended. Despite these concerns, the patient's occlusion has been described as perfectly stable, leading to a satisfactory outcome.

In another case, a young female patient presenting with a class III condylar deficit underwent multi-distraction. Her occlusion and lateral cephalometric measurements were reviewed, with particular attention directed to specific images displayed during the presentation. Upon assessment, it was concluded that a facial split might be feasible. However, following autognathic surgery and genioplasty, an evaluation conducted eight months later

revealed a return to an almost identical initial condition. This outcome was attributed to significant resorption of both the ramus and the condylar unit, which appeared to have occurred following the prior distraction procedure. As a result, the decision was made to insert two prostheses to rectify the issue, which has since stabilised.

The indications for TMJ prostheses were clarified as being quite defined. In instances involving TMJ distraction, the TMJ prosthesis presents a viable alternative. This technique is regarded as reliable and has been documented in the literature. Initially, a degree of scepticism was noted regarding this method; however, it has now been recognised as a well-established and effective option.

In the context of patients who are still growing, challenges remain, particularly in cases of major malformations. The use of grafts is not universally applicable, especially in instances of class IIb or class III malformations, where ensuring proper graft placement proves to be particularly challenging. Distraction techniques are associated with adverse effects, while both orthodontic and orthopaedic treatments demonstrate a significant likelihood of success. Given the presence of a body without a condyle in certain cases, the consideration of TMJ prostheses becomes paramount.

Although the limitations of this approach continue to be a topic of discussion, there is a strong belief that further research and development on TMJ prostheses for paediatric patients is essential, as the available prostheses currently on the market do not appear to be optimally suited for use in children.

III.3 TMJ reconstruction with autogenous graft

Minjie Chen. In the context of the recent developments in the classification of condylar and mandibular defects, a new Yang's classification was introduced, consisting of six distinct types. Grade zero represents a situation where there is a mandibular defect accompanied by a healthy condyle. Grade one pertains to defects located above the mandibular foramen, while grade two involves defects in the ramus and angle of the mandible. Grade three describes a hemi-mandibular defect, and grade four indicates a defect extending from one condyle to the contralateral ramus. Finally, grade five represents a complete mandibular defect.

The focus of this presentation was specifically on grade one defects, which are characterised by their location above the mandibular foramen. It was noted that a significant number of TMJ defects fall into this category. Various autogenous grafts have been reported for the reconstruction of TMJ destruction, including costochondral grafts, sternoclavicular joint grafts, mandibular ramus grafts, metatarsophalangeal joint grafts, as well as grafting from the medial epicondyle. Modifications to initial techniques have led to substantial clinical applications.

The costochondral graft, first described by Gillies in 1920 for TMJ reconstruction, was detailed as a primary technique utilised in the department, where it had been applied in 463 cases involving 622 joints. Complications at the donor site were reported to be rare, with regeneration typically occurring within one year. However, a study conducted by Prof. He indicated that graft absorption occurred in over 20 percent of cases, with approximately seven percent experiencing overgrowth, highlighting graft disruption as a significant issue associated with costochondral grafts.

A specific case was presented involving a female patient suffering from bilateral internal condylar resorption with an open bite, who exhibited considerable perforation of the disc and poor signal at the condyle. As a result, the decision was made to perform bilateral

costochondral graft reconstruction to address her malocclusion. While the outcome post-surgery was initially positive, recurrence of the open bite was observed one year later due to graft resorption. In light of these findings, the surgical technique was refined to include either the preservation or the replacement of the disc, which would be anchored to the costochondral graft to mitigate the risk of graft resorption.

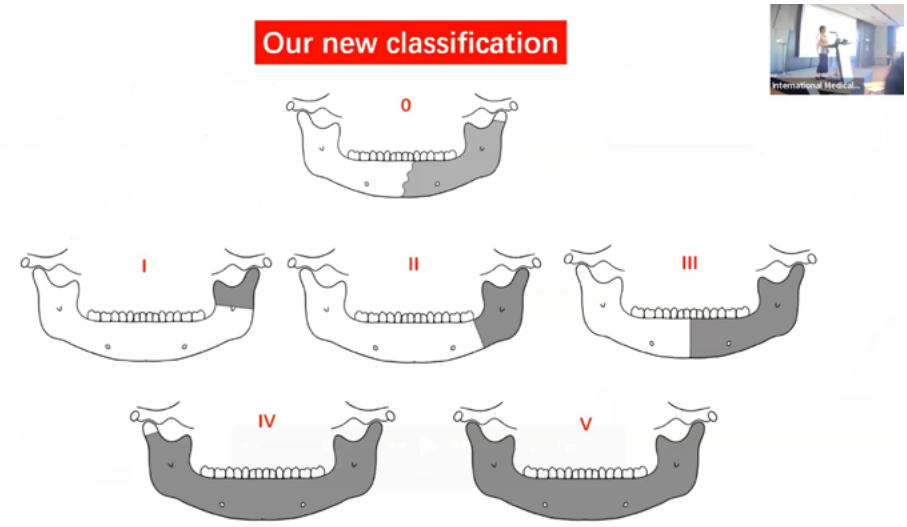


Figure 19. The new Yang's classification of condylar and mandibular defects consists of six distinct types. Grade zero represents a situation where there is a mandibular defect accompanied by a healthy condyle.

The investigation involved a cohort of 11 patients, among whom five received a costal cartilage graft accompanied by disc preservation, while the sixth patient underwent a costal cartilage graft without disc preservation, utilising a pedicled middle temporal fossa flap. Measurements were taken from the base of the titanium plate to the fossa, and the results demonstrated a statistically significant difference between the two groups at both the one-year and two-year follow-up intervals. Consequently, it was concluded that costal cartilage graft reconstruction with disc preservation could mitigate resorption.

One particular case involved a young male patient presenting with bilateral incomplete condylar reabsorption, mandibular retrusion, an open bite, and a skeletal class II deformity. Imaging findings suggested suboptimal conditions of the condyle, while surrounding disc tissue exhibited signs of remodelling. In light of these observations, a decision was made to employ a costal cartilage graft to reconstruct the TMJ, with the intention of preserving the disc. Notably, during the surgical procedure, access to the upper joint compartment was not required. The graft was secured with the assistance of endoscopic techniques.

Remarkably, six years post-operation, it was observed that the positional stability noted immediately following the surgery had been maintained. Comparative imaging analyses indicated that, over the course of two to six years, the costal cartilage graft exhibited remodelling features and retained high stability.

The second technique discussed was identified as the pedicled superior half of the sternoclavicular joint. This method was employed in a total of 19 cases and subsequently published in a paper. It was noted that the sternoclavicular joint (SCJ) is anatomically the most similar to the TMJ in the entire body, possessing a complete disc and distinct upper and lower joint compartments. Furthermore, it was highlighted that the muscular

attachment of the sternocleidomastoid muscle is encircled by four vessels.

In 1971, Dr. Snyder and colleagues reported the application of the entire joint for the reconstruction of the TMJ, considering both aesthetic and functional aspects of shoulder function. In 1994, Dr. Warford proposed a technique that utilised a free half joint to reconstruct the TMJ; however, the grafts were fixed at the lateral ramus, which raised concerns regarding the risk of graft resorption and resultant facial swelling.

To address these issues, the technique was modified to preserve the clavicular head of the muscle, with the graft fixed at the posterior border of the main ramus. This modification ensured adequate blood supply and favourable postoperative appearance, thus broadening the indications considerably, particularly for elderly patients with osteoporosis and those with infections.

An illustrative case involved a 45-year-old patient suffering from synovial chondromatosis and osteoarthritis. The TMJ lesion was excised via a temporal pre-auricular and submandibular approach, during which the posterior border of the ramus was shaved. Subsequently, the pedicled SCJ was harvested through a supraclavicular approach and subcutaneously routed to the posterior mandibular region. The graft was then fixed at the posterior border of the mandible, and a pedicled middle temporal fissure fat flap was inserted between the fossa and the graft.

Four years post-surgery, it was observed that the SCJ graft had remodelled and resembled the native condyle. The patient's aesthetic appearance, occlusion, and function were reported to be satisfactory.

The third technique discussed was the vertical ramus osteotomy. A cohort of 28 patients had been subjected to this method, which had been documented in a previously published paper. While this technique is not classified as novel, the authors highlighted the distinctive use of a digital cutting guide in conjunction with endoscopic assistance.

A specific case was presented involving a female patient who exhibited facial asymmetry as a consequence of a left condylar osteochondroma. Notably, her bilateral oral commissures demonstrated symmetry, while her occlusion remained stable. The surgical approach was initiated through a TMJ incision, during which a digital guide was employed to facilitate the resection of the tumour and to delineate the vertical osteotomy line. This guide was meticulously designed to circumvent damage to the inferior alveolar nerve, thereby ensuring that the stump of the mandible was adequately positioned within the fossa.

During the procedure, the digital guide was affixed to the mandibular notch, and the osteotomy was executed with endoscopic support. The remaining stump of the mandible was manoeuvred into alignment with the fossa and secured under the guidance of the endoscope. The surgical intervention relied on an internal incision that was simultaneously directed by the digital cutting guide, allowing for the precise removal of the mandibular margin using a piezoelectric surgery device, while effectively preserving the integrity of the inferior alveolar nerve.

Post-operative computed tomography (CT) scans revealed a symmetrical mandible and a stable pseudocondyle, indicating significant improvement in the patient's facial symmetry following the surgery. Moreover, occlusal stability was maintained throughout the recovery process. The presenters concluded that, despite the longstanding history and varied indications for autogenous bone reconstruction in TMJ surgeries, ongoing enhancements in precision, minimal invasiveness, and stability are necessary for further advancements in this field.

III.4 TMJ reconstruction with prosthesis

Leonard Duarte Moreira. Unfortunately this presentation was canceled.

III.5 How to fix a prosthesis

Ulrich Joos, Robert Schuon. The current lecture dealt with various diseases of the temporomandibular joint and the speaker pointed out an important topic that is often not recognized as a problem. The discussion encompassed the evolution of bridging osteosynthesis techniques and the reconstruction of the condyle, alongside the potential complications that may arise.

The lecturer identified that TMJ diseases can be classified into congenital and acquired types. For instance, congenital anomalies such as first arch syndrome, characterised by the absence of the complete ascending ramus and the temporal mandibular joint, were noted as a matter of concern. Additionally, acquired conditions including ankylosis and tumours were discussed, with an emphasis on postoperative strategies for effective replacement.

A historical overview was provided regarding the use of cross-ramus condyle grafts, which, although still beneficial today, revealed instances from earlier practices. The lecturer presented a case involving a young patient who underwent a cross-ramus condyle graft in 1990. Follow-up examinations eight years later demonstrated significant integration of the graft with the surrounding teeth and continued growth, with the patient being tracked for approximately 20 years.

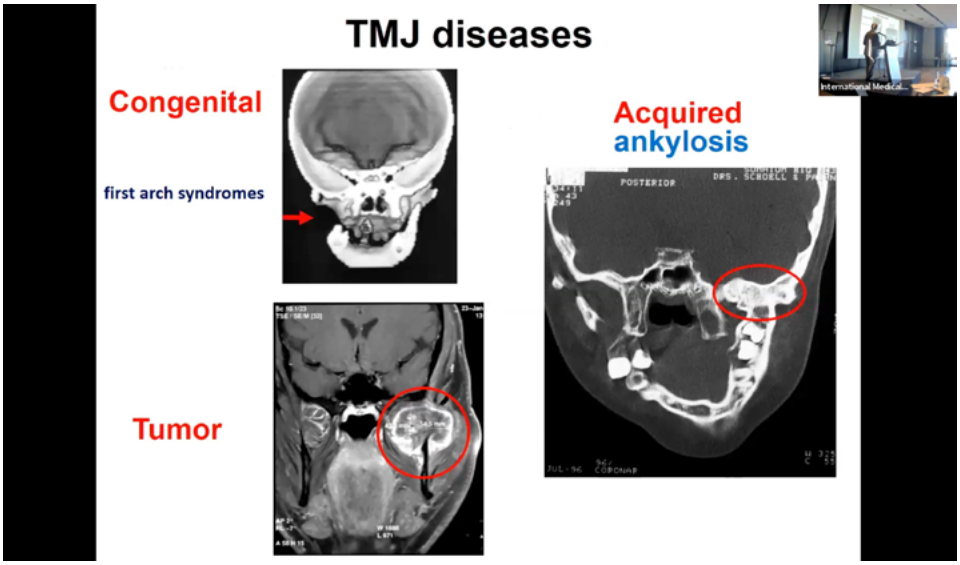


Figure 20. TMJ diseases classified into congenital anomalies such as first arch syndromes, characterised by the absence of the complete ascending ramus and acquired conditions including ankylosis and tumours.

The speaker also recounted an instance from 1983 involving a considerable tumour in the condylar region which necessitated removal but did not include reconstruction, ultimately resulting in notable facial asymmetry. In the context of ankylosis treatment, the transition from using temporalis fascia to silicone sheets was discussed, as the latter proved to be more stable and effective, significantly reducing the occurrence of postoperative residues. A patient case from Russia illustrated this technique; after surgical intervention and sili-

cone placement, the patient exhibited improved mouth opening despite facial asymmetry persisting due to the lack of condylar reconstruction.

The lecture progressed to tumour surgery, where initial practices did not employ bridging for defects. Early interventions typically resulted in severe deviations, as demonstrated by an illustrative patient case. However, advancements in technique introduced the use of reconstruction plates and implants for improved outcomes, illustrated by a series of cases, including a patient who had a pectoralis flap employed for asymmetry correction.

The speaker further elaborated on the limitations in prosthesis options for TMJ reconstruction at different points in time, referencing a case involving a malignant hemangiopericytoma. In this case, a silicone block was fashioned into a makeshift condyle which functioned for 20 years. Another patient, a young girl from Turkey with bilateral ankylosis, experienced multiple prior surgeries before receiving a prosthesis that integrated well despite its rudimentary design.

The evolution of prosthesis design over time was a key theme, with notable advancements allowing for intraoperative adaptability—a critical improvement over previous non-adjustable models. The lecturer also detailed additional cases demonstrating varying degrees of success with these prostheses, including patients exhibiting significant facial symmetry restoration post-surgery.

In conclusion, the discussion illuminated the complexities of treating TMJ disorders, particularly in relation to the innovative solutions developed to address long-standing problems in surgical practice. The speaker conveyed that while some of the historical approaches may now seem rudimentary, they laid the groundwork for modern techniques demonstrating durability and efficacy in patient outcomes.

A case was presented involving a prosthetic fracture. There was uncertainty regarding the specific type of prosthesis used. The patient arrived with a fractured prosthesis, prompting the speaker to address the topic of prosthetic fractures. Upon examination, the fracture of the prosthesis was observed, and the method of fixation was noted to be somewhat unusual. The speaker subsequently removed the defective prosthesis and replaced it with a new one. The postoperative evaluation indicated that the new prosthesis also failed shortly after surgery.

Experiences gained from such interventions revealed that prosthetic fractures are not uncommon. Another example cited involved a severe case of osteosarcoma, where a prosthesis was also implanted. After several years, a fracture was noted once again. In analysing the potential causes of these fractures, it was found that a segment of the initial structure, which had not been removed, was entirely encased in bone. Concerns regarding the removal of this segment were expressed, as it could have led to a significant defect, rendering the mandible too weak. Therefore, the speaker opted to leave this segment intact and constructed a new prosthesis. Remarkably, this new prosthesis has now been in place for 20 years.

Additionally, it was mentioned that a soft tissue grafting was performed, but over a period of about ten years, this graft had completely dissolved. The patient subsequently expressed a desire to avoid further surgical interventions, despite the occurrence of prosthetic fractures. Investigations into complications following plate reconstruction were conducted, revealing a notable incidence of fractures, infections, and exposure, particularly among tumour patients who had previously undergone irradiation. Irradiation was highlighted as a significant factor contributing to exposure of the fractures, with a fracture rate observed at approximately 10%, which is considered relatively high. The investigations revealed fractures not only of the plates but also of the screws.

Through a thorough review, including X-ray assessments, the speaker sought to ascertain

the locations and reasons behind these fractures. It was concluded that defect lengths of less than 6 centimetres yielded considerably better outcomes compared to those exceeding this measurement. Furthermore, notable differences were found between curved and straight plates. In cases involving curved plates, approximately 75% of fractures occurred at the posterior angle, while only 25% were observed at the front. Conversely, with straight plates, the pattern was reversed, with the majority of fractures occurring at the front and only 1.25% at the back. Consistently, it was observed that fractures always occurred between the holes, with no occurrences found at the holes themselves.

In the course of a detailed investigation involving the application of soft plates and unilock plates from various manufacturers, it was observed that approximately 20% of the fractures occurred in both types of plates, while around 5% were associated with the screws. From this analysis, it was concluded that the stock prosthesis necessitates geometric reinforcement of the plate, particularly at the typical fracture sites. Discussions were held with the producer to enhance the structural integrity of the plates, focusing on strengthening the angles and the residual stump.

Currently, the production of curved plates is not prohibitive when utilising a stock prosthesis. However, in instances involving stock prostheses, it is necessary for the plates to be manually bent. This bending process, when performed by less experienced surgeons, often results in repeated flexing, thereby increasing the likelihood of fractures. Furthermore, it was identified that a screw diameter exceeding 2.5 mm is desirable for optimal stability.

An analysis of the underlying causes of these fractures revealed that the issue was not isolated to the fracture of the plate itself, but rather involved the mobility of the plate. Notably, it was found that, under certain circumstances, the plate exhibited complete mobility, which predisposed it to fracture. Literature review highlighted relevant findings from distinguished academics such as Prof. Rahn, whose work indicated that circulatory disorders resulting from osteosynthesis plates could be detrimental to the vascular supply of the cortical bone. Similarly, Matter's research from Switzerland discussed the presence of porosity beneath osteosynthesis plates due to compromised blood flow.

This raised pertinent questions regarding the vascularisation of the cortical bone. It was clarified that the primary blood supply to the cortical bone originates from the periosteum, rather than from the endosteum, which is minimally involved. Consequently, the application of plates, especially larger ones, can obstruct the vascular supply from the periosteum to the cortical bone, leading to plate mobility, which in turn contributes to the risk of fracture.

Moreover, contemporary prostheses often employ plates with simple screw holes. Observations during developmental stages indicated that as screws press the plate against the bone, they inadvertently create circulatory issues for the cortical bone. Over time, this pressure may result in bone resorption beneath the plate, leading to diminished blood flow and subsequent vascular insufficiency.

The concept of internal fixation with locking screws, innovated by Prof. Raveh in Switzerland, addresses these concerns by establishing a gap between the plate and the bone, thereby preventing undue pressure on the latter. As a result, it preserves the vital blood supply within the cortical bone. This mechanism of fixation, which employs the unique threading within the plate, disrupts neither the vascular supply nor the structural integrity—an aspect considered paramount in contemporary surgical practice.

In the further course of the presentation, the speaker presented an informative case study involving osteosarcoma and the implementation of a TMJ stock prosthesis. The tumour was illustrated both pre-operatively and during the surgical procedure, accompanied by the prefabricated prosthesis, which had not been fully shaped, but was rather designed for insertion.

An emphasis was placed on the fortification of the area by incorporating a strengthened plate, allowing for a more compact structure within the surgical site, which demonstrated effective results.

The speaker highlighted the importance of maintaining the blood supply to the cortical bone, particularly concerning the TMJ. It was noted that during tumour resections, the blood supply to the condyle is reliant on muscular connections. Once removed, it became critical to manage the subsequent risk of compromised blood flow to the cortical bone, which, if obstructed, could lead to complications such as mobility of the plate and potential fractures of the screws. This risk is exacerbated when larger plates are employed, as these often facilitate simpler holes without locking screws, which can impede periosteal blood flow and encourage bone resorption.

