

# Resin InResin Infiltration Concept – Need of an Hour filtration Concept – Need of an Hour

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## ABSTRACT

Decay of teeth is one of the major diseases affecting the oral cavity. Its aetiology is multifactorial: it is a result of interaction between the microbial factors, diet, host, and time. Enamel caries lesions are characterized by a loss of mineral beneath an apparently intact surface layer. The increased porosity within the lesion body causes the characteristic whitish appearance of these lesions. The presence of these white spot lesions in the buccal faces is often associated with areas of plaque. There is regular loss and deposition of tooth substance. And when the fall in pH is for extended period of time, there is dissolution of calcium and phosphate ion. But when pH is back to normal, deposition of ion from saliva occurs. If there is more dissolution than deposition, net loss of ion occurs, and this results in decalcification of tooth structure. This lesion appears as white spot lesion [1]. Also demineralization of subsurface enamel marks the initiation of carious lesion & this is clinically presented as white spot lesion which affects the aesthetics of patient. With this, concept of “minimally invasive technique” was introduced. According to this concept, cavity preparation was restricted to actual damage and use of dental material that mimic tooth structure and function gives satisfactory clinical and aesthetic result & also this ensure better control of oral microflora as this environment is modified and that this is truly a part of conservative dentistry. But as the disease process has begun and tooth structure is lost, minimally invasive technique is a late approach as the restorative material can't be permanent replacement for natural tooth structure. So if we consider, average longevity of restoration, the actual form, strength and aesthetic can't be restored despite using any secondary retention and resistance feature like slot, tunnel, or minibus restorations. This leads to change in pattern of restoration from extensive cavity preparation to minimally invasive approach. As this lesion is capable of remineralisation, restoration should not be done. So from this article, we can learn about various conventional treatment options with their drawbacks for white spot lesion and the recent approach ie the resin infiltration technique. After learning all these options, we can conclude that Resin Infiltration Technique is a effective option. Resin infiltration technique is a minimally invasive option for treating teeth with mild to moderate white spot lesion. This is a convenient option as we need to prepare the tooth structure mechanically for treatment neither we need to go for abrasion of tooth surface. Resin infiltration is proven to be an effective treatment for masking white spot lesions.

**Key words:** White Spot lesion, Enamel, Remineralization, Resin infiltration

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## INTRODUCTION

From the end of 19th century, caries removal was mainly done by surgical approach. The idea of “extension for prevention” was introduced by WEBB [later modified by GV Black]. According to this concept, there is thorough elimination of carious tooth structure, and moreover the preparation was extended to caries resistant areas. Even though this concept had no scientific basis, this was still followed for more than 120 years. From 1922, it was suggested that preparation of carious tooth structure should be as minimal as possible i.e. “conservative” and the removal of sound tooth structure for prevention is not required [2]. In recent times, these surgical techniques are considered maximally invasive, destructive, and

outmoded. Thus we can say that there is dramatic change in approach for management of dental caries.

But using any type of cavity preparation or restorative material, once the caries process is initiated, it can't be cured. For sure, once there is formation of cavity on enamel surface, this has to be removed surgically. With this, concept of “minimally invasive technique” was introduced [3]. According to this concept, cavity preparation was restricted to actual damage and use of dental material that mimic tooth structure and function gives satisfactory clinical and aesthetic result & also this ensure better control of oral micro flora as this environment is modified and that this is truly a part of conservative dentistry. But as the disease process has begun and tooth structure is lost, minimally invasive technique is a late approach as the restorative material can't be permanent replacement for natural tooth structure. So if we consider, average longevity of

restoration, the actual form, strength and aesthetic can't be restored despite using any secondary retention and resistance feature like slot, tunnel, or minibus restorations. This leads to change in pattern of restoration from extensive cavity preparation to minimally invasive approach.

However, may it be any restorative procedure likes invasive, minimally invasive or micro invasive, it is mostly associated with postoperative sensitivity or pathogenic pulpal reaction that may require endodontic treatment? Caries is actually a process rather than simply a lesion resulting from process as we can say cavity is a symptom of disease. Thus, diagnosis of caries is much more than just identifying a frank cavity. So this concept of minimum intervention dentistry is equivalent to preservative dentistry and this should include at least following 5 general principles.

