

A MANDIBULAR SECOND PERMANENT MOLAR WITH FOUR ROOTS IN ANCIENT ANATOLIA

Ahmet Cem Erkman¹ and Yener Bektaş²

¹Ahi Evran University, Faculty of Science and Literature, Department of Anthropology, Kirsehir, Turkey; ²Yuzuncu Yil University, Faculty of Literature, Department of Anthropology, Van, Turkey

Abstract: *Although there have been numerous studies concerning supernumerary mandibular molars in archaeological populations, there is no record of mandibular second permanent molars with four roots. In the present study we found a right mandibular second permanent molar with four roots from an individual belonging to the Dilkaya population, which is regarded as probably one of the most important archaeological Anatolian populations, dating from about 3,000 years ago. Incomplete development of roots shows that this individual was around 12–13 years old. In addition, teeth wear is low, which supports the guess about the age of the individual. Due to the presence of a mandibular second permanent molar with four roots in an archaeological Anatolian population we thought it would be of anthropological interest to review the pattern of mandibular second permanent molars in the Middle East.*

Keywords: *Dental non-metric traits; Variation; Mandibular molar; Anatolia.*

Introduction

Many human phenotypic variations correspond to continuous quantitative traits. The quantitative traits can be defined as those where the phenotype is determined by the combined effect of the genes and the environment, in such a way that the distribution of their frequencies in the population is continuous (Cheverud 1982, Kohn 1991, Relethford 2007, Saunders and Rainey 2008). The quantitative traits are also known as metric traits, because they can be measured and expressed in terms of units of length, weight, and number. The other class of traits used to describe the human phenotypic variations is discrete variants, often simply called non-metric traits, meaning that the variables are either present or absent, but when present they have a range of expression (Sofaer 1970).

When choosing non-metric traits, one assumes that they are largely under genetic control and minimally affected by environmental or nutritional conditions (Corruccini 1974, Sperber 1967, 1990). Knowledge of large genetic control over the non-metric traits has been used by anthropologists for determining genotypic differences within and between populations, and making interpretations in relation to population affinity, microevolution, genetic drift, gene flow, and natural selection (Buikstra et al. 1990, Hanihara 2008, Hanihara et al. 2003, Hilson 1996, Matsumura 2007, Scott and Turner 2000, Sherwood et al. 2008, Sofaer et al. 1986, Ullinger et al. 2005). One example of such a study involves dental non-metric traits. Although there have been numerous studies of dental non-metric traits in different archaeological and modern populations (Drusini and Swindler 2009, Manning 1990a, b, Pacelli and Marquez-Grant 2010, Peiris 2008, Peiris et al. 2007, 2009, Sert et al. 2004, Turner 1971, Walker 1988), the prevalence of such morphological variations in archaeological Anatolian populations has rarely been reported (Eroğlu 2009, Eroğlu and Erdal 2009).

The present study describes a case of a mandibular second permanent molar with four roots, which is a dental non-metric trait in Dilkaya, an archaeological Anatolian population.

Materials and Methods

The Dilkaya archeological site is located near the city of Van in Eastern Anatolia (Figure 1). Study of Dilkaya and its necropolis, co-directed by Ege University, Istanbul University, and Van Museum, began with ground surface research in 1983 and lasted 8 years. Excavations in the area yielded numerous skeletal findings and made Dilkaya a rare archeological site in this respect. In particular, simple stone coffins, chamber tombs, and cremation urns from the Iron Age gave precise information about the burial customs of the pre-Urartian Kingdom and Urartian period (Çilingiroğlu 1993, Güleç 1989). All skeletal remains belonging to the Dilkaya populations are stored in the Department of Anthropology, Ankara University.

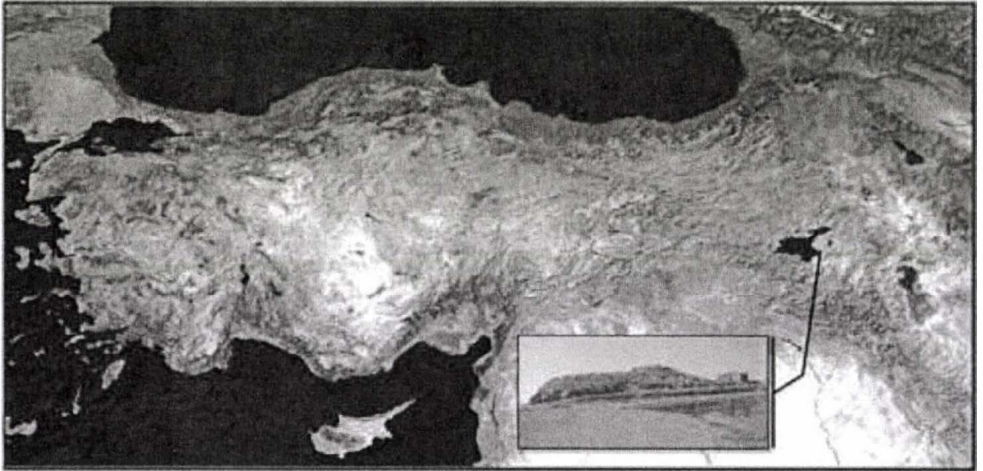


Figure 1: Location of Dilkaya in Anatolia.

