Original Article

Evaluating Cranial Bone Harvesting by Scraper Technique for Alveolar Cleft Grafting

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ABSTRACT

Background: Alveolar bone grafting is crucial for repairing alveolar clefts, yet the optimal source for autogenous grafts remains under debate. Calvarial bone grafting, harvested using a manual scraping technique, may offer an effective alternative to more conventional donor sites, such as the iliac crest and mandibular ramus, with reduced complications and improved graft quality.
Purpose: This pilot study aimed to evaluate the feasibility, outcomes, and donor site morbidity associated with using cranial bone harvested by a scraper technique for alveolar cleft grafting.
Methods: Five non-syndromic patients (aged 9–34 years) with unilateral or bilateral alveolar clefts underwent cranial bone grafting using a manual scraper. The primary outcome was bone fill, assessed radiographically by Bergland criteria at three months postoperatively. Secondary outcomes included donor site morbidity, operative time, and postoperative pain levels.
Results: Successful bone fill (Bergland types 1 or 2) was achieved in 4 out of 6 cleft sites. On average, 3 ml of bone was harvested with a mean harvesting time of 23 min. Patients reported mild incisional pain post-surgery, which decreased within one week, and no cases of infection, wound dehiscence, hematoma, or hair loss were observed at the donor site.
Conclusion: Cranial bone harvesting by a scraper technique appears to be a viable, minimally invasive method for alveolar cleft repair, offering high graft quality with low donor site morbidity. Further studies with larger samples and comparator groups are recommended to establish this technique as a routine option for secondary alveolar bone grafting in cleft patients.

KEYWORDS
Autogenous bone grafting; Alveolar bone graft; Alveolar cleft; Bone scraper; Calvarial bone graft

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INTRODUCTION

Cleft lip and palate are among the most common congenital craniofacial anomalies, affecting the formation of muscle, alveolar bone, and the hard and soft palate [1]. The severity of these deformities can range from a small defect in the lip to a wide fissure extending into the roof of the mouth and nasal cavity. During normal fetal development, the fusion of medial and lateral nasal processes, along with the maxillary processes, is crucial for forming the facial structures. A disruption in this fusion leads to cleft formation, with complete clefts often extending into the nasal cavity and involving the alveolus, requiring multiple surgical and dental interventions over a patient's lifetime [1, 2].

Effective management of patients with clefts involves a multidisciplinary approach that includes surgical repair, speech therapy, and orthodontic treatment to achieve functional and aesthetic outcomes [1-3]. Treatment goals encompass clear speech, normal hearing, facial symmetry, functional occlusion, and healthy oral structures, contributing to improved self-confidence and quality of life [2]. Alveolar bone grafting (ABG) is a critical procedure for managing cleft deformities, as it helps re-establish the continuity of the alveolar ridge, provides support for teeth, and facilitates the eruption of permanent canines by closing oral-nasal communications and reconstructing the nasal floor [3].

ABG involves filling the alveolar cleft with bone graft material, which may be sourced from autografts, allografts, xenografts, or synthetic materials [4]. The timing of ABG, typically between ages 7 and 9, is essential for optimal outcomes, as success rates decline with increasing patient age [3]. Various strategies, such as adding growth factors like platelet-rich plasma (PRP) and platelet-rich fibrin (PRF), or combining biomaterials, have been explored to improve graft quality [5, 6]. Autografts are preferred for their biocompatibility and osteogenic potential, with common donor sites including the iliac crest, mandible, tibia, and calvarium [7].

The iliac crest is often considered the gold standard for autogenous grafts; however, it carries risks such as postoperative pain, gait disturbances, and visible scarring [8-10]. The calvarium, by contrast, has gained attention as an alternative donor site due to its proximity to the facial region, favorable cortical structure, and minimal donor site morbidity. Calvarial bone shares an embryological origin with the maxilla, which may enhance its integration in maxillofacial reconstruction [8, 11]. Harvesting cranial bone using a manual scraper, rather than traditional block methods, has shown promise in reducing the risk of complications like meningitis, dural tearing, and brain injury. Additionally, the scraping technique preserves cell viability better than methods using drills or piezoelectric devices, potentially enhancing graft quality [12, 13].

