Effect of orthognathic surgery on the temporomandibular joint in patients with anterior open bite

This study examined the prevalence of temporomandibular joint (TMJ) signs and symptoms in patients with anterior open bite. The influence of orthognathic surgery on the TMJ in these patients and the interaction of occlusal and psychologic variables on the presence and/or persistence of pain was studied. A retrospective survey of 83 patients with an anterior open bite who underwent orthognathic surgery was carried out. Records were examined for the prevalence of abnormal TMJ signs and symptoms, including pain. A survey was mailed to these patients that consisted of: (1) the TMJ Scale, (2) the Symptom Checklist 90 (SCL90), (3) the Spielberger State-Trait Anxiety Inventory (STAI), and (4) a visual analog scale on which patients indicated their degree of satisfaction with the procedure. Thirty-seven (42%) patients responded to the survey, and 13 (15%) also attended a clinical and radiographic examination. Multiple regression analysis was used for statistical analysis of the factors contributing to the presence and/or persistence of pain. In the preoperative group, the prevalence of pain was 32%, dysfunction 40%, and limitation of opening 7%. Age and gender were significantly associated with the presence of pain. The overall prevalence of abnormal TMJ signs and symptoms was not significantly different after orthognathic surgery. An abnormal psychologic profile was the most significant factor associated with the presence and/or persistence of pain. It is concluded that the prevalence of temporomandibular disorders in anterior open bite patients increases with age, is significantly higher in females, and is not influenced by other occlusal variables. Furthermore, orthognathic surgery does not significantly influence temporomandibular disorders in patients with anterior open bite. Female patients, particularly those with an abnormal psychologic profile, are at a higher risk of persistent postoperative TMJ pain. (Int J Adult Orthod Orthognath Surg 2001;16: 153–160)

It is generally agreed that the etiology of temporomandibular disorders (TMD) is multifactorial. Various emotional and mechanical factors have been implicated. There has been debate as to whether peripheral factors, such as occlusal disharmony, are of primary importance or whether central factors, such as psychologic variables, play the key role. Depending on the different concepts of etiology, different treatment regimens have been advocated. The dental profession historically has favored the peripheral factors and therefore embraced treatment modalities directed toward correction of occlusal discrepancies. Some authors1,2 even advocated orthognathic surgery for cases of TMD in combination with dysgnathia. However, it is unclear whether any association exists between the maxillomandibular relationship and TMD.3,4 Certain types of malocclusion have been reported as more likely to be associated with TMD5,6 and therefore such patients are more likely to benefit from treatment strategies addressing the occlusal disharmony. However, to
date there is no randomized controlled prospective study demonstrating the efficacy of occlusal therapy in the management of TMD. Part of the difficulty in epidemiologic studies and clinical trials in relation to patients with TMD is the heterogeneous nature of the patients with regard to etiologic factors, such as occlusal or psychometric variables.

Pullinger and Seligman compared the role of occlusal variables between a large group of TMD patients and control subjects. They found that, except for anterior open bite (AOB), overbite and overjet characteristics did not distinguish the TMD patient group. Anterior open bite was rare among control subjects, and the authors reported the complete absence of AOB in the asymptomatic non-patients, as did several other authors. However, the low incidence of AOB in the general population could lead to sampling errors in such studies; this precipitates a need to study the prevalence of TMD in AOB patients.

Furthermore, the influence of orthognathic surgery on the temporomandibular joint (TMJ) has attracted a considerable amount of interest. Symptoms of TMJ disorders before and after orthognathic surgery have been documented in several clinical studies, but the reported incidence varies widely. There are reports of various degrees of improvement or deterioration, or no change at all, in TMJ symptoms after orthognathic surgery. It has been suggested that orthognathic surgery may stimulate the progress of joint disease by microbleeding in the upper joint space, increased loading, disc displacement, and immobilization. Differences in the type of malocclusion, method and duration of postoperative fixation, type of osteotomy (eg, Le Fort I versus bimaxillary osteotomy), and choice of mandibular setback procedure (eg, subcondylar versus sagittal split ramus procedure) are among the factors that have been cited to account for the differences in TMJ symptoms after orthognathic surgery.

It has been suggested that the condyles of patients with anterior open bite may be very sensitive to functional loading, and their adaptive capacity is probably lower than in patients with deep bites. However, an analysis of the data published in relation to mixed patient groups reveals that in relation to correction of AOB, the published literature is contradictory. There are reports of significant improvement in TMD as well as reports of development of a significant number of new TMD cases after orthognathic surgery. Therefore, this study was carried out to assess the influence of orthognathic surgery on the TMJ in a relatively large number of patients with AOB.

