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Evaluation of Total Alloplastic Temporomandibular Joint Replacement in TMJ Ankylosis

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Abstract

Introduction Total joint reconstruction using autologous or alloplastic materials is one of the treatment options for the reconstruction of the affected joint in TMJ ankylosis. The clinical results of alloplastic TM joint replacement (Biomet Microfixation system) that was carried out for the treatment and reconstruction of TMJ ankylosis have been summarised.

Materials and Methods A retrospective analysis of eight cases clinically and radiographically diagnosed as TMJ ankylosis with minimal facial asymmetry presenting beyond the growth period and willing for at least 12 months of follow-up who have been taken up for gap arthroplasty and reconstruction using Biomet Microfixation TMJ replacement system was carried out. Follow-up of these patients was carried out at regular intervals and assessed on the following criteria: maximal interincisal mouth opening, TM joint pain on the affected side (on VAS), lateral mandibular excursions to the unaffected side deviation on mouth opening, occlusal discrepancy and neuromotor deficit of peripheral branches of facial nerve.

Results The mean maximal interincisal mouth opening pre-surgery and 1 year post-surgery was 2 and 31.8 mm, respectively. The mean lateral excursive movement to the unaffected side was found to be 5.5 mm with mean deviation on mouth opening to be 4.6 mm. No pain, occlusal discrepancy or neurological deficit existed at the end of 1 year.

Conclusion Biomet Microfixation system is a viable treatment option for reconstruction of TMJ in cases of ankylosis with no major complications.

Keywords Temporomandibular joint ankylosis · Biomet · Temporomandibular joint replacement

Introduction

TMJ ankylosis is a condition characterised by the fusion of the joint surfaces causing severe problems in performing the basic functions of the oral cavity such as mastication, speech and deglutition [1–3] along with varying degrees of aesthetic, oral hygienic and psychological problems [4–7]. They can be classified into true or intraarticular and false or extraarticular types. Intraarticular ankylosis most commonly occurs after trauma or infection, whereas extraarticular type occurs by a large variety of other disorders including myogenic, neurogenic and inflammatory processes, bone and soft tissue tumours [2–8].

Various procedures have been described in the treatment of TMJ ankylosis. These include gap arthroplasty, interpositional gap arthroplasty and total joint reconstruction using autologous or alloplastic materials. This aim of this paper is to summarise the clinical results of alloplastic TM joint replacement (ATMJR) (Biomet) that was carried out for the treatment and reconstruction of TMJ ankylosis with late presentation (Fig. 1).

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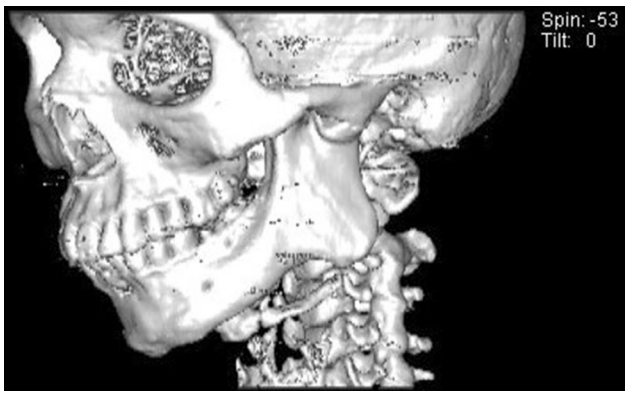

Fig. 1 Pre-operative CT 3D reconstruction

Materials and Methods

This study is a retrospective analysis of all cases treated in a single institution by a single operator during a 2-year period from 2015 to 2017 clinically and radiographically diagnosed as TMJ ankylosis that have been taken up for gap arthroplasty and reconstruction using total alloplastic joint replacement using Biomet Microfixation TMJ replacement system®. The inclusion criteria of cases included in this study were clinical and radiological evidence of bony ankylosis with minimal facial asymmetry presenting beyond the growth period and willing for at least 12 months of follow-up. Patients with previous history of surgical procedures to the jaws were excluded from the study (Fig. 2).

