https://africanjournalofbiomedicalresearch.com/index.php/AJBR
Afr. J. Biomed. Res. Vol. 28(4s) (August 2025); 969-974
Research Article

Extended Sticky Bone Versus Ethoss Bone Graft In Horizontal Ridge Augmentation With Simultaneous Implant Placement In The Maxillary Esthetic Zone

Abdullah Qannas Alruwaili[1*], Dr. Wael Said Ahmed[2], Dr. Ayman A Yaseen[3], Dr. Nesma Elgohary[4]

[1*]B.D.S. (2021), Faculty of Dentistry, Jouf University, Saudi Arabia, a.4q.7r@hotmail.com.
[2]Assistant Professor, OMFS Department, Faculty of Dentistry, Mansoura University, Egypt, drwaelmohamed2020@gmail.com.
[3]Lecturer, OMFS Department, Faculty of Dentistry, Mansoura University, Egypt, Ayman_yassen@mans.edu.eg.
[4]Lecturer, Fixed Prosthodontics Department, Faculty of Dentistry, Mansoura University, Egypt, nesmaelgohary@mans.edu.eg.

Abstract

Aim: This study aimed to compare the clinical and radiographic outcomes of extended sticky bone and Ethoss bone graft in horizontal ridge augmentation with simultaneous implant placement in the maxillary esthetic zone.

Materials and Methods: A total of 14 implants placed in maxillary esthetic zone and they were randomly assigned to two equal groups: Group I received Extended Sticky Bone (a composite of albumin-rich PRF, allograft, and xenograft), while Group II received Ethoss (β-tricalcium phosphate and calcium sulfate). CBCT was used to evaluate ridge width and bone volume at baseline, immediately postoperatively, and after 6 months. Implant stability was assessed by ISQ, and soft tissue healing was evaluated using the modified Landry index. Statistical analyses included Friedman and Wilcoxon tests for intragroup comparisons, and Mann-Whitney U for intergroup differences ($\alpha = 0.05$).

Results: There was a significant increase in ridge width over time ($p < 0.001$), with no significant resorption between immediate and 6-month follow-up ($p = 1.000$). Mean volumetric bone gain postoperatively was maintained at 6 months, with minimal loss (mean = 1.04 ± 0.70 mm; $p < 0.001$). Bone density improved from 1.00 to 1.57 (coded scale), and ISQ values increased significantly ($Z = 3.407$, $p = 0.001$). No infections or inflammatory signs were observed; all patients achieved excellent soft tissue healing by 6 months.

Conclusion: Both grafting materials demonstrated effective and stable horizontal ridge augmentation with high implant stability and optimal tissue healing. Extended Sticky Bone showed slightly greater volumetric preservation, suggesting potential advantages in esthetically sensitive implant sites.

Keywords: Horizontal ridge augmentation, Extended sticky bone, Ethoss bone graft, Dental implants, Maxillary esthetic zone.

***Authors for correspondence:** a.4q.7r@hotmail.com*

Received - 02/08/2025 *Accepted- 04/08/2025*

DOI: https://doi.org/10.53555/AJBR.v28i3S.8231

Introduction

The advent of dental implants has made tooth replacement a golden prospect, very allowing for a highly predictable treatment intervention with the best therapeutic and esthetic considerations. However, the single most frequent impediment to successful placement of implants is insufficient alveolar bone volume, especially in the maxillary esthetic zone, wherein horizontal and vertical bone deficiencies abound. These deficiencies arise mostly from post-extraction resorption, periodontal disease, trauma, or congenital anomalies 1. Gross alveolar ridge dimensional changes start happening post-tooth loss for up to 60% in bone volume just within the first two years, primarily on the buccal and labial perspectives of the ridge. This bone loss deters the correct implant positioning and affects its prognosis; therefore, that bone must be augmented before implant placement 2.

