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Assessment of anatomical and topographical individual characteristics of masticatory system in patients with complete adentium

Abstract: The results of clinical studies aimed at improving the quality of dentures allowed to categorize the correlation of alveolar processes of toothless jaws and lip length types. Particularly for accurate orientation of occlusal surface of artificial dentition in the oral cavity in sagittal, transverse and vertical planes, taking into account individual anatomical and topographical features of the masticatory system. These tasks can be solved at the stages of occlusal rims manufacturing, artificial teeth insertion and denture design examination. Clinical validation of this classification has shown its advantages in restoring the function of eating, clarity and volume of pronunciation and norms of facial aesthetics, which ultimately improves the quality of treatment of patients with complete absence of teeth.

Keywords: function, classification, effect, fixation, stabilization, dentures.

Life expectancy is currently increasing in the developed countries. In this regard, the number of people with complete absence of teeth is also increasing [3,6,9,12]. Studies in several countries have found a large percentage of the total absence of teeth in elderly patient [11,13,24]. Thus, the amount of toothless elderly patients reaches 50% in the US, 60% in Sweden and exceeds 70-75% in the United Kingdom of Denmark [2,7,23,25]. In Ukraine, complete absence of teeth is observed in 55% of cases [16].

Complete absence of teeth is caused by the same reasons as the partial loss. This is primarily a complication of carious diseases, periodontal diseases, specific inflammatory processes or functional teeth overload [6,9,12,22].

Complete absence of teeth results in a topographical change in the correlation of organs and tissues of the oral cavity [1,4,14,18]. Therefore, oral examination of

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toothless jaws has a specific character. Thorough assessment of clinical features of toothless mouth will ensure the success of orthopedic treatment [5,8,10,20]. It is necessary to provide careful examination of the mucosa, bone framework, namely alveolar processes and cells, jaws and hard palate [15,17,19,21].

Purpose of the study. To identify the orientation of occlusal plane in three dimensions in totally edentulous patients: in the oral cavity, in relation to the alveolar processes and oral opening formed by lips.

Materials and methods

The study involved 145 patients (80 male and 65 female) with complete absence of teeth and their dentures. Of them 127 patients had unusual anatomic and topographic features of the denture-bearing area structure and 18 patients had several new dentures. These were laminar dentures made by traditional technology, which did not satisfy the patients. The height of the lower third of the face in physiological rest of the mandible was measured by a beam compass, and the lip length and the height of the alveolar processes in the area of the lips and the height of the space between the tips of the alveolar processes of the lower and upper jaws by a ruling pen and an ordinary ruler with millimeter calibration. The height of the lower third of the face in physiological rest of the mandible was determined by anatomical and physiological method using bite block of denture wax placed in the oral cavity between custom trays. Articulation projection of the upper and lower lips was identified along the whole length of the mouth opening. This can be done using drawings or wire pins with a diameter of 0.6 mm, deepened in the bite block. Then, using the bite block on custom trays, plaster models of jaws were fixed in articulator and the lip length was measured from the transitional fold, which coincides with the edge of the custom tray, to the line on the bite block that meets articulation edges of the lips. Thus, it helped to identify the total length of both upper and lower lips. Then we measured the height of the alveolar process in the area of the lips from the transitional fold to its tip, and then calculating the difference between the total length of the lips and the height of the alveolar process we determined the part of the lip which was on the tip of the alveolar process; that is according to the classification - average, short and long. Alveolar space and alveolar processes orientation in sagittal, transverse and vertical planes was measured with reference to the tip of alveolar process in the area of incisal papilla, corners of the mouth opening and maxillary tubercle and on the lower jaw with reference to the tip in the area of the hyoid frenulum, corners of the mouth opening and retromolar tubercles. Results of measurements of the lengths of the lips, forming the mouth opening and location of the alveolar processes in sagittal-vertical and transverse planes were recorded to determine the relation class of alveolar processes and the type of lip lengths according to this classification. They were then used for final diagnosis according to which complete dentures were manufactured.

Results and their discussion

Occlusal plane orientation of artificial dentition in the oral space designed without considering the relation of alveolar processes of the upper and lower jaws and mouth opening formed by lips is one of the reasons for the poor fixation and stabilization of laminar dentures. The study implied the measurement of the space between the tips of the ridge bone of the upper and lower jaws in physiological rest of the mandible in vertical, transverse and sagittal planes, and the length of the upper and lower lips, that is labiometry by improved methods. Each typical length was complemented by the first and second degrees of lips length. Given the layout of the measurement data, we suggested the following classification of the lips length: type 1 — average lip (1st and 2nd degrees); type 2 — short lip (1st and 2nd degrees); type 3 — long lip (1st and 2nd degrees). Specifications of lips lengths and their evaluation criteria when measuring are as follows:

Type 1 – average lip. Half of the length of the lips, starting from the transitional fold, reaching to the tip of alveolar process, and its second half is above the alveolar process. First degree: half of the lip ($\frac{1}{2}$ of the entire length), starting from the transitional fold increases to 2 mm and is at the level of the tip of alveolar process. Second degree: half of the lip ($\frac{1}{2}$ of the entire length), starting from the transitional fold decreases to 2 mm and is at the level of the tip of alveolar process.

