

Evaluation of the Level of the Position of Canine and Premolar Germs in Mixed Dentition

Mirna Jerolimov¹
Želimir Muretić²

¹Department of Dental
Prosthetics
School of Dental Medicine
University of Zagreb
²Department of Orthodontics
School of Dental Medicine
University of Zagreb

Summary

Knowledge of the dynamics of growth and eruption of teeth during the period from mixed to permanent dentition is essential as the majority of malocclusion begins at this time, and requires prompt orthodontic treatment.

The aim of this study was to determine the level of the position of tooth germs and their zones of resistance in relation to the occlusal plane, in order to determine potential differences between male and female subjects and to conclude whether differences exist in the level of the germs and order of eruption in the examined groups of teeth.

The sample comprised 200 orthopantomograms (96 boys and 104 girls aged from 6 to 10 years) at the Department of Orthodontics School of Dental Medicine University of Zagreb. The shortest distance of the canine and both premolars to the occlusal plane was measured directly on the X-ray films.

Based on the results of the study it can be concluded that in boys, in both jaws during the defined development phase, the premolar was nearest to the occlusal plane, followed by the second premolar and then the canine. In girls, in the upper jaw, the first premolar was the nearest to the occlusal plane, followed by the second premolar and then the canine, and in the lower jaw the premolar was first, followed by the canine and the second premolar. In both sexes the position of the corresponding teeth was symmetric in the same jaw, and an identical order of the teeth eruption can be expected.

Examination of the differences in arithmetic means for all variables according to sex confirmed statistical significant differences for the canine, and other differences were incidental.

Key words: *supporting zone, mixed dentition*

Acta Stomat Croat
2001; 27-31

ORIGINAL SCIENTIFIC
PAPER
Received: September 20, 2000

Address for correspondence:

Mirna Jerolimov, D.D.S.
Department of Dental
Prosthetics
School of Dental Medicine
University of Zagreb
Gundulićeva 5, 10000 Zagreb
Croatia

Introduction

In clinical orthodontics, the development and eruption of teeth during the period of mixed to permanent dentition is particularly interesting as the majority of malocclusions appear at this time and require prompt treatment. The order of eruption of permanent dentition during this phase of the development of dentition should be well known, in order to enable early diagnosis and the planning of orthodontic therapy.

Replacement of teeth is preceded by the growth of both jaws and the appearance of free retromolar space, which is necessary for the eruption of the first permanent molar (1,2,3,4,5,6).

The eruption of teeth can be determined as axial or occlusal movement of the tooth from the area of its development in the jaw to its functional position in the occlusal plane. Three phases of eruption are differentiated: pre-eruptive, eruptive and post-eruptive.

During eruption the first permanent molar is lead-voden? by the distoapproximal surface of the second primary molar. A caries process, traumatic injury or loss of this primary tooth can cause mesial movement of the first permanent molar, resulting in loss of space for the teeth erupting after it.

Normal mixed dentition is characterised by the eruption of the first permanent molars, permanent incisors (or erupting incisors), maintained centres of the dental arches of both jaws, 2 mm overlap of the frontal teeth, sagittal interincisal gap, not larger than 3 mm, sagittal intermaxillary relation, class I according to Angle, and preserved teeth of the zone of resistance.

The zone of resistance is the segment of the dental arch between the permanent lateral incisor and the first permanent molar. The teeth of the zone of resistance comprise a primary canine and primary molars, which are between two distinct centres of growth (first permanent molar and permanent incisors). During the period of mixed dentition this area of the dental arch does not enlarge with growth but actually becomes smaller by closing the diastema, which is a physiological process, or by the loss of tooth substance as a result of a pathological process.

The phase of mixed dentition is most frequently initiated by eruption of either the first permanent

molar or the lower middle incisors. The period of eruption of permanent teeth begins and ends between the sixth and twelfth year, with marked variability.

The interval of mixed dentition, with regard to the rhythm and time of teeth eruption, and the growth of the jaws and alveolar process can be divided into two stages: in the first, which lasts from the sixth to the ninth year, the first permanent molars erupt with the replacement of the frontal teeth, and in the second, from the ninth to the twelfth year, the canines and premolars erupt. As a rule the first to erupt in the lower jaw is the canine, followed by both premolars, and in the upper jaw the first to erupt is the first premolar, followed by the premolar simultaneously with the canine, or that tooth is last to erupt.

Replacement of the teeth begins in both sexes with the eruption of the first permanent molar. Eruption of the remaining teeth begins earlier in girls than in boys. Replacement of the teeth occurs symmetrically, i.e. simultaneously on both sides of the jaws. The order of the eruption of the successor teeth of the supporting zone area varies, depending on age, sex and even ethnic origin (7,8). The dynamics of tooth replacement can have a significant influence on the general status of dentition and occlusion, resulting in malocclusion (9,10).

