

Late Results of the Secondary Alveolar Bone Grafting in Complete Unilateral Cleft Lip and Palate Patients

J.Olekas, L.Zaleckas

SUMMARY

The reconstruction of the continuity of the cleft alveolar process is one of the necessary conditions in reaching complete rehabilitation of patients with total congenital cleft of upper lip, alveolar process of the maxilla and palate. The aim of this study was to evaluate late results of the secondary alveolar bone grafting (SABG). In the case of unilateral cleft, 76 SABG were performed during the period from 1994 to 2002. The operation was performed using transpositional mucoperiosteal flaps by bone grafting with cortical bone plate and cancellous bone chips. The height of bone bridge was estimated at minimum 3 years after SABG. The study material comprised 50 patients with unilateral cleft alveolus. The early SABG was performed for 35 patients (70%) and late SABG – for 15 ones (30%). The primary wound healing and bone bridging was observed in all cases. More bone tissue remained in the cleft area when early SABG was performed ($p = 0.000$). The general height of newly formed bone bridge was $80.39 \pm 13.8\%$ of normal septal height (in the group of early SABG – 85.74 ± 11.24 and in the late SABG group – 67.9 ± 11.01). In the early SABG group, positive results (type I and II by Bergland) were for 91.4% of patients ($n = 32$) and negative results (type III) were for 8.6% of patients ($n=3$). The height of fixed gingiva in the cleft site was bigger than the height of mobile gingiva. In the present study, correlation between the height of newly formed bone bridge and width of cleft was determined. The less was the distance between the closest cleft area teeth the bigger was the height of bone bridge. It was no correlation between newly formed bone bridge height and fixed or mobile gingiva height or height ratio.

Key words: unilateral cleft alveolus, secondary alveoloosteoplasty, bone grafting

INTRODUCTION

Cleft upper lip, alveolar process of maxilla and palate are one of the frequently congenital malformations not only in Lithuania but also in many other countries [1]. The reconstruction of the continuity of the cleft alveolar process of the maxilla at recent point of view is one of the necessary conditions in reaching full rehabilitation of patients with total congenital cleft of upper lip, alveolar process of the maxilla and palate [2, 3]. In the case of residual cleft of the alveolar process not only a facial aesthetics but also facial function, rehabilitation and integration of such patients into the society are disturbed. This is because of lack of the continuity of the dental arch, upper lip and nose deformations, speech disturbance. [4]. In Lithuania, a secondary alveolar bone grafting (SABG) has been performed only since a middle of the last decade of 20th century [5]. In our country, there are still patients who have a residual cleft alveolus. Thus, full orthodontic and prosthetic corrections are impossible.

The aim of this study was to evaluate the late results of the SABG performed at the Center of Maxillofacial Surgery, Vilnius University

MATERIAL AND METHODS

The secondary alveolar bone grafting (SABG) at the Center of Maxillofacial Surgery, Vilnius University, have been performed since 1994. In the case of unilateral cleft 76 SABG were performed during the period from 1994 to 2002. Only patients with not shorter than 3 years of postoperative time (i.e. 66 patients) are included in this investigation (postoperative time varied from 3 to 9 years). The age of patients during the operation varied from 7.3 to 27 years. It is widely recommended to perform the early SABG (when the cleft side tooth eruption is not finished). However, a big part of our SABG was a late or tertiary SABG. Early SABG was performed for 44 patients (66.7%) and 22 (33.3%) patients had late SABG. This was because that SABG has not been performed of different reasons in our country till the middle of the last decade of the 20th century. There were 35 (53%) male and 31 (47%) female. Left side clefts were 40 (60.6%), right side clefts were 26 (39.4%). All reconstructive operations of cleft alveolus site were performed by the same surgeon and using the same method.

All operations were performed under general orotracheal anaesthesia. Two surgeon teams took part during the operation. One team operated the cleft alveolus and the second team prepared bone graft from anterior iliac crest simultaneously. Cancellous and cortical bone grafting was used [1]. The incision trough the mucoperiosteum on the vestibular side was made along the gingival border embraced one or two incisors

Juozas Olekas, Assoc. prof., D.D.S., PhD., at the Institute of Stomatology at Vilnius University.

Linas Zaleckas, Assistant professor, M.D., PhD., at the Institute of Stomatology at Vilnius University.

