

Temporomandibular disorders in adults with repaired cleft lip and palate: a comparison with controls

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SUMMARY The purpose of this study was to investigate the prevalence of temporomandibular disorders (TMD), and assess psycho-social distress in adult subjects with repaired complete cleft lip and palate (CLP). Sixty-three adults (42 males and 21 females, mean age 24.2 years, range 19.5–29.2) with repaired CLP (CLP group) were compared with a group of 66 adults without cleft (non-cleft group, 49 males and 17 females, mean age 25.5 years, range 20.2–29.9). All subjects underwent a clinical TMD examination, which followed the guidelines in the Research Diagnostic Criteria for TMD (RDC/TMD). Jaw function was assessed by evaluating answers to the mandibular function impairment questionnaire (MFIQ).

Tension-type headache was diagnosed according to the International Headache Society (IHS) classification. Psychological status was assessed using the depression score and the non-specific physical symptom score with subscales of the Revised Symptom Checklist-90 (SCL-90-R).

The prevalence of reported pain in the face, jaws and/or TMJs was 14 and 9 per cent for the CLP and non-cleft group, respectively, and did not differ significantly between the groups. The CLP group exhibited a significantly reduced jaw-opening pattern ($P < 0.001$) and a higher frequency of crossbites ($P < 0.05$) compared with the non-cleft group. Whilst jaw function was similar in both groups, a few items, e.g. speech and drinking, were significantly more impaired ($P < 0.01$) in the CLP group than in the non-cleft group. There were no significant differences between the two groups concerning tension-type headache or psycho-social distress.

The study found that overall TMD pain or psycho-social distress was not more common in this CLP group than in a non-cleft group.

Introduction

Epidemiological studies have shown that temporomandibular disorders (TMD) are common in children, adolescents, and adults (Nilner, 1992; Carlsson and LeResche, 1995). TMD is characterized by pain in the temporomandibular region, pain and tenderness in the masticatory muscles and the temporomandibular joint (TMJ) upon palpation, joint sounds, and limitations or disturbances in mandibular movement (Carlsson and LeResche, 1995). Pain in the temporomandibular region has been reported in approximately 10 per cent of the

population (Dworkin *et al.*, 1990b; Le Resche, 1997) and has also been found to be the predominant reason for patients to seek treatment (Dworkin *et al.*, 1990b; List and Dworkin, 1996; Dahlström, 1998).

The aetiology of TMD is considered to be multifactorial, involving several contributing factors (Okeson, 1996). Psycho-social functions such as life stress, depression, and the presence of multiple symptoms have often been found to be risk factors for TMD pain (McCreary *et al.*, 1991; Carlson *et al.*, 1993; Dworkin *et al.*, 1994).

Occlusal factors, such as a large overjet, minimal overbite, anterior skeletal open bite, unilateral posterior crossbite, occlusal slides greater than 2 mm, and lack of posterior teeth, have been suggested to be more prevalent in TMD patients (Pullinger *et al.*, 1993). Orthodontic treatment has been discussed as a contributing, as well as a reducing factor in the development of TMD (McNamara *et al.*, 1995; Henriksson *et al.*, 1997).

The adult cleft lip and palate (CLP) patient has undergone treatment for many years, i.e. plastic surgery, orthodontics, and speech therapy. The treatment goal is to normalize both appearance (nose, lips, and teeth) and function (such as speech, mastication, nasal breathing, and hearing). By 20 years of age, facial growth is complete and patients with a cleft are likely to have completed their surgical and orthodontic treatment. Individuals born with craniofacial anomalies that affect facial appearance are thought to be more vulnerable to psychological difficulties throughout their lives (Pruzinsky, 1992). Adults with CLP are reported to have impaired levels of psychological well-being and more social, marital, and financial difficulties compared with controls (McWilliams and Paradise, 1973; Peter and Chinsky, 1974; Peter *et al.*, 1975; Heller *et al.*, 1981; Ramstad *et al.*, 1995a,b).

