Original Article

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Bony Healing Following Filling of Post Cystectomy Jaw Bone Defects with Hydroxyapatite and Beta-Tricalcium Phosphate and its Comparison with Non-Filling Case: A Clinical Study

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Abstract

Introduction: Jaw cysts are common findings in day-to-day maxillofacial practice. Enucleation has been traditionally the gold standard of treatment of cysts in maxillofacial region. Recently, several bone substitutes have been used to fill post cystectomy defects with varying degrees of success.

Aims and Objective: This study was undertaken to assess bone healing in post cystectomy defects with or without a bone substitute (hydroxyapatite (HA) or β tricalcium phosphates [TCP]).

Materials and Methods: The study was undertaken on patients with cystic lesions (<5 cm) of maxillofacial regions. The following enucleation, the patients were randomly divided into three groups. In Group 1 (*n* = 10) and Group 2 (*n* = 10), the post cystectomy defect was filled with β-TCP and HA, respectively. Group 3 (*n* = 10) patients underwent primary closure without any bone graft. Patient's pre-operative and post-operative clinical and radiological findings were recorded and subjected to statistical analysis.

Results: The cysts were a more common in the 3rd and 4th decade of life. Males were more common involved than females. The maxilla was the most common site involved. Radicular cysts were present in the majority of patients. There was no statistical difference in healing between the three groups compared.

Conclusion: The present study revealed that spontaneous regeneration of bone occurs in post cystectomy defects with or without the use of filling material.

Key words: Cystectomy, Hydroxyapatite, Jaw cysts, Tricalcium phosphate

INTRODUCTION

Odontogenic cysts are the most common osseous lesions encountered in routine oral and maxillofacial surgical practice. Treatment of mandibular cysts depends on site, size, number, etiology, pathology, soft tissue involvement, and history of previous treatment.[1] The ideal treatment of these lesions consists of enucleation of the cysts followed by primary closure, which has been described by Partsch as "Cystectomy" (Partsch II) in 1910α.[2] The following cystectomy in small cysts spontaneous regeneration of bone occurs in the majority of cases and results in filling of the residual cavity.[3] However, some controversy still exists regarding the treatment of large cysts (>4 cm) with cystectomy alone. One-stage cystectomy of large cysts with primary closure of the resultant bone defect predisposes to complications like infection and pathological fracture. To overcome these potential complications and to accelerate the bony healing, numerous bony graft have been used with varying rate of success.[4-6]

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Autogenous bone has osteoconductive and osteoinductive properties and contains a source of osteoprogenitor cells. Therefore, its transplantation is still the gold standard. However, autogenous bone grafting is often related to disadvantages like limited availability and donor site morbidity, a possible hospitalization, and the need for general anesthesia.[7,8]

To overcome these problems, large no. of synthetic grafting materials are currently being tried for defect filling after cystectomy. Available synthetic materials include bioactive glasses, glass ionomers, aluminum oxide, calcium sulfate, calcium phosphates, α and β-tricalcium phosphate (TCP), and synthetic hydroxyapatite (HA).[9] The idea of using these osteoconductive materials is to stabilize the blood clot in the defect avoiding infections and to advance bone regeneration by enhancing the migration of osteoprogenitor cells.[10]

Since the 1980s, calcium phosphate ceramics has been used as bone substitute materials because of their non-antigenicity and biocompatibility.[7,11] TCPs are bone substitute materials that are marked out by their high biocompatibility, favorable resorption properties and osteoconductivity.[12,13]

HA is known as a slowly biodegradable material with high osteocompatibility and bone binding capability, and its resorption rate is relatively slow compared with the rate of new bone formation.[11,14] Both this materials have been extensively studied and encouraging results obtained for filling of osseous defects. The main disadvantages of these materials in clinical settings may be low or unpredictable resorption and occasional inflammatory foreign body reactions.[15,16]

The purpose of this study was to investigate the bony healing following filling of post cystectomy defect with HA (Figure 1) and β-TCP (Figure 1) and to compare the results with non-filling cases.