For proper osseointegration to occur, 1 mm of bone should be present around the implant on all sides. In areas of horizontal ridge deficiency, augmentative procedures are carried out, which include GBR, onlay grafting, ridge splitting, and distraction osteogenesis. GBR has achieved the highest acceptance in clinical situations because of predictability and ability to promote healing of hard and soft tissues. The concept involves placing a bone graft material and a barrier membrane based on selective cell repopulation of osteogenic cells while excluding soft tissue infiltration 1.

With synthetic bone grafts, the advantages of unlimited supply, biocompatibility, and lack of disease transmission are promoted as an alternative to autogenous grafts. Ethoss, an entirely synthetic bone graft, represents this category, combining β-tricalcium phosphate (β-TCP) and calcium sulfate (CS). The ease of in situ setting, angiogenesis promotion, and gradual resorption coupled with the formation of new bone all attract the clinician towards its application 3.

Parallel to material-based approaches, biological advancements have introduced autologous platelet concentrates as potent enhancers of tissue regeneration. Platelet-rich fibrin (PRF), a second-generation concentrate rich in growth factors, provides a fibrin matrix conducive to cellular proliferation, differentiation, and matrix remodeling. However, its clinical utility is limited by rapid resorption (2–3 weeks), reducing its long-term regenerative potential4. To address this, Mourão et al.5 (2018) developed ALB-PRF, a formulation combining denatured albumin gel with PRF, capable of extending biological activity up to 4–6 months. This innovation has enabled the fabrication of Extended Sticky Bone—a composite of ALB-PRF and particulate grafts—that serves as both a graft and a biologically active scaffold.

Sticky Bone was designed to enhance graft stability and prevent soft tissue invasion. It is moldable, adaptable to various defect morphologies, and capable of resisting micromotion, which is critical for maintaining graft volume. However, the conventional form undergoes resorption within 8–12 days6. The evolution into Extended Sticky Bone addressed this limitation by enhancing the longevity of growth factor release, as demonstrated in the work of Kawase et al.7 (2015) and refined in the Bio-Bone protocol by Mourão et al., making it suitable for GBR procedures without additional collagen membranes.

Despite the increasing clinical adoption of both ethoss and extended sticky bone, there remains a paucity of direct comparative evidence evaluating their performance in horizontal ridge augmentation, especially when used in conjunction with simultaneous implant placement in esthetic zones. Prior literature, such as that by Sánchez-Sánchez et al.8 (2021), supported high success rates with particulate grafts and membrane-based GBR techniques; however, the comparative biological performance of synthetic versus autologous-enriched graft materials remains inadequately defined.

Accordingly, this study aimed to evaluate and compare the clinical and radiographic outcomes of horizontal ridge augmentation using extended sticky bone and ethoss, with implants placed simultaneously in the maxillary esthetic zone. The findings were expected to provide evidence-based guidance on selecting the most effective grafting material for predictable bone regeneration and long-term implant success in esthetically demanding clinical scenarios.

Materials and Methods

Study Design and Setting

This randomized clinical study was conducted at the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Mansoura University. The aim was to evaluate and compare the clinical and radiographic outcomes of horizontal ridge augmentation using Extended Sticky Bone and Ethoss bone grafts, with simultaneous implant placement in the maxillary esthetic zone.

Participants and Eligibility Criteria

A total of 14 implants placed in maxillary esthetic zone in patients, aged between 18 and 45 years, were enrolled and randomly allocated into two equal groups (n=7). Inclusion criteria included missing teeth in the maxillary esthetic zone requiring horizontal ridge augmentation, good systemic health, favourable occlusion, and willingness to participate. Exclusion criteria comprised smokers, pregnant women, patients with systemic diseases (e.g., uncontrolled diabetes, cardiovascular or autoimmune disorders), coagulation disorders, history of surgery in the target area, material allergies, psychiatric illness, and parafunctional habits.

Ethical Considerations

Ethical approval was obtained from the Ethics Committee of the Faculty of Dentistry, Mansoura University. All patients provided written informed consent. Confidentiality was preserved through anonymized coding of patient data, and all information was securely stored with access restricted to study personnel.

