

Challenge to Clinical Excellence: White Spot Lesions- A Comparative In-Vivo Study

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ABSTRACT

Aim: To study macroscopic areas of WSL(white spot lesions) on tooth surface during orthodontic treatment using two different bonding agent and also to study the added benefit of flouride.

Subjects and method: A sample size of 30 patients was divided equally in three groups (control group A : Brackets bonded using Transbond XT. Study group B : Brackets bonded using Transbond XT + Amflor mouthwash. GROUP (C): Brackets bonded using Aegis ortho. Digital photographs were taken before bonding and at follow-up appointment after 16-17 weeks. Visual assessment was done by expert raters panel using modified WSL index.

Results: WSL severity was found to be highest in Group A followed by Group C and was least in Group B.

Conclusion: The incidence of the WSL in the patient treated with comprehensive orthodontics was significantly high and subsequent prevention methods are should followed.

Keywords: White Spot, Fluoride Supplement, Demineralization.

INTRODUCTION

The term white spot lesion is defined as the 'first sign of carious lesion on enamel that can be detected by naked eye'. Individuals with malocclusions often have many plaque retention sites due to the irregularities of their teeth. Orthodontic treatment with fixed appliances and complex loop designs further increase the risk of development of WSL, as additional retention sites are created on surfaces generally not susceptible to caries.^{1,2}Hence a strong co-relation exists between oral hygiene and caries incidence in orthodontic patients as compared to untreated individuals. Decalcification is caused by prolonged adhesion of

plaque on the surface of the tooth with subsequent demineralization of the enamel. For many years, practitioners and researchers have sought out to eliminate or reduce this occurrence.¹⁻⁵

The present study was undertaken to study the extent of white spot formation or demineralization on tooth surface during orthodontic treatment by two different light cure bonding composites (one containing ACP and other commercially available light cure composite) and the supplemental effect of fluoride mouthwash on tooth surface during treatment.

AIMS & OBJECTIVES

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(1) To study macroscopic areas of white spot on tooth surface during orthodontic treatment using two different bonding agent and also to study the added advantage of flouride supplement in prevention of white spot formation.

(2) To determine which material is better in prevention of white spot formation during the orthodontic treatment.

MATERIALS AND METHOD

SOURCE OF DATA; Subjects reporting to the Department of Orthodontics and Dentofacial Orthopaedics, requiring orthodontic treatment were included in the study after obtaining an informed and written consent from the patients and their guardians. This study was approved by the ethical committee Dental College.

SAMPLE SIZE AND DIVISION

A sample size of 30 patients was taken and divided into three groups with a distribution of 10 patients in each experimental and control group.

GROUP DIVISION

CONTROL GROUP (A) : Brackets bonded onto teeth using Transbond XT (Light cure orthodontic bonding composite XT 3M UNITEK).[figure 1]

STUDY GROUP (B) : Brackets bonded onto teeth using Transbond XT(Light cure orthodontic bonding composite ,3M UNITEK) and with regular Supplements of fluoridated mouthwash i.e AMFLOR(Group pharmaceuticals containing Amine fluoride-olaflur of 480 ppm).[figure 1 and figure 2]

STUDY GROUP (C): Brackets bonded onto teeth using Aegis ortho (a light cure orthodontic composite containing Amorphous Calcium Phosphate AEGIS ORTHO of The Harry J.Bosworth@ Company USA) .[figure 3]

METHODOLOGY:

