OPEN ACCESS

Saudi Journal of Oral and Dental Research

Abbreviated Key Title: Saudi J Oral Dent Res
ISSN 2518-1300 (Print) |ISSN 2518-1297 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Review Article

Pain Management in Temporomandibular Disorders: A Review of the Literature

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DOI: 10.36348/sjodr.2020.v05i11.005 | **Received:** 02.11.2020 | **Accepted:** 16.11.2020 | **Published:** 23.11.2020

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Abstract

Temporomandibular disorders (TMD's) are defined as "A collective term embracing a number of clinical problems that involve the masticatory muscles, temporomandibular joint and associated structures or both". TMD's are considered a major source of non-dental orofacial pain interfering with normal daily activities and affecting the quality of life. Despite huge amount of research in the diagnosis and management of temporomandibular disorders, there is still no certain therapeutic method that proved to be solely effective in pain management resulting from TMD's. This review article contains a collection for the various therapeutic procedures used for management of TMD pain and discusses the most recent evidence on their effectiveness through comprehensive review of Pubmed for relevant publications within the last decade.

Keywords: Temporomandibular disorders, orofacial pain, pain management, quality of life.

INTRODUCTION

The temporomandibular joint (TMJ) is a unique diarthrodial joint that is considered as one of the most complex joints in the human body. According to the American academy of orofacial pain, temporomandibular disorders (TMD's) are defined as "*A collective term embracing a number of clinical problems that involve the masticatory muscles, temporomandibular joint and associated structures or both* [1]*"*. Consistent with the updated diagnostic criteria of temporomandibular disorders (DC/TMD) by Schiffman *et al*. [2], the most common temporomandibular disorders are arthralgia, myalgia, local myalgia, myofascial pain, myofascial pain with referral, disc displacement disorders, degenerative joint disease, subluxation and headache attributed to TMD.

TMD's are considered a major source of non-dental orofacial pain interfering with normal daily activities and affecting the quality of life [3, 4]. Moreover, pain from the TMJ can radiate to the ears, temple, occipital region, shoulders and cervical region [5].

TMD's are also considered the second most common cause of chronic pain after back pain [2]. Their prevalence ranges from 3.7 to 12 % of the population in some studies [6], other authors have reported a TMD prevalence of 10 to 15 % of the population [7].

Causes of pain in TMD's

TMD's have a multifactorial etiology where the cause of pain and dysfunction in TMD's may be attributed to several factors including genetic predisposition, local and systemic biological factors, in addition to psychological and behavioral factors [8].

Pressure exerted on the highly innervated retro-discal tissues by the condyle in cases of anterior disc displacement may lead to vasoconstriction and release of nitric oxide, reactive oxygen species and thiobarbituric acid, resulting in pain [9, 10]. However, not everyone having disc displacement evident on magnetic resonance images (MRI's) suffers from clinical signs and symptoms of TMD's. This may be due to the high adaptive and remodeling capacity of the TMJ, which explains the minimal or even absent pain in asymptomatic subjects with displaced discs [11].

Pain may also result from different inflammatory conditions affecting the joint including degenerative joint disease, infectious arthritis,

rheumatic arthritis and metabolic arthritic conditions [12].

Another significant cause of TMD pain is excessive tension of the masticatory muscles [13]. Parafunction and exposure of the joint to microtrauma or macro-trauma may as well, be the predisposing factors to TMD pain.

Association of TMD's with comorbid pain conditions: TMD's may present in association with primary headaches, pain conditions in other parts of the body as chronic back pain or systemic pain conditions as fibromyalgia. This may indicate increased susceptibility of the patient to chronic pain in multiple sites as a result of dysfunction of the pain pathways through peripheral and/or central sensitization [8, 14].

Relation between pain and psychosocial function

The biopsychosocial model of pain recognizes cognitive, emotional and behavioral aspects of pain in addition to the sensory component, which affect the pain experience and coping strategies. Axis II of DC/TMD includes measures for comprehensive assessment of psychological function in TMD patients. These tools screen the patient for pain intensity, psychosocial distress, and pain-related disability [2].

