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## **Efficacy of bone graft materials in extraction sockets for implants in maxillary posteriors- An original research**

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**Abstract**--Introduction: The aim of this study was to compare the effects of hydroxyapatite (HA), deproteinized bovine bone (DPB), human-derived allogenic bone (HALG), and calcium sulfate (CAP) graft biomaterials placed post extraction for future implant therapy in maxillary 1st molar area placed by guided tissue regeneration. Material and methods: We conducted a retrospective study. Thirty-two subjects were divided into four groups: DPB, HALG, HA, and CAP. Alveolar bone width at specific implant sites were assessed using sagittal and cross-sectional CBCT images prior grafting and at three subsequent time points. Results: The vertical and horizontal dimensions did not significantly differ between bone grafts at any time point. In addition, there were no statistically significant differences in graft remodeling rates between grafts Conclusion: Deproteinized bovine bone blocks showed equivalent volumetric shrinkage rates as man-derived allogenic bone (HALG), and calcium sulfate (CAP) graft biomaterials when used for treating circumscribed bone defects. Therefore, it is not necessary to over-contour the ridge in the maxillary molars.

**Keywords**--Bone Regeneration; Durapatite; Hydroxyapatites; Calcium Sulfate.

## **Introduction**

Various alternative bone graft materials, such as deproteinized bovine bone (DPB), human-derived allogenic bone (HALG), hydroxyapatite (HA), and calcium sulfate (CAP) bioceramic biomaterials, have been developed as alternative graft materials to autologous grafts.<sup>9,10</sup> Allografts, such as deproteinized human bone grafts, are one of the most commonly-used alternatives to autografts in the treatment of bone tissue defects. However, allografts have various disadvantages, including an increased risk of infections (hepatitis and HIV). Controversy also surrounds their osteoinductive potential. In experimental animal models, researchers reported increased bone regeneration using calcium phosphate ceramic-derived bone graft biomaterials (HA, tricalcium phosphate, and calcium sulfate), in addition to superior stability and osteogenic properties, compared to autologous bone grafts.<sup>1,2</sup> In experimental and clinical research, another study demonstrated the osteoconductive capacity of this type of graft material (ceramic-derived bone graft biomaterial) in a GBR procedure for the treatment of bone tissue defects.<sup>1-5</sup>

The aim of the present study was to compare the effects of HA-, DPB-, HALG-, and CAP-derived bone graft biomaterials placed post extraction for future implant therapy in maxillary 1st molar area placed by guided tissue regeneration.

## **Material and Methods**

A total of 32 patients with maxillary molar extraction done and insufficient bone quantity for direct implant placement were enrolled into this retrospective study and underwent hydroxyapatite (HA), deproteinized bovine bone (DPB), human-

derived allogenic bone (HALG), and calcium sulfate (CAP) graft biomaterials procedures. All patients were fully informed about the surgical procedures and treatment alternatives. The inclusion criterion was the presence of a clinically relevant bone atrophy of the alveolar ridge in the predominantly horizontal and/or vertical plane as identified by cone beam computed tomography (CBCT) para-axial reconstruction images. Exclusion criteria consisted of a history of radiotherapy in the head and neck region, systemic disease that would contraindicate oral surgery, uncontrolled periodontal disease, bruxism, a smoking habit or alcoholism, pregnancy, psychiatric problems, and/or use of medications known to alter bone healing.

SPSS 22 software was used for statistical analysis. The data were analyzed using one-way ANOVA and Tukey's HSD tests. A value of  $p < 0.05$  was accepted as denoting a statistically significant difference.

