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MORPHOMETRIC ANALYSIS OF MAXILLARY TUBERCLES IN CHILDREN TO DENERMINE THE POSSIBILITY OF THEIR USE AS A SUPPORT FOR DISTALIZATION

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High intensity and prevalence of carious process lead to premature extraction of deciduous teeth and the creation of favorable conditions for development of anomalies and deformities. To improve the efficacy in treatment of dentoalveolar malocclusions which occur as a result of pathological mesial displacement of the maxillary lateral teeth, we considered the possibility of using the maxillary tubercles as a self-sustained or additional distal support to move the permanent molar in the distal direction. As a result of studying the features of the maxillary tubercles structure, we proposed their distribution according to their form: a) flat; b) sloping; c) convex; by height into: a) low (up to 2 mm); b) medium (2-3 mm); c) high (more than 3 mm); by length into: a) short (up to 5 mm); b) medium (5-8 mm); c) long (more than 8 mm). The prevalence of maxillary tubercles different in sizes and shapes in children of different age groups was studied, as well as the orthodontic apparatus for molars distalization using a high convex maxillary tubercle as a distal support.

Key words: children, maxillary tubercles, pathological mesial displacement of the first permanent molars, anchor system, molars distalization.

The work is a fragment of the research project "Clinical and experimental justification for improving the quality of orthopedic treatment in patients with dentoalveolar pathology", state registration No. 0120U000573.

Due to the high intensity of caries and premature removal of deciduous teeth, especially molars, there are favorable conditions for the development of anomalies and deformations in the sagittal, transverse and vertical planes [1, 2, 8, 9]. Mesial migration of lateral teeth is especially pronounced, which in case of premature extraction of deciduous teeth and untimely prosthetics contributes to the occurrence of dental anomalies, and the degree of displacement depends on the time of loss of deciduous molars [3, 4].

A necessary and important stage of orthodontic treatment is to correct the position of displaced permanent molars, especially in the upper jaw. Therefore, for their bodily distal movement often use fixed orthodontic appliances, one of which components is the Nance basis, which is located on the palate and acts as a mesial support in the distalization of molars [5, 6, 7, 12, 14]. However, the problem of the fixing "anchor" loss, protraction of the dentition frontal part, combination of different anchor systems during the orthodontic treatment remains relevant [10, 11, 13, 15].

Therefore, given the causes and consequences of premature milk molars extraction, there is a need for early diagnosis of pathological mesial teeth transfer, development of measures aimed at improving methods for prevention and treatment of this pathology.

The purpose of the study was to perform morphometric analysis of maxillary tubercles in children to determine the possibility of their use as a distal support in the distalization of molars.

Materials and methods. To study the structure of the maxillary tubercles, we examined 60 children without dental anomalies (group I), which were divided into the following subgroups: 7-8 years (IA), 9-10 years (IB) and 11-12 years (IC) (20 children in each group) and studied the shape and size of 120 maxillary tubercles. During the examination, they used the "Map of determining the condition of maxillary tubercles", which contained the passport data of the child, year of birth, dental formula, data on the shape and size of the maxillary tubercles. Each child underwent the maxillary contouring with alginate masses, and using the obtained diagnostic models the shape of the maxillary tubercles was determined and their size was measured using a caliper and orthodontic dental gauge.

To determine the length of the maxillary tubercle, the orthodontic gauge was placed on the tubercle slope and the distance was measured from the distal contact surface of the last molar to the bottom of the maxillary pterygoid notch, which is formed by the lower fibers of the internal pterygoid muscle fixed to the alveolar tubercles and posterolateral surface of the palatal bone's horizontal part.

When determining the height of the maxillary tubercle, the depth gauge of the caliper was placed transversely to the bottom of the maxillary pterygoid notch so that the rod could touch the highest point of the tubercle. After fixing the position of the caliper, the height of the maxillary tubercle was determined (distance from the bottom of the maxillary pterygoid notch to the highest point on the maxillary alveolar tubercle).

