

# Relationship between root resorption and alveolar graft in teeth adjacent to the cleft lip and palate area

José Burgos **PONCE**<sup>1,2</sup>

Lidiane de Castro **PINTO**<sup>1,3</sup>

Michyele Cristhiane **SBRANA**<sup>1,4</sup>

Gisele da Silva **DALBEN**<sup>5,6</sup>

Ana Lúcia Pompéia Fraga de **ALMEIDA**<sup>4,7</sup>

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## ABSTRACT

**Introduction:** To radiographically evaluate the prevalence, extent and severity of root resorption in teeth adjacent to the cleft area after secondary alveolar bone graft.

**Methods:** Radiographs of 200 individuals with unilateral and bilateral cleft lip, alveolus and palate were analyzed to investigate the presence of root resorption related with the bone graft. A total of 1315 radiographs were analyzed (periapical, occlusal and panoramic radiographs) obtained from 200 individuals with complete unilateral or bilateral cleft lip and palate submitted to one graft surgery, available from the Radiology Section files of our institution.

**Results:** Among the 200 individuals, 33 had external root resorption. Among these, 15 were present on preoperative

radiographs, and 18 only after bone graft. Overall, 30 resorptions were located on the apical root third and 3 on the cervical third; the left central incisor was the most affected. No root resorptions were observed in the middle root third and no resorption affected more than one third. There was no statistically significant difference between age at the alveolar bone graft surgery and the presence of external root resorption. **Conclusions:** The prevalence of root resorption in teeth adjacent to the cleft area in individuals submitted to bone graft was low (16.5%). The apical root third was the most common location of external root resorption, and no resorption affected more than one root third.

**Keywords:** Cleft Lip. Cleft Palate. Root Resorption. Bone Transplantation

<sup>1</sup>Universidade de São Paulo, Hospital de Reabilitação de Anomalias Craniofaciais, Divisão de Odontologia, Seção de Reabilitação Clínica Integrada (Bauru/SP, Brazil).

<sup>2</sup>Doctorate degree in Dental Sciences, Universidade de São Paulo, Faculdade de Odontologia de Bauru (Bauru/SP, Brazil).

<sup>3</sup>Doctorate degree in Rehabilitation Sciences, Universidade de São Paulo, Hospital de Reabilitação de Anomalias Craniofaciais (Bauru/SP, Brazil)

<sup>4</sup>Doctorate degree in Oral Rehabilitation, Universidade de São Paulo, Faculdade de Odontologia de Bauru (Bauru/SP, Brazil).

<sup>5</sup>Universidade de São Paulo, Hospital de Reabilitação de Anomalias Craniofaciais, Divisão de Odontologia, Seção de Odontopediatria e Saúde Coletiva (Bauru/SP, Brazil).

<sup>6</sup>Doctorate degree in Oral Pathology, Universidade de São Paulo, Faculdade de Odontologia de Bauru (Bauru/SP, Brazil).

<sup>7</sup>Universidade de São Paulo, Faculdade de Odontologia de Bauru, Departamento de Prótese e Periodontia (Bauru/SP, Brazil).

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Contact address: José Burgos Ponce  
Centro Universitário de Adamantina  
Rua Nove de Julho, 730, Centro – Adamantina/SP  
E-mail: [pepeburgos@usp.br](mailto:pepeburgos@usp.br) - [pepitoburgos@gmail.com](mailto:pepitoburgos@gmail.com)

## Introduction

Clefts affecting the alveolar ridge require alveolar bone graft (ABG) for rehabilitation. Depending on the period when this graft is performed, it may be primary, secondary or tertiary. This procedure may be performed using autogenous bone graft, harvested from the iliac crest, calvaria, thorax or tibia.<sup>1,2</sup> The secondary alveolar bone graft (SABG) is a reliable method for reconstruction of alveolar clefts<sup>1</sup> and is necessary for oral rehabilitation, which is initiated by maxillary expansion and alignment of segments to enhance the bone grafting.<sup>1,2</sup> One of the undesirable side effects of bone grafting may be the occurrence of external root resorptions in teeth adjacent to the grafted area.<sup>1</sup>

