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WEDGE-SHAPED DEFECT — MECHANICAL TOOTH DAMAGE OR A MULTIFACTORIAL PROCESS?

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Annotation

A wedge-shaped defect is one of the clinically important forms of non-carious cervical lesions that develop in the hard tissues of teeth. This condition usually occurs on the vestibular surface of the tooth, near the cementoenamel junction, and appears as a V-shaped or wedge-shaped defect. Clinically, a wedge-shaped defect may cause dentin hypersensitivity, aesthetic problems, progressive loss of tooth tissue, and, in some cases, the need for restorative treatment. In the past, incorrect tooth brushing and mechanical abrasion were often considered the main causes of this condition. However, modern scientific views suggest that it is not enough to explain wedge-shaped defects by a single cause. Abrasion, erosion, occlusal stress, anatomical features of the teeth, dietary habits, parafunctional activities, and individual behavioral factors may interact with each other and lead to tissue loss in the cervical region. This article examines the etiology and pathogenesis of wedge-shaped defects, their clinical and morphological features, diagnosis, differential diagnosis, modern treatment principles, and prevention.

Keywords: wedge-shaped defect, non-carious cervical lesion, abrasion, erosion, abfraction, occlusal stress, dentin hypersensitivity, tooth tissues, cervical region, prevention.

Damage to the hard tissues of teeth has an important place among dental diseases. Although many dental problems are related to caries, non-carious lesions that involve the loss of hard tooth tissues are also common in clinical practice. These lesions differ from bacterial caries and include several types of tooth tissue damage. Among them, non-carious lesions in the cervical region of teeth are an important

clinical problem. Non-Carious Cervical Lesions (NCCLs) may appear in different forms. Some are shallow and rounded, while others are deep and have clearly defined V-shaped forms. The latter are often described as wedge-shaped defects. A systematic review published in 2024 showed that NCCLs have a wide variety of morphological forms. Wedge-shaped or saucer-shaped defects are often found on buccal surfaces, and their development is mainly explained by multifactorial causes.

The importance of this problem is also related to its high prevalence. A systematic review of the overall prevalence of NCCLs among adults reported a pooled prevalence of 46.7%. The prevalence was higher among people over the age of 30. A wedge-shaped defect should not be considered only an aesthetic problem. When the defect reaches the dentin, the dentinal tubules become exposed. As a result, the patient may experience short, sharp pain in response to cold, hot, sweet, sour, or mechanical stimuli. In addition, the progression of the condition may reduce the amount of tooth tissue and affect the structural stability of the tooth. The aim of this article is to analyze the mechanisms behind the development of wedge-shaped defects based on modern scientific views, evaluate their role as a form of mechanical tooth damage, and explain the clinical importance of their multifactorial etiology. A wedge-shaped defect is usually located in the cervical part of the vestibular or buccal surface of a tooth. Its typical appearance is a V-shaped defect with two walls, with the deepest part extending inward into the tooth tissues. A systematic review published in 2024 reported that the clinical and microscopic morphology of NCCLs varies considerably. Studies have described features such as wear facets, microcracks, dentin sclerosis, scratch marks, dimples, and craters. It has also been reported that these lesions occur more frequently in premolars. These findings show that it is not enough to assess a wedge-shaped defect based only on its external appearance. The morphology of the defect may provide some information about the factors involved in its development. The etiology of wedge-shaped defects has long been a subject of debate in dentistry. At first, the main focus was on mechanical

abrasion. Later, the importance of occlusal stress and chemical erosion was also recognized. According to current views, the development of non-carious cervical lesions (NCCLs) can often be explained by the interaction of biological, chemical, mechanical, and behavioral factors. A review published in 2023 also discussed the relationship between erosion, abrasion, and abnormal occlusal forces. Abrasion refers to the loss of tooth surface caused by repeated mechanical action. In the context of wedge-shaped defects, incorrect tooth brushing is one of the most frequently discussed mechanical factors. Brushing with strong pressure and horizontal movements, using hard-bristled toothbrushes, and uncontrolled use of highly abrasive products may increase mechanical stress in the cervical region. However, it is not fully supported by scientific evidence to consider the toothbrush the only cause of wedge-shaped defects. Patients with similar tooth-brushing habits may have different levels of NCCL development and different defect depths. Therefore, mechanical abrasion may contribute to the progression of the condition when combined with other factors. Erosion is the loss of mineralized tooth tissues caused by acids, independently of bacterial fermentation. These acids may come from two main sources. Acid exposure causes changes in the mineral structure of enamel and dentin. As a result, the tooth surface becomes more vulnerable to mechanical forces. Therefore, erosion and abrasion may have a combined effect: chemical exposure softens the tooth surface, while mechanical action speeds up the loss of the softened tissue.

