Relationship Between Pterygomaxillary Notches and Maxillary Anterior Teeth

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Keywords
Pterygomaxillary notch; maxillary anterior teeth; tooth selection; complete denture prosthodontics.

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Abstract

Purpose: Selection of the appropriate size of maxillary anterior teeth in complete dentures may be difficult, as there is no universally accepted method that can be used reliably. The aim of this study was to investigate whether there is a relationship between the total mesiodistal width of the six maxillary anterior teeth and the interpterygomaxillary notch distance.
Material and Methods: One hundred and ten maxillary impressions were made on dental students (67 women, 43 men; 19 to 22 years old) using stock tray and irreversible hydrocolloid impression material. The mesiodistal width of the six maxillary anterior teeth and the distance of the interpterygomaxillary notch were measured by digital caliper on stone casts (on two separate occasions by two independent observers). The results were analyzed using correlation regression tests.
Results: The mean mesiodistal width of the six maxillary anterior teeth was 46.02 ($\pm$2.8) mm, and the mean distance of the interpterygomaxillary notch was 42.38 ($\pm$3.47) mm. A significant correlation was found between mesiodistal width of the maxillary anterior teeth and the interpterygomaxillary notch distance ($p = 0.003$; $r = 0.28$). Standardized coefficient was found to be low (28%) to predict the appropriate size of maxillary anterior teeth.
Conclusion: Total mesiodistal width of the maxillary anterior teeth correlated with the distance between pterygomaxillary notches; however, measurement of the interpterygomaxillary notch could not be used for tooth selection reliably due to the low standardized coefficient. Within the limitations of this study, the interpterygomaxillary notch distance is not useful for the selection of six maxillary anterior teeth in edentulous patients.

Tooth selection is an important factor in the construction of complete dentures, which can be disappointing if they do not meet the expectations of patients. Pound[1] stated that in restoring facial appearance and function for edentulous patients, five qualities must work together in harmony: the size, form, color, arrangement, and framing of the teeth. Selecting the ideal artificial anterior teeth for edentulous patients can be difficult when pre-extraction records are not available. A number of facial landmarks have been purported as useful for anterior tooth selection;[2–14] however, there is no universally accepted single method for reliable artificial tooth selection.

The main problem of biometric measurements that use the soft structures for artificial tooth selection is the absence of a static relationship of soft structures, as the width of soft tissues may change according to several factors such as aging and the weight and build of the person. Therefore, a relationship between dimensions of the anterior teeth with anatomical landmarks can be drawn reliably only when landmarks independent of such factors are used.

The measurements used to guide the selection of anterior teeth mainly focus on the soft tissue landmarks, which may be misleading due to dynamic changes over time. Using a landmark less affected by these factors may therefore be a more reliable method for the selection of anterior teeth. The pterygomaxillary notch is the palpable notch formed by the junction of the maxilla and the pterygoid hamulus of the sphenoid bone[15] and does not appear to change with factors such as weight changes, aging, and extraction of teeth.[16] Pterygomaxillary

notches can easily be identified on dental casts and may be used as an alternative anatomical landmark for anterior teeth selection. Johnson and Stratton[17] also suggest interpterygomaxillary notch distance as a guide for artificial tooth selection. Therefore, the aim of this study was to determine whether the distance between pterygomaxillary notches correlates to the total mesiodistal width of the six maxillary anterior teeth.

Materials and methods

Dental student volunteers from the Faculties of Dentistry, Suleyman Demirel University and Atatürk University, were solicited by a written announcement to participate in the study. The study protocol was approved by the local Ethics Committee. Informed consent was obtained from all subjects prior to their participation. The inclusion criteria of the subjects limited the cohort to those with Angle class I maxillomandibular relationship, natural maxillary teeth in good alignment, no restoration or tooth loss in the maxilla, and no history of orthodontic treatment. The exclusion criteria of the subjects included interdental spacing or crowding and apparent loss of tooth structure. The volunteers were examined by one of the investigators of the study. One hundred and ten volunteers (67 women, 43 men) were chosen by drawing from the students who met the inclusion criteria. The ages of the subjects ranged between 19 and 22 years.