A full mouth oral prophylaxis was performed for all the patients before starting the treatment, polishing was performed with slurry made by flour of pumice and water by slow-speed hand piece and a rubber cup. After polishing mouth was rinsed with water spray, followed by isolation of the teeth with cheek retractor. Enamel surface

was then etched for 15 seconds with 37% phosphoric acid gel (N-ETCH Ivoclar Vivadent), rinsed thoroughly, air dried and then checked for frosted appearance. A thin layer of bonding agent was applied using an applicator tip. Patients were not informed about which bonding composite was used on their teeth and were bonded in accordance to the group they belonged, M.B.T .022 slot brackets (TP Ortho Nu-Edge) were used and positioned on the appropriate teeth and excess material was removed with an explorer. The composite was then cured for 20 seconds with a light curing unit (DENTSPLY QHL75 of output intensity 450 mW/cm² . Passive .016 SS wire were used (Ortho Organizers San Marcos, CA) with O ring (3M- Unitek) ligation for 16-17 weeks. Both pre treatment and follow up photographs were taken after 16-17 weeks of bonding.

Group B Patients and parents were asked to follow up an organized oral hygiene program that included motivation and instructions. They were instructed verbally and given printed home care directions (Amflor mouthwash using group)[figure 2]. Subjects were instructed to do mouth rinse once daily i.e. once before bed by swishing undiluted 15ml mouthwash for 25-30 seconds vigorously around tooth surface and then spitting it out. Mouthwash quantity was measured by using dosimeter provided with mouth wash bottle and regularity of mouthwash usage was monitored by printed calendar provided on the bottle back. Participants were instructed to mark with a tick, the day they did not follow mouthwash regime.⁶⁻¹²

MACROSCOPIC EXAMINATION OF SAMPLES: Macroscopic examination of maxillary anterior was done through NIKON D3100 camera to compare the demineralization or white spot formation on labial surface of teeth.

PROCEDURE FOR PHOTOGRAPHIC EXAMINATION

Digital photographs were taken as intraoral frontal views with the patient's head tilted up approximately 5 to 10 degree to limit reflection from the flash to the maxillary incisors. Several photographs were taken at each point of time to allow selection of the optimal image. The images were cropped to include only the 4 maxillary incisors, and saved in a bitmap format. Photographs



Fig 1: Transbond XT.



Fig 2: Amflor Mouthwash Used In Group B.



Fig 3: Aegis Ortho.

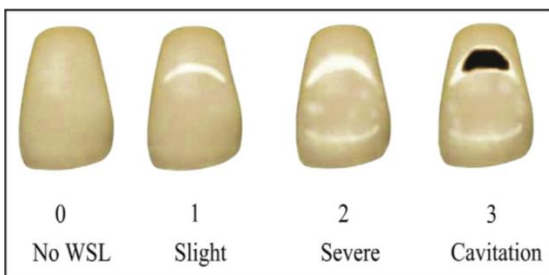


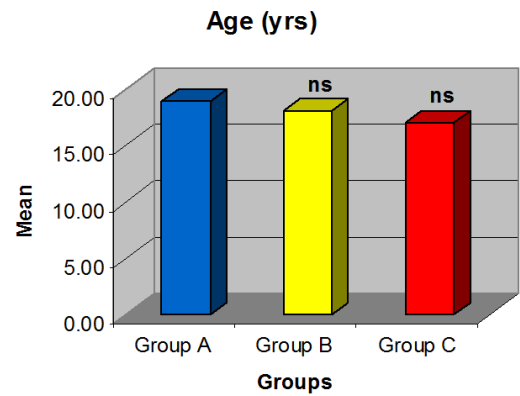
Fig 4: Scale for WSL measurement.



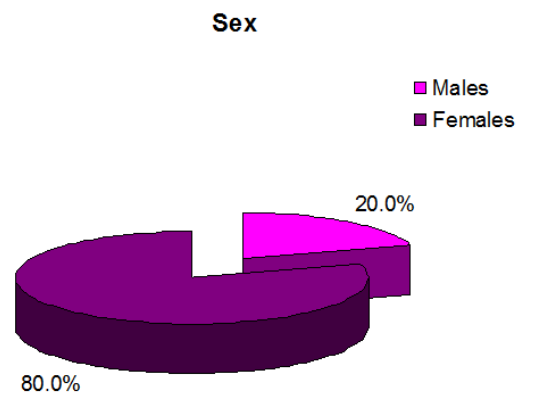
Fig 5a: Pre - Treatment and after 16 To 17 Weeks of Treatment.



