

# The prevalence of three-rooted permanent mandibular first molars in the population of Slovenia

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## Abstract

A mandibular first molar usually has a mesial and a distal root; however, a distolingually-located third root is occasionally present. The three-rooted mandibular first molar (TMFM) plays a significant role in anthropology and forensic medicine because its prevalence varies significantly among ethnic groups. The aim was to determine the prevalence of TMFMs in a population of Slovenia by using periapical radiographs. A total of 1145 mandibular first molars were evaluated using periapical radiographs that were collected from dental records of 1000 patients (470 males and 530 females). The radiographs were evaluated using a viewing box and a magnifying glass; 95% confidence intervals (CI) for the prevalence of TMFMs in the population were estimated using Wald's method. Fisher's exact test was applied to examine any statistically significant difference between left and right teeth and between male and female patients. The prevalence of TMFMs was 2.36% (1.61%-3.42%, 95% CI). No statistically significant differences were detected with respect to sex ( $p = 0.1235$ ) or the side of occurrence ( $p = 0.2505$ ). The observed prevalence of TMFMs is in the upper half of the range for ethnic European populations.

**KEYWORDS:** radix entomolaris, permanent mandibular first molar, dental morphology, dental anthropology, Slovenia

## Introduction

In Caucasians, the majority of mandibular first molars possess two roots: one mesial and one distal root (Vertucci 1984). Occasionally, there is an additional distolingual root named *radix entomolaris* (Figure 1). The prevalence of the three-rooted mandibular first molar (TMFM) varies significantly among ethnic groups, from European and African populations at the lower end (< 4%) to north-eastern Asian and derived populations (China, Japan, Siberia, Native Americans) at the upper end of the spectrum (> 20%) (Scott et al. 2018). Thus, TMFM is useful for the determination of ancestry when dealing with recent or ancient

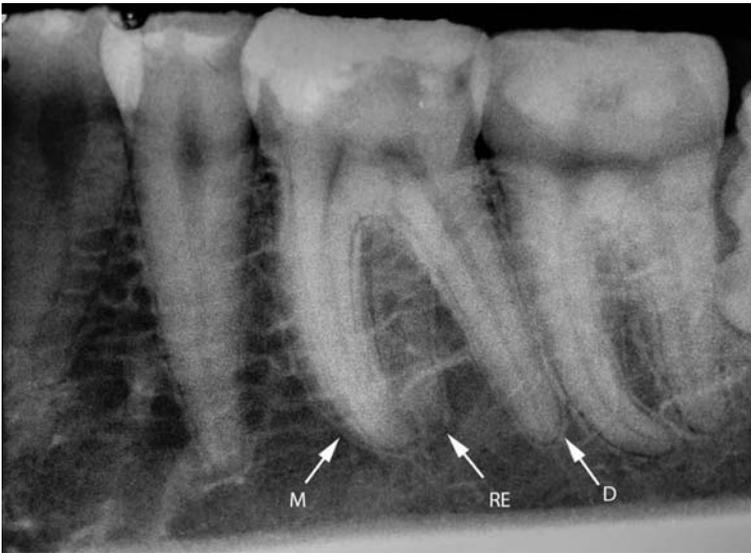
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human skeletal remains. As such, it is one of the traits used in the Arizona State University Dental Anthropology System (ASUDAS), which is currently the most widely used system for scoring dental morphology. Moreover, it is one of the traits included in the rASUDAS, a recently developed web-based application for dental ancestry estimation (Scott et al. 2018). Additionally, TMFM is a great diagnostic and therapeutic challenge in clinical dentistry, particularly in the fields of endodontics, periodontology, and oral surgery.

Most authors who have studied TMFMs in ethnic European populations used extracted teeth (Taylor 1899, Bolk 1915, Fabian 1928, Hjelmmann, 1929, Visser 1948, Curzon 1973) or periapical radiographs (de Souza-Freitas et al. 1971, Schäfer et al. 2009, Çolak 2012). The prevalence of three-rooted mandibular molars in the population of Slovenia was assessed in a recent study (Strmšek & Štampfelj 2019); however, periapical and bite-wing radiographs have been used. Unlike periapical radiographs, bite-wing radiographs depict only the cervical portion of the roots, which makes them less reliable for scoring the presence of the additional root. Clinically, bite-wing radiographs are primarily used to detect the pathological lesions in the coronal and cervical regions of the tooth. Therefore, this retrospective study aimed to obtain a more accurate estimate of the TMFM prevalence in our population by employing a larger cohort of patients and selecting exclusively periapical radiographs.



