

PREVALENCE OF FUSION AND GEMINATION IN PERMANENT TEETH IN COPPADOCIA REGION IN TURKEY

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ABSTRACT

The objective of the present study was to determine the prevalence of dental fusion and gemination in permanent teeth in Cappadocia region in Turkey. The distributions of these conditions among different types were also studied.

The present study was based on the clinical assessment and panoramic radiographs of 8,229 patients. All of these patients were examined clinically and had radiographs and photographs taken at the time of examination. All data (age, sex and systemic disease or syndrome) were obtained from the patient files and analyzed for double teeth (fusion and gemination). The distribution of double teeth was investigated according to types and clinical positions.

In this study the prevalence of double teeth (Fusion and gemination) in the permanent dentition in patients between 12 to 60 years was 0.29%. 14(0.17%) were Fused and 12(0.14%) were geminated teeth. The maxillary incisors were the most commonly affected, followed by the mandibular premolars.

Fusion and gemination are uncommon conditions in Turkish population, but they are important dental anomalies that can affect any tooth in the mouth. Recognizing the condition will facilitate the endodontist, prosthodontist, periodontist, orthodontist, and for surgical management of such teeth.

Key words: Fusion, gemination, prevalence, permanent dentition

INTRODUCTION

Fusion has been described as a developmental anomaly characterized by the union of two adjacent teeth. This union of two separate tooth germs may be either complete or incomplete. Fused teeth have separated or shared pulp chambers and canals.¹ There will be one less tooth in the arch than normal if the affected tooth is counted as one² (Fig 1: a-d) Gemination is currently recognized as an attempt by a single tooth bud to divide, with a resultant formation of either a large tooth with a bifid crown or two completely divided teeth throughout the crown and root.³ The normal

number of teeth is observed if the affected tooth is counted as one² (Fig 1: e, f) Fusion may be differentiated from gemination by the presence of two separate roots or a single root.⁴ In cases where union of a normal tooth bud to a supernumerary tooth germ occurs, the number of teeth is also normal and differentiation from gemination may be very difficult. In cases of fusion, the crowns are united by enamel and/or dentine, but there are two roots or two root canals in a single root. In contrast, in gemination, the structure most often presents two crowns, either totally or partially separated, with a single root and one root canal.⁵

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Fig 1: Typical samples of fused teeth (a-d) and geminated teeth (e, f)

The clinician must then depend on both clinical examination and radiographs to make the final diagnosis between fusion and gemination. These types of anomalies may be unilateral or bilateral and may affect either dentition, although the primary teeth are more commonly affected. Bilateral dental fusion in the primary dentition is a rare dental anomaly.⁶

Bilateral presentations are less common than unilateral ones (0% to 0.6%).⁷ Epidemiological studies have shown that the prevalence of fused teeth was similar for females and males and occurred most frequently in the primary dentition.³⁰ The etiology of

double teeth may be attributed to evolution, trauma, heredity and environmental factors.³¹

METHODOLOGY

A retrospective observational study was made of all the patients with double teeth seen in the Dental Faculty from 2006 to 2010. In the present study 18,216 patients' records were evaluated and 8,229 samples were selected. Inclusion and exclusion criteria are presented in Table 1. 26 patients (13 males and 13 females) were found with permanent double teeth ranging in age from 12 to 60 years. (Table 2).

TABLE 1: ADOPTED CRITERIA FOR SAMPLE SELECTION

Inclusion criteria	Exclusion criteria
*Permanent dentition	*Mixed/deciduous dentition
*No caries	*Extensive carious lesion
*No radiographic distortions	*Radiographs with image distortions
*All permanent teeth exist except third molars on radiographs	*One or more teeth is missing except third molars on radiographs
	*Fixed prosthodontic restoration

TABLE 2: DOUBLE PERMANENT TEETH
IN 8229 ADULTS

	N	%
Total number of double teeth	26	0.29
Fusion	14	53.8
Gemination	12	46.2
Upper jaw	15	57.6
Lower jaw	11	52.4
Unilateral	22	91.6
Bilateral	4	8.4
Boys	13	50
Girls	13	50

In each case the gender of the patient, the position of the double teeth and of other anomalies in either dentition were noted. A photograph, intra-oral radiograph and/or panoramic radiograph were taken at the time of diagnosis in all cases. Each double tooth case was thereby classified on the basis of its clinical and radiographic morphology, in terms of the number and shape of crowns and roots. Two experienced dentists examined all radiographs. They were reviewed and discussed by the panel in a negatoscope in which an a7x lens was used. Inter-examiner discrepancies were solved by consensus and agreement. The involved teeth were categorized by a method similar to the rule frequently applied in the differentiation between fusion and gemi-

