

Malocclusion characteristics of patients with cleft lip and/or palate

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SUMMARY This study aimed to evaluate the malocclusions of patients with a cleft lip and/or palate (CLP) and to compare malocclusion characteristics between subjects with a pre-foramen incisor cleft (PIC) and a trans-foramen incisor cleft (TIC).

A cross-sectional study was conducted of 117 cleft patients (53 per cent male) aged 6–37 years (mean age 14.7 ± 7.4 years) who attended the Dental Specialty Center in the city of Fortaleza, Brazil, between 2004 and 2007. Oral clefts were classified and radiographic examinations and dental casts were analysed to determine malocclusions and facial patterns. Malocclusion measurements were compared between the PIC and TIC groups by Mann–Whitney and Fisher's exact tests.

The percentage of subjects with PIC, TIC, post-foramen incisor cleft, and rare cleft were 20.5, 73.5, 5.1, and 0.9 per cent, respectively. The prevalence of malocclusions in subjects with a CLP was 82.1 per cent (molar relationships Classes II and III) in 6- to 12-year-olds, and a severe malocclusion [dental aesthetic index (DAI)] was observed in all patients aged 13 years and above. The frequency of patients with a normal canine relationship, open bite, and anterior crossbite was higher in the PIC group than in the TIC group (6–12 years). Patients aged 13 years and above in the PIC group showed lower means for the largest anterior maxillary irregularity, higher means for positive anterior mandibular overjet, a lower frequency of crowding in the anterior incisal segments, and a normal antero-posterior molar relationship compared with the TIC group.

Severe malocclusions were prevalent in subjects with a CLP. Subjects with a TIC have higher prevalence of malocclusions than those with a PIC.

Introduction

A cleft lip and/or palate (CLP) is the third most often congenital defect reported in Brazil. Its occurrence is only lower when compared with osteomuscular and nervous system anomalies (Pinto and Nascimento, 2007). The incidence of a CLP has been reported as 0.18 per 1000 live births (Loffredo *et al.*, 2001). According to the World Health Organization (WHO, 1997), a CLP is a dental public health issue because of the oral conditions of the individuals and their psychological, aesthetic, and functional impairments (Hunt *et al.*, 2005). The integration of individuals with oral clefts into society requires an interdisciplinary approach and treatment of skeletal and dental variations from birth to adulthood (De La Pedraja *et al.*, 2000; Strong, 2002).

The occurrence of malocclusions in subjects with oral clefts favours the retention of dental plaque on tooth surfaces, predisposing them to different oral diseases such as caries (Ranta, 1986; Parapanisiou *et al.*, 2009). Malocclusions and facial patterns of individuals with dentofacial deformities have been described by various authors (Baek *et al.*, 2002; Sakamoto *et al.*, 2008; Vallino *et al.*, 2008). However, few studies have characterized

malocclusions in patients with oral clefts (Baek *et al.*, 2002; Sakamoto *et al.*, 2008; Vallino *et al.*, 2008). Vallino *et al.* (2008) reported a prevalence of malocclusions in subjects with oral clefts of 62 per cent and Sakamoto *et al.* (2008) rates of 57 and 8.6 per cent for anterior and posterior crossbites, respectively. Baek *et al.* (2002) found a malocclusion frequency of 42.1 and 76.3 per cent in patients with a pre-foramen incisor cleft (PIC) and a trans-foramen incisor cleft (TIC), respectively.

There is limited evidence of malocclusion characteristics of patients with different types of CLP. However, dental anomalies (e.g. altered tooth dimensions, tooth development, supernumerary teeth) and deficiencies in horizontal and vertical facial development caused by surgical procedures affect subjects differently with different oral clefts (Ranta, 1986). Thus, it is expected that subjects with different oral clefts present differences in malocclusions.

The hypothesis of this study was that subjects with a TIC have more severe malocclusions compared with those with a PIC. The aims, therefore, were to evaluate malocclusions in patients with a CLP and to compare malocclusion characteristics between subjects with a PIC and TIC.

