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Clinical effects of different antiplaque agents on patients undergoing fixed orthodontic treatment- A comparative study

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Abstract

Objectives: The purpose of this study was to compare the short-term clinical effects of a Chlorhexidine mouth wash (CHX-MW), Chlorhexidine gel (CHX), Metronidazole gel (MTZ) and combination of Chlorhexidine and Metronidazole (CHX-MTZ) in orthodontic patients with fixed appliances aged from 14 to 25 years.

Materials and Methods: One hundred fifty subjects undergoing fixed orthodontic treatment selected and divided into five groups: Group 1 – Controls, Group 2 – Chlorhexidine mouth wash (CHX-MW) gel, Group 3- Chlorhexidine (CHX) gel, Group 4 – Metronidazole (MTZ) gel and Group 5 – chlorhexidine-metronidazole (CHX-MTZ) gel. Clinical evaluation was undertaken using the probing depth (PD), Gingival Index (GI) and the Papillary Bleeding Index (PBI) at baseline, 2 weeks, 4 weeks, 8 weeks and 12 weeks. A subjective evaluation was also undertaken by questionnaire.

Results: Groups treated with all three gels (CHX, MTZ and CHX-MTZ) showed significant clinical improvement as compared to the controls and CHX-MW group. The reduction in PD, GI and PBI in the group treated with the CHX-MTZ combination gel was significant when compared to those treated with CHX and MTZ gels.

Conclusion: Topical application of CHX or MTZ alone or in combination may have a role in the management of gingivitis in orthodontic patients.

Keywords: Chlorhexidine; Metronidazole; Fixed orthodontic treatment; Probing depth; Gingival Index; Papillary Bleeding Index

Introduction

Orthodontics has become an essential part of dental practice. Importance of maintaining good oral hygiene cannot be overlooked, especially before and during orthodontic treatment.

Nearly all fixed orthodontic appliance patients will get gingivitis at some point during the treatment.[1] Numerous studies have shown that orthodontic patients are in high risk of developing periodontal and gingival diseases because orthodontic treatment lasts for long time. Presence and position of fixed orthodontic appliance gives poor conditions for maintaining oral hygiene.[2,3]

Fixed orthodontic appliances cause an increase in all bacterial counts[4] around the bracket and band's ecosystem.[5] There is a decrease in facultative anaerobes and an increase in anaerobic rods, spirochaetes and other motile organisms which leads to gingivitis and periodontities.

Gingival and periodontal diseases are infections initiated by bacterial biofilms that form on the surfaces of teeth in close proximity to the supporting tissues.[6] The development of gingivitis within 1–2 months after the placement of fixed orthodontic appliances has been reported.[7] Some authors have also noted slight attachment loss 2 years after the removal of fixed orthodontic appliances when patients have not been continually motivated regarding oral hygiene.[8,9]

Gingival and periodontal disease in patients undergoing orthodontic treatment can be prevented by maintaining effective oral hygiene at home.[10] Antiplaque agents have been used successfully to treat moderate-to-severe periodontal diseases.[11,12,13] The rationale for the use of antiplaque agents is plaque is the major etiological factor in gingivitis.[14]

Chlorhexidine is one of the most potent topical antiseptics reported till date that has been successfully used for gingivitis and remains the superior quality of all chemical antiplaque agents.[15,16] Chlorhexidine mouth wash have some drawbacks like reversible local side effects, such as staining of the teeth and tongue and desquamation of the oral mucosa.[17] But other study shows no side effects of Chlorhexidine when used in local application in gel form.[18]

Metronidazole is effective drug in gingival and periodontal diseases due to its selective efficacy against obligate anaerobes and it has narrow spectrum and works specifically on the anaerobic flora associated with periodontitis, leaving the flora associated with health intact.[19,20]

Till date in English literature, there is no study conducted comparing the effects of chlorhexidine mouth wash, chlorhexidine gel, Metronidazole gel and combination of chlorhexidine and Metronidazole gel in orthodontic patients. This study is designed to compare the efficacy of chlorhexidine mouth rinse and topically applied chlorhexidine, metronidazole and the combination of these two gels over a period of 12 weeks in subjects undergoing orthodontic treatment.

Materials and Method

The study consists of 150 patients irrespective of gender undergoing fixed orthodontic treatment with banding of at least one molar per quadrant were selected from private Orthodontic Clinic in North Karnataka region. Most of the patients were between 14 to 25 ages. Care was taken to exclude patients who were having: major medical problems like diabetes mellitus, pregnant or lactating females, immune-compromised subjects, antibiotic therapy during the past two months, abnormal para-functional habits, abnormal hard and soft tissue morphology like cleft lip and cleft palate patients', alcoholics and subjects who used tobacco in any form were excluded. An informed consent obtained from all the subjects.

