Correlation between the Size of Maxillary Frontal Teeth, the Width between Alae Nasi and the Width between Corners of the Lips

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Summary

The aim of this study was to determine correlation between the width of upper incisors (WUI) or the width between the tips of the upper canines (WTC), or the width between distoaproximal surfaces of upper canines (WDaC) with the width of the alae of the nose (WAN) or the width between the corners of the mouth (WCM) on a representative sample. The aim was also to calculate the ratio between the measured variables, which could be helpful in clinical practice.

For this purpose two thousand individuals aged from 18 to 24 years, with intact frontal teeth were measured. There were 920 males and 1080 females.

According to statistical analysis of the results it was concluded: 1. Statistically significant difference between males and females existed for all the measured variables (WAN, WCM, WUI, WTC and WDaC), i.e. males had bigger dimensions. 2.There was no significant difference between sexes for all the calculated ratios: WCM/WAN, WAN/WUI, WCM/WDaC, WAN/WTC, WDaC/WAN ($p>0.05$). 3. The width of the nose approximates to the width between the tips of the cusps of upper canines (1.08:1). The other calculated ratios are: WAN/WUI = 1.206:1; WCM:WDaC = 1.228:1, WDac:WAN = 1.158:1 and these ratios together with the measured mean values: WUI, WCT, WDaC in the examined population, both for men and women, could be helpful for the choice of the proper size of upper frontal artificial teeth and for their setting in the wax of the denture.

Key words: *width of the nose, width between the corners of the mouth, width of upper four incisors, width between the tips of the cusps of upper canines, distoaproximal width of the upper canines.*

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Introduction

Facial appearance and aesthetic attractiveness have an important psychological effect on the human personality and human relationship. Psychologists consider that more attractive persons are more popular in the society (1-5). The mouth and eyes are the most important factors in the attractiveness of the face (1,6), and Terry considers the mouth to be the most important factor (7). Therefore, it is not surprising that the loss of frontal teeth can be psychologically devasting for some persons and their replacement is necessary and required by the patients (8). However, for the edentulous patient with no pre-extraction records available, the choice of tooth size, mold and arrangement is difficult, especially because the size or mold which is different from the patient's tooth can completely change his/her physiognomy. The dentist has to rely on his/her own clinical judgement, along with the patient's aesthetic preferences for tooth selection.

According to Lee (9) and Neill and Nairn (10), the width between the tips of the left and the right canines (WTC) equals the width of the alae of the nose (WAN), and they remark that they require the width of upper incisors + canines to be 3 - 4 mm wider than the WAN, as their width is measured on a wax plane plate, while the teeth are arranged in an arch which follows the curve of the upper residual ridge.

Hartwell (11) states that distoaproximal surfaces of the upper canines (WDaC) are positioned at the level of the corners of the mouth (WCM).

Gerber (12,13) states that there is a significant correlation between the width of the base of the nose and the width of the upper four incisors (WUI), which is a consequence of the fact that the germs of the upper four incisors are positioned in oss intermaxillare, which determines the width of the nose.

However, measurements made by some investigators on different populations did not reveal correlation between the mentioned parameters (14--16) and the authors assume that the width of the base of the nose, the WAN or the WCM are not reliable parameters for the choice of the size of upper artificial frontal teeth.

Therefore, the aim of this study was to determine the correlation of the width of the upper incisors (WUI) or the width between the tips of the upper canines (WTC), or the width between the distoaproximal surfaces of the upper canines (WDaC) with the width of the alae of the nose (WAN) or the width between the corners of the mouth (WCM) on a representative sample. The aim was also to calculate the ratio between the measured variables, which could be helpful in clinical practice.

Patients and methods

Two thousand individuals participated in this study aged from 17 to 24 years. The growth of the cranio-facial system and the growth of the teeth had to be completed for each individual. The sample consisted of 920 males and 1080 females.

Individuals with occlusal and orthodontic anomalies, individuals who showed any asymmetry of the face and individuals with fillings on the frontal teeth were excluded from the study. None of the participants had a fixed prosthodontic appliance on any of the frontal teeth in the upper or the lower jaw.

The measurements were made by using a precise calliper (MEBA, Zagreb) with precision of 0.1 mm and the possibility of measuring distances from 0-200 mm.

All the measurements were made by one dentist, directly on the participants. During the measurement they sat comfortably in a dental chair in an upright position, and before the beginning of the measurement they were required to widely open and close their mouth several times and to move their lips to allow fatigue of the mimic muscles to relax, during the measurement. The participants were also required to inhale and exhale rapidly and deeply several times and then to hold their breath during the measurements of WAN and not to expand the alae of the nose. During the WCM measurement the participant had to be relaxed, to look into the distance, the mandible was in the rest position and the lips had to be unstreched.