The etiology of root resorptions is still unknown;<sup>3,4</sup> however, several factors have been reported, including orthodontic treatment, trauma with tooth luxation or avulsion, internal tooth bleaching, periodontal therapy, bone graft, surgeries causing damage to the cementoenamel junction, besides other factors as bruxism and genetic predisposition<sup>5</sup>. Considering root resorptions as loss of dental tissue (dentin and cementum) as a result of odontoclastic action, the presence of an inflammation area is mentioned in the literature.<sup>4</sup>

The external root resorptions may be categorized as inflammatory, invasive cervical or replacement resorption.<sup>6</sup> According to the affected region, they may be classified as coronal, cervical, radicular lateral and apical. Those located at the cervical region are more related with bone grafts, while apical resorptions are related with orthodontic treatment.<sup>7</sup>

The diagnosis of external root resorptions requires special attention; depending on the severity of resorptions, the treatment may be simple or even require tooth extraction.

This study evaluated the prevalence, extent and severity of this pathology in teeth adjacent to the cleft lip and palate area.

## Methods

This study was approved by the Institutional Review Board of Hospital de Reabilitação de Anomalias Craniofaciais/USP. The study sample included radiographs of 200 individuals with cleft lip, alveolus and palate, unilateral and bilateral (UCLP - BCLP), of both genders, from the files of the Radiology sector. The inclusion criterion was previous accomplishment of alveolar bone

graft surgery.

Panoramic and occlusal radiographs were obtained from each individual, as part of the rehabilitation protocol of the institution. The radiographs were divided in two groups, namely before SABG and postoperatively after SABG.

One panoramic and one occlusal radiograph before bone graft and one panoramic and one occlusal radiograph after bone graft were taken as standard radiographs in this study, adding up to 200 panoramic and 200 occlusal pre-graft radiographs and 200 panoramic and 200 occlusal post-graft radiographs.

The radiographic images were evaluated on a film viewer with the aid of a magnifying glass with 3x magnification and 75-mm diameter and an opaque frame, in ideal observation conditions, to analyze the presence of root resorptions in teeth adjacent to the grafted cleft lip and palate area and to determine:

- a) Identification of the tooth presenting root resorption.
- b) Location and severity - the location of resorption was determined according to the affected root third: apical, middle or cervical. The severity was determined by affecting more than one root third.

Data were analyzed by the Proportion Confidence Interval and chi-square test, at a significance level of 5%.

The following parameters were also collected on the individuals' records and analyzed:

- c) Timing of appearance - resorptions were divided in two groups, either present before or after bone graft.
- d) Individual's age at the time of SABG.

## Results

A total of 800 radiographs (400 panoramic and 400 occlusal) were evaluated. Additionally, further 515 periapical radiographs of the individuals available from the files were analyzed, without a fixed number for all individuals. Therefore, the final sample was composed of 1315 radiographs (Table 1).

Among the 200 individuals analyzed, 33 (16.5%) presented external root resorption in some tooth, 15 (45.45%) were present in pre-graft radiographs and 18 (54.55%) were only present after bone graft. The Proportion Confidence Interval was applied to indicate the percentage of external root resorptions with respective upper and lower

limits, representing the maximum and minimum values under the total sample, respectively (Fig 1).

Among the resorptions observed, 30 (90.90%) were located at the apical root third and three (9.10%) at the cervical third, mainly affecting the maxillary left central incisor (Table 2). No root resorptions were observed in the middle root third, and no resorption affected more than one root third.

The age of individuals with root resorption at the time of ABG was recorded, as well as the age when root resorption was detected on the radiographs (Table 3). This revealed the presence of root resorption after alveolar bone graft in individuals aged up to 12 years (9 resorptions) and after 12 years (9 resorptions), without statistically significant difference between the two groups ( $p= 0.91$ , chi-square test).

