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A Clinical Study on Persistent Xerostomia in Patients with Temporomandibular Joint Disorders

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Abstract

Objective: The aim of the current study was to test the issue that internal derangement of the temporomandibular joint would be associated with xerostomia and decreased salivary flow rate. A hypothesis for this association is presented.

Methods: The study involved 100 individuals with temporomandibular joint disorder (TMJD) and 100 control subjects. The mean incidence of subjective xerostomia and the mean unstimulated salivary flow rate were compared between both groups.

Results: Subjective xerostomia was encountered in 72% of TMJD patients, versus 28% of control subjects (P=0.001). The mean unstimulated salivary flow rate was 0.187 mL/min in TMJD patients, versus 0.406 mL/min in control subjects (P=0.001).

Conclusion: The hypothesis of auriculotemporal nerve and chorda tympani entrapment explains the reported results.

Keywords: Temporomandibular joint disorder; Auriculotemporal nerve; Chorda tympani; Xerostomia; Salivary flow rate

Abbreviation: TMJD: Temporomandibular joint disorder; TMD: Temporomandibular disorder; TMJ: Temporomandibular joint

Introduction

Temporomandibular disorder (TMD) is a subgroup of musculoskeletal disorders that primarily affects the temporomandibular joint (TMJ), masticatory muscles, and related structures; including ligaments, tendons, and nearby nerves [1]. The signs and symptoms of TMD involve craniofacial pain, joint noises on mandibular movement, as well as functional disorders, such as locking of the jaw [2]. Symptoms outwith the musculoskeletal system are frequently reported by TMD patients, including otological symptoms and symptoms mimicking chronic rhinosinusitis (Costen's syndrome) [3,4]. Temporomandibular joint disorder (TMJD) involves an essential pathological affection of the TMJ, with or without masticatory muscle pathology [5]. Patients with TMJD present objective signs of joint pathology, including the presence of audible and palpable clicks and crepitations, trismus, episodes of joint dislocation, and deviation of the jaw on mandibular movements [6]. Several factors are implicated in the pathogenesis of TMJD, including physical and emotional stress, bruxism, malocclusion, and spasm of the lateral pterygoid muscle [7-9]. These factors create unphysiological stress-strain patterns on the joint, ligament laxity, abnormal relation of the intra-articular disc to the mandibular condyle, and eventually, degenerative joint disease [10-12].

Regarding the anatomy of the TMJ, two nerves are related to the medial aspect of the joint; the auriculotemporal nerve and the chorda tympani [13,14]. Both nerves have secretory function to the major salivary glands. The auriculotemporal nerve provides postganglionic parasympathetic nerve supply to the parotid gland, whereas the chorda tympani contain preganglionic parasympathetic nerve fibers to the submandibular, sublingual salivary glands, as well as the minor salivary glands [15]. Anterior

displacement of the intra-articular disc is the most common form of internal derangement of the TMJ. It is postulated that the disc displacement is caused primarily by increased tension or hypertrophy of the upper head of the lateral pterygoid muscle, which inserts into the disc [16,17]. This is especially so in habitual clenching or grinding of the teeth and in loss of posterior dental support [18,19]. Entrapment of the auriculotemporal nerve in the infratemporal fossa by the hypertrophied upper head of the lateral pterygoid muscle is responsible for the pain syndromes related to the nerve and, putatively, may reduce salivary flow [20].

