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TEMPOROMANDIBULAR DISC DISPLACEMENT: REVIEW ARTICLE

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The articular disc, a resilient structure situated between the surfaces of the temporomandibular joint (TMJ), plays a crucial role in joint function. Composed of dense fibrous tissue and cartilaginous cells, its primary function is to increase the contact surface area under load and ensure even force distribution. Disc dislocation, most commonly anterior or anteromedial, can be either reducible or irreducible. Clinical presentation varies depending on the type of dislocation and the degree of TMJ tissue inflammation. Diagnosis is based on clinical assessment and, when necessary, magnetic resonance imaging (MRI), often prompted by pain. Treatment approaches depend on the type of dislocation; reducible cases may not require intervention, as retrodiscal tissue adaptation can compensate for the disorder. Pain-related dislocations may be managed conservatively with analgesics, muscle relaxants, or reversible occlusal therapy (splints), depending on severity. Acute anterior dislocations without reduction typically require manual reduction followed by stabilization splint use. In chronic cases, a stabilization splint may be used initially to promote retrodiscal tissue adaptation, with surgery considered only if conservative measures fail. Treatment decisions are guided by pain severity, with carefully tailored interventions aimed at alleviating symptoms, restoring joint function, and improving the patient's quality of life.

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Key words: *articular disc, temporomandibular joint, disc displacement, splint*

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Introduction

Discus articularis, also known as the meniscus, is a vascularized, oval-shaped, fibrocartilaginous structure with a biconcave form. Located between the articular surfaces of the temporomandibular joint (TMJ), it is composed of tough, dense fibrous tissue and cartilaginous cells, providing both flexibility and adaptability. Its primary function is to increase the contact area between joint surfaces under load, ensuring the even distribution of forces (1).

Material and Methods

In 1954, Rees defined four zones of the disc (observed in the sagittal direction) (2):

- anterior thickening zone
- intermediate zone
- posterior thickening zone
- bilaminar zone.

The anterior and posterior thickenings form a circular ring that stabilizes the disc on the condyle and prevents its dislocation during mandibular movements. The intermediate zone is thinner, allowing for flexibility and shaping. The disc's shape and thickness result from functional adaptation, meaning it continuously adjusts during mandibular movements due to the incongruence of the articular surfaces. The bilaminar zone consists of two layers: the upper and lower. The upper layer is composed of loose elastic fibrous tissue elastic fibrous tissue that is well-vascularized and attaches the disc to the capsule and the posterior wall of the glenoid fossa. The lower layer is made of solid, dense, inelastic fibrous tissue, securing the disc to the condyle. Medially and laterally, the disc is fused with the capsule and anchored to the condylar poles. Fibers of the superior bundle of the lateral pterygoid muscle (LPM, *musculus pterygoideus lateralis*) directly enter the medial end of the disc. Contraction of the superior head of the LPM moves the disc forward (protraction) and inward, limiting backward movement (retraction) of the disc. The lateral pterygoid muscle is active in nearly all movements of the lower jaw, with its role in initiating mouth opening being particularly significant (3).

The disc divides the articular space into upper and lower compartments (superior and inferior synovial cavities), which do not normally

communicate. It plays a crucial role in absorbing excessive or abrupt forces, distributing the load over a larger surface area, and compensating for the incongruence of the joint surfaces (1, 2, 4).

Histologically, the disc is composed of dense fibers of type I collagen, water, proteoglycans, cells, and elastic fibers. Degeneration of discal collagen and the loss of cartilage on articular surfaces play a key role in the development of disc disease. Therefore, identifying structural abnormalities, such as degeneration, is essential for an accurate diagnosis (5).

Load Distribution on Temporo-mandibular Joint Structures

The craniomandibular joint functions as a bilateral stabilizing structure for the masticatory muscles during all movements of the masticatory system. Due to its unique characteristics, it distributes loads differently from other joints, allowing a wide range of motion without the risk of excessive strain. Unlike other joints, where maximum load coincides with the largest contact surface, the mandibular condyles do not rest deepest within the articular pits during peak loading. Instead, they are positioned on the posterior slopes of the articular eminences. This arrangement ensures that load transmission occurs through these slopes rather than the bony roof of the articular fossa, which is covered by a thin layer of fibrous tissue and is not structurally adapted to bear significant loads (4).

