

# Internal derangements of the temporomandibular joint: A review of the anatomy, diagnosis, and management

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## Abstract

Internal derangements of the temporomandibular joint are conditions in which the articular disc has become displaced from its original position the condylar head. Relevant anatomic structures and their functional relationships are briefly discussed. The displacement of the disc can result in numerous presentations, with the most common being disc displacement with reduction (with or without intermittent locking), and disc displacement without reduction (with or without limited opening). These are described in this article according to the standardized Diagnostic Criteria for Temporomandibular Disorders, as well as the less common posterior disc displacement. Appropriate management usually ranges from patient education and monitoring to splints, physical therapy, and medications. In rare and select cases, surgery may be necessary. However, in for the majority of internal derangements, the prognosis is good, particularly with conservative care.

**Key Words:** Disc displacement, internal derangement, posterior disc displacement, temporomandibular disorders

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## INTRODUCTION

“Temporomandibular disorders” (TMDs) is a collective term for conditions that involve pain and/or dysfunction of the temporomandibular joint (TMJ), and the related structures.<sup>[1]</sup> An estimated 8–15% of women, and 3–10% of men currently suffer from TMD.<sup>[2]</sup> Most TMDs involve either muscular or skeletal structures or both.

## TEMPOROMANDIBULAR JOINT ANATOMY

A review of the structure of the TMJ will provide a context for discussion of TMJ disorders.

The TMJ allows movement of the mandible, or lower jaw, relative to the maxilla, or upper jaw. The mandibular portion of the joint is composed of the mandibular condyle. The articulating head of the condyle is oblong, being longer medio-laterally than antero-posteriorly. The long axis of the condylar heads is angled and hence that the medial poles point slightly posteriorly, toward the foramen magnum.<sup>[3]</sup>

The mandibular condyle articulates against the mandibular fossa of the temporal and tympanic bone, at the base of the skull.<sup>[3]</sup>

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Both the TMJ condyle and fossa are lined with fibrous connective tissue.<sup>[4]</sup> This differs from most joints elsewhere in the body, which are usually lined with hyaline cartilage. Fibrous connective tissue shows comparatively less damage over time and has better repair properties.<sup>[5]</sup>

Between the TMJ condyle and fossa, at the 11:30–12:30 position on the condyle,<sup>[6]</sup> is an articular disc, also made of dense fibrous connective tissue. It has a biconcave shape, with the thinnest portion near its center. The posterior border is thicker than the anterior border, and the medial border is thicker than the lateral border. These thicker borders aid in keeping the disc in place atop the round condylar head.<sup>[5]</sup>

The articular disc is also held in place by additional soft tissues attached circumferentially. At the posterior portion, the retrodiscal tissue is attached. It is composed of three basic parts. The superior section is made of the elastic fibers of the superior retrodiscal lamina. This lamina attaches from the articular disc to the tympanic plate. The inferior section of the retrodiscal tissue is made of the collagenous fibers of the inferior retrodiscal lamina. This lamina attaches from the articular disc to the mandibular condyle. Between these two lamina is the venous plexus, which fills with blood during protrusion of the mandible.<sup>[3]</sup>

At the anterior portion of the articular disc, there are also three basic attachments. The superior section is attached to the temporal bone by collagenous fibers. The inferior section is attached to the condyle, also by collagenous fibers. Between the superior and inferior attachments is the lateral pterygoid muscle.<sup>[3]</sup>

The medial and lateral portions of the articular disc are attached to the condyle by collateral, or discal, ligaments.<sup>[3]</sup>

Additional ligaments attach to the TMJ, but because they are not directly involved in internal derangements, they will not be discussed in this review.

The endothelial cells of the synovial lining secrete synovial fluid. This fluid is pulled and pushed in from the boundaries to the spaces between the articular surfaces by joint movement.<sup>[5]</sup> Small-scale fluid movement also occurs with changes of pressure between the condyle and fossa. During rest, when pressure is low, the articular surfaces absorb small amounts of synovial fluid. When pressure increases, such as during clenching, the articular surfaces release the synovial fluid. Long-standing pressure can deplete this absorbed fluid.<sup>[7]</sup>

The TMJ allows mandibular movements in a hinge-like, or ginglymoid fashion. Roughly half of the maximum opening

is achieved by this motion. The TMJ condyle also slides, in an arthroïdial movement. The sliding motion allows the roughly second half of maximum opening, as well as the lateral, protrusive, and retrusive movements. This combination of hinge-like and sliding movements classifies the TMJ as a ginglymo-arthroïdial joint.<sup>[5]</sup>

The term “internal derangements” refers to conditions with the articular disc displaced from its original position on the mandibular condyle. There are several specific conditions, differentiated by the position of the articular disc during mandibular movement and nonmovement.

