

# Orthodontic Preparation for Bone Graft in Cleft Palate Patients - A Review

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## Abstract

Cleft palate patients require a multidisciplinary care from birth to adulthood by teamwork of healthcare providers; the orthodontist plays a major role in this team. Filling the bony defect at the cleft area with a bony graft requires an orthodontic preparation in order to expand the collapsed palatal segments; this is best done during the mixed dentition and before eruption of the permanent canine. The best guide to proper timing of bone graft is the stage of root formation of erupting canine shown by a radiograph.

**Key words-** Cleft Palate, Expansion, Bone Graft

## Introduction

Cleft lip and/or palate are the most common craniofacial anomalies, occurring disproportionately across the world, and presumed to be higher in developing countries. Treatment of cleft patients necessitates a team work of several medical and dental specialties. This multidisciplinary care starts from birth and continues into adulthood. The orthodontist plays an important role in the management of cleft patients especially to prepare cleft patients for bone graft and orthognathic surgery, to monitor growth and development of the face and to keep patients' records during treatment.

### Embryology and Etiology of cleft formation

The critical period for proper intrauterine development of the face is between the fifth and seventh weeks of gestation, with the sixth week being the most important. During this time, the morphodifferentiation and orientation of the unpaired frontonasal process, which includes the medial and lateral nasal processes, occur simultaneously with progressive medial migration and growth of the paired maxillary processes.<sup>1</sup>

The palate is formed in two stages: In the first stage, the primary median palatal triangle is formed, derived from the merging of the two mesial processes originated from the median frontonasal process. This is completed by the eighth intrauterine week. In the second stage, shelf-like outgrowths known as *lateral palatine processes*, derived from the maxillary processes, grow horizontally above the tongue to form the secondary palate. The merging or fusion of these processes is completed by the twelfth intrauterine week.

The etiology of cleft remains unclear. It is presumed to be multifactorial, with various contributing environmental and genetic factors.<sup>2</sup> But any insult to the fusion process between the fifth and seventh intrauterine weeks leads to the formation of clefts.

### Problems Associated With Clefts

Patients with cleft lip and palate usually face a multitude skeletal and dental abnormalities include: anterior and posterior crossbites due to anteroposterior and transverse deficiency of the maxilla, rotation of the incisors due to muscle pull, lateral

rotation of the incisors due to muscle pull, lateral incisors at the cleft site are frequently missing and supernumerary teeth may be present at the non-cleft side. Carious teeth and periodontal inflammation are often present due to dental neglect (Fig. 1 and Fig. 3), in addition to oronasal fistula, speech and hearing pathology.<sup>3,4</sup>

### Treatment Timing and Protocol

The first procedure that cleft patients receive is surgical closure of the lip. Following the "rule of 10s," a patient admitted for lip closure should be 10 weeks of age, weigh at least 10 pounds, have a hemoglobin  $\geq$  10 mg/100ml, and have a WBC count  $<$  10,000 cu/mm in order to withstand surgery and anesthesia.<sup>5,6</sup>

In the primary dentition stage, focus is on restoration of the primary dentition using mainly fillings, stainless steel crowns, and oral hygiene rather than orthodontics or surgery, because any pathology in primary teeth especially adjacent to cleft may interfere with the bone graft surgery and affects its long term success.

Sometimes, expansion by a removable appliance is carried out in cross bites with functional shifts of the mandible upon closure to avoid any asymmetric mandibular growth. At this young age, cooperation of the patient remains a factor. This further necessitates delay of treatment to the mixed dentition stage.<sup>4</sup>

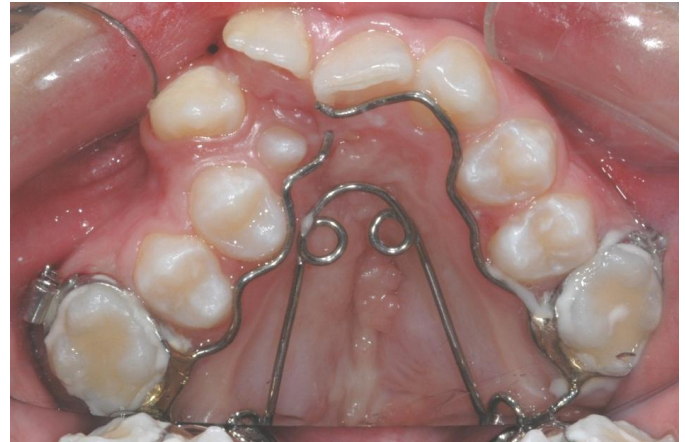
### Treatment Principles in the Mixed Dentition Stage

The main objective during the mixed dentition stage is to prepare the cleft palate patient for a bone graft. The proper orthodontic preparation for the bone graft is usually carried out in the mixed dentition. The guide for proper timing for the beginning of this procedure is the stage of formation of the root of upper canine, this is better than just following chronological age, when one third of the canine is formed viewed by a periapical x-ray is the best time to consider bone graft, this could be between 7-9 years then this could be the best time to start orthodontic preparation for the bone graft, the goal being to have the canine erupted through the bone graft at the cleft area which stabilizes the graft.