**Table 1.** Number of radiographs analyzed

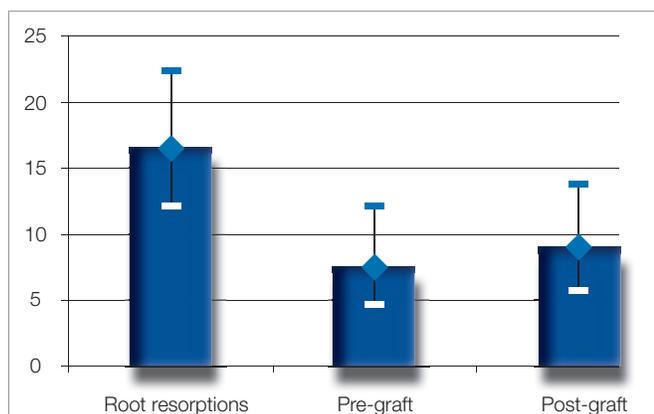
Number of radiographs	Periapical radiographs	Panoramic radiographs	Occlusal radiographs	Total
Pre-graft	281	200	200	681
Post-graft	234	200	200	634
Total	515	400	400	1.315

**Table 2.** Distribution of the number of teeth affected by external root resorption

	Central incisor		Lateral incisor		Canine	
	Left	Right	Left	Right	Left	Right
Cervical	1	0	1	0	1	0
Apical	15	13	1	0	1	0
TOTAL	16	13	2	0	2	0

**Table 3.** Mean age of individuals with root resorption according to the bone graft surgery.

	SABG surgery			Individuals with resorption after bone graft			Individuals with resorption before bone graft		
	Mean	Standard deviation	Median	Mean	Standard deviation	Median	Mean	Standard deviation	Median
Age	14.77	6.41	12	15.88	7.82	12,50	19.13	8.70	17
Total (n)		200			18			15	



**Figure 1.** Proportion Confidence Interval of root resorptions (pre- and post-graft).

## Discussion

After ABG surgery in individuals with cleft lip and palate, the alveolar processes present as a single structure,<sup>8</sup> allowing orthodontic treatment and later rehabilitation of the dental arch.

This procedure is satisfactory and allows continuity of the alveolar ridge without the need of dentures,<sup>3</sup> besides mechanically stabilizing the maxillary segments, providing healthy periodontal conditions, eliminating the airway obstruction, providing bone support for the nasal base and allow implant placement at the grafter cleft area, if needed.

The cancellous bone obtained from the iliac crest is still the most used graft material, yet new grafts using allogeneic materials are being experimentally used without variation in the outcomes compared with the cancellous bone graft.<sup>1</sup> Notwithstanding, root resorptions after this procedure are described in the literature.<sup>3,4</sup>

The precise mechanism involving root resorptions is still unclear, yet several etiologic factors have been suggested: orthodontic treatment, trauma with tooth luxation or avulsion, internal bleaching, periodontal therapy, bone graft, surgeries causing damage to the cementoenamel junction, besides other factors as bruxism and genetic predisposition<sup>3,5,9</sup> or even the superimposition of these factors.<sup>10,11</sup> When external resorption is diagnosed, multidisciplinary treatment should be offered to achieve the best possible outcome.<sup>12</sup>

At the operated cleft area, the remaining teeth are determinant for integral rehabilitation of the individual and treatment often requires more than one dental specialty.<sup>9,13,14</sup> The early diagnosis and knowledge on the possible complications caused by external root resorptions reduces the risk of tooth loss and aids the planning of oral rehabilitation, either with restorations or dentures.

The type of treatment depends on the location of root resorption. In cases of apical external root resorption (AERR), which presented the highest percentage in this study, endodontic biomechanics is indicated in the presence of pulp necrosis, with placement of root canal dressing between sessions, as described in the literature.<sup>11,15</sup> The utilization of MTA is indicated for obturation of teeth with AERR due to the high pH, which allows inactivation of the inflammatory process and delays the odontoclastic activity,<sup>15</sup> besides being able to stimulate the cementoblasts and odontoblasts.<sup>16</sup> Surgical treatment is also an option for the treatment of invasive external resorptions.<sup>15,17</sup>

In case of cervical root resorption, which was not frequent in this study, the treatment often requires periodontal intervention.<sup>13,14</sup> The material used to restore the resorption defect is related to the sealing ability and the tooth surface affected; amalgam was used for that purpose,<sup>3</sup> and currently the indicated materials include MTA,<sup>11,18</sup> glass ionomer<sup>4,13</sup> and composite resin.<sup>12,19</sup>

The early detection of external root resorptions, as well as their prevalence and incidence, is fundamental for completion of rehabilitation, since the number of

sessions, dental specialties involved and cost will depend on the extent and location of resorption.