*Figure 1: Three-rooted left mandibular first molar on the periapical radiograph of a 26-year-old male patient. M - mesial root, D - distal root, RE - radix entomolaris.*

## **Materials and methods**

The dental charts of patients who underwent examinations by students and interns at the Centre for Operative Dentistry and Endodontics of the University Medical Centre

Ljubljana in the years between 2006 and 2018 were screened for periapical radiographs depicting mandibular first molars. A total of 1000 patients (1145 mandibular first molars) participated in the study. Personal details, including sex and age at the time of the radiographical examination, were recorded. Ethnicity was not established, but the majority of patients were of Slovene origin.

The radiographs were placed on a viewing box and observed using a magnifying lens with 3× magnification. The number of roots was determined independently by both authors. In case of disagreement, a joint evaluation was conducted, and a consensus was reached.

The prevalence of TMFM was determined. A 95% confidence interval (CI) was estimated using Wald's method (Lewis & Sauro 2006). Fisher's exact test was applied to examine any statistically significant difference between left and right teeth, between male and female teeth, and to compare the results with those obtained in the previous study on Slovene dental patients (Strmšek & Štampfelj 2019). A difference was considered statistically significant at  $p < 0.05$ . All calculations were made using the GraphPad online statistical software. This study was approved by the Slovenian National Medical Ethics Committee (Approval No. 0120-292/2017-4).

## Results

There were 1000 patients, 470 males and 530 females, aged between 13 and 92 years (average  $37.2 \pm 14.3$  years) included in the study. A total of 1145 mandibular first molars, 593 right and 552 left teeth, were evaluated (Table 1).

The prevalence of TMFMs by tooth count was 2.36% (27/1145) (Table 1). The third root was observed in 2.87% (17/593) of the right teeth and in 1.81% (10/552) of the left teeth ( $p = 0.2505$ ). In females, the third root was observed in 1.68% (10/595) of teeth, whereas it was observed in 3.09% (17/550) of teeth in males ( $p = 0.1235$ ).

Twenty-six patients were found to have a TMFM, 16 males and 10 females ( $p = 0.1045$ ). The prevalence of patients with TMFMs was 2.60%. In 145 patients, periapical radiographs of both mandibular first molars were available. TMFM was identified in 3.45% (5/145) of these patients. In one patient, the trait was present bilaterally, in three patients on the right side and in one patient on the left side.

*Table 1: Number and percentage of three-rooted mandibular first molars (TMFMs) in dental patients from Slovenia.*

Mandibular first molars	N	n	%	95% CI		p
				LB	UB	
Right	593	17	2.87	1.76	4.58	0.2505
Left	552	10	1.81	0.94	3.35	
Male	550	17	3.09	1.90	4.93	0.1235
Female	595	10	1.68	0.87	3.11	
All	1145	27	2.36	1.61	3.42	-

N - number of examined mandibular first molars, n - number of TMFMs, % - percentage of TMFMs, p - Fisher's exact test, 95% CI - 95% confidence interval, LB - lower bound, UB - upper bound

## Discussion

The dental school patients who participated in this study represent the general population of Slovenia. The third root (*radix entomolaris*) was identified in 2.36% of the mandibular first molars examined on periapical radiographs. This prevalence is in the upper half of the range for ethnic European and derived populations (0.9%-3.4%) (Taylor 1899, Bolk 1915, Fabian 1928, Hjelmmann 1929, Visser 1948, de Souza-Freitas et al. 1971, Curzon 1973, Schäfer et al. 2009, Çolak et al. 2012, Martins et al. 2017, Martins et al. 2018). Moreover, this prevalence is higher than that observed in a previous study on Slovene patients using bite-wing and periapical radiographs (Strmšek & Štampfelj 2019) (1.32% vs 2.36%); the difference is close to the level of statistical significance ( $p = 0.0689$ ). Based on this, bite-wing radiographs are not suitable for the detection of TMFMs, especially in a clinical setting.

TMFMs were identified in 2.60% of the examined dental patients; however, this is a very conservative estimate because periapical radiographs of both mandibular first molars were available only in 14.5% of the enrolled patients (145/1000). Within this subgroup, the trait was present in 3.45% of the individuals (5/145).

