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Role of Tetracycline as Antibiotic Adjunctive Therapy in Local Delivery of Treatment Periodontitis

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Abstract

Most of the individuals affected by “periodontitis: had a good response to the mechanical debridement for achieving long success. The adjuncts' use may be essential in cases that had no response to treatment, especially when surgical opportunities not feasible.

Objective: to determine tetracycline's impact on Probing Pocket Depth (PPD), Plaque Index (PI), Bleeding On Probing (BOP), and Clinical Attachment Level (CAL) over a six-month follow-up period.

Method: Thirty participants diagnosed in chronic Periodontitis and selected in random assignment into two- groups: scaling and root planning (SRP) with local delivery of tetracycline (test) or SRP alone (control). The parameters, included Probing Pocket Depth (PPD), Clinical Attachment Level (CAL), Plaque Index (PI), and Bleeding on Probing (BOP), were recorded at beginning, 1, 3, and 6 months.

Result: at six months, the SRP + tetracycline group showed significant decrease in PPD, BOP, and greater CAL gain in compared with that in SRP only ($p < 0.05$).

Conclusion: A local deliver of Tetracycline, regarded as an adjunct to SRP, with a significant improvement of the clinical outcomes in the periodontitis in compared with SRP alone.

Keywords: Tetracycline, bleeding on probing, tetracycline, plaque index

The Abbreviations

PPD: Probing Pocket Depth
CAL: Clinical Attachment. Level
BOP: Bleeding. on Probing
PI: Plaque Index
SRP: Scaling and Root Planning
WMDs: Weighted Mean Differences

Introduction

Periodontal disease damage is localized site and treatment had a considerable attention (1). Three main approaches for a pharmacological therapy are: subgingival irrigation; mouth rinse; and periodontal administration of locally antimicrobial agents (2). Firstly, the subgingival irrigation, such as washing, has a disadvantages that result in a rapid outflow, leading to non-exposure of subgingival biofilms to therapy (3). Toothpaste /or varnish helps in the reduction of the supragingival bacteria, reduces gum inflammation, and possibly recolonizes the subgingival ecosystem after periodontal therapy. Their primary objective is the lack of access to the subgingival area and deep pocket (4). The Therapeutic approaches used locally should meet the three requirements:: they had the desired action area till they reach the pocket base, maintain the agent for a long time, and keep an adequate concentration (5). Many of local delivered device and pharmaceutical drugs used such as Tetracycline, metronidazole, Minocycline, azithromycin, Doxycycline, and Chlorhexidine(6).

Locally Delivered Antibiotics

Metronidazole: it has antibacterial + anti-inflammatory properties (7). In 1992, Stoltze discovered gel form and concluded that a 25% Metronidazole Benzoate is the proper concentration to use in the PP (8). Also, Ainamo J. showed that metronidazole remained detected in PP following an application of a novel 25% gel and showed that the clinical effect produced throughout a local antibiotic. They lasted for about 6 months and were comparable to those achieved by a standard treatment of subgingival scaling. (9). Finally, clinical improvements of using this gel with scaling and root planning are still investigable. It needs higher investigations and experiments, and larger sample sizes for a longer time to better detected.

2. Tetracycline: six types of polymer filled with "tetracycline" were constructed in 1993 and examined to make a local delivery device for periodontal treatment (10). Tonetti et al. showed that both of SRP within tetracycline fiber was prior to root planning only for patients who had no response to therapy of root-furcation defect (11).

Kinane. experimented with the effect of three systems in the therapeutic areas with continuous periodontal lesions in connection with SRP and found that the significant decrease in PD (12). Friesen et al. in 2002, made compare the effect of tetracycline strip utilized single or in multiple with SRP and noticed that local tetracycline administrated was better to root planning only in decreasing PD in many strips preferable in reduction bleeding on probing. In areas with continuos periodontal lesions (13). All of previous findings were compatible by Newman in 1994 to check the therapy effect of tetracycline's fiber which used with with SRP in people with local recurrent periodontitis in the phase of maintenance (14). Also, Aimetti et al. examined the clinical and radiological for local tetracycline administration with SRP and finally, concluded that SRP with additional TE fibers in no-response areas had many different advantages (15). Rodrigues et al. in 2004 showed that the sub-gingival microbiota of patients with chronic periodontitis who had either local or systemic tetracycline's therapy along with SRP, they found TE fiber treatment reduced the prevalent of resistance "A. actino-mycetemcomitans" specie, when compared with systemic tetracycline therapy. Also, authors suggested used antibiotics local /or systemic should perform to patients with aggressive diseases /or with no respond to the conventional therapy (16). Goodson. examined SRP with (periodontal surgery+local antibiotic therapy), with/or without systemic antibiotics concluded that patients whose received extra therapeutic typically display improved CAL gain and/or PPD decrease (10,17). The tetracycline is group of drug among the most often used agent to periodontitis therapy (18).

