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Research Article

UTILITY OF INTRAORAL BONE HARVESTING FOR MAXILLOFACIAL BONY DEFECTS- A CLINICAL STUDY

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A B S T R A C T

The reconstructive options of the maxillofacial region after bony defects are always challenging. The success of intraoral bone grafts depends on the choice of donor site as well as handling of the graft. Bone grafts for maxillofacial defect reconstruction can be done by extraoral donor and intraoral donor sites. The aim of this study is to evaluate the utility of intraoral bone harvesting technique for the reconstruction of maxillofacial defects. Total of 192 patients requiring bone graftingprocedures involved in this study from 2013 to 2017. The bone bone grafting techniques were used for alveolar bone defects, reconstruction of orbital bone defects, orthognathic surgical and dental implant procedures. Out of 192 patients, 48 patients underwent intraoral harvesting of bone grafting, 92 patients underwent extraoral bone harvesting and remaining patients were treated by alloplastic bone graft materials.

Results: In all together intraoral harvesting of the graft was done in mild to moderate sized maxillofacial surgical defects. Total of 27 patients underwent grafting from chin symphysis region, 5 from anterior border of ramus, 5 from anterolateral wall of maxilla, 1 from coronoid process, 2 tuberosity and 8 underwent miscellaneous source of grafting.

Conclusions: The evidence supporting the use of autogenous intramembranous bone grafts is reviewed in this presentation. The rationale of donor site selection, the technique of intraoral bone harvesting, advantages and disadvantages of harvest sites are discussed. The success of any bone grafting technique depends upon better understanding of bone graft biology, selection of appropriate site for bone harvesting, optimizing the small amount of bone graft available and recognizing alternative sources for bone harvesting.

INTRODUCTION

Bone harvesting is a surgical procedure that replaces missing bone in order to repair bone that pose a significant health risk to the patient or fail to heal properly. Bone generally has the ability to regenerate completely but requires a very small fracture space or some sort of scaffold to do so. Most of the bone grafts are expected to be resorbed and replaced as the natural bone heals over a period of time.

Bone grafting is possible because bone tissue, unlike most other tissues has the ability to regenerate completely if provided the space into which to grow. Intraoral sites generally allow for shorter procedures, avoid the need for general anesthesia, and are associated with few complications and less postoperative discomfort than extraoral sites. Somewhat less apparent than the bone quantity required, the biological qualities of the transplanted bone are also important. These include the embryological origin, morphology, cytologic constituents and biochemical composition of the extracellular matrix [1]. Local harvesting is advantageous when bone volume demands are not prohibitively high because intraoral sites can serve as an excellent readily accessible source of intramembranous bone. Utility of intraoral bone harvesting in maxillofacial defects is discussed with the rational of donor site selection and advantages and disadvantages of harvest site options.

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MATERIAL AND METHODS

This study was conducted at our department. Total of 192 patients requiring bone grafting procedure for maxillofacial reconstruction were involved in this study from 2013 to 2017. The following were the inclusion criteria

1. All the patients requiring reconstruction of bony defects.
2. Patients fit for necessary anesthesia.
3. Patients having healthy donor site.
4. Patients with mild to moderate bony defects.

Patients with severe defects were excluded for intraoral bone harvesting. In this study the intraoral harvesting of the bone was done from maxilla and miscellaneous sites using standard surgical procedure. The harvesting of the bone graft at different sites is shown in figure. (Fig 1, Fig 2 & Fig 3)The

resorption of bone grafts were evaluated according to the appearance of the screw head used for fixation when the second surgical intervention was performed. The healing of the donor and recipient sites in the postoperative period, surgical complications and the uptake & resorption of the graft were clinically assessed.

Fig. 1 Harvesting from symphysis region

Fig 2 Harvesting from ramus region

Fig 3 Harvesting from anterolateral wall of maxilla

RESULTS

In our study total of 192 maxillofacial surgical defects were included. Out of 192 defects, 77 defects were of mild size, 46 defects were of moderate size and 69 defects were of severe size. (Table 1) Out of 192 patients 48 patients underwent intraoral harvesting of bone grafting, 92 patients underwent extraoral bone harvesting technique and remaining 50 patients were treated by alloplastic bone graft material. In all together intraoral harvesting of the graft was done in mold to moderate sized maxillofacial defects. We used intraorally harvested bone graft in 2 patients of alveolar cleft, 28 patients for onlay in dental implants, 5 patients for orbital floor reconstruction, 3 patients for maxillary sinus lift, 8 patients for orthognathic surgery and 3 miscellaneous defects. (Table 2) Total of 27 patients underwent grafting from chin symphysis region, 5 from anterior border of ramus, 5 from anterolateral wall of maxilla, 1 patient coronoid process, 2 tuberosity and 8 underwent miscellaneous source of grafting. (Table 3) The patients were followed up for 2 years. With respect to surgical complications, postoperative morbidity was related to soft tissue management. The post surgical complications included mucosal dehiscence with or without exposure of the grafts. Temporary neural disturbances involving branches of the inferior alveolar nerve was seen in only one case when the graft was harvested from ramus. Out of 48 patients undergoing intraoral bone harvesting the uptake of the bone graft was excellent in all the patients. There was maximum uptake of the bone graft with minimal resorption observed radiographically in this study. (Table 4)

