

THE EFFECTIVENESS OF GUIDED TISSUE REGENERATION TREATMENT FOR FURCATION DEFECT IN MANDIBULAR MOLARS

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The study was conducted on 30 mandibular molars with grade II furcation defect to evaluate the results of treatment of furcation lesions by guided tissue regeneration surgery with Collagen membrane. Result after 6 months post-op, the probing depth decreased to 3.5 ± 0.6 mm; the level of attachment loss decreased to 4.0 ± 0.7 mm. There was a statistically significant reduction in the probing depth and clinical attachment loss at 6 months post-op with GTR. Using collagen membranes for guided tissue regeneration (GTR) treatment showed good results, achieving treatment goals such as reducing pocket depth, restoring attachment, and improving periodontal indices.

Keywords: Furcation, guided tissue regeneration (GTR), Collagen membrane.

I. INTRODUCTION

Periodontitis is one of the most common oral diseases in Vietnam, characterized by irreversible destruction of periodontal tissue. The treatment to restore the destroyed tissue, including damage to the root canal, is always a challenge for dentists. The presence of furcation involvement exceeding Grade I according to Hamp's classification seems to be at vast risk of tooth loss for molars. Various regenerative procedures have been proposed and applied with the aim of eliminating the furcation defect or reducing the furcation depth.

Guided tissue regeneration technique (GTR) is based on the placement of physical barriers, which protect against apical migrating epithelial cells and gingival connective tissue cells of the flap, thus allowing the inward migration of periodontal ligament cells and mesenchymal cells on the exposed root surface. GTR is a regenerative approach in the treatment of periodontal defects because of the

effect in achieving new attachment formation in periodontal involved teeth.

The histological evidence of new attachment formation in furcation lesions with the use of a membrane in guided tissue regeneration has been demonstrated, published, and subsequently, confirmed by many early studies. In these studies, the outcome of GTR was noted to be favorable in grade II mandibular furcation, as demonstrated by clinical soft tissue filling or reduced probing depth (G Avila-Ortiz 2015, J Mjzoub 2020).^{1,2} Collagen membrane is a biodegradable membrane of biological origin, especially suitable for GTR because of its good compatibility with periodontal ligament, acting as a barrier to prevent the migration of epithelial cells, and as a scaffold for vascular growth due to its many micropores and high fluid permeability.¹

In Vietnam, the application of collagen membrane in GTR technique in the treatment of periodontal lesions is still very limited. Therefore, we conducted a study to evaluate the results of treatment of furcation - involved teeth by guided tissue regeneration surgery with Collagen membrane.

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II. METHODS

1 Study subjects

Volunteers patients diagnosed with chronic periodontitis according to AAP 1999, with grade II furcation according to Hamp's classification in the mandibular molars (buccal or lingual) after the initial (phase 1) treatment 4-6 weeks at the Department of Periodontics, Hanoi National Hospital of Odonto-Stomatology, healthy enough for periodontal surgery.

2. Study period

From April 2017 to January 2018.

3. Study methods

Study design

Uncontrolled clinical intervention.

Sample size

Calculated according to the clinical intervention research formula with a sample size of 30 teeth. This is a convenient sampling method, purposeful, and cumulative over time until the expected study sample size is reached.

Procedures

Examination and record information

- Age, sex
- Probing depth (PD), clinical attachment loss (CAL) in the center of furcation area.
- Gingival Index (GI).
- Plaque index (PII).

These indices were recorded before and after surgery at 3 months, 6 months.

Treatment procedures

Initial treatment: including oral hygiene instruction, elimination local stimulation and systemic treatment.

Periodontal surgery

Applying the Widman-modified flap surgery procedure.

Measuring the level of bone loss during the surgery: vertical probing depth (V-PD) from enamel - cementum junction to the bottom of the defect by using PCP UNC 15 Hu-Friedy probe, and horizontal probing depth (H-PD) furcation from buccal or lingual surface to the bottom of the furcation by using the Nabers probe.

