Local Drug Delivery with Tetracycline Fiber : An Alternative to Surgical Periodontal Therapy

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Abstract

Background: Scaling and root planing is the basic treatment modality for periodontal disease. Mechanical treatment is limited by physical impediments and biochemical considerations. Antimicrobial agents may be used as an adjunct to overcome limitations of mechanical therapy.

Methods: A case-control study was carried out on 30 patients suffering from chronic periodontitis. In Group A only scaling and root planing was carried out whereas in Group B tetracycline fibers were used along with scaling and root planing.

Result: Tetracycline fibers as an adjunct to scaling and root planing was found to be more effective in reducing inflammation. The number of sites with bleeding on probing were 12 in Group A as compared to four in Group B after 30 days. The mean decrease in probing depth was more in Group B than Group A after 30 and 90 days. General linear model showed that decrease in probing depth was statistically significant with both mechanical therapy as well as adjunctive use of tetracycline fibers.

Conclusion: Local drug delivery with tetracycline fiber is an effective and simple non surgical method to improve periodontal health which can be practiced even by a general dental practitioner.

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Key Words: Mechanical therapy; Tetracycline fibers; Probing depth; Bleeding on probing

Introduction

Periodontal diseases are considered as infections of periodontium with a bacterial etiology, an immune response and subsequent tissue destruction [1]. Putative pathogens associated with periodontal disease are susceptible to a variety of antiseptics and antibiotics [2,3]. Methods employed to convey antimicrobial agents into periodontal pockets include rinsing, irrigation, systemic administration and local application using sustained and controlled delivery devices.

Success of any drug delivery system designed to target periodontal infections depend upon its ability to deliver the antimicrobial agents to the base of the pocket at a bacteriostatic or bactericidal concentration [4]. It must also facilitate retention of the medicament long enough to ensure an efficacious results. Since local drug delivery can achieve the above requirements it is important to critically assess the ability of these treatment methods to attain or maintain periodontal health.

The use of locally delivered antimicrobials is a relatively new addition in the management of periodontitis. The treatment method is primarily the result of more than 20 years of research pioneered by Goodson of Forsyth's Dental Research Center [5-7]. The commonly used drug delivery systems are:-

- a) Tetracycline fiber
- b) Metronidazole gel
- c) Chlorhexidine chip
- d) Minocycline gel
- e) Doxycycline polymer

In the present study the role of tetracycline fiber in periodontal therapy is assessed as tetracyclines are broad spectrum antibiotics capable of achieving high concentration in the sulcular fluid.

Material and Methods

The study was carried at Army Dental Centre (R&R), Delhi Cantt on 30 patients suffering from chronic periodontitis with probing depth of 5mm. In each patient two quadrants were selected which were divided in two groups:-

Control Group - Only scaling and root planing (SRP) was carried out (Group A).

Experimental Group - SRP + tetracycline fiber (Group B).

The teeth selected in two groups were molars and premolars only. The clinical parameters obtained at each test site were:-

- (i) Probing depth using Williams probe
- (ii) Bleeding on probing (BOP)

The tetracycline fiber marketed as periodontal plus AB is available as vials with tetracycline impregnated collagen

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fibers. These fibers are brownish in color and resorbable. These fibers are soaked in saline and packed into the periodontal pockets with a cotton forcep or curette until the pocket is filled upto or slightly below the gingival margin. To avoid dislodging of the fiber patients were instructed not to brush or floss the treated areas and were placed on twice a day 0.2% chlorhexidine rinses. The clinical parameters including pocket depth were recorded on Day 0, 60 and 90 days. The data was subjected to statistical analysis.

Results

The analysis of the data indicates the following:-

- Both SRP and use of tetracycline fiber as an adjunct to SRP are effective in reducing bleeding on probing and probing depth.
- Use of tetracycline fiber as an adjunct to SRP is more effective in reducing inflammation than SRP alone (Table-1, 2).
- Use of tetracycline fiber as an adjunct to SRP shows better results than SRP alone when decrease in probing depth is compared in the two groups (Table-3, 4).
- General linear model of Group A showed that decrease in probing depth after 30 and 90 days following scaling and root planing was statistically significant (Table 5).
- The probing depth after 0, 30 and 90 days in Group B was subjected to general linear model. The results showed that decrease in probing depth after 30 and 90 days following use of tetracycline as an adjunct to SRP was statistically highly significant (Table-6). The results indicated that local drug delivery with tetracycline fiber as an adjunct to conventional therapy is highly effective in reducing the probing depth.