The sample size is divided into five groups (30 subjects in each group).

1. Control group: subjects directed only oral hygiene instructions (OHI) without chlorhexidine and metronidazole agents.
2. Chlorhexidine mouth wash group (CLX-MW) (Rexidine 0.2%, Warren, Indoco Remedies Ltd): Subjects receive OHI which includes rinsing twice a day after breakfast and before bed time for 30 seconds with 15ml of 0.12% chlorhexidine mouth wash.
3. Chlorhexidine gel group (CLX) (HEXIGEL® 1% w/w, ICPA, India)
4. Metronidazole gel group (MTZ) (Metrogyl V Gel, 10 mg, Lekar Pharma, India)
5. Combination of Chlorhexidine and Metronidazole gel group (CLX-MTZ) (Metrogyl® DG Gel, 10gm, Metronidazole 10gm & Chlorhexidine Gluconate IP 0.25% w/w, J.B Chemicals and Pharmaceuticals Pvt Ltd)

Patients were scheduled for a baseline examination and instructed to not to perform any oral hygiene (including chewing gum) for eight hours prior to the baseline and follow-up examinations. Patients were assessed for probing depth (PD), Gingival Index[21] (GI) (Loe and Silness) Papillary Bleeding Index[22] (PBI) (Muhlemann). Following the assessments, all subjects received scaling and prophylaxis to remove plaque, calculus and extrinsic stain.

Control group subjects directed only oral hygiene instructions (OHI) without chlorhexidine and metronidazole agents whereas, CLX-MW group receive OHI which includes rinsing twice a day after breakfast and before bed time for 30 seconds with 15ml of 0.12% chlorhexidine mouth wash. The remaining three groups CLX, MTZ and CLX-MTZ instructed to apply a pea sized amount of gel gently with the index finger to the gums an hour after regular brushing and to leave it for five minutes before rinsing with water. All groups were also asked to refrain from all other unassigned forms of oral hygiene aids, including dental floss, chewing gum during the study. The gels and mouth wash were dispensed to subjects with a plain white covering labeled only with lot numbers to ensure proper blinding of the product from the patients.

PD was measured at six sites (mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual and distolingual) from the bottom of the pocket of the first banded permanent molar to the gingival margin with a Michigan 0 probe. GI was evaluated as indicated by Loe and Silness[21] at the mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distolingual aspects of each first banded permanent molar. PBI was taken as indicated by Muhlemann[22] at the interdental papilla (mesial and distal) on each first banded permanent molar.

The clinician, who was blinded to the gels assigned to the subjects, conducted all the examinations and scorings. Subjects were assessed for PD, GI and PBI in the same dental unit under identical conditions at baseline, 2 weeks, 4 weeks, 8 weeks and 12 weeks. Intra-examiner calibration was performed on 20 patients before the study and the intra-examiner agreement was 95.2% ($\kappa = 0.905$).

Results

Analysis of data was carried out using SPSS 10.5 (SPSS version 10.5, SPSS, Chicago, IL). The values of different parameters collected are expressed as mean and standard deviation (SD). Mean changes from baseline to 2 weeks, 14 weeks, 8 week and 12 weeks were also calculated. Comparisons among the five groups and within each group were performed using one-way ANOVA.

There were no significant differences among the groups with respect to any parameter at baseline. There was a gradual decrease in the PD, GI and PBI scores in all the groups over a period of 12 weeks (Table 1, Graph 1).

Table 1: Probing Depth (PD), Gingival Index (GI) scores and Papillary Bleeding Index (PBI) for all groups at different follow-up visits

Parameters	Groups	Baseline	2 week	4 week	8 week	12 week
Probing Depth (PD)	Controls	4.2±0.67	4.1±0.67	3.9±0.58	3.8±0.73	3.8±0.76
	CLX-MW	4.4±0.73	4.1±0.76	3.2±0.67	2.8±0.76	2.7±0.71
	CLX	4.1±0.56	3.8±0.66	2.3±0.48	2.3±0.67	2.2±0.67
	MTZ	4.5±0.45	4.1±0.58	2.2±0.67	2.3±0.71	2.1±0.77
	CLX-MTZ	4.3±0.52	4.0±0.73	2.1±0.56	1.9±0.69	1.8±0.69
Gingival Index (GI)	Controls	2.23±0.76	1.98±0.66	1.82±0.61	1.80±0.64	1.84±0.72
	CLX-MW	2.16±0.71	1.95±0.73	1.72±0.69	1.46±0.44	1.28±0.70