The small area of contact between the joint surfaces during loading poses a risk to the integrity of the joint structures. However, this risk is mitigated by the presence of the disc and the high-elastic fibrous cartilage covering the articular surfaces. Unlike hyaline cartilage in other joints, which resists compressive forces, fibrous cartilage deforms under load. Due to its high elasticity, the disc tissue compresses during loading, enabling the condyle to 'sink' into alignment with the disc and slide smoothly along the articular eminence. In this manner, the disc compensates for the incongruence of the temporomandibular joint surfaces with its structure (4).

An internal disorder is defined as a localized mechanical dysfunction that disrupts normal joint movement. Internal temporomandibular joint disorders involve abnormalities in the disc's position relative to the mandibular condyle or the articular eminence (6).

In a healthy joint, the disc is secured to the poles of the condyle by ligaments, permitting only translational movement between the condyle-disc complex and the articular eminence. The only physiological movement between the condyle and the disc is rotational, wherein the disc rotates around its ligamentous attachments to the condyle, which restrict excessive motion. The degree of disc rotation per condyle under normal physiological conditions is influenced by the disc's shape, interarticular pressure, and the coordinated function of the upper head of the lateral pterygoid muscle (LPM) and the superior portion of the bilaminar zone of the disc (4).

During physiological posterior rotation of the disc as the mouth opens, the condyle-disc complex moves forward. Subsequently, the upper layer of the bilaminar zone becomes taut and retracts, facilitating the posterior rotation of the disc. This structure is the only one capable of pulling the disc posteriorly, exerting force solely during the disc's back-and-forth movement in mouth opening. When the mouth closes, the upper layer of the bilaminar zone is no longer under tension. Additionally, as the mouth opens, intra-articular pressure increases, ensuring that the condyle remains positioned beneath the intermediate zone and preventing it from shifting into the region of the anterior thickening of the disc (4).

During physiological anterior rotation of the disc, contraction of the superior bundle of the lateral pterygoid muscle (LPM), which is activated during mouth closure, propels the disc forward. Consequently, the disc rotates anteriorly while the entire condyle-disc complex moves backward and upward, enabling translational motion (4).

The controlled rotation of the disc by the condyle, within moderate parameters and facilitated by the described mechanisms in a healthy joint, ensures continuous intimate contact between the disc and condyle during all mandibular movements and positions. Smooth and uninterrupted motion is further enabled by the lubricated, low-friction surfaces of the condyle, disc, and articular eminence (4).

The normal condyle-disc relationship is also maintained due to the disc's distinct biconcave shape. The thin intermediate zone and the annular thickening play a crucial role in stabilizing the disc on the condyle (4).

Disc dislocation can occur in multiple directions. Larheim systematized disc positions based on closed-mouth MRI recordings, classifying them into three main categories:

1. Normal superior disc position: The disc is correctly positioned at both sagittal and coronal cross-sections of the MRI.

2. Partial disc dislocation: The disc is partially displaced, with or without medial or lateral dislocation, while maintaining a normal position in certain sagittal sections.

3. Complete disc dislocation: The disc is dislocated at all cross-sections, with or without lateral or medial dislocation.

A modification of this categorization was proposed by Tasaki:

a. Normal-superior disc position ("at 12 o'clock").

b. Pathological position of the disc: includes anterior, internal, external, and posterior dislocations (7).

The most common type of disc dislocation is anterior or anteromedial displacement. Disc dislocations represent a spectrum of progressive

pathological conditions. Typically, anterior disc dislocation with reduction occurs first, which may eventually progress to anterior disc dislocation without reduction. However, in some patients, anterior dislocation with reduction can persist for decades. Several factors contribute to the progression and development of disc disorders, including gaps in the dental arch (due to the loss of lateral teeth), systemic ligamentous laxity, and parafunctional habits. These factors can significantly influence the course of the disorder (4).

