

Evaluation of commercially available biodegradable tetracycline fibers therapy in chronic periodontitis

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ABSTRACT

The purpose of the study was to compare the clinical efficacy of tetracycline impregnated fibrillar collagen in conjunction with scaling and root planing to scaling and root planing alone in the treatment of chronic periodontitis. The study was conducted in a split mouth design. Thirty five patients having at least two non adjacent sites in different quadrants with periodontal pockets \geq 5mm and with bleeding on probing at initial visit were treated with both scaling and root planing plus tetracycline fibers or with either scaling and root planing alone. Baseline and follow up measurements included plaque index, gingival index, probing pocket depth and clinical attachment level. Both treatment modalities were affective in improving clinical parameters over three months observation period. The combined antimicrobial and mechanical debridement therapy has shown better results as compared to scaling and root planing alone. Application of tetracycline in modified collagen matrix following scaling and root planing might be beneficial in treatment of chronic adult periodontitis and improving periodontal parameters for 3 months duration.

INTRODUCTION

Periodontal disease belongs to a group of inflammatory disorder whose pathogenesis is not well defined, although it is known that the interaction of host defense mechanisms and etiologic agents is an important determinate of the onset and progression of the disease. There is well documented evidence that bacteria and their products found in dental plaque comprise the primary etiologic agents responsible for periodontal disease^{1,2,3}.

The primary aim of non surgical as well as surgical treatment regimen is the removal of etiologic factor (i.e. plaque and calculus). Non surgical therapy i.e. scaling and root planing may not always result in the complete elimination of etiologic factor because of poor access to the base of deep periodontal pocket and anatomical complexities which may occasionally limit the efficiency of root planing. It has also been suggested that residual bacteria in the dentinal tubules and soft tissues may repopulate the scaled teeth⁴.

Tetracyclines have been used extensively in the treatment of periodontal disease since many years. Tetracyclines are semi-synthetic chemotherapeutic agents which are bacteriostatic in action and hence are effective against rapidly multiplying bacteria. Tetracycline and its derivatives have been used systemically as well as locally in the treatment of periodontal disease. Local drug delivery avoids most of the problems associated with systemic therapy by limiting the drug to its target site with little or no systemic uptake.

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Tetracycline have been incorporated into a variety of delivery systems (non resorbable or bio resorbable) for insertion into periodontal pockets. These include hollow fibers (Goodson et al 1979) ethylene vinyl acetate copolymer fibers (Goodson et al 1983), ethyl cellulose fibers (Friedman and Golomb 1982), acrylic strips (Addy et al 1982), collagen preparations (Minabe et al 1989) and hydroxypropylcellulose films (Noguchi et al 1984)⁵.

Recently, new biodegradable local drug delivery system, Periodontal Plus AB™ (Advanced Biotech Products, Chennai, India) i.e. tetracycline impregnated fibrillar collagen that contains 25 mg pure fibrillar collagen containing approximately 2mg of evenly impregnated tetracycline HCl, has been introduced for the treatment of gingival and periodontal diseases.

The present three months study was designed to clinically compare the efficacy of tetracycline from modified collagen matrix used as combination therapy with scaling and root planing alone in the treatment of chronic periodontitis.

MATERIALS & METHODS

A total of 35 human subjects comprising of both sexes (Male : Female = 16:19), aged between 35 to 60 years were selected from the Out Patient Department of Periodontics at the D.A.V. (C) Dental College and Hospital, Yamunanagar, Haryana (India). All the 35 subjects completed the 3 month follow up study.

STUDY POPULATION., INCLUSION CRITERIA

1. Patients who had not undergone any surgical or non-surgical periodontal therapy in the past 6 months.
2. Patients who had not taken antibiotic therapy in the past 6 month.
3. Patients able to follow verbal or written oral hygiene instructions.

4. Patients having 2 nonadjacent teeth separated by atleast 1 tooth with e" 5mm periodontal pocket that bleed on probing at the initial visit.

EXCLUSION CRITERIA

1. Patients with a history of using anti-microbial mouthrinses within 2 months of the baseline visit or on routine basis.
2. Patients having history of allergy to tetracycline or cyanoacrylate adhesive.
3. Pregnant woman or nursing mothers.
4. Patients with periodontal packets in which the depth of the pockets corresponded to the apex of the tooth as in probable endodontic – periodontic conditions.
5. Medically compromised patients.
6. Teeth with furcation involvements.

