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Eye Pain in Patients with Arthrogenous Versus Myogenous Temporomandibular Disorder Presenting to An Otolaryngology Clinic

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1. Abstract

Objective: The issue of eye pain in patients with temporomandibular disorders (TMD) had not been previously addressed; specifically, in relation to the two major subgroups of TMD; arthrogenous and myogenous. The present study aimed to compare the incidence and pattern of eye pain in arthrogenous versus myogenous TMD.

Methods: The study involved 314 consecutive patients with TMD, prospectively examined over a period of 6 months. These were stratified into 193 patients with arthrogenous TMD and 121 patients with myogenous TMD. The pattern of any eye pain in each patient was studied.

Results: Eye pain was present in 78 per cent of TMD patients. It was more commonly encountered in myogenous versus arthrogenous TMD patients. Approximately one-quarter of patients in either group had TMD-related eye pain.

Conclusion: Eye pain is significantly associated with TMD. The presence of eye pain augments the morbidity of TMD in patients afflicted with both disorders.

2. Keywords: Eye pain; Temporomandibular disorders; Temporomandibular joint; Masticatory muscles

3. Introduction

Eye pain is a common, non-specific complaint that poses significant differential diagnostic problems. The discomfort may arise from the eyeball, or the orbit, or it may be referred from the face or head and neck to the eye [1]. Temporomandibular disorders (TMD) are common causes of orofacial pain, affecting approximately 5-12 per cent of the population [2]. TMD may be associated with heterotopic, referred, or radiating facial pain, which may involve the eyes [3,4]. Both the eyes and the jaws have sensory innervation from the trigeminal nerve and nociceptive afferent nerve fibers from the eyes and the jaw structures converge onto the subnucleus caudalis of the central trigeminal nucleus [5]. Despite this, the issue of eye pain in the context of TMD had been scarcely described in the literature. Previous relevant reports have described defects of ocular convergence (resulting in eye strain), associated with TMD [6,7]. Other studies have focussed on the association between TMD and migraine [8,9]. Facial migraine is a form of migraine that is associated with facial pain, including eye and periorbital pain [10,11]. From a different perspective, neuropathic ocular pain may be referred to other cranial structures innervated by the trigeminal nerve, including the jaws (oculofacial pain) [12,13]. Both chronic TMD pain and chronic eye pain cause a significant morbidity and reduced quality of life in patients afflicted with these

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disorders [14,15].

Patients with TMD frequently present to the otolaryngologist; significantly because of the co-occurrence of jaw dysfunction and pain with otoneurological and sinogenic complaints (Costen's syndrome) [16]. The present author, in a number of prospective studies, had reported that a majority of TMD patients presenting to the otolaryngology clinic complain of the symptoms associated with Costen's syndrome (hearing loss/ blocked-ear sensation, tinnitus, vertigo, facial/nasal pain and/or nasal congestion) [3,17-19]. In the otolaryngology clinic, facilities may allow the otolaryngologist to identify causes of eye pain relevant to the sinonasal region, which is in close proximity to the orbit. Such aetiologies include infectious/inflammatory lesions of the sinonasal mucosa, contact point headaches and sinonasal masses impinging on the orbit [20,21]. Close liaison between various specialists, particularly the ophthalmologist, neurologist and otolaryngologist is necessary for the evaluation and management of patients with eye or periorbital pain, especially if the eye looks normal on examination [22,23].

TMD have been pathologically classified, according to Axis I of the diagnostic criteria for temporomandibular disorders (DC/TMD), into arthrogenous and myogenous TMD; reflecting the predominant or exclusive affection of the temporomandibular joint (TMJ) and the masticatory muscles, respectively [24,25]. These two entities may be quite distinct, regarding their clinical presentations, associated comorbidities and associated affective disorders [19,26,27]. Furthermore, epidemiological twin studies have concluded that there is a significant underlying latent genetic factor in chronic pain syndromes, including TMD [28,29]. Genetic studies have revealed that polymorphisms in certain genes are related to preferential association with arthrogenous versus myogenous TMD pain, respectively [30-32].