Several studies have emphasized the psychosocial impact of orofacial pain where the results confirmed that patients with chronic TMD pain exhibit significant psychological dysfunction and impaired health-related quality of life [15, 16]. This highlights the great importance of TMD pain management not only in relieving the physical suffering but also in improving the psychosocial quality of the patients' lives. Inadequate treatment of TMD pain which lasts for more than 6 months may result in its transformation into chronic pain where peripheral and central sensitization occur as a result of neuroplastic changes contributing to the pain chronicity [17]. A supporting evidence for central sensitization by La Touche *et al*. [18] is based on finding central and spinal hyperexcitability in TMD patients demonstrated by increase in mechanical temporal summation.

Axis II (DC/TMD) screening instruments are indicated in case of TMD pain lasting for 6 months or more without adequate response to treatment in order to reveal the need for psychological intervention as part of a multidisciplinary approach [2].

Management of pain in TMD's

Despite huge amount of research in the diagnosis and management of temporomandibular disorders, there is still no certain therapeutic method that proved to be solely effective in pain management resulting from TMD's. According to the Royal College of Surgeons' Primary Care guidance for TMD [19], the main objectives of TMD management are encouragement of self-management strategies through patient education, reducing pain and improvement of function. Therapeutic options mainly include occlusal splints, medications, physiotherapy, behavioral therapies and surgery. The effectiveness of each of those options has been thoroughly investigated in the literature during the last decades. Peripheral, central and/or behavioral positive influences have been suggested as possible mechanisms for the different therapies [4, 20].

Selection of the appropriate therapeutic method should take into account the following considerations

1. Proper diagnosis of the TMD through thorough clinical examination and if indicated, imaging and laboratory investigations.
2. Delivering the treatment within a biopsychosocial context taking into account the biological, psychological and social factors, where psychosocial factors play an important role in response to treatment in case of chronic pain [21].
3. 75-90% of patients respond well to conservative measures [22].
4. A considerable percentage of TMD patients have comorbid headaches or other pain conditions which may complicate the diagnosis and affect treatment outcome. The inclusion of a neurologist within a multidisciplinary team helps to increase the chances of treatment success in such cases [23].

Diagnosis of TMD's

All the details of DC/TMD including a symptom questionnaire, a detailed examination protocol and examination form which standardizes the examination and recording of findings in addition to Axis II screening tools are available with the most recent updated versions on the electronic page of the International Network for Orofacial pain and Research Methodology (INFORM) [24].

A few highlights of the DC/ TMD quoted from the INFORM [24] *website are provided here as essential recommendations for the clinician during TMD diagnosis:*

- Time frame for the DC/TMD is pain present within the last 30 days.
- The examiner asks the patient to point to the location of pain, this indicates the structures affected. According to subsequent clinical examination, the examiner will record the pain location as "joint" or "muscle".
- The examiner asks the patient about current history of headaches.
- Bilateral palpation of the masseter and temporalis muscles is sufficient for diagnostic

yield in 99% of the time in case of pain originating from masticatory muscles.

- One finger palpation is recommended with 0.5 to 1.0 kg pressure for at least 2 seconds or 5 seconds (in case of referred pain) followed by "familiar" pain inquiry and if positive by the "referred" pain inquiry. Goal of the examination is to replicate the patient's pain to locate the source. Each major muscle is divided into 3 zones to ensure that they are examined in a consistent manner.
- Maxillary and mandibular incisors serve as stable landmarks for measurement of the mandibular range of motion. In their absence, the nasopalatine papilla and estimated mandibular midline are used instead.
- A mm ruler starting at the zero mark should be used for measurement of maximal interincisal opening.
- Vertical incisal overlap (positive or negative) is added to the measurement of vertical movement.
- Horizontal overjet (positive or negative) is added to the measurement of protrusive movement.
- The examiner should ask the patient to slowly open 3 times and record any corrected or uncorrected deviation during opening.
- 3 types of open movements (pain-free opening, maximum unassisted opening and maximum assisted opening) are performed during examination.
- Patients should bring posterior teeth into maximal inter-cuspal position before each open-close cycle.
- Joint noises and locking during opening or closing should be noted by the examiner.

