



RESEARCH ARTICLE

EFFECTIVENESS OF RESIN INFILTRATION IN MANAGEMENT OF POST ORTHODONTIC WHITE SPOT LESIONS - A CLINICAL STUDY

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Abstract

Objective: To assess the effectiveness and durability of resin infiltration (ICON, DMG, Hamburg, Germany) in the management of post orthodontic white spot lesions.

Material & Methods: A clinical trial was conducted among 30 children who had undergone fixed orthodontic therapy presented with white spot lesions (WSLs) on maxillary or mandibular incisors and canines after debonding. Identification of WSLs was done with International Caries Detection and Assessment System (ICDAS) II criteria. The clinical photographs recorded were used to measure the size of lesion. The color assessment of the lesion and sound adjacent enamel was recorded by using spectrophotometer. Area of the lesion was calculated using Image analyzing software. The selected samples were treated with Resin infiltration- Icon, DMG, Germany. The WSLs were evaluated immediately following resin infiltration, 1, 3, 6 and 12 months.

Results: There was significant reduction in lesion area, and improvement in color of white spot lesions treated with resin infiltration.

Conclusion: Resin Infiltration have desired and durable esthetic improvement in terms of reduction in the area as well as color of post orthodontic white spot lesions.

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Introduction:-

Enamel demineralization is an ineluctable risk associated with fixed orthodontic treatment. Fixed orthodontic appliances not only do make conventional oral hygiene procedures more difficult, they also increase the number of plaque retention niches on the surfaces of the teeth. After the completion of treatment and debonding of brackets, the white demineralised area that appear on the tooth surface is termed as white spot lesion (WSL), which leads to unaesthetic appearance and increases the chance of initiation of dental caries.

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White Spot Lesion (WSL) is sub-surface enamel porosity due to demineralisation manifests clinically as a milky white opacity, located on smooth surfaces. The causative factors may be attributed to the presence of dietary carbohydrate, pH of saliva and bacterial interaction resulting in an imbalance between demineralisation and remineralisation of the enamel surface in the oral cavity and may lead to progression of dental caries. The early stage of the lesion is amenable to remineralisation or arrest and if left untreated leads to further demineralization resulting in cavity formation on smooth enamel surfaces. The basic philosophies behind the management of these early lesions are focussed on promoting natural remineralization and preventing further demineralisation. This can be achieved through topical application of Fluoride, remineralization agents (CPP-ACP) and minimally invasive technique such as resin infiltration that improves esthetics as well.

Application of fluoride may prevent initiation of dental caries in and around orthodontic brackets and further arrest incipient lesions. Complete repair of the lesion most likely is inhibited with the application of concentrated fluoride as the initial higher amount of calcium fluoride formed transforms the surface area to fluorapatite. Thus choking off and preventing further fluoride uptake by the subsurface area. The visible white spot lesions on facial surface developed during orthodontic treatment should therefore not be treated topically with concentrated fluoride agents since it may prevent complete repair.¹⁻⁵ As the children opting for treatment of WSL are mostly young and adolescents, primary focus shall be laid down towards minimal invasive procedures such as RIT (Resin Infiltration Technique) which prevent excessive sacrifice of enamel tissue.

The purpose of the present study was to assess the effectiveness and durability of resin infiltration (ICON, DMG, Hamburg, Germany) in the management of post orthodontic white spot lesions, with following objectives-

1. To assess and compare the regression of white spot lesions in terms of area (A, mm²) immediately after application, and at 1, 3, 6 and 12 months.
2. To assess and compare regression of white spot lesions in terms of difference in color (ΔE) between white spot lesion and sound adjacent enamel immediately after application, and at 1, 3, 6 and 12 months

Material And Methods:-

The study was conducted in the Department of Pediatric and Preventive Dentistry, S.C.B Dental College and Hospital, Cuttack-7, Odisha. The sample of the study consisted of 30 children from both sexes in the age range of 13-15 years who had undergone fixed orthodontic therapy for duration of 12-24 months. The children were uniformly treated with 0.022-inch slot MBT brackets (Leone, U.S.A), bonded with light-cured composite resin adhesive (Transbond XT, 3M unitek, U.S.A). The study period was from January 2018 to October 2019 with approval from Institutional Ethics Committee. S.C.B Dental College and Hospital, Cuttack

A detail medical history, as well as dental history regarding dietary habits and oral hygiene practices of participants, were recorded in proper proforma. Informed consents were obtained from parents/caregivers of the children after explaining the details of the treatment procedure in a designated format in regional and English languages. All the children included in the study were examined for the presence of white spot lesions (WSLs) on maxillary or mandibular incisors and canines.

Inclusion Criteria:

- 1) Children who had undergone fixed orthodontic appliance therapy.
- 2) Should have at least one white spot lesion on the labial surface of either maxillary or mandibular anterior teeth following debonding.

Before the assessment of white spot lesions, the investigator was trained and standardized by the principal investigator to calibrate different variables for the identification of WSLs using International Caries Detection and Assessment System II criteria, clinical photographs, assessment of color and area by using spectrophotometer and Digimizer software respectively.

