Evaluation of Secondary and Late Secondary Alveolar Bone Grafting on 66 Unilateral Cleft Lip and Palate Patients

L'évaluation des alvéoloplasties secondaires et secondaires tardives chez 66 patients ayant une fente labio-palatine unilatérale

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Abstract

Objective: The aim of this retrospective study was to evaluate the outcomes of secondary alveolar bone grafting and late secondary alveolar bone grafting in 66 unilateral cleft lip and palate patients. **Materials and Methods:** The total patients were 66 unilateral cleft lip and palate patients, out of which 19 patients underwent secondary alveolar bone grafting and 47 patients underwent late secondary alveolar bone grafting. Autogenous anterior iliac crest cancellous bone graft was harvested and used for grafting the alveolar clefts. Radiographic assessment based on Enemark's scoring according to the marginal bone levels was done on the intraoral periapical radiographs taken 6 months after performing the surgery. **Results:** Twelve (63%) out of the 19 patients on whom secondary alveolar bone grafting was done achieved score I (optimal marginal bone levels), whereas only 12 (25%) out of the 47 patients achieved score I amongst the late secondary alveolar bone graftings. Overall results showed, probability, $P = .034$ (statistically significant). **Conclusion:** This study reaffirmed the fact that alveolar bone grafting when done in preadolescent age group (secondary alveolar bone grafting) gives better results in terms of marginal bony consolidation and maintaining the continuity of the alveolar arch, but the late presentation (late secondary alveolar bone grafting) should not be the refusal criteria for performing the alveolar bone grafting. Although the latter patients may not be rewarded in terms of bony consolidation as much as the preadolescent patients the potential of successful surgery in them still exists in terms of providing a platform for the dental implant placement, improvement in the soft tissue symmetry and aesthetics of the face.

Résumé

Objectif : La présente étude rétrospective visait à évaluer le résultat des alvéoloplasties secondaires et des alvéoloplasties secondaires tardives chez 66 patients ayant une fente labio-palatine unilatérale. **Matériel et méthodologie :** Au total, 66 patients ayant une fente labio-palatine unilatérale ont participé à l'étude, dont 19 ont subi une alvéoloplastie secondaire et 47, une alvéoloplastie secondaire tardive. Les plasticiens ont prélevé de l'os spongieux autologue au niveau de la crête iliaque pour le greffer dans la fente alvéolaire. Six mois après l'opération, ils ont attribué un score d'Enemark à la hauteur de l'os marginal d'après leur examen des radiographies périapicales intraorales. **Résultats :** Douze des 19 patients (63 %) qui avaient subi une alvéoloplastie secondaire ont obtenu un score de I (hauteur optimale de l'os marginal), par rapport à seulement 12 des 47 patients (25 %) qui avaient subi une alvéoloplastie secondaire tardive. Les résultats globaux ont démontré une probabilité $p=0,034$ (statistiquement significative). **Conclusion :** La présente étude confirme que l'alvéoloplastie réalisée chez des préadolescents (alvéoloplastie secondaire) assure une meilleure consolidation osseuse marginale et la continuité de l'arc alvéolaire, mais une présentation tardive (alvéoloplastie secondaire tardive) ne devrait pas constituer un critère pour refuser

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l'alvéoloplastie. Même si les patients plus âgés ne profitent pas d'une aussi bonne consolidation osseuse que les préadolescents, il se peut tout de même que l'opération leur fournisse la plateforme nécessaire pour installer l'implant dentaire, améliorer la symétrie des tissus mous et l'esthétique du visage.

Keywords

unilateral cleft lip and palate, alveolar bone grafting, marginal bone level, bony consolidation, facial aesthetics

Introduction

Alveolar bone grafting (ABG) remains a well-known procedure for establishing the continuity between cleft segments, constructing proper alveolar contour, preventing tooth loss caused by the lack of periodontal support, providing proper support for the eruption of teeth and orthodontic tooth movements, achieving closure of the oro-nasal fistula and creating firm support for the nasal floor.

