

IMPROVING THE TREATMENT OF DENTAL CARIES IN SCHOOL-AGE CHILDREN USING THE REMINERALIZATION METHOD

Dinikulov J. A.¹,
Abdukayumova Z. X.²

¹PhD, Associate Professor of the Department of Pediatric
Therapeutic Dentistry of Tashkent State Dental Institute

² Master's student of the Department of Pediatric
Therapeutic Dentistry of Tashkent State Dental Institute

Abstract:

Despite advances and innovations in the field of dentistry, the issue of dental caries remains highly relevant in pediatric dentistry. As a result, not only do complications arise in the oral cavity, but diseases in other organ systems, psychological problems, and significant delays in growth and development can also occur. Premature loss of permanent teeth can lead to occlusal defects, which in turn cause issues with digestion, speech, and aesthetics. This highlights the importance of treating caries at an early stage — specifically during the initial "white spot" phase — to prevent future tooth loss and its associated complications.

Keywords: Caries, demineralization, remineralization.

Introduction

Dental caries remains a pressing issue for both children and adults, as it equally affects oral health across all age groups. It has been established that early detection of demineralization lesions and their elimination through remineralization methods can significantly reduce the severity of the problem. Recent research demonstrates the growing relevance of applying this approach in pediatric dentistry.

Dental caries is a multifactorial chronic disease of the oral cavity, affecting the majority of the global population and representing one of the most serious worldwide oral health challenges. The earliest clinical sign of a new carious lesion is the appearance of chalky white spots on the enamel surface, indicating enamel demineralization. At this stage, the demineralization process can still be halted or reversed. Dental caries, being one of the most widespread chronic dental diseases, is characterized by progressive destruction and has a multifactorial etiology. In most developed countries, 60–90% of schoolchildren and nearly 100% of adults are affected by caries [1].

According to Gudipani R.K. et al. (2022), more than half (57.2%) of children aged 7–9 years presented with initial forms of caries on their first permanent molars. Rozakova L.Sh. et al. (2020) reported that in children living in Samara, the prevalence of initial carious lesions on the first permanent molars increased from 27.16% at age 6 to 60.27% at age 8. Data from Abramova N.Ye. and Silina A.V. (2021) showed that among children in St. Petersburg, caries at the white spot stage was observed in 24.67% of cases at ages 5–6, 24.57% at age 12, and 38.71% at age 15. Kuzmina E.M. et al. (2022) noted that in adolescents aged 12–17, the prevalence of initial lesions (according to ICDAS criteria) ranged from 63% to 70% of affected tooth surfaces [4,2,3,5].

Initial caries refers to the demineralization process in the surface layer of dental hard tissues without the formation of a cavity, and is characterized by changes in enamel color. Clinically, it manifests as painless white or brown spots, which primarily pose an esthetic issue. This stage is called the “white spot lesion,” representing the first phase of carious pathology. If untreated, it progresses to superficial caries. The etiology of initial caries is multifactorial, including both local and systemic factors: poor oral hygiene, malocclusion, disturbances in salivary pH and composition, improper diet (high carbohydrate intake or prolonged carbohydrate retention in the mouth, vitamin and protein deficiencies, fluoride deficiency in drinking water), external influences (high radiation exposure, radiotherapy), hereditary predisposition, and systemic conditions (diabetes mellitus, hypothyroidism, gastrointestinal diseases, rickets, HIV/AIDS, etc.).

Large populations of cariogenic microorganisms capable of fermenting carbohydrates and producing acids are present in the oral cavity. They destroy the enamel’s surface layer, leading to white or brown demineralization spots. If left untreated, these lesions progress to cavitated caries and further complications. At the initial stage, the disease begins with a cariogenic environment in the oral cavity. Microorganisms within dental plaque metabolize carbohydrates, producing organic acids. As a result, the enamel surface pH shifts toward acidity, leading to hydroxyapatite crystal dissolution and subsequent demineralization. Under electron microscopy, acute lesions appear triangular in cross-section, while chronic ones appear trapezoidal, with the broader base oriented toward the enamel surface. Importantly, at the white spot stage, no breakdown of the organic matrix occurs [6].

In terms of progression, these lesions develop relatively quickly, but become clinically visible only once the enamel surface dries. Thus, the chalky white spot represents partial mineral loss that, when detected early, remains susceptible to remineralization [7].

Enamel, being a highly mineralized tissue, is unique in its structure, hardness, esthetics, and physical properties. It primarily serves to protect the underlying tooth structures but lacks the ability for spontaneous regeneration once damaged. Traditionally, restorative treatment using artificial filling materials has been employed in such cases. However, to preserve enamel integrity and halt caries progression, **biomimetic remineralizing**

agents have been proposed as a minimally invasive approach to treat early demineralization lesions [8].

According to research, the prevalence of white spot lesions (WSLs) during fixed orthodontic treatment reaches 73–95% [9]. The multibracket appliance (MBA) is a standard orthodontic treatment modality; however, one of its negative consequences is the creation of iatrogenic plaque-retentive sites, which enhance biofilm accumulation near the brackets. Apart from bracket-associated gingivitis, this often leads to white spot carious lesions (WSLs). Preventing WSLs during MBA therapy is crucial, as up to 40% of orthodontic patients—or even as high as 79.3% according to recent academic reports—develop WSLs within the first six months of treatment. This is recognized as a serious issue in orthodontics, necessitating preventive measures.

In one study, patients aged 12–17 undergoing active MBA treatment who had at least one WSL scored 1–2 on the ICDAS scale were included for resin infiltration treatment (Icon). Standardized digital images were taken before treatment, and after 1 day, 1 week, 1 month, 3 months, and 6 months. A gray reference card was used for color calibration, and MATLAB software was applied to measure the color difference between treated WSLs and adjacent sound enamel. Results showed that resin infiltration significantly improved the esthetic appearance of WSLs ($p < 0.001$), with effects remaining satisfactory even after 6 months [12].

Kobiyasova I.V. et al. (2013) aimed to evaluate the effectiveness of course-based remineralizing therapy using **R.O.C.S. Medical Minerals** calcium-phosphate adhesive gel for prevention and treatment of focal demineralization in adolescents. The study involved 115 children aged 12–13 years (67 girls, 48 boys). Initial examination revealed early caries signs in 62% of participants, highlighting a pronounced cariogenic situation during puberty. A 25-session application of the R.O.C.S. gel reduced white spot lesions by 2.8 times and increased enamel remineralization by 53.3% compared to baseline [10].

Similarly, A.A. Gegamyan et al. (2021) assessed enamel remineralization rates in adolescents with focal demineralization following fixed orthodontic treatment using the intraoral camera *Qraypen*TM and Qray software (Inspector Research Systems BV). In the first group, natural remineralization occurred due to saliva's restorative properties, while in the second group, **R.O.C.S. Medical Minerals** gel was applied. Results showed that natural saliva-mediated remineralization alone was insufficient for complete enamel recovery. In the gel group, mineral loss decreased by 20% after two weeks and by 50% after six weeks compared to baseline [11].

In conclusion, white spot lesions represent the earliest macroscopic manifestation of enamel caries. Natural remineralization of enamel occurs in the early stage through calcium and phosphate ions, buffering agents, fluoride, and other salivary components. Fluorides have long been used for caries prevention and enamel remineralization. However, the main limitation of current fluoride-containing toothpastes, rinses, and topical agents is their dependency on calcium and phosphate ion concentrations in

saliva, which are often insufficient. This has stimulated the search for new fluoride-free materials capable of supplying the oral cavity with the essential elements required for remineralization.

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