Both groups of SRP & Tetracycline and /or SRP only, showed a progressive decrease in mean PPD from baseline to six months, had an effective in improving periodontal health status. A greater reduction had observed in the SRP + Tetracycline group especially from one month, with the large separated at six months when the mean difference ≈ 0.6 mm.

In figure (1), the error bars (± SE) are non-overlapping or only slightly overlapping at later time points, suggesting that the difference is likely statistically and clinically significant (to be confirmed by mixed-model analysis). The shape of the curves shows that most of the PPD

reduction occurred in the first 1–3 months, followed by a smaller but sustained improvement up to 6 months. Clinically, this supports the hypothesis that local tetracycline delivery provides additional benefit beyond SRP alone, improving periodontal pocket reduction over time

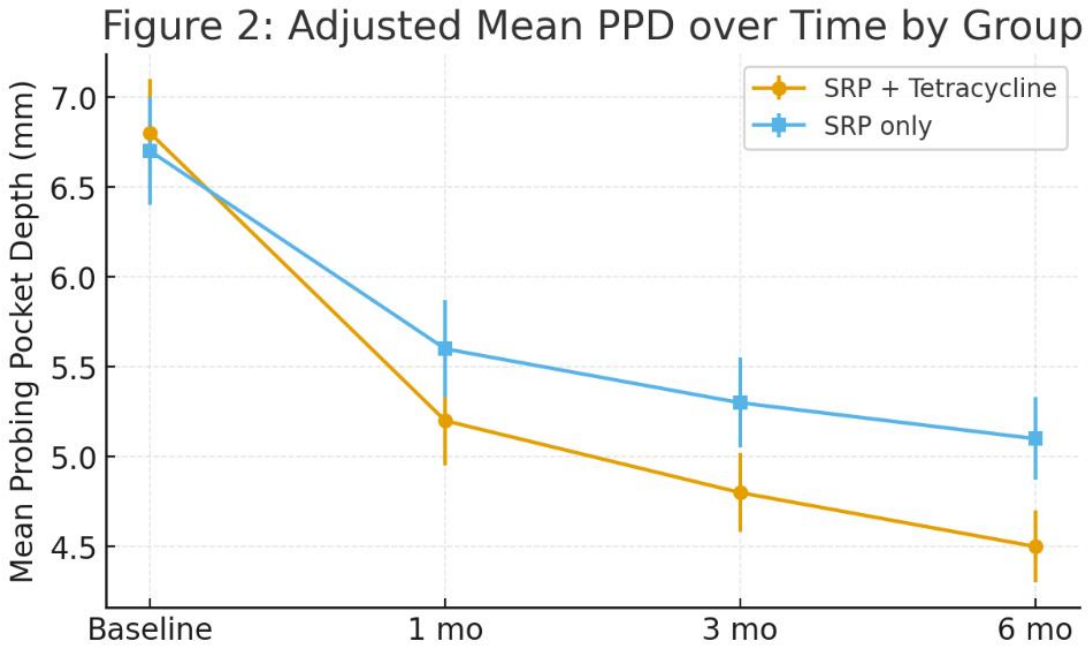

Figure 1: Adjusted Clinical and Microbiological Outcomes at 6 Months

At six-months, patients received **SRP + local tetracycline** demonstrated significantly greater clinical improvement compared with SRP alone. The adjusted mean PPD **was 4.5 mm** in the "test group" **versus 5.1 mm** in controls, yielding a mean difference of **–0.6 mm (95% CI: –0.9 to –0.3; p < 0.001).** Similar benefits were observed for CAL gain **(–0.6 mm, p = 0.003).** Indicators of inflammation also improved: bleeding on probing decreased **by 12%** more in the tetracycline group **(p = 0.01),** and plaque index scores were significantly lower (**p = 0.02).** Microbiological analysis revealed a **0.7 log-unit greater reduction** in periodontopathogen counts **(p = 0.004).** Collectively, these results suggest that local tetracycline delivery provides a statistically and clinically meaningful adjunctive benefit, producing deeper pocket reduction, enhanced attachment gain, and superior microbial control relative to SRP alone.