MATERIALS AND METHODS

This study was conducted on 30 patients (n = 30) in the Department of Oral and Maxillofacial Surgery, Buddha Institute of Dental Sciences and Hospital, Patna between 2012 and 2014. Patients with cystic lesions confined within the cortical margins of maxilla and mandible and <5 cm in diameter were included in the study. Lesions involving vital structures like floor of the nasal cavity, maxillary sinus, or inferior alveolar nerve were excluded from the study. Large bony lesions (>5 cm) or lesions eroding the cortical plate with periosteum and spreading to adjacent soft tissues were also excluded from the study.

Figure 1: β-tricalcium phosphates used in study

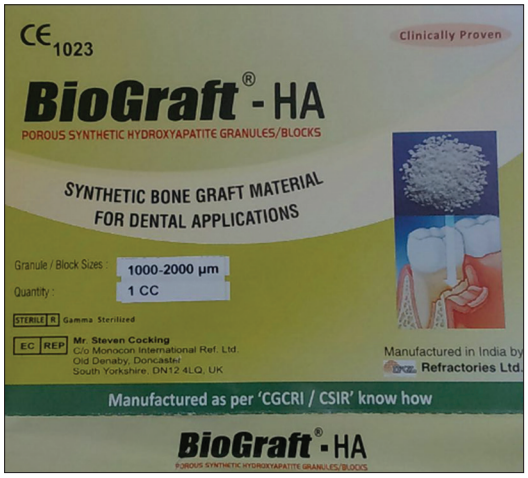

Figure 2: Hydroxyapatite used in the study

Surgical Technique

The patients were treated with standardized technique under local anesthesia. After elevation of a mucoperiosteal flap, decortication was done to expose the cystic lining. The cystic lining was then enucleated. Care was taken to protect adjacent vital structures. The following enucleation, the patients were randomly divided into three groups:

Group 1 (n = 10): The post cystectomy defect was filled with β-TCP

Group 2 (n = 10): The post cystectomy defect was filled with HA

Group 3 (n = 10): The post cystectomy was primarily closed. No bone graft/substitute was used.

Patient's clinical and radiological findings were recorded preoperatively, immediate post-operative period and 6-month postoperatively in a proforma which was then statistically analyzed.

RESULTS

Table 1 and Figure 3 show the age group and gender distribution of patients in our study. Majority of the patients were middle-aged group (30-45 years). The male:female ratio was 3:2.

Table 2 shows the pre-operative clinical findings. The main complaint was swelling (66.66%) followed by pain (60%).

Figure 4 shows distribution of cyst by anatomic site involved.

Table 3 shows the radiological findings on orthopantomogram and intraoral periapical X-ray. Bone loss was seen in all cases followed by bony expansion.

Tables 4-6 show the comparison between size of cystic cavity preoperatively and postoperatively in Group 1, Group 2 and Group 3, respectively. In all the three groups the cystic cavity showed statistically significant decrease in size in the 6-month post-operative period.

Figure 5 shows the histopathological findings of the enucleated cyst. Majority of the cysts were radicular cysts (73%).

Table 1: Age wise sample distribution

Age (years)	*n* (%)
0-15	4 (13.33)
15-30	10 (33.33)
30-45	13 (43.33)
>45	3 (10)

Table 2: Pre-operative clinical examination

Pre-operative clinical examination (*n*=30)	*n* (%)
Pain	
Present	18 (60)
Absent	12 (40)
Swelling	
Present	20 (66.66)
Absent	10 (33.37)
Pus discharge	
Present	15 (50)
Absent	15 (50)
Bony expansion	
Present	11 (36.66)
Absent	19 (63.37)
Mobility of tooth	
Present	6 (25)
Absent	24 (75)
Displacement of tooth	
Present	2 (6.66)
Absent	28 (93.33)