Before the application of topical agents on white spot lesions, oral prophylaxis was carried out and the affected tooth to be treated was cleaned with a rubber cup with prophylaxis paste (3M, Clinpro, United States of America). The assessment of White Spot Lesion (WSL) was carried out using ICDAS II criteria (Code 1 or 2), Pre-treatment photograph of the lesion was obtained and shade Analysis of the lesion and sound adjacent enamel was recorded using Spectrophotometer (Vita-Easy shade 4.0, VITA Zahnfabrik, Germany) (Figure 1). The area of White Spot Lesion was calculated using Image analyzing software (Digimizer, MedCalc Software, Belgium) (Figure 2). The

white spot lesions were evaluated immediately following the application of the resin infiltration (Figure 3), 1, 3, 6 and 12 months. The post-treatment evaluation was carried out as done in the pre-treatment assessment.

The Resin Infiltration procedure was performed according to the manufacturer's instructions (ICON, DMG, Hamburg, Germany).

The collected data were subjected to statistical analysis using SPSS version 22.0 (Armonk, NY, IBM Corp). Repeated Measures ANOVA was used to determine the mean difference in ΔE and lesion area (A , mm^2) within study groups at various time intervals.

Results:-

The age range of study participants was 13-15 years with a mean age of 13.74 ± 0.85 years. Gender wise distribution showed there were 8 (29.6 %) males and 19 (70.4 %) females. The duration of fixed orthodontic treatment ranged from 12-24 months with a mean duration of 18.4 ± 3.9 months. 25 cases (92.60%) belonged to ICDAS code 1 and 2 cases with (7.40%) code 2. The distribution of white spot lesions was 96.30% and 3.70% in the maxillary arch and mandibular arch. The incidence of white spot lesions was higher for maxillary left central incisor followed by maxillary right central incisor, maxillary right lateral incisor, maxillary left lateral incisor, and mandibular right central incisor.

A statistically significant decrease in ΔE was observed immediately after resin infiltration and stable at follow up visits at 1, 3, 6 and 12 months. Lesion area showed statistically significant reduction immediately after resin infiltration and at 1, 3, 6 and 12 months. (Table 1 & 2)

Discussion:-

The objective of fixed orthodontic therapy in young and adolescents is to achieve a pleasing smile by a proper, harmonious alignment of anterior teeth and establishment of functional occlusion. An undesirable but common complication is formation of white chalky decalcified areas under and around the brackets which is termed as white spot lesions (WSLs) with prevalence ranges from 2-96 percent. The severity of demineralization hinders the enamel translucency leading to unaesthetic appearance and the menace for the occurrence of dental caries.

The etiological factors for the occurrence of the lesion are a series of repeated episodes of mineral loss, with mineral from the surface being lost into the plaque fluid, saliva and mineral from the subsurface reconstituting the surface. This is not a continuous process but is interrupted as the dynamics of repair and destruction alter according to the oral environment. Fluctuations in pH at the interface between the tooth surface and the plaque fluid directly influence the diffusion of calcium and phosphate ions out of the enamel, as does the concentration of fluoride at the interface. The fixed orthodontic appliance attached to the tooth surfaces results in new retention sites and has shown an increase in proliferation of Streptococci mutans and Lactobacilli.^{2,6-23}

The various indices and criteria were used to identify and assess the severity of white spot lesions are Gorelick index, Nyvad criteria, and ICDAS II criteria. ICDAS II criteria was selected since other methods have difficulties in interpreting, validating and complexity of scoring. ICDAS II criteria which have both content and correlational validity with the added advantage of easiness in identification.

Several approaches were previously described for *in-vivo* measurements of post-orthodontic enamel lesions are fiber-optic transillumination, fluorescent- dye uptake, laser fluorescence, light scattering, electric resistance, and photographic image method. The photographic image method was selected because it seems to be the simplest and relevant approach for quantification of lesion size and color. Image processing software can analyse the photograph, thereby quantifying the area of the lesion. In addition to the assessment of lesion size, it can retrieve the exact position of white spot lesion in future follow-up visits.

The various methods that are currently used to assess tooth color range from visual subjective comparisons using colored porcelain or acrylic shade guides to instrumental objective measurements using spectrophotometers, colorimeters, and image analysis techniques. Spectrophotometer (Vita-Easy shade 4.0, VITA Zahnfabrik, Germany) was selected because objective and quantitative color assessment can be done when compared to other methods that are purely subjective. Color can be quantified using Commission de l'Eclairage (CIE Lab*) system and difference

between two colors can be calculated using a spectrophotometer that gives ΔE value. A difference of 3.7 units is considered a clinical indicator for mismatching colours or colour change. White spot lesions are clinically invisible when the ΔE unit between the sound enamel and white spot lesions is <3.7 .²⁴⁻²⁸

