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ORIGINAL ARTICLE

Temporomandibular disorders after orthognathic surgery in patients with mandibular prognathism with depression as a risk factor

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Abstract

Objective. To examine the prevalence of temporomandibular disorders (TMD) after orthodontic-surgical treatment in patients with mandibular prognathism and analyze psychosocial variables related to TMD. ***Materials and methods.*** The case-control study comprised 40 patients with mandibular prognathism who underwent combined orthodontic-surgical treatment (orthognathic surgery group). Forty-two patients with untreated mandibular prognathism served as a control group. Research diagnostic criteria for temporomandibular disorders was used in order to assess the clinical diagnosis of TMD (Axis I) and to estimate depression, somatization and patient's disability related to chronic pain (Axis II). ***Results.*** The overall prevalence of TMD was not significantly different between the groups. Myofascial pain was significantly higher, while arthralgia, arthritis and arthrosis was significantly lower in the orthognathic group compared with the controls (90.5% vs 50.0%, 0.0% vs 27.8%, respectively) ($p < 0.05$). Females in orthognathic surgery group showed higher prevalence of TMD ($p < 0.05$) and myofascial pain ($p < 0.01$) and increased level of chronic pain ($p < 0.05$) in comparison with post-operative males. No significant difference in chronic pain, somatization and depression scores was found between investigated groups. With respect to presence of TMD within the groups depression was higher in untreated subjects with dysfunction ($p < 0.05$). ***Conclusion.*** Prevalence of TMD immediately after completion of orthodontic-surgical treatment for mandibular prognathism is similar to frequency of dysfunction in untreated subjects, is significantly higher in females and is most commonly myogenic. Furthermore, females show an increased level of chronic pain post-operatively. Somatization and depression levels do not differ between patients with corrected prognathism and untreated prognathic patients.

Key Words: *craniomandibular disorders, depression, malocclusion-angle class III, RDC/TMD, somatization*

Introduction

Temporomandibular disorders (TMD) are acknowledged to be multifactorial in origin and factors that have been mentioned behind TMD are trauma to the masticatory system, metabolic conditions, occlusion and psychosocial factors [1,2]. Having in mind the altered anatomic foundation, TMD was widely investigated in patients with skeletal malocclusions. However, data concerning TMD appearance in patients with skeletal malocclusions showed great diversity [3–8] and no significant pattern of TMD symptoms for any specific diagnosis of the dentofacial deformity was reported [4,7]. Among individuals with class III skeletal deformities, TMD were reported in 41–88% of the subjects [3,5,6,9,10].

Correction of discrepancies in occlusion and maxilla-mandibular relationship by orthognathic surgery should not only improve facial esthetics but also rehabilitate the function and possibly reduce TMD symptoms [6]. However, orthognathic surgery affects both hard and soft tissues in the maxillofacial region and thus may have a causative role in the onset of TMD [11]. Many clinical investigations showed various degrees of improvement [4,7,9], deterioration [8] or no change [3,10,12] in TMD symptoms after orthognathic surgery. The presence of inconsistent findings across studies may lay in different factors,

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including involvement of different skeletal malocclusions in the samples investigated, use of various surgical techniques and fixation methods, the lack of separate investigation of certain TMD sub-diagnoses, application of different TMD screening instruments and the heterogeneity of patients with respect to etiology of TMD. Occlusal aspects of TMD in orthognathic surgery population have been discussed in some articles [4,7,9,12], but the investigation for psychopathology with respect to TMD after orthognathic surgery are rare. Psychological features of TMD include emotional stress [13], anxiety [14], depression [14,15] and somatization [12,15], variables related to the onset and persistence of TMD [14]. Psychosocial status refers to life interference originated in chronic pain [16].

Research diagnostic criteria for TMD (RDC/TMD) suggested by Dworkin and LeResche [16] not only provided very specific diagnostic criteria for eight TMD sub-groups; it also recognized psychosocial aspect of TMD, including depressive symptomatology, the presence of non-specific physical symptoms (somatization) and psychosocial disturbance caused by their TMD problem [17].