Materials and methods

The clinical records of 83 patients with an AOB who underwent orthognathic surgery during a 6-year period were examined; all patients had at least a 1-year postoperative follow-up period. The majority of cases were treated with a Le Fort I maxillary impaction, either alone (46%) or in combination with a mandibular procedure such as bilateral intraoral oblique (37%) or bilateral sagittal split osteotomy (14%). Only a very small number underwent segmental procedures (2%). In bimaxillary procedures, maxillomandibular fixation was used for a period of 4 to 6 weeks. Permission was granted by the Massachusetts General Hospital Human Studies Committee to review patient records, administer a mailed questionnaire, and recall patients for a review examination.

Case review

Information from the records of 83 patients with anterior open bite was recorded prior to the commencement of presurgical orthodontics. The data were collected on a standard form, which included the following: age, gender, skeletal abnormality, amount of overjet, SNA angle, SNB angle, ANB angle, mandibular plane angle, preoperative TMJ symptoms, range of mandibular movement, and radiographic abnormalities. Anterior open bite was defined by the authors as no vertical overlap of central incisors as measured parallel to the mandibular occlusal plane. Cephalometric tracings were performed by one operator to improve the reproducibility and reduce the variability of the results. Clinical examination was carried out by residents in the Department of Oral
Maxillofacial Surgery under the supervision of senior staff. This consisted of assessment of range of mandibular motion, impaired TMJ function (eg, noises, deviation), and the presence of TMJ and masticatory muscle pain. The mouth opening was measured as the distance between the edges of the mandibular and maxillary incisors recorded at maximum mandibular depression. Vertical open bite was taken into account in measuring mouth opening.

Patient survey and clinical examination

A survey was mailed to all study patients along with a cover letter describing the study and enclosing a stamped return envelope. The questionnaires included: (1) the TMJ scale,19 (2) the Symptom Checklist 90 (SCL90),20 (3) the Spielberger State-Trait Anxiety Inventory (STAI),21 and (4) a visual analog scale allowing patients to record their degree of satisfaction with the procedure.22 When a response was not received after 2 months, a single follow-up letter and a duplicate questionnaire were sent as a reminder. Attempt was made to obtain a corrected address for those patients whose surveys were returned unopened by the postal service. When a current address was not available, the patient was considered lost to follow-up. When a patient did not respond to the initial letter or the follow-up letter, it was concluded that the patient chose not to participate in the study.

Patients were recalled for a clinical examination, which consisted of assessment of range of mandibular motion, TMJ function (eg, noises, deviation), and the presence of TMJ and masticatory muscle pain. A radiographic examination included orthopantomographic views taken in open- and closed-mouth positions.

Statistical analysis

A stepwise multiple regression analysis was used to study the combined influence of various parameters on the presence and/or persistence of pain. Student’s t test and chi-square tests were used for comparison of parametric and non-parametric data, respectively. All P values less than .05 were considered statistically significant.

Results

Case review

The mean age of the patients was 28.5 ± 8.4 (years ± standard deviation; range, 15 to 60 years). The male:female ratio was almost 1:2. The range of anterior open bite varied from 1 to 10 mm (mean, 3.1 ± 2.3 mm). Mean overjet was 1.69 ± 4.1 mm (range, –9 to +10 mm). The majority of open bites were developmental in origin. Four cases were secondary to idiopathic condylar resorption, 1 case was secondary to rheumatoid arthritis, and 1 was the result of an inadequately treated Le Fort II fracture. With respect to TMD symptoms, 32% of patients had a history of pain, 40% had dysfunction, and 7% had a history of limited opening. Sixteen patients (19%) showed radiographic evidence of TMJ abnormality. In addition to 5 cases of condylysis, there were 6 cases of osteoarthritic changes and 5 cases of marked flattening of the anterior condylar surface. However, stepwise multiple-regression analysis revealed that the only statistically significant factors that were correlated to the presence of preoperative TMJ pain were age and gender (Table 1); of these, age was positively correlated to pain, ie, with increasing age the patients were more likely to experience pain. When the results were controlled for the influence of age, female subjects were more likely to experience pain.