We aimed to evaluate the feasibility and effectiveness of cranial bone harvested by a manual scraper technique for alveolar cleft repair. Given the limited use of calvarial bone in ABG procedures, this research sought to provide insight into its potential as a minimally invasive, high-quality alternative for alveolar cleft patients.

METHODS AND MATERIALS

Study Design and Sample

This pilot study included five non-syndromic patients (4 males and 1 female) aged 9–34 years, with unilateral or bilateral alveolar clefts referred for secondary bone grafting. The demographic and clinical information of these patients is presented in Table 1. Patients with American Society of Anesthesiologists (ASA) class III or higher, syndromic clefts, or those unwilling to participate were excluded from the study.

Anesthesia Protocol

All patients received anesthesia without inhaled gases, following a single biopsy protocol with propofol. Premedication included midazolam (0.1 µg/kg) and sufentanil (10 µg). Muscle relaxation was achieved with atracurium (0.5 µg/kg), while anesthesia was maintained with propofol (50 µg/kg/min) and fentanyl (0.1 µg/kg).

Table 1. Information of the patients participated in this study

Patient	Age (yr)	Sex	Alveolar cleft	Volume of graft (cc)	Time (minutes)	Bergland scale
1	34	Female	unilateral (right)	2.5	30	2
2	12	Male	Unilateral (left)	2	20	1
3	9	Male	Unilateral (right)	2	15	1
4	26	Male	Bilateral	4	30	3 , 4
5	11	Male	Unilateral (right)	3	20	2

Surgical Technique

- *Alveolar Cleft Preparation*: A perifistular incision was made to prepare the nasal floor, followed by suturing. A palatal flap was raised around two adjacent teeth and sutured to create the palatal wall. A circular incision with a distal releasing incision in the molar region was performed to mobilize the buccal flap (Fig. 1).
- *Graft Harvesting*: A 1 cm scalp incision, parallel to the hair follicles, was made in the parietal region. The periosteum was elevated, and a subperiosteal tunnel was created over the calvarium. A manual bone scraper was inserted into the tunnel, and through repeated strokes, the cortical calvarial bone was shaved and collected. The harvested bone volume was measured using a calibrated syringe (Fig. 2).
- *Postoperative Management*: Patients were discharged 24 hours after surgery. At the three-month follow-up, periapical radiographs were taken to evaluate regenerated bone in the alveolar cleft area using the Bergland criteria: type 1 (normal bone), type 2 (>¾ normal height), type 3 (<¾ normal height), and type 4 (no bone bridge) (14).

Fig. 1. Prepared alveolar cleft

Variables

- *Primary Predictor Variable*: The primary predictor variable was the use of autogenous particulate calvarial bone grafts harvested with a manual scraper for alveolar cleft repair.
- *Primary Outcome Variable*: The main outcome variable was bone fill in the alveolar cleft defect, assessed by the Bergland criteria on dental radiographs three months postoperatively.
- *Secondary Outcome Variables*: Operative time, donor site morbidity, and postoperative pain were

