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A Clinical Evaluation Of Efficacy Of Xenograft And Guided Tissue Regeneration Membrane In The Management Of Mandibular Grade 2 Furcation Defects:A Comparative Study.

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INTRODUCTION: Restoring the periodontium affected by furcation involvement poses a significant challenge in periodontal therapy. The complex anatomy of the furcation area requires specialized instruments known as furcation curettes for effective treatment. While Grade II mandibular furcation defects are more manageable, several techniques and materials have been employed to address them, though outcomes have been only moderately successful.
AIM: This study aimed to evaluate and compare the surgical results of grade II furcation therapy using either xenograft alone or in combination with a GTR membrane.
METHODS: In this prospective randomized interventional trial, 18 patients (with 18 defects) exhibiting Grade II mandibular furcation defects were included. The patients were divided into two groups: Group A, comprising 6 patients with 9 defects, underwent treatment with xenograft alone; Group B, comprising 6 patients with 9 defects, underwent treatment with xenograft as a graft along

with a Guided Tissue Regeneration membrane. Various clinical parameters, including Plaque Index (PI), Probing Depth (PD), Relative Vertical Clinical Attachment Level (RVCAL), Relative Horizontal Clinical Attachment Level (RHCAL), and the amount of Bone fill using CBCT, were evaluated at baseline and six months postoperatively. Group comparisons were conducted using the ANOVA test, while the paired t-test was employed to assess mean values within the groups.

RESULTS -The study results indicated that, with the exception of Probing Pocket Depth (PD) and Depth of Defect Fill, there were no statistically significant differences between the groups in terms of other parameters. Initially, the Probing Depth between the groups did not show statistical significance (5.73 ± 0.79 in Group A, 6.18 ± 0.75 in Group B); however, after 6 months, a significant difference was observed (1.73 ± 0.79 in Group A, 1.36 ± 0.50 in Group B). Similarly, the depth of the defect did not significantly differ between the groups at baseline (3.67 ± 0.44 in Group A, 3.95 ± 0.70 in Group B), but after 6 months, a significant difference was noted (1.51 ± 0.34 in Group A, 1.26 ± 0.26 in Group B)

CONCLUSION: Both xenograft alone (Group A) and xenograft combined with a Guided Tissue Regeneration membrane (Group B) were found to be biocompatible with the tissues. Improvement was evident in all parameters assessed across all three groups, with Group B demonstrating superior results compared to Group A.

KEYWORDS: Grade II mandibular furcation defects, GTR, Xenograft, CBCT.

KEY MESSAGES: The use of xenograft as a graft and platelet-rich fibrin (PRF) as a membrane has been effective in treating furcation defects. Nonetheless, recent materials like guided tissue regeneration (GTR) and xenograft have also shown positive effects in treating these defects.

INTRODUCTION:

Periodontal disease is a multifaceted disorder marked by the breakdown of periodontal tissues and the loss of connective tissue attachment. When it extends into the trifurcation and bifurcation of multi-rooted teeth, known as furcation involvement, it becomes a serious complication. Furcation defects restrict the efficacy of routine periodontal procedures like scaling and root planning, often necessitating surgical intervention.

The challenging aspects of periodontal therapy is regenerating the periodontium within the furcation defect. Surgical treatment for furcation defects involves accessing the area for debridement, bone recontouring, odontoblast and regenerative procedures. Over the past few decades, various methods have been tested and used to treat Grade II furcation defects. Surgical management options for Grade II furcation defects have included autografts, demineralized freeze-dried bone allografts, bovine-derived xenografts, barrier membranes, and combinations of bone grafts and membranes.[1] Currently, bone morphogenetic proteins (BMPs), recombinant human platelet-derived growth factor-BB, platelet-rich plasma, and growth factor-rich plasma are commonly used for periodontal regeneration.[2]

Xenografts consist of deproteinized cancellous bone derived from another species, such as bovine or porcine bone, or coral. They offer several advantages, including a porous architecture identical to human bone, abundant availability, and the ability to promote bone regeneration.

Guided tissue regeneration (GTR) a regenerative procedure that does not involve grafting. It works on the principle that periodontal structures can be regenerated by allowing specific progenitor cells are used to repopulate the previously damaged root surface whereas preventing the gingival epithelium and connective tissue from engaging it during the healing process.[3] Several treatment approaches have been developed to address Grade II furcation defects, often combining membranes and grafts. This study compares the regenerative efficacy of a xenograft and a guided tissue regeneration (GTR) membrane in restoring Grade II mandibular furcation abnormalities.

SUBJECTS AND METHODS: The clinical study took place from November 2019 to August 2020 at an outpatient facility in Hyderabad and included 18 patients with Grade II furcation affecting the lower arch. The study met the criteria outlined in the Helsinki Declaration of 1975, as amended in 2000, and was approved by the institutional review board.