Patient survey

Thirty-seven (42%) of the original 83 patients returned the questionnaires, and 13 (15%) also attended a clinical and radiographic examination. Compared to the original sample, proportionally more women than men returned the questionnaires (M:F = 8:29). However, the age, range of AOB, and overjet, as well as the type of malocclusion, were similar to that of the original group. Table 2 compares the prevalence of abnormal preoperative and postoperative TMJ signs and symptoms. Seventeen patients (45%) had preoperative TMJ pain. The pain was unchanged in 11 patients, and 3 patients experienced TMJ pain for the first time following
surgery. Dysfunction of the TMJ in the majority of patients with preoperative TMJ clicking persisted; in addition, there were 4 new cases of joint dysfunction, which resulted in a higher overall rate of postoperative dysfunction compared to the preoperative period. With respect to limitation of mouth opening, only a small proportion of subjects had a positive history, the majority of whom improved postoperatively. However, 4 patients complained of newly limited opening after orthognathic surgery.

A stepwise multiple regression analysis was used to study the combined influence of the following factors on the presence of postoperative TMJ pain: operator; procedure; period of fixation; degree of maxillary impaction; length of follow-up; SNA angle; SNB angle; amount of overbite; overjet; mandibular plane angle; radiographic abnormality; scores derived from the SCL90, TMJ Scale, and STAI; and the response marked on the visual analog scale regarding degree of satisfaction with the procedure. It was found that only abnormal psychologic profile, evidence of radiographic abnormality, and gender were significantly associated with presence of postoperative TMJ pain (Table 3).

Figure 1 compares the SCL90 global scale scores, which is a single numeric scale of psychologic stress, between the symptomatic and asymptomatic groups. Furthermore, according to SCL90 criteria, half of the symptomatic cases could be classified as positive psychiatric cases, ie, those who would benefit from some form of psychotherapeutic intervention. The symptomatic group also had a higher level of trait anxiety than the asymptomatic group (41 ± 7 versus 35 ± 6.9, respectively); the difference was statistically significant (P < .05). In the analysis of case review data, the presence of radiographic abnormality was not significantly related to pain. However, in the patient survey, the presence of preoperative radiographic abnormality was significantly related to the presence of postoperative TMJ pain. Among the 13 patients who attended the recall assessment, 2 showed remodeling changes of the anterior condylar surface. Both were asymptomatic.

A multiple regression analysis was also used to assess the influence of various factors on the persistence of pain after orthognathic surgery (Table 4). The only significant factors related to persistence of pain were an abnormal psychologic profile and gender. Among the different dimensions of the SCL90, it was found that somatization score was significantly higher in the patients who did not show improvement in their symptoms. When controlled for the influence of psychologic variables, women were more likely to have persistent TMJ pain after orthognathic surgery.
Discussion

Prevalence of TMD in patients with anterior open bite

The contribution of malocclusion to TMD has been debated in the literature. One explanation for the lack of agreement between various authors could be the heterogeneity of the population samples studied. Pullinger and Seligman compared the role of occlusal variables between a large group of TMD patients and control subjects. They found that except for AOB, overbite and overjet characteristics did not distinguish the TMD patient group from the controls. The strength of our study lies in the fact that the patient sample was homogenous in its type of malocclusion, ie, AOB, which is allegedly more likely to be associated with TMD. Several authors have reported the rarity or even absence of AOB in a normal population without TMD problems. The low incidence of AOB could lead to sampling errors in such studies. In our survey, almost two thirds of subjects with AOB had no history of TMD. The results of epidemiologic studies on the prevalence of TMD in the general population show a wide range. This may be due partly to the absence of a standard method of data collection. However, the calculated prevalence of TMD in the current sample of AOB patients is not different from that estimated in the general population.

Kerstens et al have suggested that AOB patients with a low mandibular plane angle are at a higher risk of TMD, whereas DeClercq et al reported the opposite. We could not find support for any relationship between mandibular plane angle or any other occlusal variable and the presence of TMD. However, the statistical analysis showed a significant influence of age and gender on TMD. Our finding of a positive relationship between age and TMD is in agreement with previous reports of a positive association between AOB and TMD in adult subjects but not in children aged 10 to 18 years. It may be hypothesized that untreated patients with AOB are more likely to develop TMD than treated subjects. However, a prospective study of untreated patients with AOB would prove difficult, since most of these subjects request some form of treatment for either esthetic or functional reasons.

<table>
<thead>
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<th>Table 3</th>
<th>Multiple regression analysis of factors influencing postoperative pain</th>
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<td>Independent variable</td>
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<td>SCL90</td>
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<td>Radiographic abnormality</td>
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<td>Gender</td>
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Dependent variable: Postoperative pain (R = 0.79).