Address correspondence to Dr. Juozas Olekas: 117 Žalgirio str., 2042, Vilnius, Lithuania. E-mail: juolek@lrs.lt



Figure 1. Raising of the periosteal flap was performed.

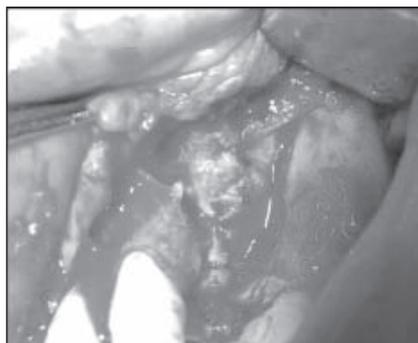


Figure 2. The nasal floor was reconstructed and the fistula closed.

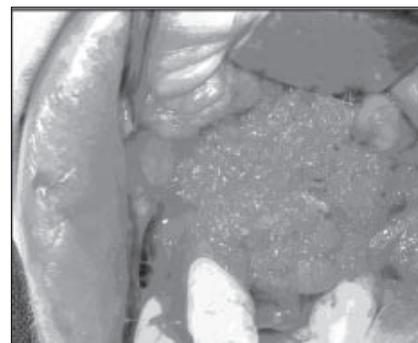


Figure 3. The remaining cleft was filled with cancellous bone chips.

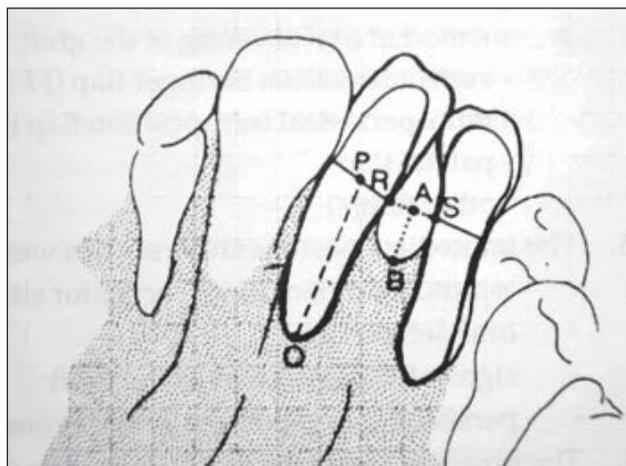


Figure 4. The scheme of bone bridge height measurement in occlusal radiographs of the cleft area according Coole [6].
R – distal cementum-enamel junction of the tooth medial to the cleft region
S – mesial cementum-enamel junction of the tooth lateral to the cleft region
A – midpoint of the intercervical line *RS*
B – the “deepest” point of the bony contour between *R* and *S*
Q – the apex of tooth medial to the former cleft
 Bone bridge height = $100\% - AB/PQ \times 100\%$

medially from the cleft. Laterally, the incision was extended to the second premolar or the first molar and then a careful raising of mucoperiosteal flaps was performed. Vertical incisions were made along the cleft margins and more tissues were left in the palatal side. No incisions were made on the palatal side (Fig. 1). On this side, only minimal raising of a mucoperiosteal flaps in the cleft region was performed and after them slightly pushed to the palatal side. The nasal mucoperiosteum was pushed upwards, the nasal floor was reconstructed and the fistula closed with 6-0 or 5-0 Vicryl sutures (Fig. 2). The superficial cortical bone layer in the cleft was refreshed with scalpel blade to improve the incorporation of bone graft. The thin bone lamellae, which covered the dental roots, were left intact. In palatal side, the cortical bone plate from iliac crest was placed between sutured palatal mucoperiosteal flaps and alveolar process bone. The remaining cleft was filled with cancellous bone chips of different size and form (Fig. 3). The cortical bone plate supports the cancellous bone chips and reduces the possibility of pushing out the cancellous bone to the vestibular side. The mucoperiosteal flaps were sutured with 5-0 Vicryl. No special wound dressing after suturing or in the

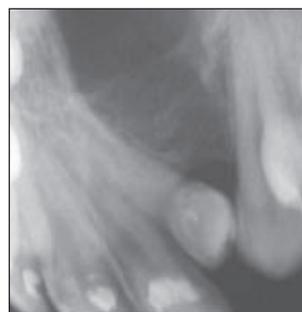


Figure 5. Bone bridging between cleft sites (5 years after SABG, patient G).



