

Morphological analysis of the maxillary arch in edentulous and non-edentulous maxilla of South Indian dry skulls

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ABSTRACT

Introduction: The morphological analysis of the maxillary arch in edentulous and non-edentulous maxilla emphasizes on the significant edentulous changes that occur in maxilla in different populations and races. This provides essential data relevant in prosthodontics and orthodontics. **Aim:** The purpose of this study is to demonstrate the role of aging in both edentulous and non-edentulous width of maxillary arch. **Objective:** The objective of the research includes providing customized more appropriate treatment of elderly edentulous patients. **Materials and Methods:** The width of the maxillary arch of 40 human dry skulls was measured using Vernier calipers. The skulls were divided into edentulous and non-edentulous, which were further divided into females and males. **Conclusion:** The maxillary arches of males have prominent widths, whereas females do not have pronounced width. Moreover, it is reduced for females. The right and the left side of the maxilla do not have much of difference observed. Hence, these prominent maxillary arches help in proper masticatory forces and maintain normal occlusion.

KEY WORDS: Maxillary arch, edentulous, non edentulous, south Indian, dry skull

INTRODUCTION

Aging is a physiological phenomenon that takes place in the life cycle of every human being that leads to senility and death on the latter half of a person's life. In both developed and developing countries, the elderly population due to aging has attained an enormous increase. This population is keen to increase furthermore from 506 million to 1.3 billion by 2040; this may increase at a basic average of 870,000 every month.^[1] Along with the other factors which include hormonal, metabolic, lifestyle, environmental, and genetic aging play a crucial role in bone remodeling. Normally, the bone metabolism will result in balanced relationship between the bone resorption and the bone formation; hence, any disturbance in these processes will lead to bone osteoporosis.^[2] The facial bones are unique in the human body. It shows a wide range of alterations not only in normal growth but also in aging.^[3] Hence, to tackle this, there are some careful operative technique and the exact prosthetic restoration

and implantation which are considered today to establish better treatment option for the partially dentate and completely edentulous individuals.^[4] The study by Parkinson^[5] has genuinely reported that the edentulous subjects present more systemic disease than the dentate in many cases as far seen. In the previous studies made, it has been proved that the cancellous bone of the mandibular condyle is adaptive, i.e., in edentulous subjects, the apparent density and bone volume fraction were found to be lower than in the dentate subjects.^[6-8] The mechanical consequence is may be a reduction of about 20–30% in the stiffness and strength.^[8] The decrease in the amount of bone is considered with more rod-like trabeculae and neither with decrease in the number of trabeculae nor with the thinning of trabeculae.^[7] However, it has been surveyed and got to know that the edentulous subjects have lower masticatory function,^[9] and hence, it produces lower bite forces.^[10] Therefore, it can be said that the survival rate of implantation is less in maxilla than the mandible, furthermore, can be added by saying that the edentulous subject has considerably lower rate of survival than the dentate subject.^[11] Hence, the present study on the morphological analysis of the maxillary arch in edentulous and non-edentulous

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maxilla of South Indian dry skulls emphasizes the significant edentulous changes that occur in maxilla, to provide an essential data relevant in prosthodontics and orthodontics to provide a better treatment strategy and eradicate the symptoms of any acute disease. Moreover, this population-based study may be beneficial to provide an essential data for the comparative analysis of different populations to study the relevant racial differences and the correlation of factors that may influence the changes in maxilla of different populations. In humans and many other species, the superior, i.e., the maxillary or dental arch is slightly larger than the inferior, i.e., the mandibular or lower arch; hence, therefore, in the normal condition, the teeth in the maxilla will slightly overlap those of the mandible both in front and at the sides. Each maxilla assists in forming the boundaries of the three cavities. These three cavities are the roof of the mouth, the floor of the nasal cavity, and the lateral wall of the nasal cavity.

MATERIALS AND METHODS

Dried Skull

Forty human dry skulls of known source with the intact maxilla with the skulls were collected from the Department of Anatomy from Saveetha Dental College and Hospitals and were used for this present study. The skulls were divided into separate divisions of edentulous [Figure 6] and non-edentulous [Figure 7]. Furthermore, divisions were categorized to them by separating the male and female in both of the groups, but pathological variation and abnormal architecture on both the divisions were excluded from the study. The age of skulls which were selected for the experiment was broadly classified on the basis of the presence or absence of complete set of teeth and their sockets as dentate and edentulous; as we know that complete edentulous is a characteristic feature of old age. The skulls for the present study were determined for their sex using the distinguishable anatomical feature. All the measurements were done twice for the reliability of the data, and further, the data were analyzed.

Morphological Analysis

The morphological appearance of maxilla of each skull in both the groups was analyzed to evaluate the size of maxilla by measuring in various diameters such as IMS–ANS – from the lower end of intermaxillary suture (IMS) to anterior nasal spine (ANS), IMS–FMS – from the lower end of intermaxillary suture to frontomaxillary suture (FMS), FMS–MT – from the frontomaxillary suture to the maxillary tuberosity (MT), MT–IMS – from the maxillary tuberosity to the intermaxillary suture (IMS), and IMS–ZMS – from the lower end of intermaxillary suture to the zygomaticomaxillary suture (ZMS).