Subjects and methods

The study was approved by the Committee of Ethics and Research of the National School of Public Health—Oswaldo Cruz Foundation (Protocol No. 166/07). The present investigation was a cross-sectional study carried out at the Dental Specialty Center (CEO-Centro) in the city of Fortaleza, Ceara State, Brazil. The CEO-Centro is a public oral health care unit to which all subjects with a CLP in the Ceara State are referred.

The study sample consisted of subjects treated surgically for the correction of a complete or incomplete CLP. All surgery was performed using the same surgical protocol and was undertaken by five oral and maxillofacial and plastic surgeons of the 'Operation Smiles' campaign. The Millard and Spina surgical techniques were employed for cheiloplasty in patients with lip clefts (Franco *et al.*, 2003). Palatoplasty in subjects with palatal clefts was performed using the Von Langenbeck technique (Lindsay, 1971). Patients with a CLP were initially treated with cheiloplasty and then a palatoplasty was performed.

Initially, all dental records of the CEO-Centro unit were screened to identify and select the subjects with oral clefts. The inclusion criteria were individuals referred for orthodontic treatment between June 2004 and August 2007. Subjects were excluded if they were younger than 6 years of age, were under orthodontic treatment before registration, refused treatment, did not have complete orthodontic documentation, or had not undergone cleft surgery repair. These criteria were used to obtain standardized information concerning dentofacial anomalies of the participants and thus to avoid measurement bias caused by orthodontic and surgical treatment prior to participation in the study.

Information concerning age, gender, race/skin colour, dentofacial anomalies, and oral cleft classification were obtained from the dental records, panoramic radiographs, documentary photographs, individual interviews, analysis of dental casts, and clinical examinations. The assessment of race/skin colour was based on self-perception of skin colour, according to the methodology described by the Brazilian Institute of Geography and Statistics Foundation (Travassos and Williams, 2004). The categories were 'white', 'lighter-skinned black', and 'darker-skinned black'. Among the subjects who were under 18 years old, the mother (or caregiver) reported the skin colour. Data collection was performed by a single trained and calibrated examiner (AESC).

The classification of oral clefts was performed by clinical examinations according to group, location, and type of defect. Four types of oral clefts were considered: PIC, TIC, post-foramen incisor cleft, and rare cleft (Veau, 1931; Spina *et al.*, 1972).

Dentofacial anomalies assessment

The characterization of dentofacial anomalies included facial pattern and malocclusion.

Facial typology analysis was conducted through cephalometric radiographs and documentary photographs obtained during treatment planning. The participants were classified according to the pattern of facial vectors of growth and facial development: mesiofacial (harmonic facial pattern), dolichofacial (facial pattern with horizontal growth), or brachyfacial (facial pattern with vertical growth; Ricketts *et al.*, 1979).

The assessment of malocclusion was performed according to the WHO (1997). The original methodology for malocclusion assessment was adapted in this study to be applied to dental casts. Dental impressions were taken in alginate and cast in hard white stone. Bite registrations were taken in toughened dental modelling wax. The dental casts employed in the malocclusion assessment were obtained during the treatment planning in a standardized manner at the Perboyre Castelo Radiographic Clinic. Periodontal probes (Hu-Friedy®, Chicago, Illinois, USA) were used to obtain malocclusion measurements. Because of the variations in the dentitions, the assessment of malocclusions was conducted according to the mean ages of 6–12 years and 13 years or older.

For those between 6 and 12 years of age (primary and permanent teeth), Angle's classification was used in malocclusion assessment (Angle, 1899). In addition, vertical anterior openbite, anterior and posterior crossbite, and crowding in the incisal segments (upper and lower) were registered. In Angle's classification, the assessment is based on the relationship of the permanent upper and lower first molars (antero-posterior molar relationship) and canines (antero-posterior canine relationship). A vertical anterior openbite was registered if there was a lack of vertical overlap between any of the opposing pairs of incisors and an anterior crossbite when the anterior buccolingual tooth relationship was abnormal, that is, when there was a reversal in the relationship, and a posterior crossbite when the posterior buccolingual tooth relationship was abnormal. Crowding in the incisal segment (upper and lower) is the condition in which the available space between the right and left canine teeth is insufficient to accommodate all four incisors in normal alignment. Teeth may be rotated or displaced out of alignment in the arch.

