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Signs and Symptoms of Temporomandibular Disorder in Male Narghile Smokers versus Male Cigarette Smokers

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1. Abstract

Objective: Narghile smoking is highly prevalent in Egypt. The act of narghile smoking involves strong contraction of the jaw muscles, which would putatively cause overloading of the temporomandibular joint; thereby leading to internal derangement of the joint. The current study compared symptoms and signs related to temporomandibular disorder in male narghile smokers versus male cigarette smokers.

Methods: This prospective clinical study involved 233 male narghile smokers and 233 male cigarette smokers. A questionnaire and examination findings protocol was applied for each participant.

Results: There was a significant increase in incidence of signs of internal derangement in the temporomandibular joints of narghile smokers versus those of cigarette smokers (p=0.001). Tympanic membrane retractions were also more common in narghile smokers versus cigarette smokers(p=0.001), reflecting the significant effects of jaw muscle mechanical efforts on the middle ear system, associated with narghile smoking.

Conclusion: Narghile smoking is a traumatizing habit as regards its effects on the temporomandibular joints and ear structures.

2. Keywords: Smoking; Narghile; Cigarette; Temporomandibular joint; Temporomandibular disorder

3. Introduction

According to the World Health Organization, tobacco smoking is the leading cause of preventable premature death worldwide. The prevalence of tobacco smoking among adult Egyptians was 22% in 2010 and is currently increasing [1]. The most common forms of tobacco smoking in Egypt are the cigarette and the narghile (water-pipe), which are both much more prevalent in males than in females [1]. Nicotine is the main addictive chemical in tobacco, leading to the release of various neurotransmitters in the brain (such as dopamine and endorphins), which cause pleasure and the relief of stress and anxiety in habitual smokers [2]. Although the acute effects of nicotine are analgesic, persistent smoking has been associated with some chronic pain conditions, such as low-back pain [3].

Temporomandibular disorders (TMDs) are a heterogeneous group of conditions affecting the temporomandibular joint (TMJ), jaw muscles and /or related structures. The prevalence of TMD signs and symptoms in the general population is high, even if treatment is needed only by a minority of subjects [4]. Although the pathological changes found in the jaw structures (eg. mechanical fatigue, oxidative stress and

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inflammation) might be similar in cohorts of patients with TMD, individual patients might report a variable degree of symptoms [5,6]. Individual psychosocial factors probably account for the differences in complaints among TMD patients with similar pathological afflictions [7,8]. Moreover, females are more likely than males to report painful symptoms, probably due to differences in estrogen signalling pathways [9].

The narghile is an oriental tobacco pipe with a long flexible tube through which the smoker draws the smoke through water (water-pipe) (Figure 1).

Figure 1: Egyptian narghile.

The act of narghile smoking entails active inspiratory efforts, involving contraction of the jaw, neck, chest muscles, as well as the diaphragm. In a previous study by the current author, narghile smokers, as compared to cigarette smokers, generated highly negative intraoral and intrapharyngeal pressures that were sufficient to cause otoscopically visible persistent tympanic membrane retractions [10]. The excessive jaw muscle contraction during narghile smoking might cause excessive loading of the TMJ, which might lead to signs of internal derangement of the joint [11,12]. Internal derangement of the TMJ, defined as abnormal relationship of the articular disc to the mandibular condyle, glenoid fossa and articular eminence can affect up to 25% of the population [13]. Given a similar psychosocial profile among male narghile and cigarette smokers, narghile smoking would putatively cause a higher incidence of internal derangement of the TMJ, compared to cigarette smoking. However, no previous study had compared TMD signs and symptoms between the two groups. The aim of this prospective clinical study was therefore to compare the signs and symptoms of TMD among male narghile smokers versus male cigarette smokers.

4. Materials and Methods

The present study was a prospective clinical study conducted over a period of 3 months, starting on the 1st of July, 2020. Appropriate ethical approval was granted prior to the study from the General Organization of Teaching Hospitals and Institutes in Cairo (approval number 93/2020). Informed consent was obtained from the participants in the study. The inclusion criteria were current male narghile smokers and current male cigarette smokers, who had a history of smoking for at least 3 years prior to the commencement of the study. The amount of smoking had to be at least 1hour smoking sessions a day for narghile smokers and at least 20 cigarettes a day for cigarette smokers. Participants in the current study were recruited from different social clubs in central Cairo. Exclusion criteria included subjects with dental pain at the time of the study, those who had previous operation, trauma or fracture of the jaw and individuals with craniofacial malformations. A standard questionnaire and examination findings protocol was filled for each participant.