- 1) Diagnosis of caries should be done as early as possible using proper diagnostic instruments.
- 2) Patient should be educated and caries process should be controlled by reduction of cariogenic bacteria.
- 3) Early lesion should be demineralised.
- 4) Cavity should be prepared as conservatively as possible.
- 5) Repair in favour of replacement of defective restoration.

Considering the mean age of 21 years, approximately 50% of patients have caries on proximal surface or proximal surface may be restored.

Caries on proximal surface is a major health issue in high risk patients [4]. This may be attributed to poor patient compliance.

In last few years, main focus is on preserving dental tissue so that we can arrest and control caries on proximal surface or in other words smooth surface caries.

The basis of this concept is to occlude the incipient enamel lesion which is highly porous by using a low viscosity resin. This is known as infiltration technique.

Infiltration in medical terms means a process in which certain liquid is infiltrated into cavity or pores of a substance.

## RESULTS

### WHITE SPOT LESION:

White opacity that occurs as a result of subsurface enamel demineralization that is located on smooth surfaces of teeth are known as White Spot Lesion (figure-1).



**Figure 1: (White Spot Lesion)**

Caries that involve enamel can be characterised by loss of subsurface enamel. As the porosity within body of lesion is increased, this causes typical whitish appearance of the lesion. Mostly, post orthodontic treatment, there is plaque accumulation around the bracket, which leads to white spot lesion on buccal surface of tooth making tooth anaesthetic [5]. The size and transparency of enamel varies with the size of inter-crystalline spaces. Initially, caries can only be seen after air drying, because of the initiation of the dissolution process of the crystal at the external marginal surface. And as the intercrystalline space is increased, white spot lesion can be seen without air drying. As air is seen surrounding enamel prism instead of water, this affects the translucency of enamel. And scattering is seen as there is difference in the refractive index of the two involved components. For Enamel refractive index is approximately 1.65. For water it is 1.33 and for air it is 1.00. Due to this greater difference, more scattering is produced at enamel/air interface.

The appearance of a WSL is indication of its activity, earlier when seen clinically when it is active it appears chalky and rough and later when it is inactive it appears bright and smooth. Though it is believed that WSL can fade by removing the affected enamel mechanically and remineralisation, when tested clinically using fluoride toothpaste and gel no significant difference was seen [6]. Thus these lesions rarely disappear clinically. Many initial lesion are seen clinically and radio graphically even after remineralisation because more often they are detected from the body of the lesion, where changes in its scattering of light and radiolucency are less likely to occur as it has very little remineralisation potential. Thus, as the surface of lesion may be seen as hard and shiny and the white spot less obvious, some interior opacity is still seen.

### CLINICAL OBSERVATIONS OF WHITE SPOT LESION

In a randomized control trial, comparison was done between treatment with varnish containing fluoride and that with cleaning of teeth at professional level demineralizing the white spot lesion in adolescence with high caries activity. From this study they found out that there was a significant difference in mean change in fluorescence between the 2 test groups; however, for lesion areas, no significant differences could be observed. In another study, weekly brushing with amine fluoride gel was compared with brushing alone with amine

fluoride dentifrice [7]. When the results were monitored under Quantitative Light Fluorescence (QLF), they found out that there was as such no significant difference when amine fluoride brushing was done weekly. This was verified in another randomized control trial, where long standing white spot lesion was observed for more than 6 months. Even though the tooth paste contains sodium fluoride in 1,500 ppm concentration or amine fluoride in 1,250 ppm concentration, there was no significant difference in their effectiveness. Also they found out that as such there is no effect of fluoride on white spot lesion. In one of the clinical study on white spot lesion which occur after orthodontic treatment, the area of demineralization were reduced by approximately half their original size during the period of 6 months after treatment. Again, here low fluoride mouth rinse in combination with dentifrice was used compared with a no active control combination failed to show any differences or therapeutic effect. As this lesion is once formed, most of them in early lesion appear to be as surface demineralization rather than subsurface lesion with an intact surface zone. In these cases, abrasive effects are very common [8]. This would be in accordance with other observations indicating that superficial lesions seen after orthodontic treatment will tend to disappear more rapidly and completely than deeper lesions on removal of the cariogenic challenge. In his original work, Backer Dirks speculated on either remineralisation, abrasion, or even both when trying to explain the clinically observable disappearance of the smooth surface white spot lesions after several years. When considering that white spot lesions on smooth surfaces disappeared while proximal caries obviously did not, and abrasion and early recession are common in patients with good oral care, the results of a previous study seem to support the idea that tooth brushing on smooth surfaces might contribute to abrasion of initial caries, in particular, if vigorous tooth brushing is implemented as a part of oral hygiene.

