Journal of Population Therapeutics & Clinical Pharmacology

Management of Tempro-Mandibular Joint Internal Derangement: A review Article

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Received: 18-11-2022**, Accepted:** 05-12-2022**, Published:** 15-12-2022

ABSTRACT

Tempro-Mandibular Joint disorders (TMD) considered the third stomatological disease in regard to inhabitant illness owing to its chronicity and widespread prevalence. The management of patients with TMD is a challenge, although the clinical examination is the most important step in the diagnosis of TMD, special imaging techniques are needed due to the complex anatomy and pathology. Managements for various TMJ disorders range from physical therapy and nonsurgical treatments to various surgical procedures. Usually, the treatment begins with nonsurgical therapies first, with surgery left as the last option. The aim of the present study was to review the pathophysiology and different modalities in the management of TMD.

Keywords: Tempro Mandibular Joint ; Internal Derangement ; Arthrocentesis

Introduction

Tempro-mandibular joint (TMJ) is associated with various muscles which provide the function to protect and move the joint. The lateral pterygoid, temporal, and masseter muscles are used to close the jaw. On the other hand, the genio-hyoid, medial pterygoid, mylohyoid, and digastric muscles are used to open the jaw **(1)**.

The supply of arterial blood to the tempro-mandibular joint is mainly from the branches of the external carotid (maxillary and superficial temporal). Other influencing branches like the deep auricular, mesenteric artery ascending pharyngeal arteries, anterior tympanic, and ascending palatine artery **(2)**. The tempro-mandibular joint sensory nerve supply is the mandibular nerve masseteric branches (innervate articular capsule in the anterolateral portion) and auriculotemporal nerve, which is a trigeminal nerve branch **(3,4)**.

Temporomandibular joint is usually loaded, even if the mouth is in the resting position in which it is hanging open. In addition, TMJ cannot be in a free load by any actions happening inside the mouth as it is a class three lever. Such as, the action of biting on a tough external object in food by coincidence will not cause condyle distraction away from the skull. Likewise, having occlusal interference in a balancing-side will not cause condyle distraction on that side **(3-5)**.

The motion range for the tempro-mandibular joint includes moving beyond the articular eminence crest in almost 75% of normal population which happens without dislocation or subluxation. Ricketts was able to find that in many patients could open 1-5 mm beyond the evidence crest and some patients could open larger than 5 mm beyond it **(6)**.

There is no other joint that has an extra-articular guidance for movement as they are

limited or permitted by each joint anatomy. So that, when closing the mouth, the mandibular condyle has to stop at F-F' on the hill that the teeth have reached maximum interdigitation. Because of the non-static movement of human body over time for the masticatory system the subsequent incidents were always happening including teeth can wear proximally and occlusally, muscles undergo continuous subtraction and addition according to functional requirements, and tempro-mandibular joint continuous remodeling is occurring in the soft and hard tissues **(7,8)**.

Pathophysiology of TMD:

Tempro-mandibular joint pathology is a dilemma that concerns with temporo-mandibular disorders, tumors, infections, growth development anomalies, and traumatic lesions. Although the exact pathophysiology remains unclear, several non- mutually exclusive mechanisms have been proposed to explain how biological, psychological and social factors can combine to predispose or initiate painful TMD. Studies of chronic pain and TMD suggest neurologic, endocrine and inflammatory pathways **(9)**.

Additionally, several alterations in pro- and anti-inflammatory cytokines have also been found in individuals with chronic painful TMD relative to TMD-controls, including elevated circulating levels pro- inflammatory monocyte chemotactic protein (MCP-1), reduced levels of anti-inflammatory (omentin and reduced transcription of anti-inflammatory transforming growth factor. Inflammation may play a more substantial role in TMJ arthralgia and degenerative joint disease (DJD), based on associations with several altered markers in the joints or synovial fluid **(10, 11)**.