The speaker concluded that customised CAD/CAM prostheses offer considerable advantages over standard models. It was asserted that these bespoke devices do not require bending or exertion of stress on the metal framework, allowing for reinforced stability without oversizing the plate. Recommendations included using locking screws, ideally of 2.8 mm in diameter, and the necessity of deploying at least four screws, especially when bridging extensive gaps. This careful design is aimed at preventing circulatory disorders within the bone, thereby minimising risk of fractures.

During the lecture, a specific case was examined involving a patient from Palestine, who had undergone prior surgeries. In this instance, a CAD/CAM prosthesis was employed, featuring locking screws designed using data specific to the procedure. The speaker showcased the implementation of a peak material for the condylar region, further emphasising the importance of these design principles in achieving successful outcomes.

Lastly, the speaker referred to a historical maxim by a Roman physician, *primum nil nocere*, which translates to *first, do no harm*. This principle was reiterated with reference to a case study from Russia involving a patient suffering from TMJ clicking. The series of interventions, including lavage and joint replacement, ultimately yielded unsatisfactory results, underscoring the necessity for surgical caution. The speaker urged practitioners to prioritise quality prosthetic materials and the inclusion of locking screws, adhering to the guideline of a minimum of four screws with a diameter of 2.8 mm.

In summary, the lecture provided valuable insights into the complexities of managing osteosarcoma in the context of maxillofacial surgery, while advocating for meticulous surgical practices and appropriate use of prosthetic solutions.

III.6 The application of digital guide plate in stock prosthesis replacement

Guo Bai. The speaker expressed their gratitude for the introduction and extended their appreciation to Prof. Joos, their fellow participants, Prof. Yang, and Prof. He for their invaluable guidance throughout the research. The focus of their presentation was identified as the utilisation of digital guide plates in stock prosthesis replacement.

In the realm of total joint replacement systems, two prominent eloplastic systems were mentioned: the Biomet/Lorenz prosthesis and the TMJ Concepts prosthesis. A particular emphasis was placed on the Biomet stock prosthesis due to its standardised design, which features a flat top surface of the fossa prosthesis and a corresponding inner surface of the medical prosthesis. It was noted that bone trimming is required during surgery to facilitate implantation.

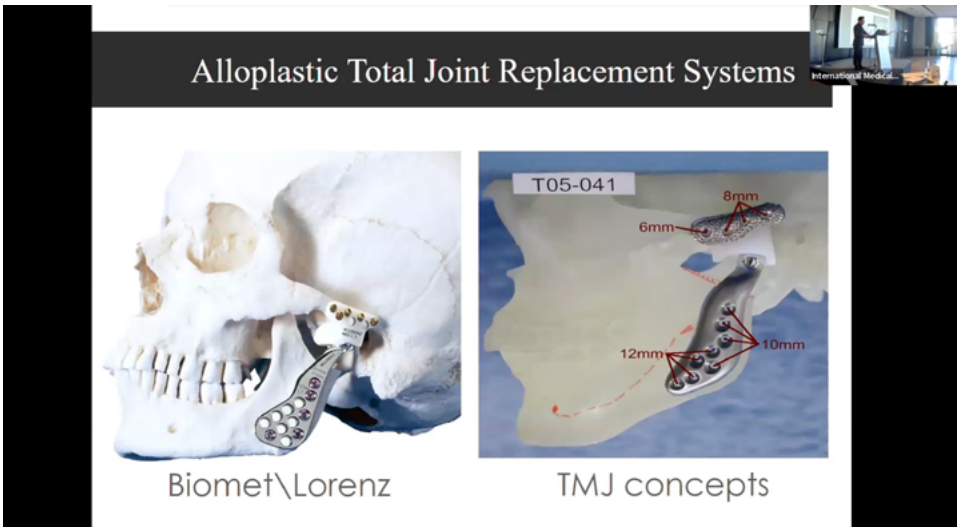


Figure 21. Examples of alloplastic total TMJ replacement systems.

Several challenges associated with the Biomet stock replacement system were highlighted. Firstly, it was reported that bone trimming predominantly relies on the surgeons' experience, which may lead to inaccuracies in the positioning of the prosthesis. Consequently, this could result in instances where screws inadvertently impinge on nerves. Furthermore, achieving an accurate positioning of the prosthesis can prove difficult, especially owing to the complexities of the fossa anatomy, which complicates the determination of the necessary amount of bone trimming and may result in insufficient prosthesis support. A case was illustrated where the fossa exhibited a lack of bone support, thus increasing the risk of long-term instability, screw loosening, and eventual implant failure.

To address these issues, the introduction of digital design and templates was proposed as a method to ensure accurate implantation. It was suggested that digital design software could facilitate the reconstruction of the skull and provide essential measurements, allowing for the selection of the appropriate prosthesis type and positioning prior to the surgical procedure. Moreover, simulated placements of the prosthesis may assist in identifying the optimal position.

Specific requirements for the positioning of the fossa prosthesis were delineated, including the alignment of the top of the prosthesis with the Frankfort horizontal plane, adequate bone volume for secure fixation, and appropriate spatial relations between the prosthesis and surrounding anatomical structures. Notably, the necessity for the posterior margin to be located two to three millimetres from the bony canal to avoid damaging the inferior alveolar nerve was emphasised.

The methodology further included the determination of the osteotomy plane, which would define the surgical approach to the mandible, particularly the condyle and the lateral surface. Subsequently, a digital template was designed to aid in guiding the osteotomy during the surgical procedure.

A visual representation of the initial digital template was presented, identifying key areas for bone trimming alongside the corresponding screw holes for prosthesis placement. It was described that, after the trimming process, the digital template could be retracted, allowing for the prosthesis to be inserted accurately in accordance with the pre-defined fixation holes.

The use of digital design methodologies and digital templates was introduced in 2013, accompanied by modifications to the template design, resulting in a significantly smaller

and more efficient format.

A comparative study was carried out to evaluate the effectiveness of these digital modifications. This study included 13 cases spanning from 2006 to 2013, which were reviewed retrospectively and were performed without the assistance of digital templates. In contrast, 62 cases from 2013 to 2017 were conducted with the help of digital design and templates, forming a prospective study. The findings indicated that the error in placement for the group utilising the digital template was markedly lower in comparison to the group that was not assisted by digital guidance. It was concluded that the digital guide facilitates optimal positioning of the prosthesis during implantation.

Furthermore, it was noted that the guide plate aided in the osteotomy and fixation of the prosthesis, effectively reducing the need for intermaxillary fixation. An example demonstrated a postoperative scenario after seven days, revealing no visible fixation screws. Additionally, a comparison of surgical durations between the two groups highlighted a reduction in surgery time by approximately 1.5 hours for those cases involving the guide plate.

In the subsequent phase of the procedure, bony grafts were employed to enhance the stability of the stock prosthesis replacement system. As outlined in the guidelines, trimming of the eminence is necessary to achieve a three-part contact prior to the implantation of the fossa prosthesis. However, difficulties may arise in cases where trimming along certain lines is attempted; for instance, if trimming occurs at the green point, the fossa surface remains uneven, while trimming along the yellow line may result in insufficient bone for adequate fixation.

A philosophical analogy was drawn using the Taiji symbol, representative of the balance of Yin and Yang. By drawing a red line through this symbol, it became clear that the green and yellow sections complement one another, illustrating a concept of mutual inclusion. This imagery was employed to reassess the earlier case.

By superimposing the Taiji symbol over the eminence, a viable solution emerged: the eminence could effectively fill the fossa, thereby offering additional bony support for the prosthesis. A bottom view of the eminence graft was also presented, depicting the surgical approach wherein osteotomy was performed on the eminence, allowing for the bony chip to be inverted and utilised to infill the fossa region.

The overall results of this approach indicated the successful creation of a flatter plane, thereby enhancing the stability and effectiveness of the bony graft in prosthetic applications.

In the course of a recent lecture on bone grafting techniques in maxillofacial surgery, it was conveyed that various strategies exist to enhance surgical outcomes when the quality of the existing bone structure is found to be inadequate. One such consideration involved the utilisation of the container neck, which could facilitate the establishment of a flatter bone plane during surgical procedures.

Evidence presented during the session highlighted the results from a study involving 24 patients who had received advanced surgical technology. It was observed that the area of bone contact atop the alloplastic prosthesis increased by 46%, thus ensuring an enhanced initial stability of the said prosthesis. Furthermore, follow-up data from 38 patients, monitored over an average duration of 22 months, indicated a minimal average volume absorption of the bone graft, reported at only 11

Additional insights suggested that bone grafts could also be applied to the lateral surface of the mandible, thereby promoting optimal positioning of the mandibular prosthesis and enhancing skeletal support.

Another case study discussed related to the deployment of a coronary prosthesis alongside a bone graft in instances where there was insufficient healthy bone mass for the effective

application of a mandibular prosthesis. Following the appropriate placement of the graft, it was reported that the screw hole measurement remained less than three. The utilisation of the coronary prosthesis as a bone graft demonstrated initial stability prior to surgery. Data from six cases involving mandibular bone grafts revealed an approximate increase in bone contact area by nearly 20 square millimetres, with a recorded average bone resorption rate of 20% at the six-month follow-up.

It was also mentioned that the research conducted by the team had been published, with particular recognition afforded to their work by Prof. Quinn, a notable figure in the field of maxillofacial prosthetics, who included their findings in his latest publication, *Adolescent TMJ Surgery*.

A specific clinical case was described involving a male patient with a longstanding limitation in muscular opening resulting from traumatic TMJ ankylosis, which had occurred two decades earlier. Despite an earlier intervention involving coronary prosthesis grafting and genioplasty, this patient experienced a relapse of symptoms. Pre-surgical osteotomy treatment was conducted over six months to realign the dental occlusion, followed by the operative design involving maxillary osteotomy and mandibular rotation paired with abutment reconstruction. The implementation of a digital template was pivotal to the successful execution of the surgery, yielding considerably improved visual outcomes.

In conclusion, the lecture summarised that the modification of bone graft techniques possesses the potential to significantly enhance the stability of alloplastic stock prosthesis implants. The integration of digital design and templating methods allows for increased accuracy and ease in surgical interventions.

III.7 Outcomes of alloplastic TMJ replacement

Andrew Sidebottom. During the recent meeting, the speaker expressed gratitude for the continued engagement of the audience. It was suggested that the alteration in the presentation order was beneficial, as it allowed for the exploration of a distinct type of prosthesis. This prosthesis exhibited similarities to the TMJ Concepts Biomet Prosthesis, effectively merging elements from both. Specifically, it utilised an initial ramus prosthesis akin to the Concepts model, coupled with a fossa component similar to that of the Biomet. The advantages of the Concepts prosthesis were highlighted, particularly in terms of the greater mobility afforded to the condylar head within the fossa, in contrast to the more constrained nature of the Biomet prosthesis, which is characterised by a shallower posterior fossa.

The speaker congratulated the audience for acknowledging the limitations associated with certain prostheses while simultaneously embracing their advantageous characteristics. The discussion then shifted towards the outcomes of joint replacement surgery, starting with an overview of outcomes from the UK, alongside personal results and international data. Reference was made to a paper presented in 2016, which focused on short-term outcomes; however, this session aimed to shed light on longer-term outcomes and the insights garnered since that time.

As mentioned, the indications for joint replacement include conditions such as ankylosis, inflammatory arthritis, degenerative disease, post-traumatic scenarios, post-resection, as well as iatrogenic and idiopathic condylar absorption. An illustrative case of a patient suffering from psoriatic arthritis and a significant fixed flexion deformity of the neck was provided, highlighting both anaesthesia and surgical challenges associated with such cases.

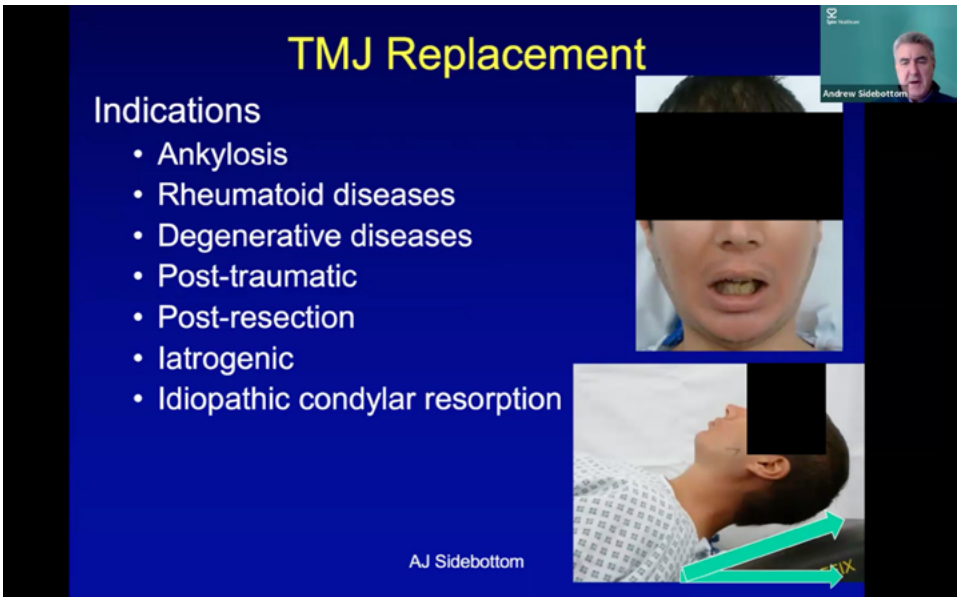


Figure 22. Indications for TMJ replacement.

The speaker reiterated the contraindications for these procedures, which encompass active local infections and severe uncontrolled diabetes. Additionally, it was noted that significant medical limitations regarding general anaesthesia (GA), such as fixed flexion deformities and limited mouth opening, pose challenges for intubation—necessitating the expertise of anaesthetists skilled in fibre optics. Moreover, limited lung capacity and an unstable cervical spine may further complicate surgical interventions.

With regard to guidelines, it was elucidated that the UK recommendations published in 2008, which were subsequently adopted by the government in 2014, pertain to the criteria for undertaking joint replacement. These guidelines emphasise that the decision-making process should be predicated not on radiological findings but primarily on functional limitations concerning mouth opening, pain levels, diet, and occlusal deformities resulting from joint collapse. Hence, while imaging studies are essential, clinical indicators remain paramount.

The existence of a national database was brought to attention, which facilitates online data collection—including baseline measurements at six weeks, one year, and annually thereafter. This resource is instrumental for the revalidation of surgical techniques and monitoring complications. Data from 2012 indicated a mean patient age of 43, predominantly female, spanning various indications, with osteoarthritis being the most prevalent in the UK, though experiences in countries such as India revealed a higher incidence of ankylosis cases.

Post-operative outcomes were discussed, focusing on mouth opening and baseline data from 288 patients one year after surgery. Notable improvements were documented, particularly in the realm of chewing difficulties and pain reduction—most patients reported experiencing minimal to no pain post-operatively.

A study undertaken between 2004 and 2011, which was published in the British Journal, detailed initial outcomes for 74 patients who were primarily diagnosed with degenerative conditions. Reported results indicated over a 90% reduction in pain levels, an average mouth opening enhancement of 11 millimetres, and significant dietary improvements, approaching normalcy. Although there were a few complications, including two failures attributed to biofilm formation and infection which were revised successfully, and other perioperative

challenges, the overall feedback from patients was predominantly positive concerning their surgical outcomes.

The lecture highlighted that myofascial pain represents a common complication, particularly following a period of restricted movement or in instances where the ramus has been lengthened. It was suggested that tricyclic antidepressants or Botox injections could be employed to manage this issue. Observations indicated that these discomforts typically resolve within six to twelve months, coinciding with the restoration of the full range of movement and function.

Furthermore, limitations in forward and lateral movement were emphasised. Patients reported an adaptation in their chewing style, transitioning from a more feline-like approach to one resembling that of a cow. A specific case demonstrated an improvement in Fray's syndrome, whereas another patient coped with temporary sensory loss, apart from an area of approximately one centimetre of numbness located over the prosthesis that persisted.

Three and five years post-procedure, the outcomes were re-evaluated and re-published. One instance of a brow lift was noted for addressing persistent frontal palsy, alongside two failures attributed to biofilm infection; nonetheless, the overall outcomes remained satisfactory. Previous studies discussed during the 2016 meeting illustrated significant improvements concerning pain, mouth opening, dietary habits, and overall quality of life.

Questions regarding the adequacy of stock prostheses for most cases, as well as the acceptability of unilateral joint replacement, were raised. Additionally, the presence of ten-year clinical outcomes was considered, along with management strategies for children under the age of sixteen. A study from the United States comparing Biomet custom prostheses with TMJ concepts revealed that a stock prosthesis could be successfully fitted in 74% of patients. However, cases involving multiple prior surgeries or concurrent orthognathic procedures proved to be considerably more challenging.

Another study focusing on an Indian population led by Ajay Rochadre examined patients presenting with pronounced ankylosis of the joint, likely developed during the pre-growth or growth phases. This condition resulted in a notably short ramus due to stunted growth. The findings indicated a significant correlation between the duration of ankylosis, ramus length, and the subsequent inability to fit a stock prosthesis. Most patients in this group experienced compromised placements of stock prostheses, as the ramus prosthesis often exceeded the length of the mandible's ramus. Consequently, the development of a 45-millimetre prosthesis was recommended to accommodate this demographic.

The study also questioned whether unilateral interventions were sufficient. It demonstrated increased stress on the contralateral condyle; however, no heightened failure rate was reported. Similar radiological findings and one-year follow-up outcomes were noted, with only two individuals from this group requiring subsequent contralateral prosthesis placement. Based on personal clinical experience, it was indicated that approximately 70% of patients undergo unilateral procedures, with around 80% of those exhibiting significant improvement, while 20% subsequently necessitate further prosthesis intervention.

Thus, treatment of the contralateral side should be dictated by ongoing symptoms. A noted concern within this study was the observed alterations in kinematics to the contralateral joint, which adapted through a remodelling process. Additionally, research from Larry Walford's unit demonstrated that a considerable number of patients benefited from unilateral procedures, with only 13% requiring contralateral joint replacement, all of whom had previously undergone disc repositioning surgery.

Meta-analyses consistently showed substantial improvements in pain, mouth opening, and quality of life across the three prostheses studied. A systematic review incorporating

17 follow-up studies involving 1,343 patients reported significant enhancements in pain, mouth opening, and quality of life, with no notable differences between the various devices compared. Furthermore, the global revision rate for prostheses was remarkably low at 0.19%, indicating that only a minimal number of prostheses necessitated revision.

The most prevalent reason for requiring revision in joint replacement procedures is identified as infection and the formation of heterotopic bone.

It was reported that follow-up studies conducted over periods of 3, 5, and 10 years included an initial cohort of 127 patients, with the data available up to 2018. Notably, these patients had received a minimum follow-up of 3 years.

The findings indicated a continuous improvement in pain levels, mouth opening capabilities, and dietary scoring throughout the 10-year span. An observation was made regarding a slightly elevated complication rate in the initial group, which may be attributed to the learning curve associated with the application of these prostheses.

A further examination of the patient cohort revealed a total of 62 joints across 43 patients, predominantly comprising females with an average age of 45 years. Statistically significant enhancements in pain scores were documented. It is noteworthy that the survivorship rate after 10 years stood at an impressive 93%, particularly with the implementation of the TMJ concept striker prosthesis.

Contrasts were drawn with data from Eric Granquist's multicentre study utilising the biomet stock prosthesis. Out of 578 cases examined, 259 were excluded due to incomplete follow-up data, potentially impacting the statistical integrity of the results. Nonetheless, a survivorship rate of 86% after 10 years was reported within this study, suggesting promising long-term outcomes with these types of prostheses.

The topic of paediatric cases remains contentious. One pertinent study advocated that all alternative treatment options should be exhausted before considering surgical intervention, especially in five patients suffering from severe ankylosis, all of whom experienced notable improvements in mouth opening following surgery.

