Chapter

Temporomandibular Joint Pain

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Abstract

Temporomandibular joint (TMJ) is a synovial articulation between mandibular condyle and glenoid fossa in the temporal bone. Any structural and/or functional changes can affect the TMJ and related structures. Temporomandibular disorder (TMD) is a heterogeneous group of musculoskeletal disorders mainly characterised by regional pain in the facial and preauricular area and/or limitations/interference of jaw movement. TMD has multifactorial aetiology, which includes biology, and environmental social, emotional, and cognitive factors. TMD is more common orofacial pain condition and nondental origin. Factors associated with TMD include other pain condition, auto-immune disorder and psychiatric illness. The clinical conditions may present with limitation in opening and closing mouth, pain and articular noise. So this chapter mainly deals with the classification of TMJ disorder, diagnosis and management particularly TENS and ultrasound therapy for TMJ disorder.

Keywords: temporomandibular joint, TMJ disorders, TENS, pain, ultrasound therapy

1. Introduction

The temporomandibular joint (TMJ) is a synovial joint. The joint is the articulation between the mandibular condyle and the glenoid fossa in the temporal bone. Temporomandibular joint disorders produce structural and functional changes of the joint. Temporalis, medial & lateral pterygoid, Masseter Maxilla/upper jaw Mandible/lower jaw and the temporal. These disorders may present with specific clinical features such as pain, muscle tightness, limitation in opening and closing the mouth [1].

TMJ is the most complex joint. TMJ disorders occur when the muscles, ligament, joint capsule or any other structure surrounding the TMJ joint are affected. This consists of joint cavity, mandibular condyle, articular disc, muscle and nerve, which interacts with various structures such as cervical spine and orofacial region. When the physiological functions of some of these components are altered, functional and structural disorders result in clinical impact [2]. The unique feature of TMJ is that it acts as a fulcrum in which the movement is controlled by both morphology of joints and the dentition at the other end.

During life, the components of the joints including temporal, condylar and disc articular surfaces undergo continuous remodelling. The synovial fluid is responsible

for nourishment and lubrication. The lateral pterygoid muscle is attached to the joint capsule. The function of the articular disc is to produce friction, stabilisation and viscoelastic properties. Mastication and speech are the main action of TMJ joint [3].

During mastication process, this joint supports a large number of forces. Excessive force on the joint can cause damage in its structure or alter normal function contact of condyles, discs and eminence. This damage and alteration can result in pain, dysfunction or both [3].

Temporomandibular disorders (TMDs) are group of heterogeneous musculoskeletal disorders mainly responsible for regional pain in the facial and preauricular, limitation and interference of the jaw movements. TMD has many causes, which includes biologic, environmental, social, emotional and cognitive factors. Factors associated with TMD include other pain condition (e.g. chronic headaches, fibromyalgia), autoimmune disorders, sleep apnoea and psychiatric illness. TMDs are the most common orofacial pain conditions other than dental origin [4].

Numerous risk factors have been implicated including joint and muscle trauma, anatomical factors (e.g. skeletal and occlusal relationship), pathophysiological factors (e.g. bone and connective tissue disorders, sensitization of peripheral and CNS pain processing pathways) and psychosocial factors (e.g. depression and anxiety, emotional and perceptual responses to psychological stressors).

2. Prevalences

The prevalence of TMDs is around 12% of world population and 35 million people in US. TMDs affect both men and women but majority seeking care are women of age group 19–49 years. TMD is diagnosed in women 2–5 times more frequently than men. Studies suggest that women tend to have more severe symptoms and are nine times as likely to be diagnosed with majority limitations in jaw movements and unremitting pain.

There are various hypothesis put forward by several researchers to demonstrate the higher prevalence rate in women. Anatomical, hormonal, behavioural and genetic differences contribute to the disproportional ratio of women to men diagnosed [4].

Anatomical differences between males and females in jaw and skull affect the forces on TMJ. Maxillary bone is longer, wider and thicker in males than in females. The angle created by mandible is less obtuse in male than in female. Mandibular condyle is larger and temporal socket is deeper in males. All these anatomical factors create more stable environment for TMJ translation in males than in females.

Hormonal differences between men and women contribute to TMDs. Oestrogen and progesterone levels are higher in women during childbearing years. There is increased ligament laxity during preovulatory phase (oestrogen dominates). During follicular phase (days 1–9), relaxin hormone is secreted and it peaks during the luteal phase (days 15–28). These differences in the level of hormones released may contribute to greater laxity in some women. Increased ligament laxity increases joint play and it irritates the joints.