Sample Size Calculation
Sample size was calculated using G*Power 3.1.9.7 based on an effect size of 1.79, alpha error of 0.05, and power of 80%, yielding 7 patients per group9.

Materials
- Extended Sticky Bone (composed of ALB-PRF, allograft and xenograft graft).
- Ethoss™ (β-TCP and calcium sulfate; Ethoss Regeneration Ltd., UK).
- Dental implants (DIO, Korea).
- Centrifuge and thermal heater for PRF preparation.
- Standard surgical instruments and sterilization protocols.

Surgical Protocol
All patients received 2g of amoxicillin one hour preoperatively and chlorhexidine gluconate 0.2% rinse. Surgery was performed under local anesthesia (articaine 4% with epinephrine 1:100,000). A four-cornered full thickness flap was elevated, and horizontal ridge defects were grafted as follows:
- **Group I (Extended Sticky Bone):** PRF and ALB-PRF were prepared by centrifuging 9 ml of blood at 2700 rpm for 8 minutes. The platelet-poor plasma was thermally denatured and mixed with liquid PRF and graft material to create extended sticky bone, which was applied post-implant placement10.
- **Group II (Ethoss):** Ethoss was hydrated with sterile saline and applied directly into the defect site. No collagen membrane was used. A sterile gauze was applied for 3–5 minutes to promote hardening. Primary closure was achieved with tension-free sutures11.

Postoperative care included chlorhexidine mouthwash for 14 days, amoxicillin 1g BID for 6 days, and ibuprofen 400 mg TID as needed.

Radiographic and Clinical Evaluations
Cone Beam Computed Tomography (CBCT) scans were performed within one week postoperatively and at 6 months to assess:
- Bone gain: measured horizontally at the implant site.
- Bone density: calculated in Hounsfield units.

Implant stability was evaluated using resonance frequency analysis (Osstell ISQ values) at implant placement and 6 months. Soft tissue healing was assessed using the Landry Healing Index at 14 days, 3 months, and 6 months.

Statistical Analysis
Data were analysed using SPSS software (version 26). Descriptive statistics were calculated for all variables. Intergroup comparisons were made using independent t-tests for continuous data and Chi-square tests for categorical data. ANOVA and regression analysis were applied where appropriate. Missing data were addressed using multiple imputation. Outliers were examined, and Cronbach's alpha was calculated to assess reliability of the healing index.

Results
This randomized clinical study included 14 patients presenting with horizontal alveolar ridge deficiencies in the maxillary esthetic zone. The patients were equally allocated into two treatment groups: Group I (Extended Sticky Bone) and Group II (Ethoss). All patients received simultaneous dental implant placement. The outcomes were assessed both radiographically and clinically over a six-month period. Data analysis was performed using SPSS version 25, with significance set at $p < 0.05$.

Demographic and Baseline Characteristics
- **Age:**

Mean age in Group I was 33.29 ± 5.83 years, and in Group II was 34.43 ± 4.47 years. The Mann-Whitney U test showed no significant difference between groups ($p = 0.606$).

- **Sex Distribution:**

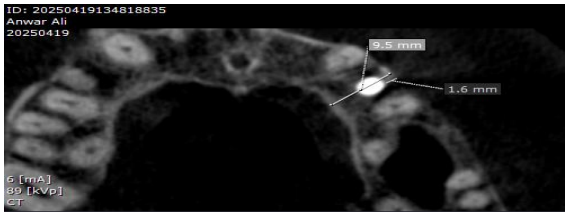

Figure 1: Linear bone width increases and stability at 6 months postoperative.

Each group included three females and four males in Group I, and four females and three males in Group II. There were no statistically significant differences.

- **Implant Site and Bone Type:**

Implants were placed across various anterior and premolar maxillary sites with no significant difference in site distribution ($p > 0.05$). Group I exclusively received extended sticky bone, while Group II exclusively received ethoss bone graft.