Figure 1 (A and B) are diagnostic decision trees which serve as helpful flow charts during TMD diagnosis [available from the INFORM website].

Diagnostic challenge of TMD's

The complexity of the anatomical structure in the orofacial region and common co-existence of multiple painful conditions can make accurate diagnosis a difficult process [25].

TMD's can mimic toothache, co-exist with headaches and cervicogenic pain or be a part of chronic widespread pain condition [25]. A recent study has also shown that migraine may present (although rare) as isolated facial pain affecting the second or third divisions of the trigeminal nerve [26].

Wrong diagnosis of orofacial pain may lead to ineffective and sometimes irreversible treatments. The holistic approach by using Axis I and Axis II for assessment in addition to appropriate investigations via a multidisciplinary team will help in proper management of patients and protecting them from unnecessary restorative or surgical procedures [25].

Treatment procedures for TMD's can be broadly categorized into non-invasive, minimally invasive and invasive therapies (Figure-2).

Non-invasive treatment options

Patient education and reassurance

Patients are educated about the nature and etiology of their condition and instructed to change some of their habits as avoiding chewing gum, extreme movements or wide opening of the jaw. They are also advised to follow a soft food diet and apply hot/cold fomentations. Following these self-care management strategies might help considerably in decreasing their pain [27]. It is also important for the clinician to emphasize, during patient education, upon the contributory role of psychological factors in pain intensity and persistence [21].

Splint/appliance therapy

There are many types of appliances that are based on expert opinion rather than high quality research evidence from randomized controlled clinical trials with adequate sample size. The most commonly used splints for TMD management are stabilization and anterior repositioning appliances [28-30]. Splint therapy has been postulated to provide significant reduction of pain in temporomandibular disorders [29]. A meta-analysis by Zhang *et al*., [30] has revealed that splint therapy helped to reduce the painful episodes in patients suffering from TMJ clicking. Several mechanisms were proposed to explain the action of splint therapy on the joint. The most likely are prevention of tooth contact, breaking parafunctional habits, reduction of muscle tension and unloading the joint.

However, a recent systematic review studying the clinical and cost effectiveness of oral splints has reached the conclusion that there is a very low-quality evidence in the literature to confirm that oral splints effectively reduce pain in TMD's as a group of conditions [31].

Splints may be soft or hard with full coverage of the upper or lower arch. Al-Moraissi *et al*. [32] have compared the various types of occlusal splints in their network meta-analysis and found that the best results were obtained by hard stabilization splints when combined with counselling therapy.

Jaw Exercises

Both active and relaxation (static) masticatory muscle exercises performed three or more times daily for ten minutes each day have been proved to effectively reduce TMD pain. Reduction of pain leads consequently to improved range of mandibular motion. Some studies have concluded that relaxation exercises

have given better results compared to active exercises in alleviation of masticatory muscle tension [13].

Physiotherapy

Different methods of physiotherapy as massage, ultrasound, short wave diathermy, iontophoresis, laser therapy and transcutaneous electronic nerve stimulation (TENS) have been used throughout the literature and their effect in reducing pain and inflammation has been demonstrated [33, 34].

Xu *et al*., [35] in their meta-analysis have concluded the effective role of low-level laser therapy in relief of pain and functional improvement of TMD symptoms. Ultrasound has also given promising results in terms of pain reduction and improving muscular function [27].

When properly administered, physiotherapy provides relief of discomfort and functional improvement at least for a short term and since no harm is usually anticipated, its use is often encouraged as a non-invasive therapy [21].

Pharmacological therapy

Medications used for TMD pain commonly include analgesics, non-steroidal anti-inflammatory drugs (NSAID's), opioids, anxiolytics, antidepressants, and muscle relaxants.

