Periodontal Status and Oral Hygiene in Two Populations of Cleft Patients

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Objective: **To evaluate and compare the oral hygiene and periodontal status in children with unilateral and bilateral cleft lip and palate treated in Łódź, Poland, and Erlangen, Germany.**

Design: **Oral health was assessed by the presence of dental plaque, pocket depth, clinical attachment levels, and pathologic teeth mobility.**

Subjects and Methods: **Thirty-seven Polish and 63 German patients participated in this study.**

Results: **Poor oral hygiene was found in 57% of all subjects. In Erlangen, 60% of patients had optimal oral hygiene, compared to 19% in Łódź. The highest scores for dental plaque were noted in both groups in the cleft region. Healthy periodontium was significantly more frequent among German patients, whereas gingival bleeding was significantly more frequent among Polish patients. Pocket depths greater than 6 mm occurred only in German subjects. No statistically significant difference was observed between the amount of tooth areas with gingival recessions and the country of origin. Periodontal pockets deeper than 3.5 mm occurred more frequently during active orthodontic treatment.**

Conclusions: **The oral hygiene regimens in Germany and Poland were not comparable, as more plaque was found in the Polish than in the German population. Plaque accumulation seems not to be a key factor in causing periodontal destruction in the cleft area. Factors other than oral hygiene should be considered of major importance in relation to the development of gingival recession on teeth in cleft areas.**

KEY WORDS: *cleft, dental plaque, periodontal health*

The cleft lip, alveolus, and/or palate is the most common congenital malformation of the face (Strobel-Schwarthoff and Hirschfelder, 2002; Lages et al., 2004). Epidemiologic studies have revealed that the prevalence of this anomaly varies with such factors as geographic location, racial background, and socioeconomic status (Shaw, 2004). The estimated mean prevalence in Europe is 0.62 in 1000 (Calzolari et al., 2004). In Poland, the incidence of cleft lip and palate is 1.67 in 1000, and in Germany it is 1.42 to 2 per 1000 live births (Antoszewski and Kruk-Jaromin, 2002; Opitz, 2002). Consultations with cleft patients begin right after birth, and initial treatment begins in the first month after birth. Treatment is performed by a team of various specialists: maxillofacial and/or plastic surgeons, orthodontists, speech therapists, pediatricians, pediatric dentists, and others (Andrä and Neumann, 1998; Dudkiewicz, 1999; Kruk-Jaromin, 2000; Małkiewicz, 2002; Strobel-Schwarthoff and Hirschfelder, 2002/2003; Hirschfelder and Iserhardt, 2003/2004).

Children and adults with cleft lip and palate are at increased risk for the development of gingival and periodontal diseases, which are associated with both anatomic defects and long-term orthodontic treatment (Quirynen et al., 2003; Lages et al., 2004). Anatomic defects, delays in the formation and eruption of teeth, problems with orthodontic movement, and the presence of prosthetic restorations all contribute to reductions in bone levels in the areas adjacent to cleft regions. Dental and arch segment irregularities, orthodontic appliances, and persisting soft tissue folds before palatoplasty as well as the presence of scar tissue after cleft closure make oral hygiene control difficult. All of these factors enhance the progression of periodontal disease (Teja et al., 1992; Wong and King, 1998; Costa et al., 2003; Quirynen et al., 2003; Lages et al., 2004).

The purpose of this research was to assess the oral hygiene status and periodontal health of children and teenagers with unilateral or bilateral cleft lip, alveolar bone, and/or palate who were treated at the Medical University in Łódź, Poland, and the University of Erlangen-Nuremberg, Germany.

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Materials and Methods

Subjects

One hundred individuals age 3.5 to 18 years participated voluntarily in this study. Thirty-seven patients (mean age = 13.7 years) were treated in the Department of Dentistry of Developmental Age at the Medical University of Łódź, Łódź, Poland, between February and April 2004. Sixty-three subjects (mean age = 13.6 years) were patients in the Cleft Palate Centre of the University of Erlangen-Nuremberg, Erlangen, Germany, between October 2004 and February 2005.