The aim of the current work was to prospectively study the causes of eye pain in patients with arthrogenous versus myogenous TMD presenting to an otolaryngology clinic. The author's hypothesis was that the incidence and pattern of eye pain might be different in the two subgroups of TMD. As far as the author is aware and after search of the PubMed database from 1934 till 2019, no previous study had investigated the causes of eye pain in patients presenting with symptoms related to TMD; specifically, the two major subgroups.

4. Materials and Methods

The present study was a prospective clinical study conducted over a period of six months, starting on the 1st of June, 2019. The clinical setting was at the otolaryngology clinic at El-Sahel Teaching Hospital, Cairo, Egypt. Appropriate ethical approval was granted prior to the study from the General Organization of Teaching Hospitals and Institutes in Cairo (approval number: 127/19). Informed consent was obtained from the patients to participate in the study. The inclusion criteria were patients presenting with headache, jaw pain, otalgia, temporomandibular joint (TMJ) noises and/or symptoms pertaining to Costen's syndrome (hearing loss/blocked-ear sensation, tinnitus, vertigo, facial/nasal pain and/or nasal congestion); which, upon further examination, were found to be attributable to temporomandibular disorder (TMD). To be included in the study, the TMD patients were required to have had the symptoms for at least four months prior to consultation. The primary presenting symptom for each patient was recorded. Patients with recent trauma to the face or jaws, otitis externa, active chronic otitis media, acute sinusitis, acute periodontal infection, acute ophthalmic conditions, or parotid gland lesions were excluded from the study. Consecutive patients who met the inclusion criteria were interviewed and examined at the clinic.

A questionnaire protocol was completed by the author for each TMD patient during the study period. If the patient with TMD complained of eye pain, the nature of the eye pain was noted. A sensation of dryness, associated with a burning pain in the eyes, foreign body sensation, frequent rubbing of the eyes, occasional visual disturbances and photophobia, suggested a diagnosis of dry eye disease [33,34]. Eye pain, associated with a

unilateral throbbing hemicranial headache, nausea, photophobia and phonophobia was diagnosed as facial migraine [10,35]. A deep dull aching pain, associated with an uncorrected refractive error or strabismus, suggested extraocular muscle strain (ocular asthenopia) [36]. Otherwise, this type of pain could be a referred pain from an area outside the orbits; such as the jaw (regional myofascial pain) [37]. A pressing type of eye and periorbital pain, associated with nasal obstruction, mucopurulent rhinorrhoea and hyposmia suggested a diagnosis of chronic rhinosinusitis [38,39]. Ocular pain, together with itching, tearing, conjunctival redness and eyelid swelling, frequently associated with allergic rhinitis, was diagnosed as allergic conjunctivitis [40]. Furthermore, the cause of eye pain was confirmed by a review of the hospital records. Any autonomic symptoms, including conjunctival redness and/or lacrimation, during the pain attack, were recorded [41]. The temporal relationship between the TMD-related symptoms and the eye pain was documented.

A history of bruxism was obtained from the patient and his/her relatives. The patients were asked about their sleep pattern and any cause of sleep disturbance was documented.

Any systemic comorbidities were noted; specifically asking about any chronic widespread pain and its possible cause (e.g. fibromyalgia, osteoarthritis, or rheumatoid arthritis) [42]. Any medications taken by the patient were recorded; especially anxiolytics or antidepressants.

During history-taking, features of a depressive disorder, such as weeping during the interview, were noted. The details of any previous operation on the head and neck were obtained from the hospital records.

Examination of the patient followed a standard protocol. The TMJ was palpated, noting for any exquisite tenderness (noted by a palpebral reflex). Any TMJ noises during opening and closing the mouth, such as clicks or crepitations, were confirmed during palpation of the TMJ.

The masticatory muscles (especially, the masseter and temporalis muscles) were palpated, noting for any exquisite tenderness and/or a referral pattern for the pain.