The underlying condition for each CLP patient often leads to compromises from the ideal occlusion because of a constricted upper arch and/or aplasia of the teeth on the cleft side. There can also be a relapse after orthodontic treatment, often seen as posterior unilateral or bilateral crossbites, or anterior crossbites (Enemark *et al.*, 1990; Paulin and Thilander, 1991). The adult treated CLP patient could have a potential risk for developing TMD because of being psycho-socially loaded and having residual malocclusion.

There are few studies on TMD among patients with CLP. A high prevalence of TMD has been reported in 6–10-year-old children with CLP (Vanderas and Ranalli, 1989). In a re-evaluation of 21-year-old patients with repaired CLP, only a few individuals with TMD were found (Enemark *et al.*, 1990).

The aim of the present study was to investigate the prevalence of TMD, assess psycho-social distress in adult subjects with repaired CLP, and compare these with an age- and gender-matched control group.

Subjects and methods

Subjects

CLP group. All consecutive patients with the diagnosis of complete unilateral or bilateral CLP without associated malformations, and born between 1968 and 1977 in the counties of Östergötland, Jönköping, and Kalmar, with a catchment area of approximately 975,000 individuals were included in this follow-up study. The subjects had received standardized plastic surgery at the Department of Plastic Surgery, University Hospital, Linköping, Sweden. Logopedic, phonetic, otology, and orthodontic examinations and treatment were supervised or given by the cleft palate team at the University Hospital, Linköping, Sweden.

A total of 80 subjects (53 males and 27 females) in the age range 20–30 years were included in the study. The exclusion criterion was medically diagnosed polyarthritis. Sixty-three subjects (42 male, 21 female; mean age 24.5 years, range 19.5–29.2) participated in the study. Sixteen subjects (11 males and five females; 20 per cent) did not participate. One female was excluded because of the presence of medically diagnosed rheumatoid arthritis.

Non-cleft group. From December 1997 to February 1998, 80 consecutive age- and sex-matched subjects were asked to participate in the study. The non-cleft group were recall patients at the 'Lilla Torget' Public Dental Service clinic with a catchment area in the central and surrounding area of Linköping, a city of 140,000 inhabitants. The patients were scheduled for an annual dental check-up. The exclusion criteria for the non-cleft group were identical with the CLP group. In the non-cleft group, 66 subjects (49 males and 17 females, mean age 25.5 years, range 20.2–29.9) participated in the study. Fourteen subjects (four males and 10 females; 21 per cent) dropped out.

Procedure

A letter was sent to the subjects to explain the purpose of the project and to invite them to participate in the study. Those subjects who agreed to participate were then asked to attend a clinical examination and answer some questionnaires. The participants received no remuneration, but those living outside Linköping city were compensated for travel expenses and both groups received a free routine dental check-up.

All subjects underwent a clinical TMD examination and evaluation of the occlusion and completed the Research Diagnostic Criteria for TMD (RDC/TMD) questionnaire according to the RDC/TMD specifications (Dworkin and LeResche, 1992). Some additional questions were included concerning socio-demographics, jaw function, and orthodontic treatment.

One operator (AM), who underwent a 40-hour calibration training in RDC/TMD clinical examination provided by one author (TL) prior to the start of the study examined all the subjects. Inter-examiner reliability was assessed between the two authors (AM and TL) in 10 TMD patients. The reliability was found to be:

1. Vertical range of motion: unassisted opening of the jaw, 0.88 intraclass correlation coefficient (ICC); maximum unassisted opening, 0.92 (ICC); and maximum assisted opening, 0.90 (ICC).
2. TMJ sounds, 0.68 Kappa (κ).
3. Extra-oral palpation, 0.84 (κ).
4. Intra-oral palpation, 0.49 (κ).
5. Diagnosis muscle disorder, 0.63 (κ).
6. Disc displacements, 0.74 (κ).
7. Arthralgia, arthritis, and arthrosis, 0.81(κ).

The local Ethical Committee approved the study and all subjects signed an informed written consent.

Clinical examination

The RDC/TMD clinical examination (Axis I) involved the clinical assessment of the following TMD signs and symptoms:

Pain site. Present pain was assessed as ipsilateral or contralateral to pain that was provoked by

clinical examination of the masticatory muscles, and by tests of jaw function.

