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MANAGEMENT OF WHITE SPOT LESION AMONG DENTAL PROFESSIONALS IN SOUTH INDIAN POPULATION – A CROSS SECTIONAL STUDY.

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Abstract

Introduction:

White spot lesions are opacities which are formed due to decalcification occurring in the subsurface layer of the enamel. These lesions are mostly seen in patients during and after fixed orthodontic treatment, due to the undisturbed accumulation of plaque. Though these lesions produce esthetic mishap, they go unattended due to the lack of clinical knowledge in interpretation and diagnosis.

Aim:

The aim of this study was to determine the knowledge, attitude and practice among dental professionals pertaining to the management of white spot lesion.

Materials and Methods:

A cross-sectional questionnaire-based survey included undergraduate practitioners, postgraduates and specialists as participants. The questionnaire was formulated in English consisting of structured 21 questions and circulated through online media across India.

Results:

The assessment of knowledge and awareness highlighted an understanding of WSL among all participants, underscoring fundamental knowledge shared across dental professionals. The attitudes towards WSL treatment showed a similar belief among participants, including undergraduate practitioners and specialists, regarding the necessity of treating WSL. Furthermore, the analysis of practice patterns revealed consistent diagnostic methods among dental professionals, with specialists showing slightly higher adherence to drying techniques for enhanced visibility.

Statistical Analysis:

Data analysis was conducted using SPSS version 23, with descriptive statistics presented in frequencies, percentages, and means. Comparisons were made across different categories of dental professionals to examine variations in responses and practices.

Conclusion:

Since untreated white spot lesions can progress into cavities, a thorough understanding of the etiology, clinical picture, early diagnosis, are very crucial in planning the treatment and managing the esthetic demands of the patients & function of the tooth.

Keywords: Demineralization, Fluoride, ICDAS, White spot lesion

Introduction

Modern advancements in the field of dentistry have paved way in conservative management and early detection of dental caries. Incipient caries are lesions which appear on the tooth surface as the early signs of enamel demineralization. These incipient lesions are otherwise called as “white spot lesion” (WSL) due to their chalky appearance on the tooth surface. WSL, which was coined by FEJERSKOV, are subsurface enamel demineralization that occurs on the smooth surface of the tooth. Due to the dynamic demin-remin process, the integrity of the oral cavity and teeth are maintained [1]. Any change in this process, leads to the formation of initial carious lesion which eventually progresses into dental caries, if left untreated. WSL, histologically has two surfaces: the superficial surface layer and the sub-surface or body of the lesion layer. The superficial layer gets remineralized due to the constant flow of salivary remineralizing proteins, whereas the underlying subsurface layer remains demineralized as the macromolecular salivary proteins does not penetrate into the subsurface layer of the enamel [2]. Due to the continuous diffusion of acids, there will be decalcification in the subsurface layer of the enamel which in turn leads to cavitation in the enamel. The initiation of any carious lesion depends upon the diet, host factor, microorganism and time. In WSL, fixed orthodontic appliances serves as a major etiological factor as it allows undisturbed accumulation of plaque and prevents easy removal [3]. According to previous studies, white spot lesion occurs in about 23 to 95% of the population with males having higher prevalence than females [4]. Patients with fixed orthodontic appliances have increased risk of WSL in the first weeks of treatment [5, 6], which increases up to 40% within the first 6 months [6]. Treatment for WSL ranges from non-invasive to minimally invasive treatment methods, which includes oral hygiene instructions, diet counselling, fluoride applications as gel, toothpastes, varnish and foams, remineralizing agents, bleaching agents, LASERs and Resin infiltration. The present study was formulated to evaluate the knowledge about the management of WSL in clinical practice among various dental professionals in South Indian population.

Materials and Methods

Dental professionals who are general practitioners, Post graduates and academicians were included in this study. Under graduate students were excluded. An ethical clearance was obtained from the institutional human ethical committee before initiating the study. A survey questionnaire was fabricated in English language by Google forms, after estimating the sample

size of about 246 by G* power software. The google form links were later circulated online after final evaluation. The questionnaire contained details regarding the motive of the study and an informed consent to be filled by the participants before entering the study. Demographic details like age, years of experience and qualification were obtained and all the data collected were maintained confidentially. The survey had questions to evaluate the oral health practices, dental knowledge and attitude of the dentist towards treating white spot lesion in a sequential manner. The questions were framed in multiple choice pattern and space were also provided to write their suitable response. The questionnaire had a question pertaining to the percentage of clinical cases of white spot lesion that the dentist had treated successfully. This question was to assess the clinician's knowledge in diagnosing the lesion and their practical planning in treating the lesion. As per the determined sample size, 246 responses were obtained by one-month time period.