Maxillary impressions were taken on subjects using irreversible hydrocolloid impression material (Tulip, Cavex Holland, Haarlem, Netherlands) and stock trays (Teknikdis Rostfrei, Istanbul, Turkey). To correctly register the pterygomaxillary notch and reduce soft tissue distortion, the impression was made under minimal pressure. The stone casts were obtained using ADA type III dental stone (Gilidur, Fachbereich Dental, Ludwigshafen, Germany). Damaged stone casts were also excluded from the study.

The buccolingual center of the pterygomaxillary notches was identified on each stone cast and marked with graphite. The distance between two pterygomaxillary notches was measured on a straight line using a digital caliper with a 0.01-mm precision level (500-196-20, Mitutoyo Ltd, Kawasaki, Japan). The arms of the caliper were adjusted so they were in contact with the graphite marks (Fig 1). For each cast, the maximum coronal widths of each of the maxillary anterior six teeth were measured with a caliper (Fig 2). The six individual anterior tooth width measurements from each cast were added to give a total width for the six anterior teeth on each cast. All measurements were performed at two separate occasions by two independent observers. The accuracy of the caliper was tested with the use of a 3.5-mm steel plate and digital micrometer before each measurement (293–812, Mattoon, Kawasaki, Japan). All measurements were recorded in mm. The data were analyzed using the SPSS 10.0 software program (SPSS Inc., Chicago, IL). Inter- and intraobserver agreements in measurements were assessed by kappa (κ) statistics. Normality distribution was checked by Kolmogorov-Smirnov test. Pearson correlation and regression tests were used to determine any relationship between total width of anterior teeth and the interpterygomaxillary notch distance. The level of significance was established as $\alpha = 0.05$ for all statistical evaluations.

Figure 1 Measurement of distance between pterygomaxillary notches.

Results

The kappa scores (κ) for the assessment of intra- and interobserver agreement were higher than 0.75, which implies almost perfect agreement between the observers. Therefore, the calculations were performed using the means of the four measurements. The distribution of the data was not different from normal distribution, as revealed by Kolmogorov-Smirnov ($p > 0.05$). The mean mesiodistal width of the six maxillary anterior teeth was 46.02 ($\pm$2.8) mm, and the mean distance of the interpterygomaxillary notch was 42.38 ($\pm$3.47) mm. Table 1 shows the maximum and minimum values, means and standard deviations of interpterygomaxillary notch distance, and total width of the maxillary six anterior teeth. The correlation and regression tests showed that there was a statistically significant positive correlation ($p = 0.003$, Pearson coefficient = 0.28) between the interpterygomaxillary notch

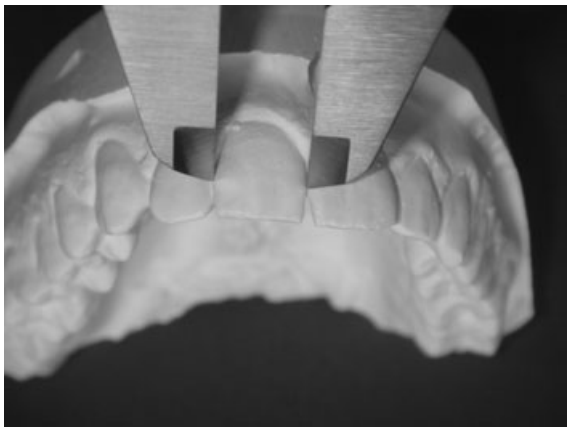

Figure 2 Measurement method used for the mesiodistal width of each maxillary anterior tooth.

Table 1 Measurements (mm)

Properties	Minimum	Maximum	Mean	SD
Total width of the maxillary anterior teeth	38.20	54.10	46.02	2.80
Interpterygomaxillary notch distance	32.35	51.35	42.38	3.47

distance and total mesiodistal width of the six maxillary anterior teeth. Figure 3 shows the distances between pterygomaxillary notches (A), which correspond to the mesiodistal width of the maxillary anterior teeth (B) for each subject. There was a linear relationship between the two measurements according to linear regression ($p = 0.003$, $F = 9.373$) analysis; however, standardized coefficients (beta) were found as 28% ($r = 0.28$).

