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Review Article

TMJ Arthroscopy

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Introduction

Temporomandibular joint (TMJ) is defined as a ginglymoarthrodial joint, and it is a diarthrosis. TMJ is composed of a synovial cavity articular cartilage and a capsule that covers the joint.(1) The features that differentiate and make the TMJ a unique joint are its articular surfaces covered by fibrocartilage instead of hyaline cartilage.(2)

Temporomandibular disorder (TMD) is a term used for any problem of the jaw joint and the common TMJ disorders are pain dysfunction syndrome, internal derangement, arthritis, and traumas. (3,4,5) Treatments for the various TMJ disorders range from physical therapy and nonsurgical treatments to various surgical procedures.(6) Surgery can play an important role in the management of TMD and the various surgical treatments for TMDs are arthrocentesis, arthroscopy, discectomy, and joint replacement. Arthroscopy is one of the most popular and effective methods for diagnosis and treatment of TMDs.(7)

History.

Year	Pioneer	Discovery
1975	Ohnishi	First report of a diagnostic arthroscope [8]
1980	Murakami	Described safe and effective method of joint puncture [9]
1980s	Holmlund and Hellsing	Published their landmark paper on the concept of reproducible puncture sites correlating measurements along the tragal-canthal line. [10]
1985	McCain	Presented complications during arthroscopic surgery [11]
1986	Sanders	Described benefits of therapeutic arthroscopy in acute painful hypo-mobility of the joint. Also introduced the term lysis. [12]
1986	Murakami and Ono	Arthroscopic suture for treatment of anterior disc displacement [13]
1991	Nitzan	Introduced Arthrocentesis based on insertion of two needles in the upper joint space for lavage without direct visualization of the joint [14]

Arthroscope

Arthroscopes are optical instruments that helps the surgeon to examine the Temporomandibular Joint in a minimally invasive manner. The arthroscope themselves are rigid endoscopes that range from 1.9 to 2.7mm in diameter.(15)

Indications

The American Association of Oral and Maxillofacial Surgeons (AAOMS) established five main indications for TMJ arthroscopy:

a. Internal derangement of the TMJ, mainly Wilkes stages 2–4 (16,17)

b. Degenerative joint disease

c. Synovitis

d. Painful hypermobility or recurrent luxation of the disc

e. Hypomobility caused by intra-articular adherences (18)

Contraindications

Common contraindications for arthroscopic treatment other than general medical and anatomical contraindications are (19):

a. Acute cutaneous infections

b. Ear or articular infections

c. Severe fibrous or osseous ankylosis

d. Risk of tumor dissemination.

Approaches

For arthroscopic approach to the TMJ, the current surgical techniques involve the placement of at least two cannulas into the superior joint space. One cannula is used for visualization whereas instruments are placed through the other cannula to allow instrumentation in the joint and the flow of the rinsing fluids. Palpate the TMJ region and determine the position of the condylar head by passive movement of the TMJ, the trocar insertion points are marked on a line between the center of the tragus and the lateral canthus of the eye (Holmlund–Hellsing Line).

- The insertion point of the first trocar is to be marked 1 cm from the center of the tragus and 2 mm below the above-mentioned line. The insertion point for the second trocar is located 2 cm from the center of the tragus and 1 cm below the out marked line. In cases in which the superior compartment is collapsed, the entrance point at the skin must be placed at approximately 1 cm ahead of and 1 cm below the entrance point of the first cannula.

- The first cannula is inserted through a skin puncture with a sharp trocar inside it at the first landmark. By pushing it upward, inward, and forward to the temporal bone, keeping the cannula tip in contact with the bone by advancing the tip approximately 2.5 cm the TMJ will be reached into the upper joint space.

- A correct placement of the arthroscope can only be verified by moving the mandible.

- The second cannula is inserted at the second landmark according to the afore-mentioned procedure. The TMJ will be reached with an upward angulation under bony contact to the temporal bone of the glenoid fossa and an advance of approximately 2.5 cm.

- If continuous irrigation is obtained with an inflow pressure of approximately 1000 mm H2O and there is a good reflux of irrigation liquid through the cannula, an infusion extension tubing can be connected to the arthroscope cannula. (20,21,22)

1. **Superior Posterolateral Approach:** Enables a visualization of the posterosuperior joint space (23,24).

2. **Superior Anterolateral Approach:** Enables visualization of the anterosuperior joint compartment (23,24).

3. **Inferior Lateral and Inferior Posterolateral Approach:** Posterior part of the upper compartment, the inferoposterior synovial pouch, and posterior condylar surface can be examined (23,24).