A particular case involving a child with three previous unsuccessful rib grafts was highlighted, where alloplastic replacement was ultimately undertaken and followed up to age 23. Remarkably, this individual maintained centric occlusion, indicating that the jaw had adapted around the prosthesis, thus preserving symmetrical growth. The occlusion and jaw opening remained satisfactory even after 15 years of follow-up, with the source of these findings attributed to Lou Mercuri's slides.

The collective data from personal outcomes with over 300 joints indicated an approximate 90% improvement in pain after one year, with this trend continuing to 10 years. Mouth opening improved by an estimated 12 millimetres, reaching up to 34 millimetres, while dietary scores showed a 90% improvement within the first year, allowing most patients to return to a normal diet. The failure rate was reported as approximately 2%, with infection and re-ankylosis each constituting around 2%, particularly in patients with a prior history of ankylosis. The presentation described the "out-in procedure" as a method to extract the ramus prosthesis, eliminate the ankylotic mass using piezoelectric techniques, and replace the prosthesis, augmented with a fat graft, all through a lower surgical approach.

International outcomes for these prosthetic implants reportedly demonstrate a sustained functional rate of 90% over 15 to 20 years, with no failures attributed to wear debris, which is a common cause of knee replacement failures after a decade.

A comparison of outcomes between the biomet stock prosthesis and the TMJ concepts prosthesis revealed that generally, the former showed slightly better mouth opening results, while the latter provided superior pain scores. The observed differences were ostensibly

linked to the larger screw and fossa component of the biomet design, which necessitated more invasive bone reduction and coronadectomy to accommodate the prosthesis. In contrast, the TMJ concepts prosthesis, featuring a smaller screw and a lower-profile fossa designed with custom fabrication, allowed for minimised bone removal and less frequent need for coronadectomy, leading to reduced pain associated with excessive bone resection.

The discussion encapsulated insights into personal and international outcomes, examining the discernible differences in results between the biomet and TMJ concepts prostheses, which remain the primary prosthetic options in Western medical practice.

The session concluded with an invitation for questions, during which Professor Seidbottom expressed his willingness to address inquiries related to the complexities of total joint alloplastic replacements, particularly concerning infection, chronic pain, and heterotopic bone formation. He noted the generally poor reporting rates of overall complications in existing literature, reiterating his commitment to transparency in documenting such complications throughout his research studies.

He shared that, internationally, meta-analyses indicated infection rates of approximately 2% to 4% associated with these prostheses, alongside a 2% incidence of re-ankylosis. Within the context of his practice, he reported that among over 300 patients he had treated, only 80 underwent surgery due to ankylosis, with roughly 5% of those experiencing recurrent heterotopic bone formation necessitating additional procedures.

He also acknowledged the greater challenge faced in India, where a significantly higher number of ankylosis cases occur in childhood, complicating the fitting of stock prostheses. Efforts to develop a more affordable custom prosthesis option in China were commended, as it may enhance accessibility for affected patients.

Regarding surgical complications, he reported that, through his experience, no permanent marginal mandibular function loss had occurred across approximately 400-450 joints, although he noted a temporary weakness rate of 3% to 4%. Hemorrhage posed a concern, particularly in ankylosis surgeries due to close proximity to the maxillary artery, and he mentioned the utility of pre-operative vascular imaging as suggested by Joe McCain's group to mitigate such risks.

The discussion closed with further inquiries about long-term outcomes experienced over the years, particularly in light of the substantial number of prostheses performed in China, with a modest revision rate attributed primarily to heterotopic bone formation.

III.8 TMJ reconstruction with Yang's customized prosthesis

Zixian Jiao. Dr. Jiao, a member of Prof. Yang's research team, focused on the reconstruction of the TMJ using customised prostheses developed by Yang's team. The lecture encompassed four key areas: the background of TMJ reconstruction, the research and development processes involved, clinical applications, and future perspectives.

The background outlined that for patients suffering from advanced TMJ diseases, such as osteoarthritis, condylar resorption, ankylosis with or without accompanying deformities, and TMJ complex tumours, reconstructive procedures are often considered the preferred treatment options, particularly within the adult population. It was noted that there are currently two commonly employed artificial TMJ prostheses available globally. The first, known as the Biomet prosthesis, is a standard option available in China but is considerably expensive. The surgical procedure associated with this prosthesis necessitates modifications to the jawbone to ensure compatibility, which can elevate the risk of postoperative infections and may not be suitable for more complex clinical cases.

The second prosthetic option, TMJ Concepts, is tailored according to the individual morphology of the patient's jawbone, yet has been restricted from use in China for particular reasons. Reference was made to a survey conducted by TMJ Concepts in 2016, which highlighted a significant increase in total jaw replacement surgeries, from 412 in 2005 to 572 in 2014, representing a growth of 133%. Projections suggested that this number could rise to 900 by the year 2030, along with a potential increase in prosthesis sales to approximately 1,600 sets worldwide.

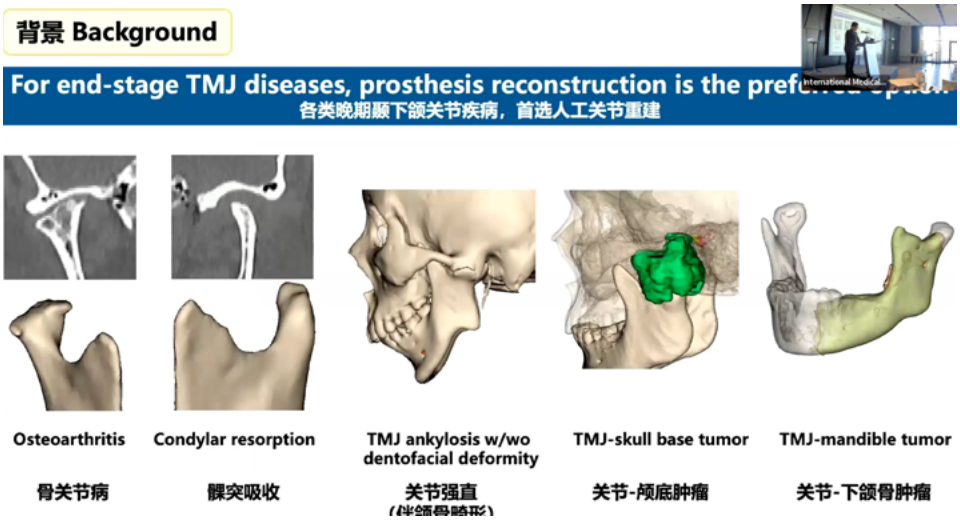


Figure 23. Patients experiencing advanced conditions of TMJ disorders, including osteoarthritis, cartilage resorption, ankylosis—either with or without associated deformities—and complex tumors of the TMJ.

The history of artificial joint reconstruction at the institution in Shanghai commenced in 2001, following Prof. Yang's return from the United States. Efforts focused on total joint replacement began earnestly, with Prof. Yang performing surgeries using both TMJ Concepts and Biomet prostheses between 2003 and 2005—the first of their kind employed in China. Since 1997, it has been reported that over 20,000 surgeries have been performed, involving more than 26,000 joint reconstructions, highlighting a substantial demand for joint surgery and TMJ reconstructions.

The process of developing the customised artificial TMJ prostheses involved extensive research. Initial testing through animal models demonstrated the biological safety and long-term stability of the prostheses, which laid the groundwork for subsequent clinical application. Anatomical assessments were conducted to measure various aspects of the bone structure surrounding the joints, including the width of the zygomatic arch and multiple diameters related to the condyle and mandible, using data sourced from CT scans of healthy patients.

The analysis of condylar movement was facilitated by capturing mandibular dynamics and integrating this with CT imaging data to determine the normal range of condylar motion, which informed the design of the core prosthetic components. Modifications to the TMJ Biomet core components included an expanded fossa range and increased depth, enhancing condylar mobility. Additionally, a posterior plate was incorporated to avert posterior dislocation of the condylar head, along with an increase in the contact area between the condylar head and fossa.

In terms of the design of additional components, the prosthesis extension was informed by

biochemical transmission characteristics, alongside comprehensive three-dimensional analyses and testing to ensure effectiveness. The final design of the prosthesis led to the development of the first-generation device, consisting of a combination of ultra-high molecular weight polyethylene for the fossa and a cobalt-chromium-molybdenum alloy for the condylar head. The manual component utilised a titanium alloy conducive to 3D printing, noted for its excellent osteointegration properties.

The surgical approach for implementing the first prosthesis involved a prior ocular extension and a submandibular extension. Procedures such as eminence osteotomy and chondrectomy were executed during surgery, with intermaxillary ligation employed to secure a stable mandibular position prior to fixing both the fossa and mandibular components via the respective incisions.

In the course of the lecture, it was noted that certain limitations still persist in the current surgical approach. Specifically, it was highlighted that two incisions are required for the procedure. Furthermore, the transition between the intra-oral and extra-oral surgical fields was identified as a potential factor that could elevate the risk of post-orbital prosthesis infection. This led to the pertinent question of whether strategies exist to mitigate these issues.

The speaker then described the innovative modifications made to the prosthesis design, which led to the development of Yang's customised prosthesis, now utilised in clinical practice. Key enhancements included the addition of a fixation screw hole at the anterior aspect of the neck of the mandibular prosthesis, facilitating the procedure's initial installation via a priorocular incision. Additionally, a fixation wavelength was incorporated at the posterior edge of the mandibular component to serve as a guide during endoscopic cyst fixation procedures.

The clinical applicability of these advancements was discussed, noting that from 2015 to the present, a total of 118 cases were recorded, encompassing 153 prosthesis applications. This cohort included instances of total jaw replacements, as well as those combined with orthodontic surgery; however, cases involving TMJ skull base or TMJ mandible combined prostheses were not covered, as these were to be addressed by Dr. Zheng.

Following the primary utilisation of the prosthesis, a publication was generated detailing a study involving 12 patients suffering from unilateral TMJ arthritis. Subjective assessments indicated remarkable improvements in pain relief, jaw function, and dietary capacity, with average reductions in pain intensity of 90%, enhancements in jaw function of 70%, and an approximate 80% improvement in dietary habits after one year post-surgery. Objective measurements revealed an average increase of 32% in maximum muscle opening following the procedure; however, lateral and forward movements were noted to be restricted.

The general procedure for TMJ reconstruction using Yang's prosthesis was elucidated. Initially, a detailed surgical design was prepared using CT scans and specific software to determine incision sites. Typically, the preservation of the disc was attempted when feasible. A surgical guide was then created, wherein the screw holes were meticulously aligned to ensure consistency with the prosthesis design.

During the surgical procedure, tumour or lesion excision was performed, followed by the preservation of the condyle. The use of the surgical guide was instrumental in assisting the osteotomy, thereby allowing for accurate prosthesis installation facilitated by the alignment of the screw holes.

Further indications for the use of Yang's customised prosthesis were presented. These included conditions such as severe osteoarthritis that is unresponsive to non-surgical interventions, idiopathic condyle resorption with non-salvageable joints and discs, ankylosis

scenarios where residue condyle preservation is not feasible, and severe condyle fractures presenting significant challenges to surgical reduction. Other indications encompassed static phase arthritis and chronic-phase rheumatoid or immune arthritis, as well as tumours and tumour-like diseases where condyle preservation is unattainable.

Conversely, the lecturer outlined absolute contraindications, which included patient allergies to materials used in the prosthesis, the presence of acute infections, and acute exacerbations of chronic or systemic diseases that remain uncontrolled. Additionally, some relative contraindications were also acknowledged.

In a recent presentation, a case was discussed that exemplifies the utilisation of an innovative surgical technique. The subject in question was a 51-year-old female patient, who had presented with a primary complaint of restricted mouth opening, accompanied by pain in the right TMJ region for a duration of two years. Diagnostic imaging, including computed tomography (CT) and magnetic resonance imaging (MRI), revealed the presence of condyle hyperplasia, a finding that was subsequently corroborated through pathological examination.

The proposed treatment plan entailed a total joint replacement of the right TMJ using a custom prosthesis developed by Yang's team. In preparation for the surgical intervention, the surgical procedure and the prosthesis were meticulously designed, which included measuring the lengths of the screws required prior to the operation. This pre-operative planning facilitated expeditious decision-making during surgery.

The surgical procedure involved designing a surgical guide to perform an eminence osteotomy and condylectomy. It was noted that the screw holes in the prosthesis aligned with those in the surgical guides, ensuring coherence in the surgical approach. Owing to the thorough 3D surgical planning, the surgery could be executed through a pre-auricular incision, which could be done in isolation or in conjunction with a transplant approach, with both the eminence osteotomy and condylectomy being conducted via the pre-auricular incision.

During the operation, the guides were secured using screws, allowing for precise osteotomy performance. It was highlighted that the initial fixation of the guide plates was achieved using two screws, which marked the optimal positioning for the screws. These screws also facilitated the temporary fixation of the mandibular prosthesis. Following this, an endoscopic assist was employed to secure the remaining screws.

Three years post-surgery, the patient demonstrated a stable occlusion with a satisfactorily positioned prosthesis. An analysis of the components indicated that the core component was less than one millimetre in size, while the extension part measured approximately one millimetre. However, it was noted that the lateral movement of the mandible had been compromised due to the atrophy of the lateral pterygoid muscle. Furthermore, the integration of the prosthesis with the skull base remains an area that requires further investigation.

The insights and methodologies discussed are elaborated upon in Prof. Yang's monograph, titled *Atlas of Customized TMJ Cranial Jaw Prosthesis*, published two years prior.

III.9 TMJ reconstruction combined with orthognathic surgery

Qianyang Xie. Diseases of the TMJ have been found to be significantly associated with facial deformities. Notably, conditions such as condylar resorption, also referred to as idiopathic condylar resorption (ICR), as well as joint ankylosis, can lead to various complications. These complications include severe mandibular retrognathia, anterior open bite, an overly steep mandibular plane, constricted airways, and sleep apnoea.

Moreover, pathologies such as osteochondromas were reported to contribute to pro-

nounced facial asymmetry and Class III deformities, as the enlarged condyle displaces the mandible laterally. This misalignment invariably results in compensatory adaptations from the upper dentition to maintain occlusal harmony.

In cases where there are no salvageable joints, such as TMJ ankylosis or advanced osteoarthritis complicated by dental-facial deformities, it is often essential to implement a dual approach that encompasses joint reconstruction surgery alongside aesthetic considerations. The reconstruction may utilise autogenous grafts or prosthetic devices.

Autogenous grafts may include chondrocostal grafts, fibular flaps, and portions of the coronoid process. In contrast, artificial joints can be categorised into stock prostheses and customised prostheses. While autogenous grafts offer notable advantages, including potential for growth, they are also associated with a relatively high risk of bone resorption. This resorption may lead to secondary deformities and malocclusion. Furthermore, there is a concerning possibility of recurrence of ankylosis following the use of autogenous grafts, complicating the management of recurrent cases of dental-facial deformity.

Figure 24. Case presentation illustrating the relationship between TMJ disorders and facial deformities.

In mandibular advancement cases, the installation of stock prostheses or rib grafts can be particularly challenging due to the anatomical angulation between the implant and the ramus. In some instances, as denoted in specific diagrams, screw insertion is contraindicated, which could compromise the stability of the implant. Additionally, when addressing deformities of the condyle and ramus, a significant gap may develop between the prosthesis and the residual bone, necessitating the use of customised artificial joints for effective joint reconstruction.

As articulated by Dr. Jiao, two generations of prosthetics have been developed, with the second generation incorporating a self-positioning feature. To date, over ten cases have utilised these customised prosthetics in orthognathic surgery.

A review of the treatment protocols reveals that the first generation of prosthetics involves a maxilla-first surgical approach. Initially, virtual planning is undertaken, wherein a three-dimensional model of the patient is created to formulate an orthognathic plan that accounts for the absence of the affected joint. Ultimately, the prosthesis is designed based on the identified defect.

The subsequent surgical procedure commences with maxillary surgery, followed by the installation of the joint prosthesis. A specific case involving hemifacial microsomia was examined, where the primary objectives were to restore joint functionality while simultaneously achieving a symmetric and aesthetically pleasing profile. Given the complete absence of the normal a customised artificial joint was deemed necessary.

Prior to treatment, the patient exhibited an unstable occlusion, necessitating preliminary orthodontic interventions. Once the dental alignment was completed, a CT scan revealed the absence of the left condyle, a deviated mandible, and a canted upper occlusal plane. Following three-dimensional assessments, the maxilla was repositioned to align with ideal occlusal relations. Simulations for the right-side sagittal split were performed, and cores were placed accordingly on the left.

The design of extension components included osteotomy templates for the eminence and mandibular positioning, ensuring that screw holes on the templates matched those on the joint prosthesis for precision during installation. Likewise, templates and customised titanium plates for maxillary osteotomies were designed to correspond with the planned cutting and positioning of the maxilla.

Post-surgical results demonstrated successful execution of the maxillary osteotomy and prosthesis installation as per the preoperative plan, resulting in a symmetric bony structure. A comparison of the virtual planning with actual surgical outcomes revealed a maximum error of 0.81 millimetres in core components and 1.47 millimetres in extension components.

Following surgery, the patient exhibited near-perfect symmetry in the frontal view, and the minimal discrepancies between the virtual plan and the actual surgical outcome attested to the procedure's precision. Six months post-operation, the patient's occlusion stabilised at a Class I relationship, with aligned midlines and successful debonding of orthodontic appliances. Two years later, the treatment results remain stable, with no relapse of deformity and absence of complications.

The discussion centred on the use of customised prostheses, which addressed challenges previously encountered with autogenous grafts and conventional stock prostheses. It was noted that the surgical procedure has become more convenient and precise.

With the introduction of second-generation self-positioning prostheses, the protocol was refined, prioritising the installation of the prosthesis at an earlier stage. The elements of virtual planning remained consistent with previous methodologies, yet a significant modification occurred in the order of surgical intervention, whereby joint reconstruction was carried out prior to orthognathic adjustments.

A particular case was presented involving bilateral condyle resorption, a consequence of anterior disc displacement and osteoarthritis. The utilisation of a self-positioning TMJ prosthesis ensured accuracy in the joint reconstruction, which subsequently facilitated the attainment of an optimal maxillary position.

Examinations of the joints revealed suboptimal condylar status, characterised by the condyles being diminutive with significant erosions on the condylar heads, accompanied by a lack of bone marrow. Consequently, a decision was made to excise the condyles and replace them with TMJ prostheses, while simultaneously addressing the underlying facial deformity.

An overview of the patient's occlusion prior to treatment illustrated a Class II malocclusion, a constricted upper arch, and an impacted left upper incisor. Following orthodontic treatment involving extractions, it was evident that the overjet had increased further due to necessary space creation for mandibular advancement.

The initial phase of the surgery involved the installation of the prosthesis, with the mandible being repositioned downward and forward through a counterclockwise rotation.

Subsequently, a LeFort I osteotomy was executed, alongside a planned genioplasty.

The speaker highlighted concerns regarding complications in maxillary surgery, particularly regarding potential discrepancies between virtual planning and actual surgical outcomes, which can jeopardise the final occlusion. Notably, it was conveyed that the approach adopted effectively mitigates such issues.

Post-operatively, notable improvements in the patient's lateral profile and significant counterclockwise rotation of the jaws were observed. Upon closer evaluation, the absence of scarring on the patient's face was also commented upon, alongside an expanded upper airway, which is anticipated to enhance breathing during sleep.

Eight months subsequent to the operation, the patient presented with a Class I occlusion and a stable upper arch width, indicating readiness for brace removal and the restoration of the upper incisor through implant placement. The speaker emphasised that customised joint prostheses are particularly advantageous for substantial mandibular advancements coupled with joint reconstruction, especially in adult patients. The prosthesis-first approach was highlighted as a facilitator for counterclockwise rotation, while the minimisation of intraoral versus extraoral shifts reduces contamination risks.

Furthermore, it was discussed that when the maxilla is in an acceptable position, bilateral TMJ prostheses can be utilised for mandibular advancement, thereby simplifying the surgical process in cases of unsalvageable joints.