Also, a displaced disc in the anteromedial direction may press on the auriculotemporal nerve. Compression of the auriculotemporal nerve may reduce parotid salivary flow directly, or via sensory-autonomic interactions [21,22]. On the other hand, the chorda tympani are a slender and very sensitive nerve. Even touching it, during stapes surgery, can lead to postoperative disturbance in taste in the tongue [23]. It is documented that in internal derangement of the TMJ, there is increased stiffness in the middle ear, attributed to medial displacement of the malleus, via tension on the discomalleolar ligament [24]. It has been hypothesized that the increased pressure in the middle ear would affect the secretory function of the chorda tympani [25]. Furthermore, in anterior disc displacement, stretching of the discomalleolar and anterior malleolar ligaments could putatively cause dysfunction of the closely related chorda tympani [26]. Self-reported taste disturbance was significantly correlated with the grade of the TMD pain, as revealed in a previous study [27]. However, the authors attributed the reason for this correlation to pain input onto the nucleus of the solitary tract in the brain stem, rather than a putative peripheral affection of the chorda tympani in the setting of TMJD. An OPPERA study on TMD pain suggested a dysregulation of the autonomic nervous system, evidenced by a generalized sympathetic nervous system bias in TMD pain patients [28]. Therefore, the sympathetic bias could contribute to xerostomia in TMD patients.

The objective of the current study was to test the hypothesis that internal derangement of the TMJ would significantly be associated with xerostomia and/or decreased salivary flow rate. Xerostomia is defined as the subjective complaint of dryness in the mouth, which is commonly associated with reduced salivary flow [29,30]. A diagnosis of hyposalivation is made when the unstimulated salivary flow rate is less than 0.1 mL/min [31]. Although a common clinical condition, persistent xerostomia significantly affects the quality of life, in addition to its deleterious effect on oral health [32]. TMJD is also a common condition in the population [33]. A significant association between TMJD and xerostomia might suggest the relevance of auriculotemporal nerve and chorda tympani irritation by the diseased joint tissues [34,35]. The hypothesis of auriculotemporal nerve and chorda tympani irritation would favor a peripheral disorder as the cause of xerostomia, rather than a central nervous system disorder [36]. Although xerostomia and hyposalivation in patients with TMJD had previously been reported in an article from Ukraine, the pathophysiology of this association was not clear [37]. The present study aimed to confirm that xerostomia and hyposalivation were significantly correlated with TMJD; and furthermore, to present a hypothesis explaining the pathophysiology of this correlation. The English language literature was searched using the PubMed and Google Scholar databases, from 1980 till 2024.

Materials and Methods

The current study was a prospective clinical study performed at the craniofacial pain clinic in a teaching hospital in Cairo, Egypt. The study period was 4 months, starting on the 1st of March, 2024. Ethical approval for the study was obtained from the General Organization of Teaching Hospitals and Institutes in Cairo (Approval number: 37/2024). Informed consent was obtained from individuals of the study group and the control group to participate in the study. A standard questionnaire and examination findings sheet were prospectively filled by the author for each individual. The study group and the control group comprised adult individuals aged between 18 and 59 years. The study group involved individuals who had arthrogenous temporomandibular disorder, with or without masticatory muscle myalgia. To be included in the study group, bilateral audible and/or palpable sounds had to be elicited on the temporomandibular joints (TMJs), on mandibular movement. The control group were individuals accompanying the participants of the study group, who did not experience joint noises, and, who on examination, had smooth movements of the joints. Both individuals from the study and control groups were from similar socioeconomic background. Examination in the clinic was performed between 9 am and 12 pm, to minimize fluctuations in salivary secretion associated with the circadian rhythm. The subjects enrolled in the study had to be refrained from eating, drinking, and chewing 1 hour before encounter with the author. The exclusion criteria for both groups were: previous cranial or jaw trauma; acute cranial or dental painful conditions; a previous diagnosis of diabetes mellitus or autoimmune rheumatological disorder; patients on psychotropic medication; and patients with persistent nasal obstruction.

