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ORIGINAL ARTICLE

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Prevalence of temporomandibular disorder signs in patients with complete versus partial dentures

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Abstract *Objectives*: To determine the prevalence of signs of a temporomandibular disorder (TMD) in completely edentulous patients wearing upper and lower complete dentures (CD) and to compare this to the prevalence of signs in partially edentulous patients wearing upper and lower clasp-retained acrylic removable partial dentures (RPD). *Materials and methods*: A questionnaire and a clinical examination were used to assess 200 patients. One hundred of these were complete denture wearers being treated for the provision of replacement CD. The other 100 patients were partially edentulous patients, who had RPD replacing upper and lower partially missing teeth and their supporting structures. *Results*: It was shown that there was a statistically significant difference between the two groups regarding the presence of temporomandibular signs. Partially edentulous patients wearing upper and lower RPD had a significantly higher prevalence of TMD signs than edentulous patients wearing CD (36% compared to 17%). They also exhibited significantly ($P<0.04$) more signs of joint tenderness (18%) on clinical examination compared to (5%) only in the CD-wearing patients. Tenderness upon palpation in the periauricular region was the most common site reported in both groups. *Conclusions*: The partially edentulous patients (wearing RPD) exhibited more TMD signs when compared with the CD-wearing patients. Significantly, more partially edentulous patients had joint tenderness ($P<0.04$) than did CD-wearing patients. The masseter muscle most commonly demonstrated muscle tenderness.

Keywords Tempromandibular disorders · Prevalence · Signs · Temporomandibular joint · Denture

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Introduction

Temporomandibular disorders (TMD) are a group of conditions characterized by pain or dysfunction in the temporomandibular joint (TMJ) and/or the muscles of mastication [43].

TMD have become topics of increasing interest in dentistry over the past two decades. There are conflicting figures related to the incidence of the signs and symptoms. Epidemiological surveys report that 50–70% of the population have signs of a disorder at some stage during their life [9, 37, 41], whereas, an estimated 20–25% of the population have symptoms of a TMD [24]. However, those who seek treatment represent approximately 2–7% of the population [39, 42, 43].

There would be varying opinions on the prevalence of TMD signs in dentate population. TMD appears to be almost as prevalent in wearers of complete dentures (CD) as in dentate individuals, varying from 15 to 25% [49, 64]. Others reported that CD wearers were found to have a higher prevalence of TMD symptoms than the normal population with natural dentition [44].

A higher figure of TMD signs in dentate individuals, when compared with completely edentulous patients was, however, reported [12]. The prevalence of edentulous patients who complain of TMD would appear to be low [24].

Signs and symptoms of TMD seem to decrease with increasing age [9, 28, 57]. Previous studies regarding the prevalence of TMD signs in the edentulous denture-wearing population ranged between 12 and 80% [29]. Generally, elderly people are not the main TMD sufferers. In one study, only 4% of the very old population had severe signs of TMD [30]. However, it has been reported that patients wearing CD suffer from more TMD signs or symptoms than the dentate population, and that patients of an older age group might be expected to demonstrate a higher incidence of osteoarathrosis [7].

The prevalence of TMD signs in partially edentulous patients wearing upper and lower removable partial dentures (RPD) has not been well-documented, on the

contrary, much of the published work was attributed to those completely edentulous CD-wearing and dentate patients.

It would appear, therefore, to be worthwhile to determine the prevalence of TMD signs in both completely edentulous and partially edentulous patients wearing removable prosthetic appliances.

Materials and methods

A total of 2,758 patients (1,273 male; 1,485 female) were treated in Prosthetic Clinic, Dental Department at Queen Alia Hospital (QAH) in Amman, Jordan, over a 1-year period (January to December 2004). Of these, 973 (35.3%) new patients who attended the clinic for the provision of CD and RPD construction, 628 (22.8%) patients who had been previously diagnosed and treated as symptomatic TMD patients, 217 (7.8%) patients wearing clasp-retained acrylic RPD replacing partially missing teeth in one jaw only, 121 (4.4%) patients with single CD, and 43 (1.6%) partially edentulous patients wearing metal-based RPD, were excluded from this study.