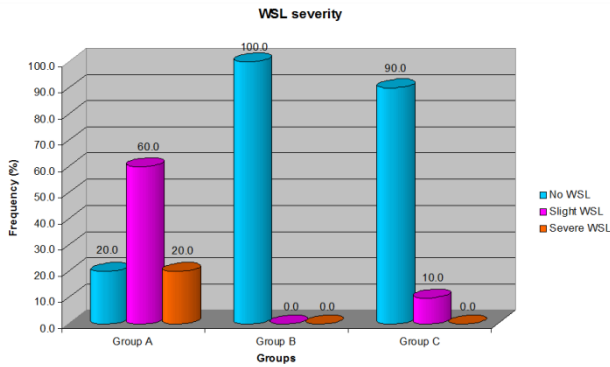
Fig 5b: Pre - Treatment and After 16 To 17 Weeks of Treatment.



Graph 1: Mean Age Of Three Groups.



Graph 2: Gender Distribution Of Three Groups.



Graph 3: WSL Severity of three groups.

were taken before bonding and at follow-up appointment 16-17 weeks later. Images for each patient were imported into a Power- Point slide with a black background (Microsoft, Redmond, Wash). The raters then viewed these randomly arranged paired images on a wall projector. Only tooth surfaces gingival to the archwire were examined for the presence of White Spot Lesions as this area is most prone to enamel demineralization. To assist with calibration of the assessors, each examiner's session began with instructions on the scoring system. A week later the same photographs were re-examined to determine inter examiner reliability (figure 4&5).^{12,13,14}

The modified WSL index by gorelick et al was used to evaluate the teeth macroscopically.(figure 4).⁸

The WSL severity scores were-

- 0- No WSL formation
- 1- Slight white spot or line formation
- 2- Excessive white spot formation
- 3-white spot formation with cavitation

Judges:

Visual assessment of photographs was done by expert raters panel that comprised of one chief invigilator (A post graduate staff member of Department of Orthodontics and Dentofacial Orthopaedics) and 2 examiners(2 post graduate student of Department of Orthodontics and Dentofacial Orthopaedics). In case of contradiction

in results, the judgement of chief invigilator was considered final.

STATISTICAL ANALYSIS

Discrete (categorical) groups were compared by chi-square (χ^2) test and inter examiner reliability of WSL severity (macroscopic examination) was tested by intra class correlation (ICC) coefficient (r) analysis and was found very high $r=0.96$ and $r=0.93$, respectively. A two-sided ($\alpha=2$) p value less than 0.05 ($p<0.05$) was considered statistically significant. All analyses were performed on STATISTICA software (Windows version 6.0).

RESULTS

The present in vivo study assessed white spot lesions around orthodontic brackets using different bonding agents. The outcome measures of the study were basic characteristics (age, sex), and WSL severity using macroscopic examination. The primary objective of the study was to compare WSL severity of three bonding agent groups.

A. Basic characteristics

The basic characteristics viz. age and sex of three groups (Group A, Group B and Group C) are summarized in Table 1 and also shown graphically in GRAPH.1, respectively. The mean age for Group A,B,C was (\pm SD) 18.90 ± 2.42 yrs, 18.10 ± 3.84 yrs and 17.00 ± 4.06 yrs, respectively. The mean age of Group C was slightly lower than both Group A and Group B. Comparing the mean age of three groups, ANOVA revealed similar age among the three groups ($F=0.74$, $p=0.488$) i.e. not significant statistically. Further, in all three groups, there were 8 females (80.0%) and 2 males (20.0%) and the sex proportions (F/M) do not differed among the three groups ($\chi^2=0.00$; $p=1.000$).GRAPH.2.

In other words, subjects of three groups were age and gender matched and comparable and thus may not influence the primary and secondary outcome measures.