Behavioural differences—Men and women manage stress differently. Clenching, grinding and poor breathing habits can increase internalisation of stress and it may irritate TMJ [5].

Various studies revealed that at least one sign of articular dysfunction is seen in about 40–75% of cases in general adult population, and in 33% of cases, there is at least one symptom of dysfunction. Signs such as noise and asymmetric mouth

opening are prevalent in about 50% of the individuals and other symptoms such as difficulty in mouth opening are present in about 5% of cases [6]. Articular disorders are present in 19%, muscular forms of disorders in 23% and both in 27% of individuals in general population. In patients, these symptoms are more pronounced in 20–40 age group, and in general population, these symptoms are most commonly seen in 17–30 age groups.

Prevalence of moderate or severe TMDs was found to be 37.4% in children and adolescents between 6 and 14 years of age in Brazilian study.

Epidemiological surveys reported that 50–70% of population have signs of a disorder at some stage during their life, whereas an estimated 20–25% of the population have symptoms of TMD. The highest prevalence of TMD in relation to age has been estimated between the age of 20 and 40s. Among the post-menopausal women, those receiving hormone replacement therapy (HRT) were found to be at higher risk for TMD than those not receiving HRT. TMD is most prevalent in adolescents and women during the reproductive years and falls off sharply with advancing middle age [7].

3. Classification of TMJ disorders

The temporomandibular joint is mainly classified into three main groups:
GROUP I—MUSCLE DISORDERS.
GROUP II—ARTHRALGIA, ARTHRITIS & ARTHROSIS.
GROUP III—DISC DISPLACEMENT.

Group I consist of myofascial pain and myofascial pain with limitation in aperture.

Group II consists of arthralgia (joint pain), osteoarthritis and osteoarthrosis.

Group III consists of disc displacement with reduction, disc limitation without reduction, and disc displacement without reduction and with limitation of aperture.

TMD can be further subdivided into pain-related disorders such as myofascial pain and arthralgia and typically non-painful disorders.

TMDs are characterised by pain in the preauricular area, TMJ/muscles of mastication, limitation/deviation in the mandibular ROM and TMJ sounds (clicking, popping and crepitus) during mandibular function, headaches and jaw tenderness on function. Clicking is the most common symptom of TMJ dysfunction.

A number of studies have examined physical therapy for TMJ dysfunction and pain, including massage, electrotherapy, active exercise and manipulation therapy. Ultrasound therapy reduces pain and inflammation and improves mouth function [8].

3.1 Causes

The main causes Of TMJ disorder are unclear, but it is multifactorial.

Capsule inflammation and muscle pain are caused by occlusion, stress, anxiety or abnormalities of intra-articular disk. Parafunctional habits may cause TMJ microtrauma or masticatory muscle hyperactivity [9].

TMJ disorders may also arise after macro-trauma or facial trauma also due to malposition of TMJ disc termed ‘internal derangement’ and osteoarthritic changes.

Severely injured in the TMJ leads to disordered; for example, it can result in a severe blow on the jaw to break bones or damaged disk, which could destroy the smooth movement of the joint, causing pain or bad occlusion [10].

Some behavioural factors like continuous chewing gum may also lead to unrest in the TMJ joint.

3.2 Clinical features

Joint erosion, osteophyte formation, hypoplasia, subchondral cyst, flattening of articular eminence and reduced jaw movements were seen.

Worsened mastication was common findings in temporomandibular joint Osteoarthritis (TMJ-OA).

General pain was correlated with condylar flattening.

Masticatory efficiency correlates with condylar flattening and sclerosis.

Psychological features like Bruxism, sleep disturbances, anxiety and depression will be seen [11].

Jaws are used to lock while opening or closing the mouth.

Head ache.

Tooth pain.

Lack of facial expression mainly over the lower face.

Pain in the neck and shoulders.

Difficulty in chewing [12].

3.3 Diagnosis

Along with proper clinical examination, imaging of TMJ joint is also necessary. The most common methods are computed tomography (CT) and magnetic resonance imaging (MRI). Even though it has many advantages, it suffers certain drawbacks, being expensive, having necessity of advanced equipment, longer time needed to use it for TMJ images, its restricted use in patients with claustrophobia, pacemakers and metallic prosthesis.