Table 3: Radiological findings

Pre-operative radiological examination (*n*=30)	*n* (%)
Bone loss	30 (100)
Bony expansion	11 (36.66)
Root resorptiom	08 (26.67)
Displacement of the root	05 (16.67)
Impacted wisdom tooth	03 (10)

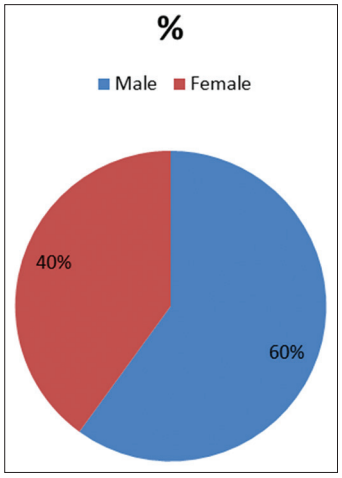

Figure 3: Gender distribution

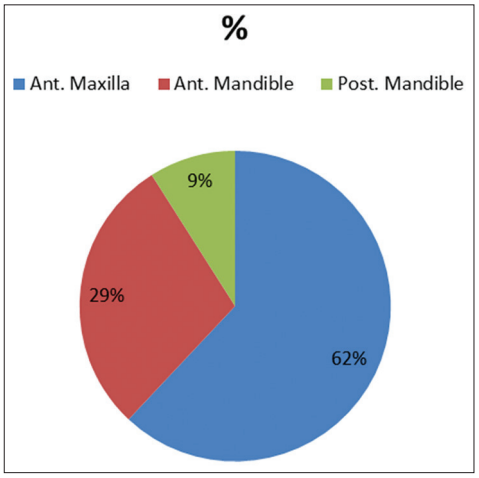

Figure 4: Anatomic site involved

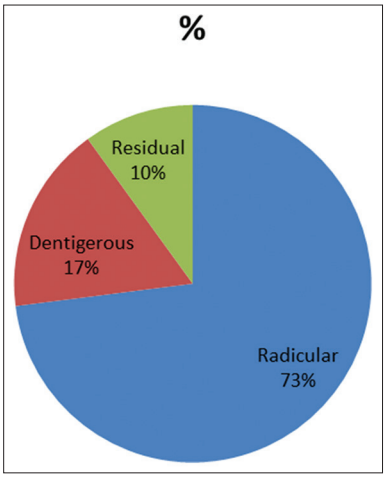

Figure 5: Histopathological findings

Table 4: Comparison of cyst size between pre-operative and post-operative follow up at 1st month, 2nd month and 6th month of Group I

Pre-operative	Mean±SD	Post-operative follow up	Mean±SD	*P* value
1st day	2.720±3.639	1st month	1.316±2.093	NS
		2nd month	1.316±2.093	NS
		6th month	0.3200±0.593	*P*<0.01
P value		*P*<0.01		

SD: Standard deviation, NS: Nonsignificant

Table 5: Comparison of cyst size between pre-operative and post-operative follow-up at 1st month, 2nd month and 6th month of Group II

Pre-operative	Mean±SD	Post-operative follow-up	Mean±SD	*P* value
1st day	3.600±0.894	1st month	1.20±0.737	NS
		2nd month	1.20±0.737	NS
		6th month	0.100±0.137	*P*<0.01
P value		*P*<0.01		

SD: Standard deviation, NS: Nonsignificant

Table 6: Comparison of cyst size between pre-operative and post-operative follow-up at 1st month, 2nd month and 6th month of Group III

Pre-operative	Mean±SD	Post-operative follow-up	Mean±SD	*P* value
1st day	4.150±2.001	1st month	2.080±1.524	NS
		2nd month	2.080±1.524	NS
		6th month	1.020±1.126	*P*<0.01
P value		*P*<0.01		