Standard timings of alveolar bone grafting are classified as primary when it is done between 0 and 2.5 years of age, early secondary when performed between 2 and 5 years of age; before the eruption of permanent incisors, secondary when it is done before the eruption of permanent canines, that is, between 6 and 13 years, and late secondary when done after the eruption of permanent canines. The most commonly performed procedure is the secondary alveolar bone grafting (SABG). Numerous studies have shown the efficacy of this procedure in satisfying the above-mentioned goals.¹⁻⁶ Performing the surgery in this age group gives the advantage of high likelihood of success in gaining excellent periodontal attachment for the adjacent teeth, allowing for eruption of the canine, allowing for orthodontic alignment, and ensuring minimal impedance on facial growth.

But all the patients do not turn up in the recommended time for ABG due to the difficult terrains from which these patients have to come to us and the poor economical condition doesn't permits them always to report timely. Sometimes patient's relatives are non-compliant and in spite of no visible reason they appear late and become the candidates for late secondary alveolar bone grafting (LSABG). Although LSABG has been considered as suboptimal age group by many cleft centres, this group should not be excluded from this treatment. Tooth eruption may not be rewarded in these cases, the potential of successful surgery still exists in terms of providing a platform for the dental implant placement, improvement in the soft tissue symmetry and aesthetics of the face and nasal sill elevation.⁷

This retrospective study concerns the evaluation of the outcomes of secondary and late secondary alveolar bone grafting in terms of bony consolidation through the alveolar cleft on a sample size of 66 patients.

Materials and Methods

The objective of this retrospective study was to assess the outcomes of 66 cases of secondary and late secondary alveolar bone grafting performed between 2006 and 2014 at the Department of Plastic & Reconstructive Surgery, Amandeep hospital, Amritsar.

This is a retrospective study done in a given time period. All the cases appropriate for the ABG procedure irrespective of the age of presentation during the said period were taken into the study. Standard protocols were followed for all the cases, and data were retrieved from the records of the patient's bed head ticket.

All these patients had unilateral cleft lip and palate. The mean age at bone grafting was 17.83 years, with a range of 10 to 28 years. The male to female ratio was nearly equal. In all patients, orthodontic treatment was performed prior to bone grafting to correct major irregularities in the position of central incisors, to reposit, and stabilize dislocated segments and to provide the surgeon with better access for graft placement and soft tissue closure. The surgical procedure was same in all the alveolar graftings performed. The cleft area was widely exposed through incisions along the edges of the cleft. The incisions on the vestibular side were made along the gingival border. Posteriorly, the incision was extended to the first permanent molar of the cleft side, and anteriorly the incision was extended along the gingival border uptill the lateral incisor of the non-cleft side. On the palatal side also, the mucoperiosteal flaps were raised along the edges of cleft if required. With these incisions, a wide exposure of the cleft area was achieved (Figure 1A). Autologous cancellous bone was harvested from the anterior iliac crest. The alveolar cleft was completely packed with cancellous bone keeping in view that the alveolar crest must be formed upto the normal height and thickness (Figure 1B). To improve the nasal symmetry, bone graft was also placed under the alar base on the cleft side. The nasal floor was reconstructed if necessary and then pushed upwards with the bone graft material. The lateral mucoperiosteal flap was advanced to cover the cleft and was sutured to the smaller medial flap and to the palatal flaps such that only the gingiva covers the marginal area of the cleft side from where the canine is expected to erupt.

