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Original article

PREOPERATIVE CBCT ASSESSMENT OF DONOR SITE- SYMPHYSIS AND RAMUS BUCCAL SHELF FOR ALVEOLAR RIDGE AUGMENTATION

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ABSTRACT

Introduction: Mandibular block autografts have been used extensively for alveolar ridge augmentation with great success and include the symphysis and ramus buccal shelf as donor sites.

Objectives: Purpose of our study is to analyze preoperative CBCT assessment of donor sites- (symphysis and ramus buccal shelf) for ranges of autogenous block graft.

Material and methods: In our study, we have analyzed with CBCT these donor sites in 15 patients and were determined the osteotomy lines of the graft depends on the limiting anatomical critical structures. Also according to CBCT with 3D printing could be done stereolithographic models and 3D cutting models for optimizing surgery.

Results: Symphysis can provide a range of dense cortical cancellous bone ranging from 17,7/7,65/6,68 mm, in contrast to a typical ramus buccal shelf block graft that is 9/9,2/8,1 mm. In symphisis area, there were observed a significant difference in width of the block at the level of the second incisor and canine. Also, the thickness of the graft differs in cranial and in caudal position. About bone graft from the buccal shell of mandibular ramus, thickness decreases from cranial to caudal direction as the measurement is at about 8mm. The width of the block is bigger in a cranial direction and smaller at the half level of its height.

Conclusion: Preoperative assessment of donor site is essential for the success of the procedure. These grafts can be used for predictable horizontal augmentation of 5 to 7 mm and vertical augmentation of up to and including 6 mm.

Keywords: autograft, block graft, donor sites, mandible, augmentation,

INTRODUCTION

Autologous bone grafts continue to represent the gold standard in the repair of alveolar atrophy and in bone defects reconstruction. If bone the volume is inadequate, several surgical techniques may be used for bone augmentation of the deficient ridge for implant placement. The morphology of a bony defect is an important consideration in the selection of a method for ridge augmentation. [1, 2, 3, 4]

The iliac crest is used often in major jaw reconstruction for implants, but also local bone grafts from the maxilla and mandible have been applied. [5, 6]

The obvious advantage of local grafts is their convenient surgical access. The close proximity of donor and recipient sites can reduce operative and anesthesia time, making them ideal for outpatient implant surgery. Mandibular bone grafts have been used for alveolar repair to allow implant placement with extremely favorable results in both- horizontal and mainly vertical bone deficiency. Block-type grafts may be harvested from the mandibular symphysis, body, or ramus area. However, the different anatomies of these regions result in different graft morphologies. The vertically deficient ridge presents the greatest challenge for reconstruction, and success with these grafts can be achieved with defects of up to 6 mm. The symphysis can provide a range of dense cortical cancellous bone ranging from 4 to 11 mm, in contrast to a typical ramus buccal shelf block graft that is 3 to 4 mm. These grafts can be used for pre- dictable horizontal augmentation of 5 to 7 mm and vertical augmentation of up to and including 6 mm. [1, 7, 8].

CBCT evaluation and comparison of intraoral harvest sites (symphisis and buccal shell of mandibular ramus) for grafting prior to implant placement are resented because of its great importance for preoperative planning and postoperative success of the procedure.

PURPOSE

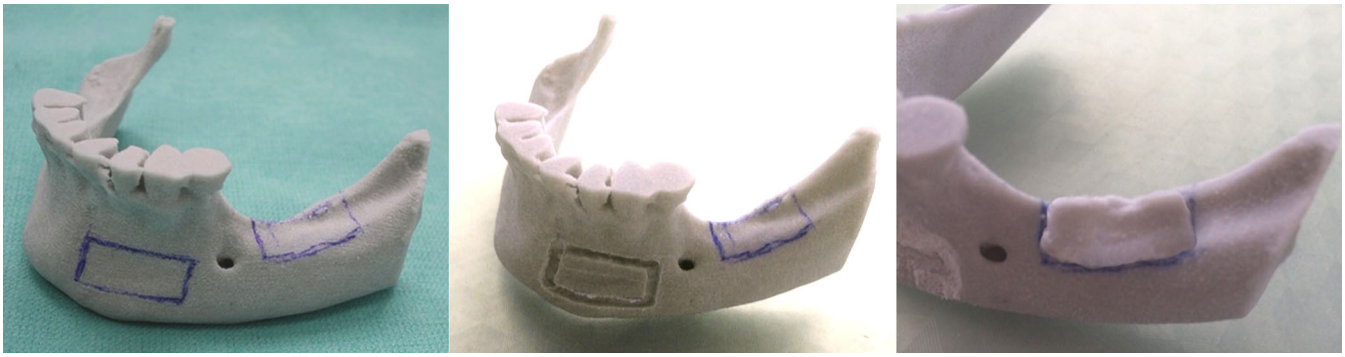
The aim of our study was to analyze preoperative CBCT assessment of donor sites- (symphysis and ramus buccal shelf) for ranges of autogenous block graft.