TABLE 3: PREVALENCE OF DOUBLE TEETH IN PREVIOUS STUDIES

	Study	Year	Country	Sample	No of double teeth	Prevalence (%)
	Primary Dentition					
1	Tinn ⁷	1940	Great Britain	8,500	22	0.3
2	Menczer ⁸	1955	United States	2,209	3	0.1
3	Clayton ⁹	1956	United States	1,795	14	0.7
4	Grahnen ¹⁰	1961	Sweden	1,173	6	0.5
5	Moller ¹¹	1963	Iceland	609	1	0.2
6	Curzon ¹²	1967	Canada (white)	776	8	0.9
7	Ravn ¹³	1971	Denmark	4,564	39	0.9
8	Holm ¹⁴	1974	Sweden	208	1	0.5
9	Jarvinen ¹⁵	1980	Finland	1,141	8	0.7
10	Buenviaje ¹⁶	1984	United States	2,439	9	0.4
11	Magnusson ¹⁷	1984	Iceland	572	4	0.7
12	Barac-Furtinovic V ¹⁸	1991	Croatia	2,987	15	0.5
13	L Aguilo ¹⁹	1999	Spain	6,000	53	0.8
14	Cheng RB ²⁰	2003	China	4,286	65	1.6
	Mixed Dentition					
15	Mckibben ²¹	1971	United States	1500	7	0.5
16	Ruprecht ²²	1985	Saudi Arabia	1581	7	0.4
17	Salem ²³	1989	Saudi Arabia	2393	2	0,08
18	Bruce ²⁴	1994	United States	2267	8	0,35
19	Backman ²⁵	2001	Sweden	793	2	0,3
20	Chen Wei ²⁶	2010	Taiwan	7868	57	0,72
	Permanent Dentition					
21	Boyne ²⁷	1955	United States	2000	2	0.1
22	Clayton ⁹	1956	United States	1762	3	0.2
23	Castaldi ²⁸	1966	Canada	451	1	0.2
24	Curzon ¹²	1967	Canada			
			White	668	0	0
			Indian	120	1	0,8
25	Hamasha ²⁹	2004	Jordan	928	39	0.42

nation. A tooth was recognized as fused if its crown and root were enlarged and the tooth count was less than one. A tooth was recognized as geminated if its crown was enlarged with a normal root and the tooth count was normal. Both fused and geminated teeth were counted as a double tooth.

The distribution of double teeth was investigated according to gender differences, types (fused or geminated), and clinical positions. The positions of the double permanent teeth were studied according to the unilateral arch and the mandibular or maxillary arch. A Pearson chi-squared test was used to determine potential differences in the distribution of double teeth when stratified by gender.

RESULTS

During the above mentioned time period 8,229 Turkish subjects were reviewed. The data obtained are shown in Table 3. From this data, double teeth were detected in 26 subjects. The sample of 8,228 adults examined showed a prevalence of (0.29%) double teeth, 53.8% of them were fused and 46.2% geminated. From Table 3 shown the anomaly is equally present in males and females with a 1:1 male/female ratio ($P < 0.001$). Furthermore, in regard to distribution in the jaws the anomaly is more frequent in the upper jaw (57.6%) than in the lower jaw (52.4%), and is more frequent unilaterally (91.6%) than bilaterally (8.4%) (Table 3).

Bilateral occurrence of double teeth in the maxilla was seen in 2 cases of which were involving the central incisors and supernumerary teeth (Table 4). The analysis of clinical and radiographic characteristics of the double teeth showed three morphological types, large crown with a large root and root canal with labiolingual grooves, two fused crowns with deep labiolingual grooves and two roots and a partially vertical separated large crown with single root and with labiolingual grooves.

DISCUSSION

Dental anomalies of number and forms may occur in the primary and permanent dentitions. They are frequently observed during routine dental examination, leading to orthodontic problems, such as spacing or crowding of teeth, loss of arch length, esthetic

problems, increased caries risk, and deviation of the midline.³¹ They may be associated with a syndrome or they can be found in non-syndromic patients. Current data in the literature show that double teeth in the permanent dentition are observed in 0.0~0.8% of the general population with no gender predilection.^{16,23,33} In the present study, the prevalence of double teeth in the permanent dentition of patients between 12 to 60 years old was 0.29%. Due to this low prevalence, the importance of these anomalies tends to be underestimated.³⁴