This can be checked using scanning electron microscope (SEM) by observing the area of demineralization that is formed beneath the orthodontic band. The white opacities that develop here had a higher luminance meaning they were appearing more white and when there boundaries were checked; they appeared to be more circular than the post orthodontic caries lesions. When white spot lesion was examined, it was seen that they had a typical pattern of initial tissue destruction. Focal holes and an accentuation of the perikymata were observed affecting the enamel surface zone Another SEM study on the fate of subsurface lesions revealed a general tendency toward levelling of the surface of the lesion indicating a loss of porous tissue, probably by attrition/abrasion due to functional wear and/or tooth brushing. These findings confirmed that removal of cariogenic challenge results in arrest of further demineralization. However, the gradual regression of the lesion at the clinical level was believed to be primarily a result of surface abrasion.

Reliability of diagnosing precipitated caries lesions for smooth (and proximal) tooth surfaces has been shown to be poor. In this context, in clinical studies access to the proximal space often is limited, thus leading to a possible underreporting of cavitation's. Accordingly, it might be speculated that clinical recording of small cavities is extremely difficult during preparation procedures

#### CONVENTIONAL TREATMENT OPTION

For early WSL with intact surface, if proper tooth brushing and flossing is done which maintains proper oral hygiene, caries can be controlled efficiently.

Though, flossing is done mainly on proximal surface, but there are no evidences to show its preventive effects on gingival health and/or proximal caries. If it is performed professionally, under supervision, caries risk is reduced to certain extent particularly in children. This is how lesion can be arrested and there is possibility of remineralisation. Remineralisation is the natural process of repair of non-capitated lesion and it mostly depends on CA and PO<sub>4</sub> ion aided by fluoride. But favourable circumstances are compulsory to make sure that repair or healing occur by mineral are deposited on damaged crystals that are already or nucleation and de novo crystal formation.

Additionally used antimicrobials should limit bacterial growth and increase oral health. However, caries-preventive properties of chlorhexidine mouth rinses are limited, and most results are inconclusive. A recent in situ study did not show any preventive effects of mouth rinsing with 0.2% chlorhexidine, neither on acid production of plaque samples nor enamel demineralization. Also, CHX clearly hinders fluoride accumulation on the surface of teeth. Based on the available literature, chlorhexidine rinses do not seem to be recommendable for caries prevention.

Topical fluoride is also used to demineralize the demineralised proximal enamel. This can be achieved by application of fluoride varnish at interval of 3 months. Obviously, caries reduction is seen in children with moderate caries risk and those with high caries activity i.e. more than 9 new lesions did not show any marked change in caries reduction. However, in a recent study, caries prevention was done using varnish that contain fluoride twice a year at interval of 6 months was 69% in high-risk areas, 66% in medium-, and 20% in low-risk areas.

Additionally, with fluoride mouth rinsing, reduced incidence of caries on proximal surface can be seen in adolescents having low to moderate caries risk as well. So it can be said that fluoride is effective to prevent caries in adolescent age group i.e. between 13 to 16 years of age, and as a supplement to oral home care and preventive efforts at dental clinics. However, fluorides are not able to completely prevent onset or progression of proximal caries in the long term.

### RESIN INFILTRATION CONCEPT

According to the early histologic studies, as the different histologic zones have different microporosities, enamel lesion can be imbibed in water or quinolone. Also this small porous opening & expanded intercrystalline space allows diffusion of acids & minerals. From this we get that we can infiltrate initial lesion using different liquids like low viscosity resins. So we can say that before the caries progress to comparatively late stage and we need to remove the lesion, an attempt should be made at initial stage to fill the micro porosities of the lesion. This will reduce the micro porosities and will helps in providing mechanical support to the tissue.

When earlier done studies were reviewed like of 1970s, the adhesive includes the leftover inorganic material of the portion that is demineralised; this transforms the lesion into an acid resistant unit. White spot lesion needs to be acid etched before it is infiltrated unlike initial carious lesion which can be infiltrated directly. Clearly, reason for this is that thickness, and the low porosity/high mineral content of the surface layer and due to organic substances found in natural caries. Demineralization can be prevented as the depth of resin infiltration was 60µm which was considered adequate even if surface coating is extricated.

