Abstract

The enamel-cementum junction represents an unique place on the dental surface, where the three hard tissues can occur under at least 4 types of ratios, and on which, in the young adult, the dento-gingival ligaments of the covering parodontium are inserted. Usually, the clinical and therapeutical implications of the morphology of the enamel-cementum junction are neglected in routine stomatological therapy. The present study aims at identifying and evaluating - through scanning electronic microscopy - the types of enamel-cementum junctions analyzed in a group of 64 teeth with intact cervical area, extracted from orthodontic and periodontal reasons. In the frontal area, an enamel-cementum juxta-ratio is most frequently occurring, in the canines a dentine band being interposed among the supradjacent tissues, which is even more common on the vestibular and oral surfaces. In the lateral area, most frequently the cementum covers the enamel, while the vestibular and oral surfaces show no instances of enamel-cementum non-coalescence. No areas of uncovered dentine could be noticed on the vestibular and oral surfaces of the mandibulary teeth, the most frequently met ratio being that in which the cementum covers the enamel. The higher frequency of the areas of uncovered dentine at cervical level, between enamel and cementum, especially in the maxillary canines, represent an alarm signal, as this is a fragile region, intensively predisposed to physiological modifications induced by age, but also to pathological modifications, which require special protection and management, even during routine therapeutical actions.

Keywords: enamel, cementum, enamel-cementum junction, scanning electronic microscopy

INTRODUCTION

In spite of the fact that the clinical and therapeutical implications of the morphology of the enamel-cementum junction (JSC) are relatively well-known, the research devoted to this topic has been shadowed by some more “fashionable” topics, which reduced the importance and incidence of the JSC-related pathology. One should not forget that this region represents one of the favourite centers for both dental caries and non-cariogenous cervical lesions represented by erosions, abrasions and abfractions. Intempestive prophylactic and therapeutical manoeuvres may generate, in their turn, dental tissular or periodontal lesions, with unfavourable future consequences. The literature in the field describes initially 3 possible relations among the hard dental tissues at this level: in 10% of the cases, the cementum does not meet the enamel, a dentine band being exposed towards the outside part, in 30% of the cases the enamel meets the cementum in a head-to-head ratio while, in the remaining 60% situations, the cementum covers the enamel (1). The first researcher who defined the types and prevalence of the tissular interrelations at JSC by optical microscopy was Chaquet (2) in 1899.

Together with the increase in life expectancy and in the number of teeth present on the arch at an advanced ages, a higher prevalence of the odontal lesions at cervical level was also noticed (3,4), so that a more profound histological investigation should become a necessity and, equally, a priority. Previous studies, performed on various populations, in which the frequency of the tissular ratios is different, support the hypothesis that the anatomical profile of JSC might be dependent on race (5,6).

Previous researches suggested some interrelation between the type of junction and dentinary permeability, especially where a band of exposed dentine occurs between enamel and cementum (7). The complex pathology observed at this level, as well as the difficult realization of some successful restorations of the cervical lesions,
require further minute studies on the inter-tissular ratios active in this region. For example, the SEM technique assures higher accuracy and precision in the interpretation of the relations between enamel, cementum and dentine, leading at the same time to a more critical study of surface morphology and analysis of the cervical perimeter.

The scope of the present study included identification and comparative analysis, by SEM examinations, of the JSC types on groups of teeth and on different dental surfaces.

**MATERIALS AND METHOD**

64 permanent human (32 maxillary and 32 mandibular) teeth, extracted for orthodontic and periodontal reasons, with no cervical lesions, of carious or non-cariogenic origin, or other morphological or growth anomalies, were analyzed. Their distribution according to the tooth type was the following: 16 incisors, 12 canines, 16 premolars, 20 molars. The extractions were performed so that not to affect the area of the enamel-cementum junction through surgical manoeuvres. Immediately after extraction, the teeth were put into a 10% formol solution. The organic and anorganic material was removed by manual intervention and immersion in a 5.25% NaOCl solution. The thus obtained samples were sectioned longitudinally in the vestibulo-oral and mezio-distal planes, by means of some diamond disks active on the edge (Gebr. Brasseler GmbH&Co, Germany), under continuous cooling with water. Further on, each sample was processed by finishing and polishing with disks of paper with decreasing granulation, up to a size of 10 μm.

**Scanning electronic microscopy**

The JSC samples with intact morphology were analyzed on a VEGA II LSH scanning electronic microscope, produced by TESCAN, Czechia. The microscope, entirely computer-controlled, is equipped with an electron cannon with a tungsten filament, which may attain a 3nm resolution at 30KV, magnification between 30 and 1,000,000 X in the resolution mode, accelerating power between 200 V and 30 kV, scanning speed between 200 ns and 10 ms per pixel. The working pressure is below 1x10^-2 Pa. The relationship between enamel, dentine and cementum was established and recorded for each sample in the junction area.