The skeletal remains excavated at Dilkaya represent three different cultural phases (Çilingiroğlu 1993): the Middle Age (10th century AD), Iron Age (800–600 BC), and Bronze Age (1900–1400/1300 BC). The skeletons were mostly incomplete and fragmented, the bone tissue was generally dry and brittle, and the in situ physico-chemical erosion had given the periosteal surface a heavily weathered appearance. Only the teeth were in fairly good condition. Since the reconstruction of individual skeletal complexes was impossible, the isolated bones and teeth were analyzed. We tried to be as careful and accurate as possible in identifying the mandibular molars as M1, M2, or M3, but some misidentifications are always possible when dealing with isolated teeth, especially between M1 and M2 (Drusini and Swindler 2009). The samples consist of 579 mandibular molars and date predominantly (n=435) from the Middle Age. The frequency of mandibular molars by age in Dilkaya populations is presented in Table 1.

Table 1. The frequency of mandibular molars by age in Dilkaya populations.

Period	M1	M2	M3
Middle Age	191	150	94
Iron Age	66	55	23
Bronze Age	–	–	–
Total	257	205	117

While examining these teeth we observed that one of the mandibular second molars from the Iron Age sample possessed four roots (two mesial and two distal) rather than the usual two roots (Figure 2). Incomplete development of roots shows that this individual was around 12–13 years old. In addition, the tooth wear is of a low extent, which also supports the guess about the individual's age (Ubelaker 1989).

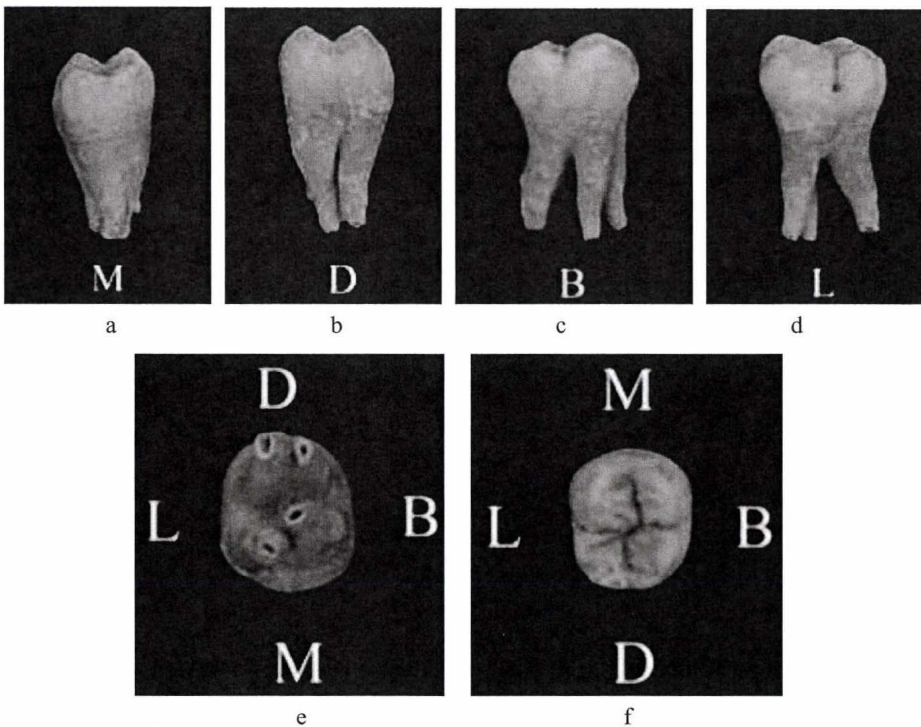


Figure 2: Right mandibular second molar with four roots: (a) mesial view; (b) distal view; (c) buccal view; (d) lingual view; (e) apical view; (f) occlusal view (M: mesial, D: distal, B: buccal, L: lingual).