Having all these facts in mind we aimed the present investigation in order to evaluate TMD as well as TMD-related psychosocial factors in patients with mandibular prognathism after combined orthodontic-surgical treatment with respect to the untreated prognathic individuals.

The first hypothesis was that TMD after completion of orthodontic-surgery treatment for mandibular prognathism is lower than in untreated subjects. The second hypothesis was that depression and somatization are increased in subjects affected with TMD.

Materials and methods

Patients

The cross-sectional case-control study was conducted on two groups of subjects. The orthognathic surgery group was derived from a population of patients operated on for various dentofacial deformities at the department of Maxillofacial Surgery at the Military Medical Academy, Belgrade. Outpatients aged at least 18 years, of both genders, were eligible for the study if they had pre-operatively been diagnosed with mandibular prognathism without mandibular asymmetry or maxillary deformities, had no previous conventional orthodontic treatment and were operated on at least 6 months before by means of bilateral sagittal split osteotomy (BSSO) only and if the post-operative orthodontic treatment was completed. A total of 40 patients, 25 females, age ranging from 19–29 years (mean (SD) was 22.8 (2.63)), who had surgical correction of madibular prognathism 9–13 months (mean duration (SD): 11.8 (1.1)) before were recruited. Rigid fixation (RF) with miniplates was performed in 20 patients and wire fixation in 20 patients as well. RF was followed by maxillomandibular training elastics for 10 days, 24 h per day. When wire fixation was performed, maxillomandibular fixation was used, from 4–8 weeks. Each patient received pre-surgical and post-surgical orthodontic treatment by means of fixed appliances (mean duration (SD): 21.53 (3.67) months for pre-surgical and 10.15 (1.08) months for the post-surgical phases). None of the patients required any kind of TMD treatment in the pre-operative period. The post-operative rehabilitation protocol for improvement of jaw functioning was not used.

The control group was derived from a population of patients with dentofacial deformities seeking orthodontic treatment at the Department of Dentistry at the Military Medical Academy, Belgrade. Subjects were selected to match the patients in the study group, considering skeletal diagnosis, with an overall age distribution similar to the cases. To be eligible to the study, the subjects should meet the following criteria: aged at least 18 years with no previous orthognathic surgery, conventional orthodontic treatment or other occlusal therapy. A total of 42 subjects, 17 females, age ranging from 18–28 years (mean (SD) was 22.90 (2.47)), were recruited.

Data concerning skeletal diagnosis, surgical procedure and TMD history were extracted from medical records. The underlying skeletal deformity was evaluated by cephalometric analysis on lateral craniograms.

The exclusion criteria for both groups were: systemic muscle or joint disorders, craniofacial syndromes and clefting, history of orofacial trauma and parafunctions.

Written informed consent was obtained from the participants and the study was carried out in accordance with the guidelines of the Helsinki Declaration of 1975, as revised in 1983. The study was approved by the Ethical Committee of the Military Medical Academy in Belgrade.

Clinical evaluation of TMD

The Research Diagnostic Criteria for TMD (RDC/TMD) described by Dworkin and LeResche [16] was used in order to establish the diagnosis of TMD and to estimate chronic pain, depression and somatization values. Axis I component of RDC/TMD was applied to obtain a diagnosis of three diagnostic categories or groups—myofascial pain, disc displacements and other joint conditions (arthralgia, arthritis and arthrosis). These entities are defined in the criteria by the presence of specific combinations of signs and symptoms gathered through subjective reporting by the patients and clinical examination. Axis II assesses psychological status (depression and tendency to report non-specific physical symptoms as noxious)

Table I. Distribution of TMD in the orthognathic surgery group and the control group.

TMD	Orthognathic surgery group (%)			Control group (%)		
	Total (n = 40)	Male (n = 15)	Female (n = 25)	Total (n = 42)	Male (n = 25)	Female (n = 17)
Without TMD	47.5	80.0	28.0	57.1	60.0	52.9
With TMD	52.5	20.0	72.0*	42.9	40.0	47.1

*$p < 0.01$ with respect to males in the orthognathic surgery group.

as well as psychosocial function related to chronic pain. Depression and somatization were measured with sub-scales of the symptom checklist (SCL-90) and chronic pain grade was calculated from visual analog pain scales and data related to impact of pain on daily, social and work activities. The RDC/TMD history questionnaire, examination forms and specifications for examinations used in the current investigation were identical, as described in the mentioned study [16]. Somatization was calculated and analyzed as the presence of non-specific physical symptoms including pain items.

