CLINICAL-STATISTICAL STUDIES ON THE FREQUENCY OF WHITE SPOT LESIONS

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ABSTRACT

The study aimed to determine the prevalence and distribution of white spot lesions (WSL) in orthodontic patients, analyzing their correlation with age and tooth type to improve preventive strategies. **Material and Methods:** The study included 85 patients aged 15-30 who underwent orthodontic treatment between 2022 and 2024. WSL diagnosis followed the Modified International Caries Detection and Assessment System (ICDAS II). Data were analyzed using the Chi-square test to assess associations between WSL occurrence, age groups, and tooth types. **Results:** WSL was detected in 31.8% of patients, with the highest prevalence (55.6%) in the 15-20 age group. Lesions were more common in the maxilla (59%) than the mandible (41%), with incisors being the most affected teeth. Chi-square analysis showed no significant association between WSL occurrence and age group ($p = 0.277$) or tooth type ($p = 0.702$). Most lesions were found on vestibular surfaces (50%), with mesial (27%) and distal (23%) surfaces also affected. **Conclusions:** The study confirms that younger patients are at higher risk for WSL, likely due to dietary habits and inconsistent oral hygiene. WSL is more prevalent in the maxilla and anterior teeth. These findings emphasize the need for early intervention, patient education, and preventive strategies, particularly for orthodontic patients, to minimize WSL risk.

Keywords: White Spot Lesions (WSL), orthodontic treatment, age, maxillary, tooth type

INTRODUCTION

Dental dyschromia is a condition marked by changes in the color of teeth, which can range from minor spots and discolorations to significant alterations in their overall appearance. The causes of tooth dyschromia can vary, including genetic and hereditary factors and lifestyle habits. Additionally, teeth may naturally change color over time; for example, it is normal for teeth to become darker and less radiant as one age [1].

In a society that places a heightened emphasis on physical appearance and beauty ideals, the perfect smile has become both a goal and an aspiration [2,3]. Teeth, as the cornerstone of an aesthetic smile, must harmoniously combine proportionality, symmetry, and, above all, naturalness [3]. Within this context, dental discoloration presents a significant challenge to dental aesthetics. Any deviation from the idealized shade of bright white can be perceived as an anomaly, leading to acute aesthetic discomfort and, by extension, an impact on self-esteem [4].

A feature as subtle as tooth color can profoundly affect an individual's social and emotional life. Research conducted in Western societies, such as England, Europe, and the United States, confirms that a considerable proportion of the adult population expresses dissatisfaction with the chromatic appearance

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of their teeth, underscoring an increasing demand for cosmetic dental services [1,5,6,7]. Although orthodontic treatments have grown in popularity in recent years, the occurrence of chalky white spots, known as white spot lesions (WSLs), following treatment remains a significant aesthetic issue in dentistry [8]. Enamel demineralization has various causes, including poor nutrition, inadequate oral hygiene, and improper bonding techniques [1,8]. While fixed appliances are essential in modern orthodontics, side effects such as WSLs can negatively impact the aesthetic outcome of orthodontic treatment [9]. Demineralization is a reversible process, meaning that partially demineralized hydroxyapatite crystals can return to their original size when exposed to an environment that promotes remineralization [10]. The chemical demineralization of teeth occurs primarily due to acidic attacks from the acids in foods and beverages, and bacterial attacks from microorganisms in the oral cavity [10,11].

Orthodontic appliances, especially brackets, ligatures, and wires, create new areas that can trap bacterial plaque [12,13]. The increase in dental plaque, which contains cariogenic bacteria, is the primary cause of enamel demineralization during orthodontic treatment. This demineralization can lead to white spots or cavities on dental surfaces [12,14].

MATERIAL AND METHODS

The study was conducted on 85 patients aged between 15 and 30 who underwent orthodontic treatment at Grigore Palade University of Medicine, Pharmacy, Science and Technology between 2022 and 2024. The study group was divided into three subgroups based on age: 15-20, 21-25, and 26-30 years.

White spot lesions were diagnosed through visual-tactile examination using appropriate magnification and illumination. The diagnosis of WSL was performed according to the Modified International Caries Detection and Assessment System (ICDAS II) [15,16], according to the criteria as follows:

Code 0 - The buccal surface shows no color changes or defects.

Code 1 (incipient lesion) – a clearly defined area on the buccal surface with color changes (matte white, yellowish) is present, but without cavitation (loss of anatomical contour <0.5 mm).

Code 2 (moderate lesion) – a well-defined area on the buccal surface with color changes (chalky white, yellowish) and cavitation (loss of anatomical contour between 0.5 mm and 1 mm).