Unilateral cleft lip and palate was the most common anomaly in both groups (32 subjects in Łódź and 47 in Erlangen). There was a greater proportion of incomplete unilateral cleft lip and palate (UCLP) in Polish patients (25 subjects), whereas in Erlangen, complete UCLP dominated (44 subjects). The majority of subjects in both populations (18 in Łódź and 33 in Erlangen) were in a phase of active orthodontic treatment. Boys outnumbered girls in both groups. All patients were nonsyndromic.

In this study, the ethical principles outlined in the Helsinki Declaration for Medical Research Involving Human Subjects were maintained (http://www.wma.net/e/policy/b3.htm).

Timing and Techniques of Therapy

In all subjects in Łódź, the surgical procedures were conducted in the Department of Plastic Surgery at the Medical University of Łódź, Łódź, Poland. The patients in Erlangen underwent surgery in the Department of Oral and Cranio-Maxillofacial Surgery at the University of Erlangen-Nuremberg, Erlangen, Germany. In both clinics the general concept of treatment was similar. Although the preferred operative techniques were comparable, there were differences in the timing of the cleft lip repair as well as closure of the alveolus and palate (see Table 1). The first operation was carried out in Łódź at a minimum of 6 months after birth, and in Erlangen this was done when the patient was between the ages of 3 and 6 months. In both clinics, the preferred operation for UCLP patients was the Tennison technique. In BCLP patients in Erlangen, the Veau technique was preferred. Closure of the hard and soft palate took place in Łódź at a later age (18–24 months of age) than in Erlangen (12–14 months of age). The Bardach technique (modification of the Wardill-Kilner-Peeta technique) was used in Łódź, while the Veau technique was used in Erlangen. Bone grafting was completed at about the age of 8 to 12 years in both clinics.

In Erlangen and Łódź, regular visits to check the status of teeth, occlusion, oral hygiene, hearing, and speech and to assess the need for speech therapy, plastic surgery, and other treatments were initiated immediately after hard and soft palate closure. After growth was completed, multidisciplinary orthodontic and surgical treatment of maxillary hypoplasia was performed, followed by esthetic and plastic correction of the lips, nose, postoperative scars, and, if necessary, a third osteoplasty (before possible implants) and/or prosthetic treatment (Kruk-Jaromin et al., 2000; Strobel-Schwarthoff and Hirschfelder, 2002, 2002/2003; Hirschfelder and Iserhardt, 2003/2004).

TABLE 1 Comparison of General Concept of Surgical Procedures and Operative Techniques for Cleft Patients in Łódź and Erlangen

	Suggested Surgical Procedures and Operative Techniques	
Time After Birth	*Erlangen*	*Łódź*
3–6 mo	Plasty of cleft lip and soft tissues in area of alveolar process Techniques: BCLP: Veau; UCLP: Tennison	Control visits, consultations
6 mo	Control visits, consultations	Plasty of cleft lip and soft tissue in area of nose, oral vestibule and alveolar process (technique: Tennison, Millard)
12–14 mo	Closure of soft tissues of hard and soft palate (technique: Veau)	Control visits
18–24 mo	Control visits, consultations	Closure of soft tissues of hard and soft palate (technique: Bardach [modification of the Wardill-Kilner-Peeta technique])
6 mo after closure	Control visits, consultations	Closure of residual foramina if any functional indication exists
After 30 mo	Closure of residual foramina if any functional indication exists	Control visits, consultations
After 5 y	Esthetic correction before school age	Control visits, consultations
6–8 y	Control visits, consultations	
8–12 y	Bone grafting with autologous pelvis bone to alveolar process	
12–14 y	Control visits, consultations	
After growth completion	Multidisciplinary orthodontic and surgical treatment of maxillary hypoplasia. Esthetic and plastic correction of lips, nose, and postoperative scares. Third osteoplasty (before possible implants), prosthetic treatment.	

