Review Article

Intra-articular disc surgery

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Abstract: Internal derangements (ID) of the temporomandibular joint (TMJ) can be present both in symptomatic and asymptomatic individuals. Accurate diagnosis forms the basis of treatment planning and effects the outcomes. Medical or non-surgical management is the first line of treatment in most cases. Surgical intervention is currently reserved for the patient who is symptomatic, dysfunctional and does not respond to non-surgical management. Exact guidelines on the timing of intra-articular disc surgery, as well as the type of surgery, are debatable. The various types of intra-articular disc surgery involve lysis & lavage, disc repositioning and discectomy. All these techniques have been reported in the literature as being successful. Current evidence supports use of minimally invasive procedures such as arthrocentesis/arthroscopy followed by arthrotomy based procedures in cases that do not respond. Advances in operative arthroscopy enable the surgeon to perform procedures such as discopexy which were traditionally performed via an arthrotomy. Hence use of arthroscopy has decreased the need for arthrotomy based procedures in general. This chapter reviews the available evidence to help arrive at an evidence-based decision regarding the indications for the various intra-articular disc surgeries. Treatments for the broader aspects of temporomandibular joint disorders (TMDs) are covered in other chapters in this publication.

Keywords: Temporomandibular joint (TMJ); internal derangement (ID); disc surgery; discectomy; discopexy; bone anchors

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Introduction

Internal derangement (ID) of temporomandibular joint (TMJ) is defined as an abnormal relationship between the articular disc, condyle, and articular eminence (1). Asymptomatic anterior disc displacement (ADD) is present in about 30-40% of the population. Hence, it is considered by some as a variation of normal TMJ anatomy (2,3). A causal role for ADD in temporomandibular joint disorders (TMDs), including degenerative joint disease, remains debatable without long term studies based on higher level of evidence (4).

TMJ ID is managed initially with non-surgical methods such as pharmacotherapy, physical therapy, diet modification, and oral appliances; surgical treatment is limited to patients who do not respond to such management. Surgical treatment of TMJ ID includes arthrocentesis, and arthroscopic and arthrotomy-based procedures. Arthrotomy-based intra-articular disc surgery, including discopexy and discectomy, continue to be an important part of armamentarium for the TMJ surgeon and the choice between the two is commonly based on the anatomical as well as functional status of the disc and Wilkes staging of the TMJ ID. However, the past decade has shown an increased use of non-surgical treatment modalities, as well as minimally invasive surgical modalities for managing TMJ ID such as arthrocentesis and arthroscopy, which has led to a decreased need for arthrotomy-based surgical procedures

Persistent pain, clicking and limitation in mouth opening are common signs and symptoms in patients with TMJ ID. Accurate diagnosis based on a thorough history, clinical examination and radiographic evaluation is essential in selection of patients who are candidates

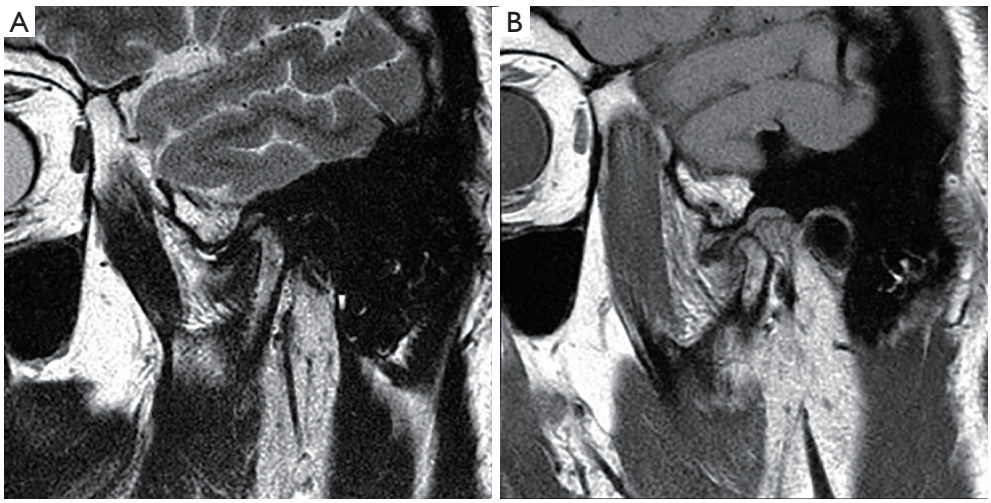

Figure 1 (A) MRI of the temporomandibular joint in the closed mouth view shows anterior disc displacement and a moderate amount of condylar flattening and osteophyte formation. (B) Open mouth view shows anterior disc displacement without reduction.