Statistical analysis

Statistical calculations of the results were performed by using SPSS 11.5 for Windows program. The means, SDs and frequencies were calculated. In order to analyze differences between the groups Mann-Whitney U-test, Chi-square test and Fisher's exact test were used. Statistical significance was determined as p-values below 0.5.

Results

The results obtained in this study showed that, of the post-operative subjects, 52.5% displayed TMD. Similarly, TMD was present in 42.9% of the untreated subjects. With respect to gender, prevalence of dysfunction in control subjects was similar in males and females, but significantly higher in females post-operatively (Table I). When patients were divided according to osteosynthesis used, no difference was observed (data not shown).

Frequency distribution of TMD sub-diagnoses, according to Axis I, is shown in Table II. In the orthognathic surgery group, myofascial pain was diagnosed in the great majority (90.5%) of patients with TMD. The most prominent sub-type of TMD among the control cases was disk displacement (66.7%). Significant difference in prevalence of certain TMD types between the investigated groups was found for myofascial pain and for other joint conditions ($p < 0.05$). Muscle type TMD was significantly more prevalent in post-operative females (100.0%) than in males (33.3%) as well ($p < 0.001$).

At least one sign or symptom of TMD was seen in all patients in orthognathic surgery group and in 87.8% of control cases. The most prominent among signs and symptoms in both investigated groups were restricted laterotrusion (85.0% orthognathic surgery group, 66.7% control group) and restricted protrusion (62.5% orthognathic surgery group, 54.8% control group) (Table III).

According to Axis II, 9.5% of subjects with TMD in post-operative cases and 38.9% of untreated subjects with TMD showed no TMD pain in prior 6 months (Table IV). With the exception of one subject in the control group, all painful patients in orthognathic surgery and control group had low disability grades of chronic pain (71.4% vs 44.4% low intensity pain, 19.0% vs 11.1% high intensity pain, respectively). Statistical analysis did not give

Table II. Frequency distribution of the sub-types of TMD (according to Axis I) in the orthognathic surgery group and the control group[a].

TMD diagnosis	Orthognathic surgery group (%)			Control group (%)		
	Total (n = 21)	Male (n = 3)	Female (n = 18)	Total (n = 18)	Male (n = 10)	Female (n = 8)
MP	90.5*	33.3	100.0**	50.0	50.0	50.0
DD	38.1	66.7	33.3	66.7	70.0	62.5
AAA	0.0	0.0	0.0	27.8†	10.0	50.0
Combined	28.6	0.0	33.3	38.9	30.0	50.0

MP, myofascial pain; DD, disk displacement; AAA, arthralgia, arthritis, arthrosis.
*$p < 0.05$ with respect to the control group; †$p < 0.05$ with respect to the orthognathic surgery group; **$p < 0.01$ with respect to males in the orthognathic surgery group.
[a]Note that patients may have had several TMD diagnoses, so the sum of the columns may not match the number of patients in each column.

Table III. Frequency distribution of TMD signs and symptoms in the orthognathic surgery group and the control group.

Signs and symptoms of TMD	Orthognathic surgery group (%) (n = 40)	Control group (%) (n = 42)
≥1 sign or symptom of TMD	100.0	87.8
Pain[a]	5.0	9.5
Deviation on opening or closing of the mandible	55.0	57.1
Restricted opening of the mandible	15.0	7.1
Restricted laterotrusion	85.0	66.7
Restricted protrusion	62.5	54.8
Pain on movement of the mandible	30.0	23.8
TMJ clicking	32.5	42.9
Muscle pain on palpation[b]	45.0	31.0
TMJ pain on palpation	25.0	11.9

[a]According to item 1 of the clinical assessment in RDC/TMD; [b]on ≥3 of the points palpated.

significant difference in chronic pain grade between investigated groups. Regarding gender, females in the orthognathic surgery group showed significantly higher levels of chronic pain (77.8% grade I, 22.2% grade II) than males (33.3% grade I, 0.0% grade II) ($p < 0.05$).

