The Frequency of Two Developmental Anomalies in Osteoarchaeological Samples

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The literature on developmental anomalies of the teeth contains a multiplicity of classifications. The most widely accepted is Schulze's (1970) classification of anomalies of tooth size and shape, structure, position, occlusion, supernumerary teeth, twin formation, and absence of teeth. The palato-gingival groove and *dens invaginatus* are two of Schulze's shape and size developmental disorders.

Developmental anomalies of teeth occur in varying frequencies in prehistoric and historic populations. The primary purpose of our investigation was to examine the prevalence of palato-gingival groove and *dens invaginatus* in osteoarchaeological samples.

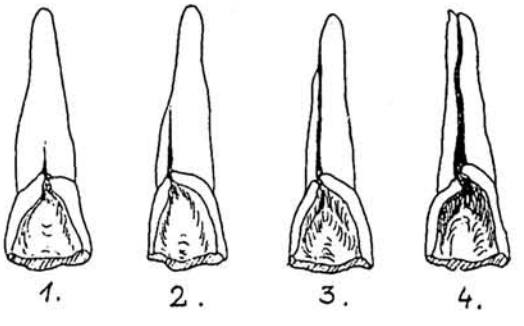
The palato-gingival groove occurs most often on the maxillary lateral incisors. However, the anterior teeth may also be affected (Winters et al., 1981). The palato-gingival groove originates in the central fossa area, crosses over the cingulum, and continues apically down the root for varying lengths (Simon et al., 1971). The feature can be classified by length (Fig. 1) and by depth.

The cause of the groove is unknown. Mechanical effects on the tooth germ may be responsible for the groove, as well as for dental invagination (Lee et al., 1968). The palato-gingival groove is considered to be a form of invagination (Walker and Glyn Jones, 1983). Fusion of the teeth may also cause malformation, as in the case of *dens invaginatus* (Bruszt, 1950).

Dens invaginatus, invaginated odontoma, or *dens in dente,* is a developmental anomaly, which results from invagination of the tooth germ prior to calcification. This anomaly is most frequent in the maxillary incisors (Aboyans and Ghaemmaghami, 1976).

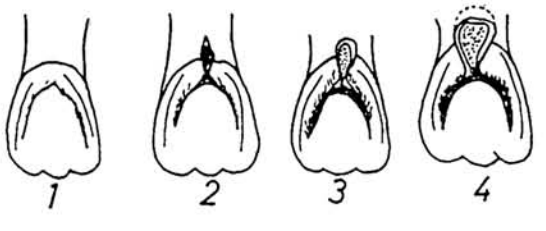
Dens invaginatus occurs in two forms: coronal and radicular. Coronal invagination is subdivided into superficial and deep cases (Schulze, 1970). Hallett's (1953) four part classification is the most widely accepted (Fig. 2). Another classification is that of Parnell and Wilcox (1978), which distinguishes minor, deep, and dilated forms.

The pathogenesis of coronal invagination is not entirely known. It may be formed by union of adjacent teeth, a single active proliferation, or passive retardation of a circumscribed area of epithelium (Schulze, 1970). Grahnén et al., (1959) have also suggested that *dens invaginatus* is genetically determined.



1. Groove is into the enamel-cementum junction.
2. Groove extends over half of the root.
3. Groove extends to the apical region of the root.
4. Groove extends to the apex of the root (bifid root).

Fig. 1. Types of palato-gingival groove (according to expansion of the groove).



1. Definite cleft is formed in the palatal enamel at the cervical level.
2. Invagination extends toward the pulp chamber, and a definite pit is formed in the cingulum.
3. Invagination extends deeply into the pulp chamber and is dilated.
4. The invagination apparently includes the entire coronal pulp chamber, and may extend beyond the enamel-cementum junction level.