Radiographic Outcomes
Ridge Width Gain
Ridge width was measured at three intervals: preoperative (T0), immediate postoperative (T1), and six months (T2).
- Friedman's test showed a significant increase across timepoints ($p < 0.001$).
- Pairwise Wilcoxon signed-rank tests revealed significant gain from T0 to T1 ($p = 0.004$) and T0 to T2 ($p < 0.001$). No significant difference was observed between T1 and T2 ($p = 1.000$), indicating stability (Fig. 1).

Table 1: Ridge Width Changes (Wilcoxon Test)

Comparison	Adjusted p-value
Pre-op vs Immediate Post-op	0.004
Pre-op vs 6-Month Post-op	<0.001
Immediate vs 6-Month Post-op	1.000

Bone Volume Changes

- Bone volume significantly increased from T0 (mean = 0.54 cm^3) to T1 (mean = 2.37 cm^3), then slightly decreased at T2 (mean = 1.61 cm^3) (Fig. 2).
- The gain from T0 to T1 was statistically significant ($p = 0.006$).
- The gain from T0 to T2 remained significant ($p < 0.001$), demonstrating maintained augmentation.
- Average bone loss between T1 and T2 was 1.04 ± 0.70 mm^3 ($p < 0.001$).

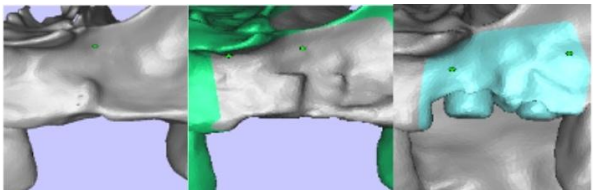

Figure 2: Volumetric measurements at T0, T1, and T2 showing significant initial bone gain with partial preservation at 6 months.

Bone Density

- All cases showed low density at T0 and T1.
- At T2, 57% of patients showed increased
- bone density, indicating mineralization of grafted bone.

Implant Stability (ISQ)

- ISQ significantly increased from immediate postoperative (mean = 66.93 ± 1.89) to 6-month follow-up (mean = 77.21 ± 1.57); Wilcoxon test: $p = 0.001$.
- Intergroup comparison using Mann-Whitney U test revealed no significant differences in ISQ at either timepoint ($p > 0.05$).

Soft Tissue Healing and Clinical Indicators

Healing Index

At 14 days, healing scores averaged 4.29 ± 0.47; by 6 months, all cases reached a perfect score of 5.0.

Predictive Analysis

Linear regression analysis between bone gain at 6 months and ISQ values showed no significant correlation ($p = 0.418$), with an R^2 value of 0.055, indicating minimal predictive value.

Discussion

The present study investigated the clinical and radiographic efficacy of two distinct grafting approaches—extended sticky bone and ethoss—in horizontal ridge augmentation with simultaneous implant placement in the maxillary esthetic zone. Both materials demonstrated comparable and clinically successful outcomes across multiple parameters including ridge width, bone volume, density progression, implant stability, and soft tissue healing over a six-month period.

The significant increase in linear ridge width observed in both groups supports the effectiveness of both materials in horizontal bone augmentation. Most of the gain occurred immediately after graft placement, with minimal dimensional changes over the follow-up period. This finding agrees with Moussa et al.12 (2024), who reported early stabilization and preservation of graft dimensions with the use of extended sticky bone in esthetic zones. Duo to fast resorption of fibrin in the sticky bone about 2-3 weeks, so the sticky bone can't hold its consistency more than 3 weeks. Attractively several recent studies documented that resorption of fibrin can be significantly extended from 2-3 weeks to more than 4 months by heating treatment, so the extended sticky bone can hold its consistency greater than 4 months.13 Similarly, the volumetric analysis revealed consistent gains in bone volume postoperatively, with a slight but statistically significant loss over six months, indicating partial resorption, which is expected in graft remodeling phases. Ethoss, as a synthetic combination of beta-tricalcium phosphate and calcium sulfate, also demonstrated excellent dimensional maintenance and integration, the calcium sulfate component functions as an inherent natural barrier, thereby obviating the necessity for an additional collagen membrane, corroborating the findings of Barroso-Panella et al.14 (2018), who observed similar performance of Ethoss in socket preservation.

