How to Cite:
Singh, V., Renu, R., Kumawat, K. R., Kumawat, R., & Bhaskar, A. (2022). Evaluation of the autogenous demineralized dentin (ADDM) graft in the formation of the new bone: An original research. *International Journal of Health Sciences*, *6*(S5), 8620–8618.
https://doi.org/10.53730/ijhs.v6nS5.10639

Evaluation of the autogenous demineralized dentin (ADDM) graft in the formation of the new bone: An original research

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Abstract---Introduction: The bone volume maintenance is important for ideal esthetic and functional outcomes. Due to the bone resorption, there is a loss of socket width three dimensionally resulting in narrowing and shortening of the alveolar ridge contour. In the present study we aim to evaluate the autogenous demineralized dentin (ADDM) graft in the formation of the new bone. Materials and Methods: We compared 200 extraction sites with the ADDM graft for various parameters such as exposure of graft, any signs of infections/pus/exudates, and bone density. Results: On follow-up, exposure of graft was recorded in five sockets at 1 month and infection was recorded in four sockets. There was a highly significant

bone formation (P < 0.01, 0.05) in the extraction group at various time intervals, while there were no significant differences in the adjacent bone group. Conclusion: ADDM graft is cost effective and also provides a single-stage treatment plan and is acceptable.

***Keywords*---**Autogenous graft, Autogenous demineralized dentin graft (ADDM), Bone Density.

Introduction

The bone volume maintenance is important for ideal esthetic and functional outcomes. The selection of an ideal bone graft relies on several factors [1-3] The various grafts are autografts, allografts, xenografts, and synthetic bone graft. Advantages and disadvantages of these grafts have been mentioned in literature and autografts are the “gold standard” for reconstructing the bony defects.[4-7] Reduction of 2.6–4.6 mm in width and 0.4–3.9 mm in height of alveolar socket was reported during the healing phase. The bone volume reduction following teeth extractions by 50% within 12 months and 2/3 of this resorption in the first 3 months have been reported by some studies. Due to the bone resorption, there is a loss of socket width three dimensionally resulting in narrowing and shortening of the alveolar ridge contour.[1-10] Hence in the present study we aim to evaluate the autogenous demineralized dentin (ADDM) graft in the formation of the new bone.

Materials and Methods

We conducted a prospective, randomized, clinical study was done after institutional ethical clearance with a total of 200 unilateral/bilateral, maxillary/mandibular, single/ multiple posterior teeth. After the consent was take selection was done for above 18 years and healthy patients with no abnormalities. Preoperative clinical and radiological evaluation was done. During extraction, extreme care was taken to preserve the surrounding bony and soft tissues. The extracted teeth were cleaned off of all the Layers of enamel, discolored dentin, and cementum. The root pulp tissue was removed. The teeth were washed with sterile normal saline. Subsequently, tooth dentin was grinded with “mortar and pestle” to prepare 0.25–2 mm particles, which was confirmed using the sieving method. For demineralization, these particles were immersed in basic alcohol for 10 min in a sterile container for defatting, dissolving all organic debris, bacteria, and toxins of the dentin particulate. After decanting the basic alcohol cleanser, the particulate was washed thrice in phosphate buffered saline (PBS). The PBS was decanted leaving wet particulate dentin ready to graft into freshly extracted sockets. The graft was carefully inserted into the alveolar socket followed by suturing Bone density measurement was performed with OPGs. To compare and evaluate bone densities in Extraction Site (Group 1) and adjacent bone (AB) (Group 2), OPGs were taken at preoperatively, immediate after extraction (IAE), immediate after grafting (IAG), and at 1 (A1), 3 (A3), and 6 (A6)-month follow-up. Statistical analysis was done using the appropriate tools keeping the $p<0.05$ as significant.