NSAID's available as over the counter or prescription pain killers are usually effective in case of mild to moderate pain resulting from acute inflammatory joint conditions. To reduce pain effectively, they should be used regularly for at least 2 weeks, taking into consideration their adverse effects especially on the gastrointestinal tract, kidneys and bleeding tendency [36].

Opioids as codeine and oxycodone are used in case of moderate to severe chronic TMD pain. [37]. However, their use is restricted to prescription by well-trained clinicians in selected cases due to the potential of these drugs to cause tolerance and physical dependence in addition to other adverse effects and drug interactions [36].

Muscle relaxants have been commonly prescribed by clinicians to alleviate TMD pain resulting from muscle hyperactivity as in clenching and nocturnal bruxism. A single dose at bed time is usually prescribed. These are centrally acting skeletal muscle relaxants that should be used with caution as they induce increased sedation [36].

Antidepressants in low doses whether tricyclic antidepressants or selective serotonin reuptake inhibitors (SSRI's) have been used as neuro-modulatory agents in patients with refractory TMD pain. Many patients with TMD have comorbid depression and sleep disturbances which may be managed by these medications, contributing to the indirect improvement of TMD pain symptoms. However, consultation with the patient's physician is necessary for management of potential side effects [36, 38].

Benzodiazepines have been used as anxiolytics and anticonvulsants. They also act as muscle relaxants and sleep inducers. Although some studies have proved the effectiveness of these agents in reducing TMD pain [39], their use is discouraged due to the numerous side effects, tendency to induce tolerance and physical dependence with prolonged use [37, 40].

Psychological management including cognitive behavioral therapy (CBT)

Pain is stressful and living with chronic pain implies stress that may lead to anxiety, depressed mood and reduced quality of life. Stress also plays an important role in amplification and persistence of pain. This confirms the importance of adjunctive psychological management in patients with chronic TMD's [21].

Cognitive behavioral therapy is based on changing the patterns of thinking or behavior that are behind people's difficulties and so changing the way they feel. There is available evidence on the added benefit of CBT in effective pain relief when combined with usual treatment for patients with persistent TMD's [41]. CBT has been proven to provide long term improvement of TMD symptoms in terms of pain severity, depression and activity interference [42].

Acupuncture

This method is well known in Asian countries and started to become popular in the western world. Some studies have pointed to the positive effect of acupuncture in reducing pain of TMD especially in patients with myofascial pain symptoms [43].

Minimally invasive treatment options

Arthrocentesis

Joint lavage using two needles was first introduced by Nitzan *et al*., [44] as a minimally invasive and efficient technique (especially for TMJ internal derangement) that can be performed under local anesthesia for release of adhesions, wash out of inflammatory mediators, improving limitation of mouth opening and pain relief. Studies using the classic double puncture technique or the alternative single puncture technique have stated marked reduction of pain following arthrocentesis, owing to the effective flush out of pain mediators, pressure relief and decrease of joint loading [10, 45, 46]. Patients with acute pain seem to respond better to arthrocentesis than those with chronic pain [47] A review has reported 83.5% success rate when arthrocentesis was performed for patients with internal derangement (disc displacement without reduction) and osteoarthritis [45].

Intra-articular injections

Throughout the literature, different medications and substances have been injected into the joint. In most instances, they were used as adjunctive to arthrocentesis.

The most common medications used after arthrocentesis are corticosteroids, sodium hyaluronate and non-steroidal anti-inflammatory drugs (NSAID's). Some studies have proved an added benefit of pain management when intra-articular injections are performed in adjunct to arthrocentesis while other studies have shown that no significant benefit has been drawn from those additional injections in comparison to arthrocentesis alone [10, 48-52].

Other studies have investigated the injection of corticosteroids with local anesthesia into the joint and reported good results in terms of pain management and improvement of function [53]. The corticosteroids commonly used intra-articular are betamethasone, methylprednisolone, dexamethasone and triamcinolone [54]. Corticosteroids suppress the inflammatory process inside the joint via prevention of the expression of cytokines and inflammatory mediators through binding to specific receptors [51]. In spite of the reported high benefit of injectable corticosteroids in management of TMD pain, they still have serious side effects as hypertension, damage of the fibrous layer and bone resorption especially with repeated injections [55].