One of the most widely discussed concepts in the etiology of wedge-shaped defects is abfraction. According to the theory of abfraction, occlusal forces acting on a tooth may cause stress concentration in the cervical region. Repeated stress may lead to slight tooth bending and the development of microdamage in the hard tissues. Some studies have reported an association between occlusal stress and NCCLs. For example, many of the studies included in a systematic review of abfraction found an association between occlusal stress and NCCLs. However, none of the clinical

studies has conclusively proved that stress alone can independently cause NCCLs. For this reason, abfraction should not be considered the only or definite cause of wedge-shaped defects. Modern scientific literature more often describes occlusal stress as a mechanism that may contribute to the condition together with other factors. In one patient, mechanical factors may play the main role, while in another, frequent consumption of acidic products may be the major risk factor. In addition, tooth anatomy, enamel thickness in the cervical region, the position of the tooth in the dental arch, and individual characteristics may also affect the development of the condition. A clinical study published in 2024 also emphasized the multifactorial nature of NCCLs. It identified erosion, abrasion, abnormal occlusion, and anatomical features of the teeth as possible risk factors. Therefore, although a wedge-shaped defect may be described as a form of mechanical tooth damage, its mechanical component often occurs together with chemical and occlusal factors. The clinical signs of a wedge-shaped defect depend on the depth of the lesion. In the early stages, patients may not have any complaints. When dentin becomes exposed, the dentinal tubules come into contact with the external environment. This may lead to the development of dentin hypersensitivity.

The diagnosis of wedge-shaped defects requires a comprehensive approach. The first step is to collect the patient's complaints and medical and dental history. Particular attention should be paid to tooth-brushing habits, the type of toothbrush used, toothpaste, consumption of acidic products, bruxism, parafunctional habits, and complaints related to occlusion. During the clinical examination, the following features of the defect should be assessed: shape, depth, location, sensitivity. When necessary, radiographic examination, assessment of pulp vitality, and occlusal evaluation may also be performed. The most important principle in the treatment of wedge-shaped defects is not only to restore the existing defect but also to identify and control its causes. According to modern clinical recommendations, conservative monitoring and preventive measures are important for small, non-progressive

NCCLs that do not cause symptoms. Restorative treatment may be considered depending on several factors, including progression of the defect, sensitivity, aesthetic problems, food impaction, and the effect of the condition on the patient's quality of life.

A wedge-shaped defect is a common and clinically important type of non-carious cervical lesion affecting the hard tissues of teeth. Its main morphological feature is the formation of a V-shaped or wedge-shaped defect in the cervical region of the tooth. The modern scientific evidence discussed in this article shows that it is not sufficient to consider wedge-shaped defects only as a form of mechanical damage. Mechanical abrasion, erosion, occlusal stress, anatomical characteristics, and individual behavioral factors may interact and increase the effects of one another. Therefore, considering wedge-shaped defects as a multifactorial pathological process is more consistent with the modern approach to dentistry. The main goal of treatment is not only to restore the existing defect but also to identify and control the factors responsible for its development. Early diagnosis, individualized preventive measures, proper oral hygiene, control of acid exposure, and restorative treatment when necessary can help preserve tooth tissues over the long term. In conclusion, from a modern scientific perspective, the question "Is a wedge-shaped defect mechanical tooth damage or a multifactorial process?" can be answered as follows: it should generally be considered a multifactorial process that develops through the interaction of chemical, mechanical, occlusal, and individual factors rather than as a condition caused by a single mechanical factor.

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