Assessment of the alveolar bone support of patients with unilateral cleft lip and palate: 
A cone-beam computed tomography study

Esra Ercana; Mevlut Celikoglub; Suleyman Kutalmis Buyukc; Ahmet Ercan Sekercid

ABSTRACT
Objective: To assess the bone support of the teeth adjacent to a cleft using cone-beam computed tomography (CBCT).
Materials and Methods: The CBCT scans of 31 patients with unilateral cleft lip and palate (UCLP) were assessed. The data for teeth neighboring the cleft were compared with those of contralateral noncleft teeth. For each tooth analyzed, the distance between the cementoenamel junction (CEJ) and the bone crest (AC) at the buccal side was measured as was the thickness of the buccal bone level at 0, 1, 2, and 4 mm.
Results: The bone thicknesses of the central teeth at the cleft region at the crest and 2 mm apically were statistically significantly thinner than that of the central incisor at a noncleft region. The CEJ-AC distance for central teeth at the cleft region was higher than that for central teeth in a noncleft region.
Conclusions: Subjects with UCLP showed reduced bone support at teeth neighboring the cleft compared with controls. This may cause some problems during orthodontic treatment. (Angle Orthod. 2015;85:1003–1008.)

KEY WORDS: Cleft lip and palate; Cone beam CT; Alveolar bone support

INTRODUCTION

Complete cleft of the lip, alveolus, and/or palate (CLAP) is the most common congenital malformation of the face.1 Most affected children show a deficiency in soft tissues and the alveolus and malformation of the teeth at the cleft region. Problems are commonly seen in feeding, speaking, and hearing; many esthetic, dental, and psychological problems may also be encountered.2 Additionally, children and youths with CLAP are at increased risk for the development of periodontitis and mucogingival problems3 for several reasons. First, the persisting soft tissue folds before closure, so it is difficult to reach for cleaning and may serve as a habitat for putative pathogens. Second, long-term orthodontic therapy may constitute an iatrogenic trauma for the periodontium.4–6 Another possible reason is poorly developed osseous structures.7,8

The few studies that have analyzed the periodontal status of these persons showed a high incidence of plaque and bleeding on probing and a high level of periodontal attachment loss.8,9 In osseous clefts, the osseous structures are absent or poorly developed in the region of periodontal supportive tissues.9 Some reports suggest that the cleft area affects the periodontal tissues of the teeth in close proximity.10 Researchers comparing sites from teeth adjacent to an alveolar cleft with unaffected control sites found that the radiographic alveolar bone level was significantly more apical at the cleft region, whereas the probing attachment level was similar in the cleft and control regions.9,11,12

These findings suggested the presence of a long connective tissue attachment in the cleft regions.12 The results of these studies are consistent with the report of Quirynen et al.2 that teeth in the cleft had...
significantly more bone loss compared with contralateral noncleft control teeth. However, approximal probing depth and attachment loss values were also significantly higher than for contralateral teeth. Bone loss was evaluated by means of parallel intraoral x-rays using special film holders. Mutthineni et al. compared bone loss between patients with unilateral cleft lip and palate (UCLP) and patients with cleft palate (CP) using parallel periapical radiographs. Patients with UCLP had poorer periodontal status and higher bone loss than patients with CP.

To our knowledge, no previous study investigated the bone support of the teeth in patients affected by cleft lip and palate (CLP) using cone-beam computed tomography (CBCT). CBCT technology facilitates true (1:1 size) images without magnification and shows high intraobserver and interobserver reproducibility compared with conventional radiographs; thus, it is important to assess the alveolar bone loss of the teeth adjacent to the cleft area using CBCT.

The aim of this study was to assess the bone support of teeth adjacent to the cleft region in patients affected by UCLP using CBCT and to provide more specific and detailed data regarding cleft-affected teeth.

MATERIALS AND METHODS

The present retrospective study was approved by the local ethics committee of Erciyes University, and all patients signed an informed consent form allowing their data to be used for scientific purposes. The patients were not exposed to any additional radiation for the purpose of this study.

The present study was conducted using 31 CBCT scans from patients with unrepaired UCLP (7
females, 24 males; mean age, 13.9 ± 2.93 years). The patients were periodontally healthy and had good oral hygiene, and no patients had received grafts before the study. Patients who were smokers were excluded. All patients were apparently medically normal and had no history of chemotherapy or radiotherapy. Patients with distorted or scattered images and the presence of restorations, root canal treatment, evident root resorption, or any apical surgery were also excluded. All images were obtained using a standardized device (NewTom5G, QR, Verona, Italy) with a voxel size of 0.125 mm by an experienced technician. Simplant Pro software (version 13.0, Materialise HQ, Leuven, Belgium) was used to create the three-dimensional images, which were transformed to digital imaging and communications in medicine (DICOM) format. The data were reconstructed with slices at an interval of 0.25 mm, positioned parallel to the horizontal axis of the alveolar bone (Figure 1).

