Chronic temporomandibular joint dysfunction: an area of debate

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Abstract
Introduction
Temporal mandibular joint dysfunction (TMD) is a common condition affecting up to 33% of population. It is characterized as a unilateral or bilateral pain in the temporomandibular joint (TMJ) and its associated craniofacial musculature; in addition, there could be joint clicking, limited mouth opening or locking, headaches, tinnitus, ear fullness and popping.

On examination, the most common features are tenderness upon palpation of the joint or muscles of mastication, diminished mouth opening, side-to-side movement and clicking or grating sounds in the joint upon movements of the mandible. Lack of tenderness in the external auditory canal could be an additional diagnostic feature of the pain syndrome.

An acute episode of pain generally has a sudden onset due to local tissue inflammation and it usually resolves within 4–12 weeks. The conversion from acute to chronic pain may result from the body’s inability to restore normal physiological function.

Historically, there have been several TMD classifications emphasizing either mechanical or psychological concepts. Classifying TMD has been a difficult task and several suggestions exist in the literature.

One of the oldest classification systems distinguishes two categories of TMJ pain: (a) masticatory pain (muscle-related) and (b) TMJ arthralgia (joint-related). The former is subdivided into splinting, spastic and inflammatory pain while the latter into discal, retrodiscal, capsular and arthropathic pain. Later, TMJ non-arthritic arthralgia was re-classified as a deep somatic pain of disc attachment.

Currently, the Research Diagnostic Criteria (RDC)/TMD is the most accepted classification; it was reported by Dworkin and LeResche and it differentiates the TMD entities along two axes. The first axis (axis I) refers to the clinical evaluation of TMD conditions. It is divided into three main groups: (a) muscular involvement, (b) disc displacement and (c) arthritic origin of the condition. The second axis (axis II) considers pain-related disability and psychological status in association with TMD. Good to excellent reliability results were found using these criteria in an adolescent study for each category of RDC/TMD. RDC/TMD and, more specifically, the jaw disability checklist, evaluates the jaw function and determines in depth the extent of interference caused by TMD. Eating, yawning and chewing were found to be the most common jaw functions that interfered with TMJ using RDC/TMD.

Another classification, reported by Goldstein, separates the condition into general groups of: (a) rheumatoid changes with synovitis, (b) arthralgia, (c) condylar degeneration, (d) open bite deformity, (e) chronic pain with link to behaviour, (f) myofascial pain and dysfunction and (g) internal derangement with displacement and reduction. A more recent classification system, reported by Ogle and Hertz and which relates TMD to masticatory myofascial pain in association to TMJ pain with or without joint sounds, suggests that myofascial pain dysfunction, masticatory myalgia, masticatory myositis, tendinitis and whiplash TMJ are all variations of the myofascial pain syndromes. This review discusses the impact of different factors on chronic TMJ dysfunction.

Pathogenesis
There is a lack of scientific evidence regarding the pathological origin of chronic TMJ dysfunction, and aetiology is unknown in up to 95% cases. Currently, there are observation studies indicating a multi-part aetiology of the disease.

Nowadays, the involvement of psychological factors in the aetiology of many TMJ disorders is well established; these implicate emotion, behaviour and personality disorders as major contributors to the pain dysfunction syndrome. Furthermore,
trauma, parafunctional habits, multiple dental extractions, somatization and female gender were identified as risk factors in patients with myofascial pain as well as in subjects with concurrent myofascial pain and arthralgia.

**Trauma**

TMJ injuries can be direct or indirect and micro- or macro-traumatic. The reaction of the mandible to whiplash injury may induce tearing in TMJ ligaments, which tends to affect mainly the temporals and masseter by the sudden protrusion and repositioning of the mandible in response to the rapid deceleration of the motor vehicle. Other traumas of TMJ could be related to scuba diving, childbirth, endotracheal intubation, violin playing, direct blow and 'banana peel' slip. The parafunctional habits such as chewing gums, biting nails and pencils and grinding teeth may cause microtrauma, which in chronic existence of the stimulus, may induce pain and various sounds of TMJ (i.e. clicking, crepitation). Because sounds of the joint are not always pathognomonic, the necessity of assessing the condition carefully is essential. In general, past trauma of the head and neck region may be a contributing factor of the joint disability. Trauma patients may show higher psychological disability than non-trauma patients, thereby emphasizing the psychological role in this disorder.