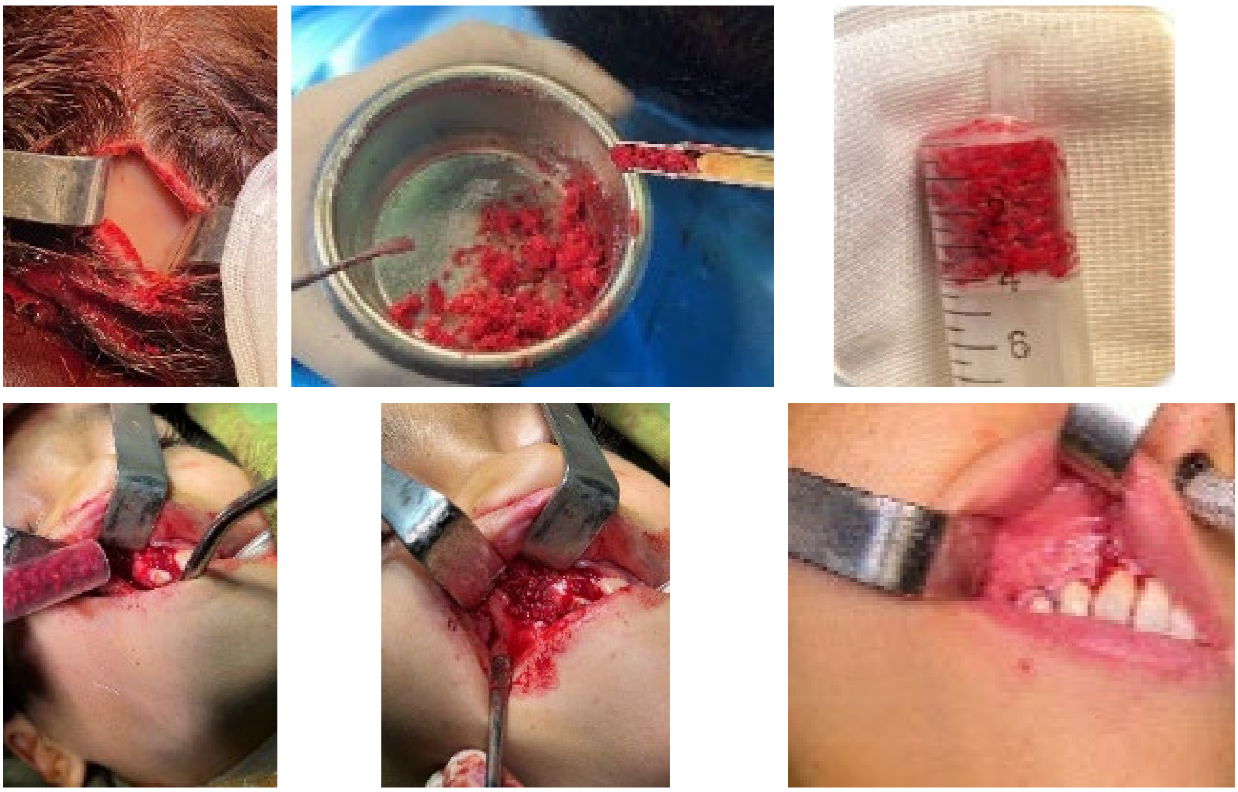

Fig. 2. A) One-centimeter scalp incision, without hairs shaved, and a bone scraper is used to harvest bone. b) Measure the bone volume harvested by this technique, c) Prepare alveolar cleft, d-f) Good adaptation of grafted bone with the bed

recorded as secondary outcomes.

- *Additional Variables*: Demographic data (age, gender), cleft type (unilateral/bilateral), anatomical location (maxilla), and cleft severity were also collected.

Data Collection

Cleft preparation and bone harvesting were performed using standard surgical techniques as described above. Harvested bone volume was measured with a calibrated syringe. Postoperative analgesic use was recorded, and pain levels were assessed at multiple intervals (immediately, 6-, 12-, and 24-hours post-surgery, and at one week, one month, and three months post-surgery) using the Visual Analog Scale (VAS), with 0 indicating no pain and 10 indicating the worst pain. Radiographic evaluations using orthopantomograms (OPG) and periapical (PA) radiographs were conducted at one- and three-months post-surgery. Donor site assessments for hair loss and wound healing were performed at the one-month and three-month follow-up visits.

Ethics Approval

All procedures were approved by the Institutional Ethics Committee (Approval code: IR.MUMS.DENTISTRY.REC.1400.044), and written informed consent was obtained from all participants in compliance with ethical standards.