## **INTERNAL DERANGEMENTS OF THE TEMPOROMANDIBULAR JOINT**

In 2014, the Diagnostic Criteria for TMDs (DC/TMDs) was published,<sup>[8]</sup> following validation studies, and the names and descriptions of the different internal derangement conditions will be described here in accordance with that criteria. However, our descriptions here are only meant to briefly familiarize the reader with the different conditions. For more detail, please reference the original manuscript by Schiffman *et al.*

### **Disc displacement with reduction**

In disc displacement with reduction, the articular disc has displaced anterior to the condylar head. It may also be displaced medially or laterally. The posterior most border of the disc is anterior to the 11:30 position of the condylar head. The disc remains in this position as long as the mouth is closed. When the mouth is opened, the disc is re-situated on the condylar head. The movement of the disc onto and off the condylar head may result in a clicking, snapping, and/or popping sound. This sound does not occur with every mandibular movement. Rather, it should be heard by the patient at least once in the last 30 days and by the examining dentist during at least a third of the mandibular movements.

Because the disc reduces during condylar translation, range of motion is not limited. However, movements may not be as smooth as a normal TMJ because of the momentary sliding of the condyle on and off of the disc.

### **Disc displacement with reduction with intermittent locking**

This condition is identical to disc displacement with reduction, with the additional feature of intermittent limited mandibular opening on the occasions that the disc does not reduce.

### **Disc displacement without reduction with limited opening**

This diagnosis is given when the articular disc consistently does not reduce, resulting in limiting opening. Limited opening

is defined as <40 mm between maxillary and mandibular incisor incisal edges with opening assisted by the dentist. This maximum assisted opening range must have factored in the vertical incisal overlap at maximum intercuspal position. The percentage of displaced discs that reduce on opening is roughly similar to the percentage that does not reduce.<sup>[9]</sup>

### Disc displacement without reduction without limited opening

This condition is identical to the previous condition with the exception that mandibular movement is not limited. However, such limitation must have occurred in the past to the extent that eating was hindered. This condition typically follows the previous condition.

### Posterior disc displacement

Because this condition occurs so rarely (0.7–2.2% of patients with internal derangement<sup>[9]</sup>), little has been written on it. Westesson *et al.* described three different presentations: (1) A thin disc spans from the superior portion of the condylar head to posterior to the condylar head (2) a centrally-perforated disc is present, with a small portion anterior to the condylar head, and a larger portion posterior to the condylar head, and (3) the entire disc is posterior to the condylar head.<sup>[10]</sup> In a review by Okochi *et al.* of 4000 patients with suspected internal derangement, 84% had the first type, 16% had the second, and none had the third.<sup>[11]</sup>

With posterior disc displacement, disclusion of the posterior dentition occurs on the affected side, typically discluding approximately 1 mm. Midline deviation toward the affected side may not be seen.<sup>[12]</sup> Pain is present more often when the disc is perforated. Joint sounds occur more often in the thin disc type, with a click in approximately half of the cases. Open lock and TMJ luxation each occur in roughly a quarter of the cases.<sup>[11]</sup>

### MANAGEMENT

In general, management of TMJ-related conditions becomes necessary when pain or dysfunction are present.

Pain requires treatment for two reasons: (1) Pain is generally not acceptable to the patient, at least if it is more than mild in intensity, and (2) pain limits range of motion, and range of motion is needed to maintain fluid flow in the joint, and thus clearance of irritants. Fluid flow also maintains lubrication between the articular surfaces.

Dysfunction requires treatment for two similar reasons: (1) Dysfunction is generally not acceptable to the patient, at least if it affects eating and/or talking in more than a small way, and (2) dysfunction usually involves a limitation in range of motion, which can perpetuate damage.

### Disc displacement with reduction

Disc displacements often involve neither pain nor dysfunction, and, therefore, do not require treatment.<sup>[13]</sup> For patients with these nonpainful joint noises, an explanation and monitoring are appropriate. However, the suddenness of onset of pops and clicks, the relative loudness of these noises (apparently louder to the patient because of their close proximity to the ear), the perception of instability within the TMJ capsule and with mandibular movement, and the lack of any signs and symptoms like this before, can cause patient anxiety, even in the complete absence of pain and dysfunction. Such fears can be alleviated by discussing several points with the patient: (1) The anatomy behind the joint noises. This provides a context for subsequent discussion of their joint. It also clarifies the unknown for the patient, which alone can lessen their anxiety.<sup>[14]</sup> (2) This condition is common. Patients often are relieved to know that rather than being alone with a rare condition, many people experience the same signs and symptoms without any negative outcomes.<sup>[14]</sup> (3) No treatment is required.<sup>[15]</sup>

Monitoring is necessary, however. Though less common than not, disc displacement may be the result of TMJ changes that have not yet been detected, such as degenerative joint disease.