Results and Discussion

The anatomy of teeth is not always similar. A great number of variations can occur in number of roots and their shape. It is known that human mandibular molars usually have two roots, one mesially and one distally placed transversely to the mesiodistal length of

the tooth crown (Barker et al. 1974, Vertucci 1984, Walker 1998). Mandibular second permanent molars with four roots have, as far as we know, not been described in archaeological populations and this finding of our study is very important in anthropological terms. In the present study, 55 mandibular second permanent molars from the Iron Age were identified and in one mandibular second permanent molar the number of roots was different. This means that in this sample 2% of the mandibular second permanent molars had four roots. The measurements of the mandibular second permanent molar were as follows: mesial-distal 14.45 mm, buccal-lingual 9.95 mm, and highest crown length 6.06 mm (Hillson 1996).

The information concerning the prevalence of root variants in archaeological Anatolian populations is insufficient from anthropological perspectives. Although there are some studies on dental non-metric traits in archaeological Anatolian populations (Eroğlu 2009, Eroğlu and Erdal 2009), spatially and temporally close comparative dental anthropological research is limited due to the lack of osteoarchaeological data on dental non-metric traits.

Unfortunately, there is not report in the literature that would allow direct comparison of our results with those of other archaeological populations. However, some variations in the root morphology associated with the mandibular second permanent molar have been described in several clinical and archaeological studies. Peiris et al. (2009) observed that a left mandibular second permanent molar with four roots was extracted from a 23-year-old woman. Several studies have shown that three roots can be found on the first, second, and third mandibular molar, occurring least frequently on the second molar (Loh 1990, Rwenyonyi et al. 2009, Tu et al. 2010, Turner 1971, Winkler and Ahmad 1997). Additionally, the roots of the mandibular second molars may fuse together (Maggiore et al. 1998, Manning 1990a, b, Rwenyonyi et al. 2009, Walker 1988). Furthermore, other reported variations in mandibular second molars are single-rooted (Carlsen 1990, Manning 1990a) and more recently C-shaped (gutter shaped) root configurations (Ahmed et al. 2007, Çalışkan et al. 1995, Cimilli et al. 2005, Ferraz and Pecora 1993, Gulabivala et al. 2001, 2002, Jayasinghe 2008, Jin et al. 2006, Kotoku 1985, Peiris 2008, Peiris et al. 2007, 2009, Rocha et al. 1996, Tamse and Kaffe 1981, Weine et al. 1988, Vertucci 1984, Yang et al. 1988).

Conclusion

There are numerous studies mentioning supernumerary mandibular molars in the literature, but no record was found indicating mandibular second permanent molars with four roots in archaeological populations, which appears to be a rare dental non-metric variation. Due to our finding of a mandibular second permanent molar with four roots in an archaeological Anatolian population, we thought it would be of anthropological interest to review the pattern of mandibular second permanent molars in the Middle East.