	CLX	2.32±0.67	1.85±0.64	1.44±0.51	1.02±0.60	0.88±0.81
	MTZ	2.21±0.77	1.88±0.68	1.52±0.62	1.22±0.78	0.92±0.76
	CLX-MTZ	2.18±0.69	1.78±0.73	1.26±0.62	0.78±0.56	0.54±0.74
Papillary Bleeding Index (PBI)	Controls	3.52±0.56	3.26±0.58	2.92±0.78	2.90±0.56	2.92±0.34
	CLX-MW	3.46±0.45	3.32±0.66	2.66±0.72	2.28±0.48	2.18±0.44
	CLX	3.18±0.48	2.98±0.58	2.52±0.68	1.94±0.58	1.54±0.48
	MTZ	3.42±0.67	2.84±0.64	2.28±0.62	1.72±0.62	1.42±0.50
	CLX-MTZ	3.24±0.58	2.92±0.78	1.62±0.70	0.84±0.56	0.58±0.52

A significant reduction in mean PD was observed in CLX-MTZ group at all intervals, in contrast CLX and MTZ group shows notable reduction in mean PD only in 2week Vs 8week, 2week Vs 12week and 4week Vs12 week. Control group and CLX-MW group shows no significant reduction in mean PD at all intervals except 2week Vs 12week.

A consequential reduction in mean GI and PBI was noticed in CLX-MTZ group at all intervals, on the contrary controls and CLX-MW group shows no significant reduction in mean GI and PBI except 2week Vs 12week. CLX and MTZ group also shows significant reduction in mean GI and PBI at all intervals except 2week and 4 week. (Table 2 & 3, Graph 2 & 3)

Table 2: Mean change from baseline in Probing Depth (PD), Gingival Index (GI) scores and Papillary Bleeding Index (PBI) scores at different follow-up visits

Parameters	Groups	Baseline- 2 weeks	Baseline- 4 weeks	Baseline- 8 weeks	Baseline- 12 weeks
Probing Deapth (PD)	Controls	0.14±0.28	0.24±0.77	0.44±0.43	0.52±0.77
	CLX-MW	0.92±0.45	1.04±0.64	1.28±0.38	1.39±0.46
	CLX	0.65±0.49	0.84±0.46	1.47±0.49	1.65±0.66
	MTZ	0.43±0.38	0.97±0.56	1.35±0.45	1.55±0.82
	CLX-MTZ	0.86±0.34	1.02±0.55	1.46±0.28	1.85±0.45
Gingival Index (GI)	Controls	0.08±0.88	0.12±0.78	0.20±0.54	0.28±0.48
	CLX-MW	0.56±0.74	0.65±0.88	0.88±0.82	1.08±0.76
	CLX	0.48±0.65	0.68±0.67	0.76±0.65	1.02±0.56
	MTZ	0.69±0.82	0.78±0.65	0.95±0.74	1.12±0.28
	CLX-MTZ	0.88±0.54	0.92±0.45	1.25±0.78	1.42±0.45
Papillary Bleeding Index (PBI)	Controls	0.12±0.43	0.28±0.67	0.38±0.34	0.68±0.38
	CLX-MW	0.48±0.34	0.76±0.56	0.98±0.65	1.38±0.43
	CLX	0.67±0.46	0.92±0.89	1.02±0.56	1.32±0.35
	MTZ	0.76±0.58	0.95±0.78	1.10±0.85	1.32±0.53
	CLX-MTZ	0.92±0.65	1.25±0.83	1.46±0.38	1.62±0.68

Table 3: Intra-group comparison of change from baseline at various follow-up visits

Parameters	Groups	2 wks vs 4 wks (p-value)	2 wks vs 8wks (p-value)	2 wks vs 12wks (p-value)	4 wks vs 8 wks (p-value)	4 wks vs 12wks (p-value)	8wks vs 12wks (p-value)
Probing Depth (PD)	Controls	0.535	0.740	0.005*	0.845	0.256	0.395
	CLX-MW	0.540	0.783	<0.001*	0.635	0.229	0.879
	CLX	0.450	<0.001*	<0.001*	0.670	<0.001*	0.850
	MTZ	0.675	<0.001*	<0.001*	0.360	<0.001*	0.485
	CLX-MTZ	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.526
Gingival Index (GI)	Controls	0.657	0.853	0.004*	0.359	0.762	0.790
	CLX-MW	0.295	0.885	<0.014*	0.553	0.894	0.452
	CLX	0.250	<0.001*	<0.001*	0.042*	<0.001*	0.022*
	MTZ	0.756	<0.001*	<0.001*	0.012*	<0.001*	0.034*
	CLX-MTZ	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
Papillary Bleeding Index (PBI)	Controls	0.873	0.759	0.014*	0.862	0.732	0.472
	CLX-MW	0.472	0.356	<0.001*	0.527	0.427	0.843
	CLX	0.835	<0.001*	<0.001*	0.002*	<0.001*	0.012*
	MTZ	0.743	<0.001*	<0.001*	0.032*	<0.001*	0.004*
	CLX-MTZ	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*

