Arthroscopy of the Inferior Compartment of the Temporomandibular Joint: A New Perspective

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Abstract

Objective Arthroscopy of the temporomandibular joint (TMJ) has become a well-standardized non-invasive procedure for the treatment of TMJ internal derangement (ID). Since the last 1980s, no clinical application for arthroscopy of the inferior compartment has been established because of the intrinsic difficulty of the technique and the believing of the absence of clinical relevance for treatment of ID.

Methods We report on a particular case in which arthroscopy of the inferior joint compartment together with the examination of the upper joint space was performed in a patient with ID of the TMJ. A 1.9 mm scope was used, while the technique for entering the inferior compartment is presented.

Results The presence of intense synovitis, fibrous adhesion, and pseudowall were observed in the inferior joint compartment, thus leading to the hypothesis of the more than likely influence of the status of the synovial lining within this space in the persistence of symptoms in recalcitrant patients with ID.

Conclusion We believe that this new insight could lead surgeons to a more complete use of this non-invasive procedure for the treatment of this entity.

Level of Evidence 4/5.

Keywords Temporomandibular joint arthroscopy · Inferior joint compartment · Synovitis · Fibrillation · Internal derangement

Introduction

Arthroscopy of the temporomandibular joint (TMJ) has been established as a reliable and predictable non-invasive technique for the treatment of internal derangement (ID) of the TMJ, mainly for Wilkes [1] stages II, III, and IV [2]. According to previous large series [3], this is especially true for the management of TMJ closed lock. Technically, arthroscopic lysis and lavage (ALL) consists on arthroscopic sweeping of the adhesions in the upper joint compartment by blunt trocar and lavage of the joint space [4]. In contrast, operative arthroscopy (OA) needs the use of two or more working cannulas for the insertion of instruments to perform procedures other than lysis of adhesions, such as anterior release of the disk by lateral pterygoid myotomy and retrodiscal scarification by electrocautery or high-frequency wave system, also named coblation [2].

Although many series [3, 5] have reported comparable results in terms of pain reduction and mouth function, it is the authors' point of view that ALL can be easily performed in cases with adhesions, scarce synovitis, and a good position of the disk (roofing 100%), while OA is the technique of choice in cases in which moderate-to-severe synovitis and/or disk malposition is observed. Through the working cannula, the experienced surgeon can scarify the

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inflamed and hypervascularized synovia, including the retrodiscal tissue. Alternatively, in cases with anterior disk displacement, an anterior release of the lateral pterygoid muscle attachments (myotomy) together with a retrodiscal cauterization can be performed with coblation. Further arthroscopic disk repositioning techniques such as suture disk fixation or rigid fixation have been described for TMJ ID [6, 7].

In relation to ID, many morphologic changes have been found within the joint, such as intra-articular adhesions (IAs) and synovitis. However, all of them have been assumed to be concentrated in the upper joint compartment, being this space the unique subsidiary to inspection and treatment by the arthroscope. Alternatively, Kondoh et al. [8], in a cadaver study of 30 joints, found that morphologic changes in the inferior surface of the TMJ disk were more prevalent than those in the upper surface, although no relationship between irregularities of the inferior surface and the position of the disk was found. Whereas these findings could prevent the clinician for a possible role of the inferior joint compartment in the development of ID, today no clinical series have focused either in the technique for the introduction of the arthroscope or in arthroscopic findings observed within the inferior joint compartment. We report on the first case of synovitis and fibrous adhesion with IAs demonstrated by arthroscopy in the inferior joint compartment in a patient presenting ID of the TMJ, while the technique for introduction of the 1.9-mm arthroscope within the inferior joint compartment is presented.

Case Report

A 27-year-old female presented with a 6-month painful left TMJ, with a severe limitation of mouth opening. No improvement in pain relief and function was observed after 3 months of conservative treatment consisting on soft diet, splint therapy, non-steroid anti-inflammatory drugs (NSAIDs), and muscle relaxants. Physical examination revealed a 19-mm maximal interincisal opening (MIO), limitation of lateral excursion movements to the right side, with selective pain when palpating the left TMJ [VAS 8 (0–10)], without clicking or popping. Magnetic resonance imaging (MRI) revealed an anterior displacement of the disk without reduction at opening. No morphological changes compatible with osteoarthritis were appreciated in bone surfaces of condyle and/or temporal fossa. With the clinical suspect of internal derangement (ID) of the TMJ, and the previous failure of conservative treatments, operative arthroscopy was programmed under general anesthesia and nasotracheal intubation. Conventional operative arthroscopy of the upper joint compartment was initially

performed by the introduction of the arthroscope through a posterolateral approach and a working cannula with instrumentation into the anterior recess of the upper compartment, as it was previously described by our group [9]. Interestingly, in this particular patient, scarce synovitis with no adhesences was observed in the synovia covering the posterior ligament at the posterior recess, being only a smooth coblation through the working cannula performed over the damaged tissue. Due to the discrepancy among the observed clinics and arthroscopic findings within the upper compartment, an arthroscopy of the inferior compartment was performed following the technique described in the section below. Under arthroscopic view, fibrous adhesion and severe synovitis were observed. Intra-articular adhesions and pseudowalls from the synovia covering the condyle to the posterior side of the synovial membrane at the inferior compartment were clearly distinguished (Fig. 1), while a spotted-pattern hypervascularization of the synovia at the inferior compartment was also noted (Fig. 2) (Electronic supplementary file: video file).

