

Periodontal Regeneration by Application of Chemical Root Conditioning to Intrabony Defects Utilizing Bioresorbable Membrane: A Comparative Study

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Abstract

Background: To improve and combat the limitations of healing capacity of periodontal tissues, quite a few research methods have evaluated the benefits of GTR inflection by root surface conditioning agents.

Objective: To assess the periodontal regeneration by utilizing the bioresorbable membrane in the intrabony defects with and without the use of TTC-HCl root conditioning.

Study design: A case-control study.

Setting: Department of Periodontics, Subharti Dental College, Meerut Uttar Pradesh, India.

Participants: 20 patients.

Sampling: Random sampling.

Statistical Analysis: SPSS 10 was used for Data entry and statistical analysis. Unpaired student “t” test was applied.

Results: Comparison of the values of Probing depth (PD) and osseous fill of the defect (OF) between Group A and Group B patients at baseline and at 6 months, a decline in the values of PD and OF after the treatment were observed. Intergroup comparison of the treatment outcomes on PD and OF revealed no statistically significant difference between the two groups.

Conclusion: It was concluded that use of GTR technique with the TTC-HCl root conditioning does not improve the results in terms of PD and bone regeneration.

Key words: Guided tissue regeneration, Bioresorbable membranes, Tetracycline root conditioning

Statement of the Problem and Study Hypothesis

The main idea behind the periodontal therapy is the reconstruction of the lost periodontal tissues and the conversion of the periodontitis - affected root surface into a biologically hospitable surface for epithelial and connective tissue cell adherence and attachment.

The classical approach to periodontal regeneration during the last decades has been the use of Guided Tissue Regeneration (GTR) in repairing periodontal defects. GTR refers to restoration of periodontal attachment through barrier techniques, using materials such as expanded polytetrafluoroethylene, polyglactin, polylactic acid, calcium sulfate and collagen, which help in excluding epithelium and the gingival corium from the root or existing bone surface, thus promoting regeneration.

Optimal removal of plaque, calculus and cytotoxic substances from the diseased root surface is a prerequisite for periodontal regeneration. Also the dentinal surface smear layer produced by most forms of root manipulation affects fibroblast adaption in the healing periodontal wound. For this purpose, various root conditioning agents have been used to decontaminate the root surface. Use of tetracycline has been advocated to achieve this goal and facilitate periodontal regeneration. The purpose of this study was to evaluate the efficacy of tetracycline as a root conditioning agent in enhancing the effect of guided tissue regeneration in treating intrabony defects.

Introduction

The restitution of the tooth structures, lost due to periodontal disease is the main aim of regenerative therapies being used

these days. Literature has supported the use of a treatment procedure known as guided Tissue Regeneration (GTR), which is based on a belief that by placing a barrier membrane over the periodontal defect, a gap is created between the barrier and the root thereby allowing Periodontal Ligament cells (PDL cells) to produce new connective tissue attachment and bone cells to produce new bone. In such cases the epithelium and connective tissue cells do not have any connection with the root surface [1].

Regeneration of intrabony defects by such a method brings about a highly pleasing result in the form of regrowth of these periodontal structures. Significant amount of discrepancy in the treatment outcomes has been observed which may be due to: the unpredictibility of the GTR, variations in the healing responses of individuals or even the surgical technique itself may hamper the regenerative potential [2].

To augment the natural potential of cells involved in healing processes, many new approaches have been advocated in the literatures which engage the use of root surface conditioning along with the GTR technique [3,4].

Studies by various researchers have suggested that PDL cells can be triggered to reproduce and move on to the preconditioned dentin surface, especially when tetracycline (TTC-HCl) has been used. It has been seen that this preconditioning by TTC-HCl disrupts the smear layer and to some extent demineralizes the dentin surface to reveal the underlying collagen fibres [5-7].

Thus, the present study was conducted to evaluate the Periodontal Regeneration by Application of chemical root conditioning to intrabony defects utilizing bioresorbable

membrane with the following objectives:

1. To compare the presurgical and postsurgical pocket depths
2. To assess the change in the overall area of the intrabony defects after periodontal surgical treatment.