A further case was briefly reviewed, underscoring the intrinsic link between joint surgeries and facial deformity correction. This patient required mandibular advancement with upper incisor adjustments achieved through preoperative orthodontics. The surgical intervention involved bilateral TMJ prostheses to rectify retrognathia, once again showcasing the lack of visible scarring.

The prosthesis was tailored to meet orthodontic requirements, with a digital osteotomy template produced via 3D printing. The surgery, guided by this digital template, was executed swiftly, with accurate prosthesis placement and a reduced risk of complications.

In conclusion, it was asserted that for patients with irreparable joints and dental facial deformities, artificial joint reconstruction represents a viable strategy, with customised joint prostheses being advocated for their efficacy, stability, precision, and overall convenience.

III.10 TMJ skull base infratemporal fossa surgery neurosurgical view

Ulrich Sure. In the context of a recent lecture delivered by Ulrich Sure, a neurosurgeon, insights were provided regarding the neurosurgical perspective relevant to the subject of discussion. The primary aim was to enhance cooperation between Chinese and German institutions through this exchange of knowledge.

Prof. Sure elaborated on certain anatomical aspects which he deemed significant for understanding various surgical approaches and pathologies related to the infratemporal fossa, a region not traditionally associated with neurosurgery. It was highlighted that certain pathological conditions do intersect with this area, necessitating an awareness of specific anatomical characteristics. Notably, the anatomy of the carotid artery as it traverses the petrous bone, along with the arrangement of venous structures such as the cavernous sinus, was discussed. The importance of recognizing these structures becomes particularly apparent during the performance of low-based craniotomies, especially when addressing topics concerning the mandibular joint, the main focus of the congress.

As the discussion progressed inward towards the skull, various dural and osseous features were mentioned, including dural duplicatures and critical yet small nerves such as the greater

petrosal nerve. Prof. Sure emphasized that the preferred surgical approach commonly employed to access the temporal basal structures is the pterional approach, which integrates a frontal-temporal technique with variations such as the orbital-zygomatic approach. Further, he introduced the rendezvous technique, a method relevant to this area of surgery.

The standard skin incision required for the pterional approach was described as necessitating dissection of the temporal muscle and the frontal dura from the lateral sphenoid wing, followed by an appropriate dural opening. A variation of this approach, known as the Kawase approach, was referenced, originally developed by a Japanese surgeon. This technique allows access to the posterior fossa by excising portions of the middle temporal bone, facilitating exposure of the fifth cranial nerve within its dural encasements.

Figure 25. The presentation covered anatomical aspects traditionally not associated with neurosurgery that are important for understanding various surgical approaches in connection with the infratemporal fossa.

Prof. Sure noted a decline in the use of the petrous approach for intricate lesions, attributing this to associated surgical morbidity that may not always be apparent. Illustrative cases were presented, including craniotomies performed in the frontal region that also exposed significant areas of the posterior fossa.

One specific case highlighted involved a surgery conducted alongside maxillofacial surgeon Christopher Mohr. The patient, who had undergone prior operations elsewhere, presented a tumour for which insufficient osseous resection had occurred. Navigation technology was utilised to ensure precise location during the procedure. Post-operative results were illustrated, demonstrating the surgical efficacy.

Another case involved an ossifying lateral sphenoid wing, with surgical management again involving collaborative efforts to reconstruct the orbit in conjunction with a split calvarial technique. Moreover, the discussion raised the case of a giant trigeminal schwannoma, managed via a frontotemporal craniotomy combined with zygoma resection for improved surgical access. The inherent risks of such extensive procedures, particularly concerning cranial nerve preservation, were acknowledged, and intraoperative neuromonitoring was underscored as a critical component of this surgical undertaking.

Finally, the closure of extensive resection cavities presented a logistical challenge. Prof. Sure detailed the use of pericranium and abdominal fat for effective wound closure, noting the patient's favourable long-term outcome which he continues to monitor.

In the presented lecture on maxillofacial surgery, a particularly challenging tumour was introduced, which is regarded as one of the most difficult to treat. The removal of this type of tumour is characterised by its extreme complexity, especially when attempting to accomplish it in a single surgical procedure. A representative example is the petroclival meningioma, which is typically smaller and may be addressed using alternative approaches, such as the Carvassus approach. This method allows for an anterior approach to excise the tumour located in the posterior fossa. Of course, there are also access points through the posterior fossa.

Another case that was highlighted as particularly interesting involved a sarcoma. The hospital treating these cases sees a significant number of sarcomas, given that oncology is one of its primary fields of expertise. A short video was presented, illustrating a typical frontal temporal craniotomy to expose the tumour at the skull base. Initially, a portion of the tumour was removed from above, and subsequently, an ENT specialist assisted in removing the inferior portion endoscopically, using a KUSA device to reduce the size of the tumour before complete excision. During the operation, a free flap was prepared to close the dura due to the extensive excision of dural and bony structures at the skull base. Post-operatively, the patient was reported to be doing well, and even after one year, there was no evidence of recurrence.

The lecture then shifted focus to intrinsic tumours, particularly gliomas, as these may be less familiar to the audience. A case was described involving a young girl with a large pilocystic astrocytoma, which necessitated a frontal temporal craniotomy with orbital zygomatic enlargement to access the lesion effectively. The anatomical structures visualised included the optic nerves, the oculomotor nerve, and the top of the basilar artery, culminating in the resection cavity within the midbrain. Pre- and post-operative images indicated that the patient was recovering well.

Another striking case involved a child from Afghanistan, who presented with a massive optic glioma that caused significant ocular protrusion. The steps taken during the removal of the tumour were detailed, including the opening of the orbit. A rare complication was noted, whereby inadequate packing of fat in the optic canal led to the development of a cerebrospinal fluid leak in the orbit, necessitating further revision; however, the child ultimately recovered well.

The discussion further examined gliomas that infiltrate dural boundaries, showcasing a gliosarcoma that infiltrates the dura and affects the dural covering of the trigeminal nerve. To navigate these complex regions effectively, it was emphasised that collaboration with various surgical specialties is crucial, including maxillofacial surgery and ENT, as well as other relevant colleagues. The ability to treat a wide range of conditions, including rare diseases, was underscored as an essential aspect of comprehensive patient care.

The lecture concluded with gratitude expressed for the audience's attention.

III.11 TMJ-mandible combined reconstruction

Minjie Chen. The revised Yang's classification of condylar and mandibular defects is comprised of six distinct categories. Grade zero denotes a situation characterised by a mandibular defect alongside a healthy condyle. In this context, it was noted that some surgeons exhibit a tendency to excise the intact condyle in conjunction with the affected area, potentially leading to instability in the function of the TMJ.

It is proposed that a healthy condyle measuring over 10 mm should be preserved. This entails that the condyle can be securely fixed using at least one screw. In such cases, an

incision through the TMJ is necessitated to maintain the integrity of the articular capsule and the lateral pterygoid muscle, allowing for precise fixation of the condyle.

For adolescents, a costochondral graft is recommended, whereas in adults, options include fibular or iliac bone grafts. Mandibular reconstruction should be considered concurrently with dental restoration. In instances where the lesion is classified as benign or intermediate, the inferior alveolar nerve is generally preserved.

A total of nine cases were presented. One specific case involved a young woman diagnosed with keratosis, who had previously failed fenestration procedures. In this instance, the lepto-ramus was severely affected, yet the healthy condyle still measured 12 mm. Utilising a digital cutting guide, the TMJ incision facilitated the removal of the lesion while safeguarding both the condyle and the nerve. A long costochondral graft was harvested, and the condyle was secured with a single screw. Seven years post-surgery, the patient exhibited favourable facial aesthetics and occlusion, with the costochondral graft having remodelled effectively and the condyle remaining stable within the fossa. This case study was subsequently published in Chinese journals.

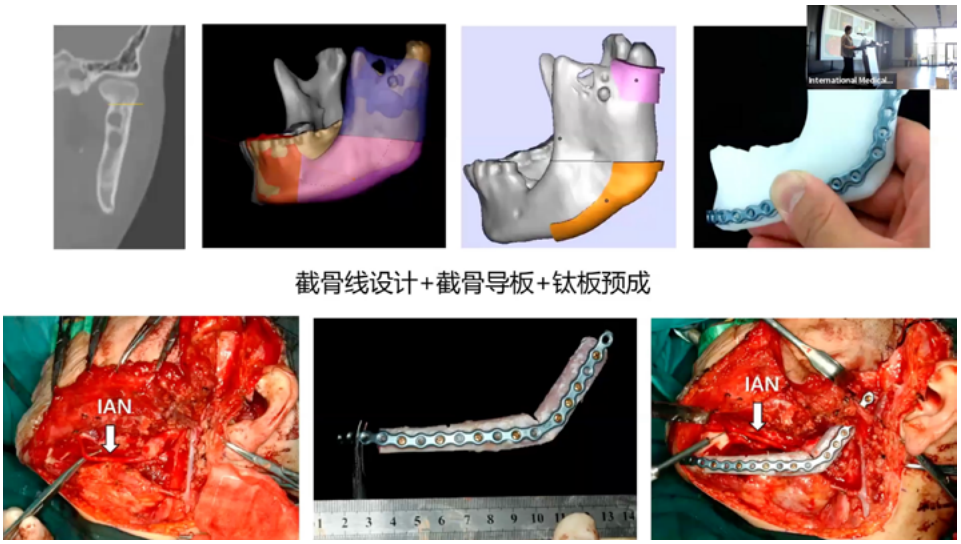


Figure 26. A case diagnosed with keratosis, who had previously failed fenestration procedures. In this instance, the lepto-ramus was severely affected, yet the healthy condyle still measured 12 mm.

Grade two involves the defect of the ramus and the angle of the mandible, without any dentition defects. In this scenario, a costochondral graft can be selected for adolescents, while adults may benefit from vascularised fibular grafts or customised prostheses. The preservation of the TMJ disc and the nerve is also feasible. An incision at the TMJ is required as the disc may be anchored to the bone graft during the procedure.

A young man suffering from osteofibroma in the right ramus was also discussed. Here, a digital cutting guide was utilised to excise the lesion, during which the nerve was preserved. A long costochondral graft was subsequently applied to reconstruct the defect. The techniques employed for nerve preservation have been documented in two separate publications. Furthermore, in this case, the disc was also successfully preserved. Two years following the surgical intervention, the patient reported no sensory disturbances in the lower lip, and mandibular function was deemed satisfactory. Imaging studies confirmed that both the disc and the pseudocondyle were correctly positioned.

Another case involved a patient diagnosed with a myeloblastoma. A customised prosthesis, combined with a free iliac bone graft, was designed to reconstruct the defect. Two years post-operation, the patient exhibited commendable appearance, function, and occlusion, with the customised prosthesis proving to be remarkably stable.

In a presentation concerning hemimandibular defects with dentition restoration, it was noted that Group 3's considerations align closely with grade 2 defects, with the key distinction being the necessity for dentition restoration in these instances. The application of this approach was illustrated through 17 cases, one of which was documented in a case report.

A particular case involved a young male patient afflicted by recurrent osteomyelitis in the right mandible, characterised by symptoms such as pain, swelling, and trismus. It was reported that anti-inflammatory treatment had not yielded any beneficial outcomes over a span of three years. During the surgical intervention, the infected bone was excised in a segmental manner, utilising digital guide assistance while ensuring the preservation of the disc and the nerve. The length of the rib graft utilised was recorded as 14 centimetres at one end and 11 centimetres at the other, with the chondral end affixed to the auricular capsule and the bony end secured to the mandible using a titanium plate. A year post-surgery, the titanium plate was removed. Five years later, it was observed through CT and X-ray imaging that the graft demonstrated a double fusion and bore a close resemblance to the natural mandible, with noteworthy regeneration of the coronoid process. Ultimately, seven years following the surgical procedure, implantation was conducted after orthodontic treatment.

An additional case discussed involved a female patient diagnosed with mandibular osteolysis, which significantly impacted her quality of life due to facial deviation and malocclusion. It was revealed that after a three-year follow-up during which the osteolysis had stabilised, a vascularised fibular graft was selected to address the defect. Unfortunately, over time, the chondral component of this graft progressively shifted out of the fossa, resulting in altered occlusion. This challenge pertaining to the use of fibular grafts for condylar reconstruction has been documented in various studies.

Another case featured a young female suffering from osteomyelitis associated with a secondary keratocyst, where the lesion extended from the left condyle to the mandibular body. The removal of the lesion was performed using a digital guide while preserving the associated nerve. In light of the potential disadvantages of the fibular graft, the decision was made to employ a customised prosthesis in combination with the vascularised fibular graft, a design that aimed to elevate the position of the bone graft. Three years post-operatively, the patient exhibited satisfactory facial appearance and functional capabilities, indicating readiness for implantation.

For grade 4 defects, defined as extending from one side of the condyle to the contralateral ramus, the vascularised fibular graft was reaffirmed as the sole viable option due to the extent of the defect. While similar key considerations as in grade 3 were highlighted, particular emphasis was placed on the need to ensure stability of the mandible prior to the reconstruction of muscle attachments. A case concerning a male patient with ankylosis of the left TMJ, secondary to mandibular osteomyelitis, illustrated that the associated lesion spanned from the left condyle to the contralateral ramus. In this instance, preservation of the right mandibular ramus was achieved, and a vascularised fibular graft was used for the reconstruction. The strategy employed involved suspending the mandible at an angle via the zygomatic arch to stabilize the graft. The patient remains under observation for long-term outcomes.

Grade 5 defects were described as encompassing an entire mandible defect accompanied

by dentition deficiencies, with some literature indicating the use of bilateral fibular grafts. In consideration of the significant trauma associated with donor sites, a fibular graft combined with a pedicle graft was selected for reconstruction in this patient. The challenges associated with determining graft positioning during surgery were underscored as particularly pertinent in these cases. The presentation included a female patient who had experienced bilateral ankylosis due to extensive mandibular osteomyelitis over a decade. After performing sacramental resection to excise the entire mandible, fibular grafts measuring up to 21 centimetres were harvested and segmented into four parts for restoration, supported by two titanium plates affixed to the maxilla for stabilization.

In summary, several critical takeaways were identified from the examination of these cases. The stability of the TMJ during reconstruction of benign and intermediate lesions necessitates a targeted approach that includes incision techniques and preservation of both the articular disc and capsule. Additionally, safeguarding the inferior alveolar nerve is essential for sensory recovery of the lower lip, supporting osteogenesis. The implementation of digital design technologies was found to enhance surgical precision. Furthermore, costochondral grafts emerged as a suitable option for adolescent patients, exhibiting significant remodelling potential and stability within the fossa. It was elucidated that the complexity of a defect correlates directly with the challenges in mandible stabilization, thus affirming the role of customised processes in ensuring the appropriate relationship between the fossa and the condylar head.

The presenters expressed gratitude towards the audience, extending thanks to Prof. Yang and Prof. Joos, as well as the design team involved in the presented cases.

Session IV - TMJ-Cranio-Jaw Related Clinical Concerns, Orthognathic Surgery

IV.1 Complications of TMJ prosthesis

Florencio Monje. During the lecture on TMJ replacement, it was conveyed that this surgical intervention is often regarded as a final option for managing advanced stages of TMJ disease. It was emphasised that total joint replacements represent one of the most intricate areas of electromyographic surgery.

The surgical techniques employed, whether utilising custom-made prostheses or standard stock models, largely remain consistent, with complications observed being quite similar across both types. The complexities inherent in this field were underscored, drawing attention to the significant experience the speakers had amassed over time.

A classification system for complications was introduced, distinguishing between non-specific complications, which are related to the patient's underlying pathology or approach to treatment, and specific complications that arise directly from the placement and maintenance of the prosthesis itself.

The necessity for thorough surgical planning, particularly for total joint replacements, was highlighted, especially for novice surgeons. The utilisation of CT imaging, in conjunction with arteriograms, was described as instrumental in clearly defining the surgical approach. This includes assessing the extent of ankylosis and vascular structures surrounding the affected area.

Furthermore, the technique of preparative embolisation was mentioned, showcasing its technical feasibility and preliminary safety benefits. It was noted that no complications had been reported regarding the surgery or embolisation in relation to the volume of blue balls used during procedures. The importance of navigation and meticulous dissection to minimise bleeding complications during surgery was also underscored.

Interoperative bleeding was identified as a potential issue, particularly from major vessels within the surgical field, such as the maxillary artery, temporal artery, masseteric artery, and facial artery. The inadvertent injury to the masseteric artery during perinectomy, especially when a proliferative approach is employed, was specifically noted as a risk.

Several surgeons were indicated to prefer the use of piezoelectric instruments for safeguarding adjacent soft tissues in order to limit bleeding. Significant challenges related to interoperative bleeding were attributed to limited accessibility in cases of ankylosis. It was suggested that, while isolating and ligating vessels would be ideal, packing followed by the exposure of external carotid branches or embolisation would be acceptable alternatives when isolation is not feasible.

Both custom and stock prostheses are designed with the intent that screw fixation remains posterior to the inferior alveolar canal, yet there is a risk that the mandibular anatomy may complicate this process. In instances where counterclockwise rotation of the mandible occurs, traction on the inferior alveolar nerve may lead to temporary or potentially permanent nerve damage.

Misplacement of the condylar component, particularly with stock prostheses, was highlighted as a frequent issue, often resulting in malocclusion, which could necessitate repositioning the prosthesis shortly after surgery. Although malpositioning is less common with custom prosthetics, it can still occur for various reasons, such as improper alignment of the temporal fossa.

Lastly, the importance of verifying the mobility of the condyle in relation to the in-

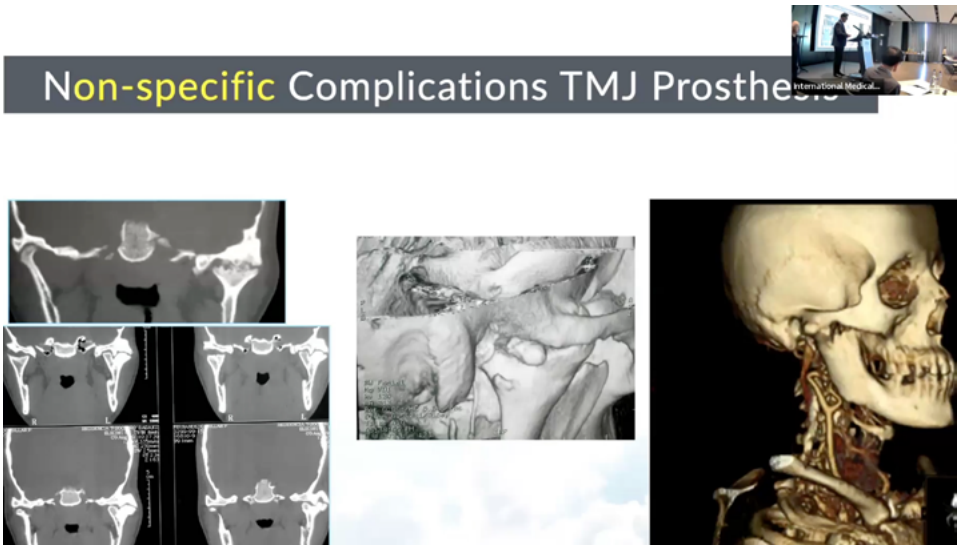


Figure 27. CT imaging as an instrument in clearly defining the surgical approach including the extent of ankylosis.

termaxillary fixation was emphasised, along with acknowledging that while the positioning guides for the mandibular component are generally reliable, doubts remain regarding the precision of the fossa guides. A proposition for modification was presented by the Spanish team, which involves merging both the guides into a single piece to improve the accuracy of osteotomy markings and the placement of the prosthetic components.

A review presented by Dr. Sy Boton, encompassing over 2,000 prosthetic cases, found that 87 required some form of re-operation, leading to a re-operation rate of 1.90% annually, which is considered low. The revision rates for stock prostheses were indicated at 0.86 per 100 prostheses per year, while the figure for custom-made devices was slightly higher at 1.65, likely due to their use in more complex cases.