The age and sex of the participants of both groups were recorded. In the questionnaire, the presence or absence of jaw pain, headache, and otalgia was noted. The jaw pain was categorized as spontaneous, or induced by mastication. The nature of headache was classified as tension-type headache or migraine. The presence of autonomic symptoms, associated with the pain (including nasal congestion, rhinorrhea, and lacrimation) was noted. The state of dentition was classified as full dentition or incomplete dentition. The number of any missing teeth was noted. The individual was asked about the experience of joint noises on mandibular movement, as well as the duration of the noises. The individuals of the study group experienced joint noises for at least 6 months. The subject was inquired about the habit of clenching or grinding the teeth (bruxism). Also, the report of previous episode(s) of open-lock was obtained. Any reported affective personality disorder, such as anxiety and depression, was noted. The experience of

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persistent dry mouth (xerostomia) was recorded. Symptoms that supported xerostomia categorization included frequent thirst, the need for frequent water sipping, and halitosis. The sensation of xerostomia had to be a conspicuous symptom for the subject. Next, the participant was asked about frequent abnormalities of taste sensation (dysgeusia), that included bitter, salty, or metallic taste.

Examination started with manual palpation including the TMJs, temporalis and masseter muscles, for tenderness (arthralgia and myalgia; respectively). On repeated opening and closure of the mouth, audible and/or palpable joint sounds (clicking or crepitation) were noted. The presence or absence of joint sounds, on mandibular movement, were used to classify the subjects as TMJD patients or control subjects; respectively. On maximal mouth opening trismus was defined as inter-incisal distance less than 3.5 mm. Also, any deviation of the jaw was noted on opening the mouth. Next, examination of the tongue was noted for evidence of dryness of the mucosa, such as fissuring or white coating of the tongue. Examination of the teeth was noted for signs of dental caries and missing teeth. Multiple missing molars were important features implicated in malocclusion. Following the examination, the subject was instructed to spit any saliva in a transparent cylinder graduated in millimeters, for 5 minutes. After 5 minutes, the volume of saliva was recorded, and the value was divided by 5 to indicate the unstimulated salivary flow in mL/min. The main criteria pertinent to this study were the subjective sensation of dry mouth (xerostomia) and the objective value of unstimulated salivary flow rate. The mean figures for these values were compared between the study group and the control group.

Statistical analysis

Results were expressed as mean ± standard deviation or number percent [n (%)]. Comparison between categorical data [n (%)] was performed using Chi square test. 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.

Results

The study involved 100 TMJD patients and 100 control subjects. Table 1 shows the demographic data of the two studied groups. There was no significant difference between the mean age or sex predominance between the two studied groups. Table 2 reveals the reported symptomatology in the two groups. Jaw pain and headache were more frequently encountered in TMJD patients compared to controls. The presence of autonomic symptoms associated with the pain were more common in TMJD patients than in controls. Significantly, subjective xerostomia and alteration in taste were more commonly encountered in TMJD patients, compared to controls. Table 3 reveals the examination findings pertinent to the study. TMJ arthralgia and masticatory myalgia were more common in TMJD patients than in control subjects. Regarding the elicited TMJ sounds in TMJD patients, clicking of both joints was encountered in 80 %, whereas crepitus was elicited in 20 %. Clinical evidence of a dry tongue was encountered more frequently in TMJD patients than in controls. Significantly, mean unstimulated salivary flow rate was 0.187 mL/min, in TMJD patients, compared to 0.406 mL/min in control subjects (P=0.001).

Table 1: Demographic data of the two studied groups.

	TMJD cases (n= 100)	Controls (n= 100)	P value
Age (years)			
Min.-max.	18-59	18-59	
Mean ± SD	38.92 ± 11.35	37.66 ± 11.09	0.428
Gender			
Female	74 (74.0%)	69 (69.0%)	0.434
Male	26 (26.0%)	31 (31.0%)	

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

TMJD= temporomandibular joint disorder.

p> 0.05= not significant.

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Table 2: Symptoms pertaining to the study.