Statistical Analysis

The socio-demographic profile and the information regarding knowledge, attitude and practice about white spot lesion among various dental professionals were collected using google forms. Data analysis was conducted using SPSS version 23, with descriptive statistics presented in frequencies, percentages, and means. Comparisons were made across different categories of dental professionals to examine variations in responses and practices.

Results

The current study investigated the Knowledge, Attitudes, and Practices (KAP) regarding WSL among 246 dental professionals, including BDS General practitioner (Undergraduate practitioners), Specialists including MDS practitioners such as endodontists, orthodontists and postgraduates. The demographic analysis (Figure 1) revealed that undergraduate practitioners accounted for the majority of participants (55.3%), with varying levels of clinical experience predominantly within the range of 0-2 years. On the other hand, specialists had diverse expertise, with significant proportions of endodontists and orthodontists representing 0-2 years of clinical experience. Furthermore, the specialists showed higher mean ages when compared to Undergraduate practitioners.

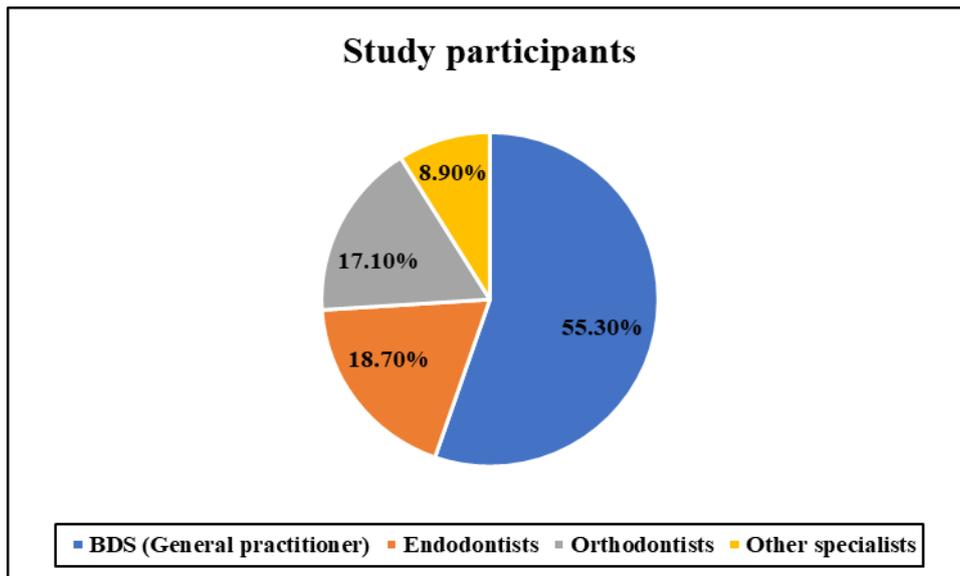


Figure 1: Distribution of various dental professionals in the study

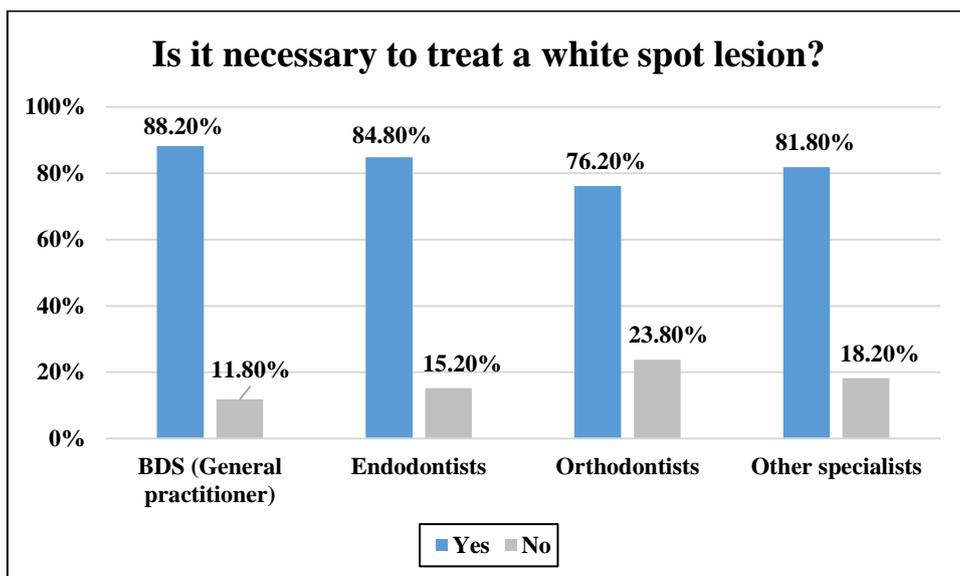


Figure 2: Attitudes towards the treatment of WSL among the dental professionals

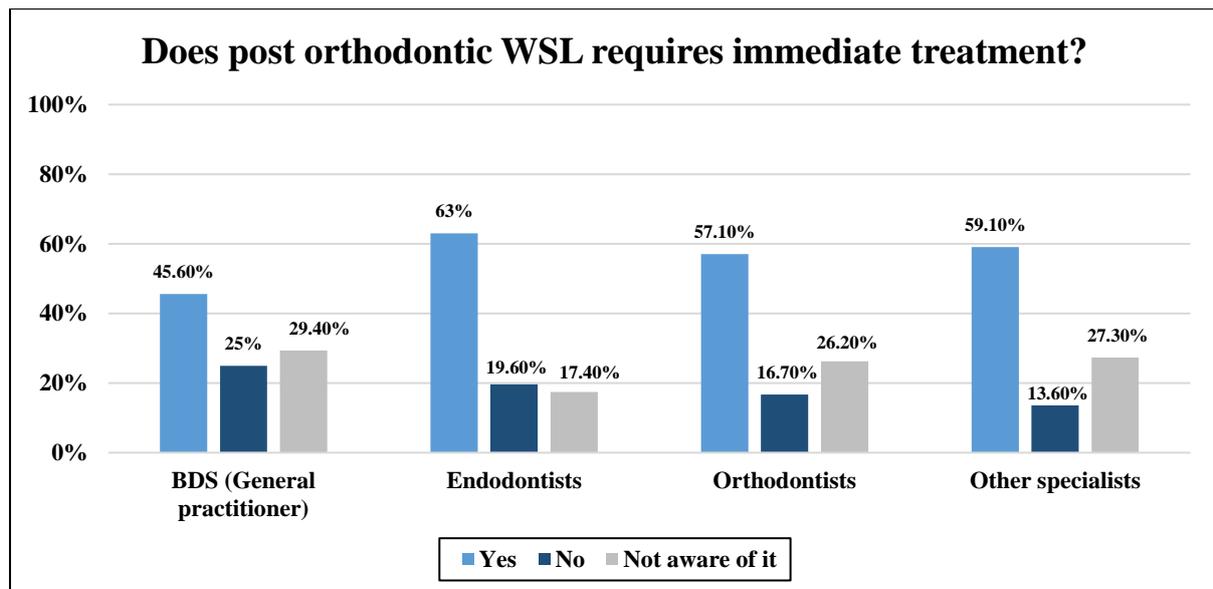


Figure 3: Awareness on the post orthodontic WSL treatment among various dental professionals Regarding the immediate treatment of post-orthodontic of WSL, specialists, endodontists (63%), orthodontists (57.1%), and other specialists (59.1%), showed a stronger consensus on the immediate treatment when compared to Undergraduate practitioners (45.6%).

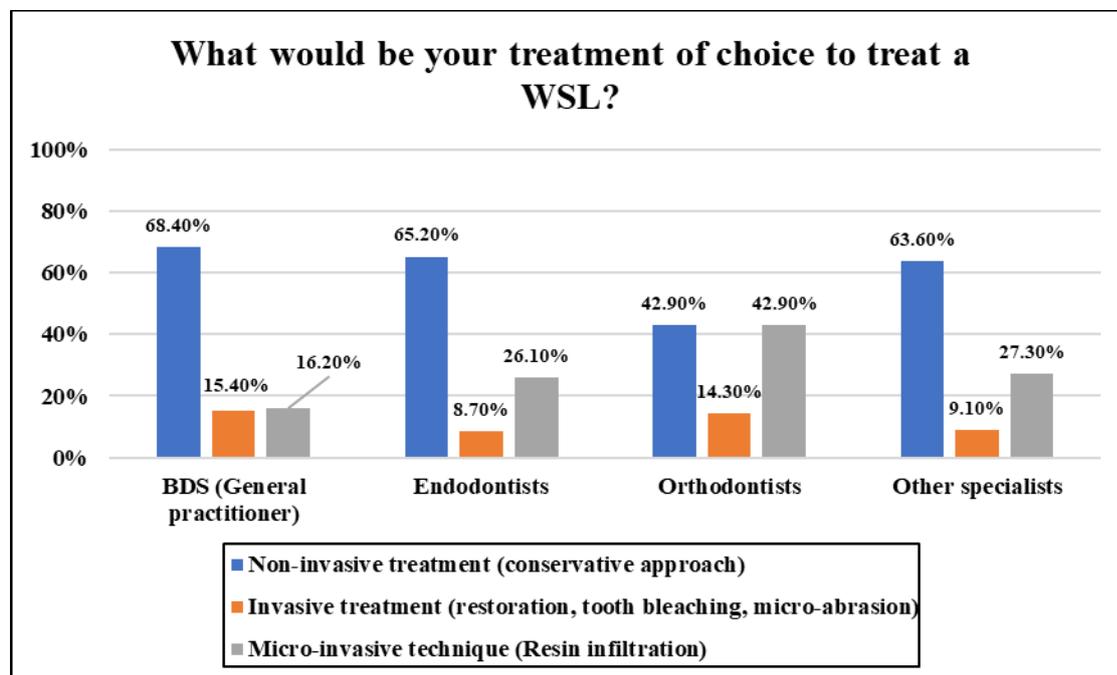


Figure 5: Distribution of treatment choice for WSL among various dental professionals a significant proportion of dental professionals across all categories showed a preference for non-invasive or conservative approaches. Undergraduate practitioners (68.4%) and

specialists (ranging from 65.2% to 63.6%) favored conservative management strategies. The second preference was given to resin infiltration technique by the specialists.

