Disc Anchoring with an Orthodontic Mini-Screw for Chronic Meniscocondylar Dislocation of TMJ

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Abstract

Introduction Various surgical modalities have been tried for the correction of chronic recurrent dislocation of the temporomandibular joint. However, most of these techniques are aimed at creating an artificial block or removing any interference in the path of the translating condyle. Chronic dislocation can also be classified as meniscotemporal and meniscocondylar, depending upon whether the dislocation occurs between the condyle–disc unit and temporal bone (meniscotemporal), or between the disc and condyle (meniscocondylar). Very few procedures address the primary issue of a malpositioned disc, which is the cause of meniscocondylar dislocation.

Materials and Methods This study was conducted on 17 patients (27 joints) who reported with chronic dislocation of the temporomandibular joint, with MRI-proven meniscocondylar dislocation. After exposure of the condyle and disc through a standard pre-auricular incision, an orthodontic mini-screw was fixed to the posterior aspect of the condylar head and a 1-0 Prolene suture passed through the screw-head eyelet, plicating the posterior edge of the disc to the condyle. This ensured that the condyle and disc would move in unison.

Results All the patients showed improvement in their symptoms of dislocation in the postoperative period, including seven patients in whom only a unilateral procedure was carried out. None of the patients had any recurrence till the 1-year followup.

Conclusion Our procedure addresses the fundamental etiology of meniscocondylar dislocation by anchoring the disc to the condyle by using an orthodontic mini-implant and correcting the condyle–disc disharmony. This technique is reliable, technically feasible, and cost-effective in the Indian set up.

Keywords Dislocation · Temporomandibular · Chronic · Meniscocondylar · Disc · Mini-screw

Introduction

Dislocation of the temporomandibular joint (TMJ) is defined as an excessive forward movement of the condyle beyond the articular eminence with complete separation of the articular surfaces [1]. Anterior condylar dislocation may be classified as acute, chronic, recurrent (habitual), and long-standing. Acute dislocation is defined as a non-reducing displacement of the mandibular condyle in front of and superior to the articular eminence, resulting in the inability to close the mouth [2].

The terms ‘chronic’, ‘chronic recurrent’, or ‘habitual’ is reserved for repeated episodic dislocations [3]. The term ‘long-standing’ is applicable to those in whom it has lasted for more than a month. Subluxation is generally defined as displacement of the condyle out of the glenoid fossa and anterosuperior to the articular eminence, which can be reduced by the patient (self-reduced) [4]. In contrast, dislocation is a similar displacement of the condyle, which cannot be self-reduced. TMJ hypermobility refers to an

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increased range of motion with the ability of the condyle to translate freely over the peak of the articular eminence and back into the fossa [5].

TMJ dislocation was further described by Silver and Simon [6] as meniscotemporal or meniscocondylar, the former describing the more common dislocation of the condyle–disc unit in unison anterior to the articular eminence and the latter describing the condyle dislocated anterior to the posteriorly displaced meniscus.

Over the years, various surgical modalities have been tried for the management of recurrent chronic temporomandibular dislocation. Table 1 classifies the different surgical treatment options for chronic dislocation. Most procedures for the treatment of recurrent chronic dislocation do not address the condyle–disc discrepancy, but only attempt to create a block in the path of the translating condyle or limit excessive condylar translation. Only few procedures like meniscocondylar plication, meniscopexy and posterior tissue scarification primarily address the disc per se for chronic dislocation.

We describe a technique for the treatment of chronic meniscocondylar dislocation by anchoring the disc to the condyle using an orthodontic mini-screw.

Materials and Methods

This study was conducted on 17 patients (27 joints) who reported to the Department of Oral and Maxillofacial Surgery, Meenakshi Ammal Dental College and Hospital, Chennai with chronic dislocation of the temporomandibular joint between May 2009 and March 2013, who underwent surgical correction for the same. The age group of the patients ranged from 20 to 55 years and included 5 females and 12 males with a mean age of 34.8 years. Ten patients underwent bilateral joint surgery whereas 7 had unilateral joint surgery (Table 2). All patients had clinically proven symptoms of recurrent chronic dislocation (Fig. 1). Preoperative tomograms and MRI were taken for all patients to assess condyle position and assess disc relationship (Figs. 2, 3, 4). Postoperative tomograms were taken to assess condylar position. Preoperative and postoperative measurements of mouth opening and episodes of dislocation per month were documented.