Although in both countries all services were offered free of charge, the organization of patients' visits was different. Nine different departments cooperated within the Cleft Lip and Palate Center at the University of Erlangen-Nuremberg. Once a year, patients were recalled and checked by a multidisciplinary team, which included a maxillofacial or/and plastic surgeon, orthodontist, speech therapist, pediatrician, pediatric dentist, and others (Andrä and Neumann, 1998; Strobel-Schwarthoff and Hirschfelder, 2002/2003; Hirschfelder and Iserhardt, 2003/2004). The specialists and patients then had an opportunity to discuss the actual treatment results and to premeditate future treatment plans. In Poland, there was no multidisciplinary cleft center, so the only way to create an effective interdisciplinary treatment was to join separate but closely cooperating departments, such as maxillofacial surgery and orthodontics. However, the ''Multi-specialist program of medical care for chil-

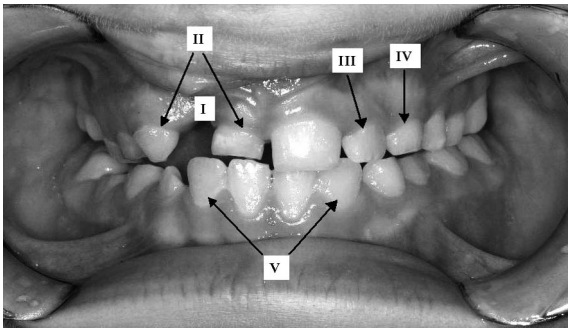

FIGURE 1 Tooth areas: I = teeth in the cleft area; II = teeth neighboring the cleft; III = teeth corresponding to the teeth in cleft; IV = tooth corresponding to the most distal tooth in the cleft; V = teeth in mandible corresponding the teeth in the cleft.

dren with palatal or/and labial cleft'' was initiated in 2001 in nine Polish cities, including Łódź (Małkiewicz, 2002).

Oral Hygiene Program

In both countries, the National Health Service provides similar caries preventive procedures but at different time intervals:

- general dental examination—Łódź: once a year; Erlangen: at least once every 3 months
- instruction in oral hygiene procedures (proper brushing techniques, if necessary, and exposing of dental plaque)—Łódź: once a year; Erlangen: at least once every 3 months
- fluoride treatment of teeth—Łódź: once every 3 months, Erlangen: at least once every 3 months

Additionally, at the Medical University in Łódź, there are two departments in which dental treatment in cleft children is performed: the Department of Developmental Age, which is responsible for caries prophylaxis and caries treatment, and the Department of Orthodontics, which is responsible only for orthodontic treatment. Hence, if an orthodontic patient had problems with oral hygiene, adequate instructions would be given during a separate visit to the other department. In Erlangen, all caries preventive procedures were undertaken in the Department of Orthodontics.

Clinical Examination

In each group of patients, data were collected by the same observer. A simple visual examination was employed. Five regions of the oral cavity were defined for comparison on the basis of distance from the cleft area (Fig. 1): I = teeth in the cleft area; II = teeth neighboring the cleft; III = maxillary teeth corresponding to the teeth in the cleft; IV = maxillary tooth corresponding to the most distal tooth neighboring the cleft; and V = teeth in mandible corresponding to the teeth in the cleft.

The following periodontal parameters were recorded:

- Approximal Plaque Index (API) of Lange et al. (1986) for all defined regions by means of probe and MIRA-2-TON solution (Hager & Werken, Duisburg, Germany) (scores: ''+'' = present, ''−'' = absent). (In regions I and V, the higher index score from one of two possible teeth was recorded.)
- Community Periodontal Index (CPI) (''Oral Health Surveys—Basic methods,'' Geneva, 1997). The scores ranged from 0 to 4, where: 0 = healthy; 1 = bleeding observed, either directly or after probing; 2 = calculus detected during probing, but all of the black band on the probe is visible; 3 = pocket of 4–5 mm (gingival margin within the black band on the probe); 4 = pocket of 6 mm or more (black band on the probe not visible). (In regions I and V, the higher index score from one of two possible teeth was recorded.)
- Amount of gingival recession or overgrowth (distance from the free gingival margin to the cementoenamel junction) by means of an orthodontic ruler.
- Tooth mobility (not for patients in the phase of active orthodontic treatment); scores of 1 to 3 were given. Physiologic tooth mobility was not recorded.