<table>
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<tr>
<th>Table 4</th>
<th>Multiple regression analysis of factors influencing persistence of TMJ pain</th>
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<tr>
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Dependent variable: Persistence of TMJ symptoms (R = 0.77).
When we adjusted for the influence of age, we found that women were more likely to experience TMD. There is controversy in the literature as to whether women are more susceptible to TMD or whether more women seek treatment more frequently than men.27

An association between AOB and osteoarthritic changes of the condyle has been reported.5,28 It has been suggested that any subject with an AOB be evaluated for latent or progressive intracapsular disease, even in the absence of TMD symptoms.8 Solberg et al29 have demonstrated that remodeling changes are common in the TMJ. Remodeling represents a biologic response to altered or increased articular loading. However, remodeling gradually merges into degenerative arthritis, and because all adaptive mechanisms of remodeling are active in the osteoarthritic joint, it is difficult to distinguish between a normally aging joint and one that has become pathologically involved.

Anterior open bite was secondary to idiopathic condylar resorption in 1 male and 3 female subjects. It seems that this phenomenon as an initiating cause of AOB may be more common in women. However, it may not be restricted to women, as has been hypothesized by Arnett and Tamborello,30 who labeled it “female idiopathic condylysis.”

Effect of orthognathic surgery

Thirty-seven of the 83 patients (42%) returned the questionnaires. It is possible that these patients may not be representative of the whole sample, as patients with symptoms may have been more motivated to respond. The incidence of preoperative pain among the responders was 46% (17/37), versus 32% of the entire original patient sample. Pain was not related to the degree of satisfaction with the procedure. Compared to the 83 examined records, there were more female respondents than male respondents. However, the respondents were similar to the original group with respect to age and occlusal characteristics.

The results of various studies of TMD in patients with AOB are contradictory. One reason for this lack of agreement could be the heterogeneity of the studied samples. Our finding of a lack of any significant difference between the preoperative and postoperative prevalence of TMD is in agreement with findings of Kerstens et al31 and de Mol van Oterloo et al.32 However, in contrast to Kerstens et al31 and White and Dolwick,6 we did not find any significant influence of mechanical factors, such as mandibular plane angle or the type of malocclusion, on the development of postoperative pain.

The most significant difference between the symptomatic and asymptomatic group was the abnormal psychologic profile, as shown by the results of the SCL90. To our knowledge, this is the first demonstration of significance of psychologic factors in a single type of malocclusion. This suggests that malocclusion alone does not cause TMD. Furthermore, the assumption that correction of malocclusion will cure TMD is misleading. In fact, we found that persistence of TMD after orthognathic surgery was significantly related to the SCL somatization scores. This dimension of SCL measures the psychologic distress induced by perception of unpleasant bodily symptoms in the absence of an organic finding. Neal and Kiyak33 have also reported that patients with high neuroticism scores had higher levels of TMJ symptoms before as well as 2 years after surgery.

In our survey, a proportionately greater number of women returned the questionnaires. However, multiple regression analysis revealed the greater vulnerability of females to postoperative TMJ pain. The underlying pathophysiologic mechanism that may account for this vulnerability is not understood. Female hormones have been mentioned as playing a role, but the question is as yet undecided, because the presence of both estrogen and/or progesterone receptors within the articular disc has been both confirmed34 and denied.35 Women do show higher intra-articular pressure than men, which may result in more ischemia, disc friction, or prolongation of chronic inflammatory synovitis.36

Preoperative radiographic TMJ abnormalities were present in almost 50% of subjects who had postoperative TMJ pain. This observation, in combination with our
findings of the absence of a significant relationship between radiographic changes and preoperative TMJ pain, implies that orthognathic surgery may make a latent asymptomatic joint disease apparent. Hoppenreijis et al, in a review of 259 patients with AOB associated with mandibular hypoplasia, also noted that patients with preexisting signs of osteoarthrosis were at a high risk of postoperative condylar resorption. It has been suggested that increased loading, disc displacement, and immobilization may contribute to the progression of the disease. Unfortunately, because of the relatively small number of those who attended the clinical and radiographic recall examination, we were unable to comment on postoperative condylar changes. Future prospective studies that stratify patients regarding etiology of AOB and specific treatment modalities (isolated Le Fort I versus combined maxillary and mandibular surgery) are needed to clarify the relationship between AOB, TMD, and the effects of orthognathic surgery on the TMJ.

In summary, the prevalence of TMD in AOB patients increases with age, is significantly higher in women, and is not influenced by other occlusal variables. Furthermore, orthognathic surgery does not significantly influence TMD in these patients. Psychologic factors, particularly somatization disorders, are the key variables affecting the presence and/or persistence of postoperative TMD. Identification of at-risk groups, such as those with other psychosomatic diseases, and detection of radiographic evidence of a latent joint disease could help clinicians in informing the patient of the potential risks and benefits of orthognathic surgery in relation to TMJ symptoms.

References