Table 2: Adjusted Clinical and Microbiological Outcomes at 6 Months

Outcome	SRP + Tetracycline (Mean ± SE)	SRP Only (Mean ± SE)	Adjusted Mean Difference (95% C	p-value
PPD (mm)	4.5 ± 0.2	5.1 ± 0.23	-0.6 (-0.9, -0.3)	<0.001
CAL (mm)	4.2 ± 0.2	4.8 ± 0.25	-0.6 (-1.0, -0.2)	0.003
BOP (%)	18 ± 5	30 ± 6	-12% (-20, -5)	0.01
Plaque Index	0.9 ± 0.1	1.2 ± 0.12	-0.3 (-0.5, -0.1)	0.02
Microbiology (log CFU)	2.1 ± 0.3	2.8 ± 0.35	-0.7 (-1.1, -0.3)	0.004

The Method

A randomized-controlled clinical study including thirty patients were diagnose with "the chronic periodontitis".

Participants assigned into two groups randomly : firstly, test group: SRP plus local tetracycline. Secondly, the "control group": SRP alone.

Inclusion criteria were patients aged 25–60 years with (PPD) ≥5 mm in at least four sites. While, the exclusion-criteria, including; systemic Antibiotic use within the last 3 months, systemic diseases, and pregnancy affecting periodontium (except controlled diabetes), and allergy to tetracycline.

The clinical assessment registered at the beginning, 1, 3, and 6 month , included: (PPD), (CAL), (BOP), and (PI). Data analyzed using mixed-effects models to account for repeated measurements within patients. Between-group differences were reported as adjusted mean differences with 95% CI, and p.value <0.05 is considered "statistic significant".

Discussion

In the randomized controlled study of thirty patients, an adjunctive local tetracycline therapy in combined with SRP was achieved significant great improvement in PPD, CAL, BOP, and plaque control, at six months, compared to SRP alone. This is consistent with existing meta-analyses demonstrating the effective of local tetracycline as an adjunctive treatment.

Tetracycline could be used systemically, but also could used as a local agent because it had the advantage to avoid a harmful effect of systemically administrated drug included; resistant flora development and suppression of the normal flora (19). "Tetracycline" had different forms in management of periodontitis due to its ability to decrease microbial loading, limited collagenase activity, and prevention the bone loss (20, 21). As compare, Matesanz-et al., found that there was no an improvement and used the data with special care because of the higher degree of heterogeneity and increased bias risk of the included studies (19). According to the European market, a study conducted by Herrera ., showed statistically significantly improved reduction in PPD when locally antibiotics to the subgingival area on short follow-up (6–9) months (22). While another product "Ligosan®" showed significant improved CAL when used as adjunct therapy to the subgingival debridement. Long-term follow-up data did not showing significant improvement of CAL for any product (23). Similarly, another systematic review reported an average CAL increase of 1.02 mm (95% CI: 0.28–1.75) and a PPD reduction of 1.20 mm (95% CI: 0.57–1.87) with local Tetracycline versus placebo at six months

More recent systematic reviews corroborate these findings: Herrera et al. (2020) reported weighted mean differences (WMDs) for reduction of PPD (0.365 mm) and gain of CAL (0.263 mm at 6–9 months). Another meta-analysis confirmed but statistically improvements significant in (PPD ~0.47 mm and CAL ~0.24 mm) with local tetracycline fibers Our study's observations of enhanced PPD and CAL improvements are thus well aligned with evidence, strengthening the credibility of local tetracycline as a clinically meaningful adjunct to SRP.

Clinical Relevance: Although some of the improvements seem modest—typically in the range of 0.3 to 1.2 mm—the cumulative benefits in deeper pockets, microbial control, and inflammation might contribute to improved long-term periodontal stability. These gains can be particularly important in challenging sites or in patients with systemic conditions.

Limitations and Considerations:

Heterogeneity in study designs, delivery vehicles (e.g., fibers, gels, films), formulations, and baseline disease severity can affect generalizability.

Long-term benefits beyond six months are still uncertain; some defects (e.g., furcations) may show early improvement that isn't maintained at longer follow-up.

A few studies found no advantage of adding local tetracycline over systemic antibiotics in certain forms of periodontitis (e.g., generalized aggressive periodontitis.

Adverse effects were minimal in most studies, but prudent antibiotic usage principles must apply to mitigate resistance risks.

Implications for Practice and Research:

Local tetracycline delivery appears to be an effective, targeted, and user-friendly adjunct to SRP, yielding statistically and clinically meaningful periodontal improvements with minimal side effects. For future research, larger and longer-term trials are needed to assess sustained benefits, cost-effectiveness, and comparative efficacy across different local antimicrobial agents and delivery systems.

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