



# **Clinical Evaluation of Surgical Orthodontic Procedure with Bone Grafts for Patients with Cleft Palate during Adolescence**

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## **Author's contribution**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

## **Article Information**

DOI: 10.9734/JPRI/2021/v33i47A33070

Editor(s):

(1) Dr. Giuseppe Murdaca, University of Genoa, Italy.

Reviewers:

(1) Uchenna Chukwuemeka Okechi, University of Nigeria, Nigeria.

(2) Olalere Omoyosola Gbolahan, University of Ibadan, Nigeria.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/75162>

**Original Research Article**

**Received 18 August 2021**

**Accepted 22 October 2021**

**Published 29 October 2021**

## **ABSTRACT**

**Background:** Cleft lip and palate is a congenital anomaly, presenting in a wide variety of forms and combinations. Successful cleft lip and cleft palate rehabilitation requires a multidisciplinary approach employing the skills of different specialists.

**Aims & Objectives:** The aim of this paper was to present orthodontic preparation of patients prior to alveolar bone grafting & to review our findings in a group of patients treated by secondary and delayed bone-grafting procedures at our institution.

**Methodology:** Thirty eight patients were examined for the type of cleft and the age at the time of examination. 10 patients were treated in our institution with presurgical orthodontics & operated by a delayed bone-grafting technique. Duration and type of expansion was noted at pre-operative, 2 months and 6 months. Crestal bone heights and the quality of the bone in the grafted areas was examined radiographically, along with presence of any fistulas.

**Results:** All the patients demonstrated improved alar base and upper lip support, also better dental stability was seen in the region of cleft.

**Conclusion:** All the patients included in this study appeared to benefit from the procedure with improved facial balance. In all ten patients the oronasal fistulas remained closed, hence was reported to be a success.

*Keywords:* Cleft Lip; cleft palate; birth defect; alveolar bone graft; pre- surgical orthodontics; maxillary expansion; quad helix.

## 1. INTRODUCTION

Cleft lip and palate is a congenital anomaly, presenting in a wide variety of forms and combinations. It occurs for every one out of 500-1000 live births [1,2]. It has a significant psychological as well as physical impact on the quality of life of patients. Cleft Lip/Palate(CL/P) is a deformity that occurs when there is failure of fusion of the premaxillary complex and the palatal shelves [3]. Classification variants of CL/P are usually based on their anatomic location. The overriding objective of CL/P repair is to reconstruct and therefore revive the regular functioning of the palate and aid in natural dialogue [3].

Maxillary clefts can prevent the natural regression of permanent teeth, therefore, interfering with the natural growth and development of the jaw [4]. The resolution of function and morphology of the maxillary jaw is crucial and the reconstruction of the bone defect is required. Satisfactory preparation at the site of the cleft allows it to receive the appropriate amount of bone graft. Early closure of the palatal defect can lead to posterior crossbite and maxillary deficiency. It is therefore preferred that expansion be carried out prior surgery, since there is less resistance, better access to the cleft close to the nasal floor, superior oral hygiene, and a reduced chance of a recurring oro-nasal fistula [4].

While early surgical intervention improves the patient's quality of life, it also tends to reduce inter-canine width and cause anterior crossbite [5]. Dentofacial orthopedics and surgery consisting of alveolar bone grafting helps in successful rehabilitation of children suffering from cleft lip and palate deformity. The aim of this paper was to present orthodontic preparation of patients prior to alveolar bone grafting & to review the findings observed in a group of patients treated by secondary and delayed bone-grafting procedures at our institution.

## 2. MATERIALS AND METHODS

Thirty eight patients were examined; the type of cleft, age at the time of examination was noted. 10 patients out of these were treated with presurgical orthodontics & operated on at our institution by a delayed bone-grafting technique (Figs. 1 and 2). These patients were examined preoperative, two months' postoperative, and 6 months postoperative. Follow-up radiographs (RVG, panoramic, maxillofacial CT) were reviewed (Fig. 3). Since our study was set in a rural environment, obtaining CTs for all cases was not feasible, therefore, RVGs and Panoramic Radiographs were also used. Duration and type of expansion and duration of presurgical orthodontics was noted. Duration of maxillary traction, correction of Class III skeletal relationship was recorded. The level of the grafted bone on the teeth adjacent to the cleft was evaluated. This was compared with the level of the grafted bone six months postoperative. The radiographic examination provided information on crestal bone heights and the quality of the bone in the grafted areas. The status of fistulas and the quality of the grafted bone was assessed. The extent to which the grafted bone elevated the nasal base and provided upper lip support was assessed. Panoramic views were taken before the surgery, after the surgery, 6 months after the surgery, and at the time of the final follow-up [6]. Since this is a prospective study that only evaluates patient records.