Ultrasonography has been suggested as an alternative diagnostic method in the imaging of TMJ disorders, because it is less expensive.

High-resolution ultrasonography (HR-US) is the best way to investigate the TMJ conditions. The articular disk can be clearly seen during the mouth opening movement [13].

3.3.1 Differential diagnosis

- Dental pain
- Referred pain—sinuses, ear, nose, cervical disease, systemic
- Neuralgias, neurologic pain disorders
- Central lesions
- Somatoform disorders
- Disorders of the temporomandibular
- Eagle's syndrome
- Maxillary sinusitis
- Management for temperomandibular joint disorders.

3.4 Ultrasound

TMD is one of the most common causes of pain in the mouth and face, affecting millions of people. It often leads to chronic pain that lasts for years. The physiotherapy management of TMJ joints includes massage, exercise and modalities. Modalities mainly the TENS and ULTRASOUND have proven to reduce pain and other symptoms of the TMJ joint disorders [14].

However, the prognosis of the treatment is relatively slow in relieving pain for patients. Ultrasound (US) has been used for treating temporomandibular joint Osteoarthritis (TMJ-OA) and hypoxia-induced chondrocytes damage in TMDs.

The ultrasound mechanical vibration is transmitted into the body as high-frequency acoustic pressure waves. These waves will mechanically stimulate living tissues, resulting in tissue healing. The ultrasound will promote cell proliferation and the synthesis of extracellular matrix in fibroblasts and myoblasts, which eventually reduces inflammation and promotes regeneration in various injured soft tissues [15].

4. Technique

Direct bath method

The treatment area should be clear and flat. Then, the coupling medium like aquasonic gel should be applied to prevent excess air between the skin and treatment head and to allow the ultrasonic beam to pass through the body tissues. The treatment head is moved in rhythmic direction in order to avoid concentration at one point.

Parameters

- FREQUENCY-3MHZ (superficial) or 1MHZ (deeper)
- INTENSITY-0.8–1 W/cm^2
- MODE-Continuous mode
- DURATION-3 minutes

Thermal effects

- Absorption of tissues
- The efficiency of circulation through the insonated tissues
- When using continuous ultrasound, the amount of heat developed is directly proportional to the intensity and duration of insonation.

Nonthermal effects

- **Cavitation** is the oscillatory activity of highly compressible bodies within the tissues such as gas- or vapour-filled voids.

It may be **stable** or **unstable** cavitation.

- **Stable cavitation** occurs when bubbles oscillate to and fro within the ultrasonic pressure waves but remains intact. And it modifies the ultrasonic beam in such a way so as to cause micro-streaming.

- **Unstable cavitation** occurs when the volume of the bubbles rapidly then collapses. It is potentially dangerous to the tissues as the collapse of the bubbles causes a great local rise in temperature. It is avoided by moving the treatment head using a low intensity.

- **Micro-massage** occurs where the longitudinal compression waves of the ultrasound beam produce compression and rarefaction of the cells and affect the movement of tissue fluid in interstitial spaces. This can help in reducing oedema

- **Biological effect** helps to clear the area of debris and to increase the tensile strength of the scar by affecting the direction, strength and elasticity of fibres [16].

5. Discussion

Ultrasound is defined as sound frequency 20,000 cycles per second. Ultrasound travels through materials. It is the modality that is used for a number of purposes including diagnosis destruction of tissue and therapy. Ultrasonic energy generated at 1MHZ is transmitted through the more superficial tissues and absorbed primarily in the deeper tissue at depths of 3-5 cm. Patient should be in lying position with head support with pillow in continuous mode with duration of 5 to 8 min. The treatment head is moved continuously over the surface, while even pressure is maintained in order to iron out irregularities in sonic field. The pattern of movement can be series of overlapping parallel strokes, circles or figure of eight. The effect of ultrasound increases intracellular ca, increases skin and membrane permeability, increases macrophage response, promotes healing, reduces swelling, and increases blood flow.

Many studies recommend ultrasound is effective for TMD treatment. The beneficial effect of Ultrasound may be associated with the effect of micro-destruction. In addition to reduction of pain in TMJ treatment, ultrasound treatment shows improvement in jaw functions.

The therapeutic effect is persistent in follow-up period of 6 months with less than 3% recurrence rate after ultrasound treatment; therefore, ultrasound may be recommended for TMD treatment [17].