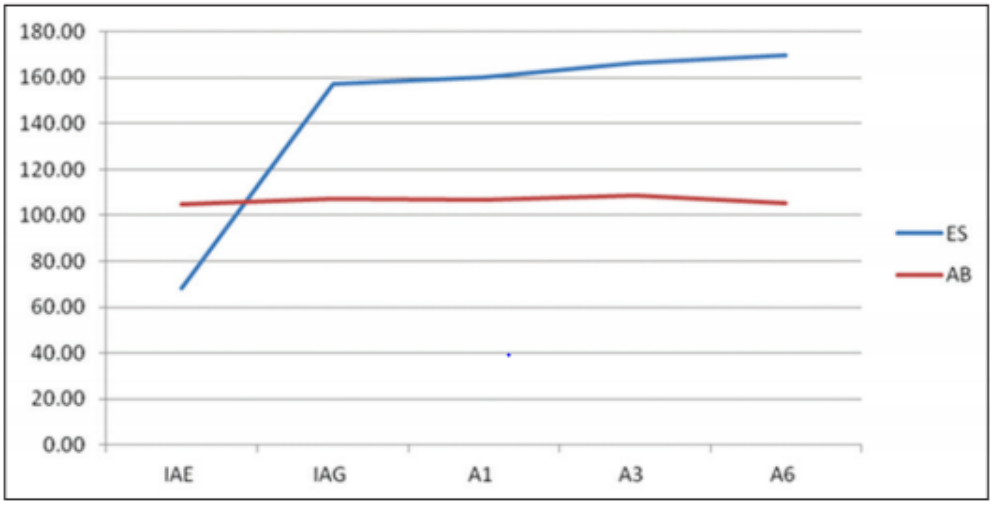
Result

We observed that Exposure of graft was recorded in five ESs at 1 month follow-up. Infection was recorded in four ESs. There was a statistically highly significant difference seen for the values between the groups (P < 0.01, 0.05). For IAE with higher values in group AB, IAG with higher values in group ES, A1 with higher values in group ES, A3 with higher values in group ES, and A6 with higher values in group ES [Table 1]. OPGs just immediately after placement of graft revealed radiopaque particles covering fully inside the socket including a sharp radiopaque line of lamina dura. At 1, 3, and 6 months of the follow-up, the alveolar socket appeared to be filled with uniform radiodense bone-like tissue indicated that the socket healed fully with new bone. In addition, the lamina dura of the socket disappeared completely by bone remodeling. Gradual absorption of the demineralized granules was observed on the sequential radiographic findings of the socket. Furthermore, the results of intergroup comparison were done, and it revealed that after the placement of DDM graft, there was a significant bone formation which can also be appreciated on the linear graph, while there were no significant differences in AB in time frames of immediately after grafting of AB with 1-month and 6-month follow-up [Graph 1].

Table 1: Bone density: Intergroup comparison extraction socket versus adjacent bone

Group	*n*	Mean	SD	SEM	Median	Mann–Whitney U-value	*Z*	*P* value of Mann–Whitney U-test
IAE								
ES	200	68.161900	33.5884116	2.3750594	74.6	9330.000	−9.232	0.000**
AB	200	104.831100	25.6039393	1.8104719	98.85			
IAG								
ES	200	157.428200	20.7078775	1.4642681	157.77	2643.000	−15.017	0.000**
AB	200	107.113700	26.5671408	1.8785805	105.82			
A1								
ES	200	160.057600	29.7568888	2.1041298	164.95	3419.000	−14.348	0.000**
AB	200	106.563750	23.7520048	1.6795204	99.87			
A3								
ES	200	166.159500	26.4783799	1.8723042	168.87	2488.000	−15.151	0.000**
AB	200	108.444000	20.6533636	1.4604133	106.16			
A6								
ES	200	169.820500	25.9920622	1.8379163	172.82	2035.000	−15.545	0.000**
AB	200	105.421150	28.5890424	2.0215506	107.32			

**Statistically highly significant difference (*P*<0.01). ES: Extraction socket, AB: Adjacent bone, IAE: Immediate after extraction, IAG: Immediate after graft, A1: After 1 month postoperative, A3: After 3-month postoperative, A6: After 6-month postoperative, SD: Standard deviation, SEM: Standard error of mean



Graph 2: Comparison of bone density in ES and AB group

A1: After 1-month postoperative, A3: After 3-month postoperative, A6: After 6-month postoperative

Discussion

We studied 200 subjects for a period of 6 months. We observed a suceessfull outcome in the extraction group. In 1967, Bang and Urist confirmed the bone-inducing property of dentin in 520 sample size of a rabbit.[6] Urist verified that completely demineralized dentin matrix (DDM) induced bone at 4 weeks, while nondemineralized dentin induced at 8–12 weeks. Therefore, DDM had a more active bone-inducing matrix than the calcified dentin.[7] Very interestingly, Reddi in 1974 stated that the demineralized treatment for bone and dentin increases their osteoinductivity and decreased their antigenicity.[8] Finkelman et al. determined that dentin and bone are mineralized tissues and almost have a similar chemical component. Both DDM and DBM are composed of predominantly Type I collagen (95%) and the remaining as non-collagenous proteins including a small amount of growth factors.[9-11] Murata reported a first clinical case in 2003 using ADDM graft in sinus lifting and found excellent bone formation on follow-up.[12] In our study, the hand operated vessel and bar was used similar to other studies. Joshi et al. conducted a prospective, randomized controlled pilot clinical trial of autogenous whole tooth autograft (WTA), dentin allograft (DA), freeze-dried bone allograft (FDBA), and left ungrafted (control) in ESs. They concluded that WTA and DA consistently showed superior results in more new bone formation than FDBA and control groups.[13] Exposure of graft was recorded in five ESs at 1-month follow-up. Infection was recorded in four ESs and they were treated with the removal of graft followed by deep curettage and antibiotics. After a close follow-up of the said subjects, the wound healing was satisfactory. There were few limitations like we couldn't test histological nature of newly formed tissues. And the absolute mineral density could be added to estimate the exact amount of bone formation. Further studies are required to establish a histological and biological safety of ADDM graft.

Conclusion

This study is a large case series using ADDM graft in providing a single-stage treatment plan, i.e., extraction of tooth followed by autogenous demineralized dentin graft in the same ES in adult patients – is an alternative for the immediate reconstruction of alveolar bone defects to facilitate the future prosthesis. It also saves the cost of other graft materials which are commercially available in market for the patient and also reduces the infective dental waste globally.

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