The WSL severity of three groups are summarized in Table 2 and also shown graphically in Graph.3. It also showed that WSL severity was highest in Group A followed by Group C and Group B, the least. Comparing the frequency (%) of WSL

Table 1: Basic characteristics of three groups.

Characteristics	Group A (n=10) (%)	Group B (n=10) (%)	Group C (n=10) (%)	F/ χ^2 Value	p value
Age (yrs):					
Mean \pm SD	18.90 \pm 2.42	18.10 \pm 3.84	17.00 \pm 4.06	0.74	0.488
Sex:					
Females	8 (80.0)	8 (80.0)	8 (80.0)	0.00	1.000
Males	2 (20.0)	2 (20.0)	2 (20.0)		

Table 2: Distribution of WSL severity of three groups.

WSL severity	Grou A (n=10) (%)	Group B (n=10) (%)	Group C (n=10) (%)	χ^2 value (DF=4)	P value
No WSL	2 (20.0)	10 (100.0)	9 (90.0)	18.29	0.001
Slight WSL	6 (60.0)	0 (0.0)	1 (10.0)		
Severe WSL	2 (20.0)	0 (0.0)	0 (0.0)		

severity of three groups, χ^2 test revealed significantly different and lower WSL severity both in Group C especially Group B as compared to Group A ($\chi^2 = 18.29$, $p = 0.001$)

DISCUSSION

White spot lesions remain a serious problem in Orthodontics. Patients with fixed orthodontic appliances are quite susceptible to plaque accumulation and consequently, white spot lesion formation as bracket placement makes conventional oral hygiene methods more difficult. In addition, the clearance of bacterial plaque adjacent to the irregular surfaces of brackets, bands, wires, and other attachments by saliva and the cheeks are reduced.

White spot is initiated via demineralization of tooth mineral by organic acids. Plaque bacteria, following exposure to fermentable carbohydrates, produce the organic acids. When a critical pH of 5.5 is reached, the organic acids are able to diffuse into the enamel surface through the acquired pellicle, initiating demineralization. Demineralization can continue as long as the oral pH remains acidic and can ultimately result in cavitation of the enamel surface.^{10,11} Various studies have reported that white spot formation during orthodontic treatment is directly attributed to the effect of prolonged accumulation and retention of visible bacterial plaque and the presence of *Streptococci mutans* and

lactobacilli^{12, 13, 14}. It has been previously reported that *S. mutans* levels can increase up to fivefold during orthodontic treatment (Sudjalim, 2006)¹⁵ The purpose of this in-vivo macroscopic study was to compare the extent of white spot formation (demineralization) during the orthodontic treatment by bonding the bracket onto tooth surface with two different bonding composites (Transbond XT and Aegis Ortho) and also to check the added benefit of low dosage amine fluoridated mouthwash which claims to prevent demineralization during orthodontic treatment (Amflor of Group Pharmaceuticals).

The study was done on multi bracket (MB) patients that were treated at the Department of Orthodontics and Dentofacial Orthopaedics, Institute Of Dental Sciences Bareilly. The decision to limit patient inclusion to 12 years or older was beneficial, since it provided patients with a better ability to comply with the home care regime.

In this study 8 females and 2 males were taken per group since the females formed 80 % present study population. This was in line with literature and reflects the ordinary situation in orthodontic practice^{12,16,17}. Regarding incidence and prevalence of white spot lesions conflicting reviews were reported. Gorelick⁸, et al 1982 stated that females have a higher incidence of white spot lesions but Ogard, b et al 1989¹³ found no significant difference

in WSL prevalence between two genders. While others found that male patient have a higher incidence of WSL. Thus, considering these views no gender differentiation was taken into account. Only the ratios between genders was kept same in all the three groups, which was in accordance to the study done by Tufekci, et al 2011.¹²

For macroscopic evaluation of white spot lesion semi-quantitative classification system by Gorelick et al (1982)⁸ was considered and teeth were evaluated before and during mid orthodontic treatment. It scores the size and the severity of WSL. The modification of this index was used in the present study in order to simplify the scoring^{1,8,13}.