The assessment of malocclusions among individuals aged 13 years and above was performed using the dental aesthetic index (DAI) and its components: dentition, space, and occlusion (WHO, 1997). The dentition was measured according to the missing incisor, canine, and premolar teeth. The space component comprised the following measurements: crowding and spacing in the incisal segments, diastema, and the largest anterior maxillary and mandibular irregularities. The occlusal component was based on measurements of anterior maxillary and mandibular overjet, vertical anterior open bite, and antero-posterior molar relationship. The DAI score was converted into the following categories: no abnormality or minor

malocclusion (less than 25), definite malocclusion (26–30), severe malocclusion (31–35), and very severe or handicapping malocclusion (36 or more; WHO, 1997).

Pilot study

A pilot study was conducted at the CEO-Centro Dental Clinic to obtain reliable information concerning the study population. The purpose of the pilot study was to calibrate one examiner for malocclusion assessment of dental casts. Twenty dental casts of patients with oral clefts were selected and examined twice with a 3 day interval between the examinations. Because of the different criteria used in the malocclusion assessment according to age, the calibration study was conducted on 10 dental casts of patients between 6 and 12 years of age and on 10 dental casts of individuals aged 13 years and above.

Reliability of all measurements used to evaluate the malocclusion for the age group of 6–12 years old was analysed using the Kappa coefficient. Exact agreement (Kappa = 1) was obtained for all measurements. For the age group of 13 years and above, the Kappa Coefficient for categorical variables was also equal to 1. In this age group, the reliability for continuous variables was verified by the intraclass correlation coefficient (ICC) of agreement. The ICC was 1 for the following variables: missing incisor, canine, and premolar teeth, diastema, and largest anterior maxillary and mandibular irregularities. The ICC findings for anterior maxillary overjet, anterior mandibular overjet, and vertical anterior open bite were 0.996, 0.994, and 0.990, respectively.

Statistical analysis

The variables were computed for each subject and then averaged across subjects in the groups. The results are presented for the total sample and according to age groups due to different criteria used in the malocclusion assessment.

The continuous variables of malocclusion measurements were compared between the PIC and TIC groups by Mann–Whitney test. The comparisons of categorical variables of malocclusion were analysed by Fisher's exact tests.

All statistical analyses were carried out using the Statistical Package for Social Sciences, Windows version 17.0 (SPSS Inc., Chicago, Illinois, USA). The significance level for all analyses was 5 per cent ($P \leq 0.05$).

Results

The sample population consisted of 145 subjects with oral clefts. Of these, 28 were excluded for different reasons, resulting in 117 selected participants. The reasons for exclusion were the following: did not undergo surgery to correct the CLP ($n = 3$), less than 6 years of age ($n = 9$), under orthodontic treatment before registration ($n = 2$), discontinued orthodontic treatment ($n = 10$), or did not have

complete orthodontic documentation ($n = 4$). Of the 28 excluded, 57.1 per cent were females and 60.7 per cent were aged between 6 and 12 years. The mean age of the excluded subjects aged 6 years and above was 17.0 ± 8.7 years.