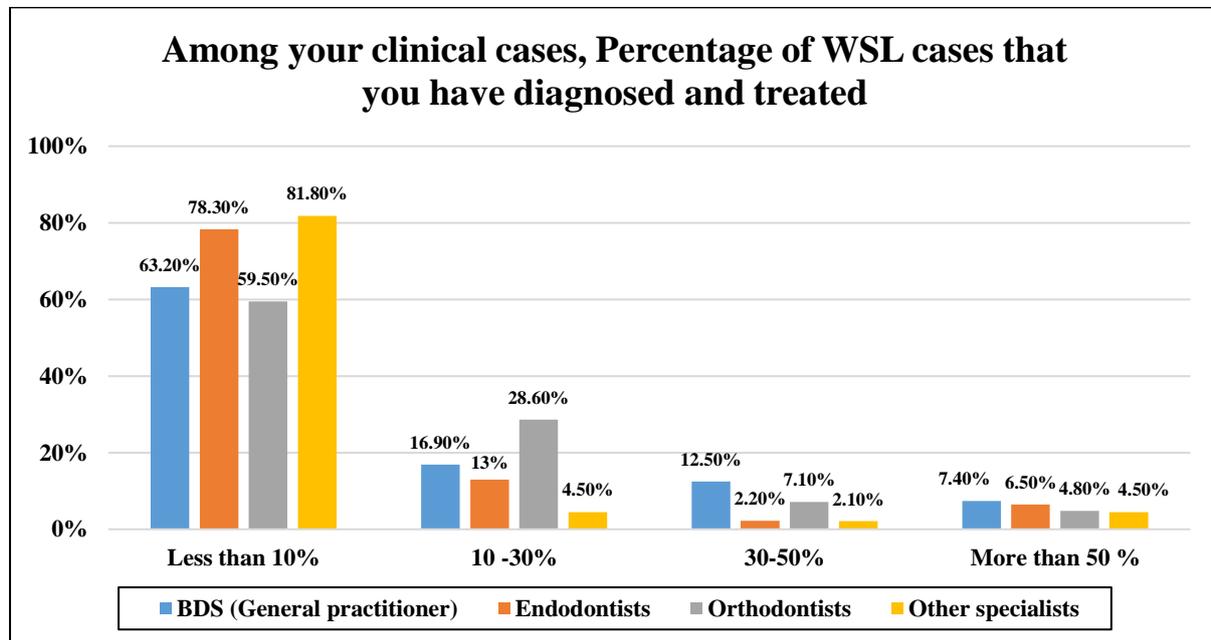


Figure 6: Distribution of WSL cases diagnosed & managed among various dental professionals. Maximum responders, in all categories, have diagnosed and treated less than 10% of WSL cases. whereas, 28% orthodontists had successfully diagnosed and treated 10 -30% of cases.

The assessment of knowledge and awareness (Table 2) highlighted an understanding of WSL among all participants, underscoring fundamental knowledge shared across dental professionals. Notably, specialists, particularly endodontists showed higher familiarity with advanced concepts such as the International Caries Detection & Assessment System (ICDAS) and the combined use of fluoride and chlorhexidine (CHX) for managing WSL. Additionally, specialists exhibited a greater consensus on the urgency of treating WSL post-orthodontic treatment and the effectiveness of xylitol gums in WSL management compared to Undergraduate practitioners. These findings reflect the comprehensive understanding and specialized training of specialists in addressing early signs of dental caries.

The attitudes towards WSL treatment (Table 3) showed a similar belief among participants, including Undergraduate practitioners and specialists, regarding the necessity of treating WSL. Furthermore, the analysis of practice patterns (Table 4) revealed consistent diagnostic methods among dental professionals, with specialists showing slightly higher adherence to drying techniques for enhanced visibility. While majority of the Undergraduate practitioners and specialists opted

conservative treatment approaches for WSL, considerable proportion of specialists showed higher preference towards micro-invasive techniques like resin infiltration and remineralizing agents to preserve tooth structure and achieve aesthetic outcomes. This emphasizes a shift towards non-invasive and minimally invasive interventions among specialists. Lastly, among the dental professionals, specialists showed varying success rates, particularly endodontists reported higher success rates when compared to orthodontists and general practitioners in non-invasive treatment for white spot lesions (WSL).