Any limitation or aberration of jaw movement was noted. The ears were examined for evidence of otitis media with effusion or a tympanic membrane perforation. The status of the nasal mucosa was assessed. The oral cavity was examined for the state of dentition and any malocclusion was noted. The eyes were examined for any abnormality, such as any evidence of inflammation, strabismus, or malposition of the globe.

TMD were classified according to the diagnostic criteria for temporomandibular disorders (DC/TMD) into arthrogenous and myogenous [24,25]. Arthrogenous TMD included arthralgia, disc displacement with reduction, disc displacement with reduction with intermittent locking, disc displacement without reduction, degenerative joint disease and a history of TMJ dislocation. Myogenous TMD included masseter, temporalis and, rarely, pterygoid muscle myalgia. Neurological, psychiatric and/or ophthalmological consultations were obtained as appropriate. Frequently, imaging studies were requested, including magnetic resonance imaging of the head and paranasal sinus computed tomograms.

The causes of eye pain were analysed in patients with arthrogenous versus myogenous TMD. Pertinent features associated with TMD included a history of bruxism, malocclusion, sleep pattern, presence of widespread body pain and a history of depression. The incidence of each of these features was also analysed in patients with arthrogenous versus myogenous TMD.

5. Statistical Analysis

Results were expressed as mean + standard deviation or number percent [n (%)]. Comparison between categorical data [n (%)] was performed using Chi square test or Fisher exact test instead if cell count was less than 5.

Comparison between mean values of age in the two groups was performed using unpaired t test. Statistical analysis was performed using SPSS computer program (version 19 windows). P value <0.05 was considered significant.

6. Results

The study group involved 314 TMD patients seen in an otolaryngology clinic. These were stratified into 193 patients with arthrogenous TMD and 121 patients with myogenous TMD (P = 0.001). The demographic data of the two groups are shown in Table 1.

Table 1: Demographic data of the two studied groups.

	Arthrogenous TMD (n= 193)	Myogenous TMD (n= 121)	P value
Age (yrs.)			
Min.-max.	9.0 - 70.0	9.0 - 70.0	-
Mean ± SD	37.72 ± 12.6	39.98 ± 13.04	0.312
Gender			
Female	169 (87.6%)	105 (86.8%)	0.839
Male	24 (12.4%)	16 (13.2%)	-

Data are expressed as mean ± SD or number (%).

TMD= temporomandibular disorder.

p> 0.05= not significant.

Table 2: Clinical categorization of arthrogenous TMD patients.

	Number	Percent
Arthralgia	99	51.3
Disc displacement with reduction	73	37.8
Disc displacement with reduction with intermittent locking	8	4.1
History of dislocation	6	3.1
Degenerative joint disease	5	2.6
Disc displacement without reduction	2	1.0

TMD= temporomandibular disorder.

Table 3: Clinical categorization of myogenous TMD patients.

	Number	Percent
Masseter myalgia	96	79.3
Temporalis myalgia	23	19.0
Medial pterygoid myalgia	2	1.7

TMD= temporomandibular disorder.

Females outnumbered males in the two groups. The clinical categorisation of the arthrogenous and myogenous TMD patients is revealed in Table 2 and 3, respectively.

The primary presenting symptom in both groups is shown in Table 4.

Table 4: Primary presenting symptom in patients with arthrogenous versus myogenous TMD.

	Arthrogenous TMD (n= 193)	Myogenous TMD (n= 121)	P value
Headache	62 (32.1%)	38 (31.4%)	0.894
Otalgia	61 (31.6%)	25 (20.7%)	0.034
Jaw pain	12 (6.2%)	23 (19.0%)	0.001
Hearing loss/blocked-ear sensation	2 (1.0%)	4 (3.3%)	0.210
Vertigo	11 (5.7%)	10 (8.3%)	0.376
Tinnitus	6 (3.1%)	7 (5.8%)	0.247
Nasal/sinus pain	13 (6.7%)	5 (4.1%)	0.334
Nasal congestion	20 (10.4%)	5 (4.1%)	0.047
Eye pain	6 (3.1%)	4 (3.3%)	0.923

Data are expressed as number (%).