Anterior Reciprocal Disc Displacement (Anterior Disc Dislocation with Reduction)

In Tasaki's classification, the normal position of the disc in the sagittal plane is the superior position, commonly referred to as the "12 o'clock position," where the posterior portion of the disc is aligned directly above the mandibular condyle (8).

In anterior displacement with reduction, the disc does not maintain its normal position relative to the condyle and articular eminence when the mouth is closed. Instead, it is displaced forward or forward and medially. However, upon mouth closure, the disc repositions itself to a more or less normal position on the condyle (4).

When the shape of the disc changes and the ligaments protrude, translational movement between the condyle and the disc becomes possible. The extent of this movement depends on alterations in disc shape, the degree of ligament elongation, and chronic hyperactivity of the upper bundle of the lateral pterygoid muscle (LPM). Since discal ligaments lack elasticity, they remain stretched once elongated. When the mouth is closed, the upper beam of the bilaminar zone does not affect disc position. However, in this state, the upper bundle of the LPM can shift the disc anteriorly. The disc maintains this position while the mouth is closed and returns to rest on the condyle's head upon opening. The displacement of the disc is limited by ligament length and the thickness of its posterior edge. Prolonged displacement can thin the posterior edge, allowing the condyle to extend beneath it or even into the retrodiscal tissue (4). As this represents the initial stage of disc disorder development, characterized as the mildest, subjective symptoms are equally mild (4) (Figure 1).

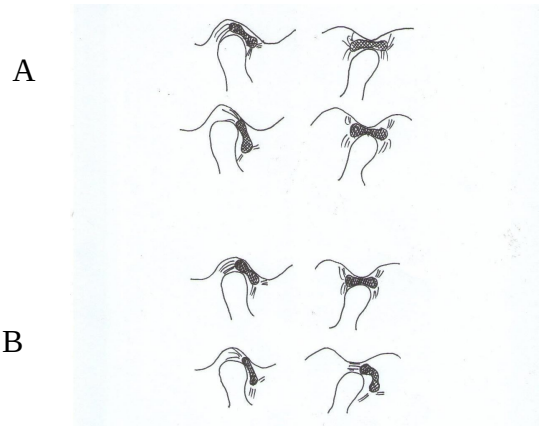


Figure 1. A) Normal position of the disc when the mouth is closed (left) and the normal position when the mouth is opened (right). B) Anterior dislocation of the disc with the mouth closed (left), followed by reduction of the disc, returning it to the normal position upon mouth opening (right).

Clinical Presentation of Anterior Disc Dislocation with Reduction

A single "click" during mouth opening and/or closing (reciprocal click) occurs when the condyle passes over the thickened posterior edge of the disc to position itself beneath the thinned intermediate zone. This click can happen at any point in the translational cycle. The term "reciprocal click" refers to a softer click upon mouth closure, indicating the disc's return to its anterior position.

• Mandibular deviation toward the affected side occurs early in mouth opening due to temporary blockage of condylar translation by disc dislocation. As the disc repositions relative to the condyle, the midline of the mandible normalizes until full mouth opening. This deviation is pathognomonic for anterior disc dislocation with reduction.

• Mandibular deflection refers to a persistent midline deviation throughout the entire mouth-opening movement. It is a key indicator of acute or chronic anterior disc dislocation without reduction (permanent disc dislocation).

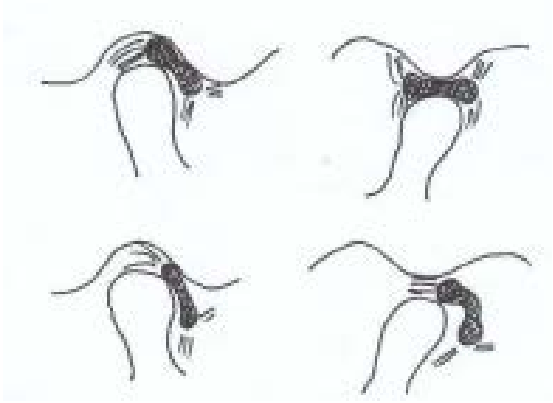
• The normal mouth opening range is 40–50 mm, with the potential for even greater maximum opening. When trismus occurs, it is often due to muscle spasm from pain rather than mechanical obstruction by the disc.