Mandibular range of motion (mm) and associated pain. Jaw-opening patterns, vertical range of motion (extent of unassisted opening without pain, maximum unassisted opening, and maximum assisted opening), and extent of mandibular excursive movements (lateral and protrusive jaw excursions) were assessed.

TMJ sounds. Clicking, grating, and/or crepitus sounds were palpated for assessment during vertical, lateral, and protrusive jaw excursions.

Muscle and joint palpation for tenderness. Assessment of extra- and intra-oral masticatory, and related muscles (20 sites) was performed by means of bilateral palpation for pain and tenderness. The TMJ (four joint sites) was also assessed by means of bilateral palpation. A standardized examination protocol was used to record the pain in 16 extra- and four intra-oral myofacial sites. A summary score of these myofacial pain sites was calculated for each individual; it ranged from 0 to 20 points for myofacial pain and 0 to 4 points for TMJ pain.

Occlusal evaluation

The occlusal evaluation included the following clinical assessments.

Functional occlusal parameters. The slide between the retruded contact position (RCP) and the intercuspal position (ICP) was assessed in the vertical, sagittal, and transversal planes and RCP with chin-point guidance. Non-working side interferences that prevented contact on the working side during lateral movements were recorded during the first 3 mm of laterotrusion. Sole posterior contacts on the working side and posterior contacts that prevented frontal contacts or caused a deviation of the mandible in protrusive movements were also recorded (Vallon, 1997).

Morphological occlusal parameters. Overjet and overbite were measured at the most proclined upper central incisor. Maxillary overjet was recorded if the overjet was 6 mm or more and

an anterior open bite when the overbite was negative. A deep bite was recorded if the overbite was 5 mm or more and lateral open bite in the canine-molar segments if the distance between one or more antagonizing teeth was at least 2 mm. The registrations were made to the nearest 0.5 mm using a sliding calliper.

Anterior and lateral crossbites were described according to the Crossbite Score of Huddart and Bodenham (1972) in which each maxillary tooth received a score depending on its relationship to its opponent in the mandibular arch (no crossbite (CB) = 0; edge-to-edge = -1; CB = -2). All maxillary teeth except the lateral incisors and the second and third molars were included in the analysis. The total CB score (0 to -20), as well as the scores for different segments of the maxillary arch were calculated (lateral 0 to -8, anterior 0 to -4). If a tooth was missing it was given a score corresponding to the mean value of the neighbouring teeth within the segment. Because the subjects with bilateral complete cleft lip and palate (BCLP) had two cleft sides, the CLP subjects were divided into two groups: unilateral complete cleft lip and palate (UCLP) and BCLP. Lateral crossbite was considered when the subjects had a score ≤ -4 and anterior crossbite when the subjects had a score ≤ -3 .

RDC/TMD classification

Since TMD and tension-type headache often co-exist, two complementary classification systems were used in parallel:

1. The RDC/TMD classifies the most common forms of TMD into three mutually exclusive diagnostic categories and allows multiple diagnoses across diagnostic categories to be made for a given patient. The RDC/TMD diagnostic groups are as follows (Dworkin and LeResche, 1992):
 - (i) myofacial pain;
 - (ii) disc displacements;
 - (iii) arthralgia, arthritis, and arthrosis.
2. Tension-type headache was diagnosed during an interview according to the International Headache Society (IHS) criteria (Headache Classification Committee, 1988). The subjects

were assigned the diagnosis episodic tension-type headache (ETH < 15 days/month) or chronic tension-type headache (CTH > 15 days/month). Reports of lifetime tension-type headache, as well as tension-type headache within the last month were determined.

History Questionnaire

The RDC/TMD history questionnaire (Axis II). Pain intensity was assessed with visual analogue scales (range 0–10). Temporal patterns of TMD-related pain and symptoms, pain localization, joint sounds, locking and catching of the TMJ, tiredness and stiffness of the jaw, and para-functional habits, were reported on dichotomous scales.