Similar operative procedures were used on all patients. Graft was harvested from the iliac crest of the patients and inserted into the cleft defect. The soft tissues lining the cleft defects were elevated and everted into the nasal cavity and sutured to form a nasal floor. After the bone was packed into the cleft, soft tissues were either rotated from the cheek to cover the grafted bone or a sliding periodontal flap was used to cover the defect. Occasionally, in narrow clefts, tissues lining the cleft defect were used to cover the oral side of the bone graft.

### 3. RESULTS

The distribution of clefts examined included twenty-seven unilateral clefts amongst which 12 were left sided unilateral clefts and 15 were right sided unilateral clefts. 6 patients were with bilateral clefts. 2 patients were with cleft palate only. Three patients were with Cleft lip & Alveolus. (Table 1) In totality, out of 38 patients, 21 were males & 17 were females (Table 2). At the time of examination, the ages groups ranged from 3.5 years to 23.7years, with a mean age of 12years and 8months. 10 patients out of these were operated on at our institution by a delayed bone-grafting technique & were evaluated for the same.

The mean age of the patients at the time of surgery was 12.5 years with a range of 9.2 years to 15.4 years. Cases were on a regular follow up for a period of 6 months.

In three patients, bone grafts were placed prior to the eruption of the maxillary canines. In four patients the teeth were moved into the bone graft orthodontically, while in three patients no movement of teeth was required in the grafted bone (Table 3), as the premaxilla was found to be stable with good arch form and continuity post surgery.

Periapical radiographs of the bone-graft sites portrayed to have bone of normal radiographic appearance in the repaired cleft alveolar region. Bone density, trabeculation, and crestal height were assessed at the end of two months and six months, and showed satisfactory results. Bone density, trabeculation was comparable to the adjacent bone. The success rate of the graft was indicated by the level of bone attachment on the proximal root surface of the tooth adjacent to the cleft, relative to the length root on the periapical radiographs. Oronasal fistulas remained closed. Palatal fistulas in two cases were persistent. An objective esthetic evaluation of the face was done. All demonstrated improved alar base and upper lip support.

Nine had pre-and/or postoperative orthodontic treatment, as follows; Quad helix was used as an expansion device in presurgical orthodontics on seven of these and hyrax rapid palatal expansion screw was used on two patients. Delaire traction face mask was used to correct the sagittal discrepancy in six patients. 8-12 months (mean 10 months) of reverse headgear treatment improved the sagittal jaw relationship, which was

affected by skeletal dental changes. Better dental stability in the region of the cleft was observed.

### 4. DISCUSSION

Marked variation is seen in both the severity and types of the clefts at the time of examination. Multidisciplinary approach is vital to successful rehabilitation of cleft lip and palate patients [7]. Presurgical orthodontics and Dentofacial orthopedics is essential for optimal results. Cleft palate cases will often have a narrow upper arch, and this should be corrected before bone grafting [8,9]. A Quad Helix appliance or palatal expansion screw was used for this purpose at our institute. Expansion will often open and identify an occult defect in the alveolar bone. For this reason, it is carried out before bone grafting procedures. Speech may deteriorate as the defect is opened, however this is temporary until surgical closure is carried out. Although this technique results in enlargement of the palatal fistula, thereby requiring more bone and rotation of more soft tissue, it makes the access easier at the time of surgery. In addition, the tendency toward postsurgical arch collapse is decreased by releasing the soft-tissue tension secondary to scarring. Patients with cleft lip and cleft palate often develop maxillary retrognathism and anterior crossbite. This is due to the combined effects of the congenital deformity and surgical repairs. Early protraction of the maxilla with extraoral force helps to achieve more balanced skeletal harmony and favorable occlusion for future growth to occur [10,11,12]. Reverse headgear used in correction of these deformities showed encouraging results. On an average 10 months of reverse headgear treatment improved the sagittal jaw relationship, which was affected by skeletal dental changes. This corroborates with the findings of Tindlund RS, Rygh P [13]. Teeth movement into grafted bone was done two months after the bone grafting procedure. All patients except one had presurgical orthodontic treatment. The age at which orthodontics was initiated varied because patients reported for the treatment or were referred at different age groups. For canine to erupt through the bone, grafting should be done before 3/4<sup>th</sup> root formation [14]. This is not always possible because pts report for treatment at different age groups. More awareness in patients and parents is required to achieve optimal treatment benefits. A designated Cleft Lip and palate center equipped to provide comprehensive cleft care will result in optimal treatment results.