Table 2: Knowledge and awareness assessment of dental professionals regarding white spot lesions and caries detection techniques (N=246)

| Questions | Undergraduate practitioners n (%) | Specialists (including MDS practitioners and postgraduates) n (%) | | | |
|-----------|---|---|---------------|-------------------|------------|
| | | Endodontists | Orthodontists | Other specialists | |
| Q1 | Are you aware of white spot lesion (WSL)? | | | | |
| | Yes | 136 (100%) | 46 (100%) | 42 (100%) | 22 (100%) |
| | No | 0 | 0 | 0 | 0 |
| Q2 | Are you aware of the International caries detection & assessment system (ICDAS)? | | | | |
| | Yes | 90 (66.2%) | 38 (82.6%) | 25 (59.5%) | 13 (59.1%) |
| | No | 46 (33.8%) | 8 (17.4%) | 17 (40.5%) | 9 (40.9%) |
| Q3 | Does combined use of fluoride and chlorhexidine (CHX), produce effect on WSL? | | | | |
| | Yes | 32 (23.5%) | 25 (54.3%) | 14 (33.3%) | 9 (40.9%) |
| | No | 18 (13.2%) | 8 (17.4%) | 6 (14.3%) | 2 (9.1%) |
| | Not aware of it | 86 (63.2%) | 13 (28.3%) | 22 (52.4%) | 11 (50%) |
| Q4 | Does post orthodontic WSL requires immediate treatment? | | | | |
| | Yes | 62 (45.6%) | 29 (63%) | 24 (57.1%) | 13 (59.1%) |
| | No | 34 (25%) | 9 (19.6%) | 7 (16.7%) | 3 (13.6%) |
| | Not aware of it | 40 (29.4%) | 8 (17.4%) | 11 (26.2%) | 6 (27.3%) |
| Q5 | Does xylitol gums help in treating WSL? | | | | |
| | Yes | 42 (30.9%) | 23 (50%) | 13 (31%) | 7 (31.8%) |
| | No | 38 (27.9%) | 8 (17.4%) | 9 (21.4%) | 4 (18.2%) |
| | Not aware of it | 56 (41.2%) | 15 (32.6%) | 20 (47.6%) | 11 (50%) |
| Q6 | The first sign of demineralization as white spot lesion can form within | | | | |

| | | | | | |
|-----|---|-------------|------------|------------|------------|
| | Correct answer (4 weeks) | 41 (30.1%) | 15 (32.6%) | 14 (33.3%) | 6 (27.3%) |
| Q7 | Frequency of application of fluoride varnish for permanent teeth | | | | |
| | Correct answer (2-4 times/year) | 110 (80.9%) | 37 (80.4%) | 36 (85.7%) | 19 (86.4%) |
| Q8 | The most common method of micro-abrasion uses | | | | |
| | Correct answer (18% Hydrochloric acid) | 31 (22.8%) | 16 (34.8%) | 5 (11.9%) | 6 (27.3%) |
| Q9 | Refractive index of enamel (RI) | | | | |
| | Correct answer (1.62 – 1.65) | 105 (77.2%) | 38 (82.6%) | 19 (45.2%) | 18 (81.8%) |
| Q10 | Resin infiltration works on the basic principle of | | | | |
| | Correct answer (Occlusion of pores that provides diffusion of acids) | 49 (36%) | 16 (34.8%) | 22 (52.4%) | 9 (40.9%) |

Table 3: Attitude towards treatment of white spot lesions among dental professionals (N=246)

| Question | Undergraduate practitioners n (%) | Specialists (including MDS practitioners and postgraduates) n (%) | | | |
|----------|--|---|---------------|-------------------|------------|
| | | Endodontists | Orthodontists | Other specialists | |
| Q1 | Is it necessary to treat a white spot lesion? | | | | |
| | Yes | 120 (88.2%) | 39 (84.8%) | 32 (76.2%) | 18 (81.8%) |
| | No | 16 (11.8%) | 7 (15.2%) | 10 (23.8%) | 4 (18.2%) |