Psychological status was assessed by the depression score and non-specific physical symptom score with subscales of the Revised Symptom Checklist-90 (SCL-90-R; Derogatis and Melisaratos, 1983). The questionnaire included 32 questions, 12 items of the vegetative symptom scale and 20 items of the depression scale. Each question was answered on a 5-point scale: not at all, a little bit, moderately, quite a bit, and extremely. The mean score ranged from 0 to 4 for both depression and non-specific physical symptoms. Classification of the depression score: normal ≤ 0.535 , moderate 0.535 to < 1.105, severe > 1.105. Classification of the non-specific physical symptom score: normal ≤ 0.500 , moderate 0.500 to < 1.00, severe ≥ 1.00 .

Jaw function was assessed by evaluating the mandibular function impairment questionnaire (MFIQ; Stegenga *et al.*, 1993). The scale consisted of 17 questions: nine dealt with mandibular function (e.g. chewing, yawning, laughing, speech, drinking), two with psycho-social activities, and six with eating and chewing specific food (e.g. meat, carrot, and apple). Each question was graded on a five-point scale: not difficult at all, a little difficult, difficult, very difficult, extremely difficult or impossible without help. Scores between 0 and 68 points were possible.

History of orthodontic treatment. The subjects were asked if they had undergone orthodontic treatment. Treatment with fixed or removable appliances and/or extractions was registered.

Statistical analysis

Two related samples were analysed using the Student's *t*-test for variables measured on a ratio scale and the Mann–Whitney *U*-test for data that did not form a normal distribution or for variables measured on an ordinal scale. When data consisted of frequencies in discrete categories, the chi-square test or Fisher's exact test was used to determine the significance of differences between groups. All statistical tests were two-tailed and at the $P < 0.05$ significance level.

Results

Demographic status

There were no significant differences between the two groups concerning age, gender, residency as a child, having children, siblings, or marital status. The CLP group had a significantly lower educational level, a significantly higher frequency of unemployment, and lived significantly more often in a small city or rural area (Marcusson *et al.*, 2001b).

TMD symptoms

The distribution of the subjective symptoms reported by the subjects is shown in Table 1. The non-cleft group reported statistically significant higher frequencies for clicking ($P < 0.001$) and grinding/clenching ($P < 0.05$) than the CLP group. TMJ locking/catching was reported with a higher frequency for the non-cleft group, but the

difference was not statistically significant. The CLP group reported higher frequencies of pain in the face, jaws, or TMJ, and for crepitus than the non-cleft group, but these differences were not statistically significant.

Mandibular range of motion

Measurement of the vertical range of motion of the mandible, unassisted opening without pain, maximum unassisted opening, and maximum assisted opening, are shown in Table 2. The mean measured range of motion for each registration was significantly smaller ($P < 0.001$) for the CLP than for the non-cleft group.

TMD signs

No significant differences were found between the two groups for clinical signs of myofacial pain scores, TMJ pain scores, or clicking (Table 3).

Jaw function

The median score and range for the mandibular function impairment questionnaire was 0 and 1–13, respectively, for the CLP group, and 0 and 0–9, respectively, for the non-cleft group. There was no significant difference in the total mean scores for jaw function between the groups. Two of the items in the MFIQ were reported to be more frequently impaired in the CLP group speech (63 per cent, $P < 0.001$) and drinking (15 per cent, $P < 0.01$).

Table 1 Frequency of symptoms reported by the patients in the CLP and non-cleft groups.

	CLP group (%) <i>n</i> = 63	Non-cleft group (%) <i>n</i> = 66	<i>P</i>
Pain in the face, jaws, or TMJ	14	9	NS
TMJ locking/catching	6	12	NS
Clicking	17	32	<0.001
Crepitus	14	8	NS
Tiredness/stiffness in the jaw	6	8	NS
Grinding/clenching	16	27	<0.05

NS, not significant.

Table 2 Vertical range of motion (mm) of the mandible (mean + SD) for the CLP and non-cleft groups.