35 subjects with a total of 70 sites were selected. The selected sites were randomly divided into test group and control group.

TEST GROUP

included 35 sites treated with local drug delivery and scaling and root planing.

CONTROL GROUP

included 35 sites treated with scaling and root planing alone (without local drug delivery).

CLINICAL PARAMETERS RECORDED

1. Plaque Index (**Silness and Loe 1964**)⁶ at baseline, 1month, 2months and 3months post therapy.
2. Gingival Index (**Loe and Silness 1963**)⁷ at baseline, 1month, 2months and 3months post therapy.

3. Probing Depth measurement from gingival margin to base of pocket using William's graduated probe at baseline, 1month, 2months and 3months post therapy.
4. Clinical Attachment Level measurement from cemento-enamel junction as a reference point to the base of pocket with William's graduated probe at baseline, 1month, 2months and 3months post therapy.

STATISTICAL METHODS

The baseline, 1month, 2months and 3months value were compared for changes that occurred over time i.e. changes in plaque index, gingival index, probing depth reduction and clinical attachment gain. Probabilities less than 0.05 ($p < 0.05$) were considered significant. Probabilities less than 0.001 ($p < 0.05$) were considered highly significant. The paired t- test and student t-test were utilized to evaluate and establish differences between baseline and 1, 2 and 3 months values of test and control sites.

TETRACYCLINE IMPREGNATED FIBRILLAR COLLAGEN

This product consists of 25mg of pure fibrillar Type-I collagen containing approximately 2mg of evenly impregnated Tetracycline HCl, USP/ IP. It is available as a strip containing four individually packed and separable sterile product packs. Just before placement, fibers were soaked with saline in a sterile dappen dish. Soaked fiber were placed at the prepared site and gently pushed inside the pocket, so that the material fills the depths and curves of the pocket. Hand pressure was applied for just a few minutes to encourage hemostasis and initial setting of the material inside the pocket. The site was sealed with cyanoacrylate adhesive to prevent ingress of oral fluids.

POST TREATMENT INSTRUCTIONS

1. Avoid chewing hard or sticky food.
2. No flossing on the treated site.
3. Do not disturb the area with tongue, finger or tooth pick.
4. To report immediately if the material is dislodged before the scheduled recall visit or if pain, swelling or any other complication occurs.

RESULT

The clinical finding at baseline, 1 month, 2 months and 3 months post operative are shown in table 1, 2, 3 and 4. At the start there was no significant difference between both treatment group for the plaque index, gingival index, probing Pocket depth and Clinical attachment level ($p < 0.001$).

Table 3 and Graph 1 shows a gradual reduction in probing pocket depth both for test and control group, with more reduction in test group as compared to control group. Similarly more gain in clinical attachment level in the test group as compared to control group is evident from table 4 and Graph 2.

DISCUSSION

One essential goal of current periodontal therapy is successful management of the suspected bacterial pathogens to the extent that destruction of the periodontium is arrested. A number of different non-surgical and surgical therapies have been successful in achieving this goal. Mechanical debridement with or without surgical manipulations, to disrupt the subgingival flora and to provide clean, smooth and biological compatible roots surfaces, had been the therapy to treat periodontal diseases till the early 1970's. Mechanical therapy may however fail to eliminate the pathogenic bacteria because of their location within gingival tissues or in other areas inaccessible to periodontal instruments⁸.

The present study was designated to access the clinical efficiency of tetracycline

impregnated collagen fibers by demonstrating then changes in plaque index and gingival index, changes in probing pocket depth and clinical attachment level. A total of 35 patients (Male: Female=16:19) were enrolled in this study. Two interproximal sites with pocket depth \geq 5mm were selected in each patient in different quadrants.

Possible side effect of therapy including slight discomfort and gingival redness were evaluated. No treatment related adverse effects were observed in any patient. Garret et al 1999⁹ also reported that treatment emergent adverse events constituted \approx 1% of the entire study population with 0.2% of them showing allergic response.

In the present study significant reduction in plaque score from baseline to 3 months for both treatment group ($p < 0.001$) was observed. Similar observation were made by Minabe et al 1991¹⁰, Heijl et al 1991¹¹, Mehta et al 2000⁵ and Frisen et al 2002¹² who found low levels of plaque index scores in this study from baseline could be due to a greater attention to oral hygiene practice by all selected participants throughout the study.

Similarly gingival index also showed significant reduction in scores from baseline to 3 months for both treatment groups. Minabe et al 1991¹⁰ and Mehta et al 2000⁵ observed low levels of gingival index scores throughout the period of study.