The primary reasons for re-operation included heterotopic bone formation and surgical site infections. Heterotopic bone formation was identified as the sole cause of revision that exhibited a notable disparity between the re-operation rates of the two types of devices, being more prevalent in custom prostheses due to the complexity of the cases involved.

Finally, it was mentioned that heterotopic ossification, which entails the abnormal development of mature lamellar bone in soft tissues, can result in pain and restricted mobility. Although various factors have been suggested to increase the risk of heterotopic bone formation—such as a history of multiple surgeries, trauma, and insufficient post-surgical physiotherapy—the most effective strategy remains preventive measures.

A surgical prophylaxis in the context of open joint surgeries, which extends beyond the mere replacement of temporomandibular joint prostheses, is crucial. The standard procedures involved in this prophylaxis include the minimisation of periosteal stripping, thorough debridement of all devitalised tissue, extensive irrigation using normal saline to eliminate loose fragments or bone debris, and effective hemostasis to reduce the likelihood of hematoma formation. Furthermore, it emphasises the importance of vigorous postoperative physiotherapy.

During the lecture, the concept of critical size defects was introduced, highlighting a bone-to-bone gap that is transcended by standard healing processes, specifically in neurosurgery where it typically ranges between 2.5 and 3.5 millimetres. However, within the realm of temporomandibular joint surgeries, the recommended distance could exceed 10 millimetres,

optimally ranging from 15 to 20 millimetres.

Modern prophylaxis techniques, such as the administration of radiotherapy, typically involve a daily dose of 200 centigrays, administered over five consecutive days following surgery. In the reviewed cases, there were no recorded complications relating to delayed bone healing during either the immediate or late postoperative periods. Nonetheless, it was noted that a limited number of patients did experience transient cirrhosis.

The application of non-steroidal anti-inflammatory drugs (NSAIDs), particularly those inhibiting prostaglandin E2 synthesis, such as indomethacin or celecoxib, has demonstrated effectiveness in preventing heterotopic bone formation (HBF) in cases involving hip or knee prostheses; however, such results have not yet been established in temporomandibular joint procedures.

Theoretical considerations concerning bisphosphonates indicate their potential to inhibit mineralization, although their impact seems to be limited to postponing the onset of issues until treatment is discontinued. Direct surgical removal of HBF has been generally deemed inadvisable, as such interventions may exacerbate the lesion and lead to increased ectopic ossification.

Consequently, the prophylactic approach during temporomandibular joint reconstructions is advocated to include the use of autogenous fat grafts in the vicinity of the joint for several rationales. The principal advantage includes obliteration of the lesion space, facilitation of hemostasis, reduction of hematoma risk, minimisation of pluripotent cells presence, and curtailment of both plastic and metallic particles, alongside the prevention of extensive fibrosis.

Citing a study by Lou Mercury involving 20 patients with temporomandibular joint granulomas—treated with prostheses and periarticular fat grafts—the outcomes were favourable. Treatment strategies for heterotopic bone formation vary according to symptomatology. In certain instances, the formation may merely represent a radiological observation without further clinical significance.

One patient, diagnosed with osteochondritis and unwilling to pursue further orthodontic or orthognathic interventions, received a custom-made Biomet prosthesis. Upon follow-up, this patient exhibited an impressive oral opening of 32 mm; however, eight years post-treatment, CT imaging revealed heterotopic bone formation that remained asymptomatic and required no medical intervention.

Conversely, another patient involved in a traffic accident was treated for condylar fracture through intermaxillary fixation lasting 17 days, with limited physiotherapy. Four months post-trauma, the patient presented with severe pain and restricted oral opening, revealing calcification in the lateral area alongside the development of the condylar head. After four years, a distinct bony mass formation surrounding the prosthesis was observed, necessitating a staged treatment where the original prosthesis was removed, revealing an unexpected significant bone formation in the prosthetic material.

Following this, a silicone ball was introduced as a spacer, facilitating eventual reconstruction with a custom prosthesis. One year post-procedure, the space was reassessed. The pathological analysis of the fibrous tissue encapsulating the material reflected synovial metaplasia, an intriguing finding. Subsequently, a temporal component, condylar component, and free-fat graft were integrated into the surrounding region through a submandibular approach, yielding promising results after a 15-year follow-up.

Lastly, the issue of postoperative infection was addressed as one of the most significant challenges associated with total joint replacements. The infection rate reported in the studies ranged between 2% and 3%, showing a decrease compared to existing figures in orthopedic

literature, where rates for knee and hip replacements are reported between 3% and 5%.

In a recent lecture concerning infections associated with temporomandibular joint prostheses, it was indicated that the bacteria most commonly linked to such infections include Staphylococcus aureus, Staphylococcus epidermidis, Pectoralis coccus, and Pseudomonas aeruginosa. Attention was particularly drawn to the role of biofilm, which is regarded as a significant contributor to prosthetic device-related infections.

It was noted that biofilms have a robust structural composition that confers reduced susceptibility to antimicrobial agents, rendering them intrinsically resistant to many treatments. In terms of clinical manifestations, three distinct categories of infection were identified: acute infections typically necessitate treatment with antibiotics, along with surgical intervention to irrigate and subsequently reseal the joint. Conversely, in the case of chronic infections, it is deemed almost imperative that the components be removed, whilst specific management protocols are applied in subacute scenarios.

Several details of Larry Wolford's protocol were highlighted; this involves reopening oral, preauricular, and submandibular incisions to gain access to the infected prosthesis. The surfaces of the mandibular and forsythia components of the prosthesis are meticulously scrubbed with a sterile toothbrush and a Betadine solution. Two irrigating catheters are employed—one positioned externally and the other internally within the prosthesis. Moreover, a Penrose drain is inserted through the submandibular incision and placed on the lateral aspect of the mandibular component array.

Should this approach prove unsuccessful, it may be necessary for the surgeon to remove both components and implement a temporary spacer within the joint. It was reported that silicone balls are often used as spacers; however, alternative surgeons may opt for orthopaedic cement impregnated with gentamicin and vancomycin to maintain the joint space. The impending new guidelines from the American Society were also acknowledged, set to be released shortly. These guidelines are critical as they stipulate that even following the removal of the prosthesis, intravenous antibiotics are required for several weeks.

The emphasis was placed on prophylaxis as the most effective treatment strategy; therefore, a comprehensive approach was advised. The lecturer summarized three essential pillars aimed at preventing infections: controlling potential risks, reducing the bacterial burden, and ensuring an optimal surgical environment.

A dearth of literature exists regarding infections in temporomandibular joints, prompting a keener interest in the outcomes observed in orthopaedic cases regarding similar complications. For instance, the control of potential risks was discussed in relation to the impact of diabetes on infection rates following primary total knee arthroplasty, as confirmed by systematic reviews.

Furthermore, considerations surrounding depression, immunosuppression, and smoking status were explored. A cohort study focusing on knee and hip prostheses classified smoking status preoperatively into categories: never smokers, former smokers, and current smokers. The study concluded that both current and former smokers exhibited a higher risk of infection within the initial years post-surgery, in comparison to never smokers following primary total knee or total hip arthroplasty.

In the context of addressing the introduction of bacterial contamination, the significance of three foundational principles was highlighted. The topic of decolonisation was specifically addressed, noting that Staphylococcus aureus is one of the organisms most frequently isolated in cases of infection. It was recommended that thorough sterilisation of the nasal cavity, hair, external auditory canal, and skin be conducted to mitigate the risk of infection.

Regarding antibiotic prophylaxis, it was indicated that the choice of antibiotics largely

depends on departmental protocols and the specific hospital setting. Options such as cephalosporins from the first, second, or third generations and vancomycin were mentioned as common choices, contingent on the practices of different departments.

Attention was drawn to the handling of prosthetic components, particularly that it has been advised for temporomandibular joint device components to be immersed in a vancomycin solution prior to their implantation in order to lower the infection risk. Additionally, it was emphasised that substantial irrigation during the cutting and shaping of the host bone, as well as whilst drilling screw holes, alongside post-implantation irrigation, is crucial for reducing infection incidence.

Furthermore, the utilisation of laminar air flow systems in surgical theatres as a means of infection control was discussed. However, it was recognised that factors such as personnel traffic, door operations, and the total number of individuals present in the operating room could disrupt the efficacy of laminar airflow. It was suggested that the optimal number of personnel in the room at the time of prosthesis placement should not exceed five or six individuals, a practice adhered to by one orthopaedic surgeon to maintain sterility.

The issue of contamination was also addressed, noting that strict separation of instrumentation used for temporomandibular joint reconstruction from that employed in oral cavity procedures is essential. This separation is particularly important in orthognathic surgeries involving temporomandibular joint reconstructions, where the risk of cross-contamination is heightened.

In discussing the duration of surgical procedures, it was pointed out that while specific data for temporomandibular joint surgeries was absent, findings from studies on total knee arthroplasty suggest that operations lasting less than 120 minutes were associated with a lower infection rate, whereas those exceeding 120 minutes presented an increased infection risk.

Finally, the experience of the surgeon was highlighted as a critical factor. A referenced study linked postoperative infection rates to the skill level of individual surgeons as well as the overall experience of the surgical team within the hospital context. This association was also seen in terms of complications such as ectopic bone formation, underscoring the impact of surgical proficiency on patient outcomes. This discussion underscored the multifaceted approach required to minimise postoperative infections in surgical settings.

IV.2 TMJ tumours and condyle reconstruction

Agnes Janovszky, József Piffkó. In the delivery of a lecture on TMJ tumours, it was noted that the speaker, Dr Agnes Janowski, currently serves as an oral and maxillofacial surgeon at the Department of Oral and Maxillofacial Surgery at the University of Szeged in Hungary. Dr Janowski was substituting for Prof. Piffkó, who was unavailable due to other professional responsibilities.

The presentation commenced with a discussion on TMJ tumours, characterised as exceedingly rare disorders. Predominantly, lesions of the mandible, such as ameloblastoma, or the local invasion of malignant tumours arising from adjacent tissues, were highlighted as common afflictions of the condylar process. Notably, TMJ tumours typically do not present with distinctive symptoms, making diagnosis particularly challenging. Patients often report nonspecific pain, and accompanying signs such as facial asymmetry and localized swelling may be observed. Consequently, accurate diagnosis frequently relies on the initial assessment by the treating clinician, who might misinterpret these symptoms as indicative of chronic pain or musculoskeletal disorders, potentially leading to further radiological investigations.

The aim of the clinical assessment, however, revolves around excluding surgical joint diseases, which typically occur in approximately 5 to 10% of temporomandibular disorders. Due to the infrequency of TMJ tumours, there exists a dearth of evidence-based guidance regarding their management. Current literature suggests that the surgical resection of the tumour, potentially augmented by chemotherapy and/or radiotherapy according to histological findings, represents the most effective treatment modality.

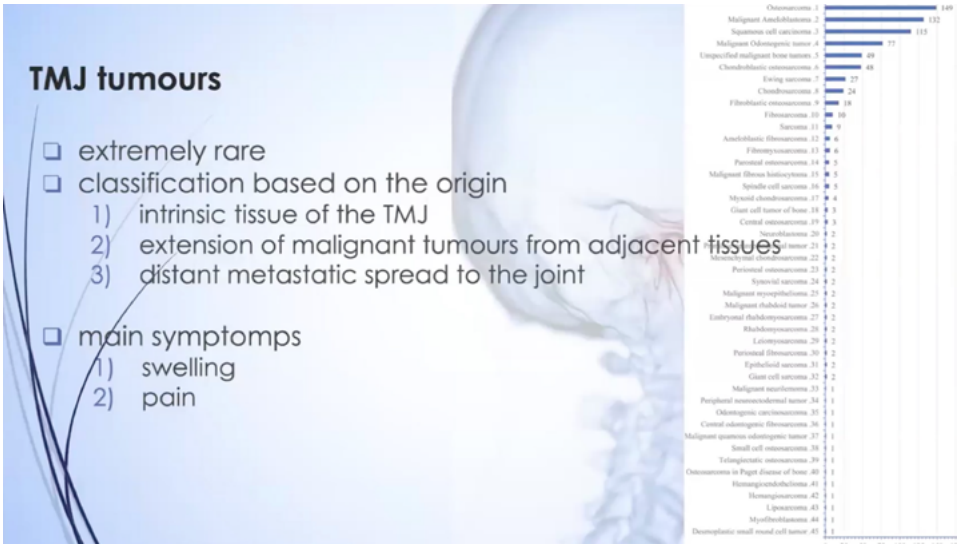


Figure 28. TMJ tumors doesn't have typical symptoms. Patients can report pain most commonly and facial asymmetry as well as localised swelling can be observed.

In situations lacking adequate professional experience or established oncological guidelines, or where the patient's overall health precludes extensive procedures, surgical interventions have occasionally been undertaken without reconstruction. Such practices have not only resulted in occlusal discrepancies and difficulties with mastication but have also adversely affected the patient's facial aesthetics.

The speaker underscored the importance of judicious patient selection and appropriate surgical reconstructive approaches in TMJ reconstruction. These critical factors serve to restore nearly normal anatomical function and mandibular movement, thus enabling occlusion restoration via dental rehabilitation. Moreover, the preservation of sensory innervation, particularly the inferior alveolar nerve, was noted as a strategy that could potentially enhance the patient's quality of life.

Particular consideration was advised for skeletally immature patients, given that ongoing bone growth could influence the treatment plan. The progression of TMJ reconstructive techniques has seen significant professional advancements, including the introduction of free flaps, alloplastic reconstruction devices, and virtual surgical planning.

Besides TMJ tumours, other indications for surgical intervention, such as ankyloses of varied aetiology or congenital malformations, were acknowledged. Conversely, local infections were highlighted as contraindications that could exacerbate postoperative complications and ultimately compromise surgical success.

For skeletally immature patients, the consensus was to defer surgical intervention until a more advanced stage of bone development whenever feasible. In cases involving isolated TMJ conditions, it was recommended that extra-oral surgical approaches take precedence, while complex cases should begin with extra-oral procedures followed by intra-oral interventions

to ensure operation sterility.

The reconstruction of the Ramus condyle unit and the replacement of the disc were discussed as distinct yet complementary aspects of the surgical management process. The use of vascularised and non-vascularised grafts or flaps for the reconstruction of the Ramus condyle unit, along with osteotomy or destructional osteogenesis as viable alternatives, was elaborated upon.

An illustrative case was presented involving a patient with advanced squamous cell carcinoma who underwent surgical intervention at the institution. This procedure was preceded by virtual surgical planning, which encompassed mandibular resection and fibular segmentation. Surgical guides were utilized to ensure precision in both the resection and subsequent reconstruction of the mandibular defect.

In the context of alloplastic reconstructive devices, the availability of both stock and custom-made prostheses was discussed, with the selection influenced by the specific clinical situation, patient condition, and, unfortunately, financial considerations. Custom-designed TMJ prostheses were noted to potentially yield superior aesthetic and functional outcomes compared with stock alternatives. Depending on the condition of the disc, options for either hemijoint reconstruction or total joint replacement were regarded as acceptable surgical strategies.

In the course of the clinical discussion, various case studies were presented, starting with a patient who had undergone surgical intervention for a myeloblastoma. A mandibular resection was carried out; however, due to the involvement of the condyle, this structure could not be preserved. The resulting defect necessitated reconstruction using a reconstruction plate alongside a condylar prosthesis, as the patient's severe atherosclerosis rendered free flap reconstruction inadvisable.

A similar case was then examined, where virtual surgical planning preceded the surgical procedure. In this instance, the reconstruction was accomplished using a custom-made prosthetic solution. The complexities associated with advanced cases can pose significant challenges to surgeons. One notable patient was treated with zoledronate for osteoporosis, who subsequently required tooth extraction despite receiving antibiotic prophylaxis and treatment. Unfortunately, this patient developed extensive osteonecrosis. Following virtual planning, a mandibular resection was performed.

It was noted that the considerable defect could not be sufficiently reconstructed with a singular free fibular flap; thus, the right condyle was reconstructed using a condylar prosthesis. Additionally, dental implants were placed during the operation with the aid of a surgical guide, showcasing the condition of the patient three months post-surgery.

In another case, a young patient, who had been bitten by a wolf, was admitted to the department at approximately 20 years of age, following inadequate primary care. This patient presented with condylar defects, malocclusion, and facial asymmetry. Based on the virtual planning conducted, the optimal outcome was attained through the use of a free fibular flap, beam axillary osteotomies, and a genioplasty to address the defect and associated deformities. Importantly, as the defects did not stem from malignancy, preservation of the inferior alveolar nerve was feasible, thus maintaining sensory innervation in the affected region.

An x-ray taken six months post-operation illustrated that the facial asymmetry had significantly diminished, with the aesthetic result deemed acceptable. Although there was a restriction in mouth opening when compared to the preoperative state, the severe deviation that had been present prior to the complex surgery was corrected, along with the occlusion.

Dynamic changes in the size and shape of the mandible, as well as the position of the

condylar process, are expected throughout an individual's lifetime. This variability necessitates special consideration for skeletally immature patients, as bone grafts or free flaps may yield more favourable outcomes. However, there is a risk that the growth of the operated side may lag behind or potentially experience overgrowth relative to the intact side.

The detrimental effects of oncological treatment on growth are well documented, particularly regarding the restoration of the TMJ. If feasible, it is advised that surgical intervention be deferred until a later phase of skeletal maturity when the likelihood of complications is reduced. Alloplastic reconstruction remains an option; however, it may necessitate secondary surgical procedures following the completion of skeletal maturity.

In the further course of the presentation, a case involving an asymptomatic 10-year-old patient was discussed. Upon conducting a biopsy under general anaesthesia, a giant cell tumour was diagnosed. According to the existing literature, potential therapeutic interventions included antiresorptive treatment or curettage. However, the patient's young age, combined with the extent of the lesion, rendered these options infeasible. Consequently, the decision was made to proceed with surgical resection and reconstruction using a free fibula flap. The process was significantly aided by pre-operative surgical planning and the utilisation of surgical guides.

An x-ray taken three months post-surgery was presented, demonstrating the treatment outcome. Most notably, the patient was shown two months after the operation, with the assessment indicating that facial asymmetry was minimal. The functional outcomes were described as acceptable, and the satisfaction regarding the sensory innervation in the region, particularly the preservation of the inferior alveolar nerve, was also noted.

Regarding postoperative care, the necessity of physiotherapy following TMJ surgery was emphasised. Various movements and exercises were recommended to be carried out throughout the extended recovery period. Additionally, the gradual reintroduction of diet was highlighted as an important aspect of the rehabilitation process.

IV.3 TMJ TMJ-skull base-ear complex and integrating disciplines

Chi Yang. The subject under discussion pertained to the complex scoring system of the TMJ and its integration with various disciplines. The speaker commenced by outlining the foundational aspects of the topic.

The initial background highlighted the potential for tumours to infiltrate surrounding bony structures. It was noted that tumours could grow and expand into the skull base, infratemporal space, and condyle. Initially, the tumours were described as being located within the upper compartment, but they could also affect the middle ear and the medial structures. Consequently, the speaker proposed a classification consisting of three categories:

1. In the first category, the tumour was identified as involving the bone wall of the ear canal without perforation.

2. The second category encompassed tumours that had breached the ear canal and spread into the middle ear.

3. The third category included tumours that extended into the internal carotid artery and affected the facial nerve.

The second background addressed the potential harm caused by these tumours, including limited mouth opening and hearing impairments.