The sequence of the treatment of TMJ ankylosis was tailor-made for each patient based on the complaint of the patient during the time of reporting, existing maximal interincisal mouth opening, general nutritional status of the patient and extent of facial deformity secondary to the ankylosis. A total of eight cases were included in the study, of whom six cases were taken up for gap arthroplasty followed by joint replacement. Two cases were taken up for distraction osteogenesis to increase the height of the ramus and length of the body of the mandible on the affected side by distraction osteogenesis. Following a consolidation period of 3 months, gap arthroplasty and total joint replacement were carried out (Fig. 3).

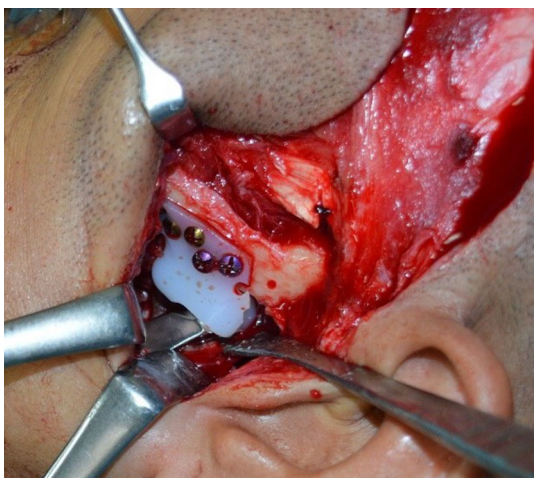

Fig. 2 Alloplastic TM joint replacement in situ

Surgical Procedure

Under general anaesthesia with nasal endotracheal tube intubation, a combined preauricular (Popowich modification of Al-Kayat and Bramley incision) and retromandibular–submandibular approach was used to expose the ankylosed joint. Traditional gap arthroplasty was carried out to remove at least 2.5 cm block of bone to release the ankylosis to facilitate the placement of the fossa component. Ipsilateral coronoidectomy was carried out through the existing incision, and a mouth opening of 35 mm was verified. Contralateral coronoidectomy was carried out through an intraoral approach if the mouth opening was found to be less than 35 mm intraoperatively (Fig. 4).

A specially designed large diamond burr or reciprocating diamond burr was used to flatten the articular eminence for better adaptation of the fossa component. The end of the burr has a radial shape, which matches the medial radial surface of the fossa component.

Intermaxillary fixation is carried out using wires or elastics. It was followed by sizing and implantation of the fossa prosthesis. Fossa trial sizer was used to assess the initial fit of the prosthesis, and fossa was positioned so that it is approximately parallel to the Frankfort horizontal plane. Fixation was carried out using two 2.0-mm screws for fixation, followed by a minimum of two additional 2-mm screws.

Fitting of mandibular component was verified using a mandibular trial (sizer). The smallest implant that could reasonably fit within the confines of the ramus was selected. However, in most of the cases it was found that even

Fig. 3 Post-operative OPG

Fig. 4 Post-operative mouth opening

the smallest of the stock prostheses extended to at least 5 mm beyond the lower border of the mandible due to the presence of exaggerated antegonial notch. Once the head of permanent mandibular prosthesis is positioned in the mid portion of the glenoid fossa, two 2.7-mm screws were placed temporarily to secure the prosthesis.

The surgical site was covered with sterile drapes, intermaxillary fixation was removed, and a reasonable range of motion with an interincisal opening of 30–35 mm to assess the mechanical functioning of the joint was carried out. The remaining screws were then placed. An average of 4–6 screws is recommended for securing the mandibular component. The surgical wounds are then irrigated with antibiotic solution, and the closure was carried out in layers.

After recovery from general anaesthesia, the patients were placed on light elastics for 18–24 h a day on soft diet for 2 weeks. Vigorous mouth opening exercises were carried out to achieve the intraoperative mouth opening. Achieving this mouth opening was generally not a problem in any of our treated cases.