The Chi-square test was utilized to analyze categorical data and examine potential associations between white spot lesion (WSL) occurrence and two key factors: age group and tooth type. First, the test was applied to determine whether WSL prevalence varied significantly across different age groups. The null hypothesis proposed that WSL occurrence is independent of age, while the alternative hypothesis suggested a possible relationship between age and lesion prevalence. The Chi-square test assessed whether WSL distribution differed among tooth groups, including incisors, canines, premolars, and molars. In this case, the null hypothesis stated that WSL occurrence was independent of tooth type, whereas the alternative hypothesis proposed that certain tooth groups were more susceptible to lesions.

RESULTS

Out of the total group of 85 patients, 27 (36%) were diagnosed with WSL (Figure 1). Male patients accounted for more than half of the studied group, representing 51% (Figure 2).

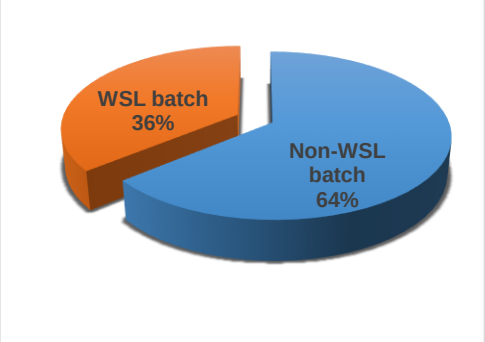

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Fig. 1 Distribution of patients with WSL

Of the total sample of 85 patients, 27 (31,8%) presented WSL. Of these affected patients, 15 (55,6%) were in the first age group of 15-20 years, 7 (25,9%) were in the second group of 21-25 years, and 5 (18,5%) in the third one of 26-30 years (Figure 3).

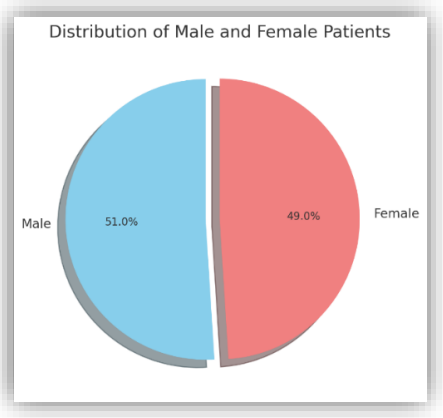

Fig. 2 Distribution of male and female patients

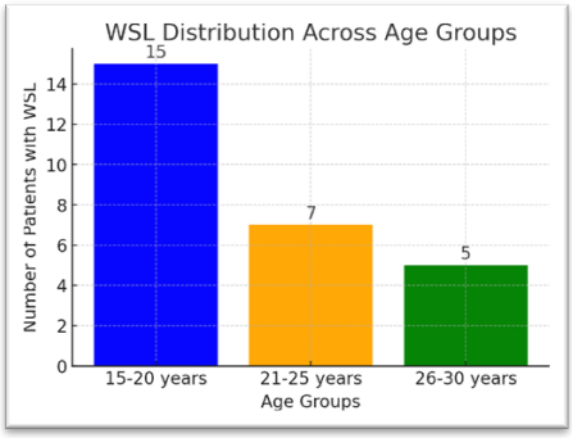

Fig. 3 WSL distribution according to age

Chi-square test results showed the p-value of 0.277 is greater than 0.05, meaning we failed to reject the null hypothesis (H_0). This suggests that WSL occurrence is not significantly associated with age group - there is no strong statistical evidence that WSL prevalence differs among the three age groups.

From the perspective of WSL distribution on the dental arches, it was found that their number is higher in the maxilla—59% compared to the mandible—41% (Figure 4).

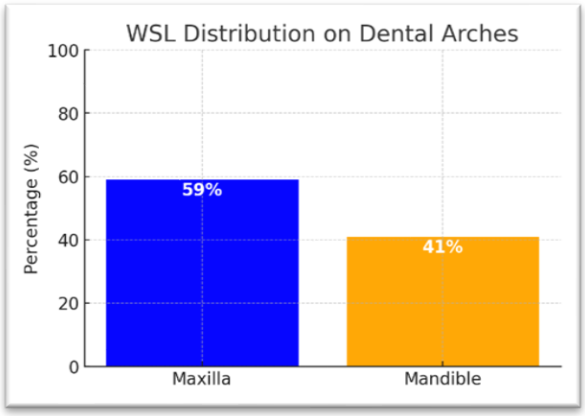

Fig.4 WSL distribution on dental arches

The discoloration distribution by tooth category shows that in the studied group, the most affected teeth are the incisors, followed by the canines and premolars (Figure 5, Table 1).