Examinations were conducted in dental clinics with good artificial light, using dental mirror, MIRA-2-TON solution, World Health Organization model millimeter probes (Hu-Friedy, Chicago, IL), and an orthodontic ruler.

Statistical Analysis

Chi-square test (χ^2), Yate's corrected Chi-square test (χ^2_Y), and Fisher's exact test were used for statistical analyses. The level of statistical significance was set at $p < .05$. The calculations were made with the STATGRAPHICS Plus 5.1 program (StatPoint, Inc., Herndon, VA).

Results

Oral Hygiene

Data on the dental plaque indices per tooth area and nationality are shown in Table 2. Optimal oral hygiene (API ≤ 40%) was detected in 60% of patients in Erlangen and in 19% of patients in Łódź. Poor oral hygiene was found in 57% of all subjects in both locations. Unsatisfactory (70% > API > 40%) or insufficient (API > 70%) oral hygiene was significantly more frequent in Polish patients ($p = .00$). The highest level of dental plaque occurrence (Łódź = 91%; Erlangen = 47%) was noted in both groups in the area of teeth neighboring the cleft (area II). This was probably caused by malposition of the teeth near the cleft, which contributed to difficulty in brushing. The lowest incidence of poor oral hygiene was noted in Erlangen (29%) in the teeth corresponding to the tooth in the cleft (area III), compared to a 51% incidence in teeth in the mandible (area V) noted in Łódź. There were statistically significant differences in the incidence of dental plaque between Łódź and Erlangen when comparing all teeth areas in maxilla ($p < .05$). The insignificant difference in the mandibular teeth

TABLE 2 Comparison of the Approximal Plaque Index (API) Between the Two Groups of Patients, by Tooth Area

Tooth Area	API %	Erlangen n	Erlangen %	Łódź n	Łódź %	Erlangen Versus Łódź p and χ^2 or χ^2_Y Level
Area I (teeth in the cleft)	≤40	18	62.1	5	27.8	$\chi^2_Y = 3.944$
	>40	11	37.9	13	72.2	$p = .047$
	All	29	100	18	100	
Area II (teeth neighboring the cleft)	≤40	29	52.7	3	8.6	$\chi^2_Y = 3.944$
	>40	26	47.3	32	91.4	$p = .047$
	All	55	100	35	100	
Area III (tooth corresponding to the teeth in cleft)	≤40	22	71	5	25	$\chi^2_Y = 8.548$
	>40	9	29	15	75	$p = .003$
	All	31	100	20	100	
Area IV (tooth corresponding to the teeth in distal position to the cleft)	≤40	31	57.4	6	17.6	$\chi^2 = 13.536$
	>40	23	42.6	28	82.4	$p = .000$
	All	54	100	34	100	
Area V (teeth in mandible corresponding the tooth in the cleft)	≤40	30	55.6	17	48.6	$\chi^2 = 0.416$
	>40	24	44.4	18	51.4	$p > .05$
	All	54	100	35	100	
Total	≤40	33	60	7	18.9	$\chi^2 = 15.191$
	>40	22	40	30	80.1	$p = .000$
	All	55	100	37	100	

can be explained by the fact that no surgical procedures are performed on the mandible.

Periodontal Health

Inadequate oral hygiene (API > 40%) was observed in all patients, with CPI scores of 1 recorded in both groups. Given that CPI scores of 2 were relatively rare, the authors focused on periodontal pocket depth when comparing periodontal status and oral hygiene (Table 3). Within those German patients with inadequate oral hygiene (API > 40%), CPI scores of 3 and/or 4 were found in 77%. Within the German patients with satisfactory oral hygiene (API < 40%), periodontal pockets deeper than 3.5 mm were recorded in 59%. The opposite was true for Polish subjects. Of those patients with good oral hygiene, 71% presented with scores of 3 and/or 4. Among those with bad hygiene, periodontal pockets deeper than 3.5 mm were found in 57% of cases.

Pathologic tooth mobility occurred neither in Łódź nor in Erlangen.

