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Original Research

Evaluating the effect of collagen resorbable membrane on wound healing after the extraction of lower posterior teeth – A split mouth study

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ABSTRACT:

Aim: The purpose of this study was to evaluate the efficacy of collagen resorbable membrane on wound healing after lower posterior tooth extraction. The primary objective of the study was to determine efficacy of using collagen membrane on wound healing and evaluation was done on the 7th day and 30th day postoperatively using wound healing indices. **Materials and Methods:** The study was carried out as randomized control trial, a split mouth design, in 15 patients who were seeking extraction of bilateral lower posterior tooth. A resorbable collagen membrane was placed on the test side after extraction to promote closure of the wound. **Results:** We were able to establish in this study that collagen has an upper hand in the healing when compared to socket healing in the control group. It was observed that collagen group showed rapid epithelial proliferation up to day 7 compared to the control group and it was statistically significant with $P < 0.05$. **Conclusion:** In the study, appreciable amount of tissue regeneration and wound healing was seen in the collagen group when compared to the control sites, thus establishing the use of collagen as a biocompatible material for socket preservation and future rehabilitation in the oral cavity.

Keywords: Collagen, biocompatible, rehabilitation.

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INTRODUCTION

Healing in a holistic sense has been abundantly mentioned in the medical literature. Pellegrino and Thomasma outline that healing is the goal of clinical medicine.¹ Teeth is indicated to be extracted if they cannot be preserved by means like conservative, periodontal, prosthetic, orthodontic or surgical measures etc.² Both hard and soft tissue undergoes amendment change during the course of healing after tooth extraction. Adequate alveolar bone volume and keratinized mucosa are critical to the success of any

rehabilitation procedures. It is clinically and practically useful to be aware of the local and general factors that are associated with disturbances of normal wound healing processes.³ As dentistry evolves into an advanced and new era, research aimed at further understanding the biological processes underlying alveolar bone healing, an area of foremost importance and urgency in health care research is the development of biomaterials that are accessible, persistent, and versatile. Collagen by virtue of its ubiquity, low immunogenicity, cost and ability to be moulded into strong, biocompatible scaffolds meets

these criteria and thus plays a leading role in wound care.³ With the advancement in technology, currently different types of wound dressing materials are available for all types of wounds. Since collagen is a major and highly conserved protein found in the connective tissues of all mammals, thus offering a high level of homology, different collagen membranes for guided tissue regeneration (GTR) or guided bone regeneration (GBR) procedures of animal origin have been engineered.⁴ Studies showed that the use of a restorable membrane as a mechanical barrier resulted in complete healing of the bone defect in vivo, and this membrane prevented the apical migration of epithelium and supported new connective tissue attachment and tissue regeneration.⁵ The regeneration process occurring within the barrier membrane involves angiogenesis and migration of osteogenic cells from the periphery towards the centre to create a well-vascularised granulation tissue. Initial organization of the blood clot is followed by vascular in growth and woven bone deposition, subsequent lamellar bone formation and finally remodelling, resembling bone growth.² A barrier membrane designed for dental indications should meet the following criteria: host tissue integration, biocompatibility, cell occlusion junctions, permeability for nutrients and ease of use.⁶ There are two broad categories of bioresorbable membranes: the natural and the synthetic membranes. Natural membranes are made of collagen or chitosan, whereas synthetic products are made of aliphatic polyesters, primarily poly(L-lactase) (PLLA) and polylactic co-glycolic acid (PLGA) co-polymers.⁷ Collagen membranes are easy to manage and to apply to different surgical sites and it has interaction with platelets and fibronectin, properties soft tissue increasing fluid exudate and its cellular component (macrophages) and the "scaffold" role for fibroblastic proliferation.⁸ The purpose of this study was to evaluate the effects of collagen resorbable membranes on wound healing clinically after the extraction of lower posterior teeth.

AIM AND OBJECTIVES

To assess the efficacy of collagen membrane on wound healing of the extraction socket when used as a socket cover after removal of lower posterior teeth with primary objective -To evaluate the efficacy of collagen resorbable membrane on wound healing after the extraction of lower posterior teeth and comparing the efficacy of wound healing by using collagen resorbable membrane on the 7th day and 30th day postoperatively using wound healing indices.

