

Characteristics of the Occlusal Surfaces of Lower Molars in a Sample of the Croatian Population

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Summary

The aim of this study was to determine the characteristics of the occlusal surfaces of lower molars in a sample of the Croatian population.

Classification of the characteristics of the occlusal surface of molars was determined according to the standards for characterisation of morphological variants of permanent teeth, of ASU (Arizona State University - Dentoanthropological System of the State University of Arizona).

On the basis of the obtained results of the shape of grooves in lower molars, with regard to the evolutive process in these teeth, it can be concluded that the first lower molar is the most conservative. The high frequency of + shape was significant in the second lower molar. As + shape can be taken as the highest evolutive stage of the conservative Y shape, i.e. the beginning of the most developed X shape, the second lower molar can be said to be in the transitive stage, and thus with its attained evolutive level it is definitely closer to the lower third molar. The third molar reached the highest developmental shape in the formation of the occlusal surfaces of lower molars.

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Introduction

The ontogenetic development of teeth in humans and animals is essentially the same. Development is relatively brief and occurs during gravidity in mammals or during maturation within the egg of non-mammals.

The patterns of the occlusal surfaces of molars are polygenically conditioned and determined by a combination of allele on two or more sites/loci, and they occur in one of the final stages of molar growth, as a result of the terminal deposition of enamel (1).

Numerous studies have shown that the genes of the X chromosome regulate the deposition of enamel, while genes of the Y chromosome influence the division of the cell connected with the formation of the dentine-enamel bond and the deposition of enamel (2-7).

Recent studies on the molecular level have confirmed earlier knowledge of the effect of sex chromosomes on the mechanism of enamel deposition. Nakahori et al arranged in sequences the gene for amelogenin from both chromosomal sexes. The gene was mapped and it was found to situated on the short

arm of the X chromosome. The gene for amelogenin is probably situated/located on the long arm of the Y chromosome. Although it has been suggested that it is situated/located on the short arm of the Y chromosome (8-10).

In his investigations Zilberman et al confirmed that the X chromosome accelerates the deposition of enamel, and that both X chromosomes in females are active in amelogenesis, while Y chromosome influences the deposit of dentine and enamel. A study carried out by Kutlešs-Oroši also confirmed that chromosomes and sex have an influence on the growth of dental tissue (11, 12).

The groove patterns between some cusps on the lower molars can be identified by the letters Y, X and the sign +. According to anthropologists and palaeontologists the groove pattern in the shape of the letter Y is the most conservative, and the letter X is the most developed degree of formation of the occlusal surface (13, 14).

The aim of this study was to determine the frequency of characteristics of the occlusal surfaces of lower molars in a sample of the Croatian population, with regard to the following:

- a) Occlusal aspect.
- b) Standard and surplus cusps.
- c) Groove pattern.
- d) Additional ridges, pits and grooves.

Material and methods

The material for this study consisted of plaster casts/impressions of dental arches from the records of the Department of Dental Anthropology School of Dental Medicine University of Zagreb, taken from 437 subjects of the Croatian population. Of the total number of casts/impressions of dental arches, 245 (56.06%) were of male subjects and 192 (43.94%) female. A total number of 1896 molars were examined. Of this number 656 were lower third molars (M3), 874 lower second molars (M2) and 366 lower first molars (M1). Two examiners in mutually independent examinations performed analysis of the material for this study.

Classification of the characteristics of the occlusal surfaces of the molars was determined according to the standards for characterisation of morphological vari-

ants of permanent teeth of ASU (Arizona State University - Dentoanthropological System of the State University of Arizona) (15).

Classification of the groove pattern on the lower first (M1), second (M2) and third (M3) molars:

- Y Contact of the second and third cusps.
- + Contact of cusps from one to four.
- X Contact of the first and fourth cusps.

The groove pattern was calculated by means of lupe at 10x magnification.

Classification of the number of cusps on the lower first (M1), second (M2) and the third (M3) molars:

4. The presence of cusps 1 - 4 (1- protoconid; 2- metaconid; 3- hypoconid; 4- entoconid).
5. The presence of 5 cusps (hypoconulid)
6. The presence of 6 cusps (entoconulid).