Orthodontic titanium mini-implants/mini-screws served as bone anchors for re-positioning of the meniscus. These self-tapping mini-implants, originally developed for orthodontic anchorage, measured 1.5 mm in diameter and 8.0 mm in length. An eyelet in the screwhead allowed for placement of sutures (1-0 Prolene) for engaging the disc (Fig. 5).

The surgical approach [7, 8] to the joint was through a standard pre-auricular incision. An incision was made

Table 1 Classification of surgical procedures for treatment of chronic TMJ dislocation

Procedures for limiting translation

Anchoring procedures

Capsulorrhaphy
Capsular plication
Ligamentopexy
Flaps secured to capsule (temporalis muscle/fascia)
Autogenous (fascia lata), alloplastic (Dacron—Polyethylene terephthalate or Mersilene) slings between condyle and zygomatic arch
Securing disc to capsule and tragus cartilage
Upper synovial cavity ablation
Arthroscopic retrodiscal cauterization
Botulinum toxin injection into lateral pterygoid
Sclerosing agent injection
Alcohol
Rivanol (aethedicaïne)
Sodium monoruate
Sodium psyllate (Sylnasol)
Sodium tetradecyl sulphate
Muscle scarification
Autologous blood injection into joint space
PRP autologous injection

Myotomy procedures: Lateral pterygoid myotomy with silicone interposition with/without discectomy

Blocking procedures (arthroreisis procedures)

Soft tissue: Disc interference by an artificial lock
Hard tissue:
Eminoplasty with inlay or onlay bone graft/hydroxyapatite
Cartilage grafting of eminence
Osteotomy of eminence and downfracture
Glenotemporal osteotomy
Downfracture of zygomatic arch
Alloplastic
Silastic ('silicone plastic' elastomer) block
Vitallium (alloy of Co–Cr–Mo) mesh implant
'L' shaped plates
Titanium screw

Procedures to eliminate blocking factors in path of closure

Discectomy
Eminectomy
High condylectomy
Condylotomy (Open/closed)
Vertical ramus osteotomy
Midline mandibulotomy
Arthroscopic lavage of superior joint space

through skin and subcutaneous tissue to the depth of the temporalis fascia. A mosquito hemostat was used to dissect bluntly along the external auditory canal in an anterior-medial direction to the level of the temporomandibular

Table 2 Demographic data

S. no.	Age	Sex	Episodes/ month	Pain	Joint sounds	Deviation	Side operated	Mouth opening (mm)				Recurrence
								Preop	1-month Postop	6-month Postop	1-year Postop	
1.	53	F	5	No	Yes	No	B/L	54	31	33	37	None
2.	35	F	4	No	No	Yes	U/L	47	28	33	36	None
3.	45	M	3	No	Yes	Yes	U/L	51	30	35	36	None
4.	23	M	4	Yes	No	No	B/L	48	27	34	37	None
5.	48	M	5	No	Yes	No	B/L	53	31	33	38	None
6.	23	M	8	Yes	No	Yes	U/L	49	29	35	39	None
7.	55	M	5	No	Yes	Yes	U/L	47	28	33	34	None
8.	21	M	5	Yes	No	No	B/L	50	32	36	40	None
9.	27	F	8	Yes	No	No	B/L	51	30	35	38	None
10.	34	M	4	No	No	Yes	U/L	46	28	34	37	None
11.	20	M	7	Yes	No	No	B/L	48	31	35	38	None
12.	26	F	6	Yes	No	Yes	U/L	44	26	34	39	None
13.	36	M	4	No	No	No	B/L	52	33	35	37	None
14.	37	F	4	No	No	No	B/L	49	31	33	35	None
15.	29	M	7	Yes	No	Yes	U/L	46	28	32	33	None
16.	48	M	5	No	Yes	No	B/L	53	30	34	36	None
17.	33	M	7	Yes	No	No	B/L	48	29	32	35	None

Fig. 1 Preoperative mouth opening in bilateral dislocation

joint capsule. Usually a vein crosses the lateral aspect of the articular fossa, and this vein is a visual landmark for identifying the correct depth to the capsule.