	TMJD cases (n= 100)	Controls (n= 100)	P value
Jaw pain	73 (73.0%)	22 (22.0%)	0.001*
Headache	84 (84.0%)	50 (50.0%)	0.001*
Headache			
Tension type	72/84 (85.7%)	38/50 (76.0%)	0.156
Migraine	12/84 (14.3%)	12/50 (24.0%)	
Otalgia	58 (58.0%)	37 (57.8%)	0.981
Jaw pain + temple headache + otalgia	41 (41.0%)	11 (11.0%)	0.001*
Autonomic symptoms (rhinorrhea + lacrimation)	30 (30.0%)	14 (14.0%)	0.006*
Bruxism	65 (65.0%)	43 (43.0%)	0.002*
History of open lock	24 (24%)	0 (0%)	0.001*
Reported affective disorder	45 (45%)	31 (31%)	0.041*
Subjective xerostomia	72 (72%)	28 (28%)	0.001*
Dysgeusia	43 (43%)	20 (20%)	0.001*

Data are expressed as number (%).

TMJD= temporomandibular joint disorder.

p> 0.05= not significant; *p≤ 0.05= significant.

Table 3: Examination findings pertaining to the study.

	TMJD cases (n= 100)	Controls (n= 100)	P value
TMJ arthralgia	73 (73.0%)	18 (18.0%)	0.001*
Masticatory myalgia	49 (49.0%)	22 (22.0%)	0.001*
TMJ sounds	80 (80.0%)	0 (0.0%)	0.001*
Trismus/deviation of jaw	12 (12.0%)	0 (0.0%)	0.001*
Signs of dry tongue	53 (53.0%)	12 (12.0%)	0.001*
Missing 2 or 3 molars in a hemi-arch	41 (41.0%)	23 (23.0%)	0.006*
Unstimulated salivary flow rate (mL/min.)			
Min.-max.	0.0-0.6	0.06-2.0	
Mean ± SD	0.187 ± 0.169	0.406 ± 0.325	0.001*

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

*p≤ 0.05= significant.

Discussion

Temporomandibular joint disorder (TMJD) most commonly involves disc displacements and degenerative joint disease. Individuals with disc displacement with reduction experience clicking sounds on moving the mandible. Patients with disc displacement without reduction experience limited opening of the mouth (closed-lock) or deviation of the mandible during mouth opening. Degenerative joint disease typically occurs after the disc is displaced, and bony contact exists between the condyle and articular fossa, leading to a grating sound (crepitus) on the working joint. Occasionally, anterior dislocation of the condyle (open-lock) occurs when the condylar head is trapped anteriorly over the articular eminence [38]. TMJ pain (arthralgia) may be reproduced clinically by manual palpation or loading of the joint [39]. The main causes of TMJ arthralgia are low-grade synovitis or capsulitis of the joint tissues, with release of a wide array of biological factors that sensitize nociceptors in the joint [40]. The current study involved 100 patients with TMJD and 100 control subjects with no evidence of TMJ pathology. In this study, bilateral TMJ sounds, on mandibular movements were elicited in all patients and in none of the control subjects. The individuals in the TMJD group elicited clicking over the joint in 80%, and crepitus in 20%. Trismus and/or deviation of the jaw were seen in 12% of the TMJD patients. A history of a previous open-lock was reported by 24% of the TMJD patients. Tenderness over the TMJ was elicited in 73% of the patients and in 18% of control subjects (P=0.001).

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The intra-articular disc of the TMJ is crucial in absorbing stresses and ensuring smooth movements of the joint, without bone-to-bone contact [41]. The most common type of disc displacement is anterior displacement, in relation to the condyle [7]. It is postulated that this disc displacement is due to a hypercontracting upper head of the lateral pterygoid muscle, which consistently inserts onto the anterior aspect of the disc [42]. This hypercontraction was revealed by electromyographic and magnetic resonance imaging studies, in patients with anterior disc displacement [16,17,43]. The anterior pull on the disc is not balanced by a corresponding tension in the retrodiscal tissue, which becomes fibrotic in anterior disc displacement [44,45]. The auriculotemporal nerve runs on the medial surface of the lateral pterygoid muscle in the infratemporal fossa, and some of its fibers may penetrate the muscle. In the confined region of the infratemporal fossa, compression of the auriculotemporal nerve, by the overcontracting muscle, may lead to pain in the distribution of the nerve, and putatively, may reduce salivary flow from the parotid gland [46]. Additionally, an anteriorly displaced disc or synovial plicae may increase the likelihood of compression of the nerve [47]. On the other hand, the chorda tympani are closely related to the discomalleolar and anterior malleolar ligaments in the region of the neck of the malleus of the middle ear, in the petrotympanic fissure, and in the retrodiscal region [48]. Irritation of this sensitive nerve by the neighboring ligaments, in the setting of anterior disc displacement could putatively diminish salivary secretion from the submandibular and sublingual glands [49]. Internal derangement of the TMJ is associated with increased stiffness in the middle ear, as well as a misplaced malleus, thereby increasing the chance of chorda tympani irritation [24,50]. Internal derangement of the TMJ is also associated with a variable degree of inflammation of the joint capsule (capsulitis), and this inflammation could involve the auriculotemporal nerve and chorda tympani, leading to a dysfunction in their secretory roles [51].