MATERIALS AND METHODS

The prospective split mouth study was conducted in the Department of Oral and Maxillofacial Surgery,

PMS College Of Dental Science and Research, Trivandrum on subjects belonging to both genders aged between 18- 45 years requiring extraction of lower posterior tooth. A written consent was obtained from the patient prior to surgical procedure. 15 subjects who need bilateral posterior tooth extraction was selected with inclusion and exclusion criteria. (Table 1) During the first session, the patient's medical history is gathered and the extraction of lower posterior tooth of one side is performed under local anaesthesia with lignocaine 2% and epinephrine 1:200000. After the extraction socket was irrigated with normal saline to remove debris. A resorbable collagen membrane (Healiguide, GTR Membrane) (Fig 1) was placed on the test side after extraction in such a way that 3 mm of the membrane extended outside the margin of the bone defect and sutures is used to promote closure of the wound (3-0 vicyl sutures). (Fig 2) In the control side (opposite side), the surgical technique was exactly the same, but no membrane was placed. After the procedure all the patients were prescribed 500 mg of Capsule Amoxicillin every 8 hours for 5 days, Tablet Paracetamol 650mg every 12 hours for 5 days. Evaluation of healing of the extraction socket was done after 7 days (Fig 3) and one month (Fig 4) by using early wound healing index by Wachtel et al.⁹ and Landry et al.¹⁰ index by a blinded examiner.

STATISTICAL ANALYSIS

The statistical analysis was performed using the statistical package for social sciences version 12.0. The paired t-test was used to determine whether there was a statistical difference between the collagen and non-collagen group in the parameters measured. Data was expressed as mean and standard deviation. P value less than 0.05 was accepted as statistically significant.

RESULTS

The study was carried out as randomized control trial, a split mouth design. Out of 15 patients 8 were female and 7 were male. All patients were seeking extraction of bilateral lower posterior tooth due to several causes like therapeutic, failed root canal, periapical infections, some cases were extraction requiring osteotomy for partially erupted molar which has associated pericoronitis. Table 2 and 3, signifies the score as well as frequency distribution of EHI (Early Healing Index), with lowest score 1 is more in the collagen group (excellent healing) and more percent of the non-collagen group showed highest score 2 on the 7th postoperative day. The score of 1 was seen in 4 patients in collagen group on the 7th day which is excellent healing. (Graph 1-2)

Fig.1- Sterile collagen membrane (resorbable collagen membrane - HEALIGUIDE™)

