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Temporomandibular dysfunction in patients treated with orthodontics in combination with orthognathic surgery

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SUMMARY Fifty-two patients with malocclusions underwent orthodontic treatment in combination with orthognathic surgery involving a Le Fort I and/or sagittal split osteotomy. Approximately 5 years after surgery, the patients were examined for signs and symptoms of temporomandibular disorders (TMD). The frequencies were found to be low in comparison with epidemiological studies in this field. The aesthetic outcome and chewing ability were improved in most patients (about 80 per cent). Some of the patients had reported recurrent and daily headaches before treatment. At examination, only two patients had reported having a headache once or twice a week, while all the others suffered from headaches less often or had no headache at all. Eighty-three per cent of the patients reported that they would be prepared to undergo the orthodontic/surgical treatment again with their present knowledge of the procedure.

This study shows that orthodontic/surgical treatment of malocclusions not only has a beneficial effect on the aesthetic appearence and chewing ability, but also results in an improvement in signs and symptoms of TMD, including headaches.

Introduction

Clinical signs and subjective symptoms of temporomandibular disorders (TMD) are common findings in humans, as has been shown in several epidemiological studies (Helkimo, 1979; Nydell *et al*., 1994; Carlsson and Le Resche, 1995). There is, however, a wide range of opinion concerning the aetiology of TMD. Today, the most accepted concept is that it is multifactorial, including both central and local factors (for review see De Boever and Carlsson, 1994). Thus, dysfunction of the masticatory system has been reported to be more frequent in subjects with dentofacial anomalies than in those without. In mostly young patients, orthodontic treatment may decrease the presence of mandibular dysfunction (Egermark and Thilander, 1992; Luther, 1998a,b), while in older patients relatively simple treatment methods, such as occlusal splints, occlusal adjustment, and therapeutic jaw exercises, have a beneficial effect on both signs and symptoms of TMD (Magnusson *et al*., 1991). Longitudinal studies though have shown that not all patients can be completely cured. Some authors have also investigated the effect of the orthognathic surgery on the function of the masticatory system, which is a common reason for requesting surgical correction (Wisth, 1984; Magnusson *et al*., 1986, 1990; Egermark-Eriksson *et al*., 1988; Igarashi *et al*., 1995; Athanasiou and Elefteriadis, 1996). A further reason for surgical correction of dentofacial anomalies is to improve the aesthetic appearance.

Investigations dealing with temporomandibular function and dysfunction after orthodontic and surgical correction of dentofacial anomalies are rare (Wisth, 1984; Magnusson *et al*., 1986, 1990; Egermark-Eriksson *et al*., 1988; Weyland-Mayer *et al*., 1991). The aim of the present study was therefore to investigate the prevalence of signs and symptoms of TMD some years after orthodontic and surgical treatment, as well as the patients' opinion concerning treatment.

Subjects and methods

All patients (53) who had undergone surgical correction at the Department of Oral and Maxillofacial Surgery, Halmstad, Sweden, in combination with orthodontic treatment performed by two orthodontists in Kungsbacka and Varberg, Sweden, during a period of 8 years (from 1988 to 1995), were included in the study. One of the subjects had moved from the area, but 52 patients (34 women and 18 men) were examined clinically and answered a questionnaire (2.2–9.5 years, mean 5 years) after the surgery. The patients had had different malocclusions and all of them received orthodontic treatment with fixed appliances, with or without extraction of premolars. After this phase of treatment, which lasted approximately 1 year, the patients underwent surgical correction. The ages at the time of the operation were 15–65 years (mean 27 years). The surgical methods were either a sagittal split and/or Le Fort I osteotomy, and the orthodontic appliances were used as fixation. After surgery, the orthodontic treatment continued in most cases for approximately 6 months, followed by a period of orthodontic retention.

On average, 5 years after the operation most of the patients were out of retention. They were asked to answer a questionnaire about awareness of oral parafunctions and subjective symptoms of TMD, such as temporomandibular joint (TMJ) sounds, fatigue of jaws, difficulty in opening the mouth wide, locking or luxation, pain on movement of the mandible, pain in the face and jaws, and questions concerning headache (described by Egermak-Eriksson, 1982), as well as about snoring and tinnitus. The variables 'subjective symptom' of TMD and 'bruxism' are described in Table 1. The patients were also asked for their opinions regarding the orthodontic and surgical treatment they had undergone.