Hyaluronic acid (HA) represents the main component of synovial fluid responsible for lubrication and nutrition of tissues inside the TMJ, so its intra-articular injection has been found to provide long term improvement of TMD symptoms [56]. There is also evidence that application of HA helps to regulate the inflammatory mediators in osteoarthritis of the TMJ [57].

Prolotherapy involving the injection of 25% dextrose into the joint has given promising results in terms of pain reduction and improvement of other TMD symptoms when used in patients with TMJ internal derangement [58]. Prolotherapy has also been used with success in case of joint hypermobility where pericapsular injection of dextrose helped to strengthen the capsule and ligaments leading to efficient management of recurrent joint dislocation [59].

Effective reduction of TMD pain has also been obtained in studies applying intra-articular injection of platelet-rich plasma (PRP) [60, 61] where the analgesic effect of PRP was suggested to be related to the up-regulation of cannabinoid receptors CB1 and CB2 [62].

Botulinum toxin type a injection

Machado *et al*., [63] in their recent systematic review have shown that injection of Botulinum toxin type A for painful TMJ disorders was well tolerated and was more effective in pain reduction compared to placebo and other treatment modalities. Patel *et al*., [64] have recommended considering the use of Botulinum toxin for TMD's only after exhaustion of other conservative measures.

A recent randomized study has compared the use of Botulinum toxin alone, stabilization splint alone and both together for management of bruxism. The pain scores had decreased significantly in the Botulinum toxin group and the combination group in comparison to the splint group [65].

Arthroscopy

This technique involves the insertion of an arthroscope into the joint under general anesthesia for diagnostic or therapeutic purposes. It can be used to perform lysis and lavage under direct visualization in addition to other operative joint procedures.

In the meta-analysis by Rigon *et al.*, [66], arthroscopy has resulted in better improvement of maximal interincisal opening after 12 months compared to arthrocentesis. However, no significant difference was found between arthrocentesis and arthroscopy in terms of pain reduction.

Invasive Treatment Options

Patients not responding to non-invasive and minimally invasive therapies may be candidates for more invasive surgical treatments including arthroplasty, discectomy, disc repositioning, disc plication and other open joint surgeries reaching to total joint replacement. Total replacement of the joint in case of severe degeneration of the articular surfaces damaged by arthritis, has resulted in satisfactory improvement of symptoms and function [67]. However, open TMJ surgeries may carry the risk of complications including wound infection, facial nerve injury and fatal vascular injuries [56].

Open joint surgery was found to be superior to arthroscopic surgery in patients with TMJ internal derangement in terms of pain reduction with comparable results in other clinical parameters [68].