Membrane preparation: the Collagen membrane was adjusted to fit the anatomical shape closely to the root, covering the lesion. The Collagen membrane produced by MEDICAL BIOMATERIAL PRODUCTS GmbH/ GERMANY, derived from pig skin with the ingredients containing at least 96.75% pure collagen and 3.25% water.

The membrane was placed correctly for furcation closure, over 2 - 3 mm from the apex bone and adjacent bone. The membrane was fixed by sling suture with Vicryl 4/0, ensuring the space for blood clot in submembrane.

Evaluation and follow-up after surgery

Infection condition, exposed membrane condition and abnormal developments at 1 – 2 weeks after surgery.

The subjects were scheduled for follow up appointment and plaque control at 10 days, 3 weeks and 6 weeks after surgery. The clinical indices were recorded at all appointments.

4. Result evaluation

The result evaluation was carried out basing on the recovery of the periodontal tissue including the reduction of PD, CAL, the improvement of GI, PII after surgery.

5. Statistical analyses

The statistic analyses software SPSS ver. 16.0 was used for data analysis.

6. Ethics approval

The study was conducted in accordance with

the ethical principles for clinical research. The study protocol was approved by the Scientific and Ethical committee of the National Hospital of Odonto-Stomatology, Hanoi, Vietnam (no.845/

QD-BVRHM signed 25 December 2012). All participants of the study were informed about the study and signed an informed consent form.

III. RESULTS

1. Subjects characteristic

Among 30 furcation involved lower teeth, there was 24 first molars (16 of the right and 8 of the left jaw) and 6 second molars in the left jaw)

2. The condition of furcation defect after surgery

Table 1. The change in probing depth

Time	First molars		Second molars		Total		p
	n	($\bar{X} \pm SD$) (mm)	n	($\bar{X} \pm SD$) (mm)	n	($\bar{X} \pm SD$) (mm)	
Before treatment (1)	24	4.8 ± 0.7	6	4.8 ± 0.4	30	4.8 ± 0.6	
3 months post-op (2)	24	4.2 ± 0.6	6	4.1 ± 0.6	30	4.2 ± 0.4	p ₍₁₋₂₎ < 0.05
6 months post -op (3)	24	3.5 ± 0.7	6	3.6 ± 0.4	30	3.5 ± 0.6	p ₍₁₋₃₎ < 0.05

Table 1 showed that there was a statistically significant gradual decrease in periodontal pocket depth after 3 and 6 months of treatment(p<0.05). After 6 months, the periodontal pocket depth decreased to 3.5 ± 0.6 mm.

Table 2. The change in clinical attachment loss

Teeth	First molars		Second molars		Total		p
	n	($\bar{X} \pm SD$) (mm)	n	($\bar{X} \pm SD$) (mm)	n	($\bar{X} \pm SD$) (mm)	
Before treatment (1)	24	5.2 ± 0.8	6	5.1 ± 0.2	30	5.2 ± 0,7	
3 months post-op (2)	24	4.7 ± 0.8	6	4.6 ± 0.2	30	4.7 ± 0,7	p ₍₁₋₂₎ < 0.05
6 months post -op (3)	24	4.0 ± 0.8	6	4.0 ± 0.2	30	4.0 ± 0,7	p ₍₁₋₃₎ < 0.05

The result from table 2 showed that the average level of periodontal attachment loss before treatment was 5.2 ± 0.7 mm, similar in the first and the second molars. There was a statistically significant gradual decrease

in periodontal attachment loss after 3 and 6 months of treatment (p < 0.05). 6 months post-op, the average level of periodontal attachment loss decreased to 4.0 ± 0.7 mm.