Orthodontics represents an important stage in the rehabilitation of individuals with cleft lip and palate and work in the preparation before bone graft. The utilization of excessive forces in the orthodontic treatment may cause tissue necrosis of the tooth root, exposing the dentin and triggering the odontoclastic activity,<sup>5</sup> being considered as an etiologic factor of root resorptions, especially of apical external root resorptions (AERR), yet the lack of randomized clinical studies precludes the full elucidation.<sup>7</sup> Conversely, Cwyk, Saint-Perre and Tronstad<sup>20</sup> associate the orthodontic treatment to cervical external root resorptions (CERR), though in low proportion.

In this study, the presence of at least two important etiologic factors (bone graft and orthodontics) and the lack of elucidation concerning the etiology of root resorptions do not allow establishing the role of each factor in the occurrence of this pathology or even stating the cause of present resorptions.

It should also be considered that root resorption often continues after cessation of orthodontic forces,<sup>21</sup> which corroborates the difficulty observed in this study to determine the role of each possible etiologic factor.

This study found a prevalence of 33 root resorptions in a sample of 200 individuals, all submitted to alveolar bone graft surgery. However, 18 root resorptions (54.5%) were diagnosed only after bone graft surgery, among which two affected the cervical third and 16 the apical third. The study conducted by Gerner et al,<sup>3</sup> on 419 individuals submitted to secondary alveolar bone graft surgery, observed root resorptions in 15 patients, all affecting the cervical third. The treatment of these pathologies is related to severity of the lesion, which may impair the orthodontic treatment<sup>22</sup> or even the completion of rehabilitation.

In individuals without clefts, the maxillary incisors are the teeth most affected by external root resorption, followed by the mandibular incisors and first molars.<sup>7,10</sup> In this study, the maxillary central incisor was the most affected among the teeth close to the cleft analyzed in this study, namely maxillary incisors and canines. It should be mentioned that, in the average, the incisors are submitted to more extensive orthodontic movement in the dental arch compared with other teeth, which may predispose to root resorptions<sup>10</sup>. However, in individuals

with cleft lip and palate, the incisor is contra-angulated and tipped, with the crown turned toward the distal side filling part of the cleft space, while the apex is mesialized. The maxillary canine also tends to present excessive positive angulation with the crown inclined toward the defect, requiring wide orthodontic movement.

By itself, age is not a predisposing factor for root resorption,<sup>23</sup> yet it may become a factor if considering the relationship between secondary bone graft period to the period of canine eruption.<sup>3</sup>

The pre- and postoperative panoramic radiographs were taken as standard images because they are part of the radiographic protocol of our institution, even though they are considered to have low quality for location of root resorptions. Nonetheless, utilization of this radiograph for identification of root resorptions has been described in the literature<sup>24</sup> because it is considered a standard in rehabilitation and orthodontic follow-up protocols.<sup>10</sup>

The occlusal radiographs allow more accurate observation of the graft area and adjacent teeth. However, in this study, despite the availability of pre- and post-graft occlusal radiographs, the second was obtained in the immediate postoperative period, which does not allow utilization as an image for evaluation of root resorptions after bone graft, reminding that the short time of exposure to the etiologic factor analyzed (ABG) would not allow radiographic observation of this pathology.

## Conclusion

The prevalence of root resorptions in teeth adjacent to the cleft area in individuals submitted to bone graft was low. The most frequent location of root resorptions was on the apical root third, and no resorption affected more than one root third. Additional follow-up clinical studies are necessary to evaluate the actual relationship between root resorptions and alveolar bone graft.

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