Bone density improvements over time were observed in both groups, reflecting biological maturation and mineralization of the grafted site. This transformation from low to higher density is critical for long-term implant support and mirrors the findings of Al-Khaldi et al.15 (2010), who reported progressive density enhancement in synthetic bone substitutes in maxillary applications.

Implant stability, measured using the ISQ scale, increased significantly in all cases from the time of surgery to the six-month follow-up, suggesting reliable osseointegration regardless of grafting technique. This uniform improvement in ISQ aligns with Baftijari et al.16 (2018), who demonstrated similar enhancement in stability when implants were placed in grafted bone using both autologous and synthetic materials. Moreover, the lack of significant intergroup differences in ISQ or soft tissue parameters indicates the comparable mechanical and biological environment created by both graft types.

Soft tissue healing was consistently optimal, with all patients showing complete mucosal maturation by the end of the study period and no signs of infection or inflammation. This further supports the biocompatibility of both materials. In particular, the absence of

complications such as membrane exposure or graft loss reinforces the stability and integration of the grafts, as previously noted by Sahithi et al.17 (2024) for Extended Sticky Bone and Passi et al.18 (1999) for synthetic calcium phosphate-based materials.

The study demonstrated strong results, but certain study constraints need to be recognized. The study tested 14 participants which resulted in limited generalizability of results and constrained statistical ability to detect minor group differences. The research period of six months allowed proper short-term evaluation of healing and integration but lacked information about implant survival rates and graft resorption that occurs at later stages. The study lacked histological analysis which prevents researchers from determining the quality of bone formation and the degree of graft remodelling.

Future investigations need to increase study populations while tracking patients for extended periods and adding histomorphometric assessments with patient-reported outcomes to obtain complete understanding about clinical performance and patient satisfaction of these grafting materials. The study established that both Extended Sticky Bone and Ethoss delivered dependable and secure outcomes for horizontal ridge augmentation alongside simultaneous implant placement in areas needing aesthetic consideration.

Conclusion

This study demonstrated that both Extended Sticky Bone and Ethoss are effective grafting materials for horizontal ridge augmentation in the maxillary esthetic zone with simultaneous implant placement. Both groups exhibited significant improvements in ridge width, bone volume, and density, as well as high implant stability and excellent soft tissue healing. Importantly, no postoperative complications or infections were recorded in either group, and no statistically significant differences were found between the two materials across all measured parameters.

This study contributes to the growing body of evidence supporting synthetic and autologous graft combinations in regenerative oral surgery and provides practitioners with evidence-based guidance on material selection for successful implant rehabilitation in challenging esthetic zones.