In the present study, no difference was found in the occurrence of the additional root on the right and left mandibular first molars, which is in agreement with studies on English (Curzon 1973) and Germans (Schäfer et al. 2009) and with a previous Slovene study (Strmšek & Štampfelj 2019). If we look at more numerous studies on non-European populations, the results are variable. Some of them did not find a significant difference between left and right teeth (Garg et al. 2010, Yang et al. 2010), some studies reported that right teeth were more frequently affected (Tu et al. 2007, Tu et al. 2009), and other studies reported that left teeth were more frequently affected (Loh 1990, Wang et al. 2010, Dube et al. 2011). Although differences in sample sizes and methodology might be responsible for some of these inconsistencies, it is very likely that in some populations a left- or right-sided predominance of TMFMs exists. In Koreans, for example, a right-sided predominance of TMFMs has been established in several radiographical studies (Song et al. 2009, Song et al. 2010, Kim et al. 2013, Park et al. 2013).

In this study, five patients with TMFMs possessed a periapical radiograph of the contralateral tooth. In one of them, both mandibular first molars were affected. The bilateral occurrence of TMFMs has been found in 33% of Turkish patients (Çolak et al. 2012) and in 50% of European descendants from Brazil (de Souza-Freitas et al. 1971); however, only unilateral cases have been found in German patients (Schäfer et al. 2009). If we look at studies on non-European populations, bilateral occurrence of TMFMs has been found in 32% to 69% of cases (de Souza-Freitas et al. 1971, Walker & Quackenbush 1985, Harada et al. 1989, Yew & Chan 1993, Jayasinghe & Li 2007, Tu et al. 2007, Tu et al. 2009, Garg et al. 2010, Yang et al. 2010, Karale et al. 2013, Kim et al. 2013, Park et al. 2013). These results are of great significance for a dentist performing the endodontic treatment on both mandibular first molars in the same patient.

The observed absence of sexual dimorphism is in line with similar studies on European descendants from Brazil (de Souza-Freitas et al. 1971), Germans (Schäfer et

al. 2009), Turks (Çolak et al. 2012) as well as with a previous Slovene study (Strmšek & Štampelj 2019). In contrast, a study on an English population reported a significantly higher prevalence of TMFMs in males (Curzon 1973). The majority of studies on non-European populations also found no statistically significant difference between the sexes (Walker & Quackenbush 1985, Loh 1990, Tu et al. 2007, Tu et al. 2009, Garg et al. 2010, Wang et al. 2010, Yang et al. 2010, Karale et al. 2013, Kim et al. 2013, Park et al. 2013, Shemesh et al. 2015, Rahimi et al. 2017). There are two exceptions, a study on Guamanians (Hochstetter 1975) and one on Koreans (Song et al. 2010), which reported a male predominance.

## Conclusions

Dentists, anthropologists, and forensic specialists should be aware that mandibular first molars occasionally possess a distolingually-located additional root. In a population of Slovenia, this root develops in 2.36% (1.61%-3.42%, 95% CI) of the mandibular first molars. The additional root apparently occurs with no side or sex preference. When identified, the possibility of bilateral occurrence should always be considered.

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## **Povzetek**

Prvi spodnji stalni kočnik ima mezialno in distalno korenino, v nekaterih primerih pa distolingvalno še tretjo korenino. Trikoreninski prvi spodnji kočnik (TPSK) ima zaradi pogostnostnih razlik med etničnimi skupinami velik pomen za antropologijo in forenzično medicino. Z raziskavo smo želeli določiti pogostnost TPSK pri prebivalcih Slovenije z uporabo periapikalnih rentgenskih posnetkov. Pri 1145 prvih spodnjih kočnikih smo število korenin odčitali iz periapikalnih rentgenskih posnetkov, ki smo jih vzeli iz zobozdravstvenih kartotek 1000 pacientov (470 moških in 530 žensk). Pri tem smo uporabili negatoskop in povečevalne lupe; 95 % interval zaupanja (IZ) za pogostnost TPSK v populaciji smo določili z Waldovo metodo. S Fisherjevim eksaktnim testom smo ugotavljali obstoj statistično značilnih razlik med levo in desno stranjo ter med spoloma. Pogostnost TPSK je bila 2,36 % (1,61 %-3,42 %, 95 % IZ). Razlika med spoloma ni bila statistično značilna ( $p = 0,1235$ ), prav tako ni bila statistično značilna razlika med levo in desno stranjo ( $p = 0,2505$ ). Ugotovljena pogostnost TPSK se uvršča v zgornjo polovico razpona za avtohtone evropske populacije.

**Ključne besede:** radix entomolaris, prvi spodnji stalni kočnik, zobna morfologija, zobna antropologija, Slovenija

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