The same measurement was completed 3 times over a period of 10 day in 10 participants to test the reproducibility of the measurements. The Kendall W test was used to test the significance between the 3 measurements. Kendall W test is a non-parametric test which compares the significance of the difference between several dependent variables (measurements of the same variables on the same patient 3 times). The Kendall coefficient of concordance was calculated, and for all the measured variables there was no significant difference between the 3 measurements ($p>0.05$), i.e. between 0.12 (rima oris) to 0.88 for the width of the upper incisors (WUI). As there was no significant differences between the 3 measurements ($p>0,05$) it was decided that all the other participants should be measured in the same way.

The following variables were measured for each participant: WAN = width between alae nasi, WCM = width between corners of the mouth, WUI = width of the upper four incisors, WTC = width between the tips of the upper canines, WDaC = distoapproximal upper canine width. All the collected data were statistically analysed by using the statistical package SPSS 1995 for Windows. Standard univariate and bivariate analysis were performed. The mean values (x) and standard deviation (SD) were calculated and the normality of the distribution was tested by one-sample Kolmogorov-Smirnov test. Descriptive statistics were carried out for all 2000 participants and then separately for the male and female subjects.

The proportions between the variables were calculated for each individual (WCT/WAN, WDaC/ /WAN, WUI/WAN, WCM/WAN, WCT/WCM; WUI/WCM and WDaC/WCM) as well as the mean values and SDs of the proportions.

To test the difference between sexes, bivariate analysis was used for all the measured variables, and then also between the proportions (Kolmogorov two sample test).

Results and discussion

Mean values and standard deviations of the measured variables (WAN, WCM, WUI, WCT and WDaC) are presented in Table 1 for all participants and also separately for males and females. Statistical analysis using the two sample Kolmogorov-Smirnov test showed significant difference for all the variables between males and females ($p<0.01$), i.e. males had significantly higher values than females.

The proportions were calculated: WCM/WAN, WAN/WUI, WCM/WDaC, WAN/WCT, WDaC/ /WAN (Table 2), for the whole sample and then separately for the males and females. There was no significant difference for the proportion ($p>0.05$) between the males and the females.

According to the results of this study WDaC (37.08 mm) is significantly bigger than ($p<0.01$) WAN (32.2 mm), and the difference is approximately 5 mm. WCT value was 32.083 mm and it was in the best correlation with WAN, and these results are similar to Smith's results (14), who determined that WTC and WAN differ from 0.5 to 2 mm on average.

According to the results of some other authors (14, 17, 18) WAN and WTC differ form each other from 3 to 6%, which is similar to the correlation of WAN and WTC in this study. However, the results of this study revealed that WDaC and WAN differ from each other approximately 15%.

Hartwell (11) stated that the distoaproximal surfaces of the upper canines were in the same position as the corners of the mouth, while Lieb (16) established discrepancy between the tips of the upper canines and the corner of the mouth.

From the results of this study it is obvious that WCM (WCM - 45.4 mm) is significantly bigger than WDaC (WDaC - 37.08 mm) ($p<0,01$, Wilcoxon sign test), and the difference between them is approximately 7.6 mm. Hartwell measured the difference between WCM and WDaC, and stated that the two distances were almost the same (11), which is not in agreement with the results of this study. The results of this study are in agreement with Lieb's results (16). However, the difference between WCT and WCM was approximately 13 mm in this study which resembles the results of Česen (15) who determined that in more than 60% of the examined subjects this difference ranged from 12 to 16 mm.

According to Sawaris, intercanine width (WCT) (20) is approximately 35.5 mm, according to Hoffman (18) WCT is 34.3 mm, according to Mavroskoufis (17) WCT is 34.2 mm and according to Mack (23) WCT is 32.64 mm in a white population. The results of this study revealed on average smaller dimensions of WCT (32.1 mm) compared to the majority of the aforementioned studies. The results of this study best corroborate the results of Mack's study (23), who carried out measurements on a British population. According to Mack (23), WCT is 35.9 mm in a black population, and according to a study by Keng and Foong (24) WCT is 35.74 in a Chinese population, which are both bigger dimensions than in this study.

Some theories state that WCT is equal to WAN (9), or that WDaC (10) is equal to WCM (11). Therefore WAN (32.2 mm) and WCM (45.4 mm) were compared and the Wilcoxon sign test revealed that WAN is significantly smaller than WCM ($p<0.01$), while WDaC (37.08 mm) is significantly bigger that WAN, and significantly smaller than WCM ($p<0.01$).

As the results of this study revealed smaller dimensions of WAN than WDaC, the significance of the difference between WUI and WAN were also tested (although Gerber stated that WUI was in correlation with the width of the base of the nose, and not the width of the alae of the nose (12)). WAN was 32 mm, and WUI was 26.8 mm, which was significantly smaller than WAN. The difference was approximately 5 mm (Wilcoxon sign test, $p<0.01$).