Activity	Range of motion (mm)		
	CLP group <i>n</i> = 63	Non-cleft group <i>n</i> = 66	<i>P</i>
Unassisted opening without pain	49.3 ± 5.8	55.6 ± 5.8	<0.001
Maximum unassisted opening	51.0 ± 6.0	57.2 ± 5.8	<0.001
Maximum assisted opening	52.3 ± 6.2	58.4 ± 5.9	<0.001

Table 3 Distribution of clinical signs in the CLP and non-cleft groups.

	CLP group <i>n</i> = 63	Non-cleft group <i>n</i> = 66	<i>P</i>
Myofacial pain score (mean + SD)	3.2 ± 3.83	1.69 ± 2.30	NS
TMJ pain score (mean + SD)	0.063 ± 0.30	0.15 ± 0.12	NS
Clicking (%)	23	23	NS

NS, not significant.

Table 4 Percentage functional occlusal interferences in the CLP and non-cleft groups.

Functional occlusal interferences	CLP group (%) <i>n</i> = 63	Non-cleft group (%) <i>n</i> = 66	<i>P</i>
Working side interferences	8	8	NS
Non-working side interferences			
≤3 mm lateral excursion	8	11	NS
Protrusion interferences	6	3	NS
Sagittal distance RCP and ICP >1 mm	6	6	NS
Lateral sliding RCP to ICP ≥0.5 mm	10	8	NS

NS, not significant.

Functional occlusion and morphological occlusion

There were few subjects with functional occlusal interferences in either group and there were no significant differences between the groups (Table 4). In the CLP group, four subjects had an anterior open bite (8 per cent) and four (8 per cent) a lateral open bite. Thirty-two per cent of subjects with UCLP had unilateral crossbites and there was a significant difference between the two groups ($P < 0.001$). Both subjects with UCLP and BCLP had a significantly higher percentage

of bilateral crossbites than those in the non-cleft group. There were few subjects in the control group with malocclusion. Four subjects (6 per cent) had a maxillary overjet ≥6 mm and four (6 per cent) a vertical overbite ≥5 mm (Table 5).

TMD classification

The distribution of diagnoses according to the RDC/TMD and IHS criteria is shown in Table 6. The groups were comparable with regard to distribution of the RDC/TMD diagnosis, while the non-cleft group showed a higher prevalence

Table 5 Percentage distribution of occlusal characteristics for the CLP group (divided in to UCLP and BCLP) and the non-cleft group.

	CLP group		Non-cleft group (%) <i>n</i> = 66	UCLP versus control <i>P</i>	BCLP versus control <i>P</i>
	UCLP (%) <i>n</i> = 53	BCLP (%) <i>n</i> = 10			
Anterior open bite	8	0	3	NS	NS
Maxillary overjet ≥ 6 mm	0	10	6	NS	NS
Vertical overbite ≥ 5 mm	2	0	6	NS	NS
Lateral open bite	8	0	2	NS	NS
Unilateral crossbite	32	20	8	<0.001	NS
Bilateral crossbite	11	30	2	<0.05	<0.01
Anterior crossbite	8	20	2	NS	<0.05

NS, not significant.

Table 6 Classification criteria: comparison of frequency of diagnosis in the CLP and non-cleft groups.

RDC/TMD diagnosis	CLP group (%) <i>n</i> = 63	Non-cleft group (%) <i>n</i> = 66	<i>P</i>
Myofacial pain	12	9	NS
Disc displacement	19	15	NS
Arthralgia, arthritis, arthrosis	0	0	NS
IHS diagnosis			
Episodic tension-type headache	38	53	NS
Chronic tension-type headache	2	0	NS

NS, not significant.

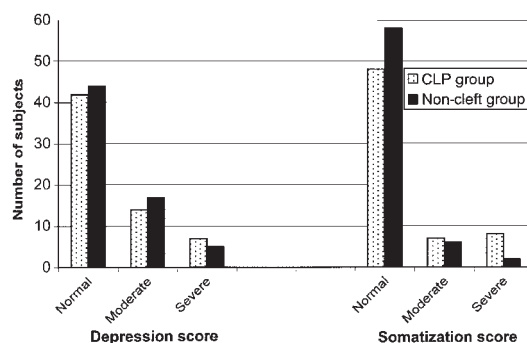
of ETH. No significant difference was found among the groups. No subjects were found to have a disc displacement without reduction.