The current study revealed that the mean subjective complaint of dryness of the mouth, xerostomia, occurred in 72% of TMJD patients versus 28% of control subjects (P=0.001). Objective determination of collected unstimulated saliva volume showed that the mean salivary flow rate was significantly less in TMJD patients (0.187 mL/min) than in the control subjects (0.406 mL/min), (P=0.001). These findings confirm the results of a previous study from Ukraine on 46 TMJD patients [37]. The authors of that study postulated that the causes of xerostomia and hyposalivation in patients with TMJD are attributed to common vegetative innervation of the TMJ and salivary glands. The current author proposes the hypothesis that the main cause of xerostomia and decreased salivary flow rate in TMJD patients, compared to the controls, is affection of the auriculotemporal nerve and chorda tympani by pathological TMJs and related ligaments. Entrapment of the auriculotemporal nerve in TMJD would typically cause pain in the sensory distribution of the nerve [52]. The current study revealed that the combination of temple headache, jaw pain, and otalgia occurred in 41% of TMJD patients, versus 11% of control subjects (P=0.001). Irritation of the chorda tympani would cause taste disturbances in the tongue [53]. In the current study 43% of the TMJD patients reported altered taste sensation, versus 20% of control subjects (P=0.001).

Other factors in TMJD patients can contribute to the experience of a dry mouth. The physiological process of mastication may be hampered in patients with TMJD [54]. Owing to the masticatory-salivary reflex, reduced masticatory efficiency may impair salivary flow, especially from the parotid glands [55]. The masticatory function is especially disturbed in incomplete dentition [54]. In the current study, missing 2 or 3 molars in one hemi-arch was encountered in 41% of TMJD patients, compared to 23% of control subjects (P=0.006). On the other hand, parafunctional activities, especially bruxism, are correlated with TMJD, owing to the mechanical overloading of the joint [56]. Bruxism, commonly a manifestation of stress, is associated with a sympathetic drive and activation of the hypothalamic-pituitary-adrenal axis [57]. It has been reported, in an epidemiological study, that sleep bruxism was significantly associated with xerostomia and hyposalivation [58]. In the current study, self-reported day-time or nocturnal bruxism was found in 65% of TMJD patients, versus 43% of control subjects (P=0.002).

A major limitation of the current clinical study was that eliciting joint sounds in the clinic, or absence of joint sounds, might not reflect the exact longterm incidence of joint pathology, as the natural course of TMJD is not stable [59]. Also, the current study was performed by a single practitioner, who was not blinded as to the clinical data. The main strength of the study was that it proposed a previously undescribed hypothesis regarding the cause of xerostomia and decreased salivary flow rate in TMJD patients. If, in the future, the results of the study would be validated, appropriate neurophysiological studies could confirm the proposed hypothesis.

Conclusion

The results of the current study confirm the association between subjective xerostomia and reduced unstimulated salivary flow rate in patients with TMJD. The hypothesis presented for this association involves irritation and entrapment of both the auriculotemporal nerve and chorda tympani by diseased joint tissues and over-contraction of the upper head of lateral pterygoid muscle.

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