Approximately one third of subjects in both the orthognathic surgery and control group (35.0% and 28.5%, respectively) were clinically depressed. Most of the depressive subjects showed moderate depression (~ 20% in both groups). There was no significant difference in values in the depression scales between the groups. With respect to TMD presence, we found no difference in scores of depression between patients with and without dysfunction in the orthognathic surgery group, but significantly higher depression grade in control subjects with TMD in comparison with TMD-free controls ($p < 0.05$) (Table V).

An increased level of non-specific physical symptom scores was observed among 45.0% of orthognathic surgery patients and in 28.5% of controls. No significant difference was found in somatization both between investigated groups and within each group, regarding presence of TMD and gender (Table VI).

Discussion

This investigation provides certain information about the short-term effect of combined orthodontic-surgical treatment for mandibular prognathism on TMD prevalence. Furthermore, the obtained results include distribution of certain TMD sub-types, as well as data concerning psychopathology related to TMD. Namely, RDC/TMD includes specific diagnostic criteria for most commonly occurring TMD types and integrated measures in psychosocial domains [17]. The latter assess to which extent a person with TMD may be cognitively, emotionally and behaviorally impaired that these factors may contribute to the development or maintenance of disorder [18]. Besides, both of the RDC/TMD components were supported as reliable, valid and clinically useful [17,19].

The results obtained in this study showed that, according to Axis I, the overall prevalence of TMD in post-operative mandibular prognathism cases was similar to untreated subjects. However, the obtained values were higher than in the general population [20,21]. Previous studies in class III subjects prior to and after the orthognathic surgery treatment

Table IV. Chronic pain and related disability (according to Axis II) in the orthognathic surgery group and the control group.

	Orthognathic surgery group (%)			Control group (%)		
Chronic pain grade	Total (n = 21)	Male (n = 3)	Female* (n = 18)	Total (n = 18)	Male (n = 10)	Female (n = 8)
0	9.5	66.7	0.0	38.9	40.0	37.5
I	71.4	33.3	77.8	44.4	40.0	50.0
II	19.0	0.0	22.2	11.1	10.0	12.5
III	0.0	0.0	0.0	5.6	10.0	0.0
IV	0.0	0.0	0.0	0.0	0.0	0.0

Grade 0 = No TMD pain in the last 6 months; Grade I = Low disability, low intensity of pain; Grade II = Low disability, high intensity of pain; Grade III = High disability, moderately limiting; Grade IV = High disability, severely limiting.
*$p < 0.05$ with respect to males in the orthognathic surgery group.

Table V. Depression scores (according to Axis II) in the orthognathic surgery group and the control group.

Depression score	Orthognathic surgery group (%)					Control group (%)				
	Total (n = 40)	Without TMD (n = 19)	With TMD (n = 21)	Male (n = 15)	Female (n = 25)	Total (n = 42)	Without TMD (n = 24)	With TMD* (n = 18)	Male (n = 25)	Female (n = 17)
Normal	65.0	57.9	71.4	66.7	64.0	71.4	83.3	55.6	80.0	58.8
Moderate	20.0	31.6	9.5	20.0	20.0	21.4	16.7	27.8	12.0	35.3
Severe	15.0	10.5	19.0	13.3	16.0	7.1	0.0	16.7	8.0	5.9

*$p < 0.05$ with respect to subjects without TMD in the control group.

revealed conflicting results [3,5,6,10]. This may partly be explained by the different criteria used for diagnosis of TMD. Namely, in the majority of investigations TMD was reported as the prevalence of various signs or symptoms. In the study of Farella et al. [10], in which TMD was assessed according to the RDC/TMD, TMD was found in 50% of untreated prognathic cases and in 29% of patients 1 year after surgical correction by Le Fort I osteotomy combined with BSSO.