Patients and parents were motivated and instructed to follow an organized oral hygiene program. Group B subjects (amflor mouthwash group) were instructed verbally and given printed home care directions. They were instructed to do mouth rinse once daily i.e once before bed by swishing undiluted 15ml mouthwash for 25-30 seconds vigorously around tooth surface and then spitting it out. Mouthwash quantity was measured by using dosimeter (for taking pre measured mouthwash) provided with mouth wash bottle and regularity of mouthwash usage was monitored by printed calendar provided on the bottle back to keep a check on patient compliance^{9,14}.

On macroscopic examination, severity of white spot lesion was highest in Group A followed by Group C and least in Group B. Comparing the frequency (%) of WSL severity of the three groups, significant difference was found between Group C and Group B as compared to Group A. This finding suggests that white spot lesion formation in control group (group A) is more as compared to group B and C where fluoridated mouthwash and aegis composite was used respectively. The observed correlations were in agreement with those described by Enaia et al¹⁹ and Ballard et al.²⁰

In the present study, the results showed that the prevalence of white spot lesion in the group that used Amflor mouthwash were far less than the group with conventional bonding composite (TransBond XT) without any fluoride supplement. Though patient compliance with the Group B (Amflor) is a major factor to be considered in its success, the same was reinforced by constant

motivation and regular clinical follow ups of the patients. Group C (AEGIS ORTHO) composite also significantly reduced the demineralization in comparison to group A but its efficacy was comparatively less in comparison with Group B, But because of its inherent demineralizing potential it can be advocated to non compliance patients for prevention of WSL.

The incidence of the WSL in the patient treated with comprehensive orthodontics was significantly high and subsequent prevention methods are advised to be followed. As this material CPP-ACP (Aegis Ortho) is new and requires further studies to prove its authenticity, we recommend that conventional form of prevention for white spot lesions should be followed.

CONCLUSION

On macroscopic examination, of maxillary incisors severity of white spot lesion was highest in group A followed group C and least in group B. Suggesting that teeth bonded with Transbond XT composite are most susceptible to demineralization then group bonded with CPP-ACP (Aegis Ortho). Group treated with Transbond XT and low doses of fluoride supplement showed least amount of demineralization.

On completion of this clinical study, conclusions drawn was that low dose of fluoridated Mouthwashes are the effective method for prevention of white spot lesions. This study also showed preventive effect of CPP-ACP (Aegis Ortho) on WSL formation but since these smart composites are new to market therefore further research is required to verify its use in orthodontic patients.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Jon Artun, Dr.Odont and Anders Thylstrup. A 3-year clinical and SEM study of surface changes of carious enamel lesions after inactivation. Am J Orthod Dento facial Orthop 1989;95:327-33.
2. Dmitry Shungin Alexandra Ioannidis Olssonand Maurits Persson. Orthodontic treatment-related