Discussion

The thrust of this study was to assess and compare the clinical effects of CHX mouth wash, CHX, MTZ and a combination of these two gels applied over a period of 12 weeks in subjects undergoing fixed orthodontic treatment. All three treatment gel groups (CHX, MTZ and CHX–MTZ) showed significant improvement in clinical parameters compared to the control group and CHX mouth wash. The differences in the GI, PBI and PD using experimental and control groups indicate that local application of CHX, MTZ and CHX–MTZ effectively reduces gingival inflammation, gingival bleeding and probing depth.

CHX is considered as the gold standard[15] anti-plaque agent because of its substantively and wide spectrum of activity encompassing Gram positive and Gram-negative bacteria. Similar results obtained from the previous studies,[23,24,25] shows that CHX mouth wash reduces gingival inflammation, bleeding and probing depth. These results are consistent with the present study. To the best of our knowledge no studies were carried out in literature comparing the CHX mouth wash, local application of CHX, MTZ and combination of CHX-MTZ in fixed orthodontic patients.

In a case-control study,[18] data indicate that local application of CHX was effective in reducing gingivitis related to fixed orthodontic patients. This data is in accordance to the present study.

One of the side effects of chlorhexidine in the form of a mouth rinse is staining, which may be of aesthetic concern to the patient. In this study staining was observed on few patients of CHX mouth wash group. Local application of CHX or in combination with MTZ show negative staining, this may be because CHX is in gel form was applied locally in the sub-gingival region rather than administering a mouth rinse.

In the current study there was significant reduction in PD, GI and PBL in the MTZ group as compared to the control group. It is known that cytotoxic metabolites of MTZ directly interact with bacterial DNA, and possibly other macromolecules, resulting in cell death.[26] Several studies[27,28] showes positive results for the topical application of MTZ in gingivities and periodonties subjects. This results are consistent with our study, but the subjects in those studies were not undergoing fixed orthodontic treatment which is major criteria in this study.

Recently, a study[29] comparing the clinical effects of CHX gel, MTZ gel, and placebo gel in persistent pockets concluded that probing depth was notably reduced by the same amount in all groups, although mean pocket reductions were greater in the CHX and MTZ group in comparison to the placebo. These findings are similar to the present study. In accordance with the previous study, the current study also showed no significant differences in PD, GI and PBI between the CHX and MTZ gel groups at the 4 week, 8week and 12 week time intervals, indicating that the MTZ gel is equally as efficacious as the CHX gel. However, the combination gel (CHX-MTZ) group showed a significant reduction in PD, GI and PBI when compared to the CHX and MTZ gel groups, indicating that the combination gel demonstrates an additive effect of both components.

Orthodontic patients wearing fixed appliances where gingivitis is evident can benefit from local gel application of CHX, MTZ or combination of both. It is recommended that orthodontists instruct the patients to apply these anti-plaque gels, aside from scaling and root planing. The reason for effectiveness of application of CHX, MTZ or combination of both is that, it remains in sulcus after application and it will be released gradually for some time; however, mouth rinse will be washed away immediately.

Finally, the use of anti-plaque agents may be used as a motivating factor for patients, as Ainamo[30] has suggested. It would make the patients aware of the sensation of cleanliness so they could make applications and develop their mechanical abilities for controlling plaque.

Conclusion

The results of this study shows that the use of CHX, MTZ and Combination of both gel can be beneficial to orthodontic patients in maintaining oral hygiene in short term. Reduced probing depth, gingival inflammation and bleeding observed in subjects who use local application of gels. Additionally, the combination gel has been shown to be more potent than the MTZ and CHX gel, which is the gold standard of anti-plaque agents. Nevertheless, topical gel application cannot be a standby for mechanical plaque control. In addition, long-term studies are required to observe the results of topical gel on gingival status and probing depth throughout orthodontic treatment and post orthodontic treatment.

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