Displaced discs that are painful do require management. Recall that the two aspects of TMD that require management are pain and dysfunction. The pain in this particular TMD is due to inflammation within the joint, and both pain and inflammation are usually adequately managed with nonsteroidal anti-inflammatory drugs (NSAIDs). Any limitation in range of motion (dysfunction) in a reducing displaced disc would be secondary to pain since by definition a reducing disc does not physically block condylar movement. Therefore, the use of NSAIDs will also address the dysfunction. NSAIDs are generally effective for such pain.<sup>[16-18]</sup> NSAIDs can even be effective in a topical medium.<sup>[18]</sup> When insufficient, steroids can be used for a limited time.<sup>[19]</sup>

Some authors advocate the use of anterior repositioning appliances, so long as pain is present, and the clinician can reduce the disc.<sup>[20,21]</sup> When designing these appliances, the clinician guides the patient's mandible forward until the disc or discs are reduced. This protruded occlusion is then indexed into the appliance, which is usually a full-coverage maxillary design. The principle behind this maxillo-mandibular relationship is that maintaining a reduced disc prevents pinching of the retrodiscal tissue.

Some clinicians instruct the patient to wear the appliance full-time for 5–7 days, then gradually convert to night-time wear only. If possible, the appliance is gradually converted to a nonrepositioning design.<sup>[1]</sup> Limiting the duration of

anterior repositioning is important for reducing the likelihood of irreversible occlusal changes, such as a posterior open bite<sup>[22]</sup> (caused by shortening of the lateral pterygoid muscle, and resultant translation of the condyle anteriorly and caudally along the articular eminence). To further reduce the possibility of occlusal changes, some recommend avoiding any full-time wear, and allowing night-time wear only.

When fabricating anterior repositioning splints, it is important to bear in mind that they are not intended to permanently reduce the disc. The disc may be reduced for the short-term,<sup>[23]</sup> it does not usually persist in the long-term.<sup>[24]</sup>

### **Disc displacement with reduction with intermittent locking**

Management of this condition will depend on how often locking occurs. If locking is rare, and not a significant bother to the patient, it may be managed in the same way as disc displacement with reduction without intermittent locking. If the lock is frequent enough to be bothersome, the patient may wish to increase lubrication of the articular surfaces, in an effort to decrease the frequency of locking. This can be done by moving the mandible fully through all directions of movement (open, protrusive, retrusive, and laterotrusive) after capturing the disc. Usually, the disc can initially be reduced with lateral movements. The patient should then perform these mobilization exercises without allowing the disc to re-displace. Rolling a tube between the teeth during these movements can provide such control.<sup>[25]</sup>

### **Disc displacement without reduction with limited opening**

This condition requires management because dysfunction is present. In the acute stage, disc mobility may be restored by manual manipulation of the mandible by the healthcare provider. Okeson recommends grasping the mandibular molars both sides, with the thumbs bimanually. The unaffected side should be stabilized firmly, and the affected side pressed inferiorly to clear the height of the disc, and then brought anteriorly to seat the condyle on the disc. With the disc now reduced, the mandible is slid anteriorly and posteriorly to re-lubricate the surfaces.<sup>[5]</sup>

Even if mobility is not restored in the acute phase, a range of motion usually returns to normal, or close to normal, for reasons discussed below. However, in the meantime, condylar mobility remains limited. Limited joint movement results in limited synovial fluid cycling, allowing the accumulation of inflammatory agents, which can cause damage if present during a prolonged period of limited mobility. For this reason, exercises focused on a range of motion can reduce the risk of joint damage during that period.<sup>[26]</sup> Maneuvers such

as those described in this review under “Disc displacement with reduction with intermittent locking” by Yoda *et al.*<sup>[25]</sup> are appropriate for such purposes in a nonreducing disc. However, because the disc does not reduce, the maneuvers should instead be done only to the point of resistance.

The specific structures that are in pain in an internal derangement often include the retrodiscal tissue. Such pain is due to the condyle compressing the highly innervated and vascularized retrodiscal tissue against the articular fossa. The inflammatory response is painful, but the chronic trauma also leads to an adaptive response. The blood vessels and nerves of the tissue eventually become replaced with more fibrous tissue, resulting in what is sometimes called a pseudo-disc, which functions as a disc.