The statistical analysis was done using SPSS Statistics version 22, with a confidence interval of 95%. A significance level of $P<0.05$ was considered statistically significant. Changes within each group from baseline to 6 months postoperative were analyzed using paired t-tests, while differences between the groups were assessed using ANOVA.

SELECTION CRITERIA: The study included patients with probing depths of ≥5mm and relative vertical clinical attachment levels (RVCAL) and relative horizontal clinical attachment levels (RHCAL) of ≥3mm. Exclusion criteria comprised non-compliant patients, smokers, individuals with systemic health issues, those taking medications that could affect periodontal wound healing, pregnant or lactating women, and teeth with mobility exceeding Grade II.

Samples were analyzed and randomly assigned to two groups. Group A received solely xenograft, whereas Group B received combination of xenograft and a guided tissue regeneration (GTR) membrane.

A Williams probe was used to perform clinical evaluations including Plaque Index (PI), Pocket Depth (PD), and Relative Vertical Clinical Attachment Level (RVCAL). The Relative Horizontal Clinical Attachment Level (RHCAL) was determined using a Naber probe. Cone beam computed tomography (CBCT) images were obtained prior and following the treatment to assess the amount of defect fill in the affected teeth's furcation area.

Each study participant's mandibular arch impressions were used to create a tailored occlusal stent. The RVCAL was calculated by measuring the distance from a reference point (the lower border of the stent) to the base of the pocket and subtracting it from the distance between the lower edge of the stent and the cemento-enamel junction. A Naber's probe was used to measure the relative horizontal clinical attachment level (RHCAL) from the stent's lower margin to the furcation fornix.

STANDARDIZATION OF RADIOGRAPHIC TECHNIQUE: All CBCT scans were conducted by the same clinician before and after surgery. The sagittal and coronal sections were generated six months after surgery using the same axial slicing as the baseline. CBCT measurements were taken both before surgery and during the six-month follow-up.

OUTCOME MEASURES: The primary metric assessed was the extent of defect fill in the furcation, with supplementary measures including Pocket Depth (PD), Relative Vertical Clinical Attachment Level (RVCAL), and Relative Horizontal Clinical Attachment Level (RHCAL). Scaling and root planning were performed before to the surgical operation, and participants were explained mechanical and chemical plaque control techniques.

SURGICAL PROCEDURE: Eight weeks following phase I therapy, patients were re-examined to confirm their eligibility for the surgical protocol. The surgical site was anesthetized locally. A No. 15 Bard-Parker blade was used to create crevicular and interdental incisions. The muco-periosteal flap was then reflected using a periosteal elevator, and necrotic tissue was removed from the defect site with furcation curettes. The sites were carefully irrigated. Following isolation, Group A sites were treated with xenograft solely while Group B sites received combination of xenograft with a guided tissue regeneration (GTR) membrane.

Figure-1

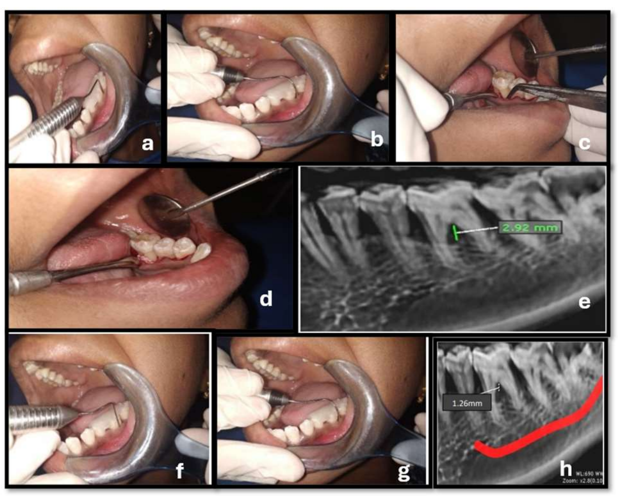

Figure 1- (a) Vertical probing depth (b) Horizontal probing depth(c) Furcation defect site(d) Xenograft placed(e) Vertical defect depth pre-op(f) Vertical defect depth post-op(g) Horizontal defect depth post -op(h) Post op vertical defect depth