Demographic characteristics and facial pattern

The age range of the subjects was from 6 to 37 years, with a mean of 14.7 ± 7.4 years. Among the 117 patients evaluated, 53 per cent were male, 21.4 per cent were white, 76.9 per cent were lighter-skinned black, and 1.7 per cent were darker-skinned black. Among the 6–12 years old, the mean age was 8.4 ± 1.9 years, 44.6 per cent were female, 19.6 per cent were white, and 80.4 per cent were lighter-skinned black. For those aged 13 years and above, the mean age was 20.4 ± 5.9 years, 60.7 per cent were female, 23.0 per cent were white, 73.7 per cent were lighter-skinned black, and 3.3 per cent were darker-skinned black. The frequency of mesiofacial and dolichofacial patterns was 40.2 and 39.3 per cent, respectively, in the total sample. Mesiofacial and dolichofacial patterns among subjects aged between 6 and 12 years were 44.6 and 42.9 per cent, respectively. The same occurrence of mesiofacial and dolichofacial patterns was observed in subjects 13 years of age and above (36.1 per cent).

Oral clefts prevalence

The classification of oral clefts according to group, location, and type of defect are shown in Table 1. The majority of the participants who had oral clefts were classified as TIC. This was observed for the whole sample (73.5 per cent) as well as for both age groups: 6–12 years old (66.0 per cent) and 13 years or older (74.3 per cent). There was a predominance of unilateral compared with bilateral clefts. PIC: 6.9 per cent versus 0.9 per cent and TIC: 60.6 per cent versus 12.8 per cent.

Malocclusion characteristics of subjects between 6 and 12 years

Malocclusion clinical parameters of subjects with oral clefts between 6 and 12 years of age and between the PIC and TIC groups are shown in Table 2. A Class I molar and Class I canine relationship were found in 10 (17.9 per cent) and 14 (25.9 per cent) of the sample, respectively. Considering Class I as the normal occlusal status in Angle's classification, the frequency of a molar and canine malocclusion was 82.1 and 74.1 per cent, respectively. The frequencies of an open bite, an anterior crossbite, and a posterior crossbite were 19.6, 60.7, and 39.3 per cent, whereas the frequency of upper crowding in the anterior segment and lower crowding in the incisal segment was 69.6 and 66.1 per cent, respectively.

The frequency of subjects with a Class I canine relationship was statistically higher in the PIC group (58.3 per cent) while the TIC group showed a higher frequency of

Table 1 Frequency of subjects in the groups according to the classification of oral clefts (Spina *et al.*, 1972). R, right; L, left.

Group	Location	Type of defect	Subjects between 6 and 12 years old (<i>N</i> = 56)	Subjects aged 13 years or older (<i>N</i> = 61)	All subjects, <i>n</i> (%)
Pre-foremen incisor cleft (<i>N</i> = 24; 20.5%)	A-unilateral (R or L)	A1 R	1 (1.8)	1 (1.6)	2 (1.7)
		A1 L	1 (1.8)	0 (0)	1 (0.9)
		A2 R	2 (3.6)	3 (4.9)	5 (4.3)
		A2 L	6 (10.7)	8 (13.1)	14 (11.9)
	B-bilateral	B1	1 (3.8)	0 (0.0)	1 (0.9)
	C-median	C1	0 (0.0)	0 (0.0)	0 (0.0)
		C2	1 (1.8)	0 (0.0)	1 (0.9)
Trans-foremen incisor cleft (<i>N</i> = 86; 73.5%)	A-unilateral R		8 (14.2)	10 (16.4)	18 (15.3)
	A-unilateral L		23 (41.1)	30 (49.2)	53 (45.3)
	B-bilateral		6 (10.7)	9 (14.8)	15 (12.8)
Post-foremen incisor cleft (<i>N</i> = 6; 5.1%)		Complete	4 (7.1)	0 (0.0)	4 (3.4)
		Incomplete	2 (3.6)	0 (0.0)	2 (1.7)
Rare cleft <i>N</i> = 1, (0.9%)			1 (1.8)	0 (0.0)	1 (0.9)
Total			56 (100)	61 (100)	117 (100)

Table 2 Malocclusion clinical parameters of subjects between 6 and 12 years old.