Table 4: Practice patterns and preferences in the management of white spot lesions among dental professionals (N=246)

| Questions | Undergraduate practitioners n (%) | Specialists (including MDS practitioners and postgraduates) n (%) | | |
|-----------|-----------------------------------|---|---------------|-------------------|
| | | Endodontists | Orthodontists | Other specialists |

| | | | | | |
|-----------|---|------------|------------|------------|------------|
| Q1 | How do you diagnose a WSL? | | | | |
| | Correct answer (By drying the tooth) | 97 (71.3%) | 36 (78.3%) | 34 (81%) | 17 (77.3%) |
| Q2 | Topical fluoride regimen, that you would recommend for treating deeper parts of the lesion and for better esthetic outcome | | | | |
| | Correct answer (Lower concentration of fluoride initially) | 77 (56.6%) | 22 (47.8%) | 22 (52.4%) | 10 (45.5%) |
| Q3 | What would be your treatment of choice to treat a WSL? | | | | |
| | Non-invasive treatment (conservative approach) | 93 (68.4%) | 30 (65.2%) | 18 (42.9%) | 14 (63.6%) |
| | Invasive treatment (restoration, tooth bleaching, micro-abrasion) | 21 (15.4%) | 4 (8.7%) | 6 (14.3%) | 2 (9.1%) |
| | Micro-invasive technique (Resin infiltration) | 22 (16.2%) | 12 (26.1%) | 18 (42.9%) | 6 (27.3%) |
| Q4 | In case of conservative management of WSL, what is your preference? | | | | |
| | Oral hygiene instructions | 15 (11%) | 6 (13%) | 1 (2.4%) | 0 |
| | Fluoride mouth-rinse/ toothpaste | 26 (19.1%) | 5 (10.9%) | 7 (16.7%) | 5 (22.7%) |
| | Fluoride gel/ varnish application | 43 (31.6%) | 11 (23.9%) | 12 (28.6%) | 7 (31.8%) |
| | Re-mineralizing agents | 52 (38.2%) | 24 (52.2%) | 22 (52.4%) | 10 (45.5%) |
| Q5 | In case of invasive approach for WSL, what is your preference? | | | | |
| | Composite restoration | 36 (26.5%) | 21 (45.7%) | 14 (33.3%) | 7 (31.8%) |
| | Tooth bleaching | 23 (16.9%) | 2 (4.3%) | 6 (14.3%) | 2 (9.1%) |
| | Veneers | 27 (19.9%) | 4 (8.7%) | 11 (26.2%) | 6 (27.3%) |
| | Micro-abrasion | 50 (36.8%) | 19 (41.3%) | 11 (26.2%) | 7 (31.8%) |
| Q6 | The percentage of WSL cases that you have diagnosed and treated | | | | |
| | Less than 10% | 86 (63.2%) | 36 (78.3%) | 25 (59.5%) | 18 (81.8%) |
| | 10 -30% | 23 (16.9%) | 6 (13%) | 12 (28.6%) | 1 (4.5%) |
| | 30-50% | 17 (12.5%) | 1 (2.2%) | 3 (7.1%) | 2 (9.1%) |
| | More than 50 % | 10 (7.4%) | 3 (6.5%) | 2 (4.8%) | 1 (4.5%) |

Discussion

The current study is one among the very few studies which aimed to focus on the diagnosis and management of white spot lesion. To the best of knowledge, the present study is the first study to compare undergraduate dental practitioners, postgraduates and academicians of various specialities emphasizing their clinical management of white spot lesion, where previous questionnaire studies had only focused on orthodontists or dental students alone [7-10].

Previous studies have stated that white spot lesions occur most commonly in patients with fixed orthodontic appliance, with incidence and prevalence percentage ranging from 23.4% to 75.6% and 33.8% to 97% respectively [11-13]. It also stated that in Indian population more than 75% of patients undergoing fixed orthodontic appliance had higher prevalence of white spot lesion [12].

In the current study, undergraduate practitioners accounted for the majority of participants (55.3%), and On the other hand, specialists together comprised of 53% of the participants but had diverse expertise, with significant proportions of endodontists and orthodontists since white spot lesion mainly concerns the orthodontic and endodontic fraternity for their preventive and esthetic treatment.

ICDAS was developed in the year 2002 and was later revised in the year 2009 (ICDAS-Caries Lesion Activity Assessment (ICDAS- CAA)) which included detection and assessment of various stages of dental caries. Later International Caries Classification and Management System (ICCMS) which considers radiographic and clinical assessment to categorize the carious lesion was introduced [14]. In the current study, a particular question regarding the awareness about International Caries Detection and Assessment System (ICDAS), majority of undergraduate practitioners (66.2%) and a higher proportion of specialists, particularly endodontists (82.6%), showed greater familiarity with ICDAS system. On the other hand, orthodontists and other specialists also exhibited notable awareness levels (59.5% and 59.1%, respectively) regarding ICDAS.

In this study, when questioned about the necessity to treat WSL, most of the responders, including general practitioners and specialists, revealed that it is essential to treat the incipient lesion (Figure 2). According to the ICDAS scoring, when a lesion is visible on drying, but appears normal during wet condition, the lesion is classified as Code 1 and if it is seen both on wet and dry conditions, it is classified as a Code 2. Based on this, if a Non-cavitated caries is inactive, it does not require any treatment. Non-cavitated approximal lesions require Resin

infiltration alone or Resin infiltration in combination with 5% sodium fluoride (NaF) varnish for 3 to 6 months [15]. The protocol for management of Non- cavitated lesion occurring on the labial and palatal smooth surfaces advises the use of 1.23% of acidulated phosphate fluoride (APF) or 5% NaF for 3 to 6 months [16].