4. **Inferior Anterolateral Approach:** Lower anterior synovial pouch can be examined (23,24).

5. **Endaural Approach:** The endaural approach provides access and visualization of the posterior superior joint space as well as to the medial and lateral paradiscal troughs. This approach also provides better access for the retrieval of loose bodies and broken instruments and permits access to other portals for instrumentation (23,24) .

Diagnostic Anatomy

During diagnostic TMJ arthroscopy, seven anatomic areas are to be examined (25,26):

1. The medial synovial drape
2. The pterygoid shadow
3. The retrodiscal synovium and the posterior ligament
    a. Zone 1, oblique protuberance
    b. Zone 2, retrodiscal synovial tissue attached to posterior glenoid process
    c. Zone 3, lateral recess of retrodiscal synovial tissue
4. The posterior slope of the articular eminence and glenoid fossa

5. The articular disc
6. The intermediate zone
7. The anterior recess
    a. Zone 1, disc synovial crease
    b. Zone 2, midportion
    c. Zone 3, medial-anterior corner
    d. Zone 4, lateral-anterior corner

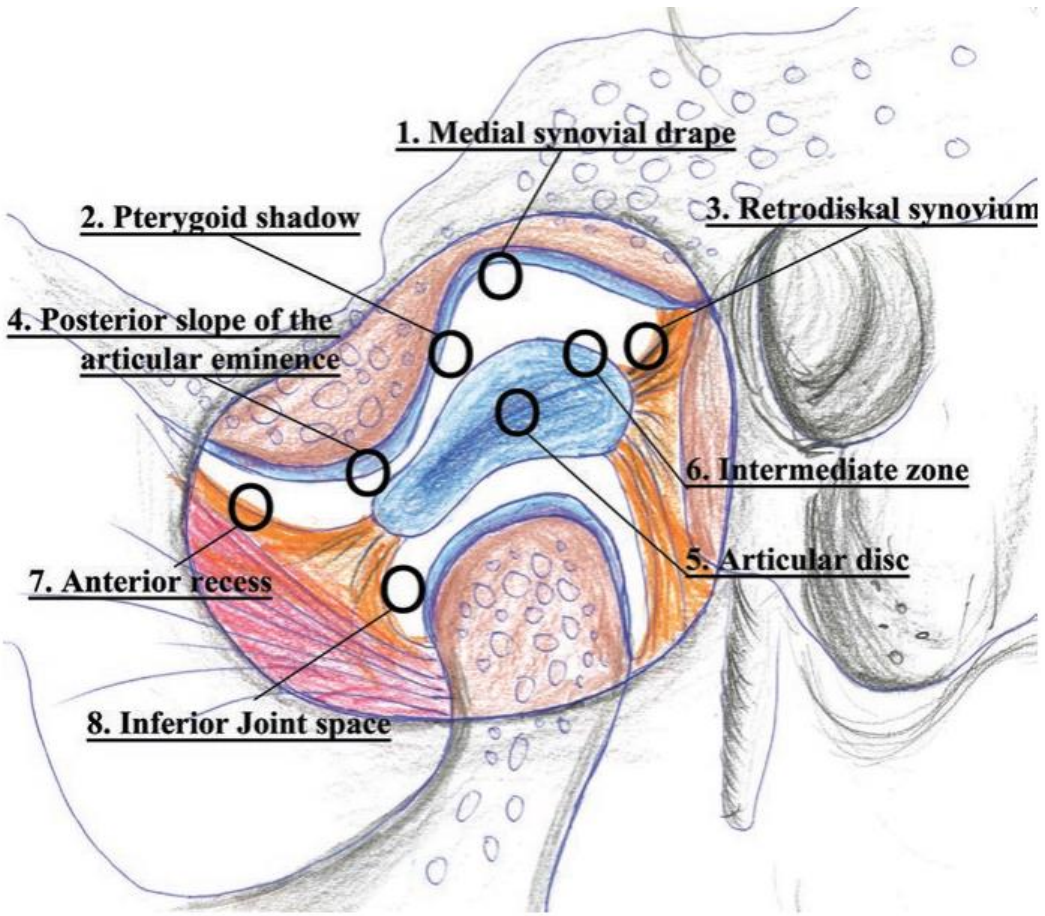

Figure 1: TMJ anatomy

We start diagnostic arthroscopy in the posterior recess, looking at the position of the disc, the condition of the posterior attachment tissues, and the synovium on the medial aspect of the joint. The scope is then swept anteriorly over the top of the disc to look at the anterior parts of the joint. By inspection alone, it is possible to detect disc displacement, adhesions, degenerative changes in the disc and cartilage over the glenoid fossa and articular eminence, and synovial inflammation.