The 52 patients were also invited for a clinical examination of the stomatognathic system. This comprised a registration of occluding pairs of teeth in intercuspal position. Registration was also made of overjet and overbite, as well as of occlusal interferences. This included registration of any lateral deviation, ≥0.5 mm between the retruded contact position (RCP) and intercuspal position (ICP), unilateral contact in RCP, and non-working side interferences (see Egermark-Eriksson, 1982).

The standardized examination of the masticatory system included measurements of the range of movement of the mandible, function of the TMJs, and palpation of the TMJs and masticatory

Table 1 Number of patients with reported subjective symptoms of temporomandibular disorders (TMD) and oral parafunctions in the different operation methods in combination with orthodontic treatment. The third column shows the precentage frequencies of subjective symptoms of TMD and oral parafunctions in all the subjects ($n = 52$).

		Max $n = 20$	Mand $n = 23$	Bimax $n = 9$	Total in % $n = 52$
1. TMJ clicking	Frequent	3	5	–	15
	Occasional	6	9	3	35
2. Tiredness in jaws	Frequent	1	3	–	8
	Occasional	2	2	1	10
3. Difficulties in mouth opening	Frequent	2	3	–	10
	Occasional	4	3	1	15
4. Subjective symptoms (one or more of 1–3)	Frequent	5	10	–	29
	Occasional	9	9	5	44
5. Tooth clenching	Frequent	3	4	–	13
	Occasional	7	9	3	37
6. Tooth grinding	Frequent	–	1	–	2
	Occasional	2	7	–	17
7. Bruxism (one or both of 5–6)	Frequent	2	4	–	12
	Occasional	7	11	2	38

Max = Le Fort I osteotomy; mand = sagittal split osteotomy; bimax = combination of the above.

muscles, as well as examination of the patient for pain on movement of the mandible. From these recordings, a clinical dysfunction index, Di, devised by Helkimo (1974) and with some modifications, was determined. This has been described in detail previously (Egermark-Eriksson, 1982).

Statistical methods

Differences between the variables were tested for statistical significance and correlations were analysed with Spearman's rank correlation (Siegel, 1956).

Results

Questionnaire

The frequencies of subjective symptoms of TMD and orofacial parafunctions are listed in Table 1. For the three operation methods there were no statistically significant differences between the frequencies in the different questions or any sex-differences. No subject had daily headache at follow-up, but two patients reported recurrent headache (once or twice a week; Table 2). When headache was reported, four stated this to be of an extreme character, but most (60 per cent) had a slight headache with a duration of 1 or 2 hours. Eight patients reported daily headache before treatment, but were almost free from headache at follow-up. As can be seen from Table 3, the presence of headache decreased dramatically after surgery. Furthermore, headache was found to be significantly more common in females than in males ($P < 0.05$).

Occasional snoring occurred in 23 per cent of the patients, while 8 per cent reported frequent snoring. Regarding the presence of tinnitus, 15 per cent of the patients answered positively. The frequencies concerning snoring and tinnitus were, however, almost the same before and after surgery.

Concerning the aesthetic outcome and chewing ability following surgery, approximately 80 per cent of the patients stated that they were improved, while approximately 20 per cent reported that these variables before and after treatment were almost the same (Table 3). Only one significant sex difference was found; females were more positive concerning the aesthetic outcome than males ($P < 0.05$). Half of the subjects reported an improvement in the function of the masticatory system, while six experienced an impairment (Table 3).

The patients answered questions regarding the convenience of the different treatments. Eight patients thought that the orthodontic treatment was inconvenient, while 59 per cent were bothered sometimes. The corresponding figures during and after the surgery were 31 and 42 per cent, respectively. An interesting question concerned whether the patients would be willing to undergo orthodontic and surgical treatment having experienced the treatment procedure. The answer was yes in 83 per cent, while 9 per cent of patients answered no and 8 per cent did not know.

Clinical findings

At examination, the mean value of the occluding pairs of maxillary teeth was 11 (range 6–14). The

Table 2 Number of patients reporting headache for different operation procedures in combination with orthodontic treatment. Explanation for max, mand, and bimax see Table 1. The third column shows the percentage frequencies of headache in all the subjects (52).

Headache	Max *n* = 20	Mand *n* = 23	Bimax *n* = 9	Total in % *n* = 52
Daily	–	–	–	–
1–2 times a week	1	1	–	4
1–2 times a month	3	8	2	25
Sometimes	12	13	3	54
Never	4	1	4	17

Table 3 Changes before and after the different operation procedures in combination with orthodontic treatment according to chewing ability, aesthetic outcome, temporomandibular disorders (TMD), and headache. Explanation for max, mand, and bimax see Table 1. The third column shows the percentage frequencies of the changes in all the subjects (n = 52).