The remaining 776 (28.1%) patients were divided into two groups: in the first group, there were 472 (60.8%) completely edentulous patients wearing upper and lower CD, and in the second group, there were 304 (39.2%) partially edentulous patients wearing upper and lower clasp-retained acrylic RPD.

A sample of 200 patients was included in this study. One hundred patients were randomly selected from the first group; those were CD wearers being treated for the provision of replacement CD. The reasons for replacement of dentures were poor denture retention, poor denture stability, overclosure, excessive wear of artificial teeth, and repeated fractures.

The other 100 patients were also randomly selected from the second group; those were partially edentulous patients wearing clasp-retained acrylic RPD replacing upper and lower partially missing teeth and their supporting structures. The missing teeth ranged between eight and 24 with an average of 14.70 (SD=5.01). They were attending prosthetic clinic for routine follow up, denture fracture repair, and addition of lost artificial tooth or clasp.

None of the patients in both groups complained of symptoms or had previously sought any treatment for a TMD.

All patients were required to complete a questionnaire and undergo a clinical examination. Initially, each patient was directly questioned as to whether he or she was aware of any of the specific signs associated with a TMD; these signs were TMJ tenderness, limitation and/or deviation of mandibular movement, joint sounds (e.g., clicking or crepitus), and masticatory muscle tenderness.

The clinical examination of the patients was essentially the same as that performed by Gray et al. [25, 26].

Joint sounds were determined with the aid of a stethoscope placed in front of the external auditory meatus. Clicking and crepitus of the TMJ, either unilateral or bilateral, was recorded.

The maximum jaw opening was measured using a millimeter ruler after asking the patient to open as wide as possible while remaining comfortable. For RPD wearers with natural anterior teeth, the maximum opening was recorded between the incisal edge of the maxillary central incisor that is the most vertically oriented and measured vertically to the incisal edge of the opposing mandibular incisor. The amount of vertical incisor overlap (the distance between the incisal edges of the upper and lower central incisors) was added to each of these measurements to determine the actual amount of opening [19].

For those wearing CD and RPD with artificial anterior teeth, the maximum opening was recorded between the incisal edges of the maxillary central incisors and measured vertically to the incisal edges of the opposing mandibular incisors (at the midline). To ensure that the dentures stayed in place during maximum jaw opening, denture adhesive powder was used. In cases of severe mandibular and/or maxillary bone resorption coupled with unstable dentures, a light finger pressure was applied on the denture to help retain the denture in place during maximum jaw opening.

The pathway of mandibular opening for each patient was recorded as follows: straight opening with no deviation, deviation to the right side, or deviation to the left side. Any mandibular deviation on opening and closing was recorded. A patient's tendency to deviate towards the affected side was regarded as a positive diagnostic sign [27].

Joint tenderness was determined by bilateral digital palpation posteriorly via the external auditory meatus and laterally over the condyle in the immediate peri-auricular region.

The masseter and temporalis muscles were palpated bimanually for any signs and tenderness. The lateral pterygoid muscle was examined by recording its response to resisted movements, as this muscle is not accessible to manual palpation [34, 56].

All prosthetic appliances (CD and RPD) were carefully examined. For the CD-wearing patients, the existing dentures were examined for support, retention, stability, occlusion, vertical dimension of occlusion, and freeway space. For the partially edentulous patients wearing upper and lower RPD, the edentulous spaces were examined for support of the partial dentures, the remaining teeth, especially the abutments, were also examined and evaluated for mobility and malocclusion. The existing dentures were examined for retention, stability, occlusion, and extension of the base. The method of dentures evaluation was the same as that performed by MacEntee and Wyatt [40].

Clinical examination of the patients and prostheses was performed by two "prosthodontist" examiners who applied a standardized procedure before the collection of the data. Replicate examinations were conducted on 5% of the sample and each examiner was paired with each of the other examiner on at least five examinations.