for surgical intervention. Although the exact etiology is unknown, TMJ ID is presumed to be secondary to factors such as micro or macro-trauma, laxity of the joint soft tissues, parafunctional habits, and changes in the synovial fluid composition (5-7). Patients with a significant component of primarily myofascial pain may not respond well to surgical treatment. Hence, it is essential to identify such patients from among those who are indicated for intra-articular disc surgery. Diagnosis and management of myofascial pain and dysfunction is covered in a related chapter in this publication and will not be presented here.

Diagnosis

Diagnosis of TMJ ID is based on combination of a detailed history, clinical examination, imaging and laboratory evaluation. MRI of the TMJ remains the standard imaging modality in the diagnosis of ID. MRI shows the position and shape of the intra-articular disc in the open and closed mouth position, joint effusion, and any degenerative changes in the joint (*Figure 1*). However, bony changes are better assessed with computed tomography (CT) or a cone beam CT (CBCT) scan. Patient's subjective report of TMJ clicking can a clinical sign indicating disc displacement, but other noise-causing etiologies such as hypermobility of the TMJ or joint pathology should be ruled out. Commonly used staging for progression of TMJ ID is the Wilkes classification (8).

Selection of intra-articular disc surgery

Disc repositioning

A displaced disc in a dysfunctional TMJ indicated for surgical intervention is either repositioned/repaired or removed. Disc repositioning was first described in 1887 by Annandale but was popularized after 1979 by McCarty and Farrar (9). The technique has since been modified by numerous other authors. Repositioning of the displaced TMJ disc (discopexy) with good structure and mobility has been reported to have high success rates (80–94%) in several retrospective studies (9-17). Currently available evidence supports salvaging the disc when possible (10,18,19). However, long-term follow-up studies after disc repositioning have shown that the abnormal disc position may persist despite improvement in clinical signs and symptoms (19). A retrospective survey-based long-term study with a mean of 20 years follow-up (range of 18–22 years) on patients who underwent disc repositioning (18 patients, 36 joints) showed 94% improvement in quality of life and 77% reduction in pain at rest. Only 1 patient requiring subsequent surgery, which was attributed to a post-traumatic malocclusion (20).

Conventionally, intra-articular disc surgery is performed via arthrotomy-based approaches with endaural or pre-auricular incisions, but arthroscopic discopexy has evolved significantly and reported to be similarly effective as arthrotomy-based procedures (21). Although the literature supporting disc repositioning and repair shows high success rates, there are still questions regarding the variability

among surgical techniques, proper patient selection, length of follow up, concomitant orthognathic surgery, etc. (22,23).

Arthroscopic discopexy

Operative arthroscopy has become increasingly popular in the last decade. Being a minimally invasive procedure, it has the advantage of smaller scars and lower risk of facial nerve injury as opposed to arthrotomy-based procedures, but requires a greater learning curve. Arthroscopic discopexy was initially reported by Israel (1988), Tarro (1989), and McCain (1992), but several other authors have reported variations in the technique with an aim to simplify it or improve the stability of the disc and hence the clinical outcome (24-28).

Fixation methods used in arthroscopic discopexy include sutures, resorbable pins and bone anchors. In a prospective study by McCain using a single suture-based arthroscopic discopexy, the outcomes after an average of 12 months follow-up were compared based on the Wilkes classification stage of TMJ ID (21). It showed 86.7% success rate for the Wilkes II and III stages as compared to 25% for the Wilkes IV and V stages. Another study by Goizueta Adame *et al*. studied 16 patients with TMJ ID who underwent arthroscopic discopexy with a double suture technique and had MRI obtained at 1-year follow-up (11). Although the clinical outcome showed a significant decrease of pain and improvement in mouth opening, only 4 of the 16 patients showed normal disc position at 1-year MRI while 13 of the 16 showed improved disc position compared to the preoperative condition. Most studies have a follow-up of up to a year, and the efficacy and stability of arthroscopic discopexy in the long-term is not well supported.

