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Research Paper

Total Temporomandibular Joint Replacement: Bridging Current Practice With Innovative Horizons For Oral And Maxillofacial Surgeons

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Abstract: *Total temporomandibular joint replacement represents a significant advancement in oral and maxillofacial surgery by addressing the complex issues of temporomandibular joint dysfunction and degeneration. This procedure entails the implantation of a joint customized to the patient's specific requirements, addressing conditions such as benign and malignant lesions, osteoarthritis, and more severe disorders. Available options range from standard commercial prosthetics to custom designs that leverage high-quality graphics and 3D printing for enhanced fit and functionality. Recent innovations have notably advanced temporomandibular joint surgery, with improvements in integration through information matching and shared processes that boost efficiency and longevity. Additionally, the adoption of minimally invasive techniques and robotic assistance has contributed to shorter recovery times, reduced complications, and increased surgical precision. However, challenges persist. Extended implant times, complications, and the need for ongoing patient care remain significant concerns. Long-term follow-up is crucial for evaluating the effectiveness and durability of new prosthetic designs. The field of temporomandibular joint replacement is rapidly evolving, driven by ongoing research and technological advancements aimed at improving patient outcomes, alleviating pain, and enhancing overall health. This review underscores the need for continuous innovation to address the complexities of integration and to advance patient care in the face of evolving surgical demands.*

Keywords: *Temporomandibular joint, Total joint replacement, Clinical guideline, Temporomandibular joint reconstruction, Mandibular lesions*