The most accepted categorization helps to understand the pathophysiology is Schiffman et al. introduced a categorization that classifies temporomandibular joint disorders which is approved by the American Dental Association (ADA) with a few modifications. All TMJ disorders divide to 4 broad classifications having similar characteristics as follows **(12, 13)**:

(a) Disorders of Masticatory Muscle: The most popular pain type detected in patients is in the muscles of mastication during chewing, swallowing, and talking. The palpation or muscle manipulation cause increasing in the pain. It is related to the restriction of movements of mandible.

(b) Chronic Mandibular Hypo-mobility: It is a painless long-term mandibular limitation. Pain happens during the opening beyond limits. The situation categorization is according to the etiology, as ankylosis, contracture of the muscle, and impedance of coronoid process.

(c) Growth Disorders: The disturbances in the growth might be in the muscles or the bones. Popular disturbances in the growth in bones are agenesis (no growth), neoplasia (growth of destructive), hypoplasia, and hyperplasia. Popular disturbances in the growth of the muscles are hypertrophy, and neoplasia (destructive growth). It causes by the alterations in growth that usually caused by trauma.

(d) Intracapsular TMJ Disorders: Intra-capsular TMJ disorders were subdivided to 3 main classifications are condylar-disc complex derangement, incompatibility of the structures with articular surfaces, and inflammatory disorders of the TMJ that included synovitis or capsulitis, retrodiscitis, arthritis, osteoarthritis, osteoarthrosis, and systemic arthritis **(9)**.

Diagnosis of Temporomandibular joint disorders:

Many different forms of TMD assessment were Helkimo Index and the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). Later on, revising and validating the RDC/TMD, the Diagnostic Criteria for Temporomandibular Disorders

(DC/TMD) was reported which give an evidence-based set of tools with which to diagnose TMD. The DC/TMD offers a standardized and operationalized method to examine the masticatory structures physically (Axis I) and also to screen the presenting patient for psychosocial and comorbid factors (Axis II). The most important new part of the examination is confirmation that any pain elicited during examination is familiar, meaning that it reproduces or is similar to the pain that the patient experiences in their life and which was reported in the history section of the assessment **(14,15)**.

Management of TMD:

The majority of TMD patients can be successfully treated by non- surgical and minimally invasive therapies while invasive surgical interventions may be required for only a small part of TMD population. Many of the treatments may work best when used in combination.

- **Occlusal splint (OS)**

Occlusal splint is a removable appliance that covers all the occlusal and incisal surfaces of teeth in the upper or lower jaw, and it is the most frequently recommended. Although the mode of action of OS is not fully clear, studies show that it promotes bilateral balancing and protects teeth from wear caused by bruxism. There are many types of OS with different indications and functions. The splint is designed to provide a temporary and ideal occlusion leading to neuromuscular balance and decreasing muscle tension **(16,17)**.

- **Low-level laser therapy (LLLT) – Photobiomodulation Therapy**

It is the application of light within the red and near infra-red wavelength range of 600-1000 nm. It is a non-ablative and non-thermal light. There is evidence that LLLT modulates the inflammatory process, reduces pain and edema, and increases blood circulation and extensibility of the nervous system. The clinical efficacy of TMD is controversial due to the difference in parameters, dosimetry, and assessment criteria used by studies, besides the clinical variability of TMD patients **(18,19)**.

- **Therapeutic ultrasound (US)**

It is the application of mechanical vibrations, known as sound energy, at increasing frequencies above 16 Hz generated by a piezoelectric effect using a frequency between 1.0 and 3.0 MHz. It is useful in fresh injuries with acute inflammation. Another useful application of ultrasound is in the administration of anti-inflammatory ointments with a hand-held transducer. The energy forces the diffusion of medications through the skin to target underneath soft tissues. This method is called phonophoresis **(20)**.

- **Transcutaneous electrical nerve stimulation (TENS)**

Among therapies for TMD, TENS has been proposed as a safe and noninvasive therapy with low-voltage electrical pulses. Using electrodes on the skin over the painful area, TENS can modulate the control system of endogenous pain promoting pain relief **(21,22)**.