When assessing the combined use of fluoride and chlorhexidine (CHX) in managing WSL, awareness levels varied among specialist subgroups. Endodontists (54.3%), orthodontists (33.3%), and other specialists (40.9%) demonstrated relatively higher awareness compared to undergraduate practitioners (23.5%). However, a significant proportion of respondents across all groups (ranging from 28.3% to 63.2%) showed a lack of awareness regarding this therapeutic approach. Among the dental varnishes available, fluoride varnish has proven to be safe and effective against the development of new carious lesions [17,18]. Apart from fluoride, CHX as varnish performs better due to the higher concentration of chlorhexidine and better contact time. The combined use of CHX and fluoride, seems to have a synergistic effect, as CHX reduces the acid production by its antimicrobial action and fluoride works on the remineralization of the white spot lesion [19]. 0.12% chlorhexidine mouthwash can also be used along with fluoride therapy.

Another agent which has proven to be synergistic with above mentioned combination is Xylitol, a non-fermentable sugar. Xylitol incorporated chewing gums have proven to increase the production of stimulated saliva, which has higher concentration of bicarbonate and phosphate. This improves the buffering action of the saliva thus preventing demineralization. Along with this calcium, phosphate and hydroxyl ions are also produced in higher concentration which accountable for remineralization [20]. In the current study, when questioned about the effectiveness of xylitol gums in treating WSL, Notably, a considerable proportion of participants across all categories (ranging from 32.6% to 50%) reported being unaware of the therapeutic role of xylitol gums.

Questions based on practice patterns and preferences in the management of white spot lesions, when recommending a topical fluoride regimen to treat deeper parts of the lesion and improve aesthetic outcomes, undergraduate practitioners (56.6%) favoured initiating treatment with a lower fluoride concentration. In contrast, specialists' preferences varied, with only 47.8% of endodontists, 52.4% of orthodontists, and 45.5% of other specialists opted for lower fluoride concentrations. Though higher concentrations of fluoride are opted in clinical practice, there are increased chances of mineralization occurring only on the surface layer thereby acting as

hindrance for the penetration of calcium and phosphate ions into the deeper layers. This process is known as lamination. Hence, when low concentrations of fluoride are applied to the WSL, slow remineralization occurs from the deeper surface to the superficial layer of the lesion, thereby producing esthetic results [21].

Regarding treatment choice for WSL, a significant proportion of dental professionals across all categories showed a preference for non-invasive or conservative approaches (figure 5). WSL have the property to remineralize naturally over period of time within the first six months. Hence remineralizing agent and fluoride therapy can be advised. Bleaching can be a treatment of choice, to camouflage the affected area from normal site [22]. In cases, where bleaching did not work, microabrasion followed by Casein PhosphoPeptides- Amorphous calcium phosphate (CPP-ACP) therapy has proven to produce effective results [23].

Conversely, for cases requiring invasive interventions, preferences diverged across undergraduate practitioners and specialists. Orthodontists and endodontists exhibited a higher preference towards composite restorations, micro-abrasion, and interest in using veneers for managing WSL, highlighting the approach towards achieving aesthetic outcomes through invasive treatment modalities. Apart from these techniques, Resin infiltration has produced evident results in masking the WSL. It is a micro-invasive technique which occludes the micro-porosities of the enamel with low-viscosity light-curing resins. It is the preferred treatment option for smooth surface caries occurring on the facial and proximal surfaces producing esthetic results [24].

Though the incidence of white spot lesion appears to be higher, among various dental professionals the percentage of cases diagnosed and treated seems to low (Figure 6). Though the knowledge and awareness about the management of white spot lesion among various dental professionals seems to be appreciable, the application of theoretical knowledge in the preventive management of such lesion seems to be low. Further importance should be given to the early diagnosis and minimally invasive management of such lesions.

Conclusion

It is essential that all dental practitioners, must formulate a caries risk assessment chart for patients with active and non-active caries lesion, to determine the occurrence of new caries and re-emission of old ones. Though preventive treatment options are available for more than a decade, the awareness about incorporating such preventive methods in clinical practice still seems to be scarce. A proper evaluation, assessment, treatment planning and preventive

management of initial caries lesion should be taught to students at their under graduate curriculum, which can efficiently decrease the incidence of cavitation.