3. The recovery of periodontal tissue after GTR treatment

Table 3. The Change in probing depth and clinical attachment loss after GTR treatment

Reduccion of Clinical Parameters	First molars		Second molars		Total	
	n	($\bar{X} \pm SD$) (mm)	n	($\bar{X} \pm SD$) (mm)	n	($\bar{X} \pm SD$) (mm)
PD	24	1.3 ± 0.3	6	1.1 ± 0.9	30	1.3 ± 0.1
CAL	24	1.2 ± 0.0	6	1.1 ± 0.4	30	1.1 ± 0.5

The table 3 showed that after 6 months post-op, the periodontal pocket depth decreased on average 1.3 ± 0.1 mm and the level of periodontal attachment loss decreased on average 1.1 ± 0.5 mm. There was no significant difference between the recovery of the first and the second molars.

Table 4. The change in Gingival index (GI) after GTR treatment

Time	Teeth	First molars		Second molars		Total		t	p
		n	($\bar{X} \pm SD$)	n	($\bar{X} \pm SD$)	n	($\bar{X} \pm SD$)		
Before treatment (1)		24	1.8 ± 0.5	6	1.8 ± 0.4	30	1.8 ± 0.5	12.339	< 0.05
3 months post-op (2)		24	0.3 ± 0.6	6	0.8 ± 0.4	30	0.4 ± 0.6		
6 months post -op (3)		24	0.9 ± 0,6	6	1.0 ± 0.0	30	1.0 ± 0.5	9.304	< 0.05

The result from table 4 showed that after 3 months post-op, the gingival index decreased to an average of 0.4 ± 0.6. At the time of assessment

(6 months post-op), the mean GI was 1.0 ± 0.5. The t-student test showed that this change is statistically significant with p < 0.05.

IV. DISCUSSION

Guided tissue regeneration (GTR) is a procedure to reconstruct lost tissue and is based on the concepts of selective regeneration, where the first cell type involved in the healing process influences the type of attachment. Periodontal attachment will form on the root surface. Previous studies have shown that, although periodontal tissue is made up of four types of cells (epithelial, connective tissue, alveolar bone, and periodontal ligament), regenerative cells actually have only a source derived from cells of the periodontal ligament

and/or cementum. To exclude the rapid growth of epithelial cells migrating to the wound, GTR uses barriers placed between the periradicular flap and the bony defect to maintain a space for the cells to grow and and regenerate.¹

The results in Table 1 showed that the periodontal probing depth tends to decrease in the entire treatment course with an average pre-treatment probing depth of 4.8 ± 0.6 mm. There was a statistically significant decrease in probing depth after 3 and 6 months of treatment with p < 0.05. After 6 months, the probing

depth decreased to 3.5 ± 0.6 mm. There was no difference between the first molars and the second molars.

The reduction in probing depth was statistically significant at the 2 following up points compared with preoperatively ($p < 0.05$). This suggests that treatment of grade II furcation lesions with GTR can achieve good results in reducing inflammation and reducing probing depth.

The results of this study are consistent with the study of Jad Majzuob et al (2020), when treating ninety-eight furcation defects with GTR using an allogeneic cancellous bone graft and covered by an absorbable membrane with at least 1-year follow-up. At the 1-year post-surgical recall, 1.23 ± 1.48 mm CAL gain was observed. Although only using collagen membranes to treat the furcation defects, our study also achieved similar results in clinical attachment gain (table 2).³

In this study, we only used collagen membranes, indicated for teeth with grade II furcation defect, the width of the flap can be enough to cover the membrane and the defective area; however, we had lower results than the study of Odontuya Dorj et al (2015). 32 men and 28 woman with at least one tooth exhibiting class II furcation defects of the first molars of upper and lower jaw were treated using bovine bone xenograft and porcine collagen membrane to cover the furcation defects. The reduction of probing depth and clinical attachment loss in 4-6mm pockets were 2.38 mm and 3.32 mm, respectively. The difference in the reduction of PD and CAL may be caused by the using of bone graft in the study of Odontuya Dorj.³

Along with reducing the periodontal pocket depth, after the treatment, the periodontal attachment level was significantly restored,

as shown in Tables 3. The level of clinical attachment loss continued to decrease after 6 months post-op and the reduction was significant compared to 3 months post -op. This showed that with time, the recovery and regeneration of periodontal tissues continues to be maintained compared to the first 3 months post -op, an average of 1.1mm, of which almost in the first molars, regrowth is achieved with more attachment (1.2mm).