In view of the fact that significant variability exists in the levels of the position of the germs of permanent canines and premolars, and in the order of their eruption, the aim of our study was as follows:

1. To determine the level of the position of the germ of the canine and premolar in both jaws in relation to the occlusal plane.
2. To determine possible differences in the position of the germ of the defined groups of teeth between male and female subjects.
3. To establish whether difference exists in the levels of the germ and the order of eruption of the examined groups of teeth.

Sample and methods

The sample consisted of 200 orthopantomograms of patients from the Department of Orthodontics School of Dental Medicine, University of

Zagreb (96 boys and 104 girls) aged from 6 to 10 years. Only the films of patients prior to eruption of the canines and premolars were selected. The orthopantomograms of patients with symptoms of severe skeletal anomalies and with anomalies in the number and shape of teeth were excluded.

As reference lines during measurement in the upper and the lower jaw, occlusal lines were applied which connects the incisal ridges of the first permanent incisors with the most prominent cusps of the first permanent molars. For each jaw 6 variables were established by which the vertical position of the germ of the canine and premolar in relation to the occlusal plane was determined.

The distance was measured from the point on the tooth, nearest to the occlusion plane, vertically to the reference line.

The results of the measurements were analysed by the application of basic statistical parameters (arithmetic mean and standard deviation). Examination of the differences in arithmetic means according to sex was carried out separately.

Results

The results are presented in tables. The arithmetic means and standard deviations of the examined variables are presented for the whole sample and separately for male and female subjects (Tables 1,2,3). The arithmetic means are also presented in a graph (Figures 1,2,3). The results of testing differences in arithmetic means, according to sex, are presented in Table 4.

Discussion

Knowledge of the level of the position of the germ of the canine and premolar prior to their eruption has diagnostic and prognostic importance in view of frequent premature loss of primary teeth and the consequent shifting of permanent teeth.

The results of the study indicate that in boys, in both jaws, the first premolar is the nearest to the occlusal plane, which is particularly marked in the upper jaw, followed by the second premolar and then the canine. The position of the analogous teeth

is symmetric in both sides of the same jaws. Thus, for example, the arithmetic mean for parameter 15=10.76, parameter 25=11.03, parameter 14=8.01, and parameter 24=7.65. The arithmetic means for the upper canines show higher values and consequently greater distances of those teeth from the occlusal plane (13=17.80, 23=17.25). Such a high position of the canine is called vertical baton.

In the mandible/lower jaw the arithmetic mean for parameter 35=15.46, parameter 45=15.04, parameter 34=13.14, and parameter 44=12.83. The arithmetic means for the lower canines are also quite high, parameter 33=16.91 and parameter 43=16.89.

Because of the position of the aforementioned groups of teeth in both jaws, uniform order can be assumed for eruption of the canines, first premolars and second premolars, with the first premolars erupting first.

In girls the nearest to the occlusal plane in the maxilla was the first premolar, followed by the second premolar, and the canine, and in the lower jaw the first premolar, the canine and the second premolar. Comparison of the arithmetic means of the examined variables for the female subjects showed that the position of the analogous teeth was symmetric in the same jaw. The arithmetic mean for parameter 15=10.18, parameter 25=10.12, parameter 14=7.81, and parameter 24=7.73. As the upper canines are last to erupt, these values are noticeably higher than for the aforementioned teeth (13=15.76, 23=15.84).

In the mandible/lower jaw the arithmetic mean for parameter 35=13.93, parameter 45=14.13, parameter 34=11.93, parameter 44=11.80, parameter 33=13.77 and parameter 43=13.44. As all the mean values were higher in the male subjects, which was confirmed by the greater distance of the examined teeth from the occlusal plane, it can be anticipated that the eruption of teeth will be earlier in girls than in boys.

By examining the differences in arithmetic means according to the sex of the subjects it was confirmed that statistically significant differences exist for the canine, because of the greatest distance of this tooth from the occlusal plane. Other differences are incidental and not statistically significant.

Many studies carried out to date have enabled the production of chronological tables on teeth eruption

and shown great variability in the periods of teeth eruption, not only in ethnically different groups but also individually (11).

According to Cozzi et al. (12) and Gorlina, Cohen and Levin (13) the most frequent order of eruption is as follows: in the upper dental arch the first to erupt is the first premolar, followed by the second premolar and the canine. In the lower dental arch the first is the canine, followed by the first premolar and the second premolar.

Radica and Rak (14) carried out a study by means of cross section on a sample of 2356 children from the region of Split, of which 1199 were boys and 1157 girls. They presented the mean time and order of eruption of permanent teeth, differences according to sex, symmetry or asymmetry in the rhythm of teeth replacement, and established the interval in which certain teeth most frequently erupt. They determined that eruption of permanent teeth occurs in two phases, between which there is an interval of rest amounting to 1.72 years in boys and 1.70 years in girls.