Gingival recession was found in 42% of Polish and 14% of German patients. To determine the relationship between frequency of recession occurrence and periodontal pocket depth, a correlation analysis was conducted, with all five tooth areas considered separately in each patient. In Erlangen, as well as in Łódź, the relationship was not significant in spite of the greater frequency of gingival recessions in teeth with periodontal pockets up to 3.5 mm deep, as compared to those with pockets deeper than 3.5 mm. There was also no statistical relationship between amount of tooth areas with gingival recessions and the country of origin. In both populations, gingival recession was seldom observed. If found, it was associated with the teeth neighboring the cleft (area II).

TABLE 3 Correlation Between Oral Hygiene Status and Pocket Depth in Erlangen and Łódź*

Group	Pocket Depth	Oral Hygiene Status: API < 40% n	API < 40% %	API > 40% n	API > 40% %	Statistical Tests and Significance Level
Erlangen	<3.5 mm	12	41.4	5	22.7	Fisher test;
	≥3.5 mm	17	58.6	17	77.3	$p = .267$
	Total	29	100	22	100	
Lódź	<3.5 mm	2	28.6	13	43.3	$\chi^2_Y = 1.209$
	≥3.5 mm	5	71.4	17	56.7	$p > .05$
	Total	7	100	30	100	
Erlangen and Lódź	<3.5 mm	14	38.9	18	34.6	$\chi^2 = 0.168$
	≥3.5 mm	22	61.1	34	65.4	$p > .05$
	Total	36	100	52	100	

* API = Approximal Plaque Index.

In both groups, periodontal pockets deeper than 3.5 mm were found in the majority of patients during the active phase of treatment. In both groups, there was a statistically significant difference in the number of patients with periodontal pockets up to 3.5 mm deep during the active phase of treatment in comparison to the number before and after the active phase. In contrast to the Polish patients, pocket depth up to 3.5 mm was recorded more frequently in German patients before the orthodontic treatment phase.

The difference between the Polish and German patients in periodontal health in five teeth areas, as measured using the CPI, was significant. CPI scores above 0 were more frequent among German patients. A CPI score of 1 was more common in Polish patients, and a CPI of 4 was found only in German subjects ($p < .05$).

Area I

There were as many German subjects with a CPI score of 0 as there were with a score of 3 in this area. In Polish subjects, a healthy periodontium was found most frequently. No pocket deeper than 6 mm was recorded in this group. No calculus was noted in this area in either group (Fig. 2).

Area II

No significant differences were observed in healthy periodontium between the patient groups. CPI scores of 1 were significantly more frequent in Polish patients ($p < .05$). No calculus was found in either group, as well as in Polish subjects. In both populations, periodontal pockets between 3.5 and 5.5 mm deep were detected most frequently, owing to frequent teeth malposition and malformation.

Area III

In the majority of Polish and German patients, a CPI score of 0 was noted. No significant difference was recorded in periodontal status between the groups.

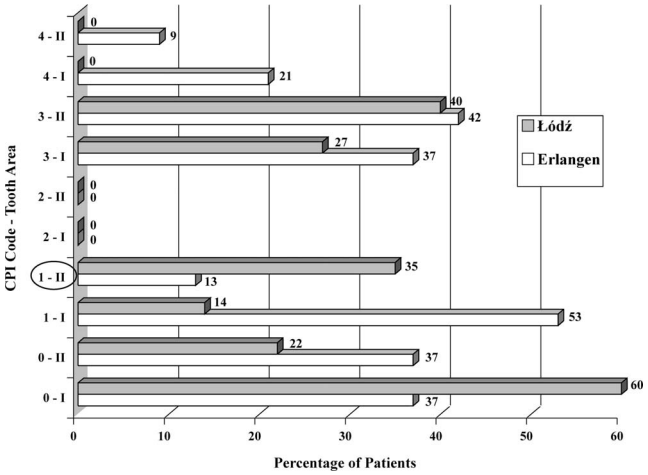

FIGURE 2 Proportion of patients with each CPI score (1 to 4) in the cleft area (I) and in the area of teeth neighboring the cleft (II). Statistically significant difference is indicated by a circle.

