

Cementoenamel Junction: Morphological Characterization in Nepali Population

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ABSTRACT

Introduction: Cementoenamel junction (CEJ) represents the anatomic limit between the crown and root surface and is defined as the area of the union of the cementum and enamel at the cervical region of the tooth. However, the type of CEJ in the Nepali population is not well documented.

Objective: In the present study, the authors attempt to characterize the morphological type of CEJ in the Nepali population.

Methods: This is a descriptive cross-sectional study using a total of 300 CEJs from the Nepali population visiting the Kathmandu University School of Medical Sciences, Department of Dental Surgery, Dhulikhel Hospital (KUSMS-DH) between January 2023 to August 2023. Extracted teeth were sectioned to 250µm thickness and observed under the light microscope to determine the type of CEJ.

Results: Most of the samples presented type I CEJ. Type I, II, and III CEJ were seen in 149 (49.67%), 103 (34.33%), and 48 (16%) of the samples respectively. Additionally, 110 (73.34%) of the samples showed similar types of CEJ in both the buccal and palatal sides of the same tooth while 40 (26.66%) had different types of CEJ within the same tooth.

Conclusions: Type I CEJ is the most common in the Nepalese population. The type of CEJ shows variation within the same teeth in different areas.

Keywords: Cementoenamel junction; morphological types; nepali population.

INTRODUCTION

Cementoenamel junction (CEJ) represents the anatomic limit between the crown and root surface and is defined as the area of the union of the cementum and enamel at the cervical region of the tooth.¹ After the eruption of teeth, CEJ is covered by gingiva and is located at the gingival sulcus in

a healthy mouth. Gingival recession, as a part of advancing age and periodontal diseases, tends to expose the CEJ. Clinical exposure of the previously hidden cementum and the CEJ may lead to dentinal hypersensitivity when exposed to hot/cold, and sweet/salty foods as well as increased susceptibility to radicular caries.² It also plays an important role in periodontal health and diseases.²⁻⁴ The location and morphological type of CEJ is equally important in academic and research as is in its clinical values. Several international studies have characterised the type of CEJ in human dentition.^{1,2,5,6} However, the data regarding the CEJ in the Nepali population are very few.⁷ In the present study, authors attempt to characterize the morphological type of CEJ in the Nepali population.

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METHODS

This is a descriptive cross-sectional study using a total of 300 CEJ sites from 150 extracted teeth of the Nepalese population between the ages of 10 years and 80 years who visited the Kathmandu University School of Medical Sciences, Department of Dental Surgery, Dhulikhel Hospital (IRC-KUSMS), between January 2023 to August 2023. The sample size was calculated based on previous studies on the prevalence of teeth extraction.⁸

The sample size was calculated using the following formula:

$$\text{Sample Size (n)} = Z^2 p(1-p) / e^2$$

Prevalence of cause of extraction of teeth (p) = 17.44%⁸

Z = 1.96 at 95% of Confidence Interval; Margin of error (e) = 5%

The minimum sample size was 221.25 (rounded to 222), however 300 CEJ sites were included.

Ethical clearance for the study was taken from (IRC-KUSMS, Ref no: 237/22). Teeth extracted due to endodontic failure, trauma, grossly decayed conditions, those indicated for orthodontic and prosthodontic treatment, and with intact cervical region were included in this study. Teeth in which cemento-enamel junction could not be determined due to reasons including cervical abrasion/erosion/resorption, cervical caries, or restoration were excluded from the present study. Following informed consent, age, gender and teeth to be extracted were recorded before commencement of teeth extraction. Teeth extraction was performed under local anaesthesia maintaining the aseptic minor surgical protocols. Following extraction, the teeth were fixed in a 10% neutral formaldehyde (formalin) solution, dried, and encoded. Teeth sectioning was

done in a buccolingual direction near the centre of each tooth using an air-rotor high-speed handpiece and diamond-coated burs and disks. Teeth sections of final thickness measuring 250µm were obtained by manually grinding on Arkansas stone. The final thickness was measured on a digital vernier caliper (Ingco, China). Prepared sections were cleaned on xylene, mounted on microscopic slides, and covered with coverslips using DPX adhesive solutions. Prepared slides were examined at 100X magnification under the light microscope (Olympus CX22, Olympus Corporation, Tokyo, Japan), to determine the morphological type of CEJ. CEJ on both the buccal and lingual sides were examined and recorded. The relationship of cemento-enamel junction was classified into four types: Type I - Cementum overlapping enamel (COE), Type II - Cementum and enamel edge to edge (Butt), Type III - Cement and enamel fail to meet (gap), and Type IV - Enamel overlapping cementum (EOC). Data were collected and entered in Microsoft Excel sheets. The Statistical Software Statistical Package for Social Sciences (IBM SPSS Statistics for Mac, version XX (IBM Corp., Armonk, N.Y., USA) was used for the analysis of the data. Descriptive statistical analysis was performed. Data is presented as a number (percentage).