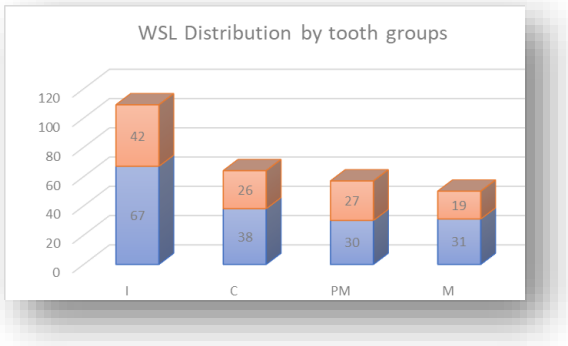

Fig.5 Distribution of WSL by tooth groups

Table 1. Distribution of WSL by tooth types and dental arches

Tooth Type	Maxilla (WSL)	Mandible (WSL)	Total (WSL)
Incisors (I)	67	42	109
Canines (C)	38	26	64
Premolars (PM)	30	27	57
Molars (M)	31	19	50
Total	166	114	280

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The Chi-square test yielded a p-value of 0.702, which exceeds the significance threshold of 0.05. As a result, the null hypothesis could not be rejected. This finding indicates that there is no statistically significant association between WSL occurrence and specific tooth types, suggesting that lesions are distributed relatively evenly across different groups of teeth.

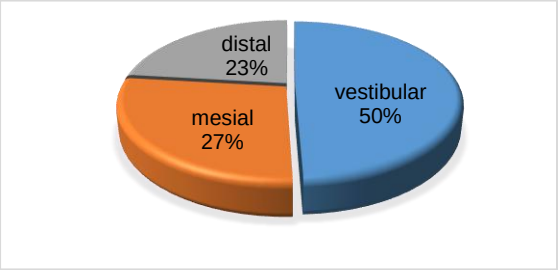

Fig. 6 Distribution of WSL on dental surfaces

Half of the WSL are located on the vestibular surface of the teeth. The proximal surfaces are affected in relatively equal proportions: 27% on the mesial surfaces and 23% on the distal surfaces (Figure 6).

The distribution of scores by tooth category shows a predominance of score 0 at the level of the maxillary incisors (Figure 7).

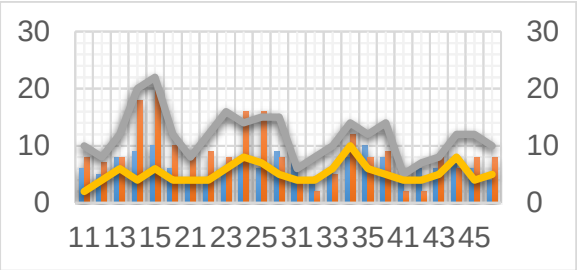

Fig. 7 Distribution of WSL Scores

DISCUSSIONS

The results of this study highlight notable differences in the prevalence of WSL across different age groups, suggesting potential trends in disease progression, risk factors, or management effectiveness over time.

The study result highlights a significant finding: the highest incidence of white spot lesions (WSL) occurs in the 15-20 age group (Figure 3). It can be attributed to several behavioral and lifestyle factors characteristic of this developmental stage. Adolescents and young adults often exhibit dietary habits that include acidic foods and beverages, such as soft drinks, energy drinks, and processed snacks. These acidic consumables can weaken enamel integrity, making teeth more susceptible to demineralization and the development of WSL [17,18].

Moreover, this age group is more likely to engage in rushed and less meticulous oral hygiene practices. The fast-paced nature of their daily routines with a lack of consistent focus on proper brushing and flossing techniques, further contributes to the higher prevalence of WSL [17]. These factors underscore the need for targeted educational and preventive interventions to promote healthier dietary choices and improve oral hygiene practices among adolescents and young adults [17,18]. Such measures could play a role in reducing the incidence of WSL and enhancing overall oral health outcomes for this vulnerable age group [19]. Adolescents and young adults often exhibit risk-taking behaviors and may have lower adherence to oral hygiene due to lifestyle changes, independence from parental supervision, or psychological stress. Examining how cognitive development influences dental care habits could be relevant [20].

Adolescents and young adults undergo hormonal fluctuations that can influence saliva composition, buffering capacity, and microbiome composition, potentially impacting WSL development [21]. Investigating the role of hormonal changes on oral health could provide deeper insights. The high prevalence in this group underlines the importance of early intervention strategies, including preventive measures and patient education to reduce the risk of progression.