Figure 6. Bone bridging between cleft sites (6 years after SABG, patient B).

postoperative period was used.

Standardized clinical and radiological (orthopantomograms and occlusal radiographs of cleft side) examinations were carried out for the evaluation of bone bridge on the cleft side. Formation of bone bridge and distance between closest teeth in the cleft area were estimated in accordance with the method suggested by Koole [6] (Fig. 4) and Bergland [2]. Two independent investigators performed the assessment of radiographs.

In addition, the height of fixed and mobile gingiva was measured and it was compared to the healthy side. According to medical documentation, the wounds healing in the recipient and donor places were evaluated.

Statistical evaluation was performed by using Student's *t*-Test and the Pearson product moment correlation coefficient *r*.

RESULTS

The mean postoperative time was 5 years (range from 3 to 9 years). In all cases, the recipient alveolar clefts area healed in primary way. In the later period for one patient (1.52 %) the soft tissues granuloma developed and the oronasal fistula reappeared. The bone grafting was repeated after 3 years because of large bone resorption [7]. In this case, the height of bone bridge, which remained after the first operation, was evaluated. For all other patients the oronasal fistula was fully eliminated. In all cases, after SABG the bone bridging between cleft sites was clinically and radiologically observed (Fig. 5, 6). No haematomas, wound dehiscences, early or late wound infections, which would give clear clinical expressions, were

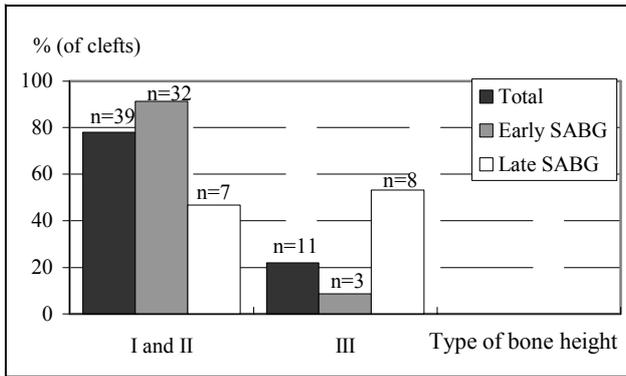


Figure 7. The distribution of bone bridge height according to the criteria of Bergland.

observed.

To check the results, 50 patients from 66 arrived (75.76%). The ratio between male and female was 1.1:1. This allowed us to refuse the influence of sex factor for the results. Thirty five (70%) patients were after the early SABG and 15 (30%) patients had the late SABG.

By evaluating subjective complaints it was found that one patient (2 %) had a tenderness touching the operated area by tongue. It was noticed after 5 years and 4 months passing SABG. Other patients had no complaints.

The height of fixed and mobile gingiva was measured. Statistically significant difference in the height of mobile gingiva was observed between operated and healthy sites. In this study correlation coefficient *r* is used to determine any correlation between gingiva height in cleft and healthy site (Table 1).

These results show a reduced height of the vestibule in cleft site due to decreased height of mobile gingiva.

There was no correlation between newly formed bone bridge height and fixed or mobile gingiva height or height ratio.

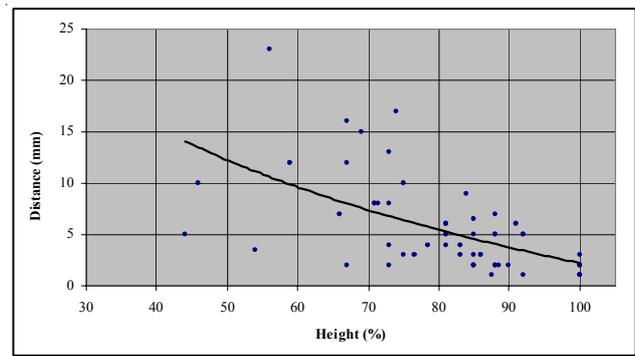


Fig. 8. The correlation between the bone bridge height and distance between the teeth in the closest cleft area.

Two independent investigators performed the assessment of radiographs. Their results were the same ($p = 0.46$). The general height of newly formed bone bridge was 80.39 ± 13.8 % of normal septal height (range from 44 to 100%). No statistically significant difference in the height of bone bridge was observed between patients' genders.