MATERIALS AND METHODS

Fifteen patients scheduled for implant prostheses presented with inadequate bone volume for implant placement. Radiographic examination with CBCT was performed to evaluate the bone graft donor sites. The choice of the donor site, either symphysis or ramus, was determined preoperatively based on defect morphology and recipient site location and bone volume that can be a harvest.

CBCT radiographs were been evaluated to map the mandibular canal and inferior alveolar nerve course and also intraforamen area anatomy. A surgical template for guide bone block graft of donor site can be made using 3D cutting models in some cases. (fig.1)

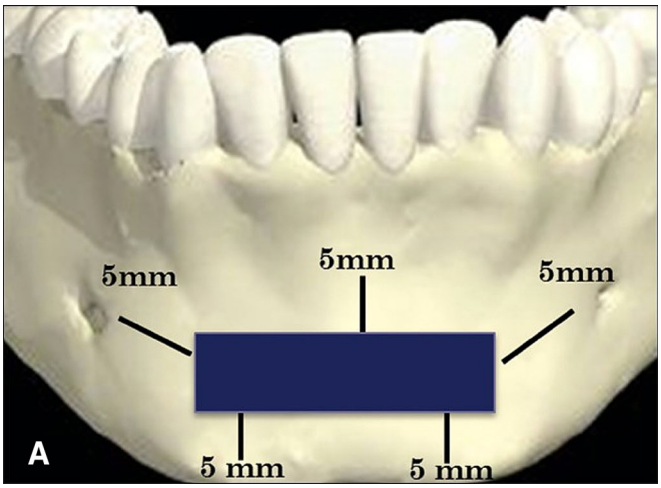
Fig. 1. According to CBCT with 3D printing could be done stereo lithographic models and 3D cutting models for optimizing surgery.

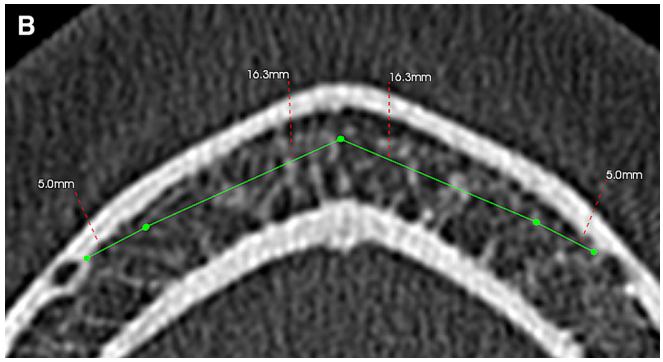


While planning the volume/borders of bone graft we used "the 5 mm rule".

In symphisis block, auto graft measurements were done, so it is important to not encroach within 5 mm of the apices of the incisor and canine teeth as well as the mental neurovascular bundles. Also, the inferior osteotomy is made no closer than 4/5 mm from the inferior border. The distance from these structures to block graft borders couldn't be less than 2-3 mm to prevent postoperative complications. (fig. 2 A ,B, C)