References

1. Esposito M, Worthington HV, Coulthard P, Thomsen P. Maintaining and re-establishing health around osseointegrated oral implants: a Cochrane systematic review comparing the efficacy of various treatments. Periodontology 2000. 2003 Aug 29;33(1):204–12.
2. Bodic F, Hamel L, Lerouxel E, Baslé MF, Chappard D. Bone loss and teeth. Joint Bone Spine. 2004 Jun 2;72(3):215–21.
3. Cheah CW, Al-Namnam NM, Lau MN, Lim GS, Raman R, Fairbairn P, et al. Synthetic material for bone, periodontal, and dental tissue regeneration: Where are we now, and where are we heading next? Materials. 2021 Oct 15;14(20):6123.
4. Csifó-Nagy BK, Sólyom E, Bognár VL, Nevelits A, Dőri F. Efficacy of a new-generation platelet-rich fibrin in the treatment of periodontal intrabony defects: a randomized clinical trial. BMC Oral Health. 2021 Nov 15;21(1).
5. De Almeida Barros Mourão C, Gheno E, Lourenço E, Barbosa RL, Kurtzman G, Javid K, et al. Characterization of a new membrane from concentrated growth factors associated with denaturized Albumin (Alb-CGF) for clinical applications: A preliminary study. International Journal of Growth Factors and Stem Cells in Dentistry. 2018 Jan 1;1(2):64.
6. Rupawala TA, Patel SM, Shah NH, Sanghvi KB, Makwana SV, Bhimani KK. Efficacy of sticky bone as a novel autologous graft for mandibular third molar extraction socket healing - An evaluative study. Annals of Maxillofacial Surgery. 2020 Jan 1;10(2):335.
7. Kawase T, Kamiya M, Kobayashi M, Tanaka T, Okuda K, Wolff LF, et al. The heat-compression technique for the conversion of platelet-rich fibrin preparation to a barrier membrane with a reduced rate of biodegradation. Journal of Biomedical Materials Research Part B Applied Biomaterials. 2014 Aug 14;103(4):825–31.
8. Sánchez-Sánchez J, Pickert FN, Sánchez-Labrador L, Tresguerres FG, Martínez-González JM, Meniz-García C. Horizontal Ridge Augmentation: A Comparison between Khoury and Urban Technique. Biology. 2021 Aug 5;10(8):749.
9. Kang H. Sample size determination and power analysis using the G*Power software. Journal of Educational Evaluation for Health Professions. 2021 Jul 30;18:17.
10. Gheno E, De Almeida Barros Mourão CF, De Mello-Machado RC, Lourenço ES, Miron RJ, Catarino KFF, et al. In vivo evaluation of the biocompatibility and biodegradation of a new denatured plasma membrane combined with liquid PRF (Alb-PRF). Platelets. 2020 Jun 12;32(4):542–54.
11. Lashkarizadeh N, Mohammadi M, Mohyadin Z, Kalantari M, Kakooei S, Karamoozian A. Histological study of the effect of different hydration times of bone allograft and xenograft particles on the rate of bone formation in critical size defects in the rat calvarium - international journal of implant dentistry. Springer Berlin Heidelberg; 2025.
12. Moussa A, Saleh M, Osman S. Efficacy of sticky bone in horizontal alveolar ridge augmentation in maxillay anterior region. Alexandria Dental Journal. 2024 Apr 18.
13. Gheno E, De Almeida Barros Mourão CF, De Mello-Machado RC, Lourenço ES, Miron RJ, Catarino KFF, Alves AT, Alves GG, Calasans-Maia MD. In vivo evaluation of the biocompatibility and biodegradation of a new denatured plasma membrane combined with liquid PRF (Alb-PRF). Platelets. 2020 Jun 12;32(4):542–54.
14. Barroso-Panella A, Gargallo-Albiol J, Hérnandez-Alfaro F. Evaluation of bone stability and esthetic results after immediate implant placement using a

novel synthetic bone substitute in the anterior zone: results after 12 months. The International Journal of Periodontics & Restorative Dentistry. 2018 Feb 15;38(2):235–43.

15. Al-Khaldi N, Sleeman D, Allen F. Stability of dental implants in grafted bone in the anterior maxilla: longitudinal study. British Journal of Oral and Maxillofacial Surgery. 2010 Jun 10;49(4):319–23.
16. Baftijari D, Benedetti A, Kirkov A, Iliev A, Stamatoski L, Baftijari F, et al. Assessment of primary and secondary implant stability by resonance frequency analysis in anterior and posterior segments of maxillary edentulous ridges. Journal of IMAB - Annual Proceeding (Scientific Papers). 2018 Jun 20;24(2):2058–64.
17. Sahithi TVL, Reddy DSSP, Prasad DSK, Sistla LS, Yandapalli R, Nagireddy RR. Comparative analysis of sticky bone and demineralized bone matrix with calcium sulfate hemihydrate on alveolar bone and papillary levels in immediate two-stage dental implant placement: A clinico-radiographic evaluation. Journal of Orofacial Sciences. 2024 Jan 1;16(1):17–26.
18. Passi P, Girardello G, Piattelli A, Scarano A. Synthetic bone grafts in peri-implant bone dehiscences: histological results in humans. PubMed. 1999.