Analysis of the Width of the Maxillary Arch

The width of the maxillary arch was studied in both the groups of dentate and edentulous skulls according to the method of Burris and Harris using a digital Vernier caliper.^[12] The distance between the tips of individual teeth of corresponding side (I2–I2, C–C, PM1–PM1, PM2–PM2, M1–M1, and M2–M2) was measured and the data were compared between the groups of edentulous and non-edentulous.

RESULTS

The present study which was conducted emphasizes on the marked structural alterations in the maxillary arch of the edentulous skulls when compared to the non-edentulous skulls. There are certain structural alterations in the female edentulous maxillary arch when compared with the male. This variation may be possible due to the postmenopausal changes that keep on exaggerating both aging and teeth loss. The present survey is restricted only to the South Indian skulls, which may give a better view on the regional basis to evaluate a proper treatment strategy option to the southern population of India. The maxillary arch width was measured from the extreme palatal points of the permanent teeth's both in case of male and female. This measurement was done for both edentulous and non-edentulous group, and accordingly, statistical aspect was seen into consideration. Later, on gap was made for each group. However, there must be more study which will be necessary to analyze the regional variations in normal and edentulous subjects for their effective treatment. Moreover, such population-based analysis of skulls can help in providing relevant data which will be helpful for anthropologists, for their comparative analysis between different populations to get better understanding option for their racial differences and to study the correlation of various factors that may have a great influence on the changes seen in the maxillary arches.

Figure 1 is a graph showing the variation seen in the width of maxillary arch of edentulous male when compared with edentulous female. In case of permanent molars, premolars, and canine, both male and female have same prominent width of the maxillary arch; but then, male has a little wider width when seen in case of female. This more width enables to provide more masticatory forces to the tooth present in the labial section of the oral cavity. Incisors have same measurements for both male and female.

Figure 2 is a graph showing the variation seen in the width of maxillary arch of non-edentulous male when compared with edentulous female. However, the non-edentulous has wider width for all teeth when seen with edentulous people. In case of permanent molars, premolars, and canine, there is not much of difference

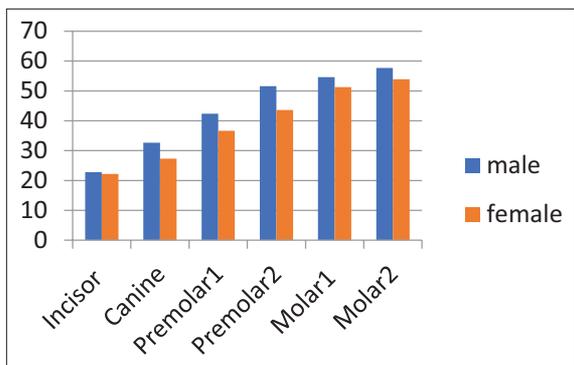


Figure 1: Edentulous male and female

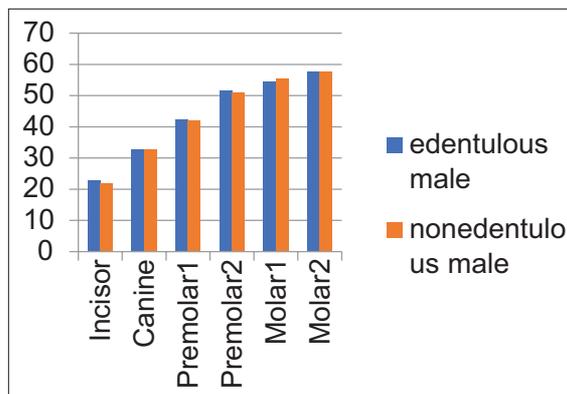


Figure 3: Male and female edentulous and non-edentulous

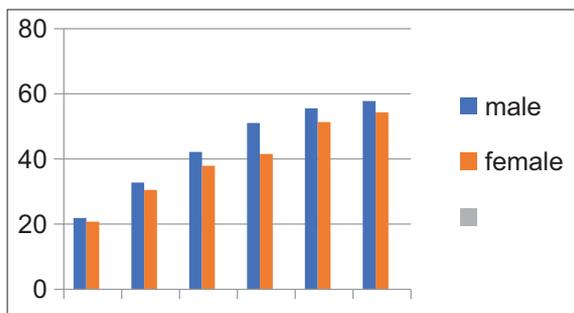


Figure 2: Non-edentulous male and edentulous female

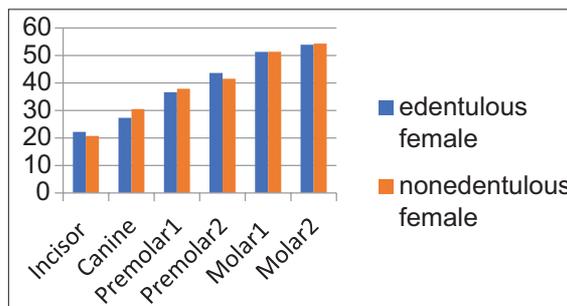


Figure 4: Female in edentulous and non-edentulous

in the measurements. For the incisor, the width is very less for both male and female of this group.