	Pre-foremen incisor cleft (<i>N</i> = 12)	Trans-foremen incisor cleft (<i>N</i> = 37)	Total (<i>N</i> = 56)
Molar relationship			
Class I	4 (33.3)	3 (8.1)	10 (17.9)
Class II	6 (50.0)	26 (70.3)	33 (58.9)
Class III	2 (16.7)	8 (21.6)	13 (23.2)
Canine relationship†*			
Class I	7 (58.3)	4 (11.4)	14 (25.9)
Class II	4 (33.3)	22 (62.9)	27 (50.0)
Class III	1 (8.3)	9 (25.7)	13 (24.1)
Open bite*			
No	7 (58.3)	32 (86.5)	45 (80.4)
Yes	5 (41.7)	5 (13.5)	11 (19.6)
Anterior crossbite*			
No	9 (75.0)	11 (29.7)	22 (39.3)
Yes	3 (25.0)	26 (70.3)	34 (60.7)
Posterior crossbite			
No	8 (66.7)	22 (59.5)	34 (60.7)
Yes	4 (33.3)	15 (40.5)	22 (39.3)
Upper anterior crowding			
No	5 (41.7)	11 (29.7)	17 (30.4)
Yes	7 (58.3)	26 (70.3)	39 (69.6)
Lower anterior crowding			
No	4 (33.3)	15 (40.5)	19 (33.9)
Yes	8 (66.7)	22 (59.5)	37 (66.1)

* $P \leq 0.05$; Fisher's exact test in the comparisons between pre-foremen incisor and trans-foremen incisor cleft groups.

†Canine relationship was not measured in two subjects due to the absence of the canines.

subjects with a Class II canine relationship (62.9 per cent; $P < 0.05$). The prevalence of an openbite was significantly higher in the PIC group compared with the TIC group (41.7 per cent versus 13.5 per cent; $P < 0.05$). On the other hand, an anterior crossbite was statistically lower in the PIC group compared with the TIC group (25.0 per cent versus 70.3 per cent; Table 2).

Malocclusion characteristics of subjects 13 years of age and above

Table 3 shows the clinical parameters related to DAI employed in malocclusion assessment in subjects aged 13 years and above. The mean number of missing incisor, canine, and premolar teeth (dental component) was 1.15 and it was statistically higher in the TIC group compared with the PIC group. For the space component, the prevalence of anterior crowding was 65.6 per cent. The TIC group showed a higher prevalence of crowding in one or two incisal segments compared with the PIC group ($P < 0.05$). Spacing in one or two anterior segments was 34.4 and 13.1 per cent, respectively, for both groups. The mean diastema, largest anterior maxillary irregularity, and largest anterior mandibular irregularity was 0.66, 2.46, and 0.98 mm, respectively. The mean of the largest anterior maxillary irregularity was statistically higher in the TIC group compared with the PIC group ($P < 0.05$). For the occlusal component, the mean of the anterior maxillary overjet, anterior mandibular overjet, and vertical anterior open bite was 4.30, 7.56, and 0.38 mm, respectively. Anterior mandibular overjet was greater in the PIC group compared with the TIC group ($P < 0.05$). The antero-posterior molar relationship was normal in only 8 per cent of the subjects. The prevalence of a normal antero-posterior molar relationship was significantly associated with the PIC group. According to the DAI scores, all subjects aged 13 years and above had a very severe or handicapping malocclusion.

Discussion

Oral clefts are public health issues because of malformation of oral structures and consequently related dental/occlusal anomalies. Individuals with an initial diagnosis of a cleft lip need to be monitored by an interdisciplinary team for speech, language, ear diseases, hearing, and dentition beginning in infancy and followed up until all management

Table 3 Dental aesthetic index (DAI) components: dentition, space, and occlusion and DAI scores in subjects aged 13 years or older.