Reliability for measures of maximum jaw opening, ±1 mm, exceeded 90% for the examiners. Intraexaminer correlations exceeded 0.90 for both examiners. Intraexaminer correlations were 0.88 for examination of prosthetic appliances and 0.92 for clinical examination of the patients.

Results

Age and sex distribution of the patients and age of the existing removable prostheses worn by the patients, are shown in Table 1.

The frequency and distribution of the signs of TMD were also recorded (Table 2). It was shown that fewer CD-wearing patients exhibited TMD signs when compared with the RPD patients. Statistically significant findings were only present in two signs; the prevalence of TMD complaint (Table 3) and the prevalence of joint tenderness (Table 4).

Tenderness upon palpation followed a similar pattern between the two groups. TMJ region was the most common site, followed by the mandibular region; zygoma and neck were less frequently involved (Table 5).

The other TMD signs in both groups showed a similar pattern of frequency and distribution. Although the signs were more frequently recorded in partially edentulous group, they were found to be statistically insignificant. However, the most common sign in both groups was muscle tenderness in the masseter than the other muscles (Table 6).

Joint sounds (clicking and crepitus) were also recorded, but again the majority of cases were found in the partially edentulous group. Only three patients had any symptoms of trismus; only one case was found in the CD-wearing group.

The majority of patients (85%) had straight opening with no deviation. The mean value of maximum opening for partially edentulous group was 39.9 mm (±2.65); CD-wearing patients had comparable reading with a mean value of 40.2 mm (±3.07).

For CD-wearing patients, 65% were recorded as having poor denture retention, 55% as having poor denture stability, and 70% as having a freeway space in excess of 7 mm.

Table 1 Age and sex distribution of the sample and age of the existing prostheses

	Age (years)		Sex		Prostheses age	
	Range	Mean (SD)*	Male (%)	Female (%)		
Complete denture patients	41–76	62.22 (8.51)	53	47	3 W†	25 Y§
Removable partial denture patients	29–64	54.05 (7.61)	48	52	2 M‡	12 Y§
		58.14 (8.06)				

*SD Standard Deviation, †W weeks, ‡M months, §Y years

Table 2 Comparison of frequency and distribution of TMD signs in complete denture and removable partial denture patients

Sign of TMD	Complete denture patients	Removable partial denture patients
Presence of TMD complaint	17	36
Joint tenderness	5	18
Clicking	14	19
Crepitus	10	12
Muscle tenderness	25	26
Deviation to the right side	7	8
Deviation to the left side	5	10
Trismus	1	2

Table 3 Prevalence of patients with TMD complaint even though, until asked, they were unaware of their presence

	No sign	Signs
Complete denture patients	83 (83.0%)	17 (17.0%)
Removable partial denture patients	64 (64.0%)	36 (36.0%)
Total	147 (73.5%)	53 (26.5%)

CHI-square value=3.83; P=0.04

Table 4 Prevalence joint tenderness elicited upon palpation

	No tenderness	Tenderness
Complete denture patients	95 (95.0%)	5 (5.0)%
Removable partial denture patients	82 (82.0%)	18 (18.0%)
Total	179 (89.5%)	21 (10.5%)

CHI-square value=4.03; P=0.04

Table 5 Prevalence of tenderness upon palpation by site in both complete denture and removable partial denture patients

	TMJ	Mandible	Zygoma	Neck
Complete denture patients	12	8	5	2
Removable partial denture patients	13	7	4	4
Total	25	15	9	6

Table 6 Prevalence of muscle tenderness in the masseter, temporalis, and lateral pterygoid muscles

	Masseter (%)	Temporalis (%)	Lateral pterygoid (%)
Complete denture patients	15	8	4
Removable partial denture patients	18	10	9
Total	33	18	13

For the partially edentulous patients; 25% of the RPD were ill-fitting, 40% were unstable, 75% of the abutment teeth (clasped teeth) had a certain degree of mobility, and

70% of patients had one or more tooth alignment abnormality, i.e., extrusion, rotation, drifting, etc.