Follow-up

Regular follow-up of these patients was carried out at 1 week, 1, 3, 6 months and 1 year and was assessed on the following criteria:

1. Maximal interincisal mouth opening
2. TM joint pain on the affected side (on VAS)
3. Lateral mandibular excursions to the affected side
4. Deviation on mouth opening
5. Occlusal discrepancy
6. Neuromotor deficit of peripheral branches of facial nerve

Results

All the cases except for one were trauma, while one case was severe recurrent ear infections. Details of the cases included in the study are given in Table 1. All patients had significant improvement in mouth opening with mean maximal interincisal mouth opening of 2 mm before surgery and 31.8 mm post-surgery at the end of 1 year (Table 2). None of the patients complained of pain at the end of 1 year (Table 2). The mean lateral excursive movement to the unaffected side was found to be 5.5 mm at the end of 1 year (Table 2) with mean deviation on mouth opening to be 4.6 mm (Table 2). Only two cases of occlusal discrepancy were identified during the immediate post-operative period: one causing open bite on the affected side and one causing open bite on the contralateral side (Table 2). However, they were corrected within the first post-operative month by the use of elastics. One case each of temporary paresis of temporal branch and marginal mandibular branch of facial nerve was reported with complete recovery being made in 3 and 6 months, respectively (Table 2).

Discussion

TMJ ankylosis is frequently interpositional gap arthroplasty to achieve mouth opening followed by joint reconstruction. The various autogenous materials that can be used for joint reconstruction are usually associated with multitude of disadvantages including a second surgical site, donor site morbidity, increased surgical time, possibility of reankylosis, fracture of the graft and possible of overgrowth. As an alternative, a number of alloplastic materials and systems have been developed for use in reconstruction of the TMJ [9]. ATMJR can be either stock or custom-made. Though stock prostheses may not be advantageous to the surgeon during surgery with its lack of precision and pre-surgical virtual planning, it is definitely a cost-effective alternative to custom prostheses.

Saeed et al. [10] recommended the use of ATMJR in cases with history of ankylosis, multiple surgical procedures and previous alloplastic joints. The current

Table 1 Case details

Case	Side	Age of presentation (in years)	Aetiology	Surgery
1	Lt	32	Trauma	Gap arthroplasty, joint replacement and genioplasty
2	Lt	33	Trauma	Gap arthroplasty, joint replacement and genioplasty
3	Lt	26	Trauma	DO followed by gap arthroplasty, joint replacement and genioplasty
4	Rt	21	Ear Infection	DO followed by gap arthroplasty, joint replacement and genioplasty
5	Lt	23	Trauma	Gap arthroplasty and joint replacement
6	Rt	33	Trauma	Gap arthroplasty and joint replacement
7	Rt	23	Trauma	Gap arthroplasty and joint replacement
8	Rt	29	Trauma	Gap arthroplasty, joint replacement and genioplasty

recommendation for the reconstruction of TMJ in a skeletally mature patient is ATMJR [11]. Conversely, perhaps the major indication for reconstruction of TMJ using ATMJR is late-onset TMJ ankylosis with minimal maxillomandibular deformities which may not require a second surgical procedure or can be managed concomitantly (like genioplasty). Genioplasty was carried out in patients who exhibited only mild facial deformity perhaps due to the minimal growth left over after the onset of ankylosis.

The major advantages of using ATMJR in ankylosis are that it resembles TMJ anatomy, allows immediate physiotherapy with negligent chances of reankylosis and resurgery, and has no donor site morbidity or second surgical site. Although ATMJR is considered to be a final treatment option, earlier treatment can result in better outcomes (Loveless et al.) [12].

In order to conclude that ATMJR can be an effective method for reconstruction of TMJ post-ankylotic release, outcomes of ATMJR need to be compared with other treatment options for ankylosis. Saeed et al. concluded that reconstruction using costochondral graft and ATMJR share similar improvement in the outcomes and incidence of complications. However, the complications occurring in the ATMJR group were self-limiting, most of them requiring no surgical interventions.

Gerbino et al. [13] used a one-stage treatment of TMJ complete bony ankyloses using Biomet Microfixation system and found a mean post-operative mouth opening of 26.5 mm against a mean pre-operative mouth opening of 7.9 mm. Hu et al. [14] found similar results in 11 patients of TMJ ankylosis with a mean pre-operative mouth opening of 5.5 mm and a mean post-operative mouth opening of 31.5 mm. However, the massive difference in our results may be attributed to the fact that 50% of our cases had nil mouth opening pre-operatively. Karaca et al. [15] have used custom-made inverted T-shaped silicone implants for 10 years. The cause of ankylosis was trauma in all patients. The mean pre-operative interincisal opening was 7 mm and post-operative 23.1 mm. The authors obtained excellent long-term post-operative results in six patients. Jones [16] also used alloplastic material for reconstruction of TMJ. The results of this study show an increase in mandibular opening from the pre-operative average of 14.4 mm to an average opening of 29.7 mm post-operatively. Gerbino et al. [13] also found that occlusion remained unchanged in nine out of 12 cases. In two cases, the occlusion was changed by means of custom prostheses design. In one patient, occlusion worsened with less stable functional contact. In two of our cases, we recorded an open bite 1 week post-surgery which settled down without any intervention later.