• Pain is not always present in anterior disc dislocation with reduction. When it does occur, it is typically due to sprained discal ligaments or condylar pressure on the retrodiscal tissue (4).

Permanent Anterior Disc Dislocation (Disc Dislocation without Reduction)

This condition is characterized by anterior or anteromedial dislocation of the disc in the closed-mouth position, with the disc failing to return to its normal alignment upon mouth opening. It arises from the gradual, progressive degeneration of joint structures and is often preceded by symptoms of anterior disc dislocation with reduction. In this case, condylar translation along the articular surface is restricted or impaired because the displaced and deformed disc acts as a physical barrier, preventing the condyle from passing beneath it. The disc undergoes morphological changes, shifting from a biconcave to a biconvex shape. Additionally, loosening of the anterior discal attachment leads to the loss of contact between the condyle, disc, and articular eminence. These structural deformations and the altered disc position significantly limit the translational movement of the condyle within the affected joint (4) (Figure 2).

A



B

Figure 2. A) Normal position of the disc when the mouth is closed (left) and the normal position when the mouth is opened (right). B) Anterior dislocation of the disc in the closed mouth (left), with the disc returning to an anterior position upon mouth opening (right).

Clinical Presentation of Anterior Disc Dislocation without Reduction

• Mouth opening is limited to 25–30 mm and may sometimes present as a complete blockage ('closed lock'). Some patients report sudden onset of blockage without any prior trauma to the area.

• Clicking Sounds: Some patients report joint clicking, sometimes accompanied by blockages during prolonged chewing or episodes of bruxism. Occasional blockages may indicate irreversible elongation of the bilaminar zone of the disc, leading to a loss of elasticity and function.

• Mandibular deviation towards the affected side during mouth opening (mandibular deflection).

• Restricted mandibular movements:

-Limited protrusion may occur in some patients with mandibular deflection.

-Lateral movement of the mandible toward the healthy side remains unaffected, as the dislocated disc obstructs all translational movements of the condyle. Unrestricted lateral movement toward the affected joint serves as an important differential diagnostic indicator, distinguishing this condition from anterior irreversible disc dislocation caused by trauma.

• Pain: Results from concurrent inflammation of the of the joint capsule, retrodiscal connective tissue, and discal ligaments. Some patients find relief by applying pressure to the affected joint, which alleviates the pain.

• Impaired activity of the temporal and masseter muscles on the affected side: Muscle spasms exacerbate pain and further restrict mouth opening.

• Crepitus During Mandibular Movement: Absent in the acute stage when joint function is

significantly impaired but may develop in chronic cases due to degenerative changes in the joint surfaces (4).

Magnetic Resonance Imaging

In 1946, Purcell and Bloch established the principles of nuclear magnetic resonance spectroscopy, which later paved the way for the development of magnetic resonance imaging (MRI). In 1973, Lauterbur produced the first images using proton MR signals on phantoms. The first application of MRI to the temporomandibular joint (TMJ) was reported by Helms in 1984, though image quality at the time was limited by low resolution and thicker cross-sections. In 1985, Katzberg, Harms, and Roberts highlighted the advantages of MRI in detecting disc pathology. TMJ MRI provides imaging in the parasagittal and coronal planes without requiring reconstruction. While axial imaging has limited diagnostic significance, it helps determine the positioning of sagittal and coronal cross-sections. Standard imaging of the condyle-disc complex is performed with the mouth in habitual occlusion (closed position) and at maximal opening. The most critical parameters assessed in MRI scans using the T1 sequence include the continuity of articular surfaces, the bony architecture of the articular eminence and condyles, and the position and shape of the disc. The T2 sequence is used to detect inflammatory exudate within the TMJ (9, 10).