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References

- Ahmed, H.A., Abu-bakr, N.H., Yahia, N.A., Ibrahim, Y.E. (2007): Root and canal morphology of permanent mandibular molars in a Sudanese population. *Int. Endod. J.*, 40: 766–771.
- Barker, B.C., Parsons, K.C., Mills, P.R., Williams, G.L. (1974): Anatomy of root canals. III. Permanent mandibular molars. *Aust. Dent. J.*, 19: 408–413.
- Buikstra, J.E., Frankeberg, S.R., Konigsberg, L.W. (1990): Skeletal biological distance studies in American physical anthropology: recent trends. *Am. J. Phys. Anthropol.*, 82: 17.
- Çalışkan, M.K., Pehlivan, Y., Sepetcioglu, F., Turkun, M., Tuncer, S.S. (1995): Root canal morphology of human permanent teeth in a Turkish population. *J. Endod.*, 21: 200–204.
- Carlsen, O. (1990): Root complex and root canal system: a correlation analysis using one-rooted mandibular second molars. *Scand. J. Dent. Res.*, 98: 273–85.
- Cheverud, J.M. (1982): Phenotypic, genetic, and environmental morphological integration in the cranium. *Evolution*, 36(3): 499–516.
- Çilingiroğlu, A. (1993): Van Dilkaya Höyüğü Kazıları Kapanış XIV. *Kazi Sonuçları Toplantısı*, I: 469–489.
- Cimilli, H., Cimilli, T., Mumcu, G., Kartal, N., Wesselink, P. (2005): Spiral computed tomographic demonstration of C-shaped canals in mandibular second molars. *Dentomaxillofac. Radiol.*, 34: 164–167.
- Corruccini, R.S. (1974): An Examination of the meaning of cranial discrete traits for human skeletal biological studies. *Am. J. Phys. Anthropol.*, 40: 425–446.
- Drusini, A.G., Swindler, D.R. (2009): Frequency and variation of three-rooted lower first permanent molars in precontact Easter Islanders and in Pre-Conquest Peruvians. *Dental Anthropology*, 22(2): 33–38.
- Eroğlu, S. (2009): Ölçülemeyen diş özelliklerinin biyolojik uzaklık çalışmalarındaki önemi. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 6(11): 545–570.
- Eroğlu, S., Erdal, Y.S. (2009): Diş ve kafatası morfolojisine dayanarak üç eski Anadolu topluluğunda biyolojik uzaklıkların belirlenmesi. *Hacettepe Diş Hekimliği Fakültesi Dergisi*, 33(3): 78–90.
- Ferraz, J.A., Pecora J.D. (1993): Three-rooted mandibular molars in patients of Mongolian, Caucasian and Negro origin. *Braz. Dent. J.*, 3: 113–117.
- Gulabivala, K., Aung, T.H., Alavi, A., Ng, Y.L. (2001): Root and canal morphology of Burmese mandibular molars. *Int. Endod. J.*, 34: 359–370.
- Gulabivala, K., Opananon, A., Ng, Y.L., Alavi, A. (2002): Root and canal morphology of Thai mandibular molars. *Int. Endod. J.*, 35: 56–62.
- Güleç, E. (1989): Paleoanthropological structure of Van/Dilkaya dwellers: B.C. First Millenium – A.D. First Millennium". *Humanbiologia Budapestinensis*, 19: 47–52.
- Hanihara, T. (2008): Morphological variation of major human populations based on nonmetric dental traits. *Am. J. Phys. Anthropol.*, 136(2): 169–182.
- Hanihara, T., Ishida, H., Dodo, Y. (2003): Characterization of biological diversity through analysis of discrete cranial traits. *Am. J. Phys. Anthropol.*, 121: 241–251.
- Hillson, S. (1996): *Dental Anthropology*. Cambridge University Press: United Kingdom.
- Jayasinghe, R.D. (2008): C-shaped canals in mandibular second molars in the Hong Kong population: a computed tomographic study. *Hong Kong Dental Journal*, 5: 27–30.
- Jin, G.C., Lee, S.J., Roh, B.D. (2006): Anatomical study of C-shaped canals in mandibular second molars by analysis of computed tomography. *J. Endod.*, 32: 10–13.
- Kohn, L.A.P. (1991): The role of genetics in craniofacial morphology and growth. *Annu. Rev. Anthropol.*, 20: 261–278.
- Kotoku, K. (1985): Morphological studies on the roots of the Japanese mandibular second molars. *Shikwa Gakuho*, 85: 43–64.
- Loh, H.S. (1990): Incidence and features of three-rooted permanent mandibular molars. *Austral. Dent. J.*, 35: 434–437.