Psychological status

The RDC/TMD measures of depression and presence of non-specific physical symptoms, i.e. somatization showed no differences between the groups (Figure 1). The means and standard deviation (SD) for depression and somatization were 0.50 ± 0.63 , 0.43 ± 0.51 for the CLP group and 0.43 ± 0.40 , 0.26 ± 0.27 for the non-cleft group, respectively.

History of orthodontic treatment

All subjects except one in the CLP group had received orthodontic treatment with fixed

**Figure 1** Distribution of normal, moderate, and severe scores for depression and somatization scales scores (SCL-90R) in the CLP and non-cleft groups.

appliances. One patient refused orthodontic treatment because of a fear of premolar extractions. In the non-cleft group, eight had received orthodontic treatment with fixed appliances

and 11 with removables four had undergone interceptive extractions, and 43 had no orthodontic treatment.

Discussion

Children born with CLP will undergo substantial surgical and orthodontic treatment. The cleft and the frequent treatment will also have an impact on the patient's psycho-social development. This study investigated the prevalence of TMD in adults with repaired CLP, and in matched non-cleft controls from the clinical and psychological perspectives. The majority of the subjects in the CLP group were males, reflecting a gender distribution similar to that in other CLP populations (Henriksson, 1971). The response rate was acceptable (79 and 83 per cent for the CLP, and non-cleft group, respectively). There were no significant differences in age or gender between the drop-outs and the active participants, which strengthens the representativeness and generalizability of the results of the study.

There were no significant differences between the groups concerning marital status: in the CLP group 43 per cent were married or cohabiting compared with 55 per cent in the control group. This is contrary to other studies (McWilliams and Paradise, 1973; Peter and Chinsky, 1974; Ramstad *et al.*, 1995a) who found that subjects with repaired CLP married later in life.

There were significant differences in some of the background factors between the two groups such as education level, occupation, and current residence. These differences can partly be explained by the fact that 78 per cent of the non-cleft group lived in an urban area compared with 47 per cent of the CLP group.

The RDC/TMD was developed through the collaborative efforts of clinical researchers and TMD specialists at several major university-based clinics in the United States specializing in the diagnosis and treatment of TMD. The major purpose was to develop common methods for reliably examining TMD patients in different settings and for arriving at a diagnostic classification system that was based, to the largest extent possible, on data of known reliability. RDC/TMD is an instrument developed to

measure the prevalence of TMD and psycho-social distress, and it has been used in various studies (Dworkin and LeResche, 1992; List *et al.*, 1999b). It has been shown to have acceptable reliability in adult populations (Zaki *et al.*, 1994) and to be a valid instrument for cross-cultural studies on TMD (List and Dworkin, 1996).

For dentistry, it has been recommended that data regarding the reliability of clinical measurements should be included in all oral health surveys (World Health Organization, 1971). A calibration procedure has been found to substantially improve the reliability of the clinical examination and diagnostic classification of TMD (Dworkin *et al.*, 1990a). In the calibration procedure before the start of the present study, the second author (TL) served as an instructor to the examiner (AM), to ensure that the same principles and methods were adopted. 'Acceptable' to 'very good' inter-reliability values were found between the two authors for the clinical examination and diagnostic classification.

The prevalence of reported pain in the face, jaws, and/or TMJs was 14 and 9 per cent for the CLP and non-cleft group, respectively, and did not differ significantly between the groups. This result is in line with epidemiological studies where the prevalence of pain in the masticatory system was found to be approximately 10 per cent (Dworkin *et al.*, 1990b; Goulet *et al.*, 1995).

In epidemiological studies, an association between tension-type headache and TMD has been reported (Wänman and Agerberg, 1986; List *et al.*, 1999a). No significant difference in tension-type headache was found between the two groups in the present study. The prevalence of tension-type headache of 40 and 53 per cent for the CLP and non-cleft groups, respectively, is similar to that (a prevalence of 48 per cent within the time-frame the last month) reported using the IHS classification in a population-based study (Rasmussen *et al.*, 1991).