Control of plaque and gingivitis is important in clinical studies because both vary in their association with periodontitis and both affect measured response to therapy, in this study, the reduction in plaque and gingival index may be due to thorough oral prophylaxis and proper home care by patients.

Since increased probing depth and loss of clinical attachment are pathognomonic for periodontitis, hence pocket probing is a crucial and mandatory procedure in diagnosing periodontitis and evaluating the success of periodontal therapy. In the present study intra group observation showed highly significant ($p < 0.001$) reduction in probing depth from baseline to 3 months in both group.

On comparison, statistically significant differences was observed from baseline to 3 months between scaling and root planing alone and combination therapy. The results are consistent with the findings of Goodson et al 1991¹³, Minabe et al 1991¹⁰, Newman et al 1994¹⁴, Tonetti et al 1991¹⁵, & Mehta et al 2000⁵. These findings are in contrast with the result of Drisko et al (1995)¹⁶ who observed no significant difference among the different regimens at any point in time. This could be attributed to the fact, that in Drisko et al 1995¹⁶ study tetracycline fibers were placed in non root planed sites and benefit of mechanical debridement was not obtained.

Newman et al 1994¹⁴ quoted that patients tend to have approximately 1 mm reduction of probing depth on average, but in some cases, can have more dramatic effects, such as 2mm or greater. It was similar to the findings of this study.

Goodson et al 1991¹³ also observed that probing depth reduction was higher in combination therapy than scaled sites. Heijl et al 1991¹¹ in their comparative study also observed that there was significant pocket depth reduction in the combination therapy than scaling root planing alone.

A significant gain in clinical attachment level was also obtained from baseline to 3 months in both the treated sites ($p < 0.001$) difference was observed. Similar observation were made by Goodson et al 1991¹³, Heijl et al 1991¹¹, Minabe et al 1991¹⁰, Newman et al 1994¹⁴, Drisko et al 1995¹⁶, Kinane and Radvar 1999¹⁷.

On comparison, highly significant ($p < 0.001$) difference was observed between combination therapy and scaling and root planing alone. This finding is similar to that of Goodson et al 1991¹³, Minabe et al 1991¹⁰, and Newman et al 1994¹⁴.

Minabe et al 1991¹⁰, found gain of clinical attachment level around 2mm, and suggested that the local application of antibiotic using a local drug delivery in combination with root debridement may contribute to clinical attachment gain.

The finding of the study is in contrast with those of Drisko et al 1995¹⁶ who found no

significant among the different regimens at any time point. This could be due to reason as mentioned earlier.

The higher efficacy of the modified collagen matrix and tetracycline over scaling and root planing, could be attributed to the availability of a modified collagen matrix to accelerate tissue restructuring, the sustained delivery of a potent drug (tetracycline) that eradicated periodontopathic microorganisms and the ability of tetracycline to inhibit bacterial collagenases.

The reduction of probing depth and gain of clinical attachment were significant in all treatment groups. These improvements might simply reflect a change in tissue composition of periodontal tissues, rather than a true gain of new attachment.

Armitage et al. and Spray et. al. have found that inflammation of the gingival tissue has a significant influence on the degree of probe penetration⁵. Improved gingival health may have contributed to the observed reduction of probing depth, presumably by decreasing the edematous swelling of the marginal gingiva and / or by decreasing the penetrability of tissue by the probe as a result of an increase of collagen content.

The crux of the present study clearly shows that mechanical debridement and locally delivered tetracycline work by two different mechanisms. Scaling and root planing removes some amount of bacteria without providing bactericidal activity whereas tetracycline does not remove any calculus deposits. Hence neither is the ideal control for the other. Together, locally delivered tetracycline therapy has a specific purpose of controlling localized infection, and scaling and root planning to remove calculus and other deposits, providing added benefits and the rate of new lesion formation is also decreased by the combination therapy.

CONCLUSION

1. Application of the tetracycline in modified collagen matrix following scaling and root planing might be beneficial in treatment

of chronic adult periodontitis and improving periodontal parameters for 3 months duration.

2. Though the local drug delivery system used in the study is the safe and effective treatment modality, further clinical and microbiological studies are required to determine the effect of this treatment modality over long period.
3. In spite of the proven additive benefits, the availability and cost associated with various controlled delivery devices (EVA fibers) have so far limited the application of tetracycline fibers. As this material is relatively cost effective and biodegradable, its use can be expanded in general population.