Various clinical and radiological criteria were used to assess the success of the alveolar bone grafting. Maxillofacial CT proved to be a good tool for judging bone consolidation and trabecular patterns and crestal bone levels. Graft groups showed a significantly higher incidence of bony bridging.

Supporters of secondary grafting assert there is little disruption to facial growth. This disruption is seen because a larger percentage of the adult size has been achieved before grafting [14,15]. In addition, it is expected that the canines would migrate and erupt through the grafted area, thus resulting in improved development of the dentition. Additionally it will also result in improved bony environment so as to facilitate orthodontic and prosthodontic treatment. Last but not the most important, it would render improved stability and health of the periodontium [16].

Recently, delayed grafting has been reported as a possible method to achieve a firm anatomic base to aid orthodontic or prosthodontic management while avoiding interference with facial growth [16]. In our study, in two patients, the bone graft was placed prior to eruption of the canines in order to provide support for the unerupted canines. In the remaining eight patients, the bone grafts were placed post canine eruption. In three of these patients teeth were orthodontically moved through the grafted bone.

Literature suggests a trend toward increased incidence of graft failure in the secondary alveolar bone grafting [17]. This was not observed in the current study. Reasons for this could be improved surgical technique and strict adherence to the post surgical care. A follow up of up to two years is required to arrive at a definite conclusion. Larger sample is required to study the factors such as the effect of age in success of bone grafting. Future studies are planned in which the sample size would be increased and additional populations will be evaluated.

All patients in this study demonstrated varying sizes of oral-nasal fistulas pre surgically. In our patients, four palatal fistulas persisted while all buccal fistulas remained closed. This indicates the success in the technique of closing fistulas by the three-layered closure method. The success of closing fistulas with only soft tissues, without bone grafts, was not assessed.

Improved alveolar ridge morphology and ridge contour was observed in all patients. This is

exclusively true when this patient population is compared to other cleft patients who have not had bone grafts.

In spite of the placement of a bone graft, adequate retention was provided to prevent transverse collapse of the arch, this is because tension from palatal scars causes transverse relapse.

The esthetic benefits of alveolar bone grafting were complimentary to facial form. It provided support to the nasal structures. All patients demonstrated improved nasal base support and improved nasolabial projection.

## 5. CONCLUSION

A retrospective analysis of ten cleft patients who had undergone bone-grafting procedures has been reported. All the patients included in this study appeared to benefit from the procedure. In all ten patients the oronasal fistulas remained closed. All patients demonstrated improved facial balance.

## CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the author(s).

## ETHICAL APPROVAL

Institutional ethical approval was obtained from the institute.

## COMPETING INTERESTS

Author have declared that no competing interests exist.

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**Annexure 1: Tables**

**Table 1. Three patients were with Cleft lip**

| Types of cleft       | Number of patients |   |
|----------------------|--------------------|---|
| Unilateral clefts    | 27                 | 15 right sided clefts.<br>12 left sided clefts. |
| Bilateral clefts     | 6                  |   |
| Cleft Palate only    | 2                  |   |
| Cleft lip & Alveolus | 3                  |   |

**Table no. 2:**

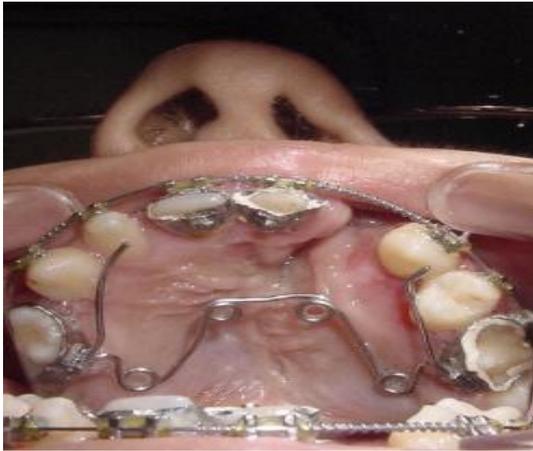
**Sex-wise distribution**

| Males | Females |
|-------|---------|
| 21    | 17      |

**Table 3. Amongst the 10 patients: 9 patients had pre/ post operative orthodontic treatment**

|                |  |
|----------------|--|
| Three patients | Bone grafting was done prior to eruption of canines.     |
| Four patients  | Orthodontic tooth movement was achieved with bone graft. |
| Three patients | No tooth movement was required post bone grafting.       |

**Annexure 2: Figures:**



**Fig. 1. Expansion with quad helix**



**Fig. 2. Bone grafting**



**Fig. 3. Maxillofacial CT 6months after bone grafting**

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