A large variability has been reported in epidemiological studies in pain upon palpation of the masticatory muscles and the TMJs. This is most probably due to differences in methods, e.g. palpation site and number of sites measured, pressure and pressure rates applied, and differences in instructions to the patient on when to

report pain. No significant differences between the groups were found in palpation of pain in the present study. The mean values for myofacial and TMJ pain score in the non-cleft group are very similar to those in control groups reported by others who used an identical examination technique (Dworkin *et al.*, 1990b).

TMJ sounds are reported as clicking or crepitus/gratings. Clicking is assumed to be related to a disc displacement and crepitus/grating to degenerative changes in the TMJs. In the present investigation, clicking was more frequently reported than crepitus, which was also found by Carlsson (1984). In a review of 18 epidemiological studies, Carlsson (1984) found that clinical signs of clicking were more common than subjective reports, which is in agreement with the present study. The median values for subjective reports and clinical registrations of clicking were 19 and 26 per cent, respectively in that review, which is similar to the 17 and 23 per cent found for the CLP group in this study. Similar frequencies of clicking have also been reported in studies of orthodontically treated patients (Enemark *et al.*, 1990; Tanne *et al.*, 1993; Henriksson *et al.*, 1999). The non-cleft group in the present investigation reported significantly higher frequencies of clicking compared with the CLP group. However, since there was no difference between the groups in clinically registered clicking, this finding should not be overvalued.

Bruxism has been suggested to reflect hyperactivity in the masticatory muscles and to perpetuate TMD. In epidemiological studies, bruxism has frequently been reported to be more common among TMD patients than controls (Nilner, 1981; List *et al.*, 1999a). However, bruxism is also a common finding in non-TMD populations (List *et al.*, 1999a). In the current investigation, the non-cleft group reported significantly more bruxism than the CLP group. The frequency of bruxism, though, seem to be similar to that reported by others (Henriksson *et al.*, 1999).

Measurement of mandibular function is important since it reflects limitations in daily activities. The scale has shown acceptable reliability in subjects with TMD and CLP

subjects (Stegenga *et al.*, 1993; Marcusson *et al.*, 2001a). Overall, the total score of all the items in the MFIQ did not differ significantly between the groups. In evaluations of single items, however, the CLP group reported a significant increase in impairment of speech and drinking compared with the non-cleft group. These functional limitations in the CLP subjects can be related to having had a palatal cleft and should not be associated with TMD. A majority of the CLP subjects (63 per cent) said their speech was 'slightly' impaired. Other studies have also shown that CLP patients have considerable concerns about their speech (Noar, 1992; Turner *et al.*, 1997).

Mean values for the mouth opening capacity of the CLP group were significantly lower than for the non-cleft group. This is in agreement with Johanson *et al.* (1974), the hypothesis being that the smaller mouth opening capacity in the CLP group might be a sequela of the lip and palatal surgery. Although the CLP group had a reduced vertical range of motion of the mandible, it was not as reduced as in TMD patients (Dworkin *et al.*, 1990b; List *et al.*, 1999b).

A diagnosis of disc displacement was registered in 19 per cent of the CLP subjects and 15 per cent of the non-cleft subjects. Disc displacement with reduction was diagnosed when TMJ clicking occurred on opening and closing the jaw, and was eliminated on protrusive opening. No significant difference was found between the groups. Clicking is reported to be a common symptom in the population, but rarely develops into a more serious disease (Carlsson and LeResche, 1995).

The RDC/TMD classification system groups the most common forms of TMD into three diagnostic categories (myofacial pain, arthralgia, and disc displacement) and allows multiple diagnoses to be made for a given patient. Twelve per cent of the CLP group and 9 per cent of the control group were diagnosed with myofacial pain, which indicates a report of pain localized to the masticatory muscles, as well as pain upon palpation on three or more of the muscle sites. Arthralgia or osteoarthritis of the TMJ was not registered in any of the examined individuals. The diagnosis is based upon pain on palpation of

one or both joint sites, a self-report of pain in the region of the TMJ or pain in the TMJ upon movement of the jaw, and crepitus from the joint in the case of osteoarthritis. Several studies have found that myofacial pain is more common than TMJ pain in TMD clinical populations and controls (Dworkin *et al.*, 1990b; List *et al.*, 1999b). This is in agreement with the present study. The prevalence of self-reported TMD pain was 14 and 9 per cent for the CLP and non-cleft groups, respectively, which was similar to the prevalence of diagnosed myofacial pain (12 and 9 per cent, respectively). This indicates that the results of self-reported and diagnosed TMD pain are approximately similar to the average of 10 per cent TMD pain reported in epidemiological studies (LeResche, 1997). This suggests that TMD pain is not more common in adult CLP subjects than in a normal population.