The most prominent among TMD signs and symptoms in both groups were restricted jaw-movements. Accordingly, previous studies have shown that orthognathic surgery temporarily reduces mandibular mobility [9,10], with recovery requiring 6–12 months [3,22]. Reduction in mandibular mobility in our study is probably a consequence of short mean time of post-operative examination (6–13 months), of use of BSSO [23], as well as to wire intermaxillary immobilization [7,10,22] and presence of muscle pain [10] in a significant number of the investigated subjects, the factors related to occurrence of post-operative hypomobility. Moreover, Athanasiou and Yücer-Eroglu [9] suggest that post-operative hypomobility that is not combined with other symptoms of TMD should not be regarded as a sign of dysfunction. Restricted jaw movements found in control subjects should be considered conditionally as a TMD manifestation as well as a decrease in maximum voluntary excursions in subjects with dentofacial deformities compared with the healthy controls, which has been reported previously [3,22].

It is well known that signs and symptoms of TMD are more prominent and more often in females in the general population [7,24]. However, the findings in orthognathic surgery patients have been somewhat contradictory. Our results obtained among control cases are consistent with the findings of Dervis and Tuncer [7] who have found higher prevalence of TMD in females than in males with untreated dentofacial deformities, but the difference did not reach the statistical significance. Different findings were obtained in the orthognathic surgery group, where 72% of females and 20% of males reported TMD. These results supported the findings of Westermark et al. [5] and Dervis and Tuncer [7] who reported more TMD in female than in male patients post-operatively. It is possible that biologic susceptibility for TMD [25] and more common presence of psychosocial disorders in females [26] in combination with orthognathic surgery effects could lead to a greater prevalence of TMD in women after orthognathic surgery.

The importance of a separate investigation of different TMD sub-types has been suggested in previous studies [10,27]. Namely, TMD sub-diagnoses may differ in importance of associated factors [27], as well as in treatment procedure and outcome [25]. Data concerning distribution of certain TMD sub-diagnoses in class III subjects before and after surgical correction vary among the studies [10,28]. According to Farella et al. [10], all mandibular prognathism subjects with TMD had disk displacement and none of the cases was classified as having myofascial pain or arthralgia, both pre- and post-operatively. The authors also reported lower occurrence of disk displacement post-operatively compared to the pre-operative results. On the other hand, while control subjects in our study

Table VI. Somatization scores (according to Axis II) in the orthognathic surgery group and the control group.

Somatization score	Orthognathic surgery group (%)					Control group (%)				
	Total (n = 40)	Without TMD (n = 19)	With TMD (n = 21)	Male (n = 15)	Female (n = 25)	Total (n = 42)	Without TMD (n = 24)	With TMD (n = 18)	Male (n = 25)	Female (n = 17)
Normal	55.0	57.9	52.4	66.7	48.0	71.4	75.0	66.7	80.0	58.8
Moderate	40.0	42.1	38.1	33.3	44.0	19.0	25.0	11.1	16.0	23.5
Severe	5.0	0.0	9.5	0.0	8.0	9.5	0.0	22.2	4.0	17.6

exhibited all TMD sub-types, with disc displacement as the most prominent diagnosis, predominant TMD type in orthognathic surgery group was myofascial pain, observed in 90.5% of the cases. Significantly less post-operative patients had a diagnosis involving arthralgia, arthritis and arthrosis, which is similar to the study of Panula et al. [4] and Dervis and Tuncer [7], who found improvement in joint pain on palpation after orthognathic surgery. On the other hand, muscle type TMD was significantly higher in our orthognathic surgery group. Beside clenching and third molar removal, trauma and somatization have been identified as risk factors for subjects with myofascial pain [29]. Having in mind that muscle tenderness caused by orofacial trauma last up to 3 months after injury [30], higher prevalence of muscle type of dysfunction in orthognathic group could be related to the certain psychological mechanisms which may influence patient's pain experience [15,29] as well as to high prevalence of females among post-operative TMD cases.