For statistical processing of the study results we used the generally accepted Student-Fisher method, variational-statistical method of analysis on a personal computer using a package of statistical software "Microsoft Excel – 2007" and "Statistica-6.0".

Statistical processing of the study results was performed by calculating the following indices: arithmetic mean (M), arithmetic mean error (m), the reliability of the differences in the results (P), which were considered significant with a probability factor less than 0.05.

To perform distal movement of permanent molars using the maxillary tubercle as a distal support, we have proposed an orthodontic appliance for distalization, which permits to use high and convex maxillary tubercles as a self-sustained or additional anchor system.

Results of the study and their discussion. In cases when in premature extraction of deciduous molars prophylactic prosthetics was not performed and pathological mesial displacement of the first permanent molar was revealed, we considered the possibility of using the maxillary tubercle as a self-sustained or additional intraoral distal support to move the permanent molar, which prompted us to study in detail topographic and anatomic features of maxillary tubercles structure in children.

Thus, in order to improve the methods of molar distalization, we studied the structural features of 120 maxillary tubercles in children.

As our studies have shown, maxillary tubercles differ in shape and size. When studying the tubercles' size, we paid attention to their height and length, and as a result of our studies, we proposed the following distribution of maxillary tubercles.

1. By shape: a) flat; b)sloping; c) convex.
2. In height: a) low (up to 2 mm); b) medium (2-3 mm); c) high (more than 3 mm).
3. In length: a) short (up to 5 mm); b) medium (5-8 mm); c) long (more than 8 mm).

Fig. 1. Flat maxillary tubercle.

Fig. 2. Sloping maxillary tubercle.

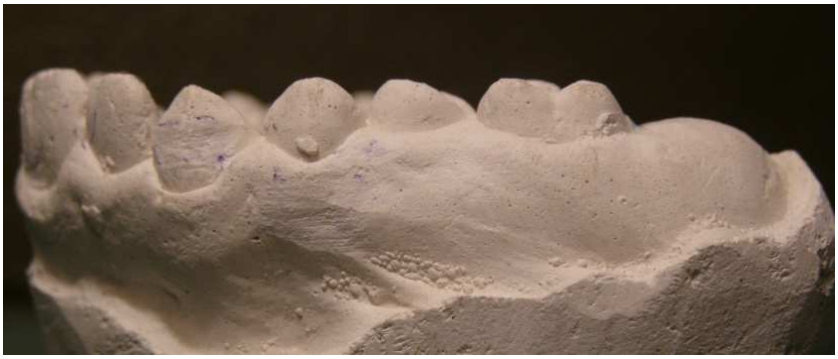

Fig. 3. Convex maxillary tubercle.

Varieties of the shape of the humps of the upper jaw are shown in Fig.1, 2, 3.

The prevalence of different shape maxillary tubercles in different children's subgroups is presented in table 1.

From the data presented in the table it is seen that in the subgroup IA the prevalence of flat tubercles was (22.5±6.6) %, significantly higher ($p < 0.05$) was the prevalence of sloping tubercles, which was 50.0±7.9) %, and convex ones - (27.5±7.1) %. In subgroup IB, the prevalence of flat tubercles was (22.5±6.6) %, sloping - (42.5±7.8) % and convex - (35.0±7.5) %, with a significant difference between the prevalence of flat, sloping and convex tubercles not being detected. In subgroup IC, the prevalence of flat tubercles was (20.0±6.3) %, sloping tubercles - (32.5±7.4) % and convex ones - (47.5±7.9) % ($p < 0.05$).

Thus, at the age of 7 to 12 years, there is a change in the maxillary tubercles shape from sloping to convex one, due to the growth of the alveolar process and the preparation of the body to eruption of other permanent molars.

Table 1

Distribution of maxillary tubercles by shape in children during the mixed occlusion period

Shape of tubercle	Age of children (years)					
	7-8 (IA)		9-10 (IB)		11-12 (IC)	
	n	%	n	%	n	%
Flat tubercle	9	22.5±6.6	9	22.5±6.6	8	20.0±6.3
Sloping tubercle	20	50.0±7.9*	17	42.5±7.8	13	32.5±7.4
Convex tubercle	11	27.5±7.1	14	35.0±7.5	19	47.5±7.9*

Note: * - p <0.05, compared to the prevalence of flat tubercles.