Four teeth were analyzed for each patient affected by a cleft. Data for the central and canine teeth close to the cleft area were used as the test, and the contralateral central and canine teeth were used as the controls. Because lateral teeth at the cleft area were absent (in 28 of 31 patients), the contralateral lateral teeth were not evaluated. For each tooth analyzed, the distance between the cementoenamel junction (CEJ) and the bone crest (AC) was measured, as well as the thickness of the buccal bone level at 0, 1, 2, and 4 mm, using the Simplant Pro software (Figures 2 through 4). Measurements were performed at buccal site of teeth by an experienced operator.

**Statistical Methods**

Shapiro-Wilks and Levene variance homogeneity tests were performed to test the normality of the data distribution. Because the data were found to be normally distributed ($P > .05$), parametric tests were used. A paired $t$-test was performed to compare bone thicknesses at the cleft and healthy sides of the central and canine teeth in the cleft area. A Student's $t$-test was used to compare the groups.

To evaluate random error, 15 images were selected randomly. The same operator conducted all measurements 4 weeks after the first examination and had no knowledge of the first measurements. According to the Houston test, calculated to assess the reliability of the measurements, the values were greater than 0.921, confirming the reliability.
RESULTS
In total, 62 central teeth (31 cleft, 31 contralateral noncleft region) and 40 canine teeth (18 cleft, 22 contralateral noncleft region) were analyzed (Table 1).
Table 2 presents comparisons of the bone thickness distribution at different levels of the central and canine teeth. The bone thickness of central teeth at crest (M0) was 0.91 ± 0.24 mm at the cleft region, and 1.09 ± 0.26 mm for the noncleft region. This difference was statistically significant (P = .001). The bone thickness at 2 mm apical of the alveolar crest (M2) was also thinner at the cleft region for central teeth. The values for central teeth were 1.11 ± 0.38 mm and 1.30 ± 0.35 mm for cleft and noncleft regions, respectively (P = .048). The values for M1 and M4 for central teeth and the M0, M1, M2, and M4 measurements for canine teeth were similar in the cleft and noncleft regions.
The distances between the CEJ and AC are shown in Table 3. The CEJ-AC distance for central teeth at the cleft region was 2.34 ± 1.09 mm, and 1.53 ± 0.69 mm for the noncleft region. This difference was statistically significant (P = .002), confirming that the bone crest of central teeth was positioned more apically in the cleft region.
However, distances between CEJ-AC for canine teeth in cleft and noncleft regions were similar (2.51 ± 1.11 and 2.15 ± 0.81 mm for cleft and noncleft regions, respectively; P > .05). The horizontal distances of teeth in the cleft region were 1.6 ± 0.7 mm for central teeth and 1.9 ± 0.9 mm for canine teeth. This difference was not statistically significant (P > .05).

DISCUSSION
The radiographic amount of bone loss in teeth adjacent to a cleft area was evaluated previously. Bragger et al.12 reported that radiographic alveolar bone loss was greater at a cleft site compared with controls, despite a similar clinical attachment level. This suggested the presence of a periodontal attachment apparatus characterized by the presence of a long supracrestal connective tissue attachment. In the split-mouth study of Teja et al.,11 the periodontal conditions and bone levels in patients with unilateral alveolar cleft were evaluated using parallel periapical standardized radiographs. The results showed reduced bone levels on both the mesial and distal surfaces of central teeth adjacent to the cleft, compared with contralateral control teeth. However, no difference in the bone level for canines was noted between cleft and noncleft regions. Quirynen et al.2 evaluated 75 patients with UCLP with regard to periodontal health status. Radiographic bone loss was diagnosed when the distance between the CEJ and AC exceeded 1.5 mm. The results showed that bone loss was significantly higher for teeth on the cleft side compared with the contralateral noncleft control teeth. However, ours is the first report to evaluate the bone support of teeth adjacent to the cleft using CBCT. The results of our study indicated that the bone thickness of central teeth at crest level (M0) and 2 mm apical to the crest (M2) were thinner than in the contralateral noncleft region. Also, the CEJ-AC distance of central teeth adjacent to the cleft was

Table 2. Comparison of the Bone Thickness Distribution at Different Levels in Central and Canine Teeth