These materials i.e. resin infiltrates must have following properties:

- Surface activity should be more and viscosity less
- Bacteriostatic
- Safe for oral tissues
- Resist mechanical & chemical changes of the oral cavity
- Aesthetically suitable
- Hydrophilic

When the incipient lesion was acid etched with phosphoric acid, the pattern was same as sound enamel. And when bonding was done after etching subsurface lesion it was considered better and it can then resist thermo cycling. Thus these lesions can be treated well by resin infiltration. But the surface of white spot lesion seems to resist etching done by phosphoric acid more than sound enamel.

When many studies were evaluated, it was thought that surface tension, viscosity and contact angle were factors that affect penetrating ability of restorative resin into enamel after acid etching. But when factors were considered regarding the penetrating ability of restorative resin monomer into pores of enamel surface that was acid etched, viscosity was not a limiting factor & depth of penetration was affected minimally when viscosity was changed. Moreover, the depth of penetration i.e. the tag length which was nearly 50µm or more which was seen with composite as well as with non-composite resins on (non carious) phosphoric acid-etched enamel. According to the latest studies, when surface conditioning using Hall acid was done on natural lesion, same depth of penetration was observed Few of commercially obtainable adhesives i.e. sealant or bonding

agent were found to be appropriate for infiltration of artificial lesions. But obviously difference was seen when same lesion was infiltrated with infiltrate that had different penetration co-efficient Therefore, we can say that resin infiltrate with more penetration co-efficient can penetrate more profoundly in the lesion And this study was approved by a recent SEM study in which penetration of sealant in fissure that was etched was done using low viscosity sealant was used. Here, the resin infiltrated layer was established in enamel below the etched depth. Unlike high viscosity sealant that was used did not penetrated to the desired depth.

Degree of micro porosity is also an important factor to be considered. And that the more mineralised the hard tissue be, more will be the penetration of the unfilled resin in the enamel. When resin tags formed in demineralized enamel was compared with that of demineralized enamel or when fluoride was used, length of tag was more in demineralized enamel.

Many alterations were done in technique of application so that the depth of penetration was improved in intact enamel in which etching was done. When treatment was done using ultrasonic device while etching was done and dried with acetone, mechanical interlocking was significantly more. Currently, it is known that the etching technique which was used conventionally i.e. which was done with phosphoric acid, it had certain shortcomings. And deproteinization pre-treatment which was done with Nail (5.25%; 60 seconds) had better outcome with respect to retentive surfaces. Many studies are still required to find out better results when depth of penetration of resin infiltrate is considered.

### ADVANTAGES OF RESIN INFILTRATION TECHNIQUE

The most critical task in dentistry is the diagnosis that is related to caries when clinical scenario is considered. And that in most cases we need to go for conventional treatment where conventional treatment procedures are performed. So from this review it is clear that minimal invasive techniques seem to have fruitful results. This includes "RESIN INFILTRATION TECHNIQUE". Several advantages of resin infiltration technique are:

- Demineralized enamel can be mechanically stabilized and unaffected tooth portion need not be prepared.
- Initial cavities can be treated well.
- Progress of lesion can be arrested.
- Pores can be obdurate.
- Chances of secondary caries is reduced greatly.
- Probability of postoperative sensitivity and inflammation of pulp is less.
- Gingival and periodontal inflammation is not seen.
- Aesthetically this seems to be more pleasing as it can mask the white spot lesion also.
- Patient can accept it very well.

Therefore, considering the clinical evaluation, a longitudinal clinical risk assessment to differentiate between progressive and demineralized lesions should be instituted. This resin infiltration technique can be

done in initial carious lesion and also in late stage of caries process. Also, using this technique, we need not to sacrifice sound tooth structure i.e. when cavity is prepared using conventional technique. For better results, preferably rubber dam should be used while the procedure is performed.

#### CONCLUSION

Thus, if we consider this in relation to clinical practice, resin infiltrates prove to be better with regards to penetration ability in the lesion involving enamel. This technique also proves to be better when technique of application is done carefully and lesion is arrested at much earlier stage. But clinical trials regarding this technique are too less. Thus many studies are still required to compare that which lesion should be treated with resin infiltration technique and where should we go for maintaining proper oral hygiene or fluoride application should be done. Post effect of fluoride can't be overlooked and RCT with parallel group studies are necessary. Also studies are required regarding the progression of lesion.

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