	PIC (N = 12)	TIC (N = 49)	Total (N = 61)
Dental (mean \pm SD)*	0.45 \pm 1.04	1.31 \pm 1.43	1.15 \pm 1.40
Space			
Crowding in the anterior segments, n (%)**			
No crowding	8 (66.7)	13 (26.5)	21 (34.4)
One segment crowded	3 (25.0)	21 (42.9)	24 (39.3)
Two segments crowded	1 (8.3)	15 (30.6)	16 (26.2)
Spacing in the incisal segments, n (%)			
No spacing	4 (33.3)	28 (57.1)	32 (52.5)
One segment spaced	7 (58.3)	14 (28.6)	21 (34.4)
Two segments spaced	1 (8.3)	7 (14.3)	8 (13.1)
Diastema (mean \pm SD)	0.33 \pm 0.89	0.73 \pm 1.44	0.66 \pm 1.35
Largest anterior maxillary irregularity (mean \pm SD)*	1.25 \pm 1.91	2.76 \pm 2.28	2.46 \pm 2.28
Largest anterior mandibular irregularity (mean \pm SD)	0.67 \pm 1.23	1.06 \pm 1.22	0.98 \pm 1.22
Occlusal			
Anterior maxillary overjet (mean \pm SD)	4.58 \pm 3.58	4.22 \pm 3.64	4.30 \pm 3.60
Anterior mandibular overjet (mean \pm SD)*	9.00 \pm 0.00	7.20 \pm 3.01	7.56 \pm 2.78
Vertical anterior open bite (mean \pm SD)	0.42 \pm 1.44	0.37 \pm 1.29	0.38 \pm 1.31
Antero-posterior molar relationship, n (%)**			
Normal	3 (25.0)	2 (4.1)	5 (8.2)
Half cusp	8 (66.7)	24 (49.0)	32 (52.5)
Full cusp	1 (8.3)	23 (46.9)	24 (39.3)
DAI score (mean \pm SD)†	75.2 \pm 8.9	76.5 \pm 14.7	76.3 \pm 13.7

* $P \leq 0.05$; Mann–Whitney test in the comparisons between the pre-foramen incisor cleft (PIC) group and trans-foramen incisor cleft tic group (TIC).

** $P \leq 0.05$; Fisher's exact test in the comparisons between the PIC and TIC groups.

†All subjects were classified as having a very severe or handicapping malocclusion.

needs are met (Lohmander and Persson, 2008; Vallino *et al.*, 2008).

In the present study, oral cleft compromising the lips, alveolar arches, and hard and soft palate were the most prevalent (TIC group). The PIC group accounted for 20.5 per cent and only a single case of a rare cleft was observed. The findings concerning the types of CLP are in accordance with earlier studies (Jensen *et al.*, 1988; Taher, 1992; Al-Balkhi, 2008; Sakamoto *et al.*, 2008). However, Garcia-Godoy (1980) described a higher prevalence of PICs.

Frequently reported dental anomalies of subjects with a CLP include permanent tooth development (Borodkin *et al.*, 2008; Lai *et al.*, 2008), dental asymmetry (Lai *et al.*, 2008; Tortora *et al.*, 2008), and hypodontia and supernumerary teeth (da Silva *et al.*, 2008; Tortora *et al.*, 2008; Vallino *et al.*, 2008). In addition, dental dimensions in patients with oral clefts have been reported to be smaller than in subjects without clefts in both the affected maxillary and the mandibular dental arches (Akcem *et al.*, 2008). Other oral health conditions associated with children with oral clefts are early childhood caries and poor feeding habits (Mutarai

et al., 2008). Despite the fact that dental anomalies have been studied in subjects with oral clefts, few investigations have described the malocclusions of these individuals (Baek *et al.*, 2002; Sakamoto *et al.*, 2008; Vallino *et al.*, 2008).

Dentofacial anomalies in the subjects in the current study showed a high prevalence of abnormal facial patterns and malocclusions. This high prevalence is in agreement with earlier research on both children and adults (Baek *et al.*, 2002; Sakamoto *et al.*, 2008; Vallino *et al.*, 2008). Occlusal dysfunction accompanying malocclusions has been reported in 90 per cent of children (Vallino *et al.*, 2008) and 61 per cent of adults (Sakamoto *et al.*, 2008) with oral clefts. In the present study, malocclusion prevalence based on Angle's classification was 91.8 and 82.1 per cent for those aged between 6 and 12 years, and 13 years and above, respectively.