When the bone graft is performed at the proper timing, this may lead to spontaneous canine eruption through the graft and healthy gingiva surrounding the graft, with normal bone height.<sup>3,6</sup>

The collapsed (overlapped) alveolar segments may be impeded in their growth. It is important that these segments be unlocked by expansion during the early stages of development when growth is most rapid. Orthodontic expansion of collapsed buccal segments will also facilitate the push-back of the premaxilla to restore a favorable arch form, which was initially interrupted by the lack of alveolar bone continuity on the cleft side.

Expansion is carried out successfully by a quadhelix expansion appliance, giving the surgeon a more favorable surgical field to perform the bone graft. Expansion devices should be used for at least four months after the bone graft, as freshly grafted bone is unable to maintain the expansion (Fig.1 and Fig. 2).<sup>4</sup>



**Figure 1: Collapsed buccal segments in unilateral cleft palate patient before expansion**

Crowding is usually present on the non-cleft side in unilateral cleft patients, and should also be relieved during the mixed dentition stage. At the crowding site, serial extractions can sometimes be carried out to provide space for eruption of the canine, while lateral incisors are usually missing at the cleft side. Supernumerary teeth should be extracted during the bone graft surgery and primary teeth adjacent to cleft should be extracted at least two months prior to surgery.<sup>7</sup>



**Figure 2: Post orthodontic expansion of collapsed buccal segments**

The central incisor is usually distolabially rotated and inclined due to muscular pull (Fig.3, Fig. 4 and Fig. 5). Care should be taken while leveling this incisor and other teeth, so as not to push the roots of these teeth into the cleft space. Following a successful graft placement, it is preferable to keep the incisor roots invested in bone at

the pre-grafting stage while the correct tooth angulation is achieved at least 2 months after grafting (Fig.6).<sup>4</sup>



**Figure 3: The central incisor is usually distolabially rotated and inclined in a cleft palate patient**

Bone grafting has several advantages. It is performed to support the long-term expansion of the dental arch, maintaining arch continuity and form while also providing bone for the passage of the erupting canine through the graft.<sup>3</sup>

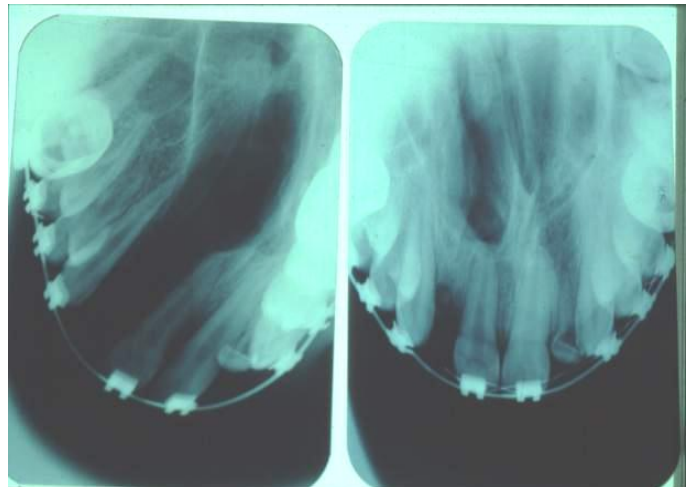


**Figure 4: Corrected position of the central incisor after bone graft**

A bone graft will also support the teeth adjacent to the cleft site, ensuring orthodontic movement of these teeth without periodontally compromising them. The bone graft will also improve facial esthetics by providing support to the base of the nose which is lacking due to



**Figure 5: A successful bone graft placement appearing by a periapical X-ray**



**Figure 6. Incisor roots invested in bone at the pregrafting stage while the correct tooth angulation can be achieved after successful graft placement**

the cleft space; in addition, closure of oronasal fistulas is usually performed during the bone grafting procedure. The bone graft is usually taken from the cancellous bone of the iliac crest. According to White and White Bone from the anterior portion of the iliac crest provides a better quality and quantity of graft with minimal morbidity. Other donor sites that provide cancellous

bone include the mandibular symphysis, the rib, and the skull.<sup>3</sup>

### Summary

The orthodontist plays a major role in the team management of cleft palate patients. The surgical filling the bony defect at the cleft area with a bony graft requires an orthodontic preparation in order to expand the collapsed palatal segments and level and align the teeth in the arch without bringing the roots to the cleft are, this is best done during the mixed dentition and before eruption of the permanent canine. The best guide to proper timing of bone graft is the stage of root formation of erupting canine shown by a radiograph.

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