Discussion

Numerous methods have been devised for the evaluation of esthetic factors in determining artificial tooth size; however, none of these methods have been used alone for tooth selection reliably. The majority of the studies employed soft tissue landmarks for determination of anterior tooth selection. Intercanthal distance has been reported as a useful preliminary method for establishing the width of the maxillary anterior teeth.[13,14] Interalar nasal width was also suggested as a guide for selecting anterior teeth.[12] Sears[9] stated that the total width of the maxillary anterior teeth can be determined by dividing the bizygomatic width by 3.3. In a more recent study, Hasanreisoglu et al[11] also showed that bizygomatic width and interalar width may serve as references for establishing the width of the maxillary anterior teeth, particularly in women; however, other authors have demonstrated inconsistencies in relating biometric measurements to artificial tooth selection.[6,10]

The position of the pterygomaxillary notches do not appear to change with factors such as weight changes, aging, and extraction of teeth.[16] Pterygomaxillary notches are easily localized on the dental casts. Measurements of interpterygomaxillary notch distance could be a practical method for clinical application in tooth selection; however, the results of this study showed that although there was a positive relation between pterygomaxillary notch and tooth size, the standardized coefficient value was too low to predict accurate tooth size using this landmark. Selection of anterior tooth size may be more appropriate using multiple facial measurements to achieve ideal esthetic outcome. A final decision about tooth selection also should be made according to patient expectations during the trial insertion stage.

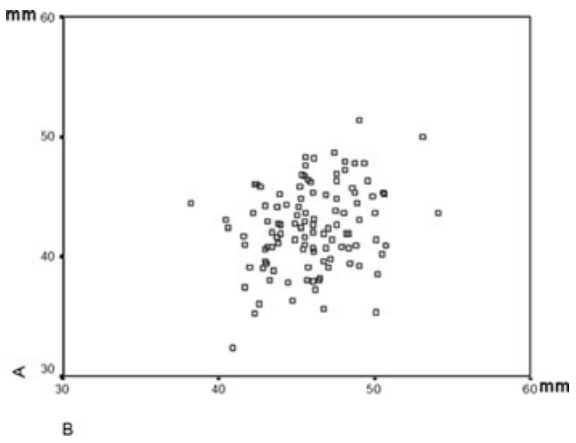

Figure 3 Mesiodistal width of six maxillary anterior teeth (B) corresponding to the distance between pterygomaxillary notches (A) for each patient.

Varjao and Nogueira[6] showed that the use of the corners of the mouth for the selection of artificial teeth is generally inaccurate, especially in the Asian cohort. Further studies on whether there is any relationship between maxillary anterior tooth size and interpterygomaxillary notch in other racial populations are required to make a definite conclusion about this matter. Johnson and Stratton[17] stated that the width of the six anterior teeth equals the distance between the buccolingual centers of the pterygomaxillary notches plus 5 mm. In contrast, in this study the mean total size of the six maxillary anterior teeth was found to be 46.2 mm, and the mean pterygomaxillary notch distance was found to be 42.38 mm, with a mean difference of 3.82 mm. The discrepancy between the results may be due to differences in the evaluation method, as the authors did not describe the measurement procedure in detail.[17]

The present study showed there is a significant correlation between the two pterygomaxillary notches and the total mesiodistal width of the six maxillary anterior teeth; however, the standardized coefficient was 28%, as opposed to at least 70% to 80% for practical importance. Therefore, the pterygomaxillary notch should not be accepted as a reference point alone for the selection of artificial maxillary anterior teeth in edentulous patients.

Conclusion

Measurements of interpterygomaxillary notch distance could be a practical method for clinical application for tooth selection; however, the relationship found between the measurements of the total mesiodistal width of the six maxillary anterior teeth and the distance between pterygomaxillary notches was not high enough to be used as a predictive factor for anterior tooth selection. Therefore, the distance of the pterygomaxillary notch is not recommended to be used alone for artificial maxillary anterior tooth selection in edentulous patients. Further studies on whether there is any relationship between maxillary anterior tooth size and interpterygomaxillary notch in other racial populations are required.

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