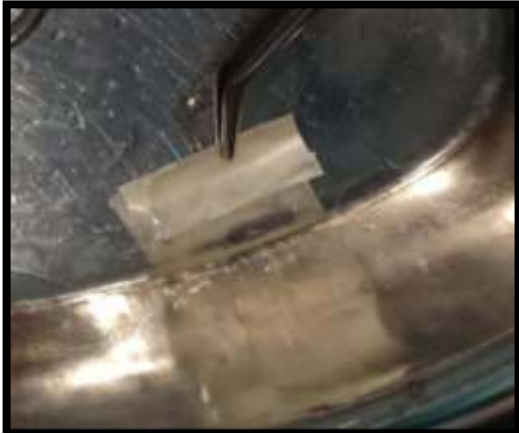


Fig 3- Post-operative photo 7th day collagen group



Fig 2- Intra operative photo of collagen secured with vicryl sutures

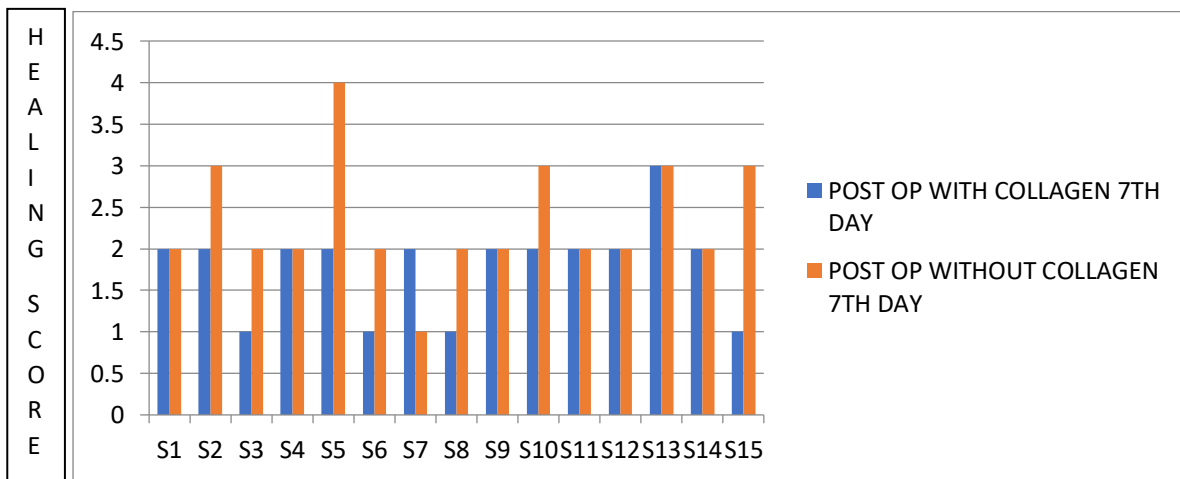


Fig 4-Post-operative photo 30th day collagen group

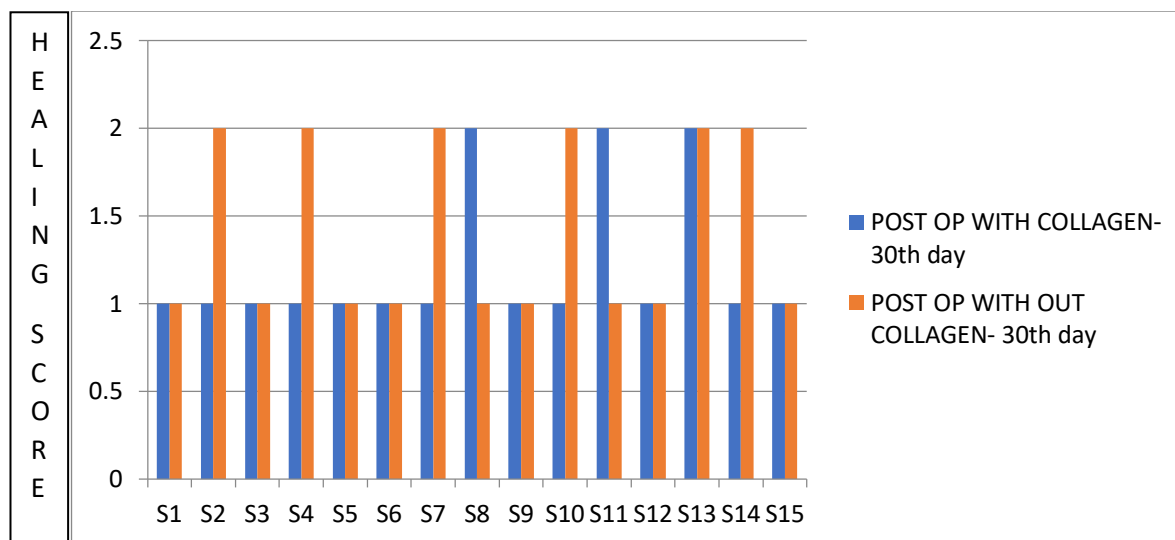


INCLUSION CRITERIA	EXCLUSION CRITERIA	OUTCOME VARIABLE
<ul style="list-style-type: none"> • Patients of both genders. • Patients who require extraction of bilateral posterior tooth (non-restorable, defective tooth and therapeutic extractions). • 18 years of age or older. • Healthy patients ASA 1 or II patients. 	<ul style="list-style-type: none"> • Patients above 60 years age. • Systemic complications. • Patients present with severe horizontal and vertical bone loss. • Patients present with allergic reaction to any drugs or product. • Patients on immunosuppressive drug therapy. 	Collagen will accelerate wound healing

Table 1- Inclusion, exclusion criteria's as well as outcome variable of the study.



Graph 1: Clustered cylindrical representation of EHI score on 7th day



Graph 2: Clustered cylindrical representation of EHI score on 30th day

PATIENT	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
post op with collagen 7 th day	2	2	1	2	2	1	2	1	2	2	2	2	3	2	1
post op with collagen-30 th day	1	1	1	1	1	1	1	2	1	1	2	1	2	1	1

PATIENT	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
post op without collagen 7 th day	2	3	2	2	4	2	1	2	2	3	2	2	3	2	3
post op without collagen-30 th day	1	2	1	2	1	1	2	1	1	2	1	1	2	2	1

Table 2: Clinical recording of healing score of 15 patients on 7th day and 30th day.