The dynamics of changes in the height of the maxillary tubercles in children during the mixed occlusion period are shown in table 2.

Table 2

Distribution of maxillary tubercles by height in children during the mixed occlusion period

Tubercle's height	Age of children (years)					
	7-8 (IA)		9-10 (IB)		11-12 (IC)	
	n	%	n	%	n	%
low	12	30.0±7.3	7	17.5±6.0	5	12.5±5.2
medium	17	42.5±7.8	19	47.5±7.9*	16	40.0±7.8*
high	11	27.5±7.1	14	35.0±7.5	19	47.5±7.9*

Note: * - p <0.05, compared to the prevalence of low tubercles.

Analysis of the obtained data shows that the height of maxillary tubercles in children during the mixed occlusion period changes. Thus, in children of subgroup IA the prevalence of low tubercles was (30.0±7.3) %, medium - (42.5±7.8) %, high - (27.5±7.1) % and a significant difference between these indices was not detected. In subgroup IB, the prevalence of low tubercles was (17.5±6.0) %, and the prevalence of medium maxillary tubercles reliably (p <0.05) increased, making (47.5±7.9) %, and the percentage of high tubercles was (35.0±7.5) %. In subgroup IB it was found that the prevalence of low tubercles was (12.5±5.2) % and significantly higher (p <0.05) were the prevalence of medium and high maxillary tubercles, which were, respectively, (40.0±7, 8) % and (47.5±7.9)%.

Thus, during the mixed occlusion period, the height of the maxillary tubercles gradually changes from low to medium in 7-9 years and from medium to high in 10-12 years, depending on the growth and development of the jaw and the alveolar process, the stage of permanent molars eruption and, possibly, genetically determined features of child development.

The dynamics of changes in the length of the maxillary tubercles in children during the mixed occlusion period are shown in table 3.

Table 3

Distribution of maxillary tubercles by length in children during the mixed occlusion period

Tubercle's length	Age of children (years)					
	7-8 (IA)		9-10 (IB)		11-12 (IC)	
	n	%	n	%	n	%
short	9	22.5±6.6	6	15.0±5.7	10	25.0±6.9
medium	19	47.5±7.9*	21	52.5±7.9*	13	32.5±7.4
long	12	30.0±7.3	13	32.5±7.4	17	42.5±7.8

Note: * - p <0.05, compared to the prevalence of short tubercles.

The data in table 3 indicate that in children aged 7-8 years (IA) the prevalence of middle maxillary tubercles (47.5±7.9) % was significantly higher (p <0.05), the prevalence of short maxillary tubercles was (22.5±6.6) %, and long ones - (30.0±7.3) %. In children aged 9-10 years (IB) (15.0±5.7) % of short, (52.5±7.9) % (p <0.05) of medium and (32.5±7.4) % of long maxillary tubercles were revealed. At the age of 11-12 years (IV), the prevalence of short, medium and long maxillary tubercles was (25.0 ± 6.9)%, (32.5 ± 7.4)% and (42.5 ± 7.8)%, respectively, and a significant difference between these indices was not found, which indicates their redistribution due to the increase in the number of long tubercles, as a result of the alveolar process preparation to eruption of other permanent molars, and short tubercles due to the fact that other permanent molars were erupting or have already erupted.

Comparing the maxillary tubercles on the right and the left sides in each child, we can conclude that in the first two age groups, the difference between the size and shape of the right and left tubercles is not observed. However, at the age of 11-12 years, in 75.0% of the examined children, the shape and size of the maxillary tubercles differ from each other, which can be associated with nonsimultaneous eruption of other permanent molars on both sides. Thus, in 9 children (22.5% of the examined in this group) we

observed a combination of short and long maxillary tubercles, which was due to the nonsimultaneous eruption of other permanent molars. In 19 children (47.5%) medium tubercles on one side and long tubercles on the other side were found, and only 2 children (5.0%) had a combination of short and medium tubercles.