Analysis of the results according to the periodontal pocket depth pre-op found that the change in attachment loss post-op was related to the pre-op periodontal pocket depth of the lesions. At all depths, there was a significant improvement in periodontal attachment loss. However, in deeper pockets there is a greater tendency to restore attachment. With a periodontal pocket depth of more than 6 mm, attachment restoration achieved after 6 months post-op was 1.30 mm, whereas, at pocket depths of 4 to 6 mm, the attachment gain was 1.07 mm.⁴

Our results are consistent with some previous studies in the treatment of GTR in the furcation defect. In a multicenter evaluation study on the use of collagen membranes for GTR in furcation, Djurkin A et al (2019) also showed different results from different authors and different collagen membrane origins.⁵ However, the results of all studies showed that achieving the goal of re-attachment and reduction of periodontal pocket depth during the follow-up period of 6-8 months. Studies that have evaluated the furcation bone filling have been observed after 8-12 months. When evaluating bone filling, the flap must be opened to expose the furcation area for evaluation, so this procedure must also be considered. In our study, only soft tissue was evaluated for 6 months by probing measurements.

The initial clinical level of attachment recovery after treatment, mainly due to increased resistance of the connective tissue at the base of the pocket after the inflammation has subsided, resistance to probe penetration, partly due to attachment of connective tissue fibrous components, periodontal ligaments, and extension epithelial cells to the root surface rather than as a result of a new attachment. The presence of a separating membrane in the GTR technique helps prevent the development of the longitudinal epithelium, avoiding the formation of pockets around the teeth.

Guided tissue regeneration is an effective technique to regenerate periodontal tissue destroyed by inflammatory processes, but it is a very sensitive technique that requires strict indications and precise technique. Accurate assessment of the extent and type of lesions before surgery is very difficult, during surgery it is possible to identify lesions that are not pre-diagnosed or have more complex forms than expected. Therefore, the initial examination and evaluation are very important for planning and specifying treatment. Surgical treatment with GTR should only be considered after a comprehensive initial treatment, including treating the underlying cause, cleaning the plaque, eliminating occlusal trauma, and performing other supportive treatments and the patient had a good response after initial treatment.⁵

In GTR membrane surgery, flap reflection and flap tension relief are decisive factors for treatment success. When reflecting a full-thickness flap, care must be taken, carefully reflecting beyond the gingival margin, creating the necessary to relieve tension and avoid tearing the flap. Therefore, assessing flap status in both thickness and width is very important for prognosis and success of treatment. The

limitation of this technique is that it is difficult to perform in areas where the furcation is too narrow, or the mucosal flap is too thin and not wide enough, which is common on the lingual side of mandibular molars.

The collagen membrane has pores of the optimal size so that it does not prevent absorption through the granulation tissue, creating a framework for the regeneration and growth of new tissues. This material, when placed in the wound, is like a plastic gauze, absorbing secretions from cells, facilitating nutrition of the soft tissue flap. This may be the advantage of Klee Collagen Membrane over some other non-absorbable membranes such as Gore-Tex (e-PTFE), Deflon, or other absorbable membranes.⁶

V. CONCLUSION

This study shows that the guided tissue regeneration (GTR) with Collagen membrane for treating grade II furcation defect of mandibular molars yielded good results, reaching treatment goals such as reducing pocket depth, restoring periodontal attachment and improvement of periodontal parameters. The selection of the appropriate defect and precise technique along with the coordination of the patient's postoperative oral hygiene care are important factors for the success of the technique. Further studies are needed to evaluate the effectiveness of GTR with Collagen membrane and other bio-material in periodontal generation.

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