Pain is the most common reason for seeking treatment in TMD patients [1,24]. In a huge epidemiological study [24], TMD-related pain was reported by 97% of subjects in a clinical TMD population, with increased rates among females. According to our results, 90.5% of subjects in post-operative cases and 61.1% of untreated subjects with TMD showed the presence of chronic TMD pain. Almost all painful patients in both groups had low grades of chronic pain and no significant difference in graded pain between investigated groups was found. However, in relation to gender, females in the orthognathic surgery group had significantly higher levels of chronic pain. Our results support findings of Aghabeigi et al. [12] who have suggested that female patients are at higher risk of persistent TMD pain after orthognathic surgery. Greater sensitivity of females to TMD pain was previously explained by sex-linked behavior [1], influence of female hormones [26,31] and central nociceptive processing up-regulation [32]. In addition, females with abnormal psychological profile were even more prone to have persistent post-operative TMD pain [12].

Somatization and depression in particular have been shown to influence the expression of signs and symptoms of TMD [17]. Besides, depression in orthognathic surgery population may be related to present facial deformity as well as to certain post-operative factors [33]. In our study, a considerable portion of subjects in the orthognathic surgery group (35%) and in the control group (28.5%) were clinically depressed, but most of the depressive patients had moderate depression. Accordingly, using the Hospital Anxiety and Depression Scale, Cunningham et al. [33] found low grade of depression in both subjects with dentofacial deformities and patients after orthodontic-surgical treatment. With regards to TMD presence, significantly higher depression values were found in control subjects with dysfunction. This can be related to the role of depression in the presence of TMD [14-16], whether as a cause of TMD [14,15] or as an effect of TMD-related pain [14]. With respect to gender, depression levels were similar in males and females in the orthognathic surgery group. In untreated subjects women were found to be more depressed than men, but the observed difference was not statistically significant.

Somatization is characterized by a pre-disposition to report many non-specific physical symptoms in the absence of an organic finding [12,15]. It has been suggested that those high in somatization amplify bodily signals and perceived them as more intense [34]. Women exhibited higher somatization levels, but the role of gender in somatizing remains unclear [35]. Increased somatization scores in an orthognathic surgery population have been related to persistence of TMD after orthognathic surgery [12]. In this study 45% of post-operative cases and 28.5% of untreated subjects had increased degrees of non-specific physical symptoms. Although not meeting a level of adjusted statistical significance, higher somatization values were observed in the orthognathic surgery subject, as well as in affected TMD patients and women in both investigated groups. Having in mind the fact that somatization might be related to self-reporting of pain [17] and palpation pain perception at masticatory muscle areas [15,17], higher prevalence of myofascial pain and chronic pain in post-operative cases and females might be associated with generalized heightened perceptual reactivity of somatizing cases.

There are some limitations inherent in this study. The cross-sectional study design helps identify the prevalence of TMD and its relationship to depression and somatization in orthognathic surgery patients with prognathism. However, it is unable to address changes over time at an individual level or to determine causality between psychosocial variables and the dysfunction. Therefore, further prospective studies will be needed to examine the psychosocial factors and their role in TMD development after surgical correction of mandibular prognathism.

Another limitation lies in the fact that the possible influence of occlusal interferences on the presence of TMD is not considered. Namely, the study has been focused on the presence of TMD-related psychological factors which might be affected by both the presence and correction of the skeletal deformity, so the control group has been derived from the population of untreated prognathic subjects. This could have confounded our results, as subjects in investigated groups might have differed with respect to occlusion. Although there is some controversy in the literature regarding the existence of a relationship between occlusal variables and TMD after orthognathic surgery [4,5,7,12], the influence of occlusion in the onset of TMD symptoms

should not be rejected. Therefore, it would be interesting to assess whether psychosocial and occlusal factors differ between treated prognathic patients and non-operated individuals having a normal skeletal and occlusal relationship.

Another concern may be that the study group is heterogenic regarding ostheosynthesis used. As we have followed normal practice we have chosen to include different types of ostheosynthesis in our study group. This fact to some extent might have confounded our results as it has been suggested that TMD after orthognathic surgery treatment may be influenced in different ways by the fixation methods used [5,7,9,10]. Having in mind the fact that intermaxillary fixation strongly reduces the mandibular range of motion [7,9,10], examination was performed at least 6 months post-operatively, when normalization in a range of jaw movements in prognathic patients was observed [10]. On the other hand, the risk of post-operative TMD following the use of rigid fixation is attributed to the lag screws which compress the bone fragments and increase the risk of condyle dislocation [5]. In our study, the screws used were position screws. These may be the reasons why no difference in dysfunction has been observed with respect to the osteosynthesis used.