RESULTS

A total of five non-syndromic patients aged 9–34 years underwent autogenous CBG using the manual bone scraper technique. Six alveolar cleft sites were grafted in total, comprising five unilateral and one bilateral cleft.

Bone Fill and Graft Success

At the three-month follow-up, radiographic evaluations showed successful bone fill (Bergland types 1 and 2) in 4 out of 6 cleft sites (66.7%). Incomplete bone formation (Bergland types 3 and 4) was observed in the remaining two sites. These results suggest favorable outcomes in mixed dentition patients with calvarial bone grafts.

Harvested Bone Volume and Operative Time

On average, 3 ml of bone was harvested per patient, with volumes ranging from 2 to 4 cc. The mean time required for harvesting was approximately 23 min, with a range from 15 to 30 min. This relatively short operative time and sufficient bone volume support the practicality of the scraper technique for alveolar cleft grafting.

Donor Site Morbidity and Postoperative Pain

No instances of infection, wound dehiscence, hematoma, or hair loss were observed at the donor site (Fig. 3). The results of this bone graft technique in mixed dentition were favorable (Bergland type 1 or 2) (Figs 4 and 5). Patients reported mild incisional pain, which gradually subsided within one week. Pain was assessed using the Visual Analog Scale (VAS) at multiple intervals, with an overall reduction in pain levels within the first week postoperatively (Table 2).

Effect of Patient Age on Graft Success

This technique is typically performed between ages 7 and 9. The three adolescent patients achieved successful graft outcomes, whereas one of the two adult patients (aged 34 and 26 years) experienced graft failure, suggesting a potential influence of age on graft success.

Fig. 3. A well-hidden scar on the scalp, 3 months after the operation.

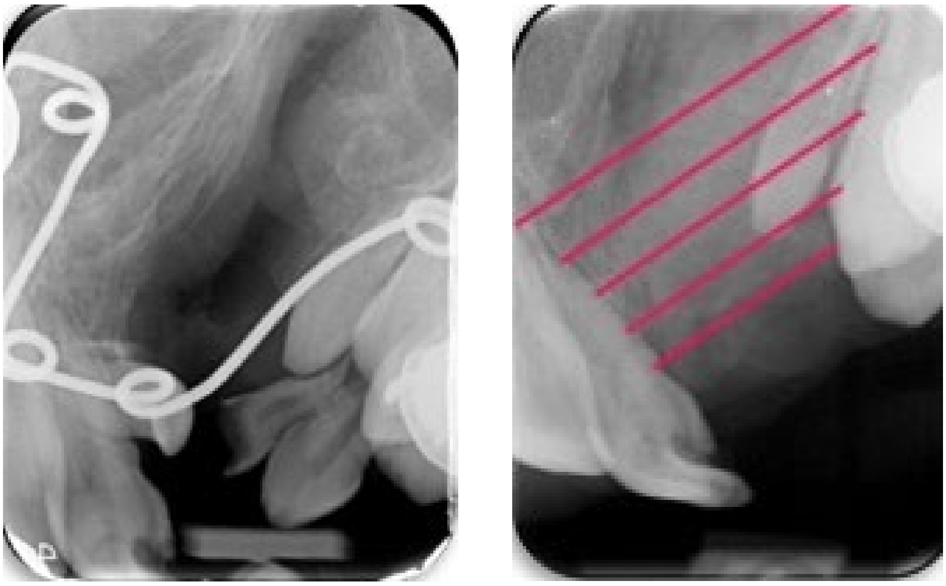

Fig. 4. A) Preoperative alveolar cleft, b) 3 Months after bone graft shows type 1 Bergland scale

Fig. 5. A) Per operative, b) post-operative

DISCUSSION

This pilot study evaluated the feasibility and outcomes of cranial bone grafting using a manual scraper technique for alveolar cleft repair. The findings showed favorable outcomes, with successful bone fill in the majority of cases and minimal donor site morbidity. These results suggest that the scraper technique may be a viable alternative to more commonly used donor sites, particularly for patients with mixed dentition requiring alveolar bone grafting.