TMD= temporomandibular disorder.

p> 0.05= not significant.

p≤ 0.05= significant.

Most patients primarily presented to the otolaryngology clinic with headache, otalgia, or jaw pain. Other patients primarily presented with symptoms pertaining to Costen's syndrome (hearing loss/blocked–ear sensation, vertigo, tinnitus, nasal/ sinus pain, or nasal congestion). The incidence of symptoms pertaining to Costen's syndrome in both groups is compared in Table 5.

Otoneurological symptoms were significantly more commonly associated with myogenous TMD; whereas (sinus) symptoms were significantly more commonly associated with arthrogenous TMD (P = 0.001). Eye pain

was reported by 245 patients of the total studied patients (78%). Eye pain was reported by 141 of the 193 patients with arthrogenous TMD (73.1%) and in 104 of the 121 patients with myogenous TMD (86.0%). The difference is statistically significant (p=0.007). The causes of eye pain in the studied groups is shown in Table 6. Of note, TMD-related eye pain was encountered in either group in approximately one-quarter of the patients (Table 6).

Table 5: Symptoms pertaining to Costen's syndrome in patients with arthrogenous versus myogenous TMD.

	Arthrogenous TMD (n= 193)	Myogenous TMD (n= 121)	P value
Hearing loss/blocked -ear sensation	42 (21.8%)	92 (76.0%)	0.001
Vertigo	103 (53.4%)	94 (77.7%)	0.001
Tinnitus	42 (21.8%)	82 (67.8%)	0.001
Nasal/sinus pain	115 (59.6%)	28 (23.1%)	0.001
Nasal congestion	116 (60.1%)	29 (24.0%)	0.001

Data are expressed as number (%).

TMD= temporomandibular disorder.

p≤ 0.05= significant.

Table 6: Causes of eye pain in patients with arthrogenous versus myogenous TMD.

	Arthrogenous TMD (n= 193)	Myogenous TMD (n= 121)	P value
TMD-related	44 (22.8%)	31 (25.6%)	0.568
Dry eye disease	28 (14.5%)	28 (23.1%)	0.052
Migraine	15 (7.8%)	14 (11.6%)	0.258
Dry eye disease + migraine	9 (4.7%)	6 (5.0%)	0.905
Allergic conjunctivitis	21 (10.9%)	12 (9.9%)	0.786
Ocular asthenopia	10 (5.2%)	5 (4.1%)	0.671
Chronic rhinosinusitis	7 (3.6%)	3 (2.5%)	0.746
Allergic fungal sinusitis	2 (1.0%)	0 (0.0%)	0.525
Frontal mucocele	1 (0.5%)	0 (0.0%)	0.428
Trochleodynia	1 (0.5%)	0 (0.0%)	0.428
Hemicrania continua	1 (0.5%)	0 (0.0%)	0.428
Contact point headache	1 (0.5%)	1 (0.8%)	0.738
Glaucoma	1 (0.5%)	2 (1.7%)	0.561
Optic neuritis	0 (0.0%)	2 (1.7%)	0.148
No eye pain	52 (26.9%)	17 (14.0%)	0.007

Data are expressed as number (%).

TMD= temporomandibular disorder.

p> 0.05= not significant.

p≤ 0.05= significant.

Widespread body pain was present in 156 patients of the total cohort of TMD patients (49.6%). It was present in 88 patients with arthrogenous TMD and in 68 patients with myogenous TMD (P = 0.067). The causes of widespread pain in arthrogenous versus myogenous TMD patients are revealed in Table 7.

Regarding history of bruxism reported by the patients or their relatives, 38 per cent of arthrogenous TMD patients gave a history of bruxism, versus 52 per cent of myogenous TMD patients (P = 0.025). Approximately one-half of the TMD patients in either group reported an impaired sleep quality. The most common reasons for the imperfect sleep quality were headaches, generalised body pains, affective disorders, laryngopharyngeal reflux and obstructive sleep apnoea. Of note, 16.5 per cent of myogenous TMD patients gave a history of a

depressive disorder, versus 6.7 per cent of arthrogenous TMD patients (P = 0.006). Malocclusion was detected in 33.7 per cent of arthrogenous TMD patients and in 28.1 per cent of myogenous TMD patients (P = 0.30).