The surgeon may find it helpful to palpate the lateral pole of the condyle continually while constantly moving the mandible to ascertain the exact position of the lateral pole and the palpable capsular depression between the glenoid fossa and the lateral pole. Above the zygomatic arch, the superficial layer of the temporalis fascia was incised in an oblique line running from the tragus to the superior end of the skin incision, parallel to the temporal branches of the facial nerve. A vertical incision was made along the root of the zygoma through the temporalis fascia and the periosteum. This was contiguous with the incision

superior to the arch. With blunt hemostat dissection, a plane was developed through this incision, just above the white, glistening temporomandibular joint capsule.

A horizontal incision was made over the zygomatic arch at the attachment of the capsule to the periosteum. The opening was extended anteroposteriorly by cutting along the lateral aspect of the eminence and fossa. With the mandible distracted inferiorly, pointed scissors entered the upper joint space anteriorly along the posterior slope of the eminence. The blade was angled superiorly at approximately 45° to prevent any iatrogenic damage to the disc as it courses over the lateral pole, attached to the capsule. An assistant may depress the posterior teeth inferiorly to increase the joint space during this maneuver. The small hemostat may be used to widen the opening into the superior joint space. The egress of synovial fluid should confirm immediately that the surgeon is in the superior joint space. Incision into the inferior joint space was made on the neck of the condyle, just above the inferior attachment of the lateral discal ligament. The incision was made with a number 15 blade to avoid cutting the disc and to allow the hemostat to pass up and over the condyle. Care was taken not to damage the fibrocartilage covering on the condyle.

After exposure of the disc (Fig. 6), right-angled vascular clamps were used to clamp the anterior and posterior attachments of the retrodiscal tissue and a full wedge of retrodiscal tissue removed. Clamping provided both

Fig. 2 Preoperative tomogram showing condylar dislocation

Fig. 3 Preoperative CT showing condylar dislocation

hemostasis and control of the soft-tissue edges. Care should be taken not to remove an excessive amount of retrodiscal tissue.

It is not necessary to strip soft tissue from the posterior surface of the condyle for anchor placement. Initially a 701 pilot drill was sunk through the periosteum to maximize soft tissue attachment and blood supply to the condyle. Then the titanium mini-screw was driven through this pilot

hole and anchored 8–10 mm below the articulating surface of the condylar head just lateral to the mid-sagittal plane [9, 10] until the eyelet component of the anchor alone projected over the posterior surface of the condyle (Fig. 7).

The disc was then repositioned posteriorly and 1-0 Prolene suture passed through the posterior cut surface of the disc in a horizontal mattress fashion and threaded through the eyelet of mini-screw head (Fig. 8). The suture

Fig. 4 Preoperative MRI showing abnormal disc position

was tightened, thus anchoring the disc to the mini-screw (Fig. 9). Condylar movements were carried out intraoperatively by manipulation to assess the new disc position and function.

Results

All patients showed improvement in their symptoms of dislocation in the postoperative period (Fig. 10), including the 7 patients in whom only a unilateral procedure was carried out. A postoperative tomogram was carried out in

the closed- and open-mouth positions to assess the position of the mini-screw and ascertain condylar translation. It showed normal condylar function with no evidence of dislocation (Figs. 11, 12).

The difference in the preoperative and postoperative mouth opening was statistically analyzed. The mean preoperative mouth opening was 49.2 mm. The mean 1-month, 6-month and 1-year postoperative mouth openings were 29.5, 33.8 and 36.7 mm respectively (Table 2). A 'paired *t* test', set at a confidence level of 95 %, was carried out using SPSS statistics software to compare the statistical difference in preoperative and postoperative mouth opening, to assess the effectiveness of the procedure on condylar translation (Table 3). The results were highly significant ($p < 0.001$) for the amount of reduction in condylar subluxation and hypermobility at the 1-month, 6-month and 1-year postoperative intervals.

Discussion

The purpose of this study was to evaluate the efficacy of disc re-positioning and anchorage with an orthodontic mini-screw for the treatment of chronic meniscocondylar dislocation. The stability of any joint depends on 3 factors: (1) the integrity of the ligaments associated with the joint (2) the activity of the musculature acting on the joint and (3) the bony architecture of the joint surfaces [11]. Both dislocation and subluxation are caused by internal derangements of the TMJ, weakening of the capsular ligaments, occlusal disharmony, masticatory muscle dysfunction and atrophic eminence [12].