The following relationships between the obtained data were statistically examined:

1. Distribution of the examined characteristics (absolute and relative) according to the values expected on the scales used for measuring in the study, separately for each tooth.
2. Contingency tables were developed for relationships between the examined characteristics within each tooth. Tables were not developed for characteristics with or without minimal variability. Correlation within the tables was tested by chi-square test, and the results of the test are shown as zero-hypothesis probability of the non-existence of correlation.

Results

Table 1 shows the distribution of M3 characteristics from the right and left sides.

The most frequent occlusal aspect in the case of M3 was square (64.63% right and 63.72% left), followed by oval and pentagonal.

Mesiobuccal, mesiolingual and distobuccal cusps were found in all M3, apart from one on the left side, which did not have a mesiolingual cusp. Distolingual cusps were found in 92.38% right, 92.07% left, and distal cusps in 39.02% right and the same amount left M3.

The shape + groove pattern was determined in 70.40% right, and 72.20% left; shape X 25.11% right, and 24.21% left; while Y shape was present in only ten molars on the right and eight on the left side.

The frequency of additional ridges was almost identical on the right and left (14.63%/14.33%); additional pits were the same on the left and right (2.74%); additional grooves were statistically significantly more frequent on the left (13.72%) than on the right (10.37%) ($p < 0.05$).

M3 statistically significantly differed only with regard to the last quoted characteristic - additional grooves.

Table 2 shows the distribution of the characteristic M2 from the right and left side.

As in the case of M3 the most frequent form of occlusal surface was also square (94.28% right and 94.51% left) while the remainder consisted of the pentagonal form.

Mesiobuccal, mesiolingual, distobuccal and distolingual cusps were present in all teeth on both sides (apart from one on the right side in which distolingual was missing). The presence of a distal cusp was almost identical on the right (5.95%) and on the left (5.49%) side.

+ Groove pattern was most frequently found (87.82% teeth right and 88.06% left). This was followed by X shape with 8.43% on the right and 8.19% on the left side. Y shape was least frequent and was the same on both sides (3.75%).

Additional ridges were found in only one tooth on the right and left, and the same was found for additional pits, while additional grooves were found in 2.06% right and 2.29% left M2.

None of the characteristics were statistically significantly different with regard to the frequency of occurrence on the side of the dentition/teeth.

Table 3 shows the distribution of M1 characteristics from the right and left side.

The square shape of the occlusal aspect occurred slightly more on both sides (58.47% right and 50.02% left) than pentagonal shape (41.53% right and 40.98% left).

Mesiobuccal, mesiolingual, distobuccal and distolingual cusps were found in all teeth (apart from

one on the left side, which did not have a mesiobuccal cusp). Distal cusp was statistically significantly more frequent on the left (74.32%) compared to the right side (69.95%) ($p < 0.01$). Tuberculum intermedium (one tooth on the left side), and tuberculum sextum (four teeth on the right side and two on the left) were very rare findings.

Y groove pattern was most frequent on both sides (70.23% right and 73.03% left). + pattern was rarer (29.21% right and 26.41% left) and X pattern was a sporadic finding (one tooth on both sides).

Additional ridges (three teeth right and four left), additional pits (three teeth on each side) and additional grooves (five teeth on each side) was a rare finding on M1.

Discussion

A lower molar with Y groove pattern and five to six cusps occurred in *Dryopithecus*. Taking this groove pattern and number of cusps as a starting point it should be emphasised that the number of cusps can be reduced (from six to four or even less) and alteration in their size and position is possible. In this case Y shape grooves change into + shape grooves, which change into X shape grooves. In the case of Y shape a line of contact is created between metakonid and hypokonid; in the case of + shape four main cusps have a contact point in the grooves which separate them: in the case of X shape there is no contact between metakonid and hypokonid, although there is a fissure between protokonid and entokonid, which separates them (16, 17).

In this study the characteristics of the occlusal surfaces of lower molars were determined in a sample of the Croatian population.

The groove pattern of Y shape was found most frequently on M1, with participation of 70.23%. In his investigation Dumančić found Y shape on 66.70% of M1 (18). In a sample of Jews (Lublin) Steslicka found Y shape on M1 in 78.00% (19). In American children Hellman found Y shape on M1 in 86.00% and in European Caucasians in 94.00% (20).