- **Manual therapy (MT):**

MT is an important method that promotes the release of opioid and non-opioid substances and inhibitory neurotransmitters that act in the central nervous system. It also promotes muscular relaxation, stimulates joint proprioception, relieves pain, and improves mandibular

movements **(23)**.

- **Oral exercises and behavioral education (OE/BE):**

Self-management (SM) or self-care includes cognitive behavioral therapies as education about negative habits and counseling, relaxation techniques, and home exercises. Benefits of exercises include decrease in pain due to the release of endogenous non-opioid and opioid substances. There is poor evidence of its effectiveness due to the differences on prescription **(24)**.

- **Pharmacological treatments:**

Pharmacological treatment is a common approach for orofacial pain as a monotherapy or associated with other therapies and surgical interventions. Used alone, it is considered a palliative therapy. The most commonly used drugs to decrease pain and inflammatory process in joints and/or muscles are melatonin, gabapentin, myorelaxants, non- steroidal anti-inflammatory drugs (NSAIDs), analgesics, tricyclic antidepressants (TCAs), benzodiazepines, corticosteroids **(25-29)**.

- **Invasive therapy:**

Surgical invasive treatments represent the unique option for patients suffering severe TMD like traumatisms, neoplasia, or developmental malformations. In most cases, it is necessary to perform an arthrotomy to restoring joint tissues or replace TMJ with autogenous or alloplastic material. In the TMD due to disc alterations, surgical repositioning (discopexy), disc removal (discectomy) or disc replacementhave been used with variable efficacy **(30-32)**.

- **Minimally invasive therapy:**

The synovial fluid has been identified in rheumatoid arthritis since the Hippocratic Corpus period. In 1592, Dr. Frey Augustin Farfan explained the technique and benefit of the knee arthrocentesis in his textbook. Dr. Fabricius Hildanus is the first surgeon that treated the knee joint by puncture. However, no evidence of therapeutic punctures in knee joint until Jean Gay published his work in 1792 **(33)**.

TMJ arthrocentesis was developed after casual events in TMJ arthrography. Patients who underwent TMJ arthography, where the contrast dye was injected for purpose of TMJ imaging, experienced improved pain and jaw movement after the dye was washed out **(34)**.Moreover, unlike TMJ arthroscopy, the use of microscope to visualize the joint is not necessary because of the limited space of TMJ. As a consequence, TMJ arthrocentesis was first introduced in 1991 by Dr. Nitzan **(35,36)**.

- **Arthroscopy:**

Introduction of arthroscopic surgery for the management of internal derangements by Ohnishi in 1975 and the subsequent development of the technique. Although initially this procedure consisted mainly of irrigation of the joint and the breaking up of adhesions (lysis and lavage), various surgical manipulations similar those performed arthroscopically in other joints were subsequently introduced by some surgeons. It soon became evident that in the treatment of patients with internal derangements, restoring joint mobility rather than disc position was the important factor. This produced a better distribution of forces within the joint, allowed more physiologic function by improving the diffusion of nutriments and the elimination of

inflammatory breakdown products, and ultimately resulted in transformation of the painful anteriorly displaced retrodiscal tissue into a more fibrotic functional pseudodisc. The endoscope is introduced into the joint cavity and allows examination of the intra-articular cavity through the transmission of the intra-articular image to the display. The endoscopes intended for the TMJ arthroscopy usually have a diameter of 1.9–2.7 mm **(37-40)**.

Diagnostic arthroscopy consists in the visualization of each part of the joint space, while lysis of the adhesions and joint lavage are also carried out during the arthroscopy. In addition to the endoscope, the needle used to release the irrigation fluid is introduced into the joint during the diagnostic arthroscopy. Through arthroscopic joint visualization, diagnosis of ID stage and identification of osteoarthritic changes can be established. The needle can also be used for the direct injection of medications into the inflammatory changed synovial tissue and the retrodiscal tissue **(41)**.