Figure 3 is a graph showing the variation seen in between the width of maxillary arch for both male and female in edentulous and non-edentulous groups. The graphs depict that the permanent canine, premolar 1, and molar 2 have the same measurements, but in case of incisors, premolar 2, and molar 1, they have a slight variation in the level of bar. Incisor and premolar 2 of the edentulous male have more prominent maxillary arch width when compared with non-edentulous male. For molar 1, non-edentulous male has more prominent maxillary arch width having more measurements when compared with non-edentulous male.

Figure 4 is a graph showing the variation seen in between the width of maxillary arch for both females in edentulous and non-edentulous groups. The graphs depict that the permanent incisors, canine, premolar 1, and premolar 2 have a great difference in the measurements. Incisor and premolar 2 of the edentulous male have more prominent maxillary arch width when compared with non-edentulous male. For canine, premolar 1, molar 1, and molar 2 of non-edentulous male have more prominent maxillary arch width having more measurements when compared with edentulous male.

Figure 5 is a graph showing the variation of both non-edentulous male and female when compared with edentulous male as well as female. It is very

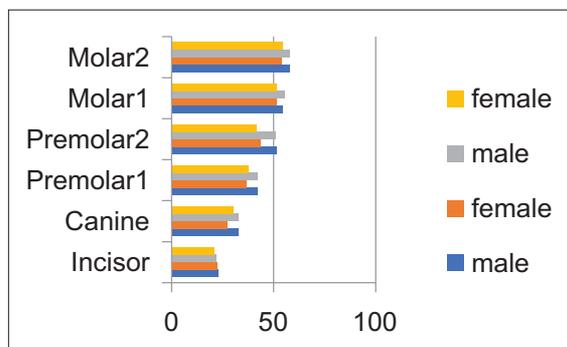


Figure 5: Male and female in edentulous and non-edentulous

evident from the graph that the males have much more prominent maxillary arch both in case of edentulous and non-edentulous. On the other hand, females have less prominent maxillary arch in case of edentulous and non-edentulous.

DISCUSSION

The present study greatly emphasizes on the marked structural alterations in maxillary arch of the edentulous skulls in comparison to the dentulous skulls. The data clearly indicate the significance of aging process and basically its associated teeth loss may have a possible role particularly on bone resorption in the alveolar process and the hard palate which results in the horizontal regression of the maxilla both in male and female. The female edentulous maxillary arch has shown numerous structural alterations than the male



Figure 6: Edentulous maxillary arch



Figure 7: Non-edentulous maxillary arch

edentulous maxillary arch; this sexual variation can be due to the reason of postmenopausal changes that exaggerate aging or tooth loss – which induces bone resorption. Morphologically, the edentulous maxillary arch of both male and female groups was markedly reduced than the dentate maxillary arch in particular. This may be due to the fact of indirect effect due to alveolar regression on the morphology of maxillary bone. The more prominent morphological changes were primarily seen in the horizontal dimension than in the vertical. This clearly tells that the edentulous maxilla may have altered not only by the reduction in its alveolar process but also in the hard palate. It appears that with the increasing morphology, the middle ridge of maxilla is shifted toward the palatal position. Thus, the morphology of the hard palate that proceeds from front to back can cause perforation to the hard palate that, in turn, can bring the mucous membrane of the oral cavity come in contact with the nasal cavity.^[4] Hence, understanding the maxillary and mandibular arch patterns is a very necessary factor to determine the proper orientation of artificial teeth implantation. These changes are produced mainly by aging and

external factors.^[13] Mechanical loading has been an additional preserving effect on bone dimension.^[14] Thus, the dental implantation, nowadays, has become a proper and a well-established method in prosthodontic treatment to preserve the most important mandible or maxillary bone resorption. Furthermore, care and protection should be taken for the aged or edentulous maxilla during the dental implantation procedure to avoid the unwanted entry of implants into the nasal cavity. Finally, the loss of teeth is considered for the resorption of the alveolar process that eventually affects the maxillary arch. This functional reduction may further lead to the enhancement of the bone resorption in the maxillary alveolar process and the hard palate.^[15] The structural and functional aspect of females is comparatively less strong than that of male. As the aging is seen in females, they become more prone to diseases due to their postmenopausal changes. This normal anatomical and physiological change in female may be a very important cause for the more significant edentulous changes in female maxilla than the male. This may be the reason for the low implantation survival rate in maxilla than the mandible when seen in female and males.

CONCLUSION

Therefore, we can conclude that the maxillary arch width of both male and female in edentulous and non-edentulous groups shows a slight variation. The male of both the groups has very prominent and wider width of maxillary arch in case of edentulous and non-edentulous groups.^[16] On the other hand, the female of both groups does not have that prominent and pronounced maxillary arch. The width of the arch is also reduced in this case. The right and the left side of the maxilla do not have much of difference observed.^[17] Hence, these prominent maxillary arches help in proper masticatory forces and maintain normal occlusion.

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