Table 1 Distribution of defect size

Maxillofacial defects	Number of patients (N)	Mild sized defects (N)	Moderate sized defects	Severe defects
Alveolar clefts	52	10	12	30
Onlay for implants	48	36	12	--
Orbital floor reconstruction	12	4	3	5
Maxillary sinus lift	30	16	14	---
Reconstruction of mandibular defect	12	---	---	12
Orthognathic surgical procedures	20	8	4	8
TMJ ankylosis	10	---	---	10
Miscellaneous	08	3	1	4
Total	192	77	46	69

Table 2 Source of bone graft and type of defect

Maxillofacial defects	Number of patients (N)	Intraoral bone harvesting	Extraoral bone harvesting	Alloplastic material
Alveolar clefts	52	2	51	Nil
Onlay for implants	48	28	Nil	20
Orbital floor Reconstruction	12	5	4	03
Maxillary sinus lift	30	3	Nil	27
Reconstruction of mandibular defect	12	Nil	12	Nil
Orthognathic surgical procedures	20	8	12	Nil
TMJ ankylosis	10	Nil	10	Nil
Miscellaneous	8	3	05	Nil
Total	192	48	94	50

DISCUSSION

Bone grafting is a surgical procedure that replaces missing bone to repair Bone fractures. Bone generally has the ability to regenerate completely but requires a very small fracture space or some sort of scaffold to do so. Bone grafts may be autogenous (boneharvested from patients own body), allograft (cadaveric bone usually obtained from a bone bank) or

Table 3 Intraoral source of bone graft and the use in maxillofacial defects

Maxillofacial defects	Chin	Anterior Border of ramus	Anterolateral Wall of Maxilla	Coronoid process	Maxillary Tuberosity	Miscellaneous
Alveolar clefts	02	Nil	Nil	Nil	Nil	Nil
Onlay for implants	20	05	Nil	01	02	Nil
Orbital floor reconstruction	Nil	Nil	5	Nil	Nil	Nil
Maxillary sinus lift	03	Nil	Nil	Nil	Nil	Nil
Orthognathic surgical procedures	03	Nil	Nil	Nil	Nil	Nil
Miscellaneous	Nil	Nil	Nil	Nil	Nil	05
Total	27	5	5	1	2	8

Table 4 Showing surgical complications in intraoral harvesting sites

Complications	Intraoral sites	Extraoral sites	Alloplastic
Wound dehiscence	01	----	----
Neural Disturbances	01	----	---
Teeth vitality	---	----	---
Graft resorption	-----	-----	---

synthetic (often made of hydroxyapatite or other naturally occurring biocompatible substances) with similar mechanical properties to bone. Most bone grafts are expected to be resorbed and replaced as the natural bone heals over a period of time. [2] Bone grafting is possible because bone unlike most other tissues has the ability to regenerate completely if provided the space into which it grows. As native bone grows, it will generally replace the graft material completely, resulting in a fully integrated region of new bone. The biologic mechanisms that provide a rationale for bone grafting are osteoconduction, osteoinduction and osteogenesis [3]. Osteoconduction occurs when the bone graft material serves as a scaffold and new bone growth is perpetuated by the native bone. Osteoinduction involves the stimulation of osteoprogenitor cells to differentiate into osteoblast that then begin new bone formation. Osteogenesis occurs when vital osteoblasts originating from the bone graft material contribute to new bone growth along with bone growth generated via the other two mechanisms [3]. Autogenous bone grafting involves utilizing bone obtained from the same