The prevalence of an anterior crossbite in the current study was similar to that reported by Sakamoto *et al.* (2008) 61 per cent versus 57 per cent. However, a posterior crossbite was higher (39 per cent versus 9 per cent). The mean age of the participants and the sample size might explain this discrepancy.

The main malocclusion characteristics among those between 6 and 12 years of age in this study were related to molar and canine relationships as well as anterior crossbite and upper and lower crowding. A crossbite was also the most frequent occlusal anomaly found by Vallino *et al.* (2008). All participants aged 13 years and above were classified as having a very severe or handicapping malocclusion using the DAI. The mean DAI score was 76.25, which is more than twice that compared with the cut-off for very severe or handicapping malocclusion category—DAI 36 or more (WHO, 1997). However, this result is difficult to compare with other findings because of the different criteria employed in malocclusion assessment.

Comparisons of malocclusion characteristics between subjects with different types of oral clefts have been carried out in only one study (Baek *et al.*, 2002). Similar to the present findings, malocclusion severity was positively related to the severity of the oral cleft. However, some methodological issues, including differences related to malocclusion criteria, age range of participants, and if the patient was underwent surgery for the oral cleft, limit comparisons between the studies.

Apart from the expected high malocclusion prevalence in patients with oral clefts, the hypothesis that the TIC group has more severe clinical characteristics related to malocclusion compared with the PIC group was confirmed in both age groups. While 6- to 12-year-old subjects in the TIC group showed a higher prevalence of an abnormal antero-posterior canine relationship and anterior crossbite, those in the PIC group had more open bites. Subjects aged 13 years and above in the TIC group had more anterior crowding and an increased anterior mandibular overjet,

whereas those in the PIC group had higher anterior maxillary irregularities and more changes in the antero-posterior molar relationship.

There are only a few descriptive studies on the prevalence of dentofacial anomalies in subjects with oral clefts. Thus, the present research reinforces the need for new strategies to obtain more information of populations not included in oral health surveys, such as subjects with oral clefts.

A positive aspect of the present investigation was the methodology applied in the selection of the participants and data collection, which assured the validity of the study. The data regarding the assessment of malocclusion and facial pattern were obtained using standardized procedures by one calibrated examiner. One limitation of this study was the exclusion of 28 subjects. However, this was necessary to obtain standardized measurements of dentofacial anomalies since some patients did not have complete orthodontic documentation and/or did not undergo surgery to repair the cleft. Demographic characteristics (age and gender) of the excluded subjects were very similar to the participants, which suggest an unbiased exclusion. Another limitation is the lack of information concerning the time of surgical repair. However, all selected patients underwent the same surgical protocol for the correction of a complete or incomplete CLP and they had not started orthodontic treatment when the study commenced, which allowed adequate comparisons of malocclusions between subjects with different types of oral clefts. The selection of subjects from the public health centre resulted in a sample composed of those with a low income and young people and so, the findings cannot be generalized for the whole population.

The acquisition of epidemiological information concerning these individuals should be considered relevant for health service planning so as to provide adequate health care for individuals with clefts. The absence of appropriate dental treatment for individuals with oral clefts exacerbates the skeletal and dental changes resulting from the malformation, further compromising the function, aesthetics, and psychosocial aspects of the individuals (Parapanisiou *et al.*, 2009).

Conclusions

The findings from the present study suggest that patients with oral clefts need special oral health care for treatment of dentofacial anomalies. In addition, it was also found that orthodontic treatment needs differ between patients with different oral clefts.

Further studies are suggested to characterize dentofacial anomalies in subjects with oral clefts in other socio-economic strata and from the private health sector. In addition to this, further investigations aiming to identify the risk factors for dentofacial anomalies in subjects with oral clefts would be useful for preventive strategies.

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