The age of the smoker was recorded. The questionnaire included the presence or absence of chronic headache, otalgia, jaw pain or non-painful jaw symptoms (such as stiffness or fatigue) [14,15]. Chronic symptoms also enquired about were facial pain, eye pain, neck pain and chest pain [16-18]. The experience of TMJ noises during function or parafunction, as well as the dental status were noted [19]. A history of any episode(s) of inability to close the jaw after wide mouth opening,

such as during yawning (open-lock), was recorded [20]. Symptoms pertaining to Costen's syndrome (hearing loss, blocked-ear sensation, tinnitus, vertigo and/or nasal congestion) were specifically asked about [21]. A history of day-time or night-time bruxism was noted [22]. The sleep quality and features of any affective disorder, especially anxiety or depression, were noted during the questionnaire [23]. The participants were asked about the presence or absence of systemic co-morbidities, especially musculoskeletal pain [24]. Examination of each participant involved palpation of the temporalis and the masseter muscles; and if tenderness was elicited at these sites (noted by a palpebral reflex), the condition was assigned as myalgia. Tenderness over the TMJ was assigned as arthralgia. During palpation of the TMJ, the participant was then asked to widely open and close the mouth repeatedly, noting for any abnormal sounds. Clicking over the TMJ signified disc displacement with reduction and a grating sensation(crepitus) signified degenerative joint disease. The presence of trismus (limited mouth opening; less than 4 cm interincisal distance) or deviation of the jaw were also noted [20]. The dental status was assessed and the participant was assigned as having normal dentition, or being partially or totally edentulous. Next, examination of the tympanic membranes was performed, noting specifically for the presence or absence of tympanic membrane retractions [10].

5. Statistical Analysis

Results were expressed as mean ± standard deviation or number (%). 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.

6. Result

The study groups involved 233 male narghile smokers and 233 male cigarette smokers. There was no statistically significant difference between the mean value of age between narghile smokers (41.18 ± 11.61 years) and cigarette smokers (39.51 ± 11.47 years) (p=0.120). Symptoms related to temporomandibular disorder in narghile smokers versus cigarette smokers are shown in Table 1.

Table 1: Symptoms related to temporomandibular disorder in narghile smokers versus cigarette smokers.

	Narghile smokers (n= 233)	Cigarette smokers (n= 233)	P value
Headache (yes)	80 (34.3%)	74 (31.8%)	0.555
Otalgia (yes)	40 (17.2%)	39 (16.7%)	0.902
Jaw pain/non-painful symptoms (yes)	72 (30.9%)	67 (28.8%)	0.613
Facial pain/eye pain (yes)	93 (39.9%)	74 (31.8%)	0.066
Neck pain (yes)	94 (40.3%)	88 (37.8%)	0.569
Chest pain (yes)	112 (48.1%)	119 (51.1%)	0.517
Hearing loss/blocked -ear sensation (yes)	54 (23.2%)	29 (12.4%)	0.002*
Tinnitus (yes)	88 (37.8%)	65 (27.9%)	0.023*
Vertigo (yes)	81 (34.8%)	81 (34.8%)	1.000
Sinus congestion (yes)	83 (35.6%)	75 (32.2%)	0.434
History of open-lock (yes)	31 (13.3%)	15 (6.4%)	0.013*
History of bruxism (yes)	101 (43.3%)	112 (48.1%)	0.306
Impaired sleep quality (yes)	54 (23.2%)	65 (27.9%)	0.243
Affective disorder(s) (yes)	70 (30.0%)	79 (33.9%)	0.371
Systemic musculoskeletal pain (yes)	62 (26.6%)	60 (25.8%)	0.833

Data are expressed as mean ± SD or number (%). p> 0.05= not significant. p≤ 0.05= significant.

The incidence of head and neck subsite, pain-related symptoms were not statistically significantly different between the two groups. Narghile smokers reported more symptoms of hearing loss/blocked ear sensation than cigarette smokers (p=0.002). Features related to the psychosocial profile (affective disorder(s), impaired sleep quality, history of bruxism and the experience of systemic musculoskeletal pain) were not significantly different between the two groups (Table 1). Notably, a history of previous open-lock was more common in narghile smokers, compared to cigarette smokers (p=0.013).

Table 2: Examination findings related to temporomandibular disorder in narghile smokers versus cigarette smokers.

	Nerghile smokers (n= 233)	Cigarette smokers (n= 233)	P value
Myalgia (yes)	23 (9.9%)	21 (9.0%)	0.751
Arthralgia (yes)	39 (16.7%)	22 (9.4%)	0.020*
Clicking TMJ (yes)	118 (50.6%)	48 (20.6%)	0.001*
Crepitus in TMJ (yes)	10 (4.3%)	3 (1.3%)	0.049*
Deviation of jaw (yes)	17 (7.3%)	5 (2.1%)	0.009*
Trismus (yes)	5 (2.1%)	1 (0.4%)	0.100
Dental status			
Normal dentition	155 (66.5%)	136 (58.4%)	
Partially edentulous	76 (32.6%)	91 (39.1%)	0.101
Totally edentulous	2 (0.9%)	6 (2.6%)	
Retracted tympanic membranes (yes)	104 (44.6%)	26 (11.2%)	0.001*

Data are expressed as number (%). TMJ= temporomandibular joint. p> 0.05= not significant. p≤ 0.05= significant.