Tissular inter-relations were synthesized, according to the literature in the field, in 4 types:

- The enamel ends with a pointed or irregular shape, being covered by cementum.
- Between enamel and cementum, a dentine band directly exposed to the external medium is present.
- The enamel is directly continued with the cementum, through a head-to-head relation.
- The cementum is covered by a very fine enamel band.

**RESULTS AND DISCUSSION**

The results obtained on the distribution of the tissular ratios at JSC level on various tooth groups and dental surfaces have been synthesized as follows:

- for maxillary teeth, on vestibular and lingual surfaces, in the case of incisors, the highest frequency was recorded by the head-to-head junction, followed by that of an exposed dentine band where the cementum covers the enamel and by another one, in which the enamel covers the cementum. In canines, the exposed dentine was most common, followed by the head-to-head junction, cementum covering the enamel and, in no case, enamel covering the cementum. In premolars, the distribution was similar with the one in incisors, most frequently the cementum covering the enamel, the enamel covering the cementum, while the presence of an area of exposed dentine was the most rare (Fig. 1)
- for the maxillary teeth, on the proximal surfaces, the cementum covered the enamel most frequently in molars, followed by incisors, canines and premolars. The head-to-head junction was equally distributed
among the 4 dental groups. The exposed dentine was present only in canines and molars, while the enamel covered the cementum in the highest ratio in premolars, incisors and molars, followed by canines. (Fig 2)

Fig. 1. Pattern of the anatomic profile of the maxillary teeth on the vestibular and oral surfaces

Fig. 2. Pattern of the anatomic profile of the maxillary teeth on the proximal surfaces

- in the case of mandibulary teeth, the enamel most frequently covered the cementum on the proximal surfaces of the incisors, then the cementum covered the enamel, following the head-to-head junction and, most rarely, the area of exposed dentine. As to the head-to-head junction, it was most frequently occurring in molars, followed by premolars and, most rarely, by incisors and canines. The enamel covered the cementum most frequently in molars, followed by premolars, canines and incisors (Fig 4).

Fig. 3. Pattern of the anatomic profile of the mandibulary teeth on the vestibular and oral surfaces

Fig. 4. Pattern of the anatomic profile of the mandibulary teeth on the proximal surfaces

SEM analysis provided the most suggestive images of the anatomic pattern of JSD, as shown in the present study (Figs. 5-8).
DISCUSSION

The morphology of JSC in permanent teeth has a considerable clinical and therapeutical significance, due to its association with dental sensitivity and susceptibility to pathological modifications, such as carious cervical wounds, radicular and cervical non-carious wounds. It is expected that prolongation of the average life span will result in an increased number of such wounds. Several studies contradict the validity of the results provided by handbooks of histology on the anatomical profile of JSC (4,8,9). Usually, JSC is covered by the gingival tissue, however, with the advance of age and continuous eruption, which compensates for occlusal wear, this area becomes exposed in the oral medium. Consequently, JSC will be subjected to the action of various chemical and physical factors that might alter its morphology, in most cases the cementum being affected.

The present study demonstrated the occurrence of a higher percentage of head-to-head ratios than usually known, which agrees with the results of other investigations. Thus, Benevius, in a study developed on freshly-erupted premolars found out a ratio of 76%, the cementum covering the enamel only in a ratio of 14% (9). The same head-to-head manner was evidenced as prevailing by Kapila Arambawatta, who examined, by optical microscopy, 67 premolars, the percentage of head-to-head occurrence being of 55.1% (10).

The low extent of enamel over the cementum has been described by several authors (4,8,9), even if an embryologic-type explanation is quite difficult to establish, once known that cementum formation begins when enamel formation is completely over. In some studies (8), the existence of the band of exposed dentine between enamel and cementum was considered to be accidental. In the present study, the presence of empty spaces with dentin exposure was more frequent in the maxillary teeth from the frontal area, suggesting that JSD is a center highly exposed to the occurrence of some pathological modifications during therapeutical manoeuvres, such as installation of rings from the rubber dam.
of the covering crowns, of restorations materials and whitening techniques. The above observations indicate a considerable morphological diversity of the anatomical pattern of JSD on both groups of teeth and dental surfaces.

The results of the present investigation, in agreement with the conclusions of other studies (7,10), provide evidence that the distribution of the three mineralized tissues and the relations established among them in the cervical region are irregular and often unforeseeable. Considering its consistency and brittleness, JSC requires a careful management during any therapeutical procedure, for avoiding wounding, which might cause cervical dentinary sensitivity and radicular resorptions.

CONCLUSIONS

In the maxillary:
1. The vestibular and oral surfaces are more “exposed” than the mezial and distal ones
2. In the frontal area, a S-C juxta ratio occurs more frequently
3. In the canines, a dentine band is interposed between the supradjacent tissues
4. In the lateral area, in most cases, the cementum covers the enamel

In the mandible:
1. The vestibular and oral surfaces show no S-C uncoalescence
2. On the mezial and distal surfaces, it was very uncommon to find areas of uncovered dentine
3. Most frequently, the enamel covers the cementum.

References

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