Nitzan [2] described a phenomenon of condylar or meniscotemporal dislocation and 'open lock' or meniscocondylar dislocation. A prerequisite for 'open lock', is

Fig. 5 Schematic diagram showing disc anchoring technique

Fig. 6 Disc exposed after dissection into inferior joint space

Fig. 7 Miniscrew fixed on the posterior aspect of condyle

the positioning of the condyle in front of the disc. This may occur when the disc which normally moves together with the condyle, lags behind the condyle to the point where the condyle is displaced in front of the disc under the eminence and unable to return back to the fossa. According to Nitzan, in open-lock, the condyle is trapped in front of the folded lagging disc and cannot return to the fossa. Slow sliding of

the disc may occur as a result of increased friction between the sliding disc and the fossa in the upper compartment. He used a nonsurgical technique of arthroscopic lavage of the upper compartment for release of the disc. This enabled re-establishment of the simultaneous sliding of the disc with condyle by rehabilitation of the lubrication system, thus preventing the condyle from getting trapped in front of the

Fig. 8 Sutures passing through posterior disc edge and miniscrew

1-0 Prolene sutures passing through posterior aspect of disc and orthodontic mini-screw

Fig. 9 Disc anchored to miniscrew after sutures tightened

Posterior aspect of disc anchored to orthodontic mini-screw with 1-0 Prolene

disc. Our technique surgically repositions the disc and anchors it to the condylar head.

Weinberg and Cousens [13] proposed a technique of meniscocondylar plication for the surgical correction of the ectopic temporomandibular disc by repositioning the

disc and securing it with a Mersilene suture to the lateral surface of the condyle.

Mehra and Wolford [9] described a procedure for the treatment of internal derangements of the TMJ in 105 patients, where they used a Mitek screw anchor to

Fig. 10 Postoperative mouth opening in bilateral dislocation

reposition the anteriorly displaced disc with 0-Ethibond sutures. Our procedure is similar to the technique described by the same authors, except that we used an orthodontic mini-screw instead of a Mitek screw. Although not designed for temporomandibular joint surgery, we consider the innovative use of a mini-screw for disc anchoring technically more feasible and cost effective. In our unit, we initially used the mini-screw technique to treat anterior disc displacement for internal derangements of the TMJ; however, we found the same to be equally effective in treating chronic dislocation as well. Valero et al. [14] also carried out meniscopexy with Mitek mini-anchor in 6 patients with anterior disc location and chronic subluxation in their series of 50 patients with internal derangement.

Fig. 11 Postoperative tomogram showing no condylar dislocation

Fig. 12 Postoperative CT showing no condylar dislocation

Internal derangement is the etiologic factor in cases of meniscocondylar dislocation [6]. Condyle–disc disharmony is inherent to internal derangements; hence by repositioning the disc and rectifying the internal derangement, we aim to address dislocation as well. By repositioning and securing the disc to the condyle, we aim to minimize condylar–disc conflicts that may cause chronic dislocation. We found significant improvement in subluxation in the 1-month postoperative period with stable results up to the 1-year postoperative period (Table 3). The gradual increase in the mouth opening from the immediate postoperative to the 1-year followup could be attributed to the ensuing laxity of the capsule.

Ohnishi [15] described an arthroscopic technique for posterior disc repositioning for the treatment of recurrent dislocation and hypermobility by posterior tissue

Table 3 Paired ‘t test’. Preoperative and postoperative mouth opening

Mouth opening (mm) <i>Preoperative vs</i>	Paired differences					t	Degrees of freedom	Significance (2-tailed)
	Mean	Standard deviation	Standard error of mean	95 % confidence interval of the difference				
				Lower	Upper			
1-month postoperative	19.64706	1.86886	.45327	18.68618	20.60794	43.346	16	.000
6-month postoperative	15.29412	2.82322	.68473	13.84255	16.74568	22.336	16	.000
1-year postoperative	12.41176	3.10360	.75273	10.81604	14.00749	16.489	16	.000

scarification and disc plication to limit condylar translation. Torres and McCain [5] carried out arthroscopic electrothermal capsulorrhaphy for the treatment of recurrent temporomandibular joint dislocation and concluded that electrothermal shrinkage of the posterior TMJ capsule and attachments, effectively limited forward translation of the mandibular condyle and ultimately prevented dislocation or painful subluxation.