Various complex methods of assessing the success of bone grafts have been proposed in the literature.⁸⁻¹⁰ Amongst these, the Bergland grading system has remained the gold standard.¹¹ In this system, the occlusal level of bone graft is compared with that of normal interdental bone that approximates the amelocemental junction of the adjacent teeth in the corresponding radiograph. However, we could not use this system of analysis as the presence of permanent canine is a prerequisite for using this scale, which is not likely to be fulfilled in the cases of LSABG. Instead, Enemark's scale of radiographic assessment was applied to the current study.¹² According to Enemark, the esthetic and functional properties of the reconstructed alveolar process are assessed by an index with scores of 1 to 4 that

Figure 1. A, Intraoperative view of the alveolar cleft. B, Alveolar cleft packed with cancellous iliac crest bone graft.

Figure 2. Enemark's scoring for marginal bone levels assessed on intraoral films.

indicate the morphology of the alveolar process in the bone-grafted region (Figure 2).

Score I—More than 75% of normal bone height.

Score II—Level between 50% and 75% of normal bone height.

Score III—Level between 25% and 50% of the normal bone height.

Score IV—Less than 25% bony bridge achieved (failures).

Score 1 indicates the optimal bone level, score 2 the acceptable bone level (ie, minor reduction of the height of the alveolar process making an esthetic and functional rehabilitation of the patient possible), score 3 indicates unacceptable possibilities for rehabilitation, and score 4 indicates that rehabilitation of the patient is impossible without reoperation.¹²

An intraoral periapical radiograph (IOPAR) was taken for each grafted alveolar cleft. The occlusal level of the newly obtained interdental bone in the alveolar cleft was recorded and with the help of this method of assessment, the patients were categorized into 1 of 4 types, and a score of 1 to 4 was given (Figure 3). The radiographic assessment was done on the IOPAR taken 6 months after the surgery was done.

Results

The distribution of alveolar bone graft levels within its 4 categories performed in SABG as well as LSABG groups is shown in Figures 4 and 5, respectively.

Marginal Bone Levels in SABG and LSABG

Enemarks scale	SABG (N = 19)	LSABG(N = 47)	Total
Score I	12	12	24
Score II	04	21	25
Score III	02	06	08
Score IV	01	08	09
Total Patients (N)	19	47	66

Out of these 66 patients, 19 patients underwent secondary alveolar bone grafting and remaining 47 underwent the late secondary alveolar bone grafting. Amongst the 19 patients in the SABG group, 12 had score 1 bone level, 4 patients had score 2, 2 patients had score 3, and 1 patient had score 4 bone level. Whereas in the LSABG group, 12 out of the total 47 patients had score 1 bone levels, 21 had score 2 bone levels, 6 had score 3 bone levels, and 8 patients corresponded the score 4 category. Results showed, probability, $P = .034$ (statistically significant) with $\chi^2 = 8.69$ and degrees of freedom = 3. It clearly indicates and strengthens the concept of better results of secondary alveolar bone grafting as compared to late secondary alveolar bone grafting as far as consolidation of the grafted bone is concerned.

Discussion

To establish the integrity of maxillary arch, it is very critical to achieve structural balance, functional harmony, and facial aesthetics. Bone grafting the alveolar cleft helps to stabilize the arch in both unilateral and bilateral clefts, provides solid bone for the eruption of teeth, and helps in successful closure of oronasal communication. It facilitates the orthodontic tooth movement; specially of those teeth that are along the cleft

Figure 3. Radiological assessment according to the Enemark's scoring. (A) Score 1, (B) Score 2, (C) Score 3, (D) radiograph showing the erupted canine through grafted alveolar cleft.