Figure 2

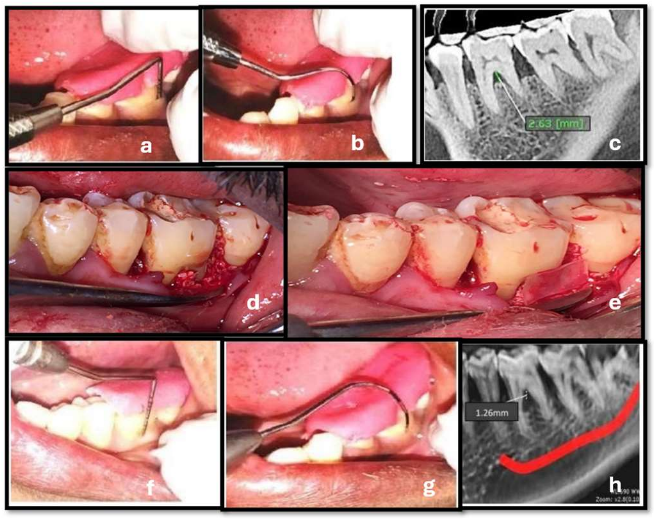

Figure 2- (a) Vertical probing depth (b) Horizontal probing depth(c) Pre op vertical defect depth (d) Xenograft placed (e) GTR membrane placed (f) Post op vertical defect depth (g) Post op horizontal defect depth (h) Post op vertical defect depth

Healiguide, a commercially available bioresorbable guided tissue regeneration membrane, was used in Group B. Healiguide Type-I collagen extracted from certain animal tissues is a thin sheet refined with distinctive American technology.

Following flap elevation and thorough debridement of the defect in Group B, xenograft was inserted into the site. Subsequently, the Healiguide membrane, a form of guided tissue regeneration membrane, was positioned over the graft. Tissue holding tweezers were used to place the membrane, and a wet blunt instrument was used to adjust its position. Finally, the flap was sutured in place using 3.0 black silk suture material.

POSTOPERATIVE CARE:

Each patient was prescribed medications that included antibiotics (Amoxicillin 500mg, three times daily) and analgesics (Aceclofenac 100mg + Serratiopeptidase 15mg + Paracetamol 325mg, three times daily) for five days following post-operative guidance.

Following surgery, the patient was instructed to rinse twice daily with 0.12% chlorhexidine digluconate for two weeks. The sutures and periodontal dressing were removed two weeks after surgery. Surgical wounds were gently washed with 0.12% chlorhexidine digluconate and patients were instructed to brush them with a soft toothbrush. Patients were checked weekly for up to one month after surgery and given additional instructions on proper oral hygiene at 8 weeks and 6 months postoperatively.

RESULTS: Six months post-surgery, evaluations of hard and soft tissues were conducted. Soft tissue measurements were repeated using the same acrylic stents as before. For reassessment of hard tissue, a CBCT scan of the defect site was performed, and the bone defect was evaluated.

The intragroup comparison of clinical (PI, PD, RVAL, RHAL) and radiographic characteristics (Height, Width, and Depth of bone fill) yielded statistically significant findings ($p < 0.001$). However, the intergroup comparison revealed that, with the exception of Probing Pocket Depth (PD) and Depth of Defect Fill, all other parameters were not statistically significant.

At baseline, there was no statistically significant difference in probing depth between the groups. However, after 6 months, the probing depth was 1.73 ± 0.79 in group A and 1.36 ± 0.50 in group B, which was statistically significant ($p < 0.05$).

DISCUSSION-

Periodontal disease originates from bacteria and triggers an inflammatory reaction. Several factors contribute to the onset and progression of periodontal disease, with root attachment loss being a critical consequence.[4] Molars are especially prone to periodontal disease due to the accumulation of bacterial plaque, which occurs because they are challenging to clean thoroughly with regular oral hygiene practices.

Periodontal lesions that impact furcation's are typically observed in the first maxillary and mandibular molars. These teeth, having been exposed to plaque for the longest period in a person's life, are more prone to such issues. This link implies that furcation problems become more common as a person ages. When a furcation becomes evident the likelihood of losing the affected tooth rises. The buccal furcation is frequently the most afflicted in lower molars, followed by the mesiobuccal and distobuccal furcation in upper molars. Upper first molars are more commonly affected than lower first molars.

Despite significant advancements in periodontics, there has been relatively little focus on furcation measurement, despite being one of the most common concerns in managing periodontal patients.[5]

Traditionally, furcation defects have been assessed using probes like the straight periodontal probe (including variations such as the TPS probe), automated probes such as the Florida probe with a disc attachment, and various specifically designed furcation probes such as the Nabers, NP2C, NS2, ZA3, ZA2, HO2 and ACE probes.