Table 7: Causes of widespread pain in arthrogenous versus myogenous TMD patients.

	Arthrogenous TMD (n= 193)	Myogenous TMD (n= 121)	P value
Osteoarthritis	28 (14.5%)	13 (10.7%)	0.335
Fibromyalgia	11 (5.7%)	25 (20.7%)	0.001
Radiculopathy from vertebral spondylosis	15 (7.8%)	13 (10.7%)	0.369
Diabetic neuropathy	9 (4.7%)	8 (6.6%)	0.458
Rheumatic arthritis	11 (5.7%)	5 (4.1%)	0.539
Rheumatoid arthritis	7 (3.6%)	2 (1.7%)	0.491
Gouty arthritis	4 (2.1%)	0 (0.0%)	0.302
Thyroid related myopathy	1 (0.5%)	1 (0.8%)	0.738
Vitamin related neuropathy	1 (0.5%)	1 (0.8%)	0.738
Multiple sclerosis	1 (0.5%)	0 (0.0%)	0.428
No widespread pain	105 (54.4%)	53 (43.8%)	0.067

Data are expressed as number (%).

TMD= temporomandibular disorder.

p> 0.05= not significant.

p≤ 0.05= significant.

7. Discussion

Temporomandibular disorders (TMD) are considered a major cause of orofacial pain. TMD are pathologically classified, according to Axis I of the diagnostic criteria for temporomandibular disorders (DC/TMD), into arthrogenous and myogenous TMD; reflecting the predominant or exclusive affection of the temporomandibular joint (TMJ) and masticatory muscles, respectively [24,25]. These two entities may be quite different regarding their clinical presentation. In a previous prospective clinical study, involving a relatively large group of TMD patients presenting to the otolaryngology clinic, the current author reported that arthrogenous TMD patients had significantly more complaints regarding facial pain and nasal congestion than myogenous TMD patients. On the other hand, myogenous TMD patients reported significantly more complaints of hearing loss/blocked-ear sensation and vertigo than arthrogenous TMD patients [19]. Based on literature review, the author postulated that central nervous system (CNS) neuroplastic changes, involving relevant brain networks, were putatively responsible for this discrepancy in presentation [19]. The current prospective study validates these observations (Table 5). In the current study, hearing loss / blocked-ear sensation, vertigo and tinnitus were more commonly associated with myogenous TMD; whereas nasal/sinus pain and nasal congestion were more commonly encountered in arthrogenous TMD patients (P = 0.001).

It had previously been postulated that mechanical aberrations involving jaw kinematics, such as occurring in malocclusion or bruxism, play a crucial role in the pathogenesis of TMD pain [43-45]. However, this view had been challenged in recent systematic reviews [46,47]. Instead, more emphasis has been placed on CNS maladaptive neuroplastic changes, involving pain, affective and motor networks in the brain [48-50]. Indeed, clinical studies have concluded that chronic TMD are associated with global CNS hyperexcitability to noxious stimuli [51]. Human neuroimaging studies, in patients with chronic TMD pain have demonstrated structural and functional brain changes. These changes

were detected both in arthrogenous and myogenous TMD [52,53]. The pathological correlates underlying the CNS neuroplastic changes in patients with TMD pain include neuronal and glial cell activation, as well as a degree of neuroinflammation in the CNS [54,55].

The subnucleus caudalis of the trigeminal nucleus, in the brainstem and upper cervical spinal cord, appears to play a vital role in the development of central sensitization in the whole trigeminal nociceptive system [56]. Moreover, at the level of the subnucleus caudalis, convergent nociceptive afferent fibres from the ophthalmic (V1) and mandibular (V3) divisions of the trigeminal nerve account for the association of eye pain in patients with TMD pain.9 In the current study 78 per cent of TMD patients complained of eye pain. Of note, TMD-related eye pain (heterotopic, radiating, or referred pain from the jaw) was encountered in approximately one-quarter of TMD patients in either group. This is a significant observation which, as far as the author is aware, had not been quantified before.