Surgical arthroscopy consists in the surgical intervention in the joint under arthroscopic view. In addition to the endoscope and the needle for releasing, the working (surgical) input for surgical tools (hook, probe, scissors, forceps, laser fiber, and shaver) is also introduced into the joint. The surgical arthroscopy is used to remove adhesions and to align and fix the disc, for discectomy (surgical removal of herniated disc material), or eminectomy (removal of the articular tubercle) procedures **(42)**.

- **Arthrocentesis:**

This is the minimal-invasive surgical method in order to perform the lavage of the superior joint space. Arthrocentesis is recognized as first line of interventional procedure in patients who do not respond to conservative treatment. Because of the minimal complications, low morbidity, relative ease, and less expense, arthrocentesis is ideal for early management of TMJ disorders.[(6)] Arthrocentesis reduce the inflammatory process, evacuates inflammatory exudates, release the disc, breaks up adhesions, eliminates pain and improves joint mobility **(43,44)**.

Currently, TMJ arthrocentesis is not indicated only for acute disc displacement without reduction (Closed lock) but it is also recommended for various TMD conditions including; internal derangement's patients who fail from conservative treatment, limited mouth opening caused by internal derangement or adherence/adhesion, disc displacement with/without reduction, chronic joint pain or TMJ arthralgia/arthritis and degenerative joint disease **(45)**.

Even though arthrocentesis is a safe procedure, the complications of this technique depend on the anatomy of the TMJ and related structures, skill of operators and the technique used. The complications include extravasation of the fluid around the operation field, nerve injury especially facial nerve, trauma to the TMJ structure, preauricular hematoma, transarticular or intracranial perforation, extradural hematoma, unsuccessful induction of the needle and broken needle tip which ranges between 2-10% **(46)**.

- **Injectable materials after arthrocentesis:**

Several medical substances can be used after arthrocentesis such as non-steroidal anti-inflammatory drugs (NSAIDs), opioid analgesics, corticosteroid, sodium hyaluronate (SH), platelet-rich plasma (PRP) and recently ozone **(6,47)**.

A. Non-steroidal anti-inflammatory drugs (NSAIDs):

Tenoxicam and Piroxicam have been used to treat inflammatory articular disorders [(127)].

They reduce the biosynthesis of prostaglandins by direct inhibition of cyclo- xygenase (COX)**.** Combination of NSAIDS and arthrocentesis has been supported on the basis that the anti-inflammatory action of NSAIDS would decrease synovial inflammation and remove the inflammatory and associated mediators from the synovial space **(48)**.

However, not all NSAIDS are suitable for intra-articular use because of their formulation. NSAIDs also inhibit chondrocyte biosynthesis and have been implicated in cartilage destruction with intra-articular use. One of the commonly used intra-articular NSAID is tenoxicam. Parentral tenoxicam has an aqueous base without an organic stabilizer which makes it ideal for intra-articular administration **(49)**.

B. Opioid analgesics (morphine and tramadol):

Morphine given into the joint during arthrocentesis substantially decreases pain **(134)** Intra-articular morphine 1 mg gives efficient analgesia, through the activity of the opioid receptors in the inflamed tissue rather than a systemic effect. Morphine affects the peripheral opioid receptors in primary afferent neurons and reduces the local post-traumatic inflammation. The analgesic efficiency of tramadol depends on the activation of opioid receptors and it is obviously clear that opioid analgesics had lost their effect by 6 months **(50)**.

C. Corticosteroids:

Corticosteroids are methylprednisolone, triamcinolone acetonide, betamethasone, and dexamethasone more potent anti-inflammatory agents, and they act by entering the cell and bind with the glucocorticoid receptor. Steroid receptor complex enters into the nucleus and binds with DNA at specific sequence and increase the anti-inflammatory gene expression. Corticosteroids also inhibit the prostaglandin synthesis which are inflammatory mediators **(51)**.