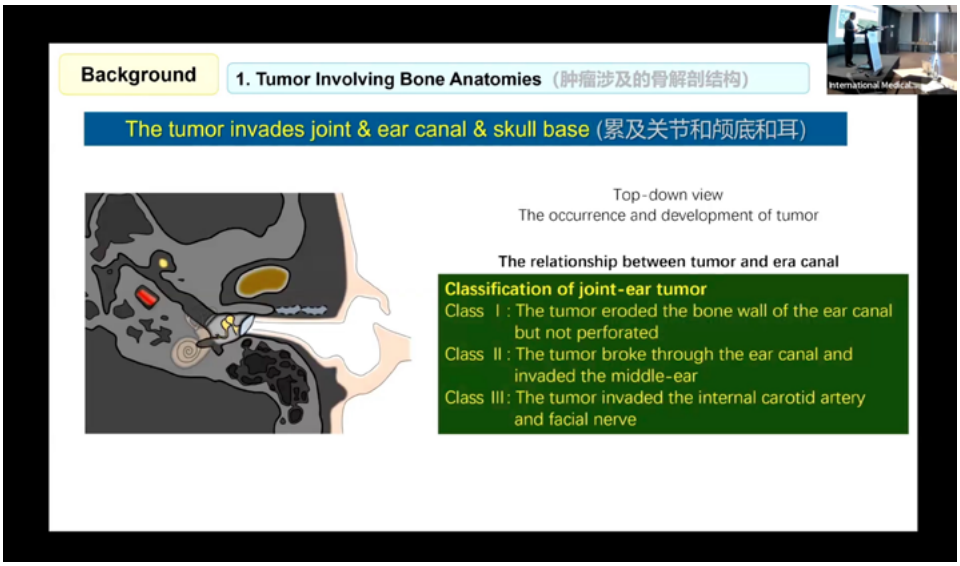


Figure 29. Tumours located within the upper compartment, the middle ear and the medial structures.

The third background highlighted the objective challenges presented by surgical interventions for such tumours, particularly those that involve the joints, skull base, ear, and infratemporal space. It was conveyed that these surgical procedures are particularly demanding. The inherent complexities were attributed to the deep anatomical positioning of the tumours within a confined space, surrounded by considerable vascular structures and significant nerves.

The fourth background focused on the interdisciplinary challenges encountered in these cases. The speaker pointed out that TMJ surgery, as well as otorhinolaryngological (ENT) and other maxillofacial surgeries, often operate in silos, which complicates collaborative efforts. This fragmentation leads to numerous challenges:

1. There is an absence of a comprehensive diagnostic and treatment system, coupled with a lack of standardised surgical methods and criteria for assessing therapeutic outcomes.

2. Incomplete surgical procedures have been observed to result in tumour recurrence. For instance, surgery performed by ENT specialists on one side led to a recurrence within several months, similar to the outcomes observed when neurosurgeons operated on the opposing side.

3. Exclusive surgical approaches can lead to the loss of normal anatomical structures, particularly the condyle. It was highlighted that prior to surgical intervention, a tumour located at the skull base and eminence was seen alongside a healthy condyle, yet typical procedures often involved excision of the condyle for better access to the infratemporal space, without any subsequent reconstruction.

4. The difficulties associated with reconstructing the joint surface post-resection were also raised, particularly in complex cases where reconstruction proved to be exceptionally challenging.

In summary, the speaker underscored the necessity for novel ideas and the integration of different disciplines to address these multifaceted challenges effectively.

In the recent lecture, the speaker emphasised the need for innovative ideas that integrate various disciplines within the field. A review of the speaker's philosophy regarding the peripheral joint complex was presented. Following this, a rapid overview of anatomical perspectives, including an upward view of the relevant joint structure, was provided. Key components such as the fossa, infratemporal surface, and ear canal were identified, alongside surrounding anatomical structures: the medial and lateral aspects were related to the glands, the anterior region to muscle areas, and the posterior aspect to the ear canal.

The speaker also addressed the complex nature of lateral views, noting the interplay between the skull base, ear space, and infratemporal space. A new classification system for surgical procedures was introduced, categorising different integrated disciplines related to the joint, skull base, and connected pathways. This categorisation facilitated the identification of pertinent indications for surgical interventions, particularly in cases involving tumours affecting both the joint and surrounding anatomical areas.

The classification system comprised four distinct classes, determined by the relationship between the joint and the skull base. Class one involved tumours restricted to the skull base and the upper compartment, whereas class two encompassed tumours located in both the skull base and the infratemporal space. Class three and four highlighted tumours impacting the total joint as well as the adjacent anatomical spaces.

A further sub-classification was developed for each primary class, incorporating treatment strategies. For instance, class one was differentiated into subclasses A, B, and C, with specific recommendations based on the extent of skull base damage and the presence of perforations. Subclass A indicated skull base damage without perforation, while subclass B involved perforations affecting less than 50% of the fossa area. Subclass C represented significant perforations exceeding 50%. Recommended approaches for these classifications included careful tumour excision, dural protection, and, when necessary, the use of bone grafts or prosthetic materials for significant defects.

Classes two, three, and four maintained similar protocols, with emphasis on tumour removal and subsequent repair strategies. Notably, class three necessitated total joint replacement combined with skull base repair, particularly in complex cases involving dural and mandibular nerve involvement. The most challenging cases, often characterised by deep-seated tumours affecting critical structures such as the internal carotid artery and facial nerve, required advanced surgical techniques akin to those employed in neurosurgery to ensure maximum preservation of neurological function.

The speaker also discussed the implications of large defects following tumour resection, suggesting the use of autogenous bone grafts for repair, particularly from iliac or rib sources, as well as the potential for custom prosthetics.

Finally, clinical data from over 23 years demonstrated that 1,209 cases involving TMJ tumours were managed, including 203 cases with joint and skull base tumours. The lecture culminated in a focused discussion on repair strategies, particularly addressing soft tissue and autogenous bone graft techniques which were thoroughly described to enhance understanding of effective surgical practices in these complex cases.

In the course of the lecture on maxillofacial surgery, the presenter's discussion centred on a specific surgical case characterised as Class 1B. During this procedure, a minor perforation was identified, necessitating an osteotomy, after which a downward thrust was performed. It was emphasised that the condyle should remain intact throughout the procedure. Furthermore, the preservation of the disc, condyle, and lateral pterygoid muscle was highlighted as critical to ensuring the normal functionality of the temporomandibular joint.

The procedure involved an upward force to gain access to the infratemporal space,

wherein the tumour was excised. Post-excision, only the sub-tissue was repaired. The middle temporal vessels were noted to have a fissure, alongside fat that required repair, concluding with the fixation of the condyle.

It was noted that specialised attention should be paid to sub-tissue repair in cases of perforation, especially when such perforations exceed 50%. The tumour referred to was identified as a common type known as synovial chondromatosis. The initial steps included exposure, followed by the design of the osteotomy. A titanium plate was fixed in place post-tumour removal. The procedure also involved repositioning the disc, which resulted in the disc, condyle, and muscle complex being displaced forward and medially, thereby facilitating the tumour excision within the infratemporal space.

Subsequently, fat was utilised to separate the fossa from the disc, thereby mitigating the risk of adhesion. The outcome was favourable, as the patient was able to open her mouth wide following the surgery, while ensuring that the disc-condyle muscle complex remained connected and undisturbed. Follow-up after two years indicated a return to normal joint structure and function, with the anatomy appearing satisfactory and the mandible along with occlusion also functioning normally.

During the follow-up, it was reported that the area of perforation, which was over 100 square millimetres prior to the surgery, decreased to approximately 30 square millimetres after two years, indicating significant post-operative bone regeneration.

The subsequent technique introduced revolved around the reconstruction of the skull base and fossa with the utilisation of iliac bone grafts or temporal bone grafts. The focus remained on the indications for surgery, particularly when the perforation exceeded 50% and the disc-condyle muscle complex could be preserved. The initial step in this method again involved the design of an osteotomy, following which the tumour was excised. A particular emphasis was placed on ensuring separation from the surrounding structures during tumour removal, with the iliac bone graft employed for reconstruction of the skull base and fossa, complemented by the application of soft tissue to prevent adhesion between the graft and the disc, culminating in a final fixation.

In the lecture, the use of iliac bone grafts in reconstructive surgery was highlighted as essential, particularly in cases involving significant perforations. It was noted that such cases require iliac bone grafting for effective repair. A successful long-term follow-up of over eight years demonstrated satisfactory remodelling, with no adverse effects observed in the condyle, attributed to the careful protection of the articular disc, condyle, and surrounding musculature. Thus, maintaining the normal structure and function of the joint is deemed imperative.

During the surgical procedure, an iliac bone graft is employed for the reconstruction of the skull base and the relevant fossa. An alternative approach involving a temporal bone graft was also discussed, particularly for deep-seated tumours. This method necessitates the creation of a temporal window to facilitate separation of the tumour from the dura mater, followed by its excision. Subsequently, the temporal bone graft is utilized to address defects in the skull base, while MedPor is applied to repair any temporal bone defects, owing to the mechanical loading considerations in that area.

An illustrative case was presented, where a third patient underwent temporal bone grafting to manage a tumour located within the infratemporal space. Importantly, the preservation of the normal condyle and disc structure eliminated the need for total joint replacement. An osteotomy of the sacrum arch was performed to enhance exposure of the tumour. The utilisation of the temporal bone graft and MedPor for reconstruction was corroborated by successful long-term follow-ups, revealing excellent remodelling of the skull base and sur-

rounding fossa, notwithstanding the presence of soft tissue that aids in preserving joint functions.

The outcomes of the surgical interventions were remarkably positive, as evidenced by minimal visible scarring postoperatively. Patients were able to open their mouths widely, attributed to the strategic placement of soft tissue to bridge the new fossa and disc surface. The importance of maintaining normal occlusion was underscored, as it contributes to functional restoration.

The lecture culminated with insights into total joint replacements and skull base reconstructions. It was clarified that options for reconstruction include either autogenous grafts or prosthetic solutions. The distinction was made between cases indicating the necessity for removal and repair, particularly where extensive perforations and compromised ECM compressors were involved. Surgical procedures outlined mirrored previous methodologies but included meticulous detailing such as the creation of a temporal window and prior osteotomies for adequate tumour exposure.

In challenging cases involving malignancies, comprehensive surgical strategies were described, including the use of rib grafts, the pedicle sternoclavicular joint graft, particularly in patients who may have endured surrounding infections. A case study was shared, featuring a significant tumour impacting the ear canal, condyle, and infratemporal space, with subsequent surgical interventions yielding remarkable results.

Finally, the importance of leveraging digital imaging technology in achieving precise surgical outcomes was acknowledged. A concluding video demonstrated the effective removal of the tumour, highlighting the reconstruction process involving iliac bone and sternoclavicular joint grafts. Follow-ups indicated a successful aesthetic and functional recovery with no signs of asymmetry, further validating the efficacy of these surgical techniques in managing complex conditions.

IV.4 Application of TMJ-skull base combined prosthesis

Jisi Zheng. During the lecture, it was reported that the speaker expressed a sense of honour in presenting at the event and mentioned their first visit to Germany, conveying a feeling of happiness and excitement. The lecture was noted to be an extension of the work by Prof. Yang, focusing on the reconstruction of the TMJ and skull base using innovative techniques.

The speaker elaborated on the classification of tumours affecting the TMJ, which encompass conditions such as chondromatosis, osteochondroma, giant cell lesions, and various sarcomas, including chondrosarcoma. It was indicated that these tumours typically infiltrate upwards towards the skull base and the fossa, resulting in complex lesions involving both the TMJ and the skull base. Conversely, tumours originating in the skull base may extend downwards, impacting the condyle and the disc, thus creating combined lesions.

Surgical resection was highlighted as the primary treatment option for these combined tumours. However, following resection, significant bone defects in both the TMJ and the skull base often occur. Traditionally, neurosurgeons and ENT specialists have employed soft tissue flaps to fill these defects; nonetheless, this method has notable drawbacks, including the risk of severe facial deformities, limited mouth opening, and deviation of the mandible—all of which can diminish the patient's quality of life.

To address these complications, it was stated that approximately 18 years ago, Prof. Yang pioneered the use of an autogenous bone flap to repair these bone defects. This

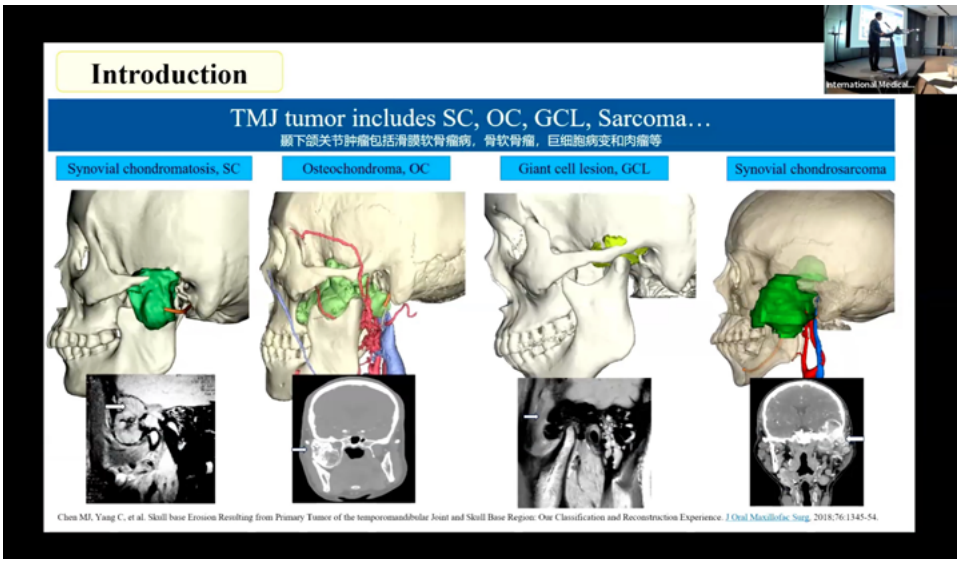


Figure 30. Classification of tumours affecting the temporomandibular joint: Chondromatosis, osteochondroma, giant cell lesions, and various sarcomas.

involved harvesting the iliac bone or a block from the temporal bone to reconstruct the skull base, while utilising the sternoclavicular joint or grafting material to repair the joint itself. Moreover, soft tissue flaps were used to replace the disc, leading to successful surgical reconstructions that were previously deemed impossible, as observed in postoperative CT scans.

However, concerns regarding donor site morbidity arose due to the requirement for additional surgical sites for bone harvesting. This method also resulted in increased surgical trauma, prolonged operative times, and extended recovery periods for patients.

In 2012, the introduction of the TMJ and skull base extended prosthesis by TMJ Concept marked a significant advancement, albeit with limited cases and a lack of long-term follow-up data regarding the outcomes. Nevertheless, this development was acknowledged as a positive step forward.

In 2009, Prof. Yang sought to further innovate by designing two types of combined prostheses whether preserving the condyle and disc or not. The first design constituted a total joint and skull base combined prosthesis, indicated for cases with extensive benign or borderline tumours that necessitate complete resection of the fossa, skull base, and condyle disc. The second design focused on the skull base-fossa prosthesis, which aims to repair just the fossa and skull base while retaining the normal condyle and disc—this aspect was emphasised as particularly crucial.

The newly developed combined prosthesis, as presented by Prof. Yang, comprises several components, including the skull base, fossa, condyle, and the mandible handle. This innovative approach encompasses a comprehensive diagnosis and treatment procedure.

Initially, advanced software systems, such as Mimics, Proplan and Simplant, are employed to create a three-dimensional (3D) model of the maxillofacial region. Subsequently, a virtual surgical plan is established, taking into account the tumour's location and its relationship with surrounding arteries and nerves. Following this planning phase, an osteotomy is performed to achieve complete tumour resection, resulting in virtual bone defects that serve as a basis for designing surgical templates and prosthetic applications.

During the surgical intervention, these templates facilitate the resection of the tumour,

as well as the concomitant removal of the skull base and joint structures. The upper compartment is subsequently stabilised, and ultimately, the mandible handle is affixed in place.

Prof. Yang's contributions to this procedure are noteworthy, particularly through the incorporation of digital medicine at every stage—from tumour analysis to prosthesis design. This application exemplifies a significant innovation within the surgical domain.

Another remarkable advancement involves the design of the skull base components. A thorough analysis of force distribution within the cranio-maxillofacial area has led to the optimisation of the skull base morphology, thereby addressing potential stress concentrations. The longevity of these prosthetic devices is evident, as they are engineered to maintain functionality even 10 or 20 years post-surgery.

Furthermore, the utilisation of 3D printing technology is pivotal in the production of various elements, including the skull base and mandible handle. A clinical case exemplifying this approach involved a 23-year-old female patient presenting with swelling and limited mouth opening. Diagnostic imaging via CT and MRI revealed an extensive tumour affecting the skull base, condyle, and disc, necessitating total joint and skull base resection.

The preoperative planning involved the creation of a 3D model of the tumour and its structural relations, revealing a significant perforation of the skull base measuring 21 millimetres by 21 millimetres. However, the surrounding areas remained intact, permitting the use of a tailored prosthesis for reconstruction following the removal of both the joint and skull base.

During the surgical procedure, a temporal bone window was created to access the upper margin of the tumour. Careful resection required meticulous attention to the carotid artery, given its proximity and potential for injury. After the complete removal of the tumour, the resulting bone defect was congruent with the preoperative design, enabling seamless integration of the prosthesis without the need for autogenous bone harvesting.

The surgical intervention involved minimal incisions, solely employing a modified preauricular incision and a temporal incision, with no requirement for additional cosmetic incisions. The temporal surgical template was utilized for the osteotomy, followed by the removal of a bone block to access the dura mater. By carefully elevating the dura, a safe working space was established between the tumour and dural tissue, allowing for the completion of anterior and posterior osteotomies.

In summary, the surgical protocol demonstrates high efficiency and minimally invasive techniques, culminating in successful outcomes when treating extensive tumours, utilising advanced technologies and innovative materials.

In a recent lecture by Prof. Yang, several noteworthy innovations in the field of oral and maxillofacial surgery were presented. The utilisation of digital medicine in conjunction with surgical templates was highlighted as a means to achieve precise osteotomy, which is fundamentally critical for the successful implantation of prostheses. The incorporation of holes within these templates facilitates the accurate repositioning and fixation of the prostheses.

Furthermore, an endoscopic approach was introduced for securing the mandible handle, thereby negating the necessity for additional incisions, particularly the submandibular incision. It was noted that Prof. Yang performed all surgical procedures himself, which typically eliminates the requirement for assistance from neurosurgeons or ENT specialists within the department.

Postoperative evaluations demonstrated that the occlusion was stable immediately following surgery, with a deviation of merely 1.5 millimetres and no other discrepancies noted. Three years post-surgery, the occlusion remained stable, with the patient achieving an mouth

opening of up to 30 millimetres. However, a minor issue was identified; when the patient opened their mouth, there was a tendency for deviation towards the affected side due to the muscle attachment loss.

The discussion then progressed to a second type of prosthesis specifically designed for skull-base and fossa reconstruction in the context of benign and borderline tumours. In this case, preservation of the disc and condyle was indicated, leading to the introduction of a customized skull-base fossa prosthesis. As with the first case, digital medicine was employed to meticulously design and analyse the entire procedure, including the creation of surgical templates aimed at simulating the surgical technique prior to the operation.

A critical aspect raised was the management of the gap between the prosthesis and the condyle. Given that this particular prosthesis is constructed from a titanium alloy, it was emphasised that maintaining an appropriate distance—at least 5 millimetres—between the prosthesis and the condyle is essential to prevent excessive bone resorption.

To illustrate the clinical application of this prosthesis, a case involving a 53-year-old female was presented. The patient reported difficulties in swallowing and limitations in mouth opening, as corroborated by MRI findings indicating a tumour affecting both the fossa and skull base. Fortunately, the disc and condyle were found to be intact. Pre-surgical digital design allowed for a comprehensive analysis of the perforation present in the skull base and fossa. The surgical procedure entailed careful dissection to temporarily detach the condyle and zygomatic arch, ensuring the preservation of muscle attachments to promote blood supply and minimize post-operative bone resorption.

Upon completing the anterior and posterior osteotomies of the skull base, total resection of the tumour was performed. The design of the prosthesis was tailored to address the specific bone defects observed. After surgery, it was confirmed that the occlusion remained stable with a prosthesis implantation deviation of only 1.2 millimetres. Long-term follow-up at one year revealed an intact cortical bone structure of the condyle, and additional assessments at five years post-surgery represented stable findings.