		Max n = 20	Mand n = 23	Bimax n = 9	Total in % n = 52
Chewing ability	Improved	19	15	8	81
	Same	1	7	1	17
	Impaired	–	–*	–	–
Aesthetic outcome	Improved	14	18	8	77
	Same	6	4	1	21
	Impaired	–	1	–	2
TMD	Improved	11	10	4	51
	Same	4	10	4	37
	Impaired	4*	2*	–*	12
Headache	Improved	15	13	4	67
	Same	4	9	4	33
	Impaired	–*	–*	–*	–

*Don't know: 1 patient.

overjet was measured to a mean of 2.5 mm (range 1–5 mm) and the overbite 1.9 mm (range 0–5 mm). The maximal mandibular opening capacity was on average 52 mm (range 34–66), and the mean laterotrusion of the mandible was 8.4 mm and for protrusion 8.3 mm (range 3–15 in all horizontal movements).

The prevalences of different clinical signs of TMD were in general low. Nine patients had a lateral deviation of the mandible of more than 2 mm during maximal mouth opening. TMJ sounds, mostly reciprocal clickings, were found in 13 patients, but no subject was recorded as having crepitation or locking. Only three patients had pain on movement. The most common clinical sign of TMD was muscle pain on palpation. Twenty-three per cent of the patients reported pain on palpation at one or two muscle sites, and another 10 per cent were tender in three or more muscle sites. Only one subject was recorded as having severe clinical signs of TMD according to the clinical dysfunction index (Di III), while 13 per cent had moderate clinical dysfunction index (Di II), half of the patients had mild dysfunction (Di I), and 35 per cent no dysfunction (Figure 1). No statistically significant differences were found between men and women, or between the different

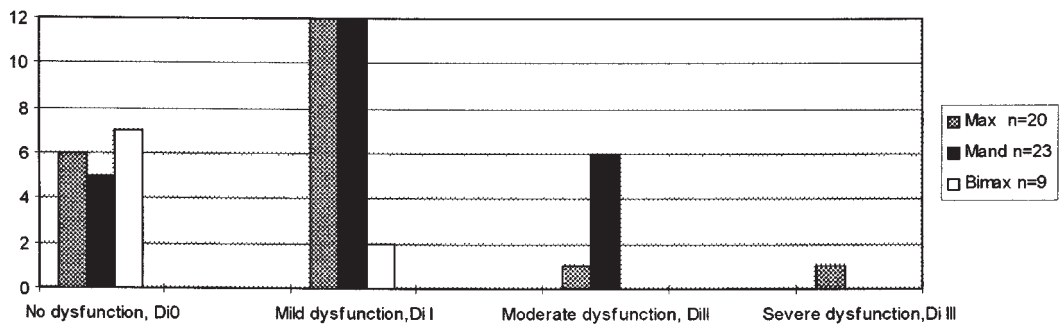

Figure 1 Distribution of the 52 patients according to the clinical dysfunction index (Di) for the different operation methods in combination with orthodontic treatment. For explanation see Table 1.

surgical procedures for the clinical dysfunction index.

The prevalences of the different occlusal interferences recorded are shown in Table 4. No significant differences could be found between the subjects in the different surgery groups.

Correlations

Weak but significant correlations were found between the variables, subjective symptoms of TMD, clinical dysfunction index, bruxism, and headache (Table 5). Furthermore, lateral forced bite was significantly correlated with headache and with unilateral interferences in RCP ($r = 0.29$ and $r = 0.30$, respectively, $P < 0.05$).

Discussion

During the last decades orthodontic/surgical treatment for patients with dentofacial anomalies has evolved, playing an important role in oral and maxillofacial surgery. Most orthognathic procedures involve functional changes and frequently also have a considerable aesthetic impact on the patients. It is usually assumed that these changes are beneficial to the patient, both physically and psychologically.

The findings in this study have several implications for clinicians. It is important to recognize that patients are seeking improvement in their aesthetic appearance in addition to functional improvement. Their expectations for an improved appearance are possibly even greater than those for better functional abilities. It is therefore important to confront these expectations and help the patient to understand a realistic perspective. Before beginning any procedure, it is essential to thoroughly ascertain the emotional desires, hopes, and expectations of the patient (Laskin, 1990). It is also essential for the orthodontic/surgical team to continously work closely with the patients for a long time after surgery to ensure a successful psychological recovery.