A dependable method for obtaining consistent measurements of furcation, particularly in the horizontal direction, is still elusive. Currently, probing the furcation using sounding is one of the reliable methods to assess the horizontal component of furcation, but obtaining an accurate and repeatable reference point remains challenging.[6]

In this study, a fixed reference point was created in an acrylic stent and used to measure all soft tissue parameters. Based on existing literature, it can be inferred that clinical techniques like bone sounding and probing with furcation probes such as the Nabers probe are straightforward, practical, and reliable methods for evaluating the horizontal and vertical dimensions of furcation involvement without needing to surgically expose the furcation defect. Clinical measurements tend to underestimate values compared to intra-surgical measurements because clinical probing only evaluates horizontal tissue attachment, while intra-surgical probing examines up to the bone level, a depth that can be approximated with furcation bone sounding.[7]

In this study, clinical parameters such as relative vertical and horizontal clinical attachment level and probing pocket depth were measured using Nabers and Willams probe, with standardization achieved using an acrylic stent.

The analysis of furcation clinically presents challenges due to constrained physical access to furcation depths, morphological differences, and measuring discrepancies. While traditional two-dimensional (2D) radiographs are routinely used to diagnose bone levels in periodontal disease, their accuracy is limited due to magnification and distortion produced by the X-ray beam's projection geometry. These 2D radiographs frequently superimpose tooth roots over the area of interest, making it difficult to see bony changes such as furcation involvement and buccal or lingual alveolar bone deformities.

Recent improvements have addressed the limits of 2D radiography by introducing cone beam computed tomography (CBCT), a technique that produces high-resolution 3D volumetric images with multiplanar reconstruction in the axial, coronal, and sagittal planes without magnification. CBCT provides these advantages at a lesser cost and with fewer radiation doses than standard CT scans.[8]

In a study, artificial osseous defects were generated in the mandibles of dry skulls. CBCT scanning, periapical radiography (PA), and direct measurements with a periodontal probe were compared to an electronic caliper that served as a standard reference. The study concluded that all three modalities are effective for identifying interproximal periodontal defects. CBCT's three-dimensional capability is particularly advantageous as it allows for the detection and quantification of all defects, which may not be possible with traditional radiographs.[9]

In this study, CBCT was utilized to assess the depth,width and height of the furcation defect due to its superior accuracy compared to 2D imaging techniques.

Over the past decade, outcomes of regenerative therapy for osseous defects have evolved, influenced by advances in understanding the disease process, wound healing, and the availability of novel materials.

Recent findings establish the biological feasibility of restoring previously damaged periodontal attachment tissues; with regeneration as primary treatment goal since 1990s. Under ideal conditions, the use of osteoconductive and osteoinductive graft materials can induce 60 to 70% regeneration of the height or volume of the bone lesion, resulting in better clinical outcomes.

Recently, the limitations of 2D radiographs have been addressed through the use of cone beam computed tomography (CBCT), which produces high-resolution 3D volumetric images with multiplanar reconstruction in the axial, coronal, and sagittal planes without magnification. CBCT delivers these benefits at a lesser cost and with fewer radiation doses than traditional CT scans.

Periodontal regeneration can be achieved through various surgical procedures such as bone grafts, bone substitutes, guided tissue regeneration (GTR), or an amalgam of the three are all options.[10] Bovine porous bone mineral is a novel material employed for periodontal regeneration, made by eliminating organic molecules from bovine bone, resulting in a structure comparable to human cancellous bone that aids bone growth.

A study evaluated the effects of bovine-derived xenograft with and without a bioabsorbable collagen membrane for treating mandibular class II furcation defects. Results after baseline and 6 months showed that xenograft, with or without a collagen membrane, significantly enhanced bone fill in these defects.[11]

In this study, A xenograft was employed to treat mandibular Grade II furcation defects, resulting in better clinical and radiographic parameters in Group A from baseline to 6 months. The combination of a graft material and GTR has shown the most favorable outcomes in periodontal regeneration for furcation defects. GTR, using membranes, has the potential to enhance the success of bone grafting by preventing the migration of epithelium and connective tissue, allowing osseous tissues and periodontal ligament to replenish the area near root surface.

In this study, the use of xenograft and a GTR membrane led to statistically significant improvements in all clinical metrics and bone defect fill at 6 months postoperatively and the addition of xenograft led to statistically significant advances in all clinical parameters and bone defect fill at 6 months postoperatively.

When comparing the groups, xenograft alone and xenograft with a guided tissue regeneration membrane (Group B), statistically significant variations were seen only in probing depth and depth of defect fill in Group B.

The study's **limitations** include a six-month follow-up duration. More research with longer study durations and larger sample numbers is required to determine the long-term durability of the results.

CONCLUSION

1.Both the treatment groups were biocompatible with the tissues.
2.All clinical and radiological assessments measured in both groups showed a significant improvement.
3.While both groups improved in pre- and post-surgical measures, However, long-term research with bigger sample sizes are required to assess the stability of these findings across time. The resorbable collagen membrane exhibited exceptional ease of use and was well-tolerated biologically.

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Conflicts of interest
There are no conflicts of interest.

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