In the older groups, we had a decrease in WSL cases compared to the younger group. This decline may indicate the impact of improved oral care practices, lifestyle modifications, or clinical interventions as individuals transition into adulthood [22]. However, despite the reduction in prevalence, a significant proportion of patients in this group still exhibited WSL, emphasizing the need for

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continued monitoring and management to prevent further dental complications.

Economic factors play a role in access to dental care and preventive treatments. The decline in WSL prevalence in the 20-25 age group may reflect access to dental insurance or increased awareness of oral health due to higher education or employment.

While some individuals may experience a reduction in WSL due to better oral care and treatment adherence, others may continue to develop lesions due to persistent risk factors such as diet, lifestyle, or inadequate treatment [23]. The observed increase also raises questions about potential relapse or new lesion development in this age group, warranting further investigation. Overall, the findings suggest a trend where WSL prevalence is highest in the youngest group, declines in early adulthood, and slightly declines again in the late twenties.

The results indicate that WSL occurrence is more prevalent in the maxilla (59%) compared to the mandible (41%) (Figure 4). This distribution suggests that teeth in the maxillary arch may be more susceptible to WSL development. This finding is consistent with previous studies, which have attributed the increased susceptibility of the maxilla to factors such as variations in enamel composition, oral hygiene practices, and exposure to cariogenic factors. The inclination of maxillary teeth, particularly the anterior ones, may also contribute to increased plaque accumulation and subsequent lesion formation [24,25].

Analysis of WSL prevalence across different tooth groups revealed that incisors were the most affected teeth, followed by canines and premolars (Figure 5, Table 1). This pattern aligns with clinical observations, as anterior teeth, especially incisors, are more exposed to cariogenic environments and are commonly involved in orthodontic treatment, a known risk factor for WSL formation. Canines and premolars also exhibited notable WSL occurrence, possibly due to their position and involvement in occlusal function, which may influence plaque retention [24,25].

To further investigate whether certain tooth types were more prone to WSL, a Chi-square test was conducted. The test yielded a p-value of 0.702, above the significance threshold of 0.05. As a result, the null hypothesis could be accepted, indicating no statistically significant association between WSL occurrence and specific tooth types. This suggests that while some groups, particularly incisors, appear to be more affected, the distribution of WSL across different tooth types does not differ significantly in a statistical sense. This finding highlights the multifactorial nature of WSL development, where several clinical and patient-related factors contribute to lesion formation beyond tooth type alone [26].

Regarding the affected dental surfaces, the study found that half of the WSL was located on the vestibular surfaces of the teeth (Figure 6). This is expected, as the vestibular surface is more prone to plaque accumulation, especially in patients undergoing orthodontic treatment with fixed appliances [9,24]. The proximal surfaces were affected relatively equally, with 27% of WSL occurring on the mesial surfaces and 23% on the distal surfaces. These findings align with the known etiological factors of WSL, as proximal surfaces often pose challenges in oral hygiene maintenance and are frequently exposed to plaque accumulation [17,24].

When analyzing the severity of WSL based on score distribution, it was observed that the maxillary incisors exhibited a predominance of score 0 (Figure 7). This suggests that despite their high prevalence of WSL, the severity in these teeth remains relatively low. This could be attributed to the accessibility of anterior teeth for oral hygiene practices, leading to early intervention and better plaque control [24-26].

The results of this study have important clinical implications for the prevention and management of WSL. Given the higher prevalence of WSL in the maxilla and vestibular surfaces, targeted preventive strategies such as improved oral hygiene instructions, fluoride applications, and patient education should be emphasized, especially for individuals at higher risk, such as orthodontic patients [24,26]. Furthermore, the lack of

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significant statistical association between WSL occurrence and specific tooth types suggests that a comprehensive preventive approach should be applied to all teeth rather than focusing solely on groups.

CONCLUSIONS

This study reveals that WSL is most common in the 15-20 age group, likely due to diet, inconsistent oral hygiene, and hormonal changes. Prevalence decreases in adulthood, suggesting improved oral care and access to treatment, though some individuals remain at risk. WSL is more frequent in the maxilla, particularly on vestibular surfaces and incisors, but statistical analysis found no significant link between lesion occurrence and specific tooth types. These findings highlight the need for early intervention, targeted education, and preventive measures, especially for high-risk individuals like orthodontic patients. Oral hygiene and fluoride application can help reduce WSL incidence across all teeth.

Conflict of interest: the authors declare no conflict of interest associated with this paper.
Institutional Review Board Statement: the study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of SC Algocalm SRL, Târgu-Mures, Romania, 03/06.05.2024.
Informed Consent Statement: informed consent was obtained from all subjects involved in the study.

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