**Psychological factors**

It is well known that pain disorders may be directly or indirectly associated with the psychological status of an individual. However, the question whether chronic pain is caused by an existing psychological condition or vice versa cannot be easily answered. Presence of widespread pain (neckache, backache, irritable bowel syndrome or other non-head and neck chronic myalgia disorders), or pain outside the masticatory system are a risk factor for chronic TMD pain among women. This means that pain in multiple body sites was significantly more common in TMD group compared with control group. This association possibly indicates a role of psychological factors in TMJ disorders in addition to the well-understood somatic causes of the related conditions, including hormonal effects. The occurrence of TMD symptoms was also found to be related to work and social factors.

Psychological factors play a more prominent role when the pain is of muscular origin and are considered to be a major issues in the onset, exacerbation or perpetuation of the pain. This theory is partly supported by scientific evidence, concluding that the perpetuation of chronic pain is influenced by psychosocial implications. In a study group, the muscular tenderness of the masticatory system was found to be correlated with facial pain. It is also identified that these patients are more distressed by cephalalgias and the cause of muscular involvement seems to be related to fatigue from chronic parafunctional habits secondary to psychological stress conditions. Patients who develop chronic TMD appear to have more psychosocial distress before diagnosis of chronicity than those individuals who have acute symptoms that subside. The demographics, emotion, behaviour and cognition, as general factors from the psychological point of view, may predict the treatment outcome. Women who developed chronic TMD were significantly more likely to be diagnosed as having a muscle disorder than those who did not develop chronic TMD.

Furthermore, it is important to note that about 50% of low-mood (depressed) individuals have pain as a current complain at examination. Depression and catastrophizing contribute to the progression of TMJ pain; therefore, they should be considered as important factors. The need for psychological assessment should be emphasized for the patients’ benefit.

In a study with a control group, a history of physical or sexual abuse was reported in 44.8% of diseased (TMD) group; a percentage that is slightly greater than the control group. Physical abuse in females seems to be worse than sexual abuse, as supported by the enhanced presence of symptoms such as pain, anxiety and depression. Patients with a history of both physical and sexual abuse in childhood suffered from more depression. Taken together, the above observations indicate a possible synergic effect between these two entities.

**Gender**

Compared with males, chronic TMJ dysfunction is more prevalent in females of reproductive age, with the prevalence being up to 80%. Chronic facial pain is also more common in women, accounting for 75% cases. The high prevalence of TMD in women is supported by several studies. Interestingly, subjective symptoms such as pain are more frequently reported by females, while objective disabilities such as diminished jaw opening and masticatory disability more commonly affect males. The uneven valence of TMJ disease between the two genders is not currently understood. Three main theories have been suggested implicating the hormonal factor, pain signal process and need for seeking medical care.

The involvement of sex hormones in the pathology of TMJ pain derives mainly from observations correlating the intake of post-menopausal hormones with an increased risk for TMD development. Furthermore, women who report orofacial pain are more likely to report symptoms associated with menstruation. Though the precise pathogenesis of the disease is unknown, the activation of cytokine production via oestrogen receptors in TMJs of females has been suggested to explain the hormonal involvement.
Another possible explanation is based on the general suggestion that men and women may not process pain signals in the same manner, developing a different perception and reaction to pain between the two sexes.88

Finally, the fact that women seek healthcare for pain more often than men also contributes to the existing high prevalence of TMD in women.47. Although TMD is more prevalent in women, men appear to have greater prevalence of objective difficulties such as jaw opening and masticatory disability than women.45,49.

Malocclusion
The role of occlusion in the pathogenesis of TMD is still controversial. Some authors support the theory that the functional patterns of malocclusion correlate to TMD. The findings from the studies in favour of this theory include the following: (a) relation of mandibular prognathism to TMJ symptoms and (b) reduction of symptoms in Angle class II retrooclusion post-operatively; however, in none of the studies, the results were statistically significant. Furthermore, it was shown that orthodontic treatment leading to extensive changes in the occlusion was not associated with the development of TMD.16,20,6

Stronger evidence comes from studies supporting that occlusion is not considered to be a significant factor for the pathogenesis of TMD.52-54. The negative correlation of occlusion with TMD symptoms was established in an observational study with two groups of individuals, one with normal occlusion and the other with malocclusion with no statistical difference between the two cohorts.55

Occlusal malformation such as bruxism has not been found to induce TMD.56,57. Moreover, bruxism activity was not correlated with myalgias.57. The predictors of the two components of bruxism, clenching during daytime and nocturnal grinding, were not the same indicating that these two entities may be different.58. The explanation here is that more than 60% of bruxismic individuals presented with TMD.59. Overall, there is insufficient evidence to implicate occlusion patterns in the pathogenesis of TMD.16.