Shuang Ba et al. concluded that US has been shown to be able to reduce excessive cytokine content in the articular fluid and the apoptosis of chondrocytes. It promotes the proliferation of articular cartilage to repair cartilage defects and inhibits the secretion of inflammatory cytokines. Hence, treating by ultrasound reduces pain effectively [18].

Sanyuktha et al. state that the generated heat presumed to increase tissue cell metabolism, which in turn helps to promote soft tissue healing. The sound wave causes tissue vibration creating heat in the treatment field and thus increases the blood flow. The pain reduces with the resolution of information.

Zhou et al. explored the efficacy of US in terms of mandibular condylar cartilage repair *via* autophagy regulation. And it reduced the injury severity and upregulated the autophagy biomarkers [19].

Liang et al. stated that US has decreased the proliferation of chondrocytes and increased the osteoclast activity in the calcified cartilage layer [20].

6. TMJ management (TENS)

Only 5–10% of patients require treatment for TMD, and 40% of patients have spontaneous resolutions of symptoms. In a long-term follow-up study, 50–90% of patients had pain relief after conservative therapy. There is evidence that supports the use of physical therapy for improving symptoms associated with TMD. TENS is one of such treatment modalities that merit unique consideration and it is one of the safest and most inexpensive modalities that are used to control both chronic and acute pains.

TENS FOR TMJ

TENS is a well-known physical therapy, which is useful for the relief of pain. Transcutaneous electrical nerve stimulation (TENS) is one of the most effective physical therapy techniques. TENS is the application of low-frequency current in form of pulsed rectangular currents through surface electrodes on the patient's skin to reduce pain.

Principles

TENS works on the principle that electrical stimulation is directed to pain areas *via* surface electrodes, and current passes through these areas, which reduces or eliminates pain. It is safe and non-invasive and effective method. Electrodes made of silicon are used for TENS. They are placed at the area with the highest pain, in the same dermatome, myotomes and/or myofascial trigger points. They can also be placed on the course or on the supplied muscles of the corresponding peripheral nerve.

Patient's position: sitting.
Therapist position: standing behind the patient.
Method: direct method.
Electrode placement: TM joint and nape of neck.
Pulse duration: 50–200 μs.
Frequency: 50 mA–100 mA.
Duration: 15 min.

7. Effects and uses

Effect of TENS is based on gate control theory and pain modulation.

TENS stimulates thick, myelinated, sensory fibres (A-fibres), which in turn blocks the impulses of pain-modulating fibres (C-fibres) and closes the gate to pain signals at the level of their entry into the spinal cord. In TENS, low-frequency and high-intensity or high-frequency and low-intensity electrical stimulation is applied, it gives sharp stimulus carried towards cerebellum, and its passage through the midbrain will cause the periaqueductal area of grey matter and raphe nuclei to interact to release opiate-like substance at cord level. The enkephalins and endorphins released have the effect of blocking forward transmission in the pain circuit. TENS treatment also relaxes the jaw muscles, lesser the degree of stress, and reduces the pain [21].

According to the gate control theory, when the large diameter, low-threshold mechanoreceptors are stimulated by simple mechanical stimulation of the receptors in the skin, muscle or joints or by electrical stimulation, the SG cells are stimulated through an excitatory synapse. The SG cells, receiving inputs from nociceptors and mechanoreceptors, integrates and modulates the pain fiber activity and prevents transmission of nociceptive information to higher centers.

8. Discussion

Rathi Rela et al. also concluded that TENS therapy showed favourable results in pain management in TMD patient [22].

Y. Zhang et al. state that TENS could attenuate movement-evoked pain and improve jaw motor function during repeated jaw movements. This study indicated that movement-evoked pain was reduced either spontaneously or by TENS in TMJ pain patients [23].

G.moger et al. concluded that TENS shows good results in relieving muscular pain and chronic pain [24].

The useful effects of the TENS are explained by different theories. One theory is that TENS directly stimulate the motor nerves resulting in rhythmic contraction of the masticator muscles. These changes lead to increased blood flow and oxygen to the muscles, and reduce interstitial oedema and build-up of harmful toxins. Thus, overall result is reduction of pain and improved mobility of TMJ.

Instead of pain, your brain feels the pleasant tingling, massage-like sensation of the TENS, and the TENS current also stimulates your body to produce endorphin, which creates dull pain and sense of well-being.

TENS treatment also relaxes the jaw muscles, lesser the degree of stress, and reduces the pain.

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