The lecture concluded with the mention of two published papers detailing the team's approaches involving combined prostheses and autogenous bone flaps. While these two techniques may appear similar in clinical examinations, it was noted that the prosthetic method is associated with reduced operative time and diminished intraoperative bleeding.

IV.5 Joint-jaw-occlusion complex and integrating disciplines

Chi Yang. During the lecture, the speaker presented an outline concerning joint-originated dentofacial deformities and their classification, particularly in relation to surgical intervention. It was explained that several conditions such as disc displacement, condylar absorption osteoarthritis, and other joint diseases could lead to what is described as joint-originated dental facial deformity.

A specific case was discussed involving juvenile anterior disc displacement accompanied by condylar resorption, which exemplified the relationship between disc displacement and retrognathia. This highlighted the clinical challenge posed by mandibular dyskinesia and its association with clockwise rotation. Furthermore, the speaker pointed out that ankylosis, tumours, and hemifacial microsomia are also relevant categories under joint-originated dentofacial deformities.

The speaker then transitioned to the topic of treatment challenges. It was noted that joint diseases and the resulting dental facial deformities are often classified within different medical specialities, including orthodontics, orthognathic surgery, plastic and reconstructive

surgery, as well as TMJ surgery. This division can lead to a narrow focus on specific aspects of treatment while potentially neglecting others, thereby resulting in prolonged treatment cycles, high recurrence rates, and additional complications.

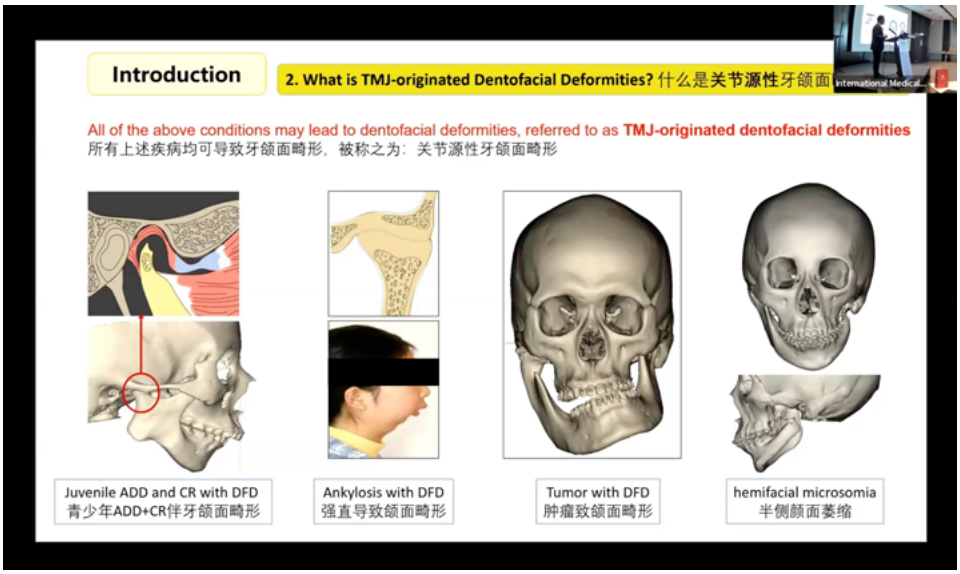


Figure 31. Categories under joint-originated dentofacial deformities: Ankylosis, tumours, and hemifacial microsomia.

The differentiation among specialities was emphasised: plastic and reconstructive surgery focuses on facial aesthetics, orthodontic surgery addresses jaw deformities, and TMJ surgery is concerned with joint diseases. It was suggested that there is a need for integrated approaches and evidence-based clinical studies to address these complexities effectively.

An illustrative case of a 20-year-old patient was described, who presented with a primary complaint of chin deviation to the left side prior to surgery. The case involved two surgical operations and two orthodontic treatments over several years, leading to an improvement in jaw structure. However, after a few months, the patient's chin deviated to the left again. The speaker highlighted that the condylar height, which had decreased by two millimetres post-surgery, was a crucial factor contributing to this recurrence. Thus, it was asserted that core issues such as joint health and stability must be prioritised.

The second challenge identified was the lack of advanced techniques and innovative TMJ prostheses for complex and precise reconstructions. An example was provided regarding the positioning of the prosthesis within the TMJ, indicating that it frequently becomes misaligned, often located anteriorly and medially instead of optimally within the fossa. This misalignment can lead to suboptimal outcomes, thus underscoring the importance of developing new reconstruction techniques and inventive prosthetic solutions to better address these surgical challenges.

In the recent lecture, the speaker highlighted the significance of new concepts and integrated disciplines within the field of maxillofacial surgery. Emphasis was placed on the *JJO complex*, which encompasses the joint, the jaw (mandible), and occlusion, referring to a harmonious interaction among these three components. The philosophy articulated by the speaker underscores that these structures function as a cohesive unit, akin to a family, necessitating a balance among them.

The speaker explained that the treatment of joint diseases associated with maxillofacial

deformities must adhere to this integrated conceptual framework. This approach involves combined diagnostic and therapeutic strategies centred on the relationship between the joint and the jaws, emphasising the importance of considering both joint and dental occlusions. An analogy was drawn to otolaryngology, indicating that collaboration with orthodontic treatments is essential.

Furthermore, the lecture introduced a comprehensive diagnostic and treatment system that encompasses these integrated disciplines. The speaker proceeded to present a selection of prevalent disease categories, starting with the first the most common class, which includes dental displacement and chondroresorption.

The initial class of conditions was detailed with four distinct protocols. The first protocol pertained to indications for salvageable discs and condyles in adolescents, involving disc repositioning and support measures, followed by orthodontic treatment. An illustrative case of a 12-year-old patient was discussed; during her initial consultation, anterior displacement of the disc and moderate chondroresorption were observed, although the condition was not deemed severe. The speaker noted that the patient's family had opted against surgical intervention, opting instead for non-surgical alternatives, such as functional appraisals and supportive therapies.

The speaker assured the audience that, under their department's guidance, with a team of six orthodontists, the patient could undergo supportive treatments for a duration of six months, after which a reassessment through clinical evaluation and MRI would take place.

When inquiring about the success rate for arthroscopic surgery, the speaker confidently relayed that over 95% of such procedures yield successful outcomes, assuring that the young patient would experience chondrogenesis. Ultimately, after six months post-disc repositioning via arthroscopic techniques, marked improvements in condylar height and volume were observed, illustrated as a significant success in the treatment outcomes.

In the course of a recent lecture on surgical procedures in orthognathic surgery, a typical case involving a thirteen-year-old patient was presented. The primary concern raised by the patient was a noticeable deviation of the chin towards the left side. Upon examination, it was noted that the patient did not exhibit any symptoms related to the TMJ, nor did she report any pain. Furthermore, she demonstrated a full range of mouth opening, measuring between 40 and 50 millimetres.

Pre-operative assessments indicated a nearly ten-millimetre deviation of the midline to the left. Post-surgery, significant asymmetry of the mandible was observed, measuring between one and at most two millimetres. The surgical approach undertaken was exclusively arthroscopic, highlighting a repositioning of the articular disc, which was completed in a notably short timeframe of ten minutes. The simplicity of the procedure was attributed to the patient's younger age, which allowed the disc repositioning to be executed with relative ease.

Before the surgical intervention, the deviation of the midline had been pronounced, yet following the repositioning of the disc, a substantial improvement in occlusion was achieved. This outcome was considered optimal as it effectively addressed the chin deformity. Following surgery, a functional appliance was employed for a duration exceeding six months, with follow-up evaluations conducted nine months post-operatively confirming sustained stability.

The discussion included an examination of the mechanisms underlying disc displacement and condylar resorption. It was explained that excessive pressure on the disc could lead to complications, resulting in both condylar resorption and an accompanying deviation of the chin, most notably favouring the affected side.

For adults, alternative protocols were outlined. These involved addressing both disc

displacement and orthodontic considerations through a slightly modified surgical approach, with an emphasis on the potential necessity for orthodontic treatment post-operatively.

A robust dataset was shared, revealing that over 10,000 joint repositioning procedures via either arthroscopic or open surgery had been performed, with long-term results indicating that the treatments proved effective and stable, particularly in adolescents. It was reported that the regeneration rate of the joint was notably high amongst teenage patients, while a similar stability rate was observed in adults.

Further protocols were discussed for patients with non-salvageable joints accompanied by maxillary deformities, necessitating a total joint replacement, in addition to a maxillary osteotomy. The principles underlying surgical success were established, focusing on anatomical repositioning and fixation while preserving muscle attachments and blood supply to vital structures.

Finally, specific treatment protocols for patients experiencing various forms of dentofacial deformities, including ankylosis and tumours, were summarised, emphasizing the multifaceted approaches taken to restore both joint function and occlusal integrity. Notably, a case involving a customised prosthesis following resection of a tumour was presented, showcasing the integration of surgical innovation with long-term functionality.

Throughout the lecture, the importance of a holistic approach in managing joint diseases and dentofacial deformities was reiterated, underscoring the need for balance among joint function, mandibular integrity, and occlusal stability for optimal treatment outcomes.

IV.6 Disc repostioning and orthognathic surgery

Qianyang Xie. The lecture on orthognathic surgery and disc repositioning, shared by the presenter, insights were provided regarding the management of a specific case involving bilateral sagittal split ramus osteotomy (SSRO) and secondary genioplasty. It was noted that the outcomes of the initial intervention did not endure, as, only seven months post-operation, the patient experienced a noteworthy displacement of the chin to the right and a loss of functional occlusion.

Upon examining pre- and post-treatment cone beam computed tomography (CBCT) scans, pronounced resorption of the right condyle was observed, prompting queries regarding the underlying causes of such events. Further magnetic resonance imaging (MRI) investigations revealed that the left condyle exhibited a proper anatomical relationship, while the right condyle demonstrated an anteriorly displaced disc, all of which resulted in a marked reduction in size when compared to its contralateral counterpart. Literature suggests that nearly 30% of patients with disc displacement who undergo orthognathic surgery may experience recurrence of symptoms and facial deformity, necessitating subsequent interventions.

In light of this, Prof. Yang has advocated for an integrated approach that encompasses both TMJ management and orthognathic surgery, particularly in cases characterised by severe dentofacial deformities and disc displacement. The primary objective of this combined strategy is to achieve stability not only in the facial profile and occlusion but also in the anatomical integrity of the joint.

A critical aspect of this protocol lies in the restoration of a stable disc-condyle relationship. Based on the assessment of TMJ status, treatment plans are formulated as either single-stage or two-stage protocols. In instances where the condyle exhibits relative stability, disc repositioning and orthognathic surgery may be performed concurrently. Alternatively, if the condyle is deemed unstable, a staged approach is recommended.
During the one-stage protocol, confidence in the prognosis of the TMJ allows for simultane-

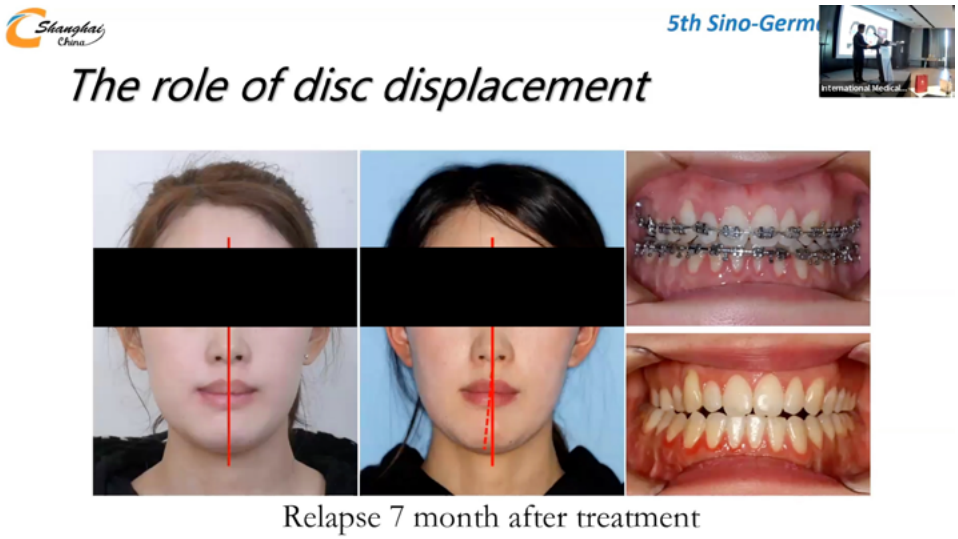


Figure 32. A case of asymmetric chin position developed over months after bilateral split osteotomy with staged genioplasty.

ous disc repositioning and orthognathic surgery. In contrast, the two-stage protocol necessitates an initial phase involving disc reposition, which is followed by orthodontic treatment and orthognathic surgery. Over a span of years, a total of 83 cases have been managed using the one-stage protocol, with a follow-up exceeding one year demonstrating stable postoperative profiles and joint structures.

When undertaking simultaneous disc repositioning and orthognathic surgery, particular technical considerations must be adhered to. It is essential to perform maxillary surgery first, followed by fixation of the osteotomy, before addressing the joint. During this process, the anterior displacement of the disc needs to be corrected, which as a result, facilitates a downward movement of the condyle, causing a slight contralateral shift of the mandible. This operational sequence necessitates the prior realignment of the maxilla preceding the surgical interventions of the joint and mandible.

Additionally, the typical scenario encountered in simultaneous surgery often entails disc repositioning and orthognathic interventions conducted after a period of decompensation. The decision to proceed with a concurrent protocol indicates that the condyle appears relatively stable, exhibiting consistent cortical bone, and that the disc maintains an adequate shape and length. Prior to surgical intervention, an orthodontic setup is crucial to ensure a stable final occlusion, and this preparation should occur as expediently as possible to maximise the likelihood of successful disc repositioning.

One illustrative case detailed involved a patient with a chief complaint of a protruding upper lip and a retrusive chin. Upon intraoral examination, a Class II molar relationship with a deep overjet but 0mm overbite—termed a horizontal open bite—was documented. Furthermore, a narrow upper dental arch was identified, particularly between the bilateral canines and premolars, presenting a mismatch between the upper and lower arches that needed rectification prior to surgery. Consequently, alignment of the upper teeth and correction of the upper dental arch were undertaken, spanning a five-month period before progressing to surgical intervention.

The combined procedure involved disc repositioning, which was conducted via endoscopic techniques on both sides, followed by bilateral SSRO. Postoperatively, although occlusion was improved, a posterior open bite bilaterally was observed, a common occurrence following

disc repositioning. A stabilising splint was employed to maintain the mandible's and disc's position in the interim.

After six months of healing, the stability of the disc was re-evaluated, followed by the initiation of postoperative orthodontics. Ultimately, a Class I posterior occlusal relationship was established, with subsequent correction of the open bite. Long-term follow-up illustrated enhancements in facial profile that surpassed preoperative conditions, which remained stable after three years. An MRI conducted at the one-year mark post-surgery indicated early signs of condylar remodelling, with further improvements noted three years later, culminating in a markedly smoother condylar surface. These outcomes underscore the success achieved through the implemented combined treatment strategy, resulting in both stable occlusion and facial profile.

In the course of the maxillofacial surgery lecture, the concept of a "Surgery First" protocol was discussed. It was indicated that, if a patient presents with a stable occlusion, a combined surgical approach could be considered as the initial step, particularly in cases where the patient reports joint symptoms. An example was provided involving a left-sided anterior disc displacement without reduction. Notably, significant joint fluid accumulation and severely limited condylar movement were observed, suggesting the patient was experiencing clinical symptoms. Additionally, the patient expressed concerns regarding facial asymmetry, which had not been addressed despite previous orthodontic treatment. It was noted that the occlusion was currently stable and well compensated, thus supporting the decision to proceed with the surgical steps.

Due to the patient's mandibular deviation, a tented upper occlusal plane was identified, necessitating the planning of a bimaxillary surgical intervention. Concurrently, a disc repositioning procedure was performed using open anchorage. A follow-up six months post-surgery revealed that the position of the disc had moved further posterior compared to immediately after the operation, while the facial asymmetry had been successfully corrected. One year after the surgery, the frontal view showed significant improvement. A post-operative splint was affixed following the surgery, and a removable splint was intended for use once the patient could open her mouth more broadly.

Modifications to the postoperative splint included a slight adjustment of the lower midline towards the contralateral side to facilitate overall correction and to provide space for the newly repositioned disc. After six months of splint use, the patient was able to discontinue the splint, allowing for a comparison of pre- and post-treatment outcomes. The occlusal relationship appeared virtually unchanged, leading to the patient expressing satisfaction with the results and the decision not to pursue further orthodontic intervention.

In instances where the joint status is not stable, a disc repositioning procedure is recommended as a priority, with orthodontic and orthognathic treatments being deferred. This case involved an adult patient with mandibular retrognathia, accompanied by disc displacement and distortion that had resulted in temporomandibular joint osteoarthritis. Such conditions contributed to uncertainty regarding the prognosis of the temporomandibular joint. Therefore, initial disc repositioning was performed, followed by stabilisation with a splint for a duration exceeding six months.

Comparative data were presented, illustrating the shape and contour improvements in the condylar relationship both prior to and subsequently after the surgical intervention. This demonstrated a markedly improved disc-condylar relationship, thereby paving the way for orthodontic setup related to orthognathic surgery. The protocol included dental extractions and expansion of the upper arch, followed by bimaxillary surgery involving counterclockwise rotation to enhance the facial profile. A comparison of pre- and post-treatment outcomes was

also presented, culminating in post-surgical maintenance of stable and functional occlusion.

Regarding adolescent patients, a two-stage protocol was proposed when deemed necessary. A case study of a 16-year-old female presenting with severe chin retrusion, an open bite, and bilateral osteoarthritis was discussed. Initially, disc repositioning was conducted, followed by the utilisation of a functional appliance as introduced by Dr. Shen the previous day. Notable regeneration was observed, and fixed orthodontic treatment successfully addressed the anterior open bite, resulting in a slight enhancement of the lateral profile; however, this was deemed insufficient. At the age of 18, a CT scan was performed, allowing for comparison with previous scans to confirm the stability of the bone structure. Subsequently, a genioplasty was designed using a customised titanium template, completing the final treatment phase.

In summary, for adults with salvageable condyles and discs presenting severe facial deformities, the maintenance of a stable disc-condylar relationship is crucial. For adolescents, it was advised to restore the disc-condylar relationship first, followed by selective orthognathic procedures in adulthood. Ultimately, the goal is to provide patients with a harmonious joint-jaw-occlusion system.

IV.7 TMJ resorption and orthognathic surgery

Thomas Fillies, Ulrich Joos. In the course of a recent lecture on orthognathic surgery, the presenter initiated the discussion by providing an overview of prior topics, specifically focusing on certain aspects of disc repositioning and displacement. The primary emphasis of the presentation was placed on condylar resorption.

It was indicated that the identification of clinical cases exhibiting condylar resorption posed a significant challenge. Over the preceding decade, the speaker noted an absence of such cases within their patient cohort at the clinic. However, they managed to uncover instances from previous records. It was asserted that the occurrence of condylar resorption subsequent to orthognathic surgery is intricately linked to a variety of patient-specific factors as well as to the intraoperative displacement of the condyles, which may result in an abnormal mechanical load on the TMJ.

The presenter expressed an intention to elucidate the risk factors associated with condylar resorption, alongside potential preventive strategies. Attention was directed towards the different fixation methods employed following a segmented osteotomy, particularly concerning their implications for condylar resorption.

According to the literature, the reported incidence of condylar resorption after orthognathic surgical procedures varies significantly, ranging from 1% to 30%. Several systematic reviews published in recent years corroborate this data, consistently reporting resorption rates within this range. It was noted, however, that a resorption rate nearing 30% is primarily applicable to specific patient groups, particularly those with pre-existing temporomandibular disorders (TMD). In contrast, healthy patient populations exhibit much lower incidences, approximately between 0% and 5%, potentially rising to 10%.