The present study revealed the frequent association between TMD and dry eye disease (DED). DED is a multifactorial disease characterized by a loss of homeostasis of the tear film and is accompanied by ocular symptoms; notably a sensation of dryness, burning, itching and photophobia. Tear film instability, ocular surface inflammation and neurosensory abnormalities play etiological roles in DED [57]. Both TMD and DED share a similar epidemiology and are both more prevalent in women. They are frequently associated with widespread body pains and they both share the high prevalence of affective disorders, such as anxiety, depression and insomnia [58,59]. In the current study, DED was diagnosed in 22.6 per cent of TMD patients (Table 6). The incidence of DED in patients with arthrogenous versus myogenous TMD was not statistically significant.

In the present study, typical migraine headaches were reported by 14% of TMD patients. Migraine is a debilitating, highly prevalent headache, which affects women more then men. The pathogenesis of migraine involves activation of peripheral trigeminal (especially, the ophthalmic) nociceptive pathways, brainstem and diencephalic nuclei and the cortex. Activation of neurons results in the release of neurotransmitters, especially calcitonin gene-related peptide (CGRP), which act on the nociceptive system and intracranial blood vessels, leading to vasodilation and stimulation of pain-sensitive neurons innervating the intracranial blood vessels [60,61]. Central sensitisation has been proposed as one of the mechanisms involved in the chronification of migraine in patients with TMD [2,62]. It had been reported that migraine is strongly associated with myogenous rather than arthrogenous TMD. Various authors hypothesized that myogenous TMD is rather a central hypersensitivity syndrome with other associated painful disorders (including migraine) and a higher incidence of affective disorders [8,26,27]. This hypothesis was corroborated by human physiological, clinical and neuroimaging studies in patients with myogenous TMD [53,63,64]. The results of the present study did not validate the predominant association of migraine with myogenous rather than arthrogenous TMD. Perhaps, this conflict may be due to the clinical setting in various studies. Migraine patients are predominantly referred to pain clinics or headache clinics, whereas the setting of the current study was an otolaryngology clinic and the number of patients with arthrogenous TMD was significantly greater than those with myogenous TMD.

In the current study, primary sinonasal causes accounted for 4.7 per cent of eye pain in patients with TMD. This low percentage probably reflects the much higher incidence of other causes of eye pain, such as TMD-related pain, DED and migraine. Chronic rhinosinusitis (CRS) is not always associated with facial pain; however, the most commonly reported site of facial pain in CRS is the periorbital region [38,39].

The major limitation of the current study is that a control group of patients with eye pain but without TMD was not included. This requires a further study. Another limitation of the study was that, frequently, patients with TMD reported tenderness to palpation of both the TMJ and the masticatory muscles. However, more severe

tenderness over the TMJ, especially if associated with objective evidence of joint derangement, was assigned as arthrogenous TMD. Exquisite tenderness over masticatory muscles, associated with trigger points and a referral pattern of the pain, was assigned as myogenous TMD.

8. Conclusion

The present study sought to determine the incidence and pattern of eye pain in patients with arthrogenous versus myogenous TMD. Seventy-eight per cent of TMD patients complained of eye pain. The incidence of eye pain was higher in myogenous versus arthrogenous TMD patients. TMD-related eye pain was encountered in either group in approximately one-quarter of the patients studied.

9. Bullet Points

- Eye pain in the context of temporomandibular disorders (TMD) had not been previously analyzed
- The current prospective clinical study investigated the incidence and pattern of eye pain in patients with arthrogenous versus myogenous TMD
- Eye pain was significantly more commonly encountered in myogenous versus arthrogenous TMD patients
- Approximately one-quarter of patients with either subgroup of TMD had eye pain directly related to TMD

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