<table>
<thead>
<tr>
<th>Bone Thickness</th>
<th>Central Cleft Side</th>
<th>Normal Side</th>
<th>P Valuea</th>
<th>Canine Cleft Side</th>
<th>Normal Side</th>
<th>P Valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>0.91 ± 0.24</td>
<td>1.09 ± 0.26</td>
<td>.001</td>
<td>1.24 ± 0.69</td>
<td>1.33 ± 0.51</td>
<td>.522</td>
</tr>
<tr>
<td>M1</td>
<td>1.02 ± 0.28</td>
<td>1.04 ± 0.27</td>
<td>.700</td>
<td>1.14 ± 0.55</td>
<td>1.22 ± 0.45</td>
<td>.335</td>
</tr>
<tr>
<td>M2</td>
<td>1.11 ± 0.38</td>
<td>1.30 ± 0.35</td>
<td>.048</td>
<td>1.48 ± 0.74</td>
<td>1.32 ± 0.61</td>
<td>.366</td>
</tr>
<tr>
<td>M4</td>
<td>1.69 ± 1.19</td>
<td>1.65 ± 0.55</td>
<td>.862</td>
<td>1.66 ± 0.58</td>
<td>1.42 ± 0.60</td>
<td>.153</td>
</tr>
</tbody>
</table>

a M0, M1, M2, and M4: thickness of the buccal bone at 0, 1, 2, and 4 mm, respectively.
b P values determined by paired t-test.

Table 3. Mean ± Standard Deviation, Median, and Interquartile Range CEJ-AC Values

<table>
<thead>
<tr>
<th></th>
<th>Central Cleft Side</th>
<th>Normal Side</th>
<th>P valueb</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEJ-AC distance</td>
<td>2.34 ± 1.09</td>
<td>1.53 ± 0.69</td>
<td>.002</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Canine Cleft Side</th>
<th>Normal Side</th>
<th>P valueb</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEJ-AC distance</td>
<td>2.51 ± 1.11</td>
<td>2.15 ± 0.81</td>
<td>.312</td>
</tr>
</tbody>
</table>

a CEJ-AC is the distance between the cementoenamel junction and the alveolar bone crest.
b P values determined by Student’s t-test.
significantly higher. Thus, it would seem that alveolar bone support for central teeth in the cleft region is important for further periodontal inflammation, bone loss, and gingival recession. However, there was no difference for the canine teeth in cleft versus noncleft regions. In a noncleft study, Papapanou et al.17 reported that incisors showed the highest frequency of advanced bone loss. This response of central teeth was also noted for patients with CP in our study, possibly because canines erupt later than central teeth and in a more eligible position.

The periodontal status of the teeth close to the cleft area has been investigated.3,10,18–20 Several studies of periodontal disease progression reported increased pocket depths, attachment loss, and gingival inflammation at the cleft region versus controls.2,4,8,16,21 Gaggl et al.7 analyzed several types of cleft, including UCLP, CP, and bilateral CLAP. Patients with UCLP and bilateral CLAP showed a greater number of periodontal lesions in the maxillary front tooth region compared with the general population. However, some studies have reported that the periodontal disease was similar to that in other noncleft populations and the teeth close to cleft area were not at greater risk than those in noncleft regions.3,10,20 These variations may be due to differences in the study populations in terms of oral hygiene status, education, and socioeconomic status, and methodologic differences. In our study, we analyzed nontreated patients with UCLP using CBCT technology retrospectively. The advantages of the CBCT technology have been previously reported.23–24

In subjects with CLP, it is difficult to maintain oral hygiene because of oronasal communication.4 Stec et al.19 compared cleft and noncleft general populations and reported high plaque indices close to the cleft area. Perdikogianni et al.1 analyzed the oral hygiene and periodontal status of children and adolescents with CLAP. The cleft group had poorer oral hygiene compared with the control group, and teeth in the cleft region showed higher levels of periodontopathogens. Salvi et al.8 examined 26 subjects who were not enrolled in a supportive periodontal therapy program and concluded that cleft sites with high plaque and gingival inflammation scores showed more periodontal tissue destruction than control sites.

In the area of the developmental defect, a long supracrestal connective tissue attachment without complete bone support was reported by Bragger et al.12 However, this long connective tissue attachment does not constitute a “locus minoris resistentiae” for the progression of periodontal inflammation.8 Similarly, plaque scores in the cleft region were high and the mean full-mouth probing depth (PD) and clinical attachment level (CAL) scores deteriorated significantly over 25 years.19,21

CONCLUSIONS

- The bone thickness of the central incisor at the crest and 2 mm apically was statistically significantly thinner at the cleft region ($P < .01$). However, the values for M1 and M4 for central teeth as well as M0, M1, M2, and M4 measurements for canine teeth were similar in the cleft and noncleft regions.
- The mean CEJ-AC distance for central teeth in the cleft region was $2.34 \pm 1.09$ mm, compared with $1.53 \pm 0.69$ mm for the noncleft region ($P = .002$), while these distances for canine teeth in the cleft and noncleft regions were similar.
- Reduced bone support might cause several problems in the future. Thus, regular and strict professional dental control is essential for maintaining the periodontal health of these patients.

REFERENCES


Angle Orthodontist, Vol 85, No 6, 2015