The post-operative period was uneventful, and the patient was discharged one day after surgery. No complications were observed during the 12-month follow-up period. VAS (0–10) decreased to 4 down to 0 from the first month to the first year postoperatively, while MIO improved to 35 up to 41 mm from the first month to the end of the 1-year follow-up period.

Technical Note

The patient is operated under nasotracheal intubation and general anesthesia. By the traditional technique, an intra-muscular G21 green 0.8 × 24 mm needle is introduced in

Fig. 1 Arthroscopic view of the inferior compartment of the TMJ showing fibrous adhesion. Note intra-articular adhesions and pseudowalls from the synovia covering the condyle to the posterior side of the synovial membrane at the inferior compartment, which appears hypervascularized

Fig. 2 Arthroscopic view of the inferior compartment of the TMJ showing pseudowalls and plication of the synovial membrane at the inferior compartment of the joint. Note severe synovitis and spotted-pattern hypervascularization of the synovia at the inferior compartment, corresponding to the inferior side of the retrodiscal tissue

the joint at the most concave point of the glenoid fossa, with insufflation of 2–3 mL Ringer lactate. This maneuver allows distension of the joint at the upper compartment and facilitates subsequent introduction of the cannula. Considering that the joint is distributed in two compartments, an excessive distension of the upper compartment may result in a clear collapse of the inferior compartment. Thus, the needle has to be introduced in a lower point from the one used traditionally, contacting the upper surface of the condyle in a smooth fashion and directing the needle medially. Once insufflation of 2 mL Ringer lactate is performed, the cannula with the sharp trocar has to be introduced by palpating the lateral pole of the condyle at approximately 1 cm below the maximum concavity of the glenoid fossa. By smooth rotational movements, the cannula with the sharp trocar is advanced superiorly while the contact with the lateral pole of the condyle is maintained. A moderate resistance should be noted when penetrating the capsule at this point (Fig. 3). Here, while the cannula is maintained, the sharp trocar is removed, followed by the insertion of the blunt trocar for further introduction of the cannula. Just when the condyle surface is turning medially, the blunt trocar is deepened in a medial fashion grazing the upper surface of the condyle. The hard touch of the bone is felt inferiorly, while an elastic consistency corresponding to the disk is noted superiorly. Note that in this particular scenario, palpation of bone is noted inferiorly and not superiorly, as it would correspond to the glenoid fossa and the eminence. Consequently, soft tissue from the disk is palpated superiorly in contrast to the conventional method, in which the disk is noted inferiorly. In our experience, the cannula has to be introduced up to 25–30 mm. Once the cannula is located inside the inferior joint, a 1.9-mm arthroscope is introduced through the cannula. Later on,

Fig. 3 Diagram of the technique (2nd step): by smooth rotational movements, the cannula with the sharp trocar is advanced superiorly keeping in contact with the lateral pole of the condyle. A moderate resistance should be noted when penetrating the capsule at this point. Later on, the blunt trocar is deepened in a medial fashion grazing the upper surface of the condyle

after verification of an adequate entrance in the inferior joint space, a 22-gauge needle is inserted 5 mm anterior and 5 mm inferior the entrance point, until continuous irrigation with Ringer solution is achieved. Direct visualization of any pathological condition in the inferior compartment of the TMJ is performed, while sweeping of potential adhesions or fibrillation is performed as in the conventional procedure within the upper compartment of the joint.

Discussion

Considering that internal derangement (ID) of the TMJ has been considered an abnormal relation of the articular disk with respect to the mandibular condyle, the articular eminence and the glenoid fossa of the temporal bone [10], several studies have focused on the morphologic changes in the upper joint compartment of the TMJ among patients with ID, including intra-articular adhesions (IAs) [11], synovitis and chondromalacia [12, 13], or disk perforation. Even, a possible etiopathogenic role for IAs has been attributed to synovitis, as causing fibrin deposition with the formation of fibrous adhesions, or alternatively IAs being the result of hematomas in the synovial membrane. Nevertheless, the etiology of ID of the TMJ is not clear yet. Given the radioactive nature of plain film arthrography and the poor accuracy of magnetic resonance imaging (MRI) for diagnosis of IAs, arthroscopy has become the gold

standard for its diagnosis and treatment, although IAs has been assumed to be concentrated in the upper joint compartment, being this space the unique subsidiary to inspection and treatment by arthroscopy.