Discussion

One or more TMD signs were present in 36% of RPD patients, compared to 17% found in CD wearers ($P<0.04$). This indicates that RPD patients had significantly more TMD signs than CD patients. RPD patients also exhibited significantly ($P<0.04$) more signs of joint tenderness (18%) on clinical examination, compared to (5%) only in the CD patients.

It has been documented that patients with few remaining natural teeth and RPD may have a higher incidence of TMD signs [1]. In addition, restoration of missing natural teeth has been suggested to decrease or eliminate signs and symptoms of TMD [53]. However, there is no sufficient evidence of an association between TMD and partial loss of teeth [48]. Moreover, restoration of missing teeth does not seem to decrease the prevalence of TMD [59].

The age distribution of the partially edentulous group was younger than that of the completely edentulous group; the mean age was 54 and 62 years, respectively. However, there was a similar sex distribution between the two groups.

Recent epidemiologic studies have generally found significantly more frequent and more severe TMD signs and symptoms in women than in men [5, 9, 30, 32]. This has been interpreted as a "more women than men appear to seek treatment for TMD symptoms" [6, 38], or is said to reflect biological, psychosocial, and hormonal differences between the two groups [14, 33, 51]. However, the commonly held belief that females suffer from TMD more than males is a fallacy. Epidemiological surveys show that signs and symptoms of TMD are present in both sexes in equal proportions [24].

The most common site of tenderness in both groups was reported over the joint in the periauricular region. Pain in or in front of the ear is one of the most commonly reported signs for patients being treated for TMD [63].

Joint sounds are very common among patients with TMD and in non-patient populations. They are recorded as clicking or crepitus. Of all the patients in this study with joint sounds, none was actively seeking treatment. Previous studies on TMD signs have shown that clicking is the most prevalent [8, 35]. In this study, RPD patients had relatively higher percentage of clicking (19%) than CD patients (14%), although this difference was not statistically significant. Recently, it has been reported that patients with partial tooth loss showed significantly higher prevalences of TMJ sounds and restricted mouth opening. The prevalence of TMD symptoms is related to consumption of hard food items [3].

A variety of different causes to TMJ sounds have been suggested, e.g., arthrotic changes in the TMJ, anatomical variations, muscular incoordination, and disc displacement. The most accepted hypothesis on what produces the click was that explained by Toller [54]; it is a "hesitation of movement" of the meniscus during its glide forward. However, recent researchers related clicking "to a sudden acceleration of condylar and internally displaced disc tissues" [21, 50].

Crepitus is a sign encountered in degenerative disease of the articular surfaces, often associated with aging, such as osteoarathrosis, which is present more frequently among edentulous patients [12]. In the present study, unexpectedly, RPD patients had a higher incidence of crepitus than the CD group, although again this difference was not statistically significant.

It is well-known that the maximum bite force and jaw-closing muscle activity are considerably reduced in CD wearers, compared to dentate individuals [55, 60]. In this study, it was found that 70% of CD wearers had an interocclusal clearance of 7 mm or more. This overclosure may result in reduction of the biting force, as a consequence; CD wearers may avoid consumption of hard food. This, coupled with the reduced forces generated during mastication, indicates that CD wearers seldom exceed their tissue tolerance and adaptability, and this could explain why they exhibit fewer signs of TMD. These findings agree with previous studies [3, 61].

Loss of molar teeth has been correlated with osteoarthritic changes in the TMJ [31], and restoration of posterior teeth has been suggested to decrease or eliminate the pain associated with TMD. The treatment effect has been attributed to stabilization of the occlusion, redistribution of occlusal forces, and reduction of joint loading [22].

The maximum mandibular opening is one of the measures used for the assessment of mandibular function. A reduced range of vertical movement may be interpreted as a sign of TMD [11, 41]. Humphery et al. [32] found that average maximum opening of 30.3 mm in TMD patients compared to 47.4 mm in "control" non-TMD group. However, Miller et al. [45] reported that the mean mouth opening of 50 mm could be regarded as normal, and mandibular movements were clinically similar in asymptomatic subjects and in patients with TMD.