Therapeutic Techniques

1. Arthroscopic Lavage and Lysis (ALL):

It is the simplest and minimal invasive form of surgery in the TMJ which aims to release the articular disc and to remove adhesions between the disc surface and the mandibular fossa, to eliminate restrictions on the disc and lateral capsule, to wash out micro debris resulting from the breakdown of the articular surfaces, to irrigate the joint by enzymes and prostaglandins, and to stimulate the normal lubricating action of the synovial membrane by means of hydraulic pressure from irrigation of the upper chamber of the TMJ (27,28,29,30) .

Advantages of TMJ arthrocentesis and lavage are that it is a simple, inexpensive, and minimally invasive procedure with little morbidity that can be easily undertaken in an outpatient setting. ALL can be performed by a single-puncture or a double-puncture technique. Eight different methods have been published (31-38):

i. The single-needle arthrocentesis

ii. The single-puncture arthrocentesis

iii. Use of a single shepherd cannula with two ports and two lumens

iv. The two-needle arthrocentesis

v. The two-needle arthrocentesis using an irrigation pump

vi. A modified two-needle arthrocentesis

vii. The double-needle cannula method

viii. The two-needle arthrocentesis with modified anatomical landmarks

2. Therapeutic TMJ Arthroscopy:

TMJ arthroscopy is more involved and invasive than ALL and is almost always done under general anaesthesia. Procedures including removing scar tissue and thickened cartilage, reshaping parts of the jawbone, disrupting adhesions, biopsy, and smoothing roughened areas are easily carried out under Therapeutic TMJ Arthroscopy but attempts are also being made to shorten the posterior attachment tissues and reposition the disc by laser, high-frequency, and waterjet applications (39,40).

3. Injection of Intra-Articular Substances:

Various studies have demonstrated the use of drugs like opioids, corticosteroids, or sodium hyaluronate as source of management for TMJ disorders.

i. Corticosteroids: Injection of intra-articular steroids has been used in different joints with good clinical outcomes. Nowadays we advise dexamethasone palmitate as a water-soluble drug. 1ml could be used at the end of lysis and lavage of the superior compartment of the TMJ. In some cases like TMJ arthritis, psoriasis, RA, SLE injection of corticoids into the inflamed tissues (subsynovial infiltration) under arthroscopic view can be advised (41).

ii. Sodium Hyaluronate (SH): It is a naturally occurring substance that is produced by synovial cells and continuously released into the synovial fluid, which serves as a lubricant, anti-inflammatory, and pain reliever and acts as adjunct. Different studies have shown the efficacy of intra-articular injection with SH in treating disc displacement and degenerative joints. The use of SH after arthroscopic lysis and lavage or after surgical arthroscopic oblation technologies has also shown good clinical outcomes. Infiltration of 1 mL of SH into the superior joint space or even also into the inferior joint space under arthroscopic view could be used in cases with degenerative joint diseases at the end of the arthroscopic procedures (42,43,44).

iii. Plasma Rich in Growing Factors: The use of plasma rich in growth factors (PRGF) is an autologous biological therapy that is based on the use of the patient's own plasma, platelet-derived growth factors, and endogenous fibrin scaffolds for regenerative purposes. Studies have shown that PRGF has better clinical results in comparison to hyaluronic acid (HA) in alleviating the symptoms of mild to moderate osteoarthritis of the knee. It has also been shown that infiltration of PGRF into TMJ joints with anterior disc displacements is a more effective method than arthrocentesis alone. Also, the use of PRGF after arthroscopy seems to be more effective when compared with the use of HA or saline solution. Infiltration of 1–2 ml of PRGF in both the superior and inferior joint compartments at the end of the surgical procedure can be indicated in cases with anterior disc displacements with or without osteoarthritis (45,46,47).

iv. Opioids: Synovial receptors of opioids can participate in the clinical perception of pain. So, the use of opioids can be indicated to decrease postoperative joint pain (48).

4. Arthroplasty: Can be used as an adjuvant procedure when severe chondromalacia or osteophytes are present. In these cases, the elimination of the altered cartilage can improve joint function after surgery. Arthroplasty can be performed using forceps, rotary motorized instruments, oblation probes, or laser systems (49).