Areas IV and V

Here, a healthy periodontium was the most common observation, as these areas are situated far from the cleft. The only significant difference between the German and Polish patients was gingival bleeding in area IV, where a CPI score of 1 was more frequent in Polish subjects.

DISCUSSION

The observation of generally high API values in Polish subjects as compared to significantly lower API values in German children suggests the need to emphasize the need for improvement in oral hygiene in Polish patients. In spite of this fact, the periodontal status in both groups of children was similar. Other studies of the oral health of children with cleft lip and palate have generally evaluated the presence of dental plaque and degree of gingival inflammation (Brägger et al., 1985; Dahllöf et al., 1989; Paul and Brandt, 1998; Wong and King, 1998; Costa et al., 2003). However, published works on the gingival health of children with clefts are not in agreement.

Similar to our experience, Dahllöf et al. (1989), Brägger et al. (1992), and Paul and Brandt (1998) recorded poor oral hygiene and gingival health in cleft patients, especially in the cleft segment, which is explained by the reduced access for cleaning in this region of teeth. Therefore, in both populations the periodontium in the neighborhood of the cleft cannot cope with difficult conditions, such as scar tissue in the upper lip, crowding, malformations, and long-term active orthodontic treatment (Teja et al., 1992; Schultes et al., 1999). Lucas et al. (2000) and Costa et al. (2003) observed that although the amount of plaque in the cleft area was greater than in other tooth areas, it did not result in greater gingival inflammation. Quirynen et al. (2003) and Dewinter et al. (2003) observed that the periodontium of teeth in and around the cleft in patients with UCLP during and after orthodontic treatment can cope relatively well with lengthy orthodontic treatment and combined surgical interventions, and detected no major difference in periodontal status between the cleft areas and other areas. However, the present study failed to detect statistically significant differences in the periodontal status in cleft areas between the patients from two institutions. That may be explained by the similar surgical treatment concept, which in both clinics agrees with the standards of the EUROCLEFT Program recommended by the Clinical Standards Advisory Group (Małkiewicz, 2002). Additionally, as stated in the literature, the experience and skills of the surgeon in terms of tissue management may have a greater influence on craniofacial development than the technique or timing of hard palate closure (Lehner et al., 2003).

There were differences in the number of patients with healthy periodontium as well as gingival bleeding between the two groups of our patients. In Polish subjects, periodontal pockets up to 3.5 mm occurred surprisingly more frequently among those with inadequate oral hygiene. At the same time, severe periodontal destruction was recorded only among the Germans, where API was significantly lower. Moreover, no statistically significant difference was observed between the two populations, when comparing the number of teeth with gingival recession despite better oral hygiene in the German population (less plaque) than in the Polish population. This could suggest that dental plaque is not the major factor causing periodontitis and that other factors such as oral hygiene, diet, general patient health or environment, and (perhaps most important) surgical procedures (probably bone grafting procedures) are responsible for contributing to gingival recession around teeth in the cleft area. These factors will be the matter of further investigation as a continuation of the present study. The fact that there were no Polish patients with a periodontal pocket over 6 mm when, at the same time, a great majority of patients presented with inadequate oral hygiene, may have been a result of the small group examined; further studies are necessary.

Periodontal pockets deeper than 3.5 mm occurred more frequently during active orthodontic treatment. This confirms the earlier conclusions of other authors that periodontal status is also influenced by orthodontic treatment (Teja et al., 1992; Quirynen et al., 2003). Our study revealed that of all five teeth regions, gingival recession was particularly frequent in the area neighboring the cleft (46% in Łódź patients and 45% in Erlangen patients). At the same time, the periodontal pockets appeared most frequently in this area (42% in Erlangen patients; 40% in Łódz patients).

CONCLUSIONS

Oral hygiene regimens in Germany and Poland were not comparable, as more plaque was found in the Polish population than in the German population. Plaque accumulation seems not to be a key factor causing periodontal destruction in the cleft area. Factors other than oral hygiene may be of major importance in relation to the development of gingival

recession on teeth in the cleft area (e.g., type of surgical procedure).

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