Neill and Nairn (10) state that the distance between the tips of the upper left and right canine (WCT) is equal to the WAN, but the width of artificial teeth should be 3-4 mm wider, as they are measured on the wax plane and set in the upper arch following the curvature of the upper residual ridge.

According to Lee (9) the width of the frontal teeth in the denture should be determined by projecting the perpendicular line from the alae of the nose to the tips of both canines. From an analysis of old photographs, Lee also found that the width of the central upper incisor equals the width of the second incisor + the width of the mesial half of the upper canine.

Smith (14) analysed the correlation between the bony aperture of the nose on *en face* rentgenograms of the head and intercanine width. He found that the differences between the two widths range from 0.5 mm to more than 2 mm.

Lieb et al. (16) investigated the correlation between the width of the corners of the mouth at rest and the WCT and found significant difference between them and the symmetry of the left and the right side.

Intercanine width measurement in dentate individuals is useful as a guide for choice of the size of all upper six frontal teeth, although the choice of the correct width of the central upper incisor has the same importance as it is the most visible tooth during normal activity of mimic muscles (19).

Different authors suggest different landmarks or formations as guidelines which could be helpful for selection and the setting procedure of artificial teeth, such as: incisive papilla, width of the base of the nose, curvature of the residual ridges, etc. (17, 20, 21). The position of the upper central incisor is a "guideline" for setting all other artificial teeth in the wax rims (22).

However, none of the theories on the choice of the size or shape of artificial teeth still today does not fulfil all requirements, it only approximates the values needed, apart from previous registration and plaster cast production of a person's teeth, or if we have the extracted teeth of any individual. The previous position of the patient's teeth before extraction is also questionable, especially in cases where the extractions were carried out due to periodontal disease with the teeth moved away from the place where they should have been or where they had been before the beginning of the disease. The dimensions of artificial teeth are very important for the setting procedure and the best dimensions of artificial frontal teeth are when they resemble their predecessors.

In 1999. Bindra et al.(25) demonstrated their method for calculating the size of the upper central incisor and is based on a pre-extraction photograph. The distance between both pupils is measured on the patient (ip_{pat}) and this distance is related to the same distance measured on the photograph (ip_{phot}). The ratio represents the number which demonstrates how many times the real distance is bigger than the distance on the photograph. If the width of the central upper incisor is measured on the photograph ($width_{phot}$) and if it is multiplied by this number, then the real width of upper central incisor can be calculated ($width_{pat}$). The formula is derived by the ratio: $ip_{pat} / ip_{phot} = width_{pat} / width_{phot}$, i.e. the width of the patient's upper central incisor ($width_{pat}$) = ippat / ipphot x $width_{phot}$ (interpupilar width measured on the patient divided by the interpupilar width on the photograph and the ratio multiplied by the width of the incisor measured on the photograph). The author checked this method on the photographs of volunteers with their own teeth in the mouth; the dimensions of the real teeth were measured and these dimensions were compared with the values calculated from the photographs. Statistical analysis using t test showed no significant difference between the real dimensions and the dimensions calculated from the *en face* photographs. The authors concluded that the proposed method is precise enough to calculate the upper incisor's dimensions using *en face* photographs. However, in oblique projection photographs the difference was statistically significant.

Although old photographs can help in calculation of the dimensions of the upper central incisor according to Bindra (25), there are many cases where the central upper incisors are not visible, or their dimension is too small to be measured correctly. Therefore some anatomic landmarks such as the width of the corners of the mouth, the width of the ale of the nose etc. are still in use to predict the size of upper frontal teeth. According to the results of this study and also to the results of some other authors (9,10,14), the dimensions in the highest correlation are the width between the tips of the cusps of upper canines (WTC) and the width between the ale of the nose (WAN) whose ratio is 1: 1.04 (1:0.99 in women and 1:1.08 in men, no significant difference between sexes p>0.05). The mentioned ratio, as well as the ratios calculated in this study (Table 2): WAN/WUI = 1.206:1; WCM::WDaC = 1.228:1, WDaC:WAN = 1.158:1 can help when selecting the proper size of the upper frontal teeth and also setting the frontal teeth correctly.

Conclusions

1. Statistically significant difference between males and females exists for all the measured variables (WAN, WCM, WUI, WTC and WDaC), i.e. males have bigger dimensions.
2. There was no significant difference between sexes for all the calculated ratios: WCM/WAN, WAN/WUI, WCM/WDaC, WAN/WTC, WDaC//WAN (p>0.05).
3. The width of the nose approximates to the width between the tips of the cusps of upper canines (1.08:1). The other calculated ratios are: WAN//WUI = 1.206:1; WCM:WDaC = 1.228:1, WDac::WAN = 1.158:1 and these ratios together with the measured mean values: WUI, WCT, WDaC in the examined population, both for men and women, could be helpful when chosing the proper size of upper frontal artificial teeth and for their setting in the wax of the denture.