Thus, when studying the features of maxillary tubercles structure, we proposed the distribution of the maxillary tubercles, which are divided by shape into flat, sloping and convex; by height – into low (up to 2 mm), medium (2-3 mm) and high (over 3 mm); by length – into short (up to 5 mm), medium (5-8 mm) and long (over 8 mm).

The study on the prevalence of maxillary tubercles of different shapes and sizes in all age groups revealed that during the mixed occlusion period due to the growth of the jaw and the alveolar process, the tubercles tend to increase in height and elongation. Given the age of the child and individual features of the dental system's development, we can assume the possibility of using high, long and convex maxillary anchor systems.

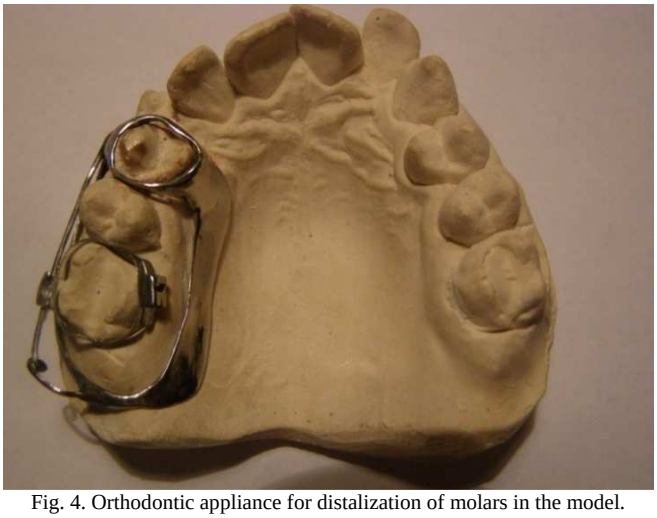

Fig. 4. Orthodontic appliance for distalization of molars in the model.

The base band covers the maxillary tubercles, which acts as a support for the distal movement of the molar, moving along the arc, which contains a loop in the distal part, which is connected to the molar attachment by means of an elastic ligature (fig. 4). The appliance is activated once a week. Using our proposed appliance, high and convex maxillary tubercles can be used as an self-sustained anchor system, as well as in combination with other anchor systems.

It is known that for bodily distal movement of molars a number of fixed appliances designs with an anchor in the form of the Nance appliance are most frequently used (pendulum appliance, distal jet, Jones-Jig, sliding mechanics, first class appliance) [5, 15], as well as distalizers, when used which anchor system are implants, alone or in combination with known anchor systems [6]. However, when using Nance "cushion" appliances as a medial support for molar movement, many authors point out that when they are used, the actual distalization amounts 70%, while the loss of the anchor due to proclination of incisors and angulation of molars accounts for 30% [11, 13].

To reduce the anchor loss and to eliminate the protraction of the frontal area during distalization of the molars, we considered the possibility of using the maxillary tubercles as a distal support for the distal movement of the molars. After analyzing the size and shape of the maxillary tubercles, we proposed an orthodontic appliance for distalization of molars, which permits both to use the maxillary tubercles as the main anchor system and to combine different types of systems when moving the first permanent molars. In addition, when using this appliance there is almost no protraction of the frontal group of teeth, and the mesial displacement of the first premolar is much smaller than in using appliances with mesial support and is corrected for further orthodontic treatment.

Conclusions

1. The features of the maxillary tubercles structure in children are studied and their distribution by shape is proposed: a) flat; b)sloping; c) convex; by height: a) low (up to 2 mm); b) medium (2-3 mm); c) high (more than 3 mm); by length: a) short (up to 5 mm); b) medium (5-8 mm); c) long (more than 8 mm).

2. In the mixed occlusion period there is a change in the shape of the maxillary tubercles from sloping to convex, increasing their height and elongation.