Fig. 2. Bone graft planning according to neighbor structures





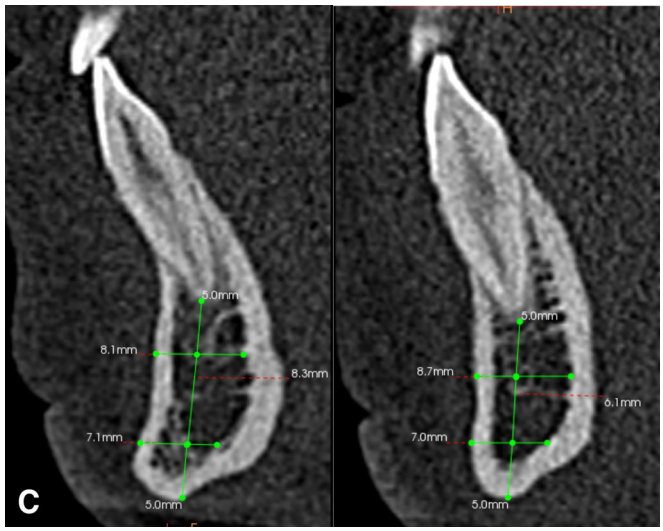
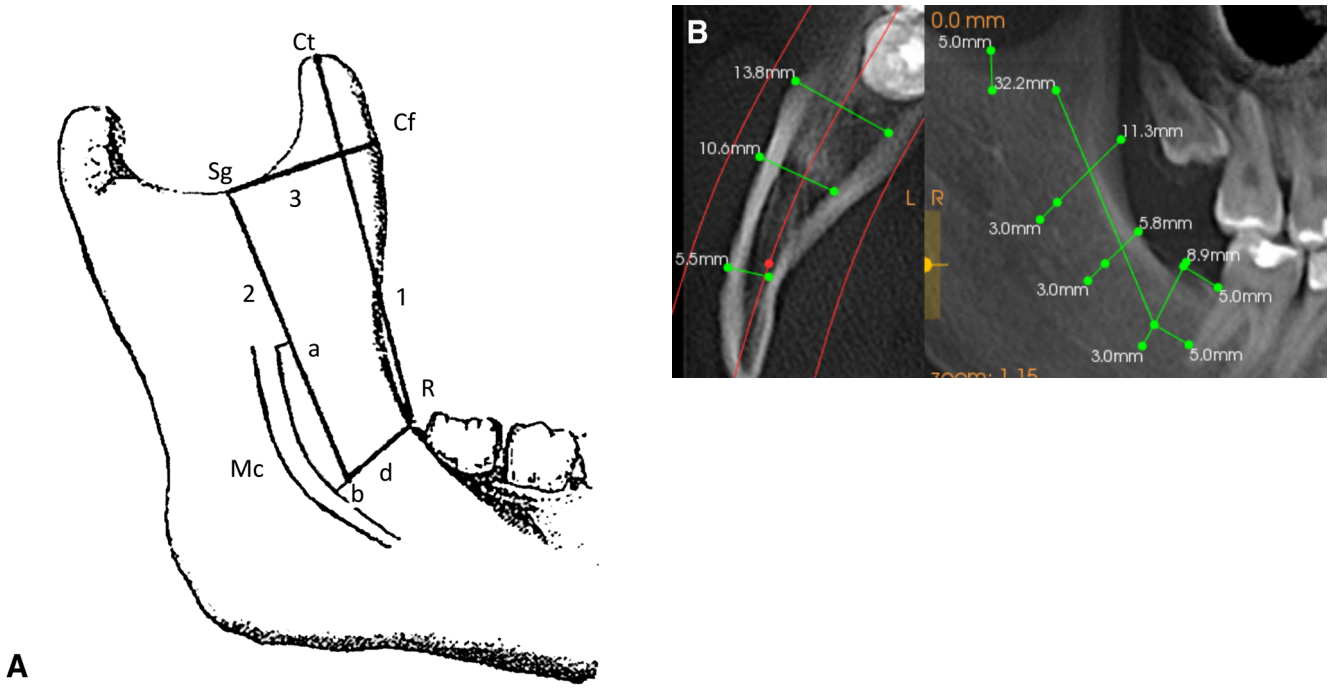


Fig. 3 A, B. Measurements of ramus buccal shelf of mandible for block bone graft planning



Measurements were done according CBCT. The width and thickness of bone graft were detected at three levels- 5mm behind the distal surface of the last molar ; upper 5 mm under the coronoid notch and third level: distance between them. The length was determined between two dots: a first dot at 5 mm from coronoid notch and the second dot- 5 mm from the distal root of the last molar. (fig. 3 A, B)

RESULTS

Onlay graft morphology from the symphysis are mainly corticocancellous; block grafts from the ramus ware more cortical. A comparison of graft size showed that the overall volume from the symphysis was approximately 40% larger, mainly because of the increased thickness of the grafts.

Symphysis can provide a range of dense cortical cancellous bone ranging from 17,7/7,65/6,68 mm, in contrast to a typical ramus buccal shelf block graft that is 9/9,2/8,1 mm. (table 1)

Table 1. Measurements of donor site block grafts volume

Symphisis					Ramus Buccal Shelf						
	Width(mm)		Thickness (mm)			Width (mm)			Thickness(mm)		
Length (mm)	At the level of incisors	At the level of canine	Caudal direction	Cranial direction	Length (mm)	Caudal aspect	midle area	Cranial daspect	Caudal aspect	middle area	Cranial aspect
18,6	10,25	7,0	6,0	7,35	30,8	9,7	9,4	13,5	11,8	8,3	4,5
17,5	9,15	5,85	7,0	8,3	35,0	10,3	8,7	15,8	13,6	7,6	3,9
15,4	7,4	4,65	6,0	6,5	23,9	8,4	7,8	11,4	8,5	5,7	2,8
17,5	5,0	3,65	4,9	5,6	26,7	6,3	7,5	12,2	11,4	7,9	6,0
17,3	10,5	5,8	7,1	6,6	36,6	3,1	2,0	5,5	11,0	4,6	2,2
18,95	10,95	10,05	7,57	9,35	25,1	7,2	6,7	11,9	10,7	7,4	5,1
17,3	4,7	3,4	6,9	9,67	33,9	9,8	8,5	14,3	14,4	10,1	5,9
18,1	10,45	6,15	4,35	5,97	33,7	7,3	7,0	8,9	13,3	7,9	3,7
16,3	8,35	5,75	7,1	8,45	32,2	8,9	5,8	11,3	13,8	10,6	5,5
19,95	13,0	10,7	6,35	6,4	32,4	8,3	5,3	10,0	12,2	7,6	4,3
17,7	8,35	7,3	5,9	3,82	40,5	10,9	10,5	19,4	13,3	8,5	4,5
cp17,7	8,9	6,4	6,28	7,09	31,9	8,2	7,2	12,2	12,2	7,83	4,4