Depression and non-physical symptoms were measured with the RDC/TMD version of the SCL-90R. The scale has been found to be reliable for CLP subjects (Marcusson *et al.*, 2001a). However, no validity testing or population-based standardized scores for Swedish populations has been reported. Chronic pain and depression, as well as reports of non-specific physical symptoms have been found to be strongly correlated (Dworkin *et al.*, 1994). The presence of multiple non-specific physical symptoms typically associated with somatization (i.e. tremors, heart palpitations, sweating) has been found to correlate with the number of masticatory muscles reported as painful to diagnostic examination and to be associated with higher levels of depression (Dworkin, 1994).

A minority in both groups exhibited a severe depression score (11 and 8 per cent in the CLP and control groups, respectively) and a severe somatization score (13 per cent in the CLP group and 3 per cent in the control group). The normative values used to define these extreme categories are derived from a large USA group (Dworkin and Le Resche, 1992) with classifications of severe symptoms above the 90th percentile in population norms. There was a slight increase in the number of subjects with severe symptoms in the CLP group in the present investigation, concerning depression

and somatization, but no significant differences between the two groups. The results indicate that adults with CLP have a fairly good psycho-social adjustment in spite of their handicap. List and Dworkin (1996) found severe depression scores in 20 per cent and severe somatization scores in 30 per cent of the TMD patients they studied. There were no differences between Swedish and USA patients. The mean values for the depression and the somatization scores in the CLP and non-cleft groups were similar to those found in a control group in another study (List *et al.*, 1999b). The mean values were also comparable to US standardized scores.

Several studies have found that TMD pain is more prevalent in females during the reproductive years of life (Carlsson and LeResche, 1995). Biological factors (e.g. oestrogen levels) have been found to interact with pain (Berkley, 1996), and it has been suggested that reproductive hormones might be involved in the development of TMD pain (LeResche, 1997). These findings could imply that CLP subjects, who are predominately male (ratio 4:1) are at less risk for developing TMD. This is also supported by the fact that the majority of the individuals diagnosed with myofacial pain in this study were female (ratio 2:1).

Ninety eight per cent of the subjects in the CLP and 35 per cent in the non-cleft groups had received some form of orthodontic treatment. The CLP group had significantly higher frequencies of crossbite than the controls, but no differences regarding TMD pain were found between the two groups. Other studies have indicated an association between unilateral maxillary lingual crossbites and TMD (Egermark-Eriksson *et al.*, 1990; McNamara *et al.*, 1995; Henriksson *et al.*, 1997). The results of the present study are supported by Tanne *et al.* (1993), who examined CLP and orthodontic patients (4–29 years) before orthodontic treatment started. They found that the overall prevalence (20 per cent) of TMD was not significantly different in the two groups. Although there were more subjects with persisting malocclusion such as unilateral and bilateral crossbites in the CLP group, there was no increase in the number of subjects with functional occlusal interferences. The persisting morphological

malocclusion with a low frequency of interferences has had no influence on TMD symptoms in the group of CLP studied.

Conclusions

Subjective and clinical signs of TMD were not more common in adults with repaired CLP than in controls in the population studied. The CLP group had a significantly reduced jaw-opening pattern, which might be related to lip/palatal surgery. The non-cleft controls reported significantly higher frequencies of clicking and grinding/clenching than the CLP group. Clinically, there were no differences between the groups regarding myofacial pain, TMJ pain, or frequency of TMJ clicking. There were no significant differences between the two groups concerning tension headache (IHS) or psycho-social distress.

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