References:

1. Weyland MI, Jost-Brinkmann PG, Bartzela T. Management of white spot lesions induced during orthodontic treatment with multibracket appliance: a national-based survey. *Clin Oral Investig.* 2022;26(7):4871-4883.
2. Ren Y, Jongsma MA, Mei L, van der Mei HC, Busscher HJ (2014) Orthodontic treatment with fixed appliances and biofilm formation– a potential public health threat? *Clin Oral Invest* 18:1711– 1718.
3. Silverstone LM, Hicks MJ, Featherstone MJ. Dynamic factors affecting lesion initiation and progression in human dental enamel. II. Surface morphology of sound enamel and carieslike lesions of enamel. *Quintessence Int.* 1988;19(11):773-785.
4. Mizrahi, E. (1983). Surface distribution of enamel opacities following orthodontic treatment. *American Journal of Orthodontics* 84, 323–331.
5. Tufekci E, Dixon JS, Gunsolley JC, Lindauer SJ (2011) Prevalence of white spot lesions during orthodontic treatment with fixed appliances. *Angle Orthod* 81:206–210.
6. Lucchese A, Gherlone E (2013) Prevalence of white-spot lesions before and during orthodontic treatment with fixed appliances. *Eur J Orthod* 35:664–668. [https:// doi. org/ 10.1093/ ejo/ cjs070](https://doi.org/10.1093/ejo/cjs070)
7. Tatsi C, Toumba KJ. Questionnaire on White Spot Lesions to Orthodontist: Members of the British Orthodontic Society. *J Contemp Dent* 2020;10(1):25–29.
8. Weyland MI, Jost-Brinkmann PG, Bartzela T. Management of white spot lesions induced during orthodontic treatment with multibracket appliance: a national-based survey. *Clin Oral Investig.* 2022;26(7):4871-4883.

9. Kerbusch, Antoine & Kuijpers-Jagtman, Anne & Mulder, Jan & Sanden, Wil. (2012). Methods used for prevention of white spot lesion development during orthodontic treatment with fixed appliances. *Acta odontologica Scandinavica*. 70.
10. Dr. Moksha Nayak and Dr. Deepa S. Nair 2017. “Awareness and prevalence of white spot lesion among dental students: A cross sectional study”, *International Journal of Current Research*, 9 (06), 53219-53222.
11. Divesh Sardana, Falk Schwendicke, Esra Kosan, Eser Tüfekçi; White spot lesions in orthodontics: consensus statements for prevention and management. *Angle Orthod* 1 November 2023; 93 (6): 621–628
12. Sagarika N, Suchindran S, Loganathan S, Gopikrishna V. Prevalence of white spot lesion in a section of Indian population undergoing fixed orthodontic treatment: an in vivo assessment using the visual International Caries Detection and Assessment System II criteria. *J Conserv Dent*. 2012; 15:104–108.
13. Geiger AM, Gorelick L, Gwinnett AJ, Griswold PG. The effect of a fluoride program on white spot formation during orthodontic treatment. *Am J Orthod Dentofacial Orthop*. 1988; 93:29–37.
14. Cheng L, Zhang L, Yue L, et al. Expert consensus on dental caries management. *Int J Oral Sci*. 2022;14(1):17.
15. Urquhart, O. et al. Nonrestorative treatments for caries: systematic review and network meta-analysis. *J. Dent. Res*. 98, 14–26 (2019).
16. Fontana, M. & Gonzalez-Cabezas, C. Evidence-based dentistry caries risk assessment and disease management. *Dent. Clin. North Am*. 63, 119–128 (2019).
17. Ogaard B. White spot lesion during orthodontic treatment: Mechanism and fluoride preventive aspects. *Seminars in Orthodontics*. 2008;14:183-193

18. Clinical Affairs Committee AAoPD. Fluoride therapy. *Pediatric Dentistry*. 2017;39: 242-245
19. de Amorim RG, Leal SC, Bezerra AC, de Amorim FP, de Toledo OA. Association of chlorhexidine and fluoride for plaque control and white spot lesion remineralization in primary dentition. *International Journal of Paediatric Dentistry*. 2008;18:446-451
20. Mäkinen KK. Sugar alcohols, caries incidence, and remineralization of caries lesions: A literature review. *Int J Dent* 2010;2010:981072.
21. Deveci C, Çınar Ç, Tirali RE. Management of White Spot Lesions [Internet]. *Dental Caries - Diagnosis, Prevention and Management*. InTech; 2018.
22. Knoßel M, Attin R, Becker K, Attin T. External bleaching effect on the color and luminosity of inactive white-spot lesions after fixed orthodontic appliances. *Angle Orthod* 2007;77: 646-52.
23. Ardu S, Castioni NV, Benbachir N, Krejci I. Minimally invasive treatment of white spot enamel lesions. *Quintessence Int* 2007;38:633-6.
24. Domejean, S. et al. Resin infiltration of non-cavitated caries lesions: a systematic review. *Med Princ. Pr.* 24, 216–221 (2015).