A retrospective cohort study on 211 patients (270 TMJs) examined the occurrence and course of postoperative malocclusion after an arthroscopic discopexy (29). It was noted that 100% of patients had an ipsilateral open bite that resolved on its own in most of the cases within 28 days, but those who continued to have a malocclusion beyond 49 days (14.2%) required additional measures to correct the occlusion. Most patients with persistent malocclusion were among the older age group, which supports the role for lower tissue adaptability with increasing age. This malocclusion was presumed to be secondary to the forward displacement of the condyle by the discopexy and resulting overlap of fibrosed retrodiscal tissue, effusion in the superior joint space immediate postoperative increase in the joint space after the disc is repositioned in the fossa. On the contrary, patients with pre-existing class II malocclusion and open bite showed improvement in their occlusion (29).

Arthrotomy-based discopexy

Discopexy or disc repositioning with an arthrotomy-based approach is also reserved for patients who have failed non-surgical management or if they did not respond to arthrocentesis or arthroscopic lysis and lavage. Since the first report, arthrotomy-based discopexy technique has been widely used with several variations in technique and fixation methods (30). It is conventionally performed via endaural or preauricular approach. A retrodiscal band of tissue is excised, the anterior attachment of the disc is released and disc is repositioned and fixed with sutures through the posterior band to the adjacent periosteum or capsular tissues. Use of an orthopedic bone anchor to fix the disc in position has been become more common lately. This is based on the concept that the disc fixed to the condyle with a bone anchor does not rely on the integrity of the retrodiscal tissue for reattachment and that it provides a more stable disc position. Bone anchors are commonly placed 8-10mm inferior to the superior surface of condyle slightly lateral to the mid-sagittal plane on the posterior aspect of the condyle (18). Commonly used bone anchors include the Mitek anchor®, Arthrex, orthodontic mini-screws, and resorbable sutures (30-34).

A long-term retrospective study by Abromowicz *et al*. of 18 patients (36 joints) with a mean of 20-years follow-up (range of 18–22 years) after arthrotomy-based disc repositioning with sutures showed 94% improvement in quality of life and 77% reduction in pain at rest (20). A recent and only prospective randomized controlled trial to date on discopexy studied the use of a bone anchor versus a suture in 7 patients in each group diagnosed with ADD without reduction (31). The primary outcome studied was increase in MIO while the secondary outcomes studied were improvement in pain and lateral excursion in the immediate postoperative state and at 3-, 6-, and 12-month follow-up and disc position with MRI at the 12-month follow up. The study concluded that the improvement in MIO and decrease in pain was better in the bone anchor group, while disc position and lateral excursions were similar. Although the study is a prospective randomized trial, the major drawback is the low number of subjects, which makes the conclusions unreliable. Furthermore, there is no mention of the severity of the ID based on a standardized classification such as the Wilkes, which makes it difficult to compare the outcomes of

the two groups.

Multiple authors have studied stability of disc position and condylar changes after discopexy with magnetic resonance imaging (MRI). Zhang *et al*. had a 96.3% success rate for stability of the disc position in all three planes among 77 of 81 patients with Wilkes stage III to V ID who underwent arthrotomy-based discopexy using bone anchors (32). However, MRI evaluation was done between 1–7 days postoperatively. Rajkumar *et al*. found stable position of the disc without any arthritic joint changes in 10 patients assessed with an MRI at 6 months after arthrotomy-based discopexy with orthodontic mini-screws (33). In another study by Zhou *et al*. on 149 patients, 4.7% of them relapsed with anterior disc displacement in 2 years following discopexy (34). Although several such studies proved the disc position to be stable in a large number of patients in short-term, it is difficult to support reproducibility of such results in long term follow-up. Furthermore, due to the inherent variation in techniques among surgeons, everyone may not have the same results.

Gonçalves *et al*. studied the effect of TMJ articular disc displacement on patients undergoing counterclockwise maxillomandibular movement during orthognathic surgery. They found that the subgroup of patients who had anterior disc displacement pre-orthognathic surgery and underwent orthognathic surgery only without simultaneous discopexy showed 28% relapse at Point B and 34% relapse at the lower incisor attributable to condylar changes (35).