Examination findings related to temporomandibular disorder in narghile smokers versus cigarette smokers are shown in Table 2. Notably, clicking and crepitation elicited on the temporomandibular joint(s) were each significantly more common in narghile smokers than in cigarette smokers (p=0.001 and p=0.049, respectively). Elicited myalgia or arthralgia were relatively not frequent in both groups (Table 2). Otoscopically visible tympanic membrane retractions were more common in narghile smokers than in cigarette smokers (p=0.001). Many smokers in both groups had missing teeth (Table 2).

7. Discussion

The temporomandibular joint (TMJ) is a sophisticated, synovial joint where the articular surfaces involve the glenoid fossa and articular eminence superiorly and the mandibular condyle inferiorly. The joint contains a fibrocartilaginous articular disc, which is supposed to compensate for the incongruency of the articulating surfaces [25]. The commonest cause of TMJ dysfunction is a displaced articular disc; a condition known as internal derangement. It has been estimated that up to 25% of the entire population have an internal derangement of the TMJ [26]. Displacement of the articular disc is associated with pathological changes in the ligamentous attachments of the disc-condyle complex (the capsular collateral ligaments), as well as pathological changes in the retro discal ligaments [27]. In most internally deranged joints, the articular disc is displaced forward when the jaw is at rest. During opening of the mouth, the disc is replaced and toward the end of closing, it is displaced forward again [28]. Both replacement and displacement may elicit an audible click [29]. Overtime, disc displacement may predispose the joint to degenerative changes of the disc and articular surfaces [30,31]. Clinically, degenerative joint disease is associated with a grating sound(crepitus), elicited over the TMJ during movement of the joint [32].

Narghile smoking is a highly prevalent habit in Egypt. The act of narghile smoking probably involves isometric contraction of all the jaw muscles, which

contributes to the generation of significant negative intraoral pressure necessary to drive the smoke into the mouth against the water and the tube resistance [10]. The jaw muscle contraction may be particularly strong when the tube system of the narghile is partially blocked by deposited tobacco. The net effect of simultaneous strong jaw muscle contraction is a forward displacement of the mandible [33]. Indeed, during the act of narghile smoking, the mandible is found to be pulled forward (personal observation). Over activity of the jaw muscles causes excessive loading of the TMJ [34]. It had been reported that overloading of the TMJ tends to squeeze the intra-articular disc forward; and with repeated activity the disc becomes permanently displaced forward at rest, leading to internal derangement of the joint [35]. The biomechanical consequences of chronic overloading of the TMJ are associated with biochemical changes inside the joint reflecting tissue hypoxia, chronic inflammation and an imbalance in proteolytic enzyme homeostasis, which may ultimately lead to degenerative joint disease [36].

Clinically, TMJ internal derangement is associated with a wide spectrum of various signs, including clicking, crepitation, tenderness, inability to widely open the mouth(closed-lock), inability to fully close the mouth(open-lock) and deviation of the jaw [37]. Signs of internal derangement were found in 54.9% of narghile smokers, compared to only 21.9% of cigarette smokers in the current study (p=0.001). This significant finding probably reflects significant overloading of the TMJs in narghile smokers, compared with cigarette smokers. The relatively high incidence of internal derangement in cigarette smokers, compared to non-smokers might be attributed to poor oral hygiene and dental loss, the latter being a risk factor for TMJ disorders [38,39]. Dental loss was detected in 33.5% of narghile smokers and in 41.7% of cigarette smokers (p=0.101).

The results of the present study suggest that narghile smoking, as compared to cigarette smoking, is indeed a traumatizing habit, as regards trauma to the TMJ structures. Notably, cigarette smoking does not require the extensive efforts of narghile smoking to draw the smoke into the mouth. The detection of joint clicks on opening and/or closing the mouth was evident in 50.6% of narghile smokers, compared to 20.6% of cigarette smokers (p=0.001). Functionally, joint clicks usually signify disc displacement with reduction [37]. The persistent abnormal mandibular kinematics in the setting of disc displacement and the act of habitual narghile smoking is a potential factor for development of further mechanical trauma to both TMJs [40]. This can eventually lead to a pathological, malpositioned disc and disc perforation [41]. If the strains on the joint are not relieved, mechanical fatigue, oxidative stress and inflammation are important pathogenetic factors for development of degenerative joint disease [42]. The high-friction movements between the articulating surfaces, in the absence of the normal disc cushioning functions contribute to osteoarthrosis of the articulating bone surfaces [43]. Clinically, degenerative joint disease is associated with a grating sound (crepitus) elicited on the joint during movement [44]. In the current study crepitus was detected in 4.3% of narghile smokers versus 1.3% of cigarette smokers (p=0.049).