Contraindications for MRI are categorized as absolute and relative. Absolute contraindications include patients with implanted aneurysm clips or pacemakers. Other absolute contraindications include the presence of ferromagnetic objects in critical areas (such as the eyes), metal heart valves, claustrophobia, uncooperative patients, individuals in the first trimester of pregnancy, and those unable to lie down for the examination. Dental fillings, implants, fixed orthodontic appliances, and metal dentures do not contraindicate MRI imaging; however, they may cause artifacts that compromise image quality (11). Additionally, MRI findings provide valuable data for anthropology, paleontology, and forensic medicine (12).

Disc Dislocation Therapy

Therapy for Anterior Disc Dislocation with Reduction

Treatment for this disorder is not necessary in every case. Some dislocations can persist for years without progression, due to the adaptation of temporomandibular joint structures. In many cases, the retrodiscal tissue elongates over time, transforming into a modified extension of the posterior edge of the disc, allowing it to function as a load-bearing structure for the condyle (13, 14). In cases where patients do not experience pain or significant impairment of joint function, such as limited mouth opening, and the surrounding muscles are not tender upon palpation, treatment is not necessary. Nevertheless, regular monitoring is recommended to identify any potential progression of the disorder over time (4). If patients report sensitivity upon palpation of the joint, even in the absence of pain, it suggests that the joint tissue has not yet adapted to the new condition. In such cases, patients should be educated about the condition, the factors influencing its progression, and potential treatment options. This is especially important for individuals engaging in parafunctional activities, as they may benefit from home-based interventions (2). Adaptation of the joint tissue is challenging and nearly impossible without adequate support from a stable bite in the lateral segments of the jaw. Therefore, referring patients for appropriate prosthetic treatment is essential (4).

If the dislocation is accompanied by pain, the treatment options follow a range of selectable approaches:

- Conservative methods (analgesics, myorelaxants)
- Reversible occlusal therapy (splint) - the choice of reversible occlusal therapy depends on the degree of dysfunction
- Permanent occlusal therapy.

These measures aim to:

- Relieve and eliminate pain, often through repositioning therapy or a repositioning splint. These interventions temporarily stabilize the mandible in a forward (propulsive, anterior) position, allowing the disc to realign with the condyle. This reduces pressure on the retrodiscal tissue, alleviating pain and joint clicking.
- Re-establish the most normal condyle-disc relationship possible by using a repositioning splint. This approach encourages adaptation and regeneration of the retrodiscal tissue, leading to the formation of a pseudodisc (fibrous tissue). This tissue is more resistant to pressure, helping reduce pain even if the disc remains permanently dislocated forward.

Repositioning therapy is generally effective in alleviating pain and clicking. However, studies show that in about 50% of clinically successful cases (where pain is absent), the disc never returns to its normal position (14). A major drawback is the potential need for extensive, irreversible occlusal reconstruction to maintain the mandible's new therapeutic position. In some cases, the degree of mandibular protrusion required to prevent disc dislocation is too significant for long-term occlusal therapy. As a result, repositioning therapy is an effective yet temporary solution that quickly relieves pain and joint sounds. Despite its limitations, it remains a valuable conservative approach for managing recurrent anterior disc dislocation (4).

Li suggests first using a stabilizing splint for a set period. If it does not produce the desired results, it should be converted into a repositioning splint (15).

The stabilizing splint is a flat, smooth plate made of transparent acrylic, primarily covering the

maxillary dental arch (although, for patients unable to tolerate an upper splint, a splint may be constructed for the lower dental arch). Commonly known as the Michigan splint, this device aims to provide optimal functional occlusion. By establishing a stable musculoskeletal relationship in the central position and increasing vertical occlusal dimension, it allows for maximum engagement of all antagonist muscles. It also provides canine guidance on the working side. Other types of stabilizing splints include the Tanner splint, Schoettl occlusal plate, and Gausch programmable functional plate, among others. However, the Michigan splint is the most commonly used in the treatment of these conditions (4). In more severe cases, where reversible occlusal therapy fails to yield satisfactory outcomes, surgical intervention may be necessary (4).

Anterior Disc Dislocation Therapy without Reduction

Acute Irreversible Disc Dislocation

During the acute phase, treatment focuses on repositioning the dislocated disc, either by the clinician or the patient. The clinician achieves this by pulling the mandible downward while pressing on the occlusal surfaces of the lower lateral teeth with their thumbs. This maneuver separates the condyle from the articular eminence, creating space for the disc to realign. Successful repositioning requires a healthy upper layer of the bilaminar zone, which helps pull the disc back into place (4).