Within the limitations of the study, we found that the prevalence of TMD immediately after completion of orthodontic-surgical treatment for mandibular prognathism is similar to the frequency of dysfunction in untreated subjects, is significantly higher in females and is most commonly myogenic. Furthermore, females show an increased level of chronic pain post-operatively. No differences were found between the two groups in levels of depression and somatization. With respect to TMD within the groups, depression but not somatization may accompany TMD in untreated subjects with mandibular prognathism. TMD after orthodontic-surgical treatment is not characterized by higher levels of investigated psychosocial factors. Further studies should elucidate the role of psychological factors and the possible interaction with other variables in TMD development in order to identify potential risk factors and to predict TMD presence and maintenance after orthognathic surgery.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

[1] Gray RJ, Davies SJ, Quayle AA. A clinical approach to temporomandibular disorders. 1. Classification and functional anatomy. Br Dent J 1994;176:429–35.

[2] McNeill C. Management of temporomandibular disorders: concepts and controversies. J Prosthet Dent 1997;77:510–22.

[3] Onizawa K, Schmelzeisen R, Vogt S. Alteration of temporomandibular joint symptoms after orthognathic surgery. Comparison with healthy volunteers. J Oral Maxillofac Surg 1995;53:117–21.

[4] Panula K, Somppi M, Finne K, Oikarinen K. Effects of orthognathic surgery on temporomandibular joint dysfunction. A controlled prospective 4-year follow-up study. Int J Oral Maxillofac Surg 2000;29:183–7.

[5] Westermark A, Shayeghi F, Thor A. Temporomandibular dysfunction in 1,516 patients before and after orthognathic surgery. Int J Adult Orthodon Orthognath Surg 2001;16: 145–51.

[6] Ueki K, Marukawa K, Nakagawa K, Yamamoto E. Condylar and temporomandibular joint disc positions after mandibular osteotomy for prognathism. J Oral Maxillofac Surg 2002;60: 1424–32.

[7] Dervis E, Tuncer E. Long-term evaluations of temporomandibular disorders in patients undergoing orthognathic surgery compared with control group. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002;94:554–60.

[8] Aoyama S, Kino K, Kobayashi J, Yoshimasu H, Amagasa T. Clinical evaluation of the temporomandibular joint following orthognathic surgery-multiple logistic regression analysis. J Med Dent Sci 2005;52:109–14.

[9] Athanasiou AE, Yücel-Eroğlu E. Short-term consequences of orthognathic surgery on stomatognathic function. Eur J Orthod 1994;16:491–9.

[10] Farella M, Michelotti A, Bocchino T, Cimino R, Laino A, Steenks MH. Effects of orthognathic surgery for class III malocclusion on signs and symptoms of temporomandibular disorders and on pressure pain thresholds of the jaw muscles. Int J Oral Maxillofac Surg 2007;36:583–7.

[11] Lindenmeyer A, Sutcliffe P, Eghtessad M, Goulden R, Speculand B, Harris M. Oral and maxillofacial surgery and chronic painful temporomandibular disorders-a systematic review. J Oral Maxillofac Surg 2010;68:2755–64.

[12] Aghabeigi B, Hiranaka D, Keith DA, Kelly JP, Crean SJ. Effect of orthognathic surgery on the temporomandibular joint in patients with anterior open bite. Int J Adult Orthodon Orthognath Surg 2001;16:153–60.

[13] Clark GT. Etiologic theory and the prevention of temporomandibular disorders. Adv Dent Res 1991;5:60–6.

[14] Kafas P, Leeson R. Assessment of pain in temporomandibular disorders: the bio-psychosocial complexity. Int J Oral Maxillofac Surg 2006;35:145–9.

[15] Sherman JJ, LeResche L, Huggins KH, Mancl LA, Sage JC, Dworkin SF. The relationship of somatization and depression to experimental pain response in women with temporomandibular disorders. Psychosom Med 2004;66:852–60.