1: complete flap closure 2: fine fibrin line 3: fibrin clot in interproximal area 4: incomplete flap closure
5:incomplete flap closure with complete necrosis

Score (Wachtel et al)	With collagen (7th day) (n)	With collagen (30 th day) (n)	Without collagen (7th day) (n)	Without collagen (30 th day) (n)
1	4	12	1	9
2	10	3	9	6
3	1	0	4	0
4	0	0	1	0
5	0	0	0	0

Table 3: Frequency distribution of EHI score (n= Number of patients)

DISCUSSION

Owing to the higher incidence of postoperative complication after extraction procedures and substantial dimensional alterations that socket undergoes after tooth extraction investigators have been attracted to research aimed at finding material which can induce tissue regeneration and bone remodelling although the treatments are always challenging. In humans, collagen comprises almost one-third of the total protein and it makes for three-quarters of the dry weight of skin. It is the most prevalent component of the extracellular matrix. The present study aim was to evaluate the effect of collagen resorbable membrane on wound healing after

the extraction of lower posterior tooth. We hypothesized that collagen membranes accelerate wound healing after extraction of lower posterior teeth. We were able to establish that collagen membranes is having a beneficial effect on wound healing when placed as a barrier membrane which enhance early epithelial proliferation from surrounding normal tissue after lower posterior tooth extractions.¹¹ Much literature exists, as to which membrane biomaterial is epitome for use in soft tissue remodelling and bone regeneration procedures. Adding to the commotion, new applications of GTR membranes still evolve, such as extraction site preservation, implant site development, ridge

augmentation, and the use of membranes in conjunction with the placement of dental implants.¹² The advantages of adopting absorbable material include promoting wound healing through isolation, clot stabilization, wound stability, and haemostasis, complement primary wound coverage through its chemotactic ability to attract fibroblasts, and augmenting flap thickness by providing a collagen scaffold. Type I collagen are indicated for filling extraction wounds to enhance haemostasis, facilitate granulation tissue formation, a high degree of vascular anastomosis in the regenerated tissue and protect the wound surface. Pitaru et al.¹³ in a series of experiments concluded that type I collagen has the capacity to support regeneration of periodontal tissues. We were able to establish in this study that collagen has an upper hand in the healing when compared to socket healing in the control group. It is speculated that the application of the collagen membrane leads to a stabilization of the blood coagulum and subsequently serves as a scaffold for the development of the extracellular matrix and the formation of connective tissue. In addition, the more rigid and denser top layer of the matrix may serve as a scaffold to accelerate the migration of epithelial cells derived from the surrounding tissue as proposed by Karring et al.¹³ To identify the clinical effects of collagen on healing the parameters we chose were tissue colour, bleeding response to palpation, presence of granulation tissue, characteristics of the incision margins, and the presence of suppuration.¹⁰ A further index used was, the Early Healing Index (EHI), developed by Wachtel et al. classifying healing in 5 degrees.⁹ It rates flap closure not only as complete or incomplete, but also registers both the amount of fibrin and necrosis. Although EHI was intended to be evaluated from the first postoperative day we chose a time interval of 7 days and 30 days for analysing the biological process of soft tissue healing haemostasis, inflammation and re-epithelialization. The score for perfect wound closure and healing is the score 1 and worst prognosis is the score 5. In accordance with the study by Minab et al. and Kodama et al. our study also demonstrates significant result on wound healing with collagen. It was observed that collagen group showed rapid epithelial proliferation up to day 7 compared to the control group and it was statistically significant with $P < 0.05$. Majority of the clinical cases in the study group showed highest degree score 1 demonstrating collagen's importance in key process of soft tissue healing and regeneration, including cell proliferation and differentiation, extracellular matrix synthesis, chemotaxis and angiogenesis (neovascularization).¹⁴ Collagen can indeed accelerate wound healing compared spontaneous healing control group, particularly during the first week. But only 1 out of 15 cases in the control group showed an excellent soft tissue score of at the end of 7th day. At later time-points, differences could no longer be observed, likely because re-epithelialization was completed by day 15

independent of the healing modality. Even though at the end of 30 days the collagen group showed satisfactorily excellent flap closure than the control group clinically it was not statistically significant p Value 0.27 ($p > 0.05$). In the collagen group complete flap closure was seen in 4 out of 15 patients on the 7th post-operative day and in the control group only 1 patient showed complete epithelialisation out of 15. As the collagen helps in the all stages of soft tissue healing the further parameters, were evaluated were tissue colour, presence of granulation tissue, bleeding, suppuration, and epithelialization as proposed by Landry et al. Exceptional healing is given score 5 and poor healing is graded as 1. There was significant difference between the collagen group and non-collagen group on 7th and 30th day based on minimal inflammatory response ($p < 0.05$). In our study, the use of collagen membrane in posterior tooth extractions resulted in relatively low complication rates compared to control group, and these differences were statistically significant. Collagen enhances oral soft tissue healing compared with control sites at selected early time-points. This was documented by a faster re-epithelialization at 7th day. In an effort to improve soft tissue healing with minimal complications the application of collagen membranes should be considered.