Intraoral bone harvesting, typically from the mandibular ramus or symphysis, is commonly used for maxillofacial reconstruction but often requires supplementation with other materials due to limited harvest volume [15]. Cranial bone, with its proximity to the surgical site and similar embryological origin to the maxilla, provides a valuable alternative for larger grafts. The iliac crest and cranial bones are preferred when substantial cortical bone is needed, though cranial bone harvesting has advantages in reducing postoperative discomfort, scarring, and sensory disturbances compared to iliac crest harvesting [8, 11]. However, alveolar cleft grafting with calvarial bone is not a common procedure. A PubMed search on this topic is shown in Tables 3 [9, 10, 16-19].

The scraper technique for cranial bone harvesting presents benefits over block harvesting, including reduced risks of complications such as meningitis, dural tears, and intracranial hemorrhage[12]. Compared to block grafting, which requires a longer

Table 2. Pain level of patients based on Visual Analog Scale (VAS)

Patintes	Immediately	6h	12h	24h	1w
Patient1	1	0	0	0	0
Patient2	2	2	1	1	0
Patient3	3	3	1	1	0
Patient4	6	5	4	2	0
Patient5	0	0	0	0	0

Table 3. PubMed search for cranial bone and alveolar bone grafting

Authors	Sample size	Technique	Success (%)	Reference
Harsha et al.	18	Corticocancellous block	100	16
Sadove et al.	15	Corticocancellous (Hudson brace)	80	9
	15	Corticocancellous (Craniotome)	53	
Kortebein et al.	27	Corticocancellous block	63	10
Eichhorn et al.	40	Bone crush	76	19
Hudak et al.	308	Shave (mallet and osteotome)	9219	17
Han et al.	32	Cancellous	87	18

incision and additional steps to mill the bone into smaller particles, the scraper method provides grafts in a particulate form, preserving more live cells and potentially enhancing graft viability [13]. This feature is particularly advantageous for alveolar cleft repair, where cell vitality is critical for integration and healing.

One of the primary advantages of cranial bone grafting with a scraper is its relatively simple learning curve, making it accessible for clinicians with standard training in maxillofacial surgery. The method requires only light sedation or mild general anesthesia, and the small incision can be concealed within hair-bearing areas. Unlike iliac crest grafts, cranial grafting minimizes the risk of mobility issues post-surgery and can be performed with limited anesthetic requirements, making it feasible in an outpatient setting [20, 21].

Compared to other methods, the scraper-harvested cranial bone has shown better graft quality, as it retains more viable osteocytes than bone particles obtained through drilling or piezoelectric devices [13]. The time required for harvesting with the scraper is shorter than with block harvesting or iliac crest grafts, and the procedure leaves minimal contour defects on the skull due to the preservation of the outer table. This approach not only enhances bone quality but also provides a flexible structure that easily adapts to the recipient site, promoting faster integration [22, 23].

Postoperative outcomes with the scraper technique were favorable, with patients reporting minimal pain and no cases of infection, hair loss, or wound complications at the donor site. Unlike block grafting, which can leave long-term contour irregularities, the scraper technique maintains the skull's appearance, further supporting its use in patients concerned with aesthetics [22]. Moreover, the hidden, small scar associated with this technique has not been a barrier to patient acceptance, which is essential in long-term treatment strategies for cleft repair [24].

This study is limited by its small sample size, a factor influenced by restrictions during the COVID-19 pandemic. Additionally, the lack of a comparator group prevents a direct assessment of this technique's advantages over other grafting methods. Future research should include larger, controlled studies with comparison groups, such as iliac crest and mandibular donor sites, and explore the use of advanced imaging techniques like cone beam computed tomography (CBCT) to enhance graft assessment. Expanding the sample size and using more sophisticated outcome measures will allow a more comprehensive evaluation of cranial bone scraping for alveolar cleft repair.