3. It is established that high, long and convex maxillary tubercles can both be used as the main anchor system, and to combine different types of systems to move the first permanent molars.

4. Запропоновано ортодонтичний апарат для дисталізації, конструкція якого дає можливість використовувати високі, довгі та випуклі горби верхньої щелепи в якості як основної якірної системи, так і поєднувати різні види систем для переміщення перших постійних молярів.

4. An orthodontic appliance for distalization is proposed, which design permits both to use high, long and convex maxillary tubercles as the main anchor system and to combine different types of systems to move the first permanent molars.

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Реферати

МОРФОМЕТРИЧНИЙ АНАЛІЗ ГОРБІВ ВЕРХНЬОЇ ЩЕЛЕПИ У ДІТЕЙ ДЛЯ ВИЗНАЧЕННЯ МОЖЛИВОСТІ ЇХ ВИКОРИСТАННЯ В ЯКОСТІ ОПОРИ ПРИ ДИСТАЛІЗАЦІЇ

Заяць О.Р., Ожоган З.Р., Ожоган І.А.

Висока інтесивність та поширеність каріозного процесу призводять до передчасного видалення молочних зубів та створення сприятливих умов для розвитку аномалій та деформацій. З метою підвищення ефективності лікування зубощелепних аномалій, які виникають унаслідок патологічного мезіального зміщення бічних зубів верхньої щелепи, нами розглянута можливість використання горбів верхньої щелепи як самостійної або додаткової дистальної опори для переміщення постійного моляра в дистальному напрямі. Унаслідок вивчення особливостей будови горбів верхньої щелепи нами запропонований їх розподіл за формою : а) на плоскі; б) пологі; в) випуклі; за висотою: а) на низькі (до 2 мм); б) середні (2-3 мм); в) високі (понад 3 мм); за довжиною: а) короткі (до 5 мм); б) середні (5-8 мм); в) довгі (понад 8 мм), вивчено поширеність різних за розмірами та формою горбів верхньої щелепи у дітей різних вікових груп, а також запропоновано ортодонтичний апарат для дисталізації молярів із використанням високого випуклого горба верхньої щелепи, як дистальної опори.

Ключові слова: діти, горби верхньої щелепи, патологічне мезіальне зміщення перших молярів, якірна система, дисталізація молярів.

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МОРФОМЕТРИЧЕСКИЙ АНАЛИЗ БУГРОВ ВЕРХНЕЙ ЧЕЛЮСТИ У ДЕТЕЙ ДЛЯ ОПРЕДЕЛЕНИЯ ВОЗМОЖНОСТИ ИХ ИСПОЛЬЗОВАНИЯ В КАЧЕСТВЕ ОПОРЫ ПРИ ДИСТАЛИЗАЦИИ

Заяць А.Р., Ожоган З.Р., Ожоган И.А.

Высокая интенсивность и распространенность кариозного процесса приводят к преждевременному удалению молочных зубов и образованию благоприятных условий для развития аномалий и деформаций. С целью повышения эффективности лечения зубочелюстных аномалий, возникающих вследствие патологического мезиального смещения боковых зубов верхней челюсти, нами рассмотрена возможность использования бугров верхней челюсти как самостоятельной или дополнительной дистальной опоры для перемещения постоянного моляра в дистальном направлении. В результате изучения особенностей строения бугров верхней челюсти нами предложено их распределение по форме: а) на плоские; б) наклонные; в) выпуклые; по высоте: а) на низкие (до 2 мм); б) средние (2-3 мм); в) высокие (более 3 мм); по длине: а) короткие (до 5 мм); б) средние (5-8 мм); в) длинные (более 8 мм), изучено распространенность различных по размерам и форме бугров верхней челюсти у детей разных возрастных групп, а также предложено ортодонтический аппарат для дистализации моляров с использованием высокого выпуклого бугра верхней челюсти, как дистальной опоры.

Ключевые слова: дети, бугры верхней челюсти, патологическое мезиальное смещение первых постоянных моляров, якорная система, дистализация моляров.

Рецензент Аветіков Д.С.