In this study the greatest frequency of + shape was found on M2, in 87.94% of teeth. This finding

agrees with the results of Blažanović, who determined greatest frequency of + shape on M2, compared with X and Y shapes (21). Dumančić found + shape on this tooth in 44.10%. Steslicka found 94.00% of ' shape on M2 in a sample of Jews (Lublin). In American children Hellman found 96.00% + shape on M2 in 96.00%, and 95.00% in European Caucasians.

In the present study the greatest frequency of + shape was determined on M2 and M3, where the degree of modification of Y shape is still in the preliminary stage.

+ shape could be taken as the highest evolutive stage of Y shape, i.e. the beginning of X shape.

X shape occurred most frequently on M3 in 24.66% of teeth. Dumančić found frequency of X shape on M3 in 61.30%.

In this study a conservative number of cusps (five) was most frequently found on M1 (71.20%), followed by M3 (41.60%) and M2 (5.30%). The following authors obtained similar results in their investigations: Dumančić (M1 66.75%; M3 40.60%; M2 6.45%) and Steslicka (M1 78.00%; M3 without data; M2 6.00%). In American children Hellman found five cusps on M1 87.00%; M3 without data; M2 6.00%, and in European children on M1 89.00%; M3 38.00%; M2 1.00%.

Based on such findings it is impossible to determine whether the tooth with four cusps occurred as a result of a reduction in hypokonid or whether the tooth with five cusps occurred due to progressive development of a new cusp, which was not homologous with any of the cusps of the tooth of conservative *Dryopithecus* shape.

Y shape with five cusps was most frequent on M1 (70.23%) and much less frequent on M3 (4.04%) and on M2 (3.00%). In their investigations Steslicka and Hellman obtained similar relationships with regard to the order of frequency of this shape. Y shape with four cusps was not found on M1 and M3 in any case, and was a very rare finding on M2 (0.75%). Steslicka did not find this shape on either M1 or M2, and no data were given for M3. In a sample of European Caucasians Helman found Y shape on M1 and M2 with four cusps in 7.00% and 5.00% respectively, while this shape was not found on M3. + Shape with five cusps occurred most frequently

on M3 (33.00%) and very rarely on M2 (2.72%), and on M1 (0.26%). Hellman found similar results in the order of frequency of this shape in a sample of European Caucasians. + Shape with four cusps occurred in a very high percentage on M2 (85.22%). The frequency of this shape was found in a lower percentage on M3 (38.30%), while it was rarest on M1 (28.95%). Steslicka and Helman obtained similar results. According to Selenka the sixth cusp, situated between entokonid and hypokonulid, corresponds to the posterior, interior and exterior accessory cusp (*tuberculum accesorium posterius internum et externum*). The present study determined that the sixth cusp was only present on M1, i.e. 2.19% right and 1.09% left teeth. When present in man today, its frequency, according to Remane, is less than 10% (22).

Conclusions

Based on an analysis of the shape of the occlusal surface of lower molars in a sample of the Croatian population the following conclusions can be made:

1. Y shape with five cusps was found most frequently on M1.
2. Y shape with four cusps was not found on M1 and M3, and was very rarely found on M2.
3. + Shape with five cusps was found most frequently on M3.
4. A very high percentage of + shape with four cusps was found on M2. + Shape could be taken as the highest evolutive stage of the conservative Y shape, i.e. the beginning of X shape, the most developed stage of formation of the occlusal surface of lower molars. + Shape was most frequently found on M2, where the stage of modification of conservative Y shape was still in the transitive stage.
5. X shape on M3 occurred most frequently on M3 as the most developed stage of occlusal surface formation.
6. The greatest frequency of the conservative number of cusps (five) was found on M1.

Based on the results obtained of the shape of the groove in lower molars, with regard to the evolutive process in these teeth, it can be concluded that M1

is the most conservative. The high frequency of + shape on M2 was significant. As + shape can be taken as the highest evolutive stage of the conservative Y shape, i.e. the beginning of the most developed X shape for M2, it can be said that it is in the transitive stage, and that with the attained evolutive level it is definitely closer to M3. M3 attained

the highest developmental form in the formation of the occlusal surface of lower molars. By comparing the lower molars of the right and left side it can be concluded that there is no statistically significant difference with regard to the side of the dentition, with the exception of additional grooves on M3 and distal cusps on M1.