Eruption occurs in girls earlier than in boys. The replacement of teeth occurs symmetrically, i.e. simultaneously in both sides of the jaw. The order of eruption of permanent teeth in the maxilla/upper jaw is the same for both sexes: the canine, first premolar and second premolar. In the mandible both the order and time of eruption of permanent teeth is different. Namely, in boys the first to erupt is the first premolar, followed by the canine and the second premolar. In girls the first is the canine, followed by the first premolar and the second premolar.

Thilander and Ronning (15) show different tables of the chronology of the eruption of permanent teeth according to Helma and Seigler, Haarikko, Van der Linden and Duterloo.

Based on the results of a study in a Finnish population, Eskelli, Laine-Alava, Hausen and Pahkala (8) concluded that in boys and girls in the maxilla the first to erupt is usually the first premolar, followed by the canine and the second premolar, and in the mandible the first is the canine, followed by the first premolar and the second premolar.

Hotz (16) and Stöckli (17) emphasise that it is desirable for the first premolar to erupt between the

ninth and tenth year in the maxilla. After a short interval in which the primary canine is shed eruption of the permanent canine should begin. Just before its eruption the second primary molar should be shed and the first premolar should move distally. In this way the extra space is utilised which occurs with the replacement of the second primary molar with the second premolar. The second premolar should erupt behind the permanent canine in order to avoid mesialisation of the first permanent molar, which would thus occupy the place of the second premolar and change the occlusal relations in the area of the first permanent molars. If the second primary molar is shed before the eruption of the permanent canine, or if the first premolar does not distalise because of the eruption of the permanent canine, the extra space which occurs with the replacement of the second primary molar with the second premolar is occupied by the first permanent molar, particularly if the second permanent molar is on the point of erupting. It is desirable for the canine and first premolar to erupt in the mandible/lower jaw at the same time so that the difference between the primary and permanent canine is equalised. When the second primary molar is shed it is undesirable for the second permanent molar to erupt before the second premolar, as it can occupy part of the space.

Van der Linden (18) also studied the sequence of eruption of the canine and premolar in the upper and lower jaw.

In the maxilla the following possibilities were observed:

- Simultaneous eruption of the canine and the first and second premolars.
- First, eruption of the first premolars, followed by simultaneous eruption of the second premolars and canine.
- Coordinated eruption of the premolar, followed by the canine, which the aforementioned author considers the best order.

The following problems were described in the mandible:

- Simultaneous eruption of the canine and first premolars, followed by the second premolars.
- First, eruption of the lower canine, followed by simultaneous eruption of the first and second premolars.

- Eruption of the canine, accompanied by eruption of the premolars.
- Order of eruption of the first premolars, canines, second premolars and second molars, which the author considers the best possible order of the teeth, if there are no other anomalies.

Veber (19) carried out a study on a sample of 632 subjects (323 boys and 309 girls) aged from 5 to 17 years. The aim of the study was to analyse the correlation between variables of the degree/level of eruption, dental and (osealne) age, sex, chronological age, height and weight. With regard to the level of eruption no statistically significant difference was found with regard to sex and chronological age.

A study by Rajić, Rajić-Meštrović and Verzak (7) included 2768 children (1398 boys and 1370 girls). All subjects were classified into age groups with a range of one year. The aim of the study was to determine the onset, order, medial time, end, dynamics, stability and intensity of eruption of permanent teeth, with a calendar of eruption in a population of children from Zagreb. Some asymmetry in eruption was observed.

Apart from inheritance several factors influence the growth and development of teeth, which increase the variations in time and order of tooth eruption, e.g. orthodontic anomalies, about which there are few data in literature (20,21).

The time and order of teeth eruption of the second phase of mixed dentition are very important for the further development of dentition, because some normal developmental conditions can acquire the characteristics of malocclusion, which can

frequently be masked by dentoalveolar adaptive mechanisms (22).

The results of this study, and the importance of the canine and premolar with regard to their functional and aesthetic aspect, indicate that further research is necessary in order to determine whether differences exist in the dynamics of the movement of the germs of the defined groups of teeth in earlier developmental phases.

Conclusions

On the basis of an analysis of the results of this study the following can be concluded:

1. In boys, during the early phase of mixed dentition, in both jaws the germ of the first premolar is the nearest to the occlusal plane, followed by the second premolar and the canine. In girls, in the upper jaw, the nearest to the occlusal plane is the first premolar, followed by the second premolar and the canine. In the lower jaw the first is the premolar, followed by the canine and the second premolar. From such a sequence of germ positions for the defined groups of teeth the same order of eruption is anticipated.
2. In both sexes the position of the analogous teeth is symmetric in the same jaw.
3. Significant difference was confirmed between the vertical position of the germ of the canine according to sex. In girls the canines were closer to the occlusal plane than in boys. The differences determined in the position of the other examined teeth were incidental.