[16] Dworkin SF, LeResche L. Research diagnostic criteria for temporomandibulardisorders: review, criteria, examinations and specifications, critique. J Craniomandib Disord 1992;6:301–55.

[17] Dworkin SF, Sherman JJ, Mancl L, Ohrbach R, LeResche L, Truelove E. Reliability, validity, and clinical utility of the research diagnostic criteria for temporomandibular disorders axis II scales: depression, non-specific physical symptoms and graded chronic pain. J Orofac Pain 2002;16:207–20.

[18] Von Korff M, LeResche L, Dworkin SF. First onset of common pain symptoms: a prospective study of depression as a risk factor. Pain 1993;55:251–8.

[19] Dworkin SF, LeResche L, DeRouen T, Von Korff M. Assessing clinical signs of temporomandibular disorders: reliability of clinical examiners. J Prosthet Dent 1990;63:574–9.

[20] Balke Z, Rammelsberg P, Leckel M, Schmitter M. Prevalence of temporomandibular disorders: samples taken from attendees of medical health-care centers in the Islamic Republic of Iran. J Orofac Pain 2010;24:361–6.

[21] Rantala MA, Ahlberg J, Suvinen TI, Savolainen A, Könönen M. Chronic myofascial pain, disk displacement with reduction and psychosocial factors in Finnish nonpatients. Acta Odontol Scand 2004;62:293–7.

[22] Song HC, Throckmorton GS, Ellis E 3rd, Sinn DP. Functional and morphologic alterations after anterior or inferior repositioning of the maxilla. J Oral Maxillofac Surg 1997;55: 41–9.
[23] Storum KA, Bell WH. Hypomobility after maxillary and mandibular osteotomies. Oral Surg Oral Med Oral Pathol 1984;57:7–12.
[24] Dworkin SF, Huggins KH, LeResche L, Von Korff M, Howard J, Trelove E, et al. Epidemiology of signs and symptoms in temporomandibular disorders: clinical signs in cases and controls. J Am Dent Assoc 1990;120:273–81.
[25] de Bont LG, Dijkgraaf LC, Stegenga B. Epidemiology and natural progression of articular temporomandibular disorders. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1997;83: 72–6.
[26] Dao TT, LeResche L. Gender differences in pain. J Orofac Pain 2000;14:169–84.
[27] Marklund S, Wänman A. Risk factors associated with incidence and persistence of signs and symptoms of temporomandibular disorders. Acta Odontol Scand 2010;68: 289–99.
[28] Abrahamsson C, Ekberg E, Henrikson T, Nilner M, Sunzel B, Bondemark L. TMD in consecutive patients referred for orthognathic surgery. Angle Orthod 2009;79:621–7.
[29] Huang GJ, Le Resche L, Critchlow CW, Martin MD, Drangsholt MT. Risk factors for diagnostic subgroups of painful temporomandibular disorders (TMD). J Dent Res 2002;81:284–8.
[30] Kasch H, Stengaard-Pedersen K, Arendt-Nielsen L, Staehelin Jensen T. Pain thresholds and tenderness in neck and head following acute whiplash injury: a prospective study. Cephalalgia 2001;21:189–97.
[31] Cimino R, Farella M, Michelotti A, Pugliese R, Martina R. Does the ovarian cycle influence the pressure-pain threshold of the masticatory muscles in symptom-free women? J Orofac Pain 2000;14:105–11.
[32] Sarlani E, Garrett PH, Grace EG, Greenspan JD. Temporal summation of pain characterizes women but not men with temporomandibular disorders. J Orofac Pain 2007;21: 309–17.
[33] Cunningham SJ, Hunt NP, Feinmann C. Perceptions of outcome following orthognathic surgery. Br J Oral Maxillofac Surg 1996;34:210–13.
[34] Barsky A. Amplification, somatization and somatoform disorders. Psychosomatics 1992;33:28–34.
[35] Ladwig KH, Marten-Mittag B, Erazo N, Gündel H. Identifying somatization disorder in a population-based health examination survey. Psychosomatics 2001;42:511–18.