Several investigations have shown a close correlation between recurrent headache and TMD (Magnusson, 1981; Forsell, 1985; Schokker

Table 4 Percentage frequency of patients with occlusal interferences for the different operation procedures in combination with orthodontic treatment. Explanation of max, mand, and bimax see Table 1 (n =52).

		Max $n = 20$	Mand $n = 23$	Bimax $n = 9$
Unilateral contact in RCP		60	61	33
Lateral forced bite (lateral deviation RCP-ICP)	= 0.5 mm	–	13	11
Lateral forced bite (lateral deviation RCP-ICP)	≥1 mm	5	13	–
Non-working side interferences up to 3 mm lateral		10	4	–
Non-working side interferences extreme		10	19	–

Table 5 Correlations between reported subjective symptoms and clinical dysfunction index, oral parafunction (bruxism), and headache in 52 patients.

	Subjective symptoms of TMD	Bruxism	Headache
Subjective symptoms of TMD	–	(0.35**)	(0.43**)
Bruxism	0.35**	–	(0.40**)
Headache	0.43**	0.40**	–
Clinical dysfunction index	0.30**	0.28*	0.41**

*$P < 0.05$; **$P < 0.01$.

et al., 1989). It is reasonable to assume that the favourable effect on headache found in this study is a result of the orthodontic/surgical treatment performed. In this investigation, 32 patients (67 per cent) reported a major improvement concerning headache, almost the same figure as that found by Magnusson *et al*. (1990). Some subjects in this investigation reported daily recurrent headaches before treatment, but infrequently after surgery. Only two patients reported headaches once or twice a week, while the other 50 patients had headaches less often or no headache at all. The presence of headache was thus low in these patients in comparison with other studies (Magnusson, 1981; Forsell, 1985).

In the correlation analysis the headache variable was significantly and positively correlated with signs and symptoms of TMD, as well as parafunctional habits (bruxism) and interference (lateral forced bite). The relationship between the above-mentioned factors underlines the opinion that dentists may have an important role in treatment of patients suffering from headache.

It has been stated that dentofacial anomalies can be a risk factor for the development of TMD. In this investigation 51 per cent of the patients reported an improvement of TMD when treated with a combined orthodontic/surgical protocol and a further 37 per cent reported no differences in mandibular dysfunction before or after treatment. The results of the orthognathic surgery and orthodontic treatment performed were thus successful. In this respect, the results support the opinion that surgical correction of dentofacial anomalies has a favourable effect on symptoms of TMD. The presence of clinical signs of TMD was also low in comparison with epidemiological groups (Helkimo, 1974, 1979; Mohlin, 1982; Carlsson and Le Resche, 1995; Luther, 1998a,b).

However, as described in other studies (Ouellette, 1978; Pepersack and Chausse, 1978), most patients continued to experience minor TMJ-problems such as joint noise, pain and limited movement, long after surgery, but this did not affect their overall satisfaction with the results. The six patients in this study who reported impairment, were all offered complementary treatment, such as grinding and splint therapy.

The results of this study show a generally high level of patient satisfaction, in chewing ability, aesthetic outcome, TMD, and headache 5 years post-surgery, in support of earlier investigations (Kiyak *et al*., 1984; Magnusson *et al*., 1986, 1990). The majority of patients (77 per cent) were satisfied with the aesthetic outcome and 81 per cent reported improved oral function.

The group of patients dissatisfied with the results were in the minority. Olsson and Laskin (1980) stated that dissatisfaction with surgery was related to inadequate explanation of the procedures, rather than the actual outcome. It is therefore of critical importance to ensure that patients are adequately prepared for the surgical procedure, the post-operative period, and the outcome. It is quite clear that false expectations can lead to patient resentment.

It is interesting to note that, in spite of extended treatment and post-operative discomfort, most patients reported satisfaction with the outcome of the treatment. It is also valuable to note that the majority indicated that, even with prior knowledge of the treatment, they would repeat the procedure.

Although the literature is increasingly concerned with the psychological aspects of orthognathic surgery, there are limited such investigations of these patients. As stated by Laskin (1990), 'we need to constantly bear in mind that it takes more than technical skills to bring a smile to a pretty face'. With an increased understanding of personality characteristics, orthodontists and maxillofacial surgeons will be better able to understand the psychological impact of treatment. Awareness of these matters, including the psychological well-being of the patients, would enable therapists to better prepare their patient for a successful post-surgical adaptation (Kiyak *et al*., 1981, 1984; Frost and Peterson, 1991).

The long-term overall post-operative attitude encourages further efforts to treat patients with dentofacial anomalies by a combined orthodontic and surgical method, and also enhance their social status and confidence in themselves.

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