Materials and Methods

The present study was conducted in the Department of Periodontics, Subharti Dental College, Meerut, Uttar Pradesh, India. Approval for study was passed from the institutional board of study meeting. Random sampling method was used to select the subjects. Systemically healthy patients (age of 20-46 years) having infrabony periodontal lesion of probing depth ≥ 6 mm were included in this control clinical trial after taking consent from them. Radiographs were taken of the specific defect areas. The subjects were divided into two independent groups; in Group A (n=10) a resorbable barrier membrane with chemical root conditioning was used, while the Group B (n=10) received the same membrane without root conditioning.

Preparation of Tetracycline hydrochloride solution

100 mg of Tetracycline powder was dissolved in 1 ml. of distilled sterile water using a micropipette. The pH of the prepared solution was checked in the pH meter (Hanna Instrument) and saturated till the pH was 2. The solution was prepared freshly every time before the surgery.

Treatment procedure [6]

The local anesthesia was given in the area which was to undergo surgery. Initial incision was given in such a manner so as to involve a tooth both mesial and distal to the tooth to be treated. A full thickness mucoperiosteal flap was reflected 2-3mm beyond the defect (*Figure 1*) and a blunt dissection

was given apical to the mucogingival junction to free the flap from tension. Degranulation of the tissues was completed using curettes and root planing was also done. A template was prepared from autoclave piece of mackintosh at the time of surgery which mimicked the defect's structural characteristics and the membrane was trimmed according to this template. Root conditioning was done in group A subjects using freshly prepared TTC-HCl solution for 3 minutes followed by sterile saline solution irrigation. The G.T.R. membrane was placed in both the groups and sutured to the root surface by using a 5-0 resorbable suture. In some cases, due to the defect anatomy, the membrane was adapted without the use of sutures using the pouch technique as advocated by Mattson et al. [8]. The flap was repositioned to cover the membrane completely and sutured with 3-0 silk suture to achieve tension free primary closure. Patients were prescribed Amoxicillin, 500 mg three times a day for seven days and were advised to rinse twice daily with a 0.12% chlorhexidine solution for 6 to 8 weeks. Sutures were removed and mechanical plaque control started after 1 week. The patients were recalled for oral prophylaxis as needed and recalled after 6 month intervals.

Parameters recorded

Probing Depth (PD) and osseous fill of the defect (OF) were recorded preoperatively at baseline and postoperatively at the interval of 6 months.

Radiographic images were obtained using a Radiovisiograph (RVG). The distance from the cusp tip to the Cementoenamel Junction (CEJ) was measured clinically after flap reflection and recorded also the same distance was measured radiographically and all radiographic measurements were calibrated as per this scale. The following landmarks were identified on the radiographs.



Flap reflection & debridement



Tetracycline root conditioning



Membrane placement



Flap sutured

Figure 1. Treatment Procedure

- In cases where CEJ was destroyed by restorative treatment, the apical margin of restoration was taken as a landmark.
- Bony defect was defined as the most coronal point where the periodontal ligament space showed a continuous width (BD).
- Alveolar crest was defined as the crossing of the silhouette of the alveolar crest with the root surface. (AC)

The intrabony component was assessed on the following parameters (Figure 2) [9]

Infra I: CEJ to BD minus CEJ to AC.

Infra II: An supplementary line (AUX I) was drawn along the tooth axis. Then another line (AUX II) perpendicular to the tooth axis was drawn through the most coronal extension of the lateral wall of the intrabony defect. Infra II was measured from the point where AUX II crossed the contour of the root to BD.

BDW: i.e. the width of bony defect was the distance from the lateral margin of the intrabony defect to the point where AUX II crossed to root surface.

Infra III: This was the third side of the defect triangle and was measured as the distance from BD to AC of the lateral wall of the defect.

Defect area: calculated as $\text{Infra II} \times \text{Infra III} \times \text{BDW}$.

Osseous fill (OF) was calculated by subtracting the defect area preoperatively at baseline and defect area postoperatively at six months.

Statistical analysis

Data entry and statistical analysis was carried out using SPSS 10. Significant difference was determined using the unpaired student “t” statistics. The result was assessed using Mean ± Standard Deviation and difference was accepted significant at more than 95% (p value<0.05).