Fig. 2. Types of invagination (Hallett, 1953)

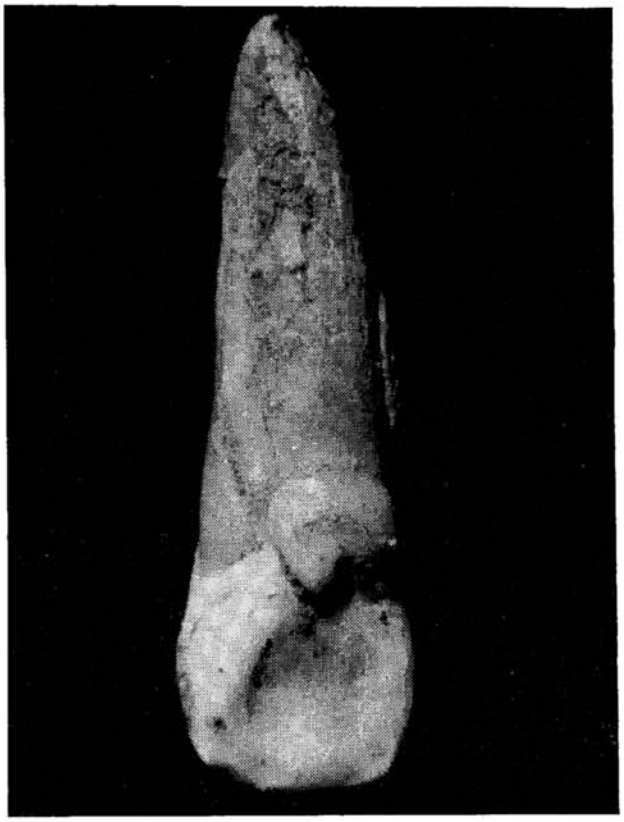


Fig. 3. Palato-gingival groove (type 2) from the site of Sárrétudvari, 10th century.

Fig. 4. *Dens invaginatus* (type 3) from the site of Szarvas, 8th century.

MATERIALS AND METHODS

Specimens dating from the Neolithic Era to the 18th century, curated in the Department of Anthropology, József Attila University, Szeged, Hungary, were used in the study. The sample examined for palato-gingival groove consisted of 1,997 specimens (skulls and individual maxillae and mandibles) with 13,708 permanent anterior teeth. Of these, 1,765 specimens with 6,183 permanent anterior teeth were examined for *dens invaginatus*. Methods used for the study of the two anomalies were direct observation and examination of X-rays.

RESULTS AND DISCUSSION

The incidence of palato-gingival groove was 12.42%, and that of *dens invaginatus*, 4.31% per individual. However, we found no tendency in the frequency of either feature from the Neolithic to the 18th century (Tables 2 and 3).

Maxillary lateral incisors most frequently contained coronal invagination (5.24%) and palato-gingival groove (10.22%) (Table 3). *Dens invaginatus* was not observed on the canines. Palato-gingival groove was found in one mandibular lateral incisor and one maxillary canine. Similar frequencies in archaeological samples have been reported by Brabant and Sahly (1962), Brabant (1969), and Kocsis and Marcsik (1983, 1991).

The majority of palato-gingival grooves were classified as types 1 and 2 according to their extension (Fig. 3). Forty-two teeth contained the maximum groove which extended to the apex of the root. Grooves on central incisors generally occurred mesially, and those on lateral incisors, distally. Through study of X-rays, we found Hallett's type 3 dilated form of invagination (Fig. 4) in 40 specimens (54 lateral incisors or 2.72%). Hallett's type 2 was found in 30 specimens (44 lateral incisors or 2.22%).

TABLE 1. Frequency of palato-gingival groove in archaeological periods (all anterior teeth)

Archaeological Period	Number of Specimens	Specimens with Groove		Number of Teeth	Teeth with Groove	
		Number	Percent		Number	Percent
Neolithic	99	11	11.11	600	12	2.0
Copper Age	278	20	7.19	1,602	22	1.37
Bronze Age	238	39	16.39	1,829	44	2.41
Iron Age	202	22	10.9	1,444	25	1.73
2nd—5th Centuries	222	23	10.36	1,487	30	2.02
7th—8th Centuries	241	38	15.77	1,965	44	2.24
10th—11th Centuries	231	39	16.88	1,705	44	2.58
12th—13th Centuries	217	29	13.36	1,509	34	2.25
14th—18th Centuries	269	27	10.04	1,567	40	2.55
Total	1997	248	12.42	13,708	295	2.15

TABLE 2. Frequency of dens invaginatus in archaeological periods (maxillary anterior teeth)