Intra-articular injections of glucocorticosteroids have been used for more than three decades in the treatment of patients with TMJ pain and dysfunction**(139)**. However, local side effects of intraarticular glucocorticosteroids include destruction of articular cartilage, bone resorption, and infections. It is reporte to have adverse effects in the knee joint, which include septic arthritis, post injection "flare," local tissue atrophy, tendon rupture, cartilage damage, flushing, and increased blood glucose level **(52)**.

The cause of these reactions has not been fully explained. Thus, an interval of at least 4 weeks between glucocorticosteroid injections and a**m**maximum number of three injections in each joint have been recommended **(51)**.

D. Hyaluronic acid:

It is a main natural component of synovial fluid that acts as an important substance in the synovial tissues lubrication. Sodium hyaluronate (SH), the sodium salt of hyaluronic acid was reported to enhance the pain of joint and avoid intra- articular adhesions. SH has a protective, lubricating, and repairing influence on the surfaces of the joint. In addition, It has an anti-inflammatory and analgesic action. Visco-supplementation with sodium hyaluronate has also become an option for the management of symptoms in the clinical setting, with the knowledge that impaired joint lubrication could be a risk factor for TMJ internal derangements **(53)**.

Intra-articular hyaluronic acid (HA) injection alone or after arthrocentesis provides palliative influences the clinical signs and symptoms of TMJ pain. Injection has successfully been used in the pain control of TMJ disorders due to their anti-inflammatory and analgesic effects, such as scavenging for free radicals, reducing vascular permeability, and inhibition of

phagocytosis, chemotaxis, prostaglandin synthesis, metalloproteinase activity **(54,55)**.

E. Platelet-rich plasma (PRP):

It is delivered by centrifuging heparinized whole autologous blood for fifteen min and platelets separating from the other blood components. Later, normal saline solution is used to dilute the platelets to get the ideal concentration. This resembles an emerging regenerative therapy for injuries in the ortho-paedic area with promising results as an analgesic, anti- inflammatory, and antibacterial properties **(56)**. It believed to restore intra-articular hyaluronic acid, balance joint angiogenesis, raise glycosaminoglycan chondrocyte synthesis, and provide a scaffold for stem cells migration. **(155)** However, different ways are used to prepare PRP solutions in the research papers studied **(156-158)**, Al-Delayme described the efficacy of injection of the PRP as a primary treatment of non- reducing disk displacement. It was assumed this to be an ideal duration of therapy six months, after which it might be considerable an additional injection **(57)**.

F. Ozone Therapy:

Ozone was first researched and documented by a German chemist Friedrich in 1840 when he detected an 'odorful gas' on passing electrical discharge through water. He is also considered as the father of ozone therapy. Also, first use of ozone gas in medicine was during the World War I for the treatment of German soldiers affected by gaseous gangrene **(58)**.

Ozone is a natural, colorless, unstable and highly reactive gaseous molecule that is chemically composed of oxygen (O2) with an extra molecule added (O3). It is produced when ultraviolet light or an electric spark passes through oxygen. Among oxidant agents, ozone is the third strongest, a fact that explains its high reactivity. The actions of ozone on the human body include analgesic, antimicrobial, immune stimulating, antihypoxic, detoxicating, biosynthetic, and bioenergetic effects **(59)**.

Using ozone gas treatment of joint disease has reached some promising results, including knee rheumatoid arthritis. In addition, clinical and experimental studies have demonstrated its safety and effectiveness **(60)**.

Conclusion:

Arthrocentesis is very effective in patients suffering from TMD by reducing pain and discomfort and increase in mouth opening.

There are many different substances that can be injected after TMJ arthroscopy or arthrocentesis. However, it is still unclear what kind of a substance injected intraarticularly following TMJ arthroscopy or arthrocentesis is able to enhance the best possible clinical results in respect of both postoperative and general pain management, and maximal mouth opening**.**

PRP injection to TMJ space for treatment of internal derangement are safe, effective, non-invasive method.

Ozone promotes better vascularization in bones and cartilage, and accelerating anabolism and recovery in osteoarticular diseases.

Conflict of interest: The authors declare no conflict of interest.

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