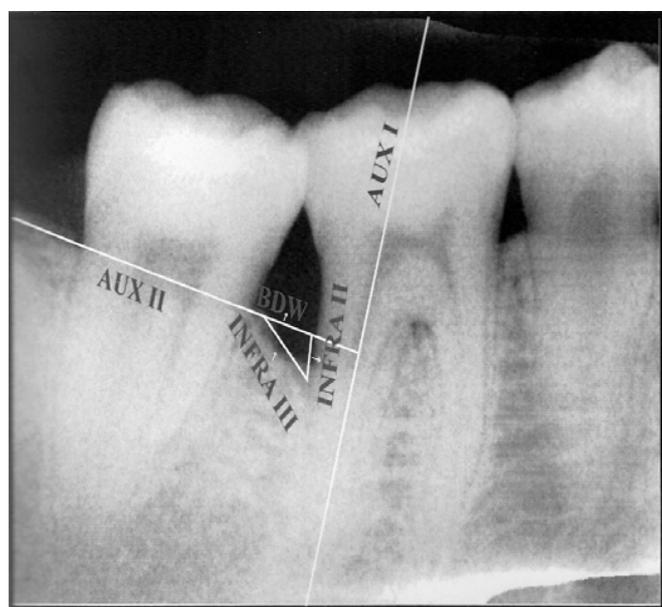


Figure 2. Radiographic images during assessment of intrabony component.

Result

On comparing the values of PD and OF between Group A and Group B patients at baseline and at 6 months, a decrease in the PD and OF after the treatment were observed.

Application of unpaired student “t” test post-operative at 6 months at 5% and 0.01% level of significance revealed the effect to be significant i.e. $P < 0.05$ and $P < 0.001$ for the reduction in PD and OF (Table 1).

On comparing the treatment outcomes by applying the statistical unpaired “t” test to the PD and OF between Groups A & B, it was observed that there was no statistically significant difference in both the groups ($P > 0.05$) (Table 2).

Discussion

GTR, a technique involving the epithelial cell segregation and discriminatory production of specific cells on to the root surface by making use of nonresorbable and resorbable barrier membranes with and without chemical root conditioning has become an established approach of treatment in periodontics. Clinical trials provide ample evidence for the effectiveness of collagen membranes in treating periodontal defects. The use of collagen has been advocated because of its being an abundant protein in the body and the main element of periodontal connective tissue. Moreover, collagen membrane is a weak immunogen, provides a scaffold for PDL cell migration, chemotactic for fibroblasts and can be effortlessly modified as required [10].

The advantage of resorbable membrane over non resorbable membrane is that they require only one surgical procedure, which is less distressing for the patient. Also, pointless distress to newly formed tissue which would have been caused due to second surgery, is prevented. It has been demonstrated through different studies that the effectiveness of resorbable barriers are almost equal to those of non resorbable expanded Poly Tetra Fluoro Ethylene (ePTFE) barrier membranes [1]. These studies favour the use of the collagen membrane in this study which appears to be economic, easily available and is well manipulated during the surgery.

The role of chemical root conditioning alone as well as an adjunct with different type of barrier membranes in GTR has been advocated by several investigators [7,11,12]. The management of root surface produces dentinal surface smear layer which may affect the fibroblast adaptation in periodontal wound healing. An *in vitro* study [13] has reported that the

Table 1. Statistical Test Application for Pocket Depths (PD) and Osseous Fill (OF) for Study Groups at Baseline Vs 6 Months.

Group	Values	Pocket depth	Osseous fill
Group A	mean ± SD	3.5±0.72	69.51± 42.79
	t-value	5.22 ,	2.37
	p value	$P < 0.05^*$	$P < 0.05^*$
Group B	Mean ± SD	4 ± 0.37	95.7 ± 37.59
	t-value	10	3.0
	p-value	$P < 0.05^*$	$P < 0.05^*$

* $P < 0.05$ =statistically significant.

state of the root surface actually determines the result of wound healing process.

The use of TTC-HCl was also supported by the findings that superficial demineralization by the use of demineralizing agents during regenerative periodontal surgery may demineralize cementum which facilitated a cell and fiber attachment to the cementum surface and was an important initial step in the natural healing process and new attachment formation. A matrix is thereby provided supporting migration and proliferation of cells related to periodontal wound healing [14].