- white spot lesions: A 14-year prospective quantitative follow-up, including bonding material assessment. *Am J Orthod Dento facial Orthop* Shungin, Olsson, and Persson; Volume 138, Number 2.
3. Elizabeth Hess, Phillip M. Campbell, Allen L. Honeyman and Peter H. Buschang. Determinants of enamel decalcification during simulated orthodontic treatment. *Angle Orthod.*2011;81:836-842.
 4. Greg J. Huang, Brie Roloff-Chiang, Brian E. Mills, Salma Shalchi, Charles Spiekerman, Anna M. Korpak, Jeri L. Starrett, Geoffrey M. Greenlee, Ross Drangsholt and Jack C. Matunas . Effectiveness of MI Paste Plus and PreviDent fluoride varnish for treatment of white spot lesions: A randomized controlled trial. *Am J Orthod Dento facial Orthop* 2013;143:31-41.
 5. Mahmoud Enaia, Niko Bock, and Sabine Ruf. White-spot lesions during multibracket appliance treatment: A challenge for clinical excellence. *Am J Orthod Dento facial Orthop* 2011;140:17-24.
 6. Philip Benson. Evaluation of White Spot Lesions on Teeth with Orthodontic Brackets. *Semin Orthod* 2008;14:200-208.
 7. Amy E. Richter, Airton O. Arruda, Mathilde C. Peters and Woosung Sohn. Incidence of caries lesions among patients treated with comprehensive orthodontics. *Am J Orthod Dento facial Orthop* 2011;139:657-64.
 8. Leonard Gorelick, Arnold M. Geiger and A. John Gwinnett. Incidence of white spot formation after bonding and banding. *Am J Orthod Dento facial Orthop* 1982;81:2-5.
 9. Samir E. Bishara and Adam W. Ostby. White Spot Lesions: Formation, Prevention, and Treatment. *Semin Orthod* 2008;14:174-182.
 10. Greg J. Huang, Brie Roloff-Chiang, Brian E. Mills, Salma Shalchi, Charles Spiekerman, Anna M. Korpak, Jeri L. Starrett, Geoffrey M. Greenlee, Ross Drangsholt and Jack C. Matunas . Effectiveness of MI Paste Plus and PreviDent fluoride varnish for treatment of white spot lesions: A randomized controlled trial. *Am J Orthod Dento facial Orthop* 2013;143:31-41.
 11. Elizabeth Hess, Phillip M. Campbell, Allen L. Honeyman and Peter H. Buschang. Determinants of enamel decalcification during simulated orthodontic treatment. *Angle Orthod.*2011;81:836-842.
 12. Eser Tufekcia, Julian S. Dixon, J.C. Gunsolley and Steven J. Lindauer. Prevalence of white spot lesions during orthodontic treatment with fixed appliances. *Angle Orthod*, 2011;81:No 2.
 13. B Ogaard, Dr. Odont. Prevalence Of White Spot Lesions in 19 Year Olds: A Study Of Untreated And Orthodontically Treated Persons 5 Years after Treatment. *Am J Orthod Dento facial Orthop* 1989; 96:423-7.
 14. Jason L. Schmit, Robert N. Staley, James S. Wefel, Michael Kanellis, Jane R. Jakobsen and Peter J. Keenan. Effect of fluoride varnish on demineralization adjacent to brackets bonded with RMGI cement. *Am J Orthod Dento facial Orthop* 2002;122:125-34.
 15. Sudjalim, MG Woods, DJ Manton. Prevention of white spot lesions in orthodontic practice: a contemporary review. *TR Australian Dental Journal* 2006;51:(4):284-289.
 16. Hosam A. Baeshen, Peter Lingstrom and Down Birkhed. Effect of fluoridated chewing sticks (Miswaks) on white spot lesions in postorthodontic patients. *Am J Orthod Dento facial Orthop* 2011;140:291-7.
 17. Eliakim Mizrahi. Enamel demineralization following orthodontic treatment. *Am J Orthod Dento facial Orthop* 1982;82:1.
 18. Amy E. Richter, Airton O. Arruda, Mathilde C. Peters and Woosung Sohn. Incidence of caries lesions among patients treated with comprehensive orthodontics. *Am J Orthod Dento facial Orthop* 2011;139:657-64.
 19. Mahmoud Enaia, Niko Bock, and Sabine Ruf. White-spot lesions during multibracket appliance treatment: A challenge for clinical excellence. *Am J Orthod Dento facial Orthop* 2011;140:17-24.

20. Richard W. Ballard, Joseph L. Hagan, Alexis N. Phaup, Nikhil Sarkar, Janice A. Townsend and Paul C. Armbruster. Evaluation of 3

commercially available materials for resolution of white spot lesions. Am J Orthod Dento facial Orthop 2013;143:S78-84.