CONCLUSION

Cranial bone harvesting using a manual scraper technique is a viable approach for alveolar cleft repair, offering several advantages over traditional donor sites. This method yields high-quality bone grafts with minimal morbidity, preserves cell viability, and requires only a brief operative time, with a short hospital stay and minimal postoperative discomfort. The small incision and reduced risk of complications make it an appealing option for patients concerned about aesthetic outcomes and postoperative recovery. Although this technique shows promise, further research with larger sample sizes and comparator groups is necessary to validate its effectiveness as a minimally invasive alternative for secondary alveolar cleft grafting. Future studies should also incorporate advanced imaging modalities to assess long-term outcomes and enhance graft evaluation.

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COMPETING INTERESTS

No competing interests.

REFERENCES

1. Santiago PE, Schuster LA, Levy-Bercowski D. Management of the alveolar cleft. *Clin Plast Surg* 2014 Apr;**41**(2):219-32. doi: 10.1016/j.cps.2014.01.001.
2. Seifeldin SA. Is alveolar cleft reconstruction still controversial? (Review of literature). *Saudi Dent J* 2016 Jan;**28**(1):3-11. doi: 10.1016/j.sdentj.2015.01.006.
3. Wu C, Pan W, Feng C, Su Z, Duan Z, Zheng Q, Hua C, Li C. Grafting materials for alveolar cleft reconstruction: a systematic review and best-evidence synthesis. *Int J Oral Maxillofac Surg* 2018 Mar;**47**(3):345-356. doi: 10.1016/j.ijom.2017.08.003.
4. Boyne PJ, Sands NR. Secondary bone grafting of residual alveolar and palatal clefts. *J Oral Surg* 1972 Feb;**30**(2):87-92.
5. Scalzone A, Flores-Mir C, Carozza D, d'Apuzzo F, Grassia V, Perillo L. Secondary alveolar bone grafting using autologous versus alloplastic material in the treatment of cleft lip and palate patients: systematic review and meta-analysis. *Prog Orthod* 2019 Feb 11;**20**(1):6. doi: 10.1186/s40510-018-0252-y.
6. Dayashankara Rao JK, Bhatnagar A, Pandey R, Arya V, Arora G, Kumar J, Bootwala F, Devi WN. A comparative evaluation of iliac crest bone graft with and without injectable and advanced platelet rich fibrin in secondary alveolar bone grafting for cleft alveolus in unilateral cleft lip and palate patients: A randomized prospective study. *J Stomatol Oral Maxillofac Surg* 2021 Jun;**122**(3):241-247. doi: 10.1016/j.jormas.2020.07.007.
7. Mikoya T, Inoue N, Matsuzawa Y, Totsuka Y, Kajii TS, Hirosawa T. Monocortical mandibular bone grafting for reconstruction of alveolar cleft. *Cleft Palate Craniofac J* 2010 Sep;**47**(5):454-68. doi: 10.1597/09-172.
8. Cohen M, Figueroa AA, Haviv Y, Schafer ME, Aduss H. Iliac versus cranial bone for secondary grafting of residual alveolar clefts. *Plast Reconstr Surg* 1991; **87**:423-427.
9. Sadove AM, Nelson CL, Eppley BL, Nguyen B. An evaluation of calvarial and iliac donor sites in alveolar cleft grafting. *Cleft Palate J* 1990; **27**:225-229.
10. Kortebein MJ, Nelson CL, Sadove AM. Retrospective analysis of 135 secondary alveolar cleft grafts using iliac or calvarial bone. *J Oral Maxillofac Surg* 1991 May;**49**(5):493-8. doi: 10.1016/0278-2391(91)90172-i.
11. Zins JE, Whitaker LA. Membranous versus endochondral bone: implications for craniofacial reconstruction. *Plast Reconstr Surg* 1983 Dec;**72**(6):778-85. doi: 10.1097/00006534-198312000-00005.
12. Young VL, Schuster RH, Harris LW. Intracerebral hematoma complicating split calvarial bone-graft harvesting. *Plast Reconstr Surg* 1990; **86**:763-765.
13. Miron RJ, Hedbom E, Saulacic N, Zhang Y, Sculean A, Bosshardt DD, Buser D. Osteogenic potential of autogenous bone grafts harvested with four different surgical techniques. *J Dent Res* 2011 Dec;**90**(12):1428-33. doi: 10.1177/0022034511422718.
14. Bergland O, Semb G, Abyholm FE. Elimination of the residual alveolar cleft by secondary bone grafting and subsequent orthodontic treatment. *Cleft Palate J* 1986 Jul;**23**(3):175-205.
15. Jensen J, Sindet-Pedersen S. Autogenous mandibular bone grafts and osseointegrated implants for reconstruction of the severely atrophied maxilla: a preliminary report. *J Oral Maxillofac Surg*