In cases where the patient is in significant pain and/or dysfunction, despite conservative efforts, arthrocentesis may be considered.<sup>[27]</sup> In this procedure, performed under local anesthesia, bupivacaine is injected into the region of the articular fossa to distend and anesthetize the superior joint compartment. A second needle is then inserted anteriorly, in the region of the articular eminence (also the inferior compartment) to allow outflow. Ringer’s solution is then flushed through the TMJ, from the superior-posterior region to the inferior-anterior region. This flushing removes degraded particles and inflammatory agents. Alternatively, the joint may be lavaged by simply placing both needles in the posterior region of the TMJ and injecting saline. The condyle is then moved through all directions, which lyses the adhesions and promotes lavage. Pain reduction and improvement in function with arthrocentesis are unpredictable, but the risks are lower than surgery, suggesting that this procedure be used before surgery is considered.<sup>[28]</sup>

Arthroscopy is a more aggressive procedure, performed with general anesthesia, involving the passage of a blunt trocar through the superior joint space to lyse adhesions. Yet while it is a surgical procedure, it is less aggressive than most other TMJ surgeries. Adverse reactions are usually transient. The outcomes appear to be more promising than arthrocentesis, with success rates of 78–90%.<sup>[27]</sup>

Arthroplasty is an open joint procedure. It may involve disc repositioning, articular surface recontouring, disc removal or a combination thereof. Its more aggressive nature increases the incidence and severity of complications. Swelling in the region of the TMJ, minor changes in occlusion, numbness, and limited range of motion are common, and usually resolve within weeks. Facial nerve injury, while less common, is the most serious complication. Inability to raise the eyebrow occurs 5% of the time, and for 1% of patients it is permanent. The

rest usually resolve within 3 months. Disc removal also may lead to TMJ ankyloses.<sup>[27]</sup>

Surgical intervention must be followed-up with rehabilitative care, or the condition will regress.<sup>[27]</sup> Furthermore, most repositioned discs become displaced again, though pain and dysfunction usually remain decreased.<sup>[29]</sup>

### Disc displacement without reduction without limited opening

Nonreducing displaced TMJ discs usually return to a satisfactory range of motion. In such cases, the displaced disc is found in a position where it does not obstruct condylar translation. It may be displaced far anteriorly, allowing a generous condylar slide before contact is made. The disc may also have become folded, making it more compact and less obtrusive.

### Posterior disc displacement

Very little has been written on the management of posterior disc displacement. Huddleston Slater *et al.* reported a case in which the patient was manually reduced by the clinician pressing the mandible caudally and dorsally, then instructed not to open widely (the point at which the disc displaces posteriorly). The disc still had to be reduced on three different occasions, with 3 and 10 days spanning the reduction appointments. Twelve months after the third and final reduction, the patient's condition changed from posterior disc displacement without reduction to posterior disc displacement with reduction.<sup>[30]</sup>

### Generalizations regarding management

Most TMDs, including internal derangements, have an excellent prognosis. In fact, of the TMDs, joint conditions have better outcomes than muscular conditions. Even without professional management, the pain tends to resolve with time, and ranges of motion tend to return to satisfactory distances.<sup>[31,32]</sup> Simple, conservative professional management can accelerate the rate of these improvements. Long-term data estimates 50–90% of patients remain improved.<sup>[24,33]</sup> The joint sounds may persist, but as long as they are neither painful nor inhibiting to function, they are clinically relatively inconsequential. This positive outlook should be communicated to the patient, as peace of mind can reduce present pain.

The self-limiting nature of most TMDs, and the high efficacy of low-cost conservative care indicate that such treatment should be the initial treatment of choice.<sup>[33]</sup> Only after failed attempts at conservative care should more aggressive methods be considered.

The general criteria for surgical intervention are the failure of conservative care, significant pain and/or dysfunction, and imaging that confirms TMJ arthritis or internal derangement.<sup>[27]</sup>

Yet a randomized controlled trial by Schiffman *et al.* compared patients treated with medical management alone (education, optimistic counseling, self-help regimen, methylprednisolone, and NSAIDs and/or muscle relaxants), medical management with rehabilitation (physical therapy, psychology, and an intraoral appliance), arthroscopy with medical management, and arthroplasty with medical management, and found statistically significant improvement in signs and symptoms for all groups from baseline, but with no statistically significant differences between groups.<sup>[19]</sup> This reinforces the principle that surgical intervention should be reserved for cases that are refractory to conservative care. In such cases, they may be of a subtype that would respond favorably to surgery, but not to nonsurgical care alone; they at least would be known by this point to not be responsive to nonsurgical care alone.

### CONCLUSION

Internal derangements are not uncommon. However, they are usually self-limiting and respond well to conservative, inexpensive care. In rare cases, surgical intervention may be indicated, but only in the presence of significant pain and/or dysfunction, despite skillful conservative treatment.

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