In this study, it was found that the mean value of maximum opening for the RPD group was 39.9 mm and for the CD group 40.2 mm. These findings agreed with at least one clinical study, which demonstrated that an average of 40 mm seems to represent a reasonable point of incisor separation on maximal opening [30].

Most of the patients had a straight opening pathway; however, few cases of deviation were recorded in both groups. It should be mentioned, however, that CD wearers might be expected to have reduced maximum opening levels as stability of the lower denture during this exercise requires muscular coordination to prevent displacement of the denture [62].

The symptom of limited mandibular movements can be classified into two categories: restricted mouth opening (trismus) and deviation during mandibular movements. The word "trismus" is defined by the American Academy of Orofacial Pain as: "Myospasm of masticatory muscles specifically causing limited jaw opening" [4].

The least common sign in both groups was trismus. However, the most commonly sign in both groups was that of muscle tenderness, masseter was the most frequently involved, followed by temporalis and, finally, lateral pterygoid. This finding differs from that of previous studies [12, 44], which found that the lateral pterygoid muscle was the more frequently involved. It has been frequently reported by patients who are not confident of denture retention that they have to clench their teeth together to ensure denture retention during normal function. This could explain the frequency of muscle tenderness in patients wearing complete dentures and why masseter and temporalis were more frequently involved than lateral pterygoid.

All the CD-wearing patients were receiving treatment for the provision of new dentures, as their existing prostheses were inadequate for a variety of reasons. This was reinforced by the results, which showed that only 35% had acceptable retention, 45% had good stability, and 30% had evidence of a satisfactory vertical dimension.

Several studies have found no correlations between certain characteristics of dentures (denture retention, stability, occlusal errors, freeway space, age of present denture, or number of sets of dentures) and the presence or severity of TMD signs and symptoms [15, 17, 47]. In addition, loss of vertical occlusal height on its own may not be responsible for the TMD occasionally seen in CD wearers with reduced vertical height [58].

Malocclusion has been one of the most frequently cited causes of both condylar displacement and masticatory muscle disorders [46]. However, Gesch et al. [23] reported that malocclusions accounted for only a small part of the differences between normal population and population with signs or symptoms of TMD. It has been proposed that malocclusion of the teeth results in mandibular displacement, usually in the posterior direction and can cause compression of sensitive soft tissue. Continued compression of this tissue could result in pain and impairment of the blood supply to the joint structures leading to degenerative changes [36].

The incidence and intensity of TMD are higher in subjects with greater tooth loss in the supporting zones [18]. Missing mandibular posterior teeth may accelerate the development of degenerative joint disease [5]. However, the presence of an adequate occlusal support is a relevant factor in maintaining an efficient chewing and may play an indirect role in preventing occurrence of symptoms of temporomandibular dysfunction [13].

In this study, 70% of partially edentulous patients wearing upper and lower RPD had malocclusion in the form of malalignment, rotation, drifting, or extrusion of a tooth or more. Only 25% of abutment teeth were sound with no signs of mobility or other periodontal disease. This could explain the findings that they had more TMD signs when compared to those in complete denture wearers or in dentate individuals.Although a TMD sign alone can indicate a clinical condition, it may also refer to a subclinical event or may just be a normal variation [52]. The prevalences of TMD symptoms and signs are apparently high in non-patient populations [2, 20]. Recording TMD signs is necessary because they have been estimated to occur approximately twice as common as symptoms, the prevalence of symptoms varying from 5 to 33%, and the prevalence of signs from 50 to 75% [10, 16].

Conclusion

From the results of this study, the main conclusions were:

1. The partially edentulous patients (wearing RPDs) exhibited more TMD signs (36%) when compared with the complete denture-wearing patients (17%); these differences were found to be statistically significant ($P<0.04$).
2. Significantly more partially edentulous patients had joint tenderness ($P<0.04$) than did complete denture-wearing patients (18 and 3%, respectively).
3. The masseter muscle most commonly demonstrated muscle tenderness.
4. Tenderness in the periauricular region was found to be the most common site reported in both groups.

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