Open lock of the TMJ is associated with acute inability to close the mouth. It occurs when the condyle is entrapped in front of a lagging disc or due to condylar dislocation anterior-superior to the articular eminence [45]. In the present study a history of open-lock was obtained in 13.3% of narghile smokers versus 6.4% of cigarette smokers (p=0.013). Persistent trismus was noted on examination in 5 narghile smokers and in one cigarette smoker. Deviation of the jaw was seen in 7.3% of narghile smokers and in 2.1% of cigarette smokers (p=0.009).

Tenderness-related signs, ie. myalgia and arthralgia were relatively few in the current study. Myalgia was noted in 9.9% of narghile smokers and in 9.0% of cigarette smokers (p=0.751). Arthralgia was noted in 16.7% of narghile smokers and in 9.4% of cigarette smokers (p=0.02). It is possible that the analgesic effect

of nicotine [3] plays a major role in blunting the pain sensation in current smokers. In support of this, many of the smokers in the current study who complained of headache reported that their headache subsided on starting smoking. In contrast to this, several epidemiological studies have found a significant positive association between cigarette smoking and the severity of pain in TMD patients [46-48]. This conflict may be related to cultural factors or to gender differences; as most cited studies on TMD patients involved predominantly female subjects, whereas the current study involved only male participants. Females are more prone to report painful symptoms than males [9]. In the current study the incidence of painful symptoms in the head and neck region was not significantly different among the two studied groups (Table 1). It should be noted that headache, otalgia, jaw pain and facial/eye pain have a multitude of etiologies other than TMD [16,17].

In the current study, hearing loss/blocked-ear sensation were reported by 23.2% of narghile smokers, compared to only 12.4% of cigarette smokers (p=0.002). It is hypothesized that the higher incidence of these symptoms in narghile smokers could be explained by mechanical factors, associated with excessive contractions of the muscles innervated by the mandibular branch of the trigeminal nerve [49]. Contraction of the medial pterygoid muscle can push the membrano-cartilaginous portion of the Eustachian tube medially, contributing to Eustachian tube dysfunction [50]. Contraction of the tensor veli palatini muscle can pull on the tensor tympani muscle, causing tympanic membrane stiffness [51]. Moreover, an anteriorly displaced TMJ intra-articular disc may cause increased tension on the middle-ear malleus via the discomalleolar and anterior malleolar ligaments [52]. Indeed, multiple frequency tympanometry had revealed evidence of increased stiffness of the middle-ear system in patients with temporomandibular joint disorders [53].

A previous study by the current author revealed a significant incidence of tympanic membrane retraction in narghile smokers compared to cigarette smokers [10]. Another study by the same author confirmed audiometric evidence of hearing loss in a significant proportion of TMD patients, compared to controls [54]. In the current study, otoscopic evidence of tympanic membrane retractions was evident in 44.6% of narghile smokers, compared to only 11.2% of cigarette smokers (p=0.001). This finding may imply transmission of highly negative pressure from the pharynx to the middle ear via the Eustachian tube [10].

The present study revealed a relatively high incidence of subjective tinnitus and vertigo in both groups of smokers (Table 1). Human neuroimaging studies in tobacco smokers have shown structural and functional alterations in various regions of the brain [55]. Recent studies have stressed the issue of maladaptive neuroplastic changes in brain networks as a crucial pathogenetic factor in the experience of tinnitus and vertigo via top-down mechanisms [56,57].

The strength of the current study is the detection of objective evidence of signs of internal derangement in the TMJs of a relatively large number of narghile smokers compared to cigarette smokers. Both groups were recruited from similar social backgrounds; thus, minimizing a probable psychosocial bias concerning the symptoms and signs of TMD in the two groups. Indeed, relevant psychosocial parameters studied in this work were not significantly different between the two studied groups. These parameters included the incidence of affective disorders, sleep disturbances, history of bruxism and systemic musculoskeletal pain (Table 1).

One limitation of the current study is that it included only male subjects. Narghile smoking is quite uncommon among females in Egypt. Another limitation of the study is that it did not include a radiographic study of the temporomandibular joints of the smokers. This would have greatly improved the characterization of specific anatomical changes in the joints.

8. Conclusion

The present study was a clinical study comparing the incidence of symptoms and signs related to

temporomandibular disorder in male narghile smokers versus male cigarette smokers. It can be concluded that narghile smoking is a traumatizing habit as regards its effects on the temporomandibular joints and ear structures.

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