- Maggiore, C., Gallottini, L., Resi, J.P. (1998): Mandibular first and second molar. The variability of roots and root canal system. *Minerva. Stomatol.*, 47: 409–16.
- Manning, S.A. (1990a): Root canal anatomy of mandibular second molars. Part I. *Int. Endod. J.*, 23: 34–39.
- Manning, S.A. (1990b): Root canal anatomy of mandibular second molars. Part II. C-shaped canals. *Int. Endod.*, 23: 40–45.
- Matsumura, H. (2007): Non-metric dental trait variation among local sites and regional groups of the Neolithic Jomon Period, Japan. *Anthropological Science*, 115(1): 25–33.
- Pacelli, C.S., Marquez-Grant, N. (2010): Evaluation of dental non-metric traits in a medieval population from Ibiza (Spain). *Bull. Int. Assoc. Paleodont.*, 4(2): 16–28.
- Peiris, R. (2008): Root and canal morphology of human permanent teeth in a Sri Lankan and Japanese population. *Anthropological Science*, 116(2): 123–133.
- Peiris, R., Pitakothuwage, N., Takahashi M., Ohzeki, S., Nakayama, M., Sakurai, S., Igarashi, Y., Matsuno, M., Sasaki, K., Satake, T., Kanazawa, E. (2009): Mandibular permanent second molar with four roots and root canals: a case report. *Odontology*, 97: 51–53.
- Peiris, R., Takahashi, M., Sasaki, K., Kanazawa, F. (2007): Root and canal morphology of permanent mandibular molars in a Sri Lankan population. *Odontology*, 95: 16–23.
- Relethford, J.H. (2007): The use of quantitative traits in anthropological genetic studies of population structure and history. In: Crawford, M.H. (Ed.) *Anthropological Genetics*. NY. pp. 187–209.
- Rocha, L.F., Sousa Neto, M.D., Fidel, S.R., da Costa, W.F., Pecora, J.D. (1996): External and internal anatomy of mandibular molars. *Braz. Dent. J.*, 7: 33–40.
- Rwenyonyi, C.M., Kutesa, A., Muwazi, L.M., Buwembo, W. (2009): Root and canal morphology of mandibular first and second permanent molar teeth in a Ugandan population. *Odontology*, 97: 92–96.
- Saunders, S.R., Rainey, D.L. (2008): Nonmetric trait variation in the skeleton: abnormalities, anomalies and atavisms. In: Katzenberg, M.A., Saunders, S.R. (Eds) *Biological anthropology of the human skeleton*. John Wiley and Sons Inc., New Jersey. pp. 533–560.
- Scott, G.R., Turner, C.G. (2000): *The anthropology of modern human teeth*. Cambridge University Press, Cambridge. pp. 36–40.
- Sert, S., Aslanalp, V., Tanalap, J. (2004): Investigation of the root canal configurations of mandibular permanent teeth in the Turkish population. *Int. Endod. J.*, 37: 494–499.
- Sherwood, R.J., Duren, D.L., Demerath, E.W., Czerwinski, S.A., Siervogel, R.M., Towne, B. (2008): Quantitative genetics of modern human cranial variation. *J. Hum. Evol.*, 54(6): 909–914.
- Sofaer, J.A. (1970): *Dental Morphologic Variation and the Hardy-Weinberg Law*. JDR, 49. pp. 1505–1508.
- Sofaer, J.A., Smith, P., Kaye, E. (1986): Affinities between contemporary and skeletal Jewish and non-Jewish groups based on tooth morphology. *Am. J. Phys. Anthropol.*, 70(2): 265–275.
- Sperber, G.H. (1967): Genetic mechanisms and anomalies in odontogenesis. *J. Can. Dent. Assoc.*, 33: 433–442.
- Sperber, G.H. (1990): The phylogeny and odontogeny of dental morphology. In: Sperber, G.H. (Ed.) *From apes to angels*. Wiley-Liss, New York. pp. 215–219.
- Tamse, A., Kaffe, I. (1981): Radiographic survey of the prevalence of conical lower second molars. *Int. Endod. J.*, 14: 188–190.
- Tu, M.G., Liu, J.F., Dai, P.W., Chen, S.Y., Hsu, J.T., Huang, H.L. (2010): Prevalence of three-rooted primary mandibular first molars in Taiwan. *J. Formos. Med. Assoc.*, 109(1): 69–74.
- Turner, C.G. II. (1971): Three-rooted mandibular first permanent molars and the question of American Indian origins. *Am. J. Phys. Anthropol.*, 34: 229–242.
- Ubelaker, D.H. (1989): *Human Skeletal Remains: Excavations, analysis, interpretation*. Smithsonian Institution, Aldinne Publishing Company, Chicago.
- Ullinger, J.M., Sheridan, S.G., Hawkey, D.E., Turner II, C.G., Cooley, R. (2005): Bioarchaeological analysis of cultural transitions in the Southern Levant using dental nonmetric traits. *Am. J. Phys. Anthropol.*, 128(2): 466–476.

- Vertucci, F.J. (1984): Root canal anatomy of human permanent teeth. *Oral Surg. Oral Med. Oral Pathol.*, 58: 589–599.
- Walker, R.T. (1988): Root form and canal anatomy of mandibular second molars in a Southern Chinese population. *J. Endod.*, 14: 325–329.
- Walker, R.T. (1998): Pulp space anatomy and Access cavities. In: Pitt Ford, Tr. (Ed.) *Harty's Endodontics in Clinical Practice*. Wright, Oxford, UK. pp. 16–36.
- Weine, F.S., Pasiewicz, R.A, Rice, R.T. (1988): Canal configuration of the mandibular second molar using a clinically oriented in vitro method. *J. Endod.*, 14: 207–213.
- Winkler, M.P., Ahmad, R. (1997): Multirooted anomalies in the primary dentition of Native Americans. *J. Am. Dent. Assoc.*, 128: 1009–1011.
- Yang, Z.P., Yang, S.F., Lin, Y.C., Shay, J.C., Chi, C.Y. (1988): C-shaped root canals in mandibular second molars in a Chinese population. *Endod. Dent. Traumatol.*, 4: 160–163.

Levelezési cím: Yener Bektaş
Mailing address: Yuzuncu Yil University, Faculty of Literature
Department of Anthropology
65080 Van
Turkey
ynrbektas@gmail.com