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I. Introduction

Temporomandibular disorders include a variety of pathologies affecting the temporomandibular joint, often presenting with a variety of signs and symptoms.[1] Epidemiological studies on temporomandibular disorders are lacking. [2]Approximately 12% of the population is affected by orofacial pain associated with temporomandibular disorders, and up to 60% of individuals may experience symptoms of temporomandibular disorders.[3] The impact of pain associated with temporomandibular joint disorders also extends to major psychiatric disorders.[4] Treatment of occlusal symptoms usually includes conservative and non-pharmacological measures, including occlusal separation, therapeutic unit , supplements , cognitive behavioral therapy and various medical treatments.[5] However, some patients may not respond to conventional treatments and may require temporomandibular joint replacement.[6] Recently, treatment options have expanded with the use of temporomandibular joint prostheses in patients who have failed various previous treatments.[7] Advances in supports make these interventions worthy of further evaluation.[8] However, collaborative partnerships and guidelines for their success and survival have not yet been developed.[9] Given the increasing interest in changes in the temporomandibular joint, there seems to be a need for standardization of both surgical and postoperative approaches. In particular, the current literature shows that little attention has been paid to post intervention recovery.[10] To address these issues, this report describes the surgical and postoperative course of a patient who underwent total unilateral temporomandibular joint arthroplasty, as well as postoperative care recommendations.[11] Total temporomandibular joint replacement is a promising surgical procedure and tool for the treatment of temporomandibular joint disorders.[12] Oncological surgery, in addition to traditional surgical procedures such as arthroplasty and arthroplasty for temporomandibular joint ankylosis, also increases the risk of reverse ankylosing or open bite deformity.[13] It plays an important role in the function and beauty of the mouth, jaw, and face, and improves the quality of life of patients by improving digestion, spoken language, and communication.[14] Although total temporomandibular joint replacement was introduced in the 1970s, it is still not recognized.[15] The quasi-revolution that Proplast and Silastic participated in in North America in the 1990s faced significant problems, including the overwhelming influence of foreign products on repair of defects.[16] In contrast, Japan avoids the use of complex allogenic materials and still relies on autologous tissues such as muscle and fat grafts to reconstruct the body. [17]In 1995, Sonnenburg I. and Sonnenburg M. achieved fusion of the temporomandibular joint with titanium mandibular condyle and polyethylene mandibular fossa implants.[18] Biomet's total temporomandibular joint replacement device was approved for clinical trials by the US Food and Drug Administration in 1995, and the temporomandibular joint Mind and NEXUS CMF products were approved in the US Clinical in 1999 and 2001, respectively. However, there is a high risk , careful selection of patients is an urgent need.[19] The Japanese Society of Oral and Maxillofacial Surgery and the Japanese Society of Temporomandibular Joint Surgery are working hard to improve the treatment of periodontal joint dysfunction.[20] This temporomandibular joint prosthesis is the only medical device approved by Japanese regulatory authorities to perform successful replacement, and is marketed under the name "TMJ Replacement Product" by Biomet Microfixation and is from Medical U and A Inc. [21]The device is a fixed temporomandibular joint replacement consisting of mandibular implants as the prosthetic device and socket implant as the glenoid device.[22] Each section is specifically designed for right- or left-handed use. It is important to note that the jaw and alveolar implants are not interchangeable. This device comes in three forms: Mandibular Implant, Mandibular Implant/Narrow and Posterior Curved Mandibular Offset with ultra-thin screws. [23] Jaw implants, including narrow and offset types, are available in three diameters: 45 mm, 50 mm, and 55 mm. The appropriate size for mandibular implants can be determined using the aluminum design guide, which is also available in these diameters.[24] The customized adjustable screws are made of a special titanium alloy (Ti-6AL-4V) and are available in various diameters: 2.7 mm for the mandible and 3.2 mm for the emergency mandible.[25] Implant lengths are available in 2 mm increments as shown in the accompanying document.[26] The socket implant is a complete replacement temporomandibular prosthesis designed to replace the articular process and glenoid fossa of the human bone. ArCom® is made of ultra-high molecular weight polyethylene.[27] When the mouth is opened and closed, the mandibular condylar component of the mandibular implant slides back onto the surface of the alveolar implant. The implants come in three sizes: large, medium, and small.[28] An alveolar template (Radel® plastic) is used to select the appropriate alveolar implant size. The length of the implant is measured in millimeter increments. All anatomic components of the temporomandibular joint, including the mandibular condyle and the overlying fibrocartilage, synovium, articular disc, fibrous capsule, and ligaments, are susceptible to neoplastic disease.[29] Symptoms that may indicate a problem in the temporomandibular joint area include pain in the temporomandibular joint area, muscle weakness, jaw deviation when opening the mouth, joint noise (such as crepitus), swelling around the temporomandibular joint open bite, and crossbite on one side of the jaw in the affected person. [30] Asymmetry that does not affect the jaw space, bone fractures, and otologic problems can cause adverse symptoms and poor response to treatment. A section describes the symptoms that distinguish these tumors from true tumors and cancer.[31] They found that the most common diseases were

pseudotumors, such as synovial chondromatosis, pigmented villonodular synovitis, eosinophilic granuloma, and osteochondroma.[32] Approximately 20% of pseudotumors are initially diagnosed with temporomandibular bilateral dysfunction. The authors noted that panoramic images showed no abnormalities in 14.6% of tumors and 7.7% of malignant lesions, indicating the need for further monitoring and the possibility of 3D imaging.[33] The greatest challenge for physicians treating temporomandibular joint patients understands the difficulties in diagnosing and treating temporomandibular joint patients with joint problems. This requires knowledge of conventional medicine and the ability to recognize tumors or other conditions in the temporomandibular region.[34] Regarding the treatment of benign temporomandibular joint lesions, there are ongoing questions about management strategies, such as for synovial chondromatosis, as well as options for joint replacement, including autologous or reconstructive approaches. The purpose of this article is to provide a comprehensive review of the indications for the use of temporomandibular joint replacement devices in the treatment of primary or secondary benign disorders involving the temporomandibular joint.[35]

