



The study of the palatal vault morphology

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Abstract

The palate growth was a topic of interest for orthodontic literature because palatal dimensions often need to be modified during orthodontic or surgical-orthodontic treatment. The study of the morphology of the palate vault has been subjected to different researches with more sophisticated methods on plaster models (three-dimensional compass G. Gala 1984). For the determination of the height of the palate, photographs, models and recent studies have used 3D tools that have opened up a new frontier

Introduction

The human hard palate is formed by the palatine processes of the jaw and the horizontal processes of the palatine bones. All components of the bone palate are joined by the median and transverse sutures (1). The growth of the upper jaw is influenced by genetic and environmental factors. Growth begins on trasversal plane, then in length and finally in height (2). Oral parafunctions or other spoiled habits can affect palatal growth in a pathological way, causing structural abnormalities in the bones (3). Breathing, sucking, chewing, swallowing, and articulating the word are under the brainstem and driven by the neuromuscular system. The palate growth was a topic of interest for orthodontic literature because palatal dimensions often need to be modified during orthodontic or surgical-orthodontic (4). Most studies concerning dimensional palatal evaluations focus on skull-facial syndromes. A high or narrow palate is associated with a number of syndromes, based on simple clinical observations. There are no studies in literature that have produced a coherent view of the height and palatal width values in healthy subjects.

Review

Previous research on the morphology of the palate has evaluated growth and remodeling mainly through longitudinal studies (1). The degree of transversal rotation of the upper jaw during growth was unknown before 1960; in that period, they were conducted by Bjork et al. In Copenhagen, the earliest longitudinal studies on jaw growth using metallic implants

positioned on the infra-zygomatic ridge and cephalograms on lateral-lateral and antero-posterior radiographs. Generally, the two jaw processes rotate on the transverse plane during development while at the same time the upper jaw as a whole moves forward on the sagittal plane and rotates, forward or backward, on the vertical plane. The displacement of the jaw in the three planes of space can be explained by the complex form of palatine bone that seems to be in growth. The descent and rotation of the maxillo-palatine complex occurs against pterygoid processes. A further growth of the jaw on the vertical plane and a further transversal rotation are possible in the transverse suture of the hard palate(6-7-8). In 1975, Melsen, using autopsy samples, histologically has examined the maturation of the median suture of the palate at different stages, from zero to eighteen years⁴. Morphologically, the development of the median suture was divided into three phases. During childhood, the suture is short, wide, and Y-shaped; in the pre-adolescent phase (10 years) is more sinuous; In the initial adolescent phase (12 years), the suture is very tortuous and there is an interdigitation of the bone spears of the two half of the upper jaw (9)(10)(11)(12). Although both studies show clear evidence of growth, they are invasive and also limited to two dimensions. The study of the morphology of the palatal vault has been the object of several researches with increasingly sophisticated methods. To measure the width and length of the palate, directly on the dental casts, a special compass was used to measure the breadth and depth of the palate vault⁴. In 1984 G.Gola, by means of a three-dimensional compass, has determined the length of the arch from the incisive point to the perpendicular passing through the distal surfaces of the second molar; the width was measured by the cusp of the canines, among the central fossa of the premolars and molars finally at the molars' vestibular faces. The metric data obtained on dental casts were related to mean values obtained from the index of Pont (13)(14). Photographs and dental casts were used for height and volume determination of the palate vault. In 2002, H. Tsai, through a digital camera, has taken photos that were then digitized using custom software. From these studies emerged that the height of the palatal vault increased with age and that men's palatal vault can be slightly higher than females of the same years. In addition, palatal width was greater in males than females, while palatal depth was

independent of correlations (1)(15). Another method of investigation was the use of 3D computer tools (4). In the years 2000 V. F. Ferrario et al. digitized the palatal landmarks with a computerized program and their coordinates were used to obtain a palatal shape model. The palatal dimensions of the frontal plane and the sagittal plane were calculated and compared with age and sex. While in adolescent females the palatal shape had the characteristics of adults, in males were found some changes between adolescence and adulthood. These changes should be considered as a possible relapse factor after orthodontic treatment (5)(16)(17). Although reliable, these methods take a lot of time and intensive work. In addition, it is difficult to evaluate the area of the palate tridimensionally due to the methodological limits. To overcome these problems, Primozi et al. in 2013 used a 3D laser scanner to get three-dimensional (3D) images of dental casts. 3D images can be used to measure: linear dimensions, palatal surface area, and palate size(18). This study has showed that the growth of maxillary bone from the deciduous dentition, to the early and late mixed dentition, has an increase in palatal surface and volume. Orthopedic treatment in the upper jaw should be performed during this period to improve the efficiency of the therapy. To monitor changes in the palate vault during growth, the palatal area should be preferred to the volume (19)(20).

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Conclusion

Over the years several authors have proposed methods to measure the morphology of the palatal vault but each method has limits due to methodology or the sample patients. In the literature there are no studies that have produced a coherent view of the height values and palatal widths in healthy subjects.

3D methods using the laser scanner, to obtain three-dimensional images of study models, are reliable. There are still important methodological limits in the three-dimensional evaluation of the entire area of the palate. The new studies will focus on finding reliable and easy to use instrumentation.

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