CONCLUSION

The present study was designed to evaluate the efficacy of collagen resorbable membrane on wound healing after the extraction of lower posterior teeth compared to the control group. Wound healing involves timed and balanced activity of many orchestrated events. Role of Collagen in the early phases of extraction socket healing was evaluated using soft tissue index scores. We utilized its potential to enhance haemostasis, facilitate granulation tissue formation, and protect the wound surface. In the study, appreciable amount of tissue regeneration and wound healing was seen in the collagen group when compared to the control sites, thus establishing the use of collagen as a biocompatible material for socket preservation and future rehabilitation in the oral cavity. The major limitation of the present study was with obtaining a statistical significance in all factors of wound healing due to a limited number of individuals included. But even with limited number of subjects included in the study, during the early phases of healing process collagen showed admirably superior results than the control group.

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REFERENCES

1. Pellegrino ED. The internal morality of clinical medicine: a paradigm for the ethics of the helping and healing professions. in the *Journal of Medicine and Philosophy: A Forum for Bioethics and Philosophy*: 2001 Jan 1 (Vol. 26, No. 6, pp. 559-579).
2. Adeyemo WL, James O, Ogunlewe MO, Ladeinde AL, Taiwo OA, Olojede AC. Indications for extraction of third molars: a review of 1763 cases. *The Nigerian postgraduate medical journal*. 2008 Mar;15(1):42-6.
3. Schwarz F, Bieling K, Latz T, Nuesry E, Becker J. Healing of intrabonyperimplantitis defects following application of a nanocrystalline hydroxyapatite (Ostim™) or a bovine derived xenograft (BioOss™) in combination with a collagen membrane (BioGide™). A case series. *Journal of Clinical Periodontology*. 2006 Jul;33(7):491-9.
4. Hurley LA, Stinchfield FE, Bassett CA, Lyon WH. The role of soft tissues in osteogenesis: An experimental study of canine spine fusions. *JBJS*. 1959 Oct 1;41(7):1243-66.
5. Dahlin C, Linde A, Gottlow J, Nyman S. Healing of bone defects by guided tissue regeneration. *Plast Reconstr Surg*. 1988;81:672-676.
6. Abbas A. Is Bio-Oss® an Osteoconductive Material when Used as an Onlay Graft in Combination with a Resorbable Membrane?: A Prospective Experiment in a Rabbit Model (Doctoral dissertation, McGill University Library).
7. Nair LS, Laurencin CT. Biodegradable polymers as biomaterials. *Progress in polymer science*. 2007 Aug 1;32(8-9):762-98.
8. Mian M, Beghe F, Mian E. Collagen as a pharmacological approach in wound healing. *International journal of tissue reactions*. 1992; 14:1-9.
9. Wachtel H, Schenk G, Böhm S, Weng D, Zuhr O, Hürzeler MB. Microsurgical access flap and enamel matrix derivative for the treatment of periodontal intrabony defects: a controlled clinical study. *J Clin Periodontol* 2003;30:496-504. patients. *Res Clin Forums* 1988;10:105-18.
10. Landry RG. Effectiveness of Benzylamine HCl in the Treatment of Periodontal Post-surgical Patients (Doctoral dissertation, Faculty of Dentistry, University of Toronto).
11. Rastogi S, Modi M, Sathian B. The efficacy of collagen membrane as a biodegradable wound dressing material for surgical defects. *Journal of Oral and Maxillofacial Surgery*. 2009;67:1600-06.
12. Gottlow, J. (1993). Guided tissue regeneration using bioresorbable and non-resorbable devices: Initial healing and longterm results. *Journal of Periodontology* 64, 1157-1165.
13. Parakkal PF. Involvement of macrophages in collagen resorption. *The Journal of cell biology*. 1969 Apr 1;41(1):345.
14. Postlethwaite AE, Keski-Oja J, Moses HL, Kang AH. Stimulation of the chemotactic migration of human fibroblasts by transforming growth factor beta. *Journal of Experimental Medicine*. 1987 Jan 1;165(1):251-6.