Statistically significant difference in the height of newly formed bone bridge was found between the early and late SABG groups. More grafted bone tissue remained in the cleft area after early SABG ($p = 0.000$). Bone bridge height in early SABG was $85.74 \pm 11.24\%$ ($n=35$) and in the late SABG group the bone bridge height was $67.9 \pm 11.01\%$ ($n=15$).

The height of newly formed bone bridge measured according to the criteria of Bergland [2] is presented in Figure 7.

The slight correlation between the bone bridge height and distance between the teeth in the closest cleft area, i.e. between 12 and 13 or 22 - 23 teeth ($r = -0.59$). If there was no lateral incisor, the distance was measured between 11 and 13 or 21 and 23 teeth. The less was the distance between teeth, the height of bone bridge was bigger is and vice versa (Fig. 8).

At the time of evaluation, in the group of early SABG, the canine was erupted trough the transplanted bone in 22 cases (62.86%). In 13 cases (37.14%), the

Table 1. The height of fixed and mobile gingiva for 50 patients with unilateral cleft

Kind of gingiva	Cleft site (height, mm)		Healthy site (height, mm)		The ratio of height between fixed gingiva in cleft and healthy site (%)	Pearson correlation coefficient <i>r</i> (between gingiva height in cleft and healthy site)
	Mean \pm SD	Range	Mean \pm SD	Range		
Fixed gingiva *	5.31 \pm 1.59	2-9	5.8 \pm 1.64	3-10	95.8 \pm 34.1	0.43
Mobile gingiva**	3.58 \pm 2.64	0-10	6.98 \pm 1.56	3-11	52.8 \pm 40.4	0.06
Total***	4.45 \pm 2.34	2-17	6.39 \pm 1.7	8-18	-	-

$p = 0.13$ (*fixed gingiva); $p = 0.000$ (**mobile gingiva); $p = 0.000$ (**total)

Table 2. Status of lateral incisor in the operated cleft site

SABG groups	Presence of lateral incisor		Absence of lateral incisor		Condition of lateral incisors					
					Healthy		Hypoplastic		Rotated	
	n	%	n	%	n	%	n	%	n	%
Early SABG	20	57.14	15	42.86	4	20.00	14	70.00	2	10.00
Late SABG	6	40.00	9	60.00	1	16.70	3	50.00	2	33.30
Total	26	52.00	24	48.00	5	19.40	17	65.40	4	15.40

n - number of cases

canine was in eruption stage. No statistically significant difference in the bone bridge height was observed between patients with erupted and unerupted canine after early SABG them ($p = 0.98$).

The lateral incisor was present only in 52 % cases in the cleft area (Table 2).

There was no statistically significant difference in the height of bone bridge between clefts with present and absent lateral incisor ($p > 0.05$).

There was no ankylosis or external root resorption of the cleft-sided teeth.

DISCUSSION

The SABG is the method of choice for the reconstruction of the continuity of the alveolar bone cleft. The best results have been reached by using the method of transpositioning flaps. In these cases, the mucoperiosteum is raised and mobilized [8]. Some of the authors have not satisfied in the results of SABG even using transpositioning flaps [4]. Therefore, various modifications of this operation have been proposed [4, 9].

According to the literature, the oronasal fistula after SABG reappeared from 0.22 - 2% [2, 10] to 9.6 - 10% [2, 11]. After our operations the oronasal fistula reappeared in one case (1.52 %).

One of the most objective and the main success criterion after SABG is radiologically detected newly formed bone at the cleft side. For this reason, two-dimension radiogram is a sufficient method for the evaluation of newly bone bridge and for estimation relation between bone and cleft-sided teeth [11, 12, 13, 14, 15, 16]. In the present study, radiological examination was carried out by performing the orthopantomograms and standardized occlusal radiograms of cleft side. In the radiograms, the height of newly formed bone bridge but not the resorption of transplanted bone was estimated. The success of SABG is better demonstrated by the height of newly formed bone bridge. The general height of newly formed bone bridge was 80.39 ± 13.8 % of normal septal height (range from 44 to 100%). The bone bridge height that was determined 1 year after SABG was the same, i.e. 80 - 85% of normal septal height [7].