The etiology of fusion is not exactly known. Some writers contend that fusion results when two tooth germs develop so close together that, as they grow, they come into contact and fuse before calcification. Other researchers believe that physical pressure of force generated during growth causes contact between adjacent tooth germs. Other authors consider a viral infection during pregnancy and the use of thalidomide as possible causes of the anomaly.³⁵ Although the etiology is still not clear, there is strong evidence suggesting a genetic link as evidenced in family and twin studies.^{32,34} Fusion has also been reported with congenital anomalies like cleft lip.³⁶ It is also seen in X-linked congenital conditions.³⁷ Some dental and non-dental abnormalities have been associated with double defects. These include: Supernumerary teeth, hypodontia, peg-shaped permanent maxillary lateral incisors, dens in dente, nail disorders, syndactyly³⁸, successional conical teeth, macrodontia and double permanent teeth have been recorded following double primary teeth.³⁹ Kolenc-Fuse⁴⁰ reported that genetic linkage and molecular biology studies allowed the identification of the mutations responsible for some patterns of syndromic and non-syndromic tooth agencies. Studying the family history of the cases reported in this article, it was observed that double teeth were not present in patients' parents or siblings.

The differential diagnosis for fused teeth includes gemination and macrodontia. Several clinical and radiographic benchmarks are used to distinguish fusion from gemination. Fusion is the incomplete attempt of two tooth buds to fuse into one, however gemination is the incomplete attempt of one tooth bud to divide into two.³⁶ Clinically, the crowns of the teeth appear to be melded together, with a small groove between the mesial and distal sections⁴¹, but on the fused teeth radiographs, two distinct pulp chambers and if the

fused tooth is counted as one unit, there will be one tooth less in the arch than normal. In cases of gemination, radiographically there is only one pulp chamber and if the anomalous tooth is counted as one unit, the number of teeth in the arch will be normal. Gemination may be differential from fusion by the increased number of teeth, except in unusual cases, in which the fusion is between a supernumerary tooth and a normal tooth. Macrodontia is a condition in which the teeth are larger than usual and exhibit normal crown, root and pulpal morphology.⁴²

Table 3 lists previous studies done on the prevalence for double teeth in the primary dentition as 0.1% to 1.5% (one to fifteen out of 1,000), in the mixed dentition it is 0.3% to 0.72% (three to seventy-two out of 1,000) and, in the permanent dentition it is 0.0% (zero to eight out of 1,000) for unilateral presentation. Hamasha et al²⁹ reported that maxillary central incisors were the most commonly affected teeth (3.55%) followed by the mandibular third molars (0.91%). However, these results are different from the present study. In this study, double permanent teeth were found mostly in the maxillary central incisors, followed by the mandibular premolars. Aguilo et al¹⁹ reported that double teeth were frequently unilateral, involving two adjacent teeth, and no difference was found in the proportion of double teeth in either the mandible or maxilla, or on the right or left side. This is in agreement with this study.

Double teeth may produce esthetic problems and malocclusions, especially when supernumerary elements are included. Since fused teeth are obviously wider than the circumjacent teeth, esthetics may be a concern. When normal teeth fuse, excess dental space can result. This can result in diastema formation. When fusion occurs in the primary dentition, some of the permanent incisors are often not present. These problems require both cosmetic and orthodontic consideration.⁴³ The presence of fissures or grooves at the union between fused teeth predisposes it to caries and periodontal disease.⁴⁴ In a preventive context, the buccal and lingual vertical grooves of the double teeth may be pronounced and difficult to clean, and are highly susceptible to caries.⁴⁵ Sealing the grooves with sealant or resin may decrease the risk of caries. The placement of fissure sealants or composite restorations in these grooves should decrease the caries risk.⁴⁶

The presence of double deciduous tooth can cause delayed resorption of the root due to greater root mass and increased area of root surface relative to the size of the permanent successor crown.⁴⁰

The management of a case of fusion depends on which teeth are included, the level of fusion, and the morphologic result. If the affected teeth are primary, they may be retained as they are. If the clinician intends to extract, it is important to first of all determine whether the corresponding teeth are present.³⁶ Several reports have suggested that in order to intercept future malocclusion, further treatment, including extraction, partial removal, or separation of double teeth, should be considered.⁴⁷ If the fused tooth is free from caries, it may require no particular treatment. Universal preventive advice should be given to the parent and the child¹⁰ and if caries already exists, a restoration should be placed in order to retain function and esthetics.⁴⁴ If there is pulpal involvement, endodontic treatment should be carried out in the same way as for a multirooted tooth.⁴⁸ When dividing double teeth, the complicated dental canal system should be evaluated carefully. Orthodontic and prosthodontics management should be considered to ensure functional occlusion and improve esthetics.

CONCLUSIONS

Understanding the prevalence of double teeth is very important to the dentists. Fusion and gemination are uncommon conditions, but they are important dental anomalies. These anomalies influence tooth alignment and interdigitation, arch symmetry, appearance, and associated periodontal tissues. Careful treatment planning, including conservative, endodontic, prosthodontics, periodontic and orthodontic considerations are required. The patients' expectations and degree of compliance must also be accurately assessed when determining suitable management.

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