Discussion
The authors have referenced some of their own studies in this review. These referenced studies have been conducted in accordance with the Declaration of Helsinki (1964) and the protocols of these studies have been approved by the relevant ethics committees related to the institution in which they were performed. All human subjects, in these referenced studies, gave informed consent to participate in these studies.

Psychosomatic approaches
Informed reassurance
Informed reassurance, as a psychological technique, is an explanation of the disease status either in verbal or written form. This should be done in ‘layman’ terms to facilitate understanding by the patient. The technique of reassurance has been found to be very useful in around 80% cases when used in conjunction with simple analgesics, physiotherapy and occlusal splints.60. Informed reassurance and placebo were found to be equally effective in relieving symptoms in 45% cases.61. Early discussion and intervention may prevent the development of chronicity.43,62. It is important to mention that only 2% to 5% of all patients treated for TMJ disorders undergo surgery, thereby emphasizing that majority of patients receive conservative management with 70% reporting good outcome.64. Most of these patients suffered from stress and pain other than TMD and were found to be sensitive to reassurance.65

Mind–body therapy
Stress was found to be an important factor in the genesis of musculoskeletal disorders with techniques such as yoga to relieve individual stress and leading to a state of relaxation.66. Evaluation of this technique was difficult due to transpersonal and philosophical dimensions.67. Yoga, hypnosis, relaxation, meditation, imagery and biofeedback are considered as mind–body therapies.68,69.

The anxiety and pain complex may be the most common indication for dental hypnosis.70. Although hypnotic-induced reduction in frequency, duration and intensity of TMD pain has been observed,71 there is no significant difference in analgesia with the addition of suggestion under hypnosis.72. Another suggestion that hypnosis could be effective for the treatment of a wide range of acute and recurring painful conditions should be considered.73

In general, relaxation and imagery techniques are not clearly understood in the treatment of both acute and chronic pain syndromes. Individuals with strong religious beliefs or other objections should be excluded from these alternatives.74. A possible target of relaxation is to control the sympathetic nervous system where decreasing function reduces metabolic activity.75

Cognitive–behavioural therapy
Any patient with long-term pain may benefit from cognitive–behavioural therapy (CBT), which is divided into cognitive restructuring and coping skills training.76. The inter-related components of the treatment are education, skill acquisition, cognitive and behavioural rehearsal, homework, generalization and maintenance.77. A recent randomized clinical trial concludes that after 6 sessions of CBT, patients with enhanced psychological and social disability showed improvement in pain variables.78. Combination treatment of cognitive skills training and biofeedback were more effective in comparison with the use of these alternatives alone.79. Individuals who suffered from dysfunctional profiles or patterns of TMD, in other terms

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high distress and pain, were associated with both failure of conservative and surgical treatment. Additionally, patients with dysfunctional pain did not benefit from brief CBT. The need for more research in this field has been emphasized.

Combining biofeedback with intraoral appliances was more favourable in comparison with each treatment alone in reducing pain, hence supporting the concept of combined management. In a study designed with a pre-test and post-test control groups, the use of habit reversal treatment for TMD revealed that reduction in pain was accompanied by a reduction in oral habits with minimal clinical contact.

Operational approaches

Occlusal therapies

Occlusal therapies can be subdivided into occlusal adjustment and appliances. Occlusal adjustment is an irreversible alteration of occlusion and it has been used for the treatment of TMD without a sound literature supporting its efficacy. The role of occlusal adjustment was considered to be the decompression of the condyle in the articulating fossa, but research showed that there is no increase in joint space during clenching. A study showed that occlusal adjustment was not convincing for the alleviation of symptoms of chronic TMD because of the non-powerful experimental evidence. Thus, occlusal adjustment cannot be recommended for the management of TMD.

Occlusal splints, as two major types of removable orthopaedic appliances, can be distinguished into repositioning and stabilization appliances; the former is used to decrease pain, clicking and secondary muscular symptoms, while the latter is mainly indicated for muscular relaxation and protection of teeth. Occlusal splints can be further classified as permissive and non-permissive. The efficacy of occlusal appliances is based on the reduction of the electromyographic activity and in modification of the parafunctional behaviour. A randomized controlled trial concluded that stabilization appliances are more effective in the myalgia type of the disorder, with regard to reduction in symptoms and signs, while the role of anterior repositioning splints is restricted mainly in joints with arthralgia and painful click.

In general, occlusal appliances are found to be significantly effective in pain reduction than the combined treatment alternative of informed reassurance and relaxation. Failure of occlusal splint therapy to resolve symptoms, particularly pain, may be related to psychological implications.