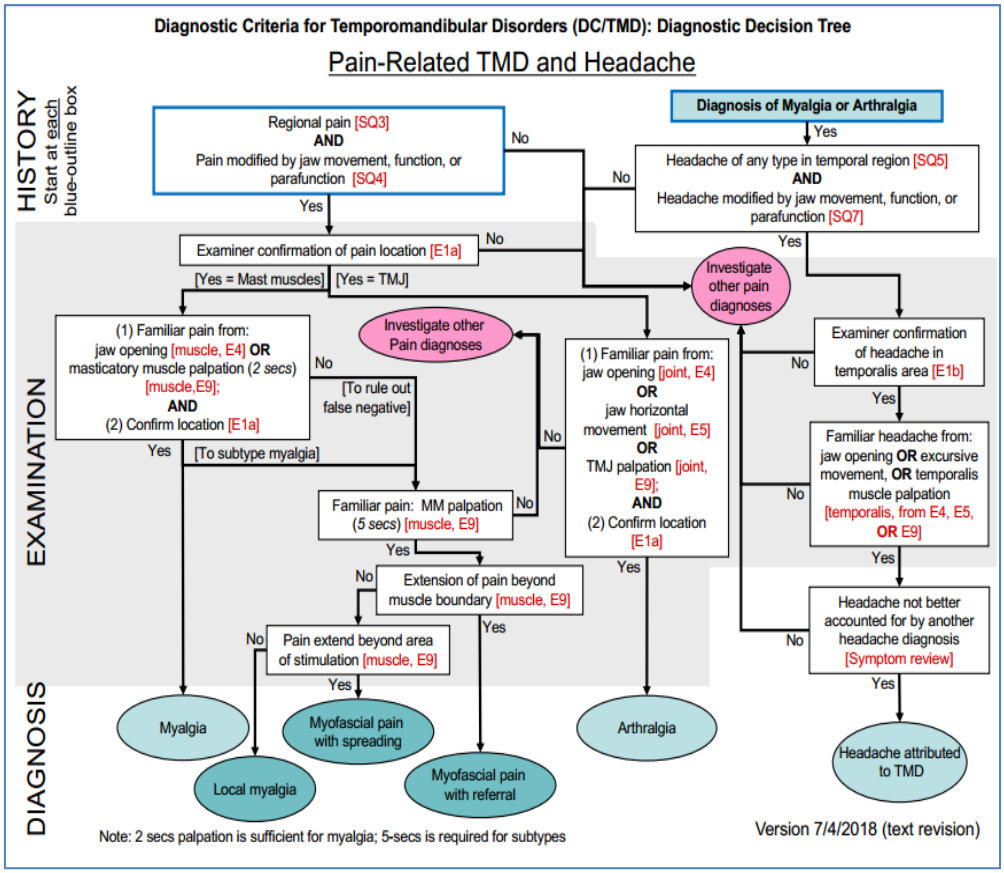

Fig-1A: Diagnostic decision tree (available from https://buffalo.app.box.com/s/btzm3fzeocw5xmh3ty2x5gjtba23hai5, accessed on 20 August 2020)

