

Alveoloplasty As a Secondary Treatment for Cleft Palate: A Review Article

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ABSTRACT

Cleft palate is the most prevalent congenital defect. It is more prevalent in 3rd world countries. The internationally accepted steps of treatment are: 3 to 6 months – surgery to repair a cleft lip if present, 6 to 12 months – surgery to repair a cleft palate, 18 months – speech assessment, 3 years – speech assessment, 5 years – speech assessment, 7 to 12 years – bone graft to repair a cleft in the alveolar bone, 12 to 15 years – orthodontic treatment and monitoring jaw growth. Secondary alveoloplasty serves to enable the patient to have a better quality of life through the augmentation of the alveolar ridge and hence open up the doorway to various modes of dental rehabilitation for proper nutrition and development. The most commonly used method is Boyne's technique. The use of growth factors has increased the success rate of the contemporary method. With the advent of virtual planning and surgery, the quality of care has recently skyrocketed, yet is still out of reach of most patients due to its high cost. In this article, we shall delve deeper into the topic of secondary alveoloplasty.

Keywords: Alveoloplasty In Cleft Palate, Secondary Bone Augmentation In Cleft Cases

INTRODUCTION

Among all of the congenital deformities, cleft palate is the most common. Average prevalence rate is 1:1000, and has several grades of severity. It is generally characterized by a discontinuity in the plate which may or may not extend to the premaxilla and alveolar ridge. Over the years various theories have been proposed to explain the phenomenon, namely (1) alteration in intrinsic palatal shelf force, (2) Failure of tongue to drop down, (3) Non fusion of shelves, (4) Rupture of cyst formed at site of fusion. The condition has been deemed to be multifactorial in etiology, which are, (1) Genetic, (2) Nutritional disturbances during development, (3) Stress during development, (4) Ischemia, (5) macroglossia, (6) Environmental factors like infection, use of teratogenic drugs, antibiotics, radiation, hormonal disturbances, (7) consumption of alcohol and tobacco by the mother during development. Classifications:

1. VEAU' CLASSIFICATION:

Group I- Involving only the soft palate

Group II- Cleft on soft and hard palate extending only till incisive foramen

Group III- Complete unilateral cleft involving the soft palate, hard palate, alveolar ridge and lip on one side

Group IV- Complete cleft on soft palate, hard palate, alveolar bone and lips bilaterally

2. KERNAHAN AND STARK'S CLASSIFICATION:

GROUP I (primary palate only)- (a) unilateral (b) bilateral (c) total (d) subtotal

GROUP II (secondary palate only)- (a) total (b) subtotal (c) submucous

GROUP III (both primary and secondary palate)- (a) unilateral (total and subtotal) (b) median (total and subtotal)

Steps in treatment plan for cleft palate cases:

Birth to 6 weeks – feeding assistance (use of obturators), support for parents, hearing tests and pediatric assessment

- 3 to 6 months – surgery to repair a cleft lip if present
- 6 to 12 months – surgery to repair a cleft palate
- 18 months – speech assessment
- 3 years – speech assessment
- 5 years – speech assessment
- 7 to 12 years – bone graft to repair a cleft in the alveolar bone
- 12 to 15 years – orthodontic treatment and monitoring jaw growth

The word ALVEOLOPLASTY means to surgically mould the size or/and shape of the alveolar process. Historically alveoplasty has been known and used for more than 170 years. A. T. Wilard of Chelsea, Massachusetts, in 1853 was the 1st known surgeon to reduce alveolar process in order to accomplish complete approximation of soft tissues over the ridge. Bone is a living tissue where osteoclastic as well as osteoblastic activities takes place, so the surgeon must start with the maxim that bone is precious and must not be wasted, therefore, its conservation is desired. Following Wolff's law of bone adaptation, alveolar bone remodels itself in response to each new situation of pressure. It will heal after dental extractions, and it will usually attempt to adapt itself to the general configuration of the rest of the alveolar arch, Alveolar cortical bone will re-form in approximately 3 months, more or less^[1]. Thus, it is an irreplaceable tool in the arsenal of surgeon in cleft palate cases involving alveolar bone.

DISCUSSION

The protocol for treatment of cleft palate cases which is widely accepted is that, 7-11 years of age is ideal for correction of maxillary bone defect. Boyne et al were the 1st to consider alveoplasty as a viable secondary corrective surgery in cleft cases. Alveoplasty performed before 2 years of age is called as primary alveoplasty. After that it is known as secondary alveoplasty. It has been observed that alveoplasty in cleft palate case has had more success and lesser adverse outcomes when performed before the eruption of the permanent canine. If done after eruption of the permanent canine, the incidence of adverse outcomes has been much higher. The perfect timing for an alveolar bone graft in a cleft palate case has been determined to be in the mixed dentition stage when the root of the canine is between ¼th to ½ of being complete, which is generally around 7-9 years of age. Reconstruction of the bone is done with autologous bone graft and the objective of the procedure is to close the oro-nasal communication, allow canine eruption, give adequate bone support to adjacent teeth, facilitate orthodontic treatment, contribute to stability and continuity to maxillary arch (avoiding collapse of structures previously expanded by orthodontics), give support to nasal ala and allow dental rehabilitation with osteointegrated dental implants when necessary.