Discussion

Dental plaque which is a primary etiological factor

Table 1

Comparison of bleeding on probing after 30 days

	Group A	Group B
Sites with no BOP	18	26
Sites with BOP	12	04

p value =1.00

Table 2

Comparison of bleeding on probing after 90 days

	Group A	Group B
Sites with no BOP	23	27
Sites with BOP	07	03

p value = 1.00

Table 3

Comparison of pocket depth in two groups after 30 days

	Mean $\pm$ SD	t value	p value
Group A	4.93 $\pm$ 1.19	1.81	0.081
Group B	4.34 $\pm$ 1.20		

for periodontal disease is composed of bacterial aggregates that are adherent to one another and to surfaces and interfaces. These bacterias form a highly resistant biofilm with an exopolysaccharide matrix protection which prevents drug penetration. Mechanical therapy which disrupts plaque biofilm is effective for the majority of patients with mild to moderate periodontitis. But mechanotherapy has its own limitations as it is a blind procedure performed in a closed environment and instruments may not reach the base of deeper pockets due to tooth or pocket morphology. Hence antimicrobial agents can be used as an adjunct to conventional therapy.

The tetracyclines comprise a group of broad spectrum antimicrobial agents that were introduced into clinical practice in the late 1940's. These are primarily bacteriostatic agents that are effective against many Gram negative species such as *Actinobacillus actinomycetemcomitans*. The proven efficacy of this group of drugs in the management of periodontal diseases may be related not only to their antimicrobial actions but to a number of additional properties that have been recently identified. These include collagenase inhibition, anti inflammatory actions, inhibition of bone resorption and their ability to promote the attachment of fibroblasts to root surfaces. Consequently tetracyclines have also been used as an adjunct to bone grafting in periodontal defects and as agents for conditioning root surfaces to enhance the regeneration of periodontal tissues.

When tetracyclines are taken orally considerations must be given both to the potential unwanted effects

Table 4

Comparison of pocket depth in two groups after 90 days

	Mean $\pm$ SD	t value	p value
Group A	4.13 $\pm$ 1.27	1.67	0.10
Group B	3.62 $\pm$ 1.08		

Table 5

General linear model Group A

Probing depth

	0 day	30 day	90 day
Mean $\pm$ SD	7.41 $\pm$ 1.40	4.93 $\pm$ 1.19	4.13 $\pm$ 1.27

Wilks Lambda value was found to be .000 with F= 96.630

Table 6

General linear model Group B

Probing depth

	0 day	30 day	90 day
Mean $\pm$ SD	7.55 $\pm$ 1.27	4.34 $\pm$ 1.20	3.62 $\pm$ 1.08

Wilks Lambda value was found to be .000 with F= 246.602

and to interactions with other drugs that are taken concurrently. Such problems are minimized however when the drugs are incorporated into controlled slow release formulations which are currently being researched and marketed for intraoral use.

Goodson et al [7], observed that tetracycline filled hollow fibers placed in the gingival sulcus have dramatic effect both on the periodontal flora and clinical manifestation of disease. Of theoretical importance was the observation that virtual elimination of spirochetes from the gingival sulcus is possible by a single placement of tetracycline filled hollow fibers and spirochetes once eliminated from a site do not recolonize despite the persistence of viable organisms elsewhere in the mouth.

Lindhe et al [8] in his experiments demonstrated that use of tetracycline filled hollow fiber devices markedly changes the composition of the subgingival flora of initially diseased periodontal sites. Pavia et al [9] showed that tetracycline and its derivatives minocycline, oxytetracycline and chlortetracycline strongly adsorb to tooth surfaces retaining their antibacterial activity and are quite effective in treating chronic periodontitis. Thomas et al [10] compared the effects of tetracycline fibers plus scaling and root planing versus scaling and root planing alone. It was observed that the use of fibers provided no significant advantage with regards to probing depth reduction or clinical attachment gain. In 2004 Rodrigues et al [11] compared antibiotic resistance profile with local and systemic tetracycline and observed that there are less chances of bacterial resistance with locally delivered tetracyclines. Local drug delivery with tetracycline fibers has also a role to play in the treatment of peri-implantitis sites as observed in microbiological studies [12].

To conclude scaling and root planing is an extremely effective treatment modality for controlling early to moderate periodontitis. Although all sites treated do not respond totally, the majority do. This would then leave a minority of sites requiring more aggressive treatment which would include locally delivered antimicrobials because of the infective nature of the disease.

It would seem that the tetracyclines afford a unique set of pharmacological properties that are ideally suited for the management of periodontal disease. Review of literature and the result of present study suggest that tetracyclines are a useful adjunct to conventional surgical or non surgical treatment but are no substitute for these measures [13,14]. The use of local delivery systems with antimicrobials will not replace the necessity for thorough scaling and root planing. Whether done before, during or after the placement of the drug delivery system

scaling and root planing remains the most important treatment modality in periodontics.

Conflicts of Interest

The study has been funded by research grants from the O/o DGAFMS.

Intellectual Contribution of Authors

Study Concept : Lt Col M Panwar

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