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Review Article

Alloplastic Temporomandibular Joint Reconstruction: An Additional Armamentarium for Maxillofacial Surgeon

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Abstract

Reconstruction of TMJ has always been a challenge to maxillofacial surgeons. There are considerable variation in the success rate of different treatment modalities. Costochondral grafts, ramus condylar unit distraction osteogenesis, gap arthroplasty have their own disadvantages and limitations. With the advent of total alloplastic joint replacement technique the maxillofacial surgeons are able to treat end stage temporomandibular joint diseases much more efficiently and with high level of precision.

Keywords: Temporomandibular joint (TMJ); Maxillofacial Surgeon; Costochondral Grafts

Introduction

Alloplastic temporomandibular joint replacement is an added surgical modality in management of end stage temporomandibular joint disorders.

Temporomandibular joint (TMJ) is a complex synovial joint formed by articulation of the condylar head of the mandible with the glenoid fossa of the temporal bone with an interposing avascular articular disc. It is encapsulated by a dense fibrous capsule and various ligaments and muscles associated with it. Some end-stage temporomandibular joint (TMJ) disorders such as ankylosis, tumors, or traumatic injury, osteoarthritis, rheumatoid arthritis, AICS (Adolescent Internal Condylar Resorption) results in anatomical architectural distortion which require total joint replacement which comprises both glenoid fossa and condylar component replacement [1].

History [2,3]

Indications of alloplastic TMJ replacement [4]

1. Ankylosis and re-ankylosis cases
2. Degenerative joint disorders such as osteoarthritis results in bony changes.
3. Inflammatory joint disorders - rheumatoid arthritis, ankylosing spondylitis,
4. Tumors of condyles
5. Crushed injuries of TMJ
6. Adolescent Internal Condylar Resorption

Ideally this kind of treatment should be restricted to the patients in whom skeletal growth has been completed. Usually first choice of treatment for children in ankylosis cases is costochondral grafts. However in special circumstances it can be used in developing children also. Oascone., *et al.* 2016 [5] presented a case of alloplastic joint replacement in 7 year old female child having obstructive sleep apnea with history of recurrent ankylosis with autogenous graft material.

Custom vs stock prosthesis

There are certain advantage and disadvantages in both the devices. It is obvious that given a choice to patient, they will prefer single stage surgery. Stock made devices need meticulous planning but have an advantage of being a single stage surgery. Most of the time these patient already had undergone multiple surgical procedure which enhances the fear and anxiety of another surgery. Comprehensive counselling of the patient is a must before planning joint replacement. Custom made devices usually require two stage surgery with minimum two non-contrast tomography scans. First scan before the surgery and second scan after the surgical site preparation for the construction of customized joint [6]. Although it is noticeable that custom made devices have specific indication in such multiple operated cases. failed stock devices and severely degenerated, anatomically distorted TMJ [1].

In stock devices the lack of posterior stop in the glenoid fossa component seems to be a greatest disadvantage in case surgeon missed to place the fossa component in correct mediolateral and anteroposterior direction. However the stock fossa component

is designed in such a way that it prevents posterior displacement of condyle in posterior direction, provided the center of the fossa aligned correctly. Posteriorly displaced condyle may leads to irritation of tympanic plate and/or the auditory canal. There is also the potential for infection as well as pressure-related perforation associated with the auditory canal. This can result in subsequent pain and mandibular dysfunction. The custom TMJ TJR fossa has a posterior stop, which relieves the problem of displacement of condyle in posterior direction.

Year	Principle worker	Conclusion/ contribution
1536	Ambrose Pare	First elbow joint excision
1840	John Murray Carnochan,	Used a block of wood for mobilizing the TMJ after creating a gap between bony surface and residual mandible
1890	Gluck	Ivory prosthetic total joint arthroplasties.
1933	Risdon	Gold foil use as interpositional material
1946 and 1947	Eggers and Goodsel	Used tantalum foil in cases of TMJ ankylosis
1951	Castiglian and Kleitsch	Vitallium resurfacing in TMJ ankylosis
1952	Smith	Used stainless steel in hemiarthroplasty
1955	Ueno., *et al*.	Use of zirconium
1960	Robinson	Alloplastic glenoid fossa use, which was made up of stainless-steel in TMJ ankylosis.
1963, 1964, and 1970	Christensen	Used Vitallium fossa-eminence and Vitallium ramal component with polymethylmethacrylate (PMMA) condylar head
1964	Hahn	Used acrylic condyle and a vitallium mesh, in a case of ablative tumor surgery
	Small., *et al*.	Recommended use of Teflon for mandibular resections and Silastic for condyle reconstruction
	Hellinger	Used tantalum foil and was the first one who stressed on the importance of physio-therapy for complete treatment
1968	Robinson	Used Silastic as an interpositional material
1970-	Hahn and Corgil	Hemiarthroplasty prosthesis in a case of treatment of ankylosis. Stainless-steel wire mesh ramal component with polymethylmethacrylate (PMMA) condylar head
1972	Tauras	Reported cast-gold ramus-condyle for hemi articulation
1972	Kent	(Proplast1)- Ramus prosthesis manufactured from chrome cobalt and condylar component was coated with carbon/ Teflon composite
1974	Hinds., *et al.*	Hemiarticulation technique with Proplast-Teflon-coated Vitallium ramus-condyle component
1983	Kent	Reported the use of a Dacron/Proplast-Teflon also
In 1985 and again in 1990	Sonnenberg and Sonnenberg	Use ramus condyle component made up of chromium-cobalt-molybdenum and fossa component. Made from UHMWPE (ultra-high molecular weight polyethylene)
1995	Mercuri., *et al*.	Used custom made total alloplastic TMJ reconstruction prosthesis .The titanium made ramal component ,chromium-cobalt-molybdenum condylar component, and with fossa component, made of titanium backed with UHMWPE .