If the repositioning is successful (restoring the normal range of mouth opening and movement to the contralateral side), it is necessary to immediately introduce an anterior repositioning splint that the patient will wear continuously for 10 days (day and night, even during meals), in order to prevent redislocation of the disc. If the disc remains in place after 10 days, the patient should continue wearing the repositioning splint day and night, with a smaller splint made for daytime use. If stability persists after two months, the patient can transition to a stabilizing splint (4).

If repositioning is unsuccessful, it is recommended to use only a stabilizing splint, assuming the patient will adapt to the new disc position by forming a pseudodisc. Surgical treatment is not recommended due to its invasiveness, and repositioning therapy is discouraged, as it may cause unnecessary tension on the retrodiscal tissue (15).

However, if there is persistent pain in the joint area, it suggests inadequate adaptation of the retrodiscal tissue. In such cases, surgical treatment options should be considered (4).

Chronic Irreversible Disc Dislocation

Given that manual disc repositioning does not yield favorable outcomes in these cases, treatment options should be carefully evaluated. The initial approach involves the introduction of a stabilizing splint to facilitate adaptation of the retrodiscal tissue. Alternatively, surgical treatment may be considered. The selection of treatment depends on the severity of pain associated with the dislocation (4).

Conclusion

The most common condition in TMJJ that require examination is anterior disc displacement. Therefore, frequent indication for TMJ imaging with MRI is to evaluate the position and structure of the disc in patients with temporomandibular joint pain. Understanding the parameters and standard dimensions of the TMJ is essential in dentistry, particularly in prosthetics, orthodontics, and maxillofacial surgery.

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DISLOKACIJE *DISCUSA ARTICULARISA* TEMPOROMANDIBULARNOG ZGLOBA: OPŠTI PREGLED

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Discus articularis je žilava, ovalna, fibrokartilaginozna, bikonkavna pločica, interponirana između zglobnih površina temporomandibularnog zgloba (TMZ). Ova pločica je sastavljena od tvrdog, gustog, fibroznog tkiva i hrskavičavih ćelija, a njena uloga je da poveća površinu kontakta između zglobnih površina u momentu opterećenja i da omogući pravilnu distribuciju opterećenja. Dislokacija diska može se kretati u više pravaca, a najčešće anteriorno ili anteromedijalno. Anteriorna dislokacija diska može biti sa redukcijom (povratna) ili bez redukcije (nepovratna). Klinička slika prednje dislokacije diska zavisi od tipa dislokacije i stepena inflamacije tkiva temporomandibularnog zgloba. Dijagnoza dislokacije diska postavlja se na osnovu kliničkog nalaza i, ako je potrebno, na osnovu snimaka sa magnetne rezonance. Najčešći razlog snimanja temporomandibularnog zgloba magnetnom rezonancom jeste prisustvo bola. Terapija dislokacije diska zavisi od vrste dislokacije. U slučaju povratne dislokacije terapija nije uvek neophodna pošto postoji mogućnost adaptacije retrodiskalnog tkiva, što rezultira kompenzacijom nastalog poremećaja. Ukoliko je dislokacija praćena bolom, mogu se primeniti konzervativne mere (analgetici, miorelaksansi) ili reverzibilna okluzalna terapija (upotreba splintova). Vrsta indikovanog splinta zavisi od stepena ozbiljnosti dislokacije. U slučaju akutne anteriorne dislokacije bez redukcije pribegava se repoziciji i upotrebi stabilizacionog splinta. Ako je reč o hroničnoj anteriornoj dislokaciji bez redukcije, prvo rešenje je uvođenje stabilizacionog splinta i omogućavanje adaptacije retrodiskalnog tkiva, a alternativa hirurška terapija. Odluka o tretmanu zavisi od intenziteta bola koji prati dislokaciju.

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***Ključne reči**: discus articularis, temporomandibularni zglob, dislokacija diska, splint*