Pain was not a major pre-operative finding in this population of patients for treatments as against other conditions indicated for ATMJR. Post-operatively, no patient reported of significant pain 3 months after surgery, a finding similar to Gerbino et al. [13]. Deviation on mouth opening, lateral excursions to the unaffected side and facial nerve function have not been assessed in any study published in the literature.

Specifically, the Biomet system has some limitations such as limited translation, development of debris secondary to function [17], pre-defined size of the implant and unknown finite life expectancy [18]. However, a stock prosthesis has specific advantages including single-stage surgery, immediate availability, lower cost, and no necessity for a stereolithic model from a hospital-grade computed tomography (CT) scan. In addition, as operator experience progresses, the length of the surgical procedure and the overall complication rate will decline [19].

Though no major complications were encountered in our patients, Giannakopoulos [19] reports a failure rate of 3.2% (14 out of 442) due to infection or heterotopic bone formation. Based on our study, we recommend the use of stock ATMJR in patients with TMJ ankylosis, especially those with late onset, since it can be effectively combined

Table 2 Follow up data of the Outcome Parameters

Case	Affected side	Maximal interincisal opening (in mm)						TM joint pain on affected side					Lateral mandibular excursions to the unaffected side (in mm)				
		Pre sure	Post-surgery					Post-surgery					Post-surgery				
			1 week	1 month	3 months	6 months	1 year	1 week	1 month	3 months	6 months	1 year	1 week	1 month	3 months	6 months	1 year
1	Lt	2	32	33	30	30	30	5	2	0	0	0	6	6	6	6	5
2	Lt	7	35	32	32	28	28	6	3	0	0	0	7	6	6	5	5
3	Lt	2	37	35	35	35	35	5	2	1	0	0	6	6	6	6	6
4	Rt	Nil	33.5	33.5	30	30	28	4	3	1	0	0	8	7	6	5	5
5	Lt	Nil	35	35	35	35	35	5	1	0	0	0	7	7	7	7	7
6	Rt	5	41	39.5	38	38	35	5	3	0	0	0	7	6	6	5	4
7	Rt	Nil	30	30	28	28	28	2	1	1	0	0	4	4	4	4	4
8	Rt	Nil	40	39	39	36	36	4	2	0	0	0	7	7	8	8	8

Case	Affected side	Deviation on mouth opening					Occlusal discrepancy					Neuromotor deficit				
		Post-surgery					Post-surgery					Post-surgery				
		1 week	1 month	3 months	6 months	1 year	1 week	1 month	3 months	6 months	1 year	1 week	1 month	3 months	6 months	1 year
1	Lt	5	5	5	5	5	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
2	Lt	6	5	4	3	2	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
3	Lt	4	3	3	3	3	1-mm open bite on affected side	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
4	Rt	10	8	8	8	8	1-mm open bite on contralateral side	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
5	Lt	8	8	6	7	7	Nil	Nil	Nil	Nil	Nil	Paresis of temporal branch	Paresis of temporal branch	Complete recovery	Nil	Nil
6	Rt	5	5	5	5	5	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	Rt	4	6	5	3	2	Nil	Nil	Nil	Nil	Nil	Paresis of marginal mandibular branch	Paresis of marginal mandibular branch	Paresis of marginal mandibular branch	Complete recovery	Nil
8	Rt	8	6	7	5	5	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

with minor surgical procedures like genioplasty to correct minimal facial deformities, if any.

Conclusion

ATMJR has been found to be an effective treatment of TMJ ankylosis, especially in patients with completed growth during presentation. The post-operative morbidity and complications appear to be minimum, leading to this being a promising alternative to autogenous grafting for TMJ reconstruction.

Compliance with Ethical Standards

Conflict of interest All authors declare that there is no conflict of interest.

Ethical Approval This article does not contain any studies with animals performed by any of the authors.

Human and Animal Rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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