In symphisis area, there were observed a significant difference in width of the block at the level of the second incisor and canine. Also, the thickness of the graft differs in cranial and in caudal position. About bone graft from the buccal shell of mandibular ramus, thickness decreases from cranial to caudal direction as the measurement is at about 8mm. The width of the block is bigger in cranial direction and smaller at the half level of its height.

DISCUSSION

Local grafts from the mandible are a convenient source of autogenous bone for alveolar ridge augmentation technique. Bone harvested from the mandible appears to have inherent biologic benefits, which have been attributed to its embryologic origin. The limits of the symphyseal site in this study were the tooth roots, mental foramina, inferior cortical border, and lingual cortex. Depending on volume requirements, the osteotomy may be between the canines. Care was taken to allow a 5-mm border between the most superior bone cut and the apices of the tooth roots. The average interforaminal distance is approximately 5 cm, so that localized bone deficiencies requiring a large graft may be better managed with the symphysis as a donor site. The symphysis has a curved triangular shape with the mental protuberance as its apex, and this morphology is often well suited for re-establishing the arch form of the grafted ridge e roots or below them if a greater graft size is necessary. Applicable situations for symphysis grafts include alveolar defects involving a span of up to four tooth sites. (2, 7, 8)

The limits of the ramus area are dictated by clinical access, as well as the coronoid process, molar teeth, and inferior alveolar canal. A rectangular piece of bone up to 4 mm in thickness may be harvested from the ramus. This morphology conforms especially well as a veneer g raft to gain additional ridge width. The anatomic proximity makes the ramus well suited for augmentation of the thin posterior mandible. Length of the rectangular graft may approach 3.5 cm, but height usually is not much greater than 1 cm. (table 1) These dimensions accommodate deficiencies involving a span of three to four tooth sites. Patients have shown less concern with bone removal from the ramus area. Because the masseter muscle provides soft tissue bulk, augmentation of this donor site has been unnecessary. (9, 10, 11, 12)

The ramus donor site was associated with fewer postoperative complications than the symphyseal site.

Although the position of the canal is variable, anatomic averages are helpful in surgical planning. The mean anteroposterior width of the ramus is 30.5 mm, with the mandibular foramen located about two thirds of the distance from the anterior border. (13, 14, 15, 16) The mean vertical distance between the superior edge of the canal and the cortical surface along the external oblique ridge is approximately 7 mm in the second molar region, 11 mm in the third molar region, and 14 mm at the base of the coronoid process which is almost the same like our investigation. (table 1) Although the buccolingual position of the mandibular canal is variable, the distance from the canal to the medial aspect of the buccal cortical plate (medullary bone thickness) was found to be greatest at the distal half of the first molar (mean = 4.05 mm). Therefore, when larger grafts are planned, the anterior vertical bone cut should be made in this area. This cut is progressively deepened until bleeding from the underlying cancellous bone is visible.(2) Implant placement must follow graft incorporation and should never be done simultaneously. This staging provides predictable bone volume and optimal bone density to be created prior to one stage surgery (2,17, 18, 19, 20). Recipient site morbidity includes trismus, bleeding, pain, swelling, bruising, infection, neurosensory deficits, bone resorption, dehiscence, and graft failure. Symphysis donor site morbidity includes intraoperative complications such as bleeding; mental nerve injury; soft tissue injury of cheeks, lips, and tongue; block graft fracture; and potential bicortical harvest. The ramus buccal shelf harvest can also result in intraoperative complications including bleeding, nerve injury, soft tissue injury, block fracture, and mandible fracture.(21)

CONCLUSION

Mandibular block autografts for vertical and horisontal alveolar ridge augmentation are predictable and offer many advantages. These grafts are primarily cortical in nature, exhibit minimal resorption, and tend to incorporate exceptionally well with recipient bone in a relatively short time. They also maintain postimplant placement bone volume and retain their radiographic density to the augmented site. The ramus area has some more advantages than the mandibular symphysis as a donor site. Morbidity of mandibular block autografts for atrophic alveolar bone augmentation is minimal. Most complications are preventable. Those that occur can be handled predictably with minimal adverse effects to the patient.

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