In the present study, the formation of bone bridge in the cleft area was estimated in accordance with the method suggested by Koole [6]. For the reason to compare the results with other studies, they also were presented according to the criteria of Bergland, because many other authors presented their results by this scale [2,4,8]. Positive results, i.e. type I and II according to Bergland would exceed 75% by Koole criteria and negative results (type III) were less than 75%. We had chosen these two methods because that in the method of Koole the points of assessment of bone bridge height are very exact and by this assessment is very simple to determine the bone bridge height for any type of Bergland method. In addition, Koole method is more precise than many other methods. For example, I type by Bergland is detected when "height approximately normal, type II - height at least $\frac{3}{4}$ of normal height" [2]. There are not very exact points and evaluation of some radiograms is difficult. For

example, bone bridge height of 76% is a positive result (by Bergland) but bone bridge height of 74% is a negative result. [17]. When there are no very exact criteria or points for evaluation, the assessment of some radiograms becomes subjective. This could not be said about Koole method. In addition, the method of Koole might be used for the evaluation of the bone bridge height in different groups or for the influence of various factors for bone bridge formation. For example, 95% and 76% according to Koole method correspond to the same type II according Bergland. However, these two results are not equivalent.

In the present study, positive results (type I and II) were 78% ($n = 39$), the type III were 22% ($n = 11$) (Fig. 7). Other authors have achieved type I and II from 44 - 70% [7, 17] to 80 - 96% [2, 11, 12, 13, 14, 18, 19]. This might be explained by the fact that even for 33.3% of our investigated patients the late SABG was performed. Other studies with the best results after SABG did not include patients older than 18 years or the part of late SABG was not bigger than 8 - 25% [2, 19]. When we calculated the results separately in the early SABG group, the bone height was considerably bigger - type I and II - 91.4% ($n = 32$), type III - 8.6% ($n=3$). This is in accordance with the good results of other studies.

We have no secondary wound healing and no failure, i.e. total resorption of transplanted bone. Other authors have reported that such complications occur more frequently: secondary wound healing from 3.96 - 5% [14, 20] to 10 - 13.9% [19] or even 23% [18] and total resorption of transplanted bone occur from 1.6 - 3% [20, 21] to 5 - 6.4% [12, 17] or even 9.3% [19].

It has been postulated that the fixed intact gingiva in the cleft site is very important for bone bridge creation and the mobile gingiva might determine the bigger resorption of transplanted bone [4, 22]. We measured the height of fixed and mobile gingiva and these results were compared to the results of other studies. The height of fixed gingiva (in millimeters) according to the results of other investigators varied from 2.0 - 2.3 mm to 4.7 - 6.3 mm and the height of mobile gingiva varied from 4.2 to 8.3 - 8.7 mm [8, 10, 20]. The height of fixed gingiva after our operations was 5.31 ± 1.59 mm. In contrast to other studies, the height of mobile gingiva was less (3.58 ± 2.64 mm). Thus, the general height of vestibule was slightly smaller. According to the fact that mobile gingiva can determine the bigger resorption of transplanted bone, we might say that after our operations the better conditions for restructuring and surviving of transplanted bone were created because of the higher fixed than mobile gingiva.

We determined the slight correlation between the bone bridge height and distance between the teeth in the closest cleft area, i.e. between 12 and 13 or 22 - 23 teeth ($r = -0.59$). If there was no lateral incisor, the distance was measured between 11 and 13 or 21 and 23 teeth. The less was the distance between teeth, the height of bone bridge was bigger is and vice versa.

In the present study, after the early SABG, the canine was erupted trough the transplanted bone in 62.86% cases ($n = 22$). In 37.14% cases ($n = 13$), this tooth was in eruption stage. These results take an intermediate position in comparing with the results of

other the authors (from 47% [20] – 52% [8, 11] to 91.8% [14] – 96.35% [13]). This difference appeared because that authors who presented very good results, for example Coolins – 96.35% [13], included all canines found in the cleft area at the time of investigations and a kind of SABG (early or late) was not distinguished in these studies. In addition, it was not noted, the eruption was spontaneous or canine tooth was treated in active orthodontical and surgical way (pulled trough the transplanted bone).

In our study, there was no statistically significant difference in the bone bridge height between patients groups with erupted and unerupted canine after the early SABG ($p = 0.98$).

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