Prolonged splint wear may induce remodelling and even TMJ injury, as indicated in a study involving miniature pigs. Therefore, splints can be constructed as an initial form of therapy. These appliances are suggested to have equivalent effect when compared with placebo.

Although splint therapy and occlusal adjustment have been extensively used, there is no evidence to suggest that they can be curative. A number of evidence-based trials have concluded that these appliances should not be suggested as part of routine care.

Pharmacological modalities

The medications reported to be effective in the management of TMD are non-steroidal anti-inflammatory drugs, corticosteroids, anti-depressants, muscle relaxants, sedative hypnotics, botulinum toxin and capsaicin. Opiates have been used for a long time for pain control, especially in chronic conditions. Intra-articular morphine has been used in a randomized double blind study showing a significant increase in pain threshold in the diseased joint. Anti-depressants such as tricyclics have been shown to produce effective pain relief at low dosage amongst chronic cases, a good example being amitriptyline and nortriptyline. Tricyclic anti-depressants are central analgesics acting by inhibition of serotonin re-uptake, norepinephrine and α-receptor blockade. Treatment with anti-depressants cannot be expected to give immediate pain relief because of the delayed onset of their action which usually takes 4–6 weeks. Corticosteroids can be injected or applied topically in cases of condylar erosion, myalgia and trismus with relatively positive therapeutic results.

A randomized controlled trial did not support the use of botulinum toxin A in patients with moderate to severe chronic muscular type of pain, concluding that these patients had less wide jaw opening compared with a placebo group. A similar design study showed that the topical application of capsaicin is statistically insignificant when compared with the placebo effect.

Physiotherapy

A study of complementary and alternative medicine showed that massage is rated as the most frequent and amongst the most effective treatment modalities. This approach seems to be more effective in sub-acute and chronic non-specific conditions. Others characterize massage as ineffective for pain in general due to lack of scientific evidence.

Heat and cold techniques (lasers, diathermy, microwaves and ice packs) and therapeutic ultrasound may be used to relieve musculoskeletal pain. These methods have been found effective through a ‘counter-irritant’ mechanism, by relaxing the muscle and reducing the spindle response, respectively.

Management with electrotherapy remains controversial due to the lack of high evidence-based studies. There is no substantial improvement of TMD signs and symptoms when managed with transcutaneous nerve stimulation. An electromyographic study revealed that an imbalance of the masticatory muscles may lead to clicking, locking, headaches, earaches and deviation of the mandible. It was suggested that this finding could be

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beneficial for the management of massetric involvement using neuromuscular electrostimulation of the weakened muscle. The use of micro-current stimulation and mid-laser were significantly better than the placebo effect. Silver spike point electrotherapy combined with occlusal splint was found to be a favourable treatment outcome intervention (good response in 90% patients). Alternatively, no statistically significant results were identified in randomized controlled trials in patients receiving electrogalvanic stimulation, low-level laser, pulsed radio-frequency and pulsed electromagnetic fields.

Acupuncture
The use of acupuncture in TMD management seems to be positive, although the analgesic effect of this technique is still under consideration. It has been suggested that acupuncture is comparable to conservative treatment alternatives. The use of acupuncture in combination with occlusal splint and point injection was found to be useful for managing TMD. The level of analgesia induced by this method may be modified by stress and anxiety. It is worth noting that electrical stimulation of acupuncture needles in comparison with transcutaneous electrical nerve stimulation has not shown any significant difference. A recent meta-analysis has shown limited evidence that acupuncture is effective for treating temporomandibular disorders.

Surgery
Less than 8% of facial arthromyalgia cases require surgery. The surgical approach should be considered in patients diagnosed with advanced internal derangement caused by ankylosis or severe degenerative joint disease with no improvement after conservative methods.

Surgical procedures such as arthroscopy, arthrocentesis, interpositional grafting, arthroscopy and arthroplasty can be helpful in certain situations where adherence to indications and limitations are observed. TMJ arthroscopy with added arthrocentesis and morphine injection in the joint compartment can be associated with symptom relief for up to 10 years. The most recently published National Institute for Health and Clinical Excellence guidelines did not support total joint replacement due to lack of good long-term outcome.

Conclusion
Chronic TMD is a complex clinical condition of yet unknown pathogenesis. Further research is required to investigate the aetiological patterns of this disorder. Management of TMD requires a multi-disciplinary approach. Working as a team of dentists, maxillofacial surgeons, psychologists, psychiatrists and physiotherapists, with interest in pain disorders, can lead to the development of a successful therapeutic strategy for the management of TMD patients.

References
Review

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