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Table 1

Mean values of plaque index at baseline, 1 month, 2 months and 3 months post operatively (test site & control site)

Time interval	Test site		Control site	
	Mean±SD	Difference from baseline	Mean±SD	Difference from baseline
Baseline	2.49±0.32	-	2.46±0.31	
1 month	1.61±0.43	0.88±0.32**	1.88±0.36	0.58±0.21**
2 month	1.06±0.43	1.43±0.37**	1.33±0.40	1.13±0.38**
3 month	0.67±0.41	1.81±0.41**	0.94±0.40	1.51±0.44**

** = Pd" 0.001 - Highly Significant

Table 2

Mean values of gingival index at baseline, 1 month, 2 months and 3 months post operatively (test site & control site)

Time interval	Test site		Control site	
	Mean±SD	Difference from baseline	Mean±SD	Difference from baseline
Baseline	2.42±0.26	-	2.43±0.28	
1 month	1.47±0.42	0.95±0.33**	1.92±0.25	0.51±0.19**
2 month	1.09±0.36	1.34±0.32**	1.53±0.25	0.90±0.26**
3 month	0.63±0.39	1.79±0.35**	1.15±0.27	1.28±0.28**

** = Pd" 0.001 - Highly Significant

Table 3

Mean values of pocket depth at baseline, 1 month, 2 months and 3 months post operatively (test site & control site)

Time interval	Test site		Control site	
	Mean±SD	Difference from baseline	Mean±SD	Difference from baseline
Baseline	6.83±0.85	-	6.71±0.95	
1 month	5.23±1.00	1.60±0.55**	5.69±0.99	1.03±0.38**
2 month	4.29±1.04	2.54±0.61**	5.29±0.78	1.43±0.50**
3 month	4.14±1.08	2.69±0.71**	5.14±0.73	1.57±0.65**

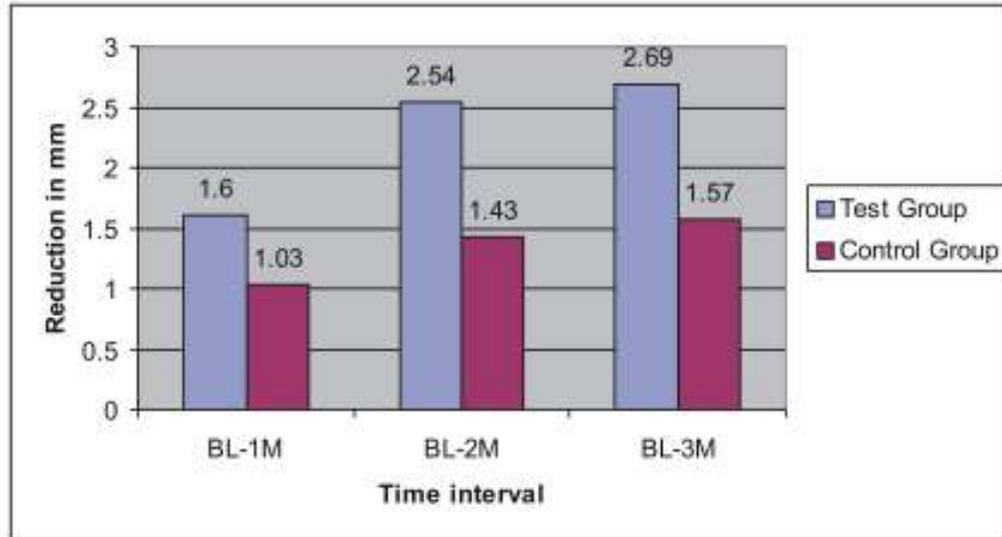
** = Pd" 0.001 - Highly Significant

Table 4

Mean values of clinical attachment level at baseline, 1 month, 2 months and 3 months post operatively (test site & control site)

Time interval	Test site		Control site	
	Mean±SD	Difference from baseline	Mean±SD	Difference from baseline
Baseline	7.31±1.10	-	7.29±1.04	
1 month	6.20±1.23	1.11±0.47**	6.49±0.88	0.80±0.47**
2 month	5.69±1.32	1.63±0.77**	6.29±1.10	1.00±0.42**
3 month	5.43±1.21	1.89±0.63**	6.26±1.06	1.03±0.51**

** = Pd" 0.001 - Highly Significant

Graph 1: mean pocket depth reduction at different time interval**Graph 2: mean clinical attachment gain at different time interval**