The philosophy behind the management of post orthodontic white spot lesions based on three important treatment methods. 1) **Natural remineralisation**- can be achieved with topical fluoride supplements and maintenance with good oral hygiene practice throughout the course of treatment which can reduce or eliminate the occurrence of white spot lesions. 2) **Microabrasion** with application of 18% Hydrochloric acid (HCl) and polishing with pumice powder leads to an improvement in esthetics primarily results from the physical removal of discoloured enamel. The microabrasion technique causes surface abrasion and has been commonly used for the treatment of WSLs can remove up to 250 micrometers of enamel and a quite invasive procedure with loss of tooth structure. 3) **Remineralization technique** -The milk protein casein can be digested with trypsin and complexed with calcium and inorganic phosphate ions to produce Casein Phosphopeptide- stabilized Amorphous Calcium Phosphate nano-complexes also known as Recaldent. CPP-ACP stabilize the calcium and phosphate ions preventing transformation into crystalline phases and maintain a highly supersaturated solution. CPP stabilized calcium phosphate solutions can remineralize enamel subsurface lesions at a rate of $1.5-3.9 \times 10^{-8}$ mol hydroxyapatite/ m^2 /s.

Hinging on the modern philosophy of minimal invasive dentistry; this infiltration technique has been increasingly gaining popularity in the recent past. It is a minimally invasive treatment with low viscous light-curing resin (Tetra Ethylene Glycol Di Meth Acrylate- TEGDMA) that has a high penetration coefficient used for treatment of subsurface lesions. This resin was first developed as *in-vitro* studies on the penetration of resin into white spot lesion. In artificial lesions, brief etching with 37% phosphoric acid-enhanced resin penetration, but with thicker and more mineralized surface layers in natural lesions, it was assumed that this etching procedure would not be effective in eroding the surface layer. The latter study confirmed that etching with 15% hydrochloric acid gel leads to more effective erosion of surface layer (40 micrometer) compared with 37% phosphoric acid gel.

The resin infiltration technique in ameliorating WSLs in terms of color and area has been reported in literature that when micropores of WSLs were infiltrated by resin (Refractive Index-1.46) which is approximated to that of enamel (1.65), the difference in refractive indices between porosities and enamel was decreased to an invisible level, WSLs regained translucency appearing similar to that of surrounding sound enamel. Infiltrating white spot lesions have achieved highly esthetic results, not just immediately after treatment but for long term effect and durability. The assimilation of effects achieved was durable after 12 months.

In the present study, the distribution of WSLs was 96.3% in the maxillary arch and 3.70% in the mandibular arch. Most common teeth affected with WSL were maxillary incisors followed by mandibular canines, mandibular incisors, and maxillary canines. The results are comparable to the findings in earlier studies. This can be attributed to a broad bracket base used in the maxillary arch, less salivary cleansing, and higher chance of plaque accumulation.

Results of the present study showed a statistically significant decrease in ΔE immediately after resin infiltration and stable at follow up visits at 1,3, 6 and 12 months. Lesion areas showed statistically significant reduction immediately after resin infiltration and at 1, 3, 6 and 12 months. Both the color improvement and reduction in the size of lesion is concurrent with the findings of earlier research reports.²⁹⁻³¹

Since the white spot lesions are ineluctant side effect of conventional fixed orthodontic treatment, needs an insight for using alternative materials with the properties of potential remineralisation effect and needs further research in this regards to prevent the undesired consequences.

Conclusion:-

Resin infiltration have desired and durable esthetic improvement in the management of post orthodontic white spot lesions (WSLs).

Table 1:- Comparison of the difference in color (ΔE) between white spot lesion and sound adjacent enamel at various time intervals.

| Time interval | ΔE (Mean \pm SD) | Mean Difference | p value |
|---------------|-------------------------------|--------------------|---------|
|---------------|-------------------------------|--------------------|---------|

| | | | | |
|-------------------------------|----------------|-----------|-------|--------|
| T ₀ (5.69±1.72) | T ₁ | 3.96±0.45 | 1.730 | 0.001* |
| | T ₂ | 3.6±0.45 | 2.090 | 0.001* |
| | T ₃ | 3.66±0.21 | 2.030 | 0.001* |
| | T ₄ | 3.62±0.24 | 2.070 | 0.001* |
| | T ₅ | 3.71±0.24 | 2.070 | 0.001* |

Table 2:- Comparison of the difference in lesion area (A, mm²) at various time intervals.

| Time interval | | A (mm ²) (Mean ± SD) | Mean Difference | p value |
|--------------------------------|----------------|-------------------------------------|--------------------|---------|
| T ₀ (15.65±12.6) | T ₁ | 4.78±3.8 | 10.876 | 0.001* |
| | T ₂ | 3.18±3 | 12.465 | 0.001* |
| | T ₃ | 2.34±2 | 13.318 | 0.001* |
| | T ₄ | 2.2±2 | 13.450 | 0.001* |
| | T ₅ | 2.17±2 | 13.485 | 0.001* |

Figure 1:-



Figure 2:-



Figure 3:-



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