Individual receiving the graft. Autogenous bone is typically harvested from intraoral sources as the chin, ramus, coronoid and anterolateral wall of maxilla or extraoral sources as the iliac crest, fibula, and rib. When a block graft will be performed, autogenous bone is the most preferred because there is less risk of the graft rejection because the graft originated from the patient's own body [4]. Extraoral harvesting of the bone requires another donor site. A negative aspect of autogenous grafts harvesting is an additional surgical site is required, in effect adding another potential location for post operative pain and complications [5]. Quantity of bone available is a critical factor when selecting a donor site for harvesting. Somewhat less apparent than the bone quantity, the biologic quality of the transplanted bone is also important [6]. Embryologically, bone is formed by two separate developmental processes described as intramembranous and endochondral ossification. In endochondral ossification, bone replaces a hyaline cartilage precursor [7]. Intramembranous ossification proceeds by direct mineralization of the organic matrix without a cartilaginous intermediate. The bones of the craniofacial complex with limited exceptions form via intramembranous ossification. The calvaria, maxillary bones, mandibular body and mandibular ramus in particular are intramembranous while most of the cranial base and a portion of the mandible are thought to have an endochondral origin [7]. From comparative studies of craniofacial reconstruction in animals and man, it appears that intramembranous grafts tend to maintain their volume whereas endochondral grafts undergo variable degree of resorption over variable period of time. Some studies have shown that the membranous bone grafts show less resorption and revascularize more rapidly than endochondral bone grafts. This rapid revascularization of membranous bone graft explains the maintenance of mandibular graft volume [8, 9, 10, 13].

Others theorize that the improved survival of membranous bone grafts is the result of their three-dimensional structure. Because they have a thicker cortical layer, membranous grafts resorb more slowly [13].

In our study intramembranous origin of the bone graft harvested from intraoral sites was preferred in maxillofacial defects. From the preceding discussion, the relative attractiveness of intraoral sites for the harvesting of donor bone can be appreciated. The particular embryologic origin of donor bone is recognized as one of the factors in the success of bone transplantation procedures in this study. Yates et al, quantified and compared the amount of bone that can be harvested from the mandibular symphysis, ascending ramus/body, coronoid process and the zygomaticmaxillary buttress (anterolateral wall of maxilla). The ramus had the highest average cortical bone area and volume harvested, while the symphysis had the highest average thickness [11]. Our experiences of intraoral harvesting of the graft were consistent with this study. In this study, the maximum volume of the corticocancellous graft was harvested from the chin region. More requirement of cortical bone graft with minimal cancellous bone can be harvested from ramus and anterior border of mandible. When cortical bone with minimum thickness is required the anterolateral wall of maxilla is more preferred. Also miscellaneous sources like coronoid process and maxillary tuberosity are used when the requirement of the graft was minimal. Chin offers a large amount of cortico-cancellous autograft and easy access among all the intraoral sites. In our study we observed that intraoral harvesting of the bone can be done easily in the office settings under local anesthesia on an outpatient basis. Proximity of the donor and recipient site reduce operative time and cost. Convenient surgical access, low morbidity, elimination of hospital stay, minimal donor site discomfort and avoidance of cutaneous scars are the added advantages of this technique. It is important to emphasize that the anatomical factors limiting bone harvesting in the posterior mandible is the mandibular canal and associated neurovascular elements. Pre-surgical treatment planning therefore should include appropriate anatomical determinations when such alternative harvesting is considered.

After harvesting the donor site must be adapted to the recipient site. Several investigators have examined the various technical considerations in this regard. These intraoperative

considerations include the adequacy of donor bone volume, use of block graftsverses ground bone, method of fixation, concomitant use of barrier membranes and degree of flap closure [12]. We used the intraoral harvesting technique in mild to moderate defects in this study. In severe defects the use of this technique was not possible as the volume of the bone harvested was less. In our study intramembranous mandibular symphysis grafts have shown less delayed resorption and less morbidity than extraoral endochondral grafts in alveolar cleft grafted patients, but the volume of the bone harvested limited the use of donor site in more number of patients [14, 15].

The review of literature supported the use of onlay bone graft from mandible as an excellent source of bone in reconstruction for endosseous implants [16-19]. We also used the mandibular symphysis and ramus as a donor site for reconstruction of the alveolar bone defect before implant placement very effectively. The use of harvested bone graft from anterolateral wall of maxilla is better option for the reconstruction of orbital floor defects. The clinical and radiographic observations showed a very low rate of bone resorption and significant improvement in diplopia and correction of continuity of orbital floor defect. Thus, the membranous origin of the bone from anterolateral wall of maxilla is a good source for reconstruction of moderate size orbital floor defects [19].

CONCLUSION

Many grafts are available for hard tissue augmentation during the past several decades. Autogenous bone grafts are generally considered one of the more ideal augmentation materials. The choice of autogenous donor site is markedly influenced by two important considerations: the quantity of bone required at the recipient site and the biologic qualities of donor bone. In addition successful augmentation of the recipient site is influenced by the technical, intraoperative surgical manipulations used. We prefer intraoral bone of membranous origin over extraoral bone of either intramembranous or endochondral origin. Mandibular donor site is preferred over maxillary bone. The donor site that is contiguous with the recipient site is preferred over intraoral bone from a second distinct location.

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