SD: Standard deviation, NS: Nonsignificant

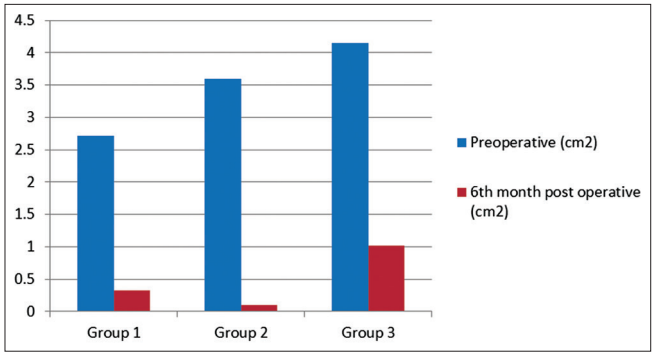

Figure 6: Comparison of cyst size between Group I, Group II and Group III pre-operative and post-operative follow-up the 6th month

Figure 6 shows the comparison between the three groups with respect to decrease in cystic size 6 months postoperatively. The results were not significant.

DISCUSSION

Odontogenic cysts account for 7-13% of the lesions diagnosed in the oral cavity.[17,18] In our study, males were a more common involved than female and the most common involved age group was middle-aged group (30-450). The radicular cyst was the most common cystic lesion followed by dentigerous cyst. These results are similar to those reported in literature.[18-20] The maxilla was the most common involved site (62%) in our study.

Up to date, several studies have reported safe and regular bone healing after enucleation and simple closure of jaw cysts without using bone grafts even in cases of large defects. The complication rate for cyst enucleation, primary closure and peri-operative antibiotic treatment seems to be <5%, even in defects measuring far more than 3 cm.[21]

Chiapasco *et al.* evaluated the spontaneous bone healing after enucleation of a large mandibular (>40 mm) cysts subjectively and with a computer analysis of post-operative panoramic radiographs. They concluded that spontaneous bone regeneration can occur in large mandibular cysts without the aid of any filling materials. Besides, simple cystectomy simplifies the surgical procedure, decreases the economic and biologic costs, and reduces the risk of postoperative complications.[22] There are numerous other studies that support the above findings.[23,24]

The role of HA specially nanoparticular HA, Ostim has been extensively studied. Bezrukov *et al.* reported the use of lincomycin with ultra-highly dispersed HA (33% OSTIM-100 paste), for filling the bone cavity formed after cystectomy in 49 patients and compared with non-filling cases. They reported that the above preparations decreased the incidence of post-operative complications and created the optimal conditions for bone repair at the site of defects of different size. They concluded that ultra-highly dispersed HA, a biochemically active form of HA, stimulates the repair osteogenesis at the early stages.[25] Similar encouraging results with HA have been reported in other studies also.[26,27]

TCPs are bone substitute materials that are marked out by their high biocompatibility, favorable resorption properties, and osteoconductivity.[12] Horch *et al.* studied the long-term effect of the ceramic β-TCP at different sites of alveolar reconstruction and to evaluate its properties. They found that because of its versatility, low complication rate, and good long-term results, synthetic, pure-phase β-TCP was a suitable material for the filling of bone defects in the alveolar region.[28]

Palm *et al.* assessed the capacity of β-TCP to stimulate the reossification of 64 defects that resulted from cystectomy in 63 patients. They reported satisfactory healing even in larger defects <2.5 cm.[29] Other studies have also reported good success rate with β-TCP.[30,31]

In our study, post cystectomy defect healing was good in all the three groups, and the results were statistically significant. In comparison of groups with respect to decrease in cyst size, the results were statistically not significant.

Ettl *et al.* reviewed various studies using autogenous, allogenic, xenogenic, and alloplastic bone grafts and compared the results with conservative cyst enucleation without using any filling materials. They concluded that enucleation of jaw cysts the so-called "cystectomy" and primary closure without the use of additional bone grafts represents the "state of the art," even in large defects of 3 cm and more in diameter.[21]

CONCLUSION

The present study revealed that spontaneous regeneration of bone occurs in post cystectomy defects with or without the use of filling material. We did note any addition advantage with the use of bone substitute. However, our study was limited by small sample size. In future, similar studies with large sample size should be undertaken to arrive at a more definitive conclusion.

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