The limitation of size in stock made devices is also an important factor in device selection. Asian jaws size are smaller than in comparison to the other part of the world. The stock devices available in a very limited size option, which are sometime not suitable for the particular patient. These devices have not been customized for the size of the Asian jaws. Sometime smallest available stock joint is bigger than the residual ramal length (the part of the ramus available for the condylar component fixation after the condylectomy). It is in this regard that surgeon has an advantage in custom made devices, where he can modify the joint as per patients' or surgical site requirement [1].

The use of ultra-high molecular weight polyethylene as articular fossa component has its own great advantages such as ductility, low coefficient of friction, high tensile strength, as well as relatively nil incidence of third body wear phenomenon which makes it an ideal material for this purpose (Figure 1). However, titanium as a backing of articular fossa in custom made devices provides an advantage of osseous ingrowth. But sometimes these exaggerated osseous growth may results in heterotrophic bone formation [4].

Figure 1

Cost of the device is also a great determining factor in treatment plan. Custom made devices are prohibitively expensive in comparison to stock made devices.

Johnson., *et al*. [7] carried out a systematic review and bias adjusted meta-analysis to compare the custom made prosthesis and stock made prosthesis. He concluded that there is no difference in maximum incisal opening in both the surgical modality.

Alloplastic joint replacement and orthognathic surgery

End-stage temporomandibular joint diseases occurring at early sage will also results in dentofacial deformity, malocclusion, TMJ dysfunction of normal side joint, headache and myofascial pain. Patients with these conditions may benefited with total alloplastic TMJ replacement with concomitant orthognathic surgery, and other adjunctive procedures. To achieve optimal esthetic and functional results, it is required to do meticulous surgical planning with the help of VSP (virtual surgical planning) such as CASS (computer assisted surgical simulation) technology. However it will increase the total cost burden. As an alternative pre-surgical STL (stereolithographic) models can be made and mock surgery can be performed. After this the model have to be send, to the custom made device manufacturer for further fabrication of Alloplastic TMJ device taking all consideration of concomitant orthognathic surgery [8].

Discussion

The complex nature of the TMJ's which is contributed by its surrounding structure made this joint so special that after the total joint replacement, expecting premorbid, fully functional condition is unrealistic [9].

Reconstruction has always been a challenge after removal of ankylotic mass [5]. Autogenous bone grafts like costochondral graft, sternoclavicular graft and distraction osteogenesis etc. are some of the treatment options in TMJ reconstruction. These procedures have their own disadvantages in the form of donor site morbidity, absence of cartilaginous cap or asymmetric growth and re-ankylosis.

The alloplastic TMJ prosthesis comprised some unique properties in addition to biologically and functionally compatible materials are low fatigue coefficients, low flow property, wear resistant [9].

Dimitroulis [10], compared condylectomy, costochondral grafts and a TMJ TJR stock device he found that condylectomy group demonstrated the best mandibular range of motion, whereas 43% of rib graft patients required re-surgery. But cumulative quality of life score in stock TMJ TJR device group was better than other modalities.

It is obvious that the selection of treatment modality should be based on patients' overall systemic condition. Alloplastic temporomandibular joint has relative contraindication in cases of uncontrolled systemic disease, such as diabetes mellitus, active infection surrounding the joint, allergy to the alloplastic materials used in the devices, and recurrent ear infection [9]. Use of such joints in case of growing children is contraindicated and every effort should be made to provide natural joint to the patient.

Conclusions

It is important to explain the patient that TMJ reconstruction is primarily for the restoration of form and function of the mandible. Relief in pain is only secondary added benefit of the joint replacement. Such patient have usually undergone multiple surgeries which make the surgical site more challenging and invariably pain is a parallel disability factor in such cases.

The Alloplastic temporomandibular joint replacement is a recently added surgical modality in management of end stage temporomandibular joint replacement. In addition to this with advent of STL models, the surgeon can perform mock surgery either manually or computer assisted and make the treatment outcome more predictive. As well as with the help of TMJ replacement and orthognathic surgery can provide a complete rehabilitation of patient in one surgical plan.

Conflict of Interest

We have no conflict of interest to disclose.

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