BOYNE'S METHOD

This is the most common procedure followed. Alveoloplasty along with autologous bone grafting is done. Bone is usually harvested from the iliac crest or if a very large defect is to be closed, then from the ribs. Two separate surgical teams work simultaneously on the operating table, one performing the alveoloplasty and the other harvesting the graft and preparing it. Preoperatively the surgery is planned with the help of panoramic X-rays and CT scans. General anaesthesia is induced, intubation is done and the two teams simultaneously prepare the two surgical sites. Incisions are placed, mucoperiosteal flaps are reflected, alveoloplasty is done to remove irregular borders and to give a definite shape to the discontinuity in order to help ease the grafting procedure. The discontinuity is measured. Simultaneously the other team harvests the bone graft in the desired size and shape. The graft is then transferred to the host site and placed so as to considerably approximate the defect. The flaps on both sites are reapproximated and sutures are placed in a layered fashion. Generally, no drain may or may not be placed. This technique is a tried and tested approach and shows excellent results even after the initial graft resorption.

USING PRP

Boyne's method can be further augmented by the use of Platelet Rich Plasma (PRP), which is a high concentration of autologous platelets in a small volume of autologous plasma^[4]. About 10ml of PRP is harvested on the day of surgery in the operating room, it is mixed with calcium chloride and incubated for 3 mins at 37 degrees Celsius and then mixed with the autologous bone graft, triturated thoroughly to form a malleable mixture which is then placed in the defect and the flaps are closed. Here placing a drain is contraindicated in the host site to enable the growth factors to work. This technique shows far better results than Boyle's method in terms of healing and lesser bone resorption and faster remodelling.

USING OF SCAFFOLD TO TRANSFER STEM CELLS

The use of stem cells obtained by the autologous bone marrow and appropriately treated in order to obtain osteoblasts is a possible alternative^[3]. Adult stem cells have the capacity to form many different tissue types. Technical advances have helped to identify multipotential stem cells and their ability to regenerate tissues is being studied in transplantation models^[3]. The idea is to place bone marrow stem cells at close proximity to the cleft through a scaffold placed in the bone defect. This technique can be used as an alternative to autologous bone grafting, to prevent the morbidity and added complexity due to the procedure. A suitable scaffold of pre formed shape is used which needs to have both osteoinductive as well as osteoconductive properties in order to enable the autologous stem cells to form complete bone and approximate the bone defect. The scaffolds commercially available may be natural or synthetic in origin and sometimes are devoid of osteoinductive property. Hence, they are mixed with PRP or Bone Morphogenic Protein (BMP) contained in a collagen matrix. Generally, about 20-30 mL of bone marrow is harvested from the iliac crest under local Anesthesia or conscious sedation. In this method hyalinization can be observed as early as 8 weeks and then proceeds onto mineralization gradually. This technique shows comparable degree of results to autologous bone grafting and hence is a viable alternative.

3D VIRTUAL PLANNING AND 3D PRINTING

With the advent of virtual surgery planning software, surgeons have added another very important tool in their arsenal. This enables the surgeon perform precise surgery virtually before the actual surgery and thus plan accordingly so as to reduce operating time, inaccuracies and complications. Cone beam CT scans are used to construct an exact replica of the maxillofacial skeleton, on which the surgeon can apply any approach or technique to see the outcome in real time. Another boon of technology has come in the form of 3D printing, where the 3D models already generated are used to create customized patient specific scaffolds. And in future it will be possible to 3D print actual live tissues as well which can then be directly placed into the bone defect. Yet the one disadvantage of this procedure is the lack of cost effectiveness and the fact that Cleft Palate cases are more prevalent in 3rd world countries where the average citizen has poor financial status.

CONCLUSION

The contemporary method shows excellent results but can be further augmented and improved with the use of growth factors. When the harvesting of autologous bone is not a viable option, then, the use of stem cells and scaffolds to naturally grow bone in the defect is a viable option, but is not very cost effective. 3D planning and 3D printing although an excellent mode of treatment, is not a viable option in the context of poorer countries due to its high cost. At the end enabling the patient to have a chance at a normal life and proper rehabilitation is the goal of alveoplasty in cleft palate patients and the financial angle is a very important factor as well.

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