Figure 4. Bar diagram depicting the distribution of patients according to the Enemark's scoring in the secondary alveolar bone grafting (SABG) group.

edges, and permits dental implant placement when indicated. Although alveolar cleft repair and grafting are being performed since near a century, significant controversy still exists regarding the timing, graft selection, and sequencing of the procedure in the patient's overall treatment plan.¹³⁻¹⁵ Since the popularization of techniques given by Boyne and Sands, most of the cleft centres around the globe now practice secondary alveolar bone grafting (ie, bone grafting being done between 6 and 13 years of age).¹⁶

In deciding the timing of alveolar bone grafting, the dental developmental age and not the chronological age should be the foremost consideration. Optimum timing for performing the procedure is when the adjacent unerupted canine root is one-

Figure 5. Bar diagram depicting the distribution of patients according to the Enemark's scoring in the late secondary alveolar bone grafting (LSABG) group.

fourth to two-thirds complete, as it is shown in many studies that this stage of root development is associated with accelerated or active eruption.¹⁷ It is also important to ascertain whether canine or lateral incisor is expected to erupt through the grafted bone, as sometimes it is seen that lateral incisor is more likely to erupt through the grafted area. In that situation, alveolar bone grafting is done at an earlier age as compared to when done in respect to the canine.

In this study, SABG was performed on 19 patients and on Enemark's scale; 12 patients (63%) had score 1 bone levels and 4 patients had score 2 bone levels. Both these bone levels are acceptable outcomes as more than 75% of the bone that has been grafted is viable.¹² In these cases, sufficient alveolar bone provided the canine to migrate through it. Also, this eruption helped the closure of space orthodontically. In 13 cases, canine erupted through the graft whereas in the remaining cases, canine were deeply impacted making them impossible to erupt. Amongst the 47 patients in the LSABG group, 12 (25%) patients had score 1 bone levels, 21 (44%) patients had score 2 bone levels, 6 (12%) patients were in score 3 category, and in 8 (17%) patients, there was less than one-fourth bone. Thus, the radiological results revealed that the SABG has better outcomes than LSABG in terms of bony consolidation (63% vs 25% score 1 patients in SABG and LSABG groups, respectively). Occlusal loading of the grafted bone in SABG group helped to maintain the bone, whereas in the LSABG group non-eruption of canine through the graft (as many were extracted before grafting was performed or they were highly impacted making them difficult to erupt) was responsible for the suboptimal level of bony consolidation.

On the basis of subjective clinical analysis, all the patients benefitted in terms of improved soft tissue symmetry and facial aesthetics. Adequate bone grafting into the cleft area reduced the bony defect and consequently the asymmetry over the cleft site drastically. There was significant upliftment of nasal sill, increased alar base support, and fullness of the lip on the cleft side (Figure 6). Overall symmetry of the lip-nose complex was enhanced, and the cleft rhinoplasty also got an added edge from this procedure. Improvement in nasal symmetry after ABG has been documented in previous studies as

Figure 6. A, Preoperative worm's eye view of the late secondary alveolar bone grafting (LSABG) patient showing the depressed nasal sill and alar base on the cleft side. B, Post-operative worm's eye view of the same patient showing elevated nasal sill and alar base. C, Pre-operative frontal view showing the lack of projection of the lip on the cleft side. D, Post-operative frontal view showing the fullness and projection of the same.

well. Van der Wal et al in 1997 studied the effect of ABG on the nasal region using a photographic technique on 9 patients with unilateral cleft lip. The authors concluded that there was improved nasal symmetry following the procedure.¹⁸ Nowadays many centres prefer to postpone cleft rhinoplasty until ABG is done in anticipation that ABG will elevate the nasal floor and restore the bony defect on the affected side at the piriform rim, thereby possibly improving nasal form that will then facilitate rhinoplasty.^{7,20}

Conclusion

Alveolar bone grafting when done at preadolescent age gives the best outcomes in terms of eruption of unerupted tooth and maintaining the continuity of the alveolar arch. But unfortunately in the Indian scenario, patients even after proper counselling and motivation do not report in recommended time. The results in such late presenting patients in relation with bony consolidation are not encouraging, but still these patients do benefit in terms of improved facial aesthetics. So as per the standard protocol, ABG should be performed at recommended preadolescent age, but late presentation should not be the refusal criteria in performing ABG, thus enabling such patients to get the aesthetic benefits of the procedure.

Declaration of Conflicting Interests

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