1991 Dec;**49**(12):1277-87. doi: 10.1016/0278-2391(91)90303-4.
16. Harsha BC, Turvey TA, Powers SK. Use of autogenous cranial bone grafts in maxillofacial surgery: a preliminary report. *J Oral Maxillofac Surg* 1986 Jan;**44**(1):11-5. doi: 10.1016/0278-2391(86)90008-x.
17. Hudak KA, Hettinger P, Denny AD. Cranial bone grafting for alveolar clefts: a 25-year review of outcomes. *Plast Reconstr Surg* 2014 May;**133**(5):662e-668e. doi: 10.1097/PRS.0000000000000109.
18. Han K, Jeong W, Yeo H, Choi J, Kim J, Son D, Oh S, Kim C. Long-term results of secondary alveolar bone grafting using a technique to harvest pure calvarial cancellous bone: Evaluation based on plain radiography and computed tomography. *J Plast Reconstr Aesthet Surg* 2017 Mar;**70**(3):352-359. doi: 10.1016/j.bjps.2016.10.018.
19. Eichhorn W, Blessmann M, Pohlenz P, Blake FA, Gehrke G, Schmelzle R, Heiland M. Primary osteoplasty using calvarian bone in patients with cleft lip, alveolus and palate. *J Craniomaxillofac Surg* 2009 Dec;**37**(8):429-33. doi: 10.1016/j.jcms.2009.07.009.
20. Touzet S, Ferri J, Wojcik T, Raoul G. Complications of calvarial bone harvesting for maxillofacial reconstructions. *J Craniofac Surg* 2011 Jan;**22**(1):178-81. doi: 10.1097/SCS.0b013e3181f75300.
21. Fretwurst T, Wanner L, Nahles S, Raguse JD, Stricker A, Metzger MC, Nelson K. A prospective study of factors influencing morbidity after iliac crest harvesting for oral onlay grafting. *J Craniomaxillofac Surg* 2015 Jun;**43**(5):705-9. doi: 10.1016/j.jcms.2015.03.023.
22. Putters TF, Wortmann DE, Schortinghuis J, van Minnen B, Boven GC, Vissink A, Raghoebar GM. Morbidity of anterior iliac crest and calvarial bone donor graft sites: a 1-year randomized controlled trial. *Int J Oral Maxillofac Surg* 2018 Nov;**47**(11):1474-1480. doi: 10.1016/j.ijom.2018.06.002.
23. Frodel JL. Calvarial bone graft harvest in children. *Otolaryngol Head Neck Surg* 1999 Jul;**121**(1):78-81. doi: 10.1016/S0194-5998(99)70129-4.
24. Al-Sebaei MO, Papageorge MB, Woo T. Technique for in-office cranial bone harvesting. *J Oral Maxillofac Surg* 2004 Sep;**62**(9 Suppl 2):120-2. doi: 10.1016/j.joms.2003.12.036.