Archaeological Period	Number of Specimens	Specimens with *dens*		Number of Teeth	Teeth with *dens*	
		Number	Percent		Number	Percent
Neolithic	77	4	5.19	247	5	2.02
Copper Age	228	7	3.07	687	10	1.46
Bronze Age	222	14	6.31	882	22	2.49
Iron Age	175	4	2.29	647	6	0.93
2nd—5th Centuries	197	6	3.05	694	8	1.15
7th—8th Centuries	227	17	7.49	834	23	2.76
10th—11th Centuries	215	8	3.72	787	12	1.52
12th—13th Centuries	191	4	2.09	715	5	0.70
14th—18th Centuries	233	12	5.15	690	19	2.75
Total	1,765	76	4.31	6,138	110	1.78

TABLE 3. Frequency of palato-gingival groove and dens invaginatus according to tooth types

Tooth Type	Palato-Gingival Groove			*dens invaginatus*		
	Number teeth	Number with Groove	Percent with Groove	Number with *dens*	Number with *dens*	Percent with *dens*
Maxillary central incisors	1,908	85	4.45	1,848	6	0.32
Maxillary lateral incisors	2,036	208	10.22	1,983	104	5.24

With regard to symmetry-asymmetry relationships, we were able to study only those skulls with both central and/or both lateral incisors. Our results showed that *dens invaginatus* was present more often bilaterally, whereas the palato-gingival groove was more frequently asymmetric. These results are similar to those reported by Withers et al. (1982).

Several studies (Lee et al., 1968; Everett and Kramer, 1972; and Walker and Glyn Jones, 1983) have shown that palato-gingival groove is associated with *dens invaginatus*. In our sample, invagination occurred together with the groove in nine out of 104 teeth (8.65%).

Different invaginations may be accessory factors in the formation of dental caries. The palato-gingival groove is also the frequent site of caries, and sometimes causes periapical pathosis (Aboyans and Ghaemmaghami, 1976). Based on clinical reports, localized bone lesions in paleoanthropological material may have been caused by the palato-gingival groove and/or *dens invaginatus*.

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Digital Radiography for the Quantification of Alveolar Bone Loss in Studies of Periodontal Disease Variation

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It has been hypothesized that differing human groups show varying patterns of periodontal disease. To test this hypothesis, accurate and reproducible measures of periodontal disease must be used. One method for achieving this end is through the use of digital radiography. Once the distribution of periodontal disease is known, it will be possible to make suggestions concerning possible etiologic agents. In this paper, we present a short review of periodontal disease epidemiology and our experience with digital radiographic methods for the quantification of periodontal disease.

The largest and most comprehensive dental survey ever undertaken was recently conducted by the National Institute of Dental Research (The National Survey of Oral Health of U.S. Employed Adults and Seniors: 1985-1986). In this study, 20,000 adults representing 104 million people were examined. This survey was a repeat of one conducted in 1979-1980. Although periodontal health had improved since the earlier time period, 42% of those over the age of 65 were toothless. Those who retained teeth had more severe and advanced periodontal diseases than did younger adults. It was concluded that "periodontal diseases remain widespread in America" (Broadening the scope: Long-range research plan for the nineties: National Institute of Dental Research, NIDR).

The actual cause or causes of periodontal disease are not well understood. Bacteria in dental plaque are generally thought to be major contributors, but whether a genetic or environmental component contributes to increased host susceptibility or whether particularly virulent strains of bacteria cause rapid disease progression is unknown. Findings that the rate of periodontal disease differs among individuals has lead to the suggestion that periodontal bone loss does not occur at equal rates throughout the population and that the highest prevalences of loss may occur in specific ethnic, geographic, and socio-economic groups (Bailit and Manning, 1988; Baelum et al., 1988; Albandar, 1990). The identification of these groups highlights an important area for future research; however, the identification of putative high-risk groups requires a suitable method that can be used to quantify periodontal disease. The development of such a method has proven to be a challenging problem (Hildebolt and Molnar, 1991).

CLINICAL METHODS FOR STUDYING PERIODONTAL DISEASE

Clinical evaluations of periodontal disease are based predominantly on probing depths, a soft tissue measurement that is made with a hand-held periodontal probe. For example, the presence of a periodontal pocket is considered to be pathognomonic of past adult periodontal disease activity and indicates cumulative damage to the junctional and sulcular epithelium, with concomitant apical migration of the junctional