RESULTS

The total number of CEJ included in the present study was 300 from 150 teeth extracted from patients aged 10 to 80 years. Out of 150 teeth, 99 of them were extracted from female patients while the remaining 51 were extracted from male. The sample teeth were equally divided into the anterior and posterior segments of the mouth, being 75 incisors and canines, and the other 75 premolars. Both the buccal/labial and lingual/palatal CEJ were examined from each of the teeth samples. Histological pictures were obtained from the microscope (Figure 1). Of the total samples, the majority presented type I CEJ (Table 1).

Table 1: Morphological types of cemento-enamel junction.

Cemento- enamel junction type	Frequency n (%)
Type I CEJ	149 (49.67)
Type II CEJ	103 (34.33)
Type III CEJ	48 (16)
Type IV CEJ	-



Figure 1: Cementoenamel junction. a) The histological pictures of three different types of CEJ are seen in the present study (first row); b) Schematic representation of each of the three types and the fourth type of CEJ (second row).

Table 2: Distribution of types of cementoenamel junction in anterior and posterior teeth.

CEJ type	Anterior teeth n (%)	Posterior teeth n (%)
Type I	73 (48.67)	76 (50.67)
Type II	49 (32.67)	54 (36)
Type III	28 (18.66)	20 (13.33)
Type IV	-	-

One-third of tooth sites had type II CEJ configuration. A small number of samples presented type III, while the rarest variant of type IV CEJ was demonstrated in none of the studied samples. Each type of CEJ in anterior and posterior teeth was analysed and the result showed almost equal distribution in anterior and posterior teeth (Table 2). Furthermore,

the variation of CEJ on different sites of the same tooth was also analyzed. The result showed that 110 (73.34%) teeth samples showed similar types of CEJ in the buccal and lingual sides of the tooth, whereas the remaining 40 (26.66%) teeth showed variation in the type of CEJ in different sides within the same tooth (Table 3).

Table 3: Distribution of cementoenamel junction types on different sides within the same teeth.

Cementoenamel junction variation within the same tooth	Frequency of teeth n (%)
Same type of CEJ on both sides	110 (73.34)
Different types of CEJ on each side	40 (26.66)

DISCUSSION

This study provided data regarding the morphological types of CEJ in the Nepali population. Three types of relation between cement and enamel were seen at the CEJ. Results show that Type I with 149 (49.67%) samples was the predominant type of CEJ and the present data agrees with the previous study.⁵ Type II CEJ was the second most common type which was presented in 103 (34.33%) samples. The result of the present study was very close to that shown by earlier researchers in a similar type of population.⁷ Although, type I CEJ is the most commonly found in configuration at the cementum and enamel interface, its prevalence is debated among the studied populations. Few of the studies have shown a higher prevalence of type II CEJ.^{9,10}

Furthermore, the present study indicated the occurrence of type III CEJ (gap junction) between the cementum and enamel with dentinal exposure in 48 (16%) cases. Leonardi et al. did not observe gap junction in any of their study samples, whereas Cloquet et al. observed dentin gaps in 28% of the primary teeth.^{6,11} The gap junction has been seen in as much as 33% of the cases in earlier studies.¹² The presence of gaps with dentinal exposure suggests that CEJ is a site strongly predisposed to the development of pathological changes during clinical procedures such as placement of clamps, stainless steel crowns, and restorative materials and utilisation of dental instruments.²

Interestingly, 40 (26.66%) teeth showed variation in the type of CEJ on the buccal and the lingual sites. The relationship between cement and enamel at the CEJ, not only varies between subjects, but also between teeth from the same individual, and even among the cuts made on the same tooth.¹ Previous studies have shown a great variation of CEJ type within the same teeth and the distribution of the enamel, cementum, and dentin at the cervix are unpredictable and irregular.^{1,5} Because of variation in these relationships over short distances, researchers

claim that the examination of ground sections may not be sufficient to correctly identify the CEJ structure.^{1,5} Nevertheless, various modalities have been adopted to study the CEJ relations including visual observations, tactile examination, light microscope, electron microscope, radiographs and computer-linked electronic constant pressure probes.² We utilised histological examination under a light microscope for examination of CEJ.