II. Discussion:

Reconstruction strategies are categorized based on timing, with Immediate Primary temporomandibular joint reconstruction indicated when reconstruction can be performed immediately after confirming the pathological diagnosis. The extent of mandibular resection will dictate whether a stock or custom temporomandibular joint reconstruction device, either standard or eTMJR, will be used.[36] Stock temporomandibular joint replacement devices can only be utilized in cases with sufficient inferior ramus left for placing an adequate number of fixation screws. In most cases, a custom temporomandibular joint replacement is chosen due to the extent of resection required.[37] A specific protocol computed tomography scan is made, from which a stereolithographic model is developed, and the final temporomandibular joint replacement device is designed and manufactured. [38] The resection is carried out utilizing virtual surgical planning, and cutting guides are developed for the surgery to guide the resection and proper placement of the temporomandibular joint replacement components. Delayed Primary temporomandibular joint reconstruction is indicated for patients who previously had primary pathology surgery where immediate reconstruction was contraindicated, such as for large lesions requiring extensive exposure or significant oral soft tissue removal with a vascularized flap.[39] Preoperative evaluation and surgical planning involve reviewing prior surgery to understand the deformity. The same presurgical computed tomography and virtual surgical planning procedures are utilized. Malocclusion often necessitates the creation of a two-part stereolithographic model.[40] Virtual surgical planning ensures proper occlusion and the final surgical splint. Custom 3D antibiotic-embedded polymethylmethacrylate spacers are used in such cases.[41] Delayed secondary temporomandibular joint reconstruction is for patients with failed previous autogenous or alloplastic reconstructions.[42] The surgeon must identify the causes of poor outcomes to prevent recurrence. Only custom temporomandibular joint replacement devices should be considered. Failed or malfunctioning devices must be removed before the computed tomography scan to avoid artifacts.[43] During device removal, accurate maxillomandibular alignment is restored using silicon or antibiotic-impregnated polymethylmethacrylate spacers, particularly if infection is present.[44]The operation consists of removing ankylosis and positioning the temporomandibular joint prosthesis. The access involves both preauricular and posteroinferior submandibular incisions. After resection and removal of heterotopic tissue, the prosthesis is placed and fixed.[45] Intermaxillary fixation is applied and later removed after verifying correct prosthesis function. ost-operative protocols, although less documented, play a crucial role in therapeutic outcomes.[46] Recent advancements in prosthetic design and surgical methods are paving the way for improved patient outcomes, including better functionality, enhanced durability, and reduced complications.[47] Custom temporomandibular joint prostheses seem to be more commonly used due to their clinical predictability and stability. Chondrocostal grafts, in contrast, are highly unpredictable, especially in growing patients.[48] Bredell et al. reported the complications of different TMJ reconstruction techniques, highlighting the unpredictability of costochondral grafts.[49] Custom temporomandibular joint replacement devices offer precise anatomical reconstruction and long-term stability. Classification and Management Algorithms Potter and Dierks proposed a classification of mandibular defects involving the temporomandibular joint based on lesion size and whether the disk or fossa is salvageable.[50] Bredell et al. provided recommendations considering anatomical structures and complication risks, mentioning both autogenous and alloplastic TMJR options.[51] Due to limited evidence, definitive management algorithms are challenging to develop, with decisions often relying on surgeon experience. The exploration of total temporomandibular joint replacement underscores both progress and challenges in oral and maxillofacial surgery. The integration of cutting-edge technology, such as custom prostheses and advanced surgical techniques, is crucial for addressing the diverse needs of patients with temporomandibular disorders. While current practices are effective, the field continues to evolve towards more sophisticated solutions to achieve superior functional and aesthetic outcomes.[52]

III. Conclusion:

Continued research and development are essential to further enhance the effectiveness of TMJ replacement procedures. By embracing new advancements and integrating them into clinical practice, oral surgeons can better manage complex TMJ conditions, improve patient quality of life, and stay at the forefront of surgical innovation. The evolution of TMJ replacement technology promises a more precise, effective, and patient-centered approach to addressing the challenges of TMJ dysfunction and degeneration.

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