TTC-HCl finds its usefulness in the regenerative therapy by the support in the findings of Yaffe et al. [15] who reported that using tetracycline and bisphosphonate together as root conditioners decreases alveolar bone resorption in rats.

Our study was supported by the findings based on the effect of TTC-HCl root preparation on GTR in treating Class II furcation defects utilizing e-PTFE membrane. This study observed an improvement in PD reduction and CAL gain in both the groups. But their findings were debatable, as no significant difference between the two treatments was seen [16].

While comparing the effect of tetracycline therapy in combination with periodontal surgical therapy, significant decreases were seen in clinical and radiographic measurements. The PD decreased by ≥ 2 mm in almost 79% of the cases and an increase in both the height and area of coronal alveolar bone after a three month period was observed radiographically [17]. This finding was in agreement with our findings where almost 60% of the sites showed improvements in the clinical parameters and radiographic parameters.

Some studies have reported the negative effects of tetracycline root conditioning thus, supporting our little improvements in results [18].

In a study on a mouse model, it has been demonstrated that using TTC-HCl conditioning on diseased cementum incites an inflammatory response thereby making the local application of tetracycline for root conditioning somewhat debatable [19]. The present study demonstrated improvement following TTC-HCl root conditioning along with a barrier membrane, compared to non-root conditioned areas which have also been suggested in earlier findings. [11,20]. The healing potential gained by the use of barrier membranes superimposes upon the clinical effects obtained by acid conditioning.

PD reduction was not different between the two groups. Many human and animal studies have indicated no effect of TTC-HCl root conditioning in periodontal regenerative procedures [5,16,17,21].

Variations in the treatment results could be suggestive of improper defect selection and also may be due to difference in evaluation processes. The present study included 1, 2, and 3-wall defects. It may be said that since initial probing depth and defect depths are the indicators of the healing responses,

only deep and narrow 3 wall defects should have been selected.

To check on the possibility of initial periodontal infection levels in the oral cavity having an effect on the final treatment result, full mouth oral hygiene and bleeding scores were evaluated. It was observed that these factors did not seem to influence the result of therapy. The use of antibiotics, analgesics, chlorhexidine mouthrinsing, and weekly professional tooth cleaning throughout the duration of the treatment may have been helpful in nullifying the effect of infection in both the groups [22-24].

Osseous fill improvement in both the groups was comparable to earlier studies following conventional flap surgery alone. The small amount of improvement in parameters can be explained by the postsurgical protocol comprising of suture removal after one week and stringent plaque control was resumed at that time. The importance of wound stabilization for the better outcome of periodontal regenerative procedures has long been advocated. It takes about 2 to 3 weeks after surgery for a periodontal wound to attain sufficient maturity in order to resist mechanical tensile forces, thus making post operative phase of great importance which includes preventing trauma from oral hygiene measures, periodontal packs and early suture removal. The 6 month data of the study showed that the GTR using bioabsorbable membrane with and without TTC-HCl root conditioning is an effective procedure in the treatment of infrabony defects at 6 months. Both the treatments resulted in significant gain in regeneration by way of reduction in probing depths and gain in the defect area. The regeneration of the bone area was seen in terms of both the treatments but was not statistically significant in terms of either of the treatments.

In the present study as far as possible all the required criteria were taken into account while performing the study. The flaps were placed at the margins as close as possible and were sutured with minimal tension. The only modification was made in the placement of the membrane which in some cases was sutured with bioresorbable sutures as per the earlier studies in regenerative therapy [15]; while in some cases pouch technique for membrane placement was used [6].

Furthermore, operator experience is another factor which needs to be taken into account. As the operator in this study was a relative beginner to regenerative procedures, the results of this study were not up to the expected level. Higher values in the improvements found in other studies could be attributed to the fact that the investigators in those studies were very experienced with years of clinical research behind them.

Conclusion

The findings of this study show that the G.T.R. procedures using bioresorbable membranes offer an easy and dependable treatment alternative in cases of intrabony defects. Combining this technique with the tetracycline root conditioning does not truly perk up the results in either the terms of clinical parameters or the defect resolution.

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