## Results

The vertical and horizontal dimensions did not significantly differ between bone grafts at any time point. In addition, there were no statistically significant differences in graft remodeling rates between grafts. Table -1

**Table -1: Comparison of the different bone grafts.**

Groups	n	Mean(%)	SD	p
Vertical				
HA	8	45.38	4.24	
DPB	8	43.63	6.30	
HALG	8	45.25	6.71	0.764
CAP	8	42.75	5.73	
Horizontal				
HA	8	40.75	3.96	
DPB	8	41	3.46	
HALG	8	36.75	4.27	0.127
CAP	8	38.38	4.21	

## Discussion

The bone formation capacity of bone graft materials differed widely, and bone regeneration capacity influenced the integration of implanted bone grafts. Although much progress has been made in recent years in oral implantology, autogenous bone grafts remain the gold standard in GBR procedures. They have a major advantage in that they supply not only bone volume but also osteogenic cells, which are capable of quickly laying down new bone. However, they also have various drawbacks, including increased patient morbidity, limited bone graft availability, and additional surgical time/costs. Thus, studies aimed at identifying substitutes have been conducted. Previous studies of an experimental animal

bone defect grafting model reported that 3 months was a sufficient time to induce healing and the emergence of angiogenesis and new bone formation.<sup>1-5</sup>

The findings of the present study showed that bone formation beyond the skeletal system should occur in a similar way to that observed in previous studies. In previous experimental animal study, reported that new bone regeneration beyond the normal anatomic limits of a rabbit's skull bone occurred with autogenous blood application.<sup>3-6</sup> The most common grafts used today are autografts, allografts, demineralized bone matrix, xenograft (bovine), and substitute bone grafts (calcium sulfate, calcium phosphate and HA).<sup>4-10</sup> To determine which graft is most appropriate for a given condition, an understanding of the biological function (osteogenesis, osteoinduction, and osteoconduction) of each graft is necessary. Furthermore, stable conditions in the host are essential for the incorporation of any graft material. Despite their drawbacks, autogenous bone autografts remain the gold standard to which every substitute must be compared. The results of the present study were in accordance with those of previous studies of experimental applications of xenografts, human allografts, HA, and calcium sulfate grafts. There are a few reports in the literature on xenograft bone substitutes. Some studies showed good results in animal models and clinical research, whereas others demonstrated slower integration using xenograft bone substitutes compared with human allografts or lower bone union rates, with persistent radiolucent lines and local complications.<sup>3-8</sup>

Calcium sulfate has been used many times as a bone void filler. Recently, surgical grade calcium sulfate has been employed as a bone graft substitute. Multicenter clinical studies demonstrated that trabecular bone filling in autografts was qualitatively similar to that seen in calcium sulfate grafts.<sup>11-15</sup> They also showed that surgical grade calcium sulfate was a host friendly and environmentally friendly biomaterial, which induced satisfactory bone production.<sup>11,5,12,16</sup> Researchers also demonstrated that the histological grade score for calcium sulfate was similar to that of other graft substitutes.<sup>3-12</sup>

Alloplastic bone graft materials should be biocompatible and not antigenic or trigger the inflammatory process.<sup>12-17</sup> A previous study revealed that HA-derived synthetic bone grafts stimulated new bone tissue formation and had high osteogenic potential.<sup>17</sup> HA-derived synthetic bone grafts, when compared with autogenous bone, were shown to encourage new bone formation in experimental animal studies, with excellent stability and new bone regenerative properties. Due to their content and structure, HA bone grafts dissolved slowly and were displaced gradually by bone tissue.<sup>18</sup> Demineralized human bone allografts are thought to have osteoinductive capabilities and fast resorption, with bone ingrowth.<sup>4</sup> Demineralized freeze-dried bone allografts are extensively utilized in regenerative oral implantology, as they possess excellent osteoconductive potential.<sup>11-17</sup>

In the present study, new bone tissue regeneration was evident in all the groups three months after implantation, with no statistically significant between- group differences. The histological findings indicated that all four graft materials (HA, DPB, HALG, and CAP) exhibited osteoconductive properties.

## Conclusion

The present study compared the histological properties of several bone graft substitutes, which are widely utilized today. According to the results, none of the grafts showed superiority with respect to new bone formation. Although a number of studies in the field of oral implantology have examined the effects of different graft materials on peri-implant bone repair and regeneration, it is still unclear how these graft materials work or under which conditions they should be used.

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