The presenter elaborated on the typical physiological adjustments occurring in the condylar region following surgery, which encompass alterations in jaw relationships, occlusion, and muscle tension, all of which influence joint load. The extent of these changes remains a pertinent question within the field.

Two distinct processes were differentiated: condylar remodelling and condylar resorption. Condylar remodelling is characterized as an adaptive process, involving minimal alterations

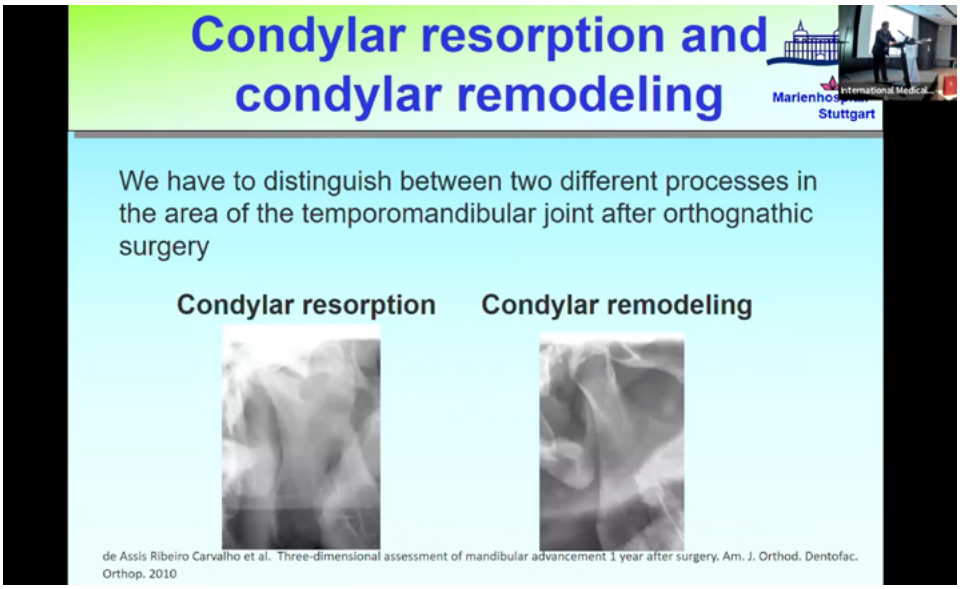


Figure 33. Physiological adjustments occurring in the condylar region following surgery.

in size, contour, and orientation of the condyle, responding positively to the modified functional loads following surgical intervention. Importantly, it does not engender a significant reduction in condylar height, and is generally regarded as a beneficial and desired adaptation.

Conversely, condylar resorption is described as a progressive condition; it entails a loss of bone mass within the condyle and is more likely when the physiological compensatory mechanisms of the joint are surpassed due to excessive and abnormal loading, potentially exacerbated by pre-existing risk factors. The onset of condylar resorption may occur gradually over a span of six months to two years post-operatively.

A multifactorial nature was attributed to condylar resorption, predominantly manifesting in patients undergoing orthognathic surgery, especially if the surgical intervention or inherent patient characteristics render the temporomandibular joint more susceptible to heightened stress or instability.

The presenter also delineated specific patient factors identified in relevant literature, which include gender, age, pre-existing TMD, mandibular morphology, and systemic conditions. It was highlighted that females, particularly those of younger age, have an increased susceptibility to condylar resorption, likely influenced by hormonal factors. Furthermore, younger patients, notably those aged between 20 and 25, exhibit a heightened risk. Pre-existing TMD issues such as internal derangements, disc displacements, or osteoarthritis of the TMJ were also acknowledged as contributors to increased resorption risk.

Lastly, the impact of certain anatomical variations, like retrognathic mandibular configurations or elevated mandibular plane angles, was noted to elevate joint loading. Additionally, systemic conditions, including rheumatoid arthritis and other inflammatory diseases affecting bone and joint integrity, were mentioned as factors that could further elevate the likelihood of condylar resorption.

In the context of surgical factors that are relevant in the field of orthognathic surgery, it was noted that the initial and crucial stage is thorough surgical planning. This planning requires consideration of various criteria, including stability, function, aesthetics, and the feasibility of the surgical procedure, whether it is conducted using digital methods or

traditional techniques.

Three-dimensional digital planning was highlighted as a beneficial approach, as it offers comprehensive visual insights into the intraoperative conditions, thereby allowing for a clearer understanding of the displacement distances of each bony landmark within the maxilla and mandible. This method further facilitates the identification of bony overlaps, which are particularly significant concerning the mandible. Such overlaps can inadvertently result in unwanted condylar displacements during the osteosynthesis phase.

An illustrative case was presented demonstrating the implications of bony overlaps, specifically in a setback procedure, where the overlaps were marked in blue on the corresponding images. To mitigate condylar displacement, it was suggested that these overlapping bony segments may need reduction. Additionally, the potential to simulate the position of the proximal segment, without factoring in the bony overlaps, was mentioned.

A notable concern, irrespective of pre-existing conditions, is that condylar mispositioning can lead to overload and eventual resorption of the condyle. This risk is inherent in all orthognathic surgical interventions, whether they involve a single jaw (monomaxillary) or both jaws (bimaxillary). Specifically, conditions such as condylar inclination, dorsal positioning, and lateral displacement were identified as significant contributors to condylar resorption, especially in the context of Sagittal Split Osteotomy, a technique that has been practiced for over fifty years.

Clinical cases were presented, illustrating how misalignment in the condyle post-surgery can lead to observable resorption phenomena over time, ultimately manifesting as loss of condylar height and associated malocclusions such as the open bite. Images from a CT scan delineated the progression of condylar resorption at various postoperative intervals, presenting a clear timeline of the deteriorating condition linked to dorsal positioning of the condyle.

The discussion progressed to the role of osteosynthesis systems in mitigating the risks associated with condylar displacement and resorption. It was indicated that contemporary practices typically offer either rigid or semi-rigid fixation systems for the management of Sagittal Split techniques. The benefits of rigid fixation were underscored, including the stabilisation of the bone segments, expedited recovery, and reduced risk of postoperative relapse; however, the drawbacks, specifically concerning the tendency for condylar displacement when screws are inserted, were also acknowledged.

Clinical examples were provided that showcased the consequences of rigid fixation, reflecting on the lateral displacements of the condyle following such interventions. These cases reiterated the challenges faced following rigid fixation, including a complete lack of self-alignment of the temporomandibular joint, often resulting in progressive condylar resorption and malocclusion.

Conversely, the semi-rigid osteosynthesis system was presented as a viable alternative, permitting some degree of transverse self-alignment and adjustment of the mandible's ascending ramus during the healing process. The surgical technique involved securing a semi-rigid plate with a temporary fixation device, allowing manual control over occlusion and condylar positioning, which improves overall alignment during the healing period.

The session concluded with a comparison of the resistance of the semi-rigid system versus traditional mini-plates, demonstrating that the semi-rigid plate provides necessary flexibility that allows for joint movement and, thus, encourages self-alignment.

Based on around twenty years of clinical experience with the semi-rigid and adjustable plating system, it was concluded that employing meticulous operative planning, informed choice of osteosynthesis materials, and the utilisation of advanced computerised planning

techniques can significantly reduce the risk of condylar resorption post-surgery. The lecture ended with expressions of gratitude for the audience's attention.

IV.8 TMJ and orthognathic surgery

Bernhard Weiland, Günter Lauer. In an afternoon session of the lecture on orthognathic surgery, the speaker communicated the structure of the presentation, which was divided into two main segments. The first segment included a case study that highlighted a particularly severe instance of bilateral dysplasia affecting the mandibular branch. The second segment revolved around a retrospective evaluation of temporomandibular disorders (TMD) prior to and following orthognathic and orthodontic treatments conducted over a ten-year period at the university hospital in Dresden, from 2014 to 2024.

The case study presented detailed the implications of dysplasia affecting either the mandibular branch or the condyle. It was noted that initial attempts at distraction osteogenesis during the patient's early childhood were unsuccessful. Consequently, the patient approached the team with expectations centered on achieving both aesthetic and functional improvements. Visual aids were utilised, displaying the patient's inadequate lip closure and notable scar tissue, both of which posed challenges during subsequent surgical interventions.

The patient's complaints were documented as particularly striking; he experienced loss of consciousness attributed to a significantly restricted upper airway. Additionally, mouth opening limitations led to difficulties in food intake and articulation problems from the inadequate lip closure. He also exhibited increased sensitivity to cold due to habitual mouth breathing, suffered from sleep apnoea, and faced associated aesthetic and social challenges. Clinical observations revealed a severe Class II malocclusion with an interarch distance of approximately two centimetres and a restricted mouth opening of merely ten millimetres. Radiographic assessments indicated the absence of a joint, along with evidence of prior attempts at osteosynthesis. A clear gap between the mandible and skull base was also identified.

Figure 34. Pretreatment intraoral situation of a patient with bilateral dysplasia of the mandibular branch.

A comprehensive therapy plan was proposed, which entailed a multi-phase treatment approach. The initial phase was designed around distraction osteogenesis, incorporating a

virtual planning process for customised distractors. The strategy accounted for anticipated pressure against the skull base, leading to a planned overcorrection by several millimetres. Post-surgery, an intraoral approach was employed, and activation devices were applied for a duration of approximately two months. Concurrently, orthodontic treatment commenced, addressing a bilateral crossbite, supported by the application of Class II elastics, which effectively aligned the sagittal plane.

Four months post-distraction surgery, notable bone gain in the mandible was observed, particularly in complex regions that were monitored rather than immediately corrected. It was decided to postpone the removal of the osteosynthesis material unless complications arose. Pre-operative and post-operative comparisons illustrated a significant improvement in the upper airway space, effectively alleviating the patient's sleep apnoea. Although intraoral conditions had markedly improved, the extraoral outcomes were deemed unsatisfactory, leading to a focus on ameliorating malocclusion. Twelve months following the initial surgery, a surgically assisted rapid palatal expansion (SARP) was performed, resulting in enhanced dental occlusion, including a retrusion of the upper anterior teeth.

Further phases of treatment included planning for bimaxillary surgery combined with osteochondral grafting, especially in the area surrounding the TMJ. The density of the bone surrounding the distractor's insertion point was reassessed through imaging, demonstrating considerable improvement. Ultimately, four years following extraction procedures, bimaxillary surgery accompanied by an osteofrontal graft was conducted, necessitating anterior rotation and advancement, as well as the use of three-centimetre-long grafts harvested bilaterally. Customised implants and cutting guides were applied during this surgical phase.

Following surgery, the distractors were removed, leading to stable occlusion. Despite only minimal improvements in the extraoral presentation, the patient reported growing satisfaction with their facial profile. Ultimately, three years later, a genioplasty was performed in conjunction with the insertion of a dental implant, which coincided with increased mouth opening, now measured at 18 millimetres. This satisfied the patient further, prompting discussions regarding soft tissue augmentation around the mandibular angle and pre-auricular region.

Conclusions drawn from this extensive case underscore the necessity of a multi-step therapeutic approach in severe cases such as this. An interdisciplinary methodology was deemed crucial, alongside the importance of customised distraction devices and implants. Notably, the patient's mandibular mobility showed improvement, as evidenced by an increase in mouth opening from ten millimetres to eighteen millimetres.

In the second part of the presentation, the speaker reported on the temporomandibular disorders (TMD) associated with orthognathic surgery, spanning the years 2014 to 2024. A total of 856 patients were included in the study, primarily treated using conventional surgical methods, such as bilateral sagittal split osteotomy, the maxillary osteotomy, or bimaxillary surgery, with 13 cases specifically involving distraction osteogenesis.

The cohort was predominantly composed of female patients, and the cases examined were largely characterised as combined dentofacial deformities, including open bites and hemifacial deformities, followed by Class II and Class III malocclusions. A retrospective evaluation was conducted, noting that all patients initially presented in the orthodontics department before being referred to the maxillofacial unit. Consequently, TMD complaints were often addressed prior to the patients' consultations in the latter department.

The study relied on clinical assessments rather than dedicated TMD questionnaires. About 77% of patients exhibited no TMD symptoms, while 23% had symptoms, some of whom received splint or physiotherapy treatment. Limitations included variability in practi-

tioner assessments and unrecorded treatments by other providers. Some patients may have become aware of their TMD after initial diagnosis.

The post-surgical TMD symptoms were further analyzed in 842 patients, using similar evaluation standards and reviewing discharge letters and prescriptions. The results showed that most patients who had no TMD symptoms preoperatively maintained this status post-operatively. However, 6% of patients exhibited TMD symptoms post-treatment, while 25% had pre-existing symptoms. Among these, 18% retained their symptoms after surgical and orthodontic interventions, and 7% developed new symptoms post-treatment.

The discussion highlighted a concerning trend: the incidence of TMD post-treatment appeared to exceed that observed pre-treatment, necessitating further analysis. Patients who were asymptomatic prior to surgery were likely to remain symptom-free post-surgery, while the majority of post-operative TMD symptoms were found in patients who already exhibited symptoms before surgical intervention. Data analysis is ongoing, and comprehensive statistical evaluation is needed due to the contentious nature of these findings. Gratitude was expressed for the audience's attention.

IV.9 Does orthognathic surgery cure TMJ pain? - The patient's perspective one year post treatment

Thomas Stamm. In a recent lecture on the impact of orthognathic surgery on temporomandibular disorders (TMDs), the impact of the procedure from the patient's perspective was addressed. The fundamental question posed was whether orthognathic surgery can effectively alleviate TMJ pain.

The lecturer highlighted that the interrelation between TMDs and malocclusion has long been a significant topic of discussion across various fields including orthodontics, oral surgery, and dentistry at large. Historically, evidence up until 1995 suggested that the association between TMDs and occlusal discrepancies was minimal. It was noted that symptoms of TMDs tend to escalate with age, which may be construed as a natural progression rather than a solely pathological one.

Subsequent research, including a substantial cohort study spanning two decades and conducted more than ten years later, reaffirmed these findings, indicating a lack of evidence to support the notion that orthodontic treatment or malocclusion is a causative or preventative factor for TMDs. By 2018, additional studies continued to show no significant correlation between TMDs and malocclusion. Furthermore, it was suggested that factors such as Angle class did not correlate with the incidence of TMDs, pointing to a predominantly biopsychosocial rather than a purely mechanical relationship.

A particularly noteworthy meta-analysis, involving over 5,000 patients and led by the research team of Edward Ellis, was referenced. Despite being conducted in 2017, it was described as seminal. Meta-analyses typically yield distinct affirmative or negative conclusions, and in this instance, the analysis documented the prevalence of TMDs pre- and post-operatively. The findings indicated a slight increase in the occurrence of TMDs following surgery, which corroborated results discussed in prior presentations.

In summary, the analysis suggested a trend towards a higher incidence of TMDs post-surgery, with no identifiable risk factors that could predict which patients might experience improvement, stability, or worsening of their TMD symptoms after undergoing orthognathic surgery. Notably, the self-assessment of patients regarding the changes in their TMD symptoms appears to be inadequately represented in current research literature.

Consequently, the primary objective of the study presented was to evaluate the self-

reported severity of patients' principal complaints before and after surgical intervention. An inquiry was made into whether patients' self-assessments aligned with the clinical research findings documented in existing literature.

Figure 35. Example of a Class III patient with her primary chief complaint.

To conduct this assessment, patients recorded their primary complaints prior to treatment, after orthodontic preparation (denoted as T1), and subsequently after surgery at the time of plate removal. Documentation was performed manually, utilising a 10-centimetre visual analog scale to illustrate the severity of symptoms. At both T1 and T2, patients were reintroduced to their initial complaints recorded at T0, albeit without prior knowledge of the intensity ratings, ensuring a blinded assessment.
The variations in symptom intensity were systematically analysed using the established scale. An illustrative example of the reporting sheet was provided, detailing how patients were instructed to document their complaints and gauge the intensity of each on a separate 10-centimetre scale, where the left end symbolised *best* and the right end *worst*. Thus, a quantitative measurement of symptom intensity was achieved in centimetres.

In a recent study involving 215 patients, comprising 125 females and 90 males, a total of 722 chief complaints were documented. The coding of these complaints was conducted independently by two investigators, utilising both symptom codes and anatomical domain codes. This coding process is essential for converting qualitative descriptions into quantitative data for statistical analysis.

The symptoms identified in the study were categorised into three main types: pain, functional issues, and aesthetic concerns. The anatomical domains encompassed dental, facial, and other areas of the head, including conditions unrelated to the face, such as headaches and cervical spine issues. It was observed that patients frequently reported discomfort in areas like the hips and arms, which were attributed to underlying jaw problems, necessitating an expansive definition of the anatomical domains considered.

Several examples were provided to illustrate the coding process. For instance, a patient expressing dissatisfaction with the size of their chin, articulating feelings of unattractiveness and a desire for surgical intervention, was coded under aesthetic concerns related to the facial

domain. In contrast, a complaint regarding the inability to bite into a bun was categorised as a functional dental issue. Another patient who experienced neck pain linked to jaw asymmetry was coded with regard to both pain and movement in the cervical spine.

The coding process also aimed to assess consistency across different raters. A random selection of chief complaints was independently coded, with the agreement measured using Cohen's kappa statistic. The resultant kappa value indicated a high level of agreement, reflecting a robust coding quality.

The demographic distribution of patients revealed a greater number of females than males, with the former exhibiting a significantly higher frequency of chief complaints. Analysis of symptom types highlighted that functional complaints were prevalent, with a slight male predominance, though this difference lacked statistical significance. Across the various anatomical domains, no significant disparities were found between males and females in relation to dental and facial complaints.

Upon further examination of the symptom and anatomical domain combination, dental issues emerged as the most prevalent, followed by aesthetic concerns and pain. Notably, certain symptoms like headaches and spinal discomfort were excluded from the analyses, as they are not indicative of temporomandibular disorders (TMDs). Post-exclusion, 72 patients remained, collectively reporting over 300 complaints, predominantly centred on mastication-related functions coded as dental and functional issues.

Intensity measurements of chief complaints were conducted prior to treatment, with results showing that pain and masticatory dysfunctions were more pronounced, although no significant intensity differences were noted. Following a year of orthodontic preparation leading to surgery, a reduction in dental pain was observed, while other symptoms remained unchanged.

Subsequently, an assessment of symptom intensity post-surgery indicated a significant reduction in functional disturbances and pain—excluding dental pain—one year following surgical intervention. A comparison of chief complaints two years after treatment revealed substantial improvements, including a notable decrease in dental pain.

From the patients' perspective, it can be concluded that orthodontic preparation for surgery does not influence TMD symptoms, corroborating existing clinical research that lacks self-reported data. However, orthognathic surgery demonstrates a significant capacity to alleviate TMD symptoms, as emphasised by patient feedback. It remains uncertain whether orthognathic surgery can prevent the onset of TMD, leaving it an open question for further investigation.

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Ethical approval

The contributions included in these conference proceedings are primarily intended to document the presentations and discussions that took place during the event. It is important to emphasise that these submissions are often provisional in nature and do not always represent complete research findings. Instead, they typically encompass discussions of new ideas or preliminary results that have not undergone the same rigorous review process as final publications. As such, while the proceedings serve as a valuable platform for the exchange of innovative thoughts and preliminary insights, the responsibility for adhering to ethical standards rests firmly with the speakers presenting their work.

Consent for publication

The speakers have granted their consent, verbally and/or in writing, for the use of images from their presentations in the current conference report.

Authors' contributions

The author(s) declare that all the criteria for authorship designated by the International Committee of Medical Journal Editors have been met. More specifically, these are: (a) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND (b) Drafting the work or revising it critically for important intellectual content; AND (c) Final approval of the version to be published; AND (d) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Competing interests

The author(s) declare that there are no competing interests related to this work.

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