Type IV CEJ was not seen in the present study. Previous studies stated that the fourth type of relation was not seen or at least reported very rarely.^{11,12} As the type IV CEJ does not have developmental foundations, the observation of enamel overlapping cementum has been attributed to a methodological or an interpretative error. In the developing tooth bud, the outer and inner enamel epithelium of the enamel organ gives rise to Hertwig's epithelial root sheath (HERS). Irregular fragmentation of HERS in time and space promotes the formation of cementum and periodontal ligament on the newly formed radicular dentin.¹ This irregular fragmentation of HERS helps in setting the limit of cervical enamel and the formation of CEJ. Fragmentation of HERS and exposure of dentin covered by a thin layer of intermediate cementum are fundamental for the onset of cementogenesis. In very rare cases where HERS is refrained from fragmentation, there will be enamel deposition over the radicular dentin and the former will be transformed into reduced epithelium, thus preventing cementum deposition on its surface. Depending upon various timings and factors leading to the formation of cementum, the relationship between cementum and enamel at the CEJ presents various patterns and an irregular contour. Accordingly, in clinical practice we observe major three different types of CEJ. Regarding the fourth type, since cementogenesis is initiated only after the completion of enamel formation, odontogenesis does not explain the fourth possible type of CEJ from an embryological standpoint. The presence of enamel over cementum observed in ground sections may be

caused by an optical illusion.¹ The existence of this pattern is still controversial.

The nature of the CEJ is not limited to descriptive terms simply used to describe some aspects of tooth morphology, rather they have definite clinical significance. CEJ morphology in permanent teeth has become an area of great clinical interest, because of its sensitivity and increased susceptibility of the dentin in the CEJ to pathological changes, such as radicular caries or non-carious lesions.¹⁻³ It may be necessary to determine the nature, location, and pathological changes occurring at the CEJ to make a diagnosis of and treat dental diseases. CEJ finds its application in the recording of clinical attachment level and is considered to estimate the risk and progression of periodontitis as well the outcome of periodontal therapy.¹⁻³ The clinical morphology and location of CEJ is a static landmark that serves as an important anatomical site for the measurement of probing pocket depth and clinical attachment level. CEJ is therefore considered to be an important reference point for diagnosing the severity of gingival/periodontal diseases.¹⁻³ Furthermore, CEJ in human teeth is located at the anatomical site which is the thinnest portion of dental tissue covering the dentin.

CONCLUSIONS

The present study indicated a considerable morphological diversity in the pattern of CEJ in the Nepali population. It also showed that the type of CEJ varies among the different sites within the same tooth. The overlapping of enamel by cementum and the edge-to-edge relation are the most commonly found types of CEJ. The present study utilised the histological observation on the ground section of the tooth to study the CEJ and can show CEJ at only two focal points. Newer methods should be devised in which CEJ along the entire circumference of the tooth can be studied. The findings of the present study provide baseline data regarding the morphological types of CEJ in the Nepali population.

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Conflict of Interest: None.

REFERENCES

- Schroeder HE, Scherle WF. Cemento-enamel junction revisited. *J Periodontal Res.* 1988;23(1):53-9.
- Vandana KL, Haneet RK. Cementoenamel junction: An insight. *J Indian Soc Periodontol.* 2014;18(5):549-54.
- Vandana KL, Gupta I. The location of cemento enamel junction for CAL measurement: A clinical crisis. *J Indian Soc Periodontol.* 2009;13(1):12-5.
- Sodal ATT, Hove LH, Diep MT, Skudutyte-Rysstad R, Koldslund OC. Periodontal conditions in a 65-year-old population and prevalence of periodontitis according to three different bone level thresholds. *BMC Oral Health.* 2022;22(1):246.
- Grossman ES, Hargreaves JA. Variable cemento-enamel junction in one person. *J Prosthet Dent.* 1991;65(1):93-7.
- Rosalia L, Venera M, Carla L, Rosario C, Candida C, Orazio V, et al. The amelocemental junction ultrastructure in primary teeth. A SEM investigation. *Int J Anat Embryol.* 1995;100(1):11-7.
- Koju S, Maharjan N, Yadav DK, Bajracharya D, Baral R, Ojha Bidhata. Morphological analysis of cemento-enamel junction in permanent dentition based on gender and arches. *J Kantipur Dent Coll.* 2021;2(1):24-8.
- Desar B, Sharma BP, Shakya R. To find out the causes of extraction of teeth in the patients coming to the department of oral and maxillofacial surgery at kantipur dental college teaching hospital and research center from january 2014 to december 2018. *Am J Biomed Sci Res.* 2019;2(2):1-5.
- Astekar M, Kaur P, Dhakar N, Singh J. Comparison of hard tissue interrelationships at the cervical region of teeth based on tooth type and gender difference. *J Forensic Dent Sci.* 2014;6(2):86-91.
- Teodorovici P, Gianina I, Simona S, Andrian S. On the ratio among tough dental tissues at cervical level on various groups of teeth. *Int J Med Dent.* 2010;14(3):198-202.
- Francischone LA, Consolaro A. Morphology of the cemento-enamel junction of primary teeth. *J Dent Child Chic Ill.* 2008;75(3):252-9.
- Arambawatta K, Peiris R, Nanayakkara D. Morphology of the cemento-enamel junction in premolar teeth. *J Oral Sci.* 2009;51(4):623-7.