5. Disc Repositioning Techniques:

i. Oblation: It is a low-temperature technique that can avoid deleterious effects into the surrounding tissues. The technique of oblation has proved to be an effective and minimally invasive option for the treatment of TMJ internal derangement, with advantages such as offering a high degree of precision, haemostasis, leaving smooth anatomic surfaces and causing little or no thermal damage to surrounding tissue. Using oblation probes to execute an anterior disc release and posterior coagulation of the retrodiscal tissues are surgical technique used in surgical TMJ arthroscopy. Oblation can also be used to resect adherences or to treat altered cartilage surfaces in the joint. Laser can be a surgical alternative to perform all these techniques; however, it is a more dangerous and expensive technique (50,51,52).

ii. Sutures: Although posterior repositioning of the anteriorly displaced disc can be accomplished with the oblation techniques already described stabilization of the disc in the long term is not possible when this technique is used. Posterior fixation of the disc with the use of sutures or pins could be used to stabilize the disc. Few studies have been published about the arthroscopic suture techniques, e.g., Joe Mc Cain. Also, Zang (53) and Goizueta (54) offer the possibility to stabilize the disc using two or three traction points fixated to the articular capsule. Clinical results using these techniques are promising. All these techniques need a third trocar portal entry to be performed, so they can be considered as difficult techniques for the beginner in arthroscopy.

iii. Pins: Fixation and stabilization of the articular disc can also be achieved using the surgical technique described by McCain (55). In this case the disc is stabilized to the posterolateral condylar side with resolvable pins. Recent publications offer good clinical outcomes with reduction of postoperative pain and normalization of the mandibular function, when this technique is used (56,57). Occlusal changes after the surgical procedure are not uncommon. A posterior open bite in the ipsilateral side of the surgical procedure is the most frequent sign described. It resulted from the presence of joint effusion and inflammation of the posterior disc attachment. most cases, it lasts only some days and does not need any additional treatment. When aggressive disc repositioning techniques (sutures or pins) are performed, these occlusal disturbances can last more time or even become permanent. In this case the use of postoperative elastic traction can be necessary. Long-term clinical results are still lacking.

6. Other Arthroscopic Procedures

i. Synovial Chondromatosis: Synovial chondromatosis (SC) is a benign disease characterized by the formation of metaplastic cartilaginous nodules within subsynovial connective tissue that may detach inside the joint space, forming loose bodies. The standard treatment is arthrotomy of the affected temporomandibular joint, along with removal of the loose tissues and synovectomy. Otherwise, arthroscopy, a less invasive surgical procedure, could be effective in some patients with SC to remove the loose bodies, with coagulation of the affected synovium using conventional bipolar electrocautery or radiofrequency devices (59). Loose bodies can be removed using a wider third cannula but is restricted by diameter. In selected cases, fragmentation of the largest loose bodies with forceps may

be helpful.

ii. Stuck/Fixed Disc, "Anchored Disc Phenomenon" Anchored disc phenomenon—ADP—is one of the possible etiologies of TMJ closed lock (60,61). ADP is characterized by a sudden, severe, limited mouth opening associated with pain on forced mouth opening. MRI studies with the presence of a disc fixed to the glenoid fossa facilitate a final diagnosis. Arthroscopic findings of ADP are adherences and synovitis (hypervascularity, hyperemia, and redundancy of the posterior ligament) both in the anterior and posterior compartments of the superior joint space (62). Arthrocentesis, a least invasive technique with predictable outcomes, the alternative is arthroscopy which allows direct visualization and removal of adhesions with injection of anti-inflammatory drugs or coagulation into inflamed synovial tissue (63). Recurrent

iii. Mandibular Dislocation Arthroscopy can be used to treat recurrent mandibular dislocation. Different surgical techniques have been used to create scarification and contracture in the retrodiscal synovial tissue and the oblique protuberance. Oblation lasers have been reported with good clinical results (64).

Complications

Intraoperative Complications (65-70)

i. Intra-Articular Damage:

ii. Instrument Breakage:

iii. Joint Irrigation Fluid Extravasation

iv. Vascular Complications

v. Neurological Complications

vi. Otological Complications

Postoperative Complications (71-77)

i. Infection Arthritis

ii. Malocclusion

iii. Other Infrequent Complications: Severe swelling, Reaction to foreign bodies, Arteriovenous fistula, condylar resorption, pseudoaneurysm, hematoma, synovial fistula, skin atrophy, and thermal skin injury also have been described in some isolated cases.

Conclusion

Arthroscopy of the temporomandibular joint (TMJ) is a procedure that permits direct visual examination of the internal structures of the joint, including diagnosing and other surgical treatments under visual guidance using an arthroscope. Skilled surgeons proficient in intraarticular arthroscopic anatomy can perform arthroscopy with minimal instruments, involving joint irrigation and tissue removal. Over the recent years, arthroscopy of the TMJ has undergone significant advancements, and both basic and advanced techniques are currently employed. This approach holds great potential for the diagnosis and treatment of TMJ disorders.

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