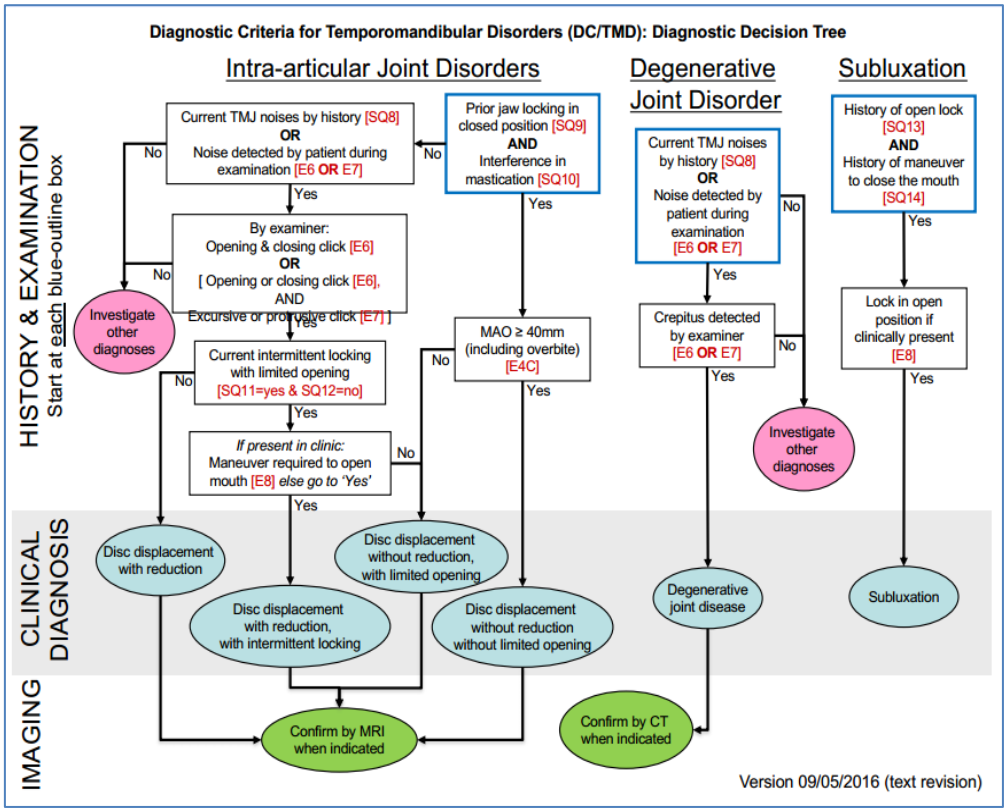

Fig-1B: Diagnostic decision tree (available from https://buffalo.app.box.com/s/btzm3fzeocw5xmh3ty2x5gjtba23hai5, accessed on 20 August 2020)

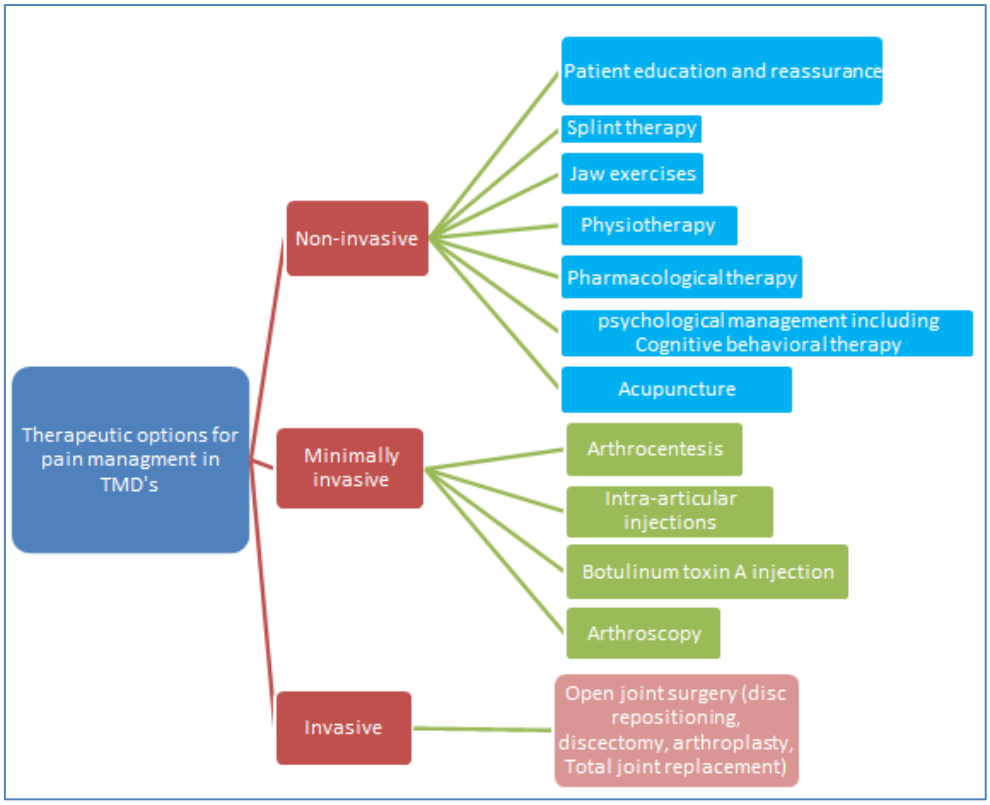

Fig-2: Diagram showing the categories of pain management options in TMD's

A paradigm shift in the hierarchy of TMD treatment

It was traditionally accepted among clinicians that all conservative non-invasive measures should be first applied for painful TMD's before shifting to the next level of minimally invasive procedures. However, there is a recently emerging evidence that minimally invasive procedures especially intra-articular injections of pharmacologic agents with or without arthrocentesis is more effective in pain reduction and improvement of maximal mouth opening than conservative measures both in the short (≤ 6 months) and intermediate term (6 months- 4years) levels. This advocates the benefit for the early use of minimally invasive therapies as soon as the patient does not show initial response to conservative treatment [68].

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