Patients undergoing TMJ discopexy for ADD are often reported to show postoperative ipsilateral posterior open bite, which is presumed to be due to increase in joint space. There is no clear consensus on management of this postoperative malocclusion and treatment has varied from orthodontic therapy, an occlusal guard, to simultaneous mandibular sagittal split osteotomy (35). Orthodontic treatment has been said to be counterintuitive as it loads the joint with class III elastics. Unloading the TMJ during the immediate postoperative period after discopexy has been recommended universally to avoid relapse of the disc to an anterior position. Wang *et al*.'s study on postoperative malocclusion after arthroscopic discopexy found that the disc undergoes remodeling to decrease the joint space and may even achieve its original biconcave shape on sagittal view. Therefore, it may only be a temporary condition not requiring surgical correction. Moreover, the previously mentioned prospective randomized trial on arthrotomy-based discopexy on 14 patients using bone anchors in 7 and sutures in the other half found no postoperative malocclusion in either group (31).

Discectomy and replacement

Discectomy is conventionally reserved for a dysfunctional, deformed, immobile disc with or without perforation. Efficacy of discectomy in reducing pain and dysfunction at long-term follow-up is supported by several retrospective studies (36-40). The suggestion by some authors that discopexy eventually leads to discectomy is not well supported (41). In general, studies on surgical management of TMD have the drawback of heterogeneity, low number of subjects, variability in study design, and short-term follow- up. Association of discectomy with subsequent degenerative joint disease is based on morphologic changes such as condylar flattening, osteophyte formation, and reduction in joint space following discectomy (42-46). These bony changes in the condyle after discectomy have been reported to become quiescent with time (44). Given that these condylar changes are also seen in unoperated joints, contralateral TMJs in patients with unilateral discectomy and when disc is replaced with autogenous grafts, it is suggested that these could be adaptive rather than pathologic changes (40,47).

This association of degenerative changes in the condyle with/without persistent symptoms in some patients after discectomy led to the development of the disc replacement concept (46). Both autogenous and alloplastic disc replacement options have been used. Alloplastic disc replacement is mostly abandoned at this time due the adverse outcomes, including foreign body reactions, fragmentation, condylar resorption, etc. (48,49). Silastic and Proplast-Teflon (Vitek, Inc, Houston, TX) disc replacements that were reported to have a high success rate in the short term were then found to cause a foreign body giant cell reaction resulting in severe bone resorption (50-52). The FDA has cautioned against use of silicone as TMJ implant, while Proplast-Teflon is off the market since 1988 (53).

Autogenous TMJ disc replacement options continue to be used given their biocompatibility, availability, and lack of adverse events such as those related to their alloplastic counterpart. The temporalis flap is the most frequently used replacement. This flap is accessed via an extension of the preauricular incision used to access the TMJ, whereas other the other options require an additional surgical site (auricular cartilage graft, dermal graft, abdominal dermal-fat graft). Kramer *et al*. in a meta-analysis compared discectomy without replacement to discectomy with various autogenous

interpositional grafts. Comparable mean success rates in terms of pain relief and increase in mouth opening were found for all groups (Discectomy alone: 86.5%, Temporalis flap: 91.4%, Auricular cartilage graft: 82.4%, Dermal graft 87.9%) (54). Based on these findings there seems to be no superiority of interpositional grafts over discectomy alone for the purpose of treating TMJ ID. Tissue engineered disc replacements are still in nascent stages of development without studies on clinical use.

Conclusions

The results of intra-articular disc surgery are promising, but long-term studies with higher levels of evidence are required to prove superiority of one treatment method over the other. Minimally invasive procedures such as operative arthroscopy and regenerative therapies may become the norm going forward, but further investigations into clinical applicability, training, costs and availability of instrumentation can be a barrier. Intra-articular disc surgery for ID of the TMJ should only be considered in cases where non-surgical options fail. However, the duration of non-surgical management prior to surgical intervention is uncertain. A prospective randomized controlled trial with long-term follow-up comparing non-surgical management, arthroscopic disc surgery and arthrotomy-based surgical options is highly required. Although most TMJ surgical techniques, both minimally invasive and open approaches have been claimed to be successful, each should be considered based on the clinical diagnosis, stage of disease and changes in disc morphology, type of derangement and surgeons' training.

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