In our study, the capsular plication/capsulorrhaphy carried out during capsular closure further ‘tightens’ the capsule, thus preventing dislocation from a lax capsule since laxity of the capsule is one of the contributing factors for chronic dislocation.

According to Weinberg and Cousens [13], the rationale for their procedure of meniscocondylar plication to the lateral aspect of the condyle was based on the concept of intracapsular decompression. They concluded that their surgical technique achieved a more anatomically precise and secure disc–condyle relationship. They also cautioned against excision of an excessive amount of posterior attachment tissue combined with meniscocondylar plication as it might markedly restrict condylar translation.

Their technique of meniscocondylar plication, while it permitted absolute movement between the disk and the temporal bone, virtually eliminated any relative movement between the disk and the condyle. By reducing the volume of the inferior joint space and increasing the capacity of the superior joint space, it essentially converted a diarthrodial joint to a monoarthrodial joint in which both hinge (ginglymoid) and sliding (arthrodial) condylar movements occurred in the superior joint space [13]. In our study too, anchoring the disc to the condyle essentially confined all condylar movements to the superior joint space.

Fields, Cardenas and Wolford [16] studied the pull-out strength of Mitek mini-anchors inserted in 20 human cadaver condyles, demonstrating an average pull-out load of 16.0 lb (range 8.5–28.4 lb). The pull-out strength of the orthodontic mini-implants range between 17.8 and 66.3 lb [17], and this strength appeared to be more than adequate to stabilize the disc to the anchor along with condylar

movement. Zhang et al. [18] used self-tapping titanium screws of 5 mm, which were originally developed for use in orthopedic surgery procedures, to serve as disc anchors. They used 2 screws, on the medial and one on the lateral aspect of the condyle respectively, and repositioned the disc posteriorly with Ethibond sutures.

Another factor to be considered in subluxation is the influence of the muscles of mastication. Naidoo [19] studied the anatomy of the lateral pterygoid in 40 cadaveric dissections and found that the IHLP (inferior head of the lateral pterygoid) inserts into the condylar neck and capsule, and the SHLP (superior head of the lateral pterygoid) has a complex insertion into the condyle and the disc–capsule complex. Based on MRI findings, Omami and Lurie [20] classified the anatomy of lateral pterygoid based on the insertion of the superior head. Type I: the superior head of lateral pterygoid inserted solely into the disc and Type II: the superior head of lateral pterygoid inserted into the disc and condyle. In our study, 1-0 Prolene sutures securing the meniscus to the condyle act as artificial ligaments, counterbalancing the influence the lateral pterygoid has on the anterior displacement of the disc and condyle.

Unlike the Mitek screw technique where the screwhead is flush with bone, our technique has the disadvantage of the orthodontic mini-screw head protruding from the surface of the condyle, but we have not encountered any complications or interference in condylar function with this. However, considering the overall advantage in terms of cost factor and technical feasibility of using the mini-screw, we consider this disadvantage acceptable.

Almost all surgical procedures for the disc are aimed at correction of internal derangements of the TMJ. Very few surgical procedures for correction of chronic TMJ dislocation address the disc, except for the techniques of meniscocondylar plication by Weinberg and Cousens [13] meniscopexy by Valero [14], and posterior tissue scarification by Ohnishi [15]. The technique described by us also primarily addresses the disc for chronic dislocation.

In summary, our technique aims to correct meniscocondylar dislocation in the following 3 ways:

1. By anchoring the disc to the condyle, we aim to minimize condyle–disc conflicts. The condyle and disc would move as one unit, preventing meniscocondylar dislocation.
2. A capsulorrhaphy or capsule-tightening procedure reinforces the joint capsule around the condyle and disc, maintaining their anatomical relationship.
3. The posterior disc repositioning and securing it to the condyle would counter the anterior pull of the lateral pterygoid on the disc and condyle.

Conclusion

Our procedure addresses the fundamental etiology of meniscocondylar dislocation by anchoring the disc to the condyle and correcting condyle–disc disharmony. It is a reliable and cost-effective technique in our setup with predictable long-term stability.

Human and animal rights The treatment plan and surgical protocol was reviewed and approved by the Ethics Review Committee of our institute and informed consent was obtained for all patients. No animals were used in this study.

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