Type 2 – short lip. Most of the length of the lip starts from the transitional fold, reaching the tip of alveolar process, and its second half is above the alveolar process. First degree: half of the lip (½ of the entire length), starting from the transitional fold increases to 5 mm and is at the level of the tip of alveolar process, and its lower part is above the alveolar process. Second degree: the edge of the lip is almost at the level of the tip of alveolar process hypertrophy, or atrophy of muscles, forming lips);

Type 3 – long lip. Part of the lip with lesser length, starting from the transitional fold, reaches the tip, is at the level of alveolar process, and its second half is above

the alveolar bone. First degree: half of the lip ($\frac{1}{2}$ of the entire length), starting from the transitional fold increases to 5 mm and is at the level of the tip of alveolar process with part of the lip with greater length above it. Second degree: part of the lip length, which is at the level of the tip of alveolar process is reduced to a few millimeters or even coincides with the transitional fold (in case of severe or total atrophy of the alveolar process).

Final assessment of the measurements of orientation of toothless jaws in sagittal, transverse and vertical planes in the mouth in physiological rest of the mandible showed that all patients could be divided into three groups: Group 1 (31 patients) with direct (orthognathic) relation of alveolar processes in the frontal area of toothless jaws; Group 2 (88 patients) with progenic relation of alveolar processes in the frontal area of toothless jaws; Group 3 (26 patients) with prognathic relation of alveolar processes in the frontal area of toothless jaws (Fig. 1). Thus, assessment of these findings revealed a pattern in the relation of toothless alveolar processes in physiological rest depending on the type of occlusion, presence of deformations and Godon's phenomenon to complete loss of teeth and alveolar process type. This gave a possibility to divide different variants of relation of toothless jaws into separate groups in the form of classification. This classification was proposed for use in diagnosing, selecting and justifying the construction of dentures. This classification has three classes and three subclasses (Fig. 1) and complications.

Class 1: subclass 1 (1.1): the relation of alveolar processes of the lower and upper jaws in lateral areas, located in parallel along the entire length equidistantly; subclass 2 (1.2), discrepancy in the size of alveolar processes in lateral areas on both sides in the lower jaw; subclass 3 (1.3; a, b – in horizontal and transverse planes), discrepancy in the size of the mandible on the right or left side, lateral areas of the mandible are larger than the top ones.

Class 2: subclass 1 (2.1; a, b – in sagittal and transverse planes): alveolar processes of the upper and lower jaws in sagittal plane are arranged in such a way that tubercular areas of the upper jaw are aligned with areas of retromolar tubercles of the lower jaw; subclass 2 (2.2; a, b – in horizontal and transverse planes): discrepancy in the size of alveolar processes due to an increase in the lower or a decrease in the upper jaw; subclass 3 (2.3; a, b, c, d – in horizontal and transverse planes): increase in the size of alveolar process on the right or left side. At the same time on the opposite sides the size of the alveolar processes of upper and lower jaws are similar;



Fig. 1. Classification of alveolar processes relation in toothless jaws in physiological rest of the mandible (a – upper jaw, b – lower jaw, c – similar in other planes)

Class 3: subclass 1 (3.1; a, b – in sagittal and transversal planes): alveolar processes of the upper and lower jaws converge in the frontal area and compared to them are at a far distance from each other in the lateral areas. The remotest are maxillary tubercles and retromolar tubercles of the mandible; subclass 2 (3.2; a, b –in horizontal and transversal planes), discrepancy in the size of alveolar processes of the upper and lower jaws due to an increase in the upper or a decrease in the lower jaw; subclass 3 (3.3; a, b, c – in horizontal and transversal planes): discrepancy in the size of alveolar processes of the upper jaw are bigger and those of the lower are smaller. On the opposite side the size of the processes of the upper and lower jaws are similar.

Each listed class and subclass can have complications requiring changes in the design of conventional dentures or application of innovative methods of their manufacturing at clinical and laboratory stages of treatment. The most common complications are postoperative defects of the jaws; jaw deformation after injuries; microstoma due to burns of the face; congenital defects of the maxilla; short or long lips; false joints et cetera.

These findings concerning the measurement of the length of the upper and lower lips in relation to the alveolar process in the lip origination area and between the alveolar space allow to determine the orientation of the mouth opening in regard to the tips of alveolar processes. This creates the conditions for constructing occlusal surface of artificial teeth with adequate fixation and stabilization of dentures, increasing their functional efficiency.

Conclusions

1. Assessment of the length of the lips, forming the mouth opening, the height of alveolar processes in the lips area and the space between the tips of the alveolar processes in toothless jaws gives a possibility to make occlusal rims on custom trays in three-dimensional parameters, i.e. sagittal, transverse and vertical planes, taking into account individual characteristics mentioned in the proposed classification. At first these occlusal rims help to define central relation of the toothless jaws by functional method and then to receive functional impression with the closed mouth under the pressure of the chewing muscles. At the same time it is possible to make a simulation of chewing movements of the mandible and conversational tests.

2. Full information on the location of the mouth opening and its correlation with alveolar processes and spatial orientation of the toothless jaws is used in articulators during the construction of the occlusal rims. It provides an opportunity to better target the occlusal surface in the oral space at first when defining central correlation of the toothless jaws, and then for insertion of teeth, which ultimately significantly improves stabilization of dentures in toothless jaws.

3. Functional impression in functional movements of the mandible under masticatory muscles pressure increases the accuracy of the impression, helping improve fixation of the denture by functional suction, which is promising.

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