From a morphologic point of view, Davis et al. [14] described the presence of fibrous bands, fibrosynovial bands, intra-capsular fibrosis, capsular fibrosis, discal osseous bands, and pseudowalls in patients with ID. Later on Murakami et al. [15] classified IAs according to their shapes in film-like, band-like and pseudowall-like adhesions, whereas Zhang et al. [11] have recently focused on shape, distribution and extension to classify IAs in 4 grades. Nevertheless, all these authors report their arthroscopic findings to occur within the upper joint compartment, being IAs directly related to other structures such as anterior or posterior recesses, eminence, temporal fossa and disk. It is also interesting to note that most of disruptions of the synovial lining have been reported to occur in the upper compartment, as was suggested by Holmlund et al. [12] for entities such as synovial chondromatosis with five among 87 published cases (6%) involving the upper and inferior compartments. While three among these 5 cases presented a perforation of the disk, the remaining two cases and another one recently reported by Sato et al. [16] did not show any perforation, thus alerting about the independent evolution of synovial lining disturbances in the inferior joint compartment. While the inferior joint compartment is narrower and its area of synovia smaller than that from the upper compartment, disruption of the synovial membrane may be less evident from a clinical and radiological point of view, and thus its involvement may be overlooked. This is also remarkable for non-invasive diagnostic and therapeutic procedures such as conventional arthroscopy of the TMJ, in which only the upper compartment is investigated.

Concurrently, Murakami et al. [15] found a weak but statistically significant negative correlation between the presence of IAs and mouth opening, although they were not associated with TMJ pain. Previously, Davis et al. [14] had also suggested that limitations of jaw movements were directly related to the presence of adhesions laterally and anteromedially, and also to the obliteration of the anterior recess of the upper compartment of the joint. More recently, a direct relationship between IAs and ID has been retrospectively analyzed by Zhang et al. [11] in a series of 524 joints with IAs among 1822 TMJs (28.76%), concluding that the adhesion grade was positively correlated with the stage of ID according to Wilkes' classification [1, 2], ranging from almost 14% in stage II to more than 40% in stage V. These authors also checked that IAs were associated with longer locking duration and older age. Thus, it seems clear from the previous mentioned studies

that an association between IAs and TMJ locking or diminished mouth opening is present, in addition to other contrasted etiopathogenic factors, such as disk displacement. Nevertheless, we could previously demonstrate that arthroscopy was a reliable and safe procedure for decreasing pain and increasing mouth opening in patients with ID, independently of the grade of involvement of the joint surface and the synovial lining [13].

Due to the incongruence of TMJ articulating bony surfaces, looseness of the articular capsule, and deformability of the disk, the condyle is able to move almost freely in the 3D half-space tied superiorly by the articular surface of the temporal bone [17]. According to dynamics of the normal TMJ, Park et al. [18] have recently shown that the condyle exhibits a hinge movement at the beginning of mouth opening, with pure rotation of approximately 13 degrees, with a maximal interincisal opening (MIO) of 20 mm. Then, if further opening is achieved, translation and hinge movement within the condyle take place simultaneously, with a 17° rotation of the ramus horizontal axis, and a MIO up to 50 mm. It is interesting to note that transition from a simple rotation of the condyle to a combination of rotation and translation is observed at a MIO ranging from 20 to 25 mm, with the disk moving with the condyle in this second phase.

Since the first step of the mouth opening movement consists on a pure rotation of the condyle over the disk, it is plausible that any alteration in the normal relationship between the condyle and the disk may alter this process leading to a severe limitation of mouth opening. Based on the previously observed association between IAs in the upper compartment of the TMJ and locking or mouth opening restriction [11, 14, 15], a similar etiopathogenic role for IAs could be attributed to those placed in the inferior compartment of the TMJ, except for a major role in the first part of the dynamic. IAs between the synovial lining covering the condyle and the inferior side of the disk could be responsible for a limitation of the hinge or rotational movement that could limit mouth opening from the very beginning of the movement. Concomitant IAs in the upper compartment from the synovial lining of the upper slope of the disk and retrodiscal tissue to the temporalis fossa could also add further limitation in translational movement.

From our findings within the inferior compartment of the joint, we may hypothesize about a more active role of this compartment in the etiopatogenesis of ID than previously thought. Even the persistence of symptoms and locking in patients successfully treated with operative arthroscopy of the TMJ may be the result of misdiagnosed and untreated fibrillation and synovitis within the inferior joint compartment.

Conclusions

We hypothesize that the development and persistence of symptoms in some refractory patients with ID of the TMJ in which conventional arthroscopy has been performed may be secondary to the presence of severe synovitis and fibrous adhesion involving the synovial lining of the inferior compartment. Further prospective controlled studies in which arthroscopy of the inferior compartment is routinely performed are necessary to determine the influence of this compartment in the development and maintenance of symptoms of the TMJ.

Compliance with Ethical Standards

Conflicts of interest All authors declare that they have no conflict of interest.

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

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

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