Quantitative CT Analysis of the Glabellar and Anterior Nasal Spine Regions for the Placement of Implants for Nasal Prosthesis Retention

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Objectives: *The aim of this study was to determine the precision of the measurements of 2 craniometric anatomic points—glabella and anterior nasal spine—in order to verify their possibility as potential locations for placing implants aimed at nasal prostheses retention.* ***Methods:*** *Twenty-six dry human skulls were scanned in a high-resolution spiral tomography with 1-mm axial slice thickness and 1-mm interval reconstruction using a bone tissue filter. Images obtained were stored and transferred to an independent workstation containing e-film imaging software. The measurements (in the glabella and anterior nasal fossa) were made independently by 2 observers twice for each measurement. Data were submitted to statistical analysis (parametric* t *test).* ***Results:*** *The results demonstrated no statistically significant difference between interobserver and intraobserver measurements (*$P > .05$*). The standard error was found to be between 0.49 mm and 0.84 mm for measurements in bone protocol, indicating a high level of precision.* ***Conclusions:*** *The measurements obtained in anterior nasal spine and glabella were considered precise and reproducible. Mean values of such measurements pointed to the possibility of implant placement in these regions, particularly in the anterior nasal spine.* INT J ORAL MAXILLOFAC IMPLANTS 2008;23:445–448

Key words: *computer-assisted, extraoral implants, nasal prostheses, tomography*

Defects in the nasal region most frequently occur as a consequence of oncologic surgery. Partial nasal losses can be satisfactorily restored by plastic surgery, but when total nose loss occurs, the esthetic results are more favorable with prosthesis implantation. However, in order to be successful, a facial prosthesis must provide esthetic acceptability, good functional performance, tissue biocompatibility, long-term durability, and secure retention without compromising skin integrity. Mechanical prosthesis retention and the use of adhesive systems have been associated with poor stability and durability of the prosthetic piece and require frequent replacement.[1–3]

According to Parel et al,[2] the introduction of osseointegrated implants for the retention of facial prostheses has been a substantial advance in this field, enabling retention and preserving the integrity of the skin, the underlying tissues, and the prosthesis itself. However, the reported experiences with osseointegrated implants for nasal reconstruction have indicated that further in-depth studies are still needed to determine which locations are have the best potential for such craniofacial implants.[2–4]

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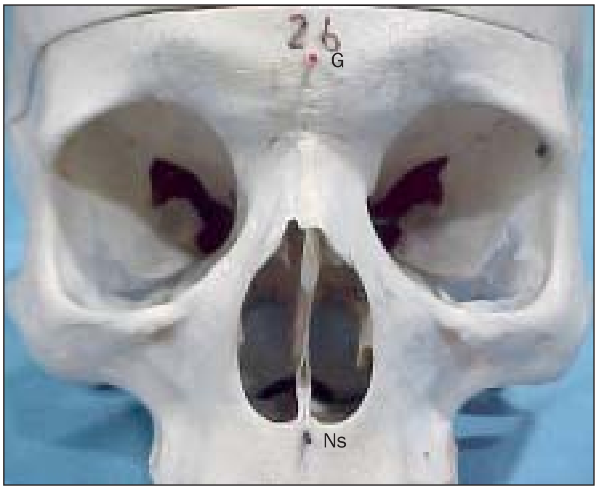

Fig 1 A dry skull prepared with pieces of copper glued at pre-established points (G and Ns).

It has been stated in literature that precision and accuracy of measurements in the craniofacial complex obtained with computed tomography (CT) and the applicability of this methodology for planning and follow-up treatment need to be tested.[5–7] The present study aimed at determining the precision of pre-established anthropometric measurements that are recommended for the placement of osseointegrated implants to support or retain nasal prostheses.

MATERIALS AND METHODS

The study population consisted of 26 dry human skulls of white individuals (13 male and 13 female), with ages ranging from 45 to 65 years. Pieces of copper wire of 1 mm in diameter were placed at the pre-established craniometric points using cyanoacrylate glue: glabella (G), the most anterior point of the skull in the sagittal plane, and anterior nasal spine (Ns), the highest point on the nasal spine (Fig 1).

The skulls were then scanned with high-resolution continuous spiral computed tomography (model AVI 0133; Philips Medical Systems, Bothell, WA), which produced axial cross-sections of 1-mm axial slice thickness at 1-mm reconstruction intervals using a bone tissue filter. The matrix utilized was 512 × 512, FOV 22.0 cm, with 120 Kvp and 50 mA. The specimens were attached to the apparatus table in the supine position using tape to maintain the parallelism between the zygomatic arches. The images were stored on CD-ROM and transferred to an independent Pentium III workstation (IBM, Armonk, NY) with 256 MB RAM, a 900 MHz processor, and Windows 98 in the 3D Imaging Laboratory of the Department of Stomatology of the School of Dentistry of the University of São Paulo, containing the software eFilm (version 1.5.3), which was used to process and analyze all original images. The craniometric points (glabella and anterior nasal spine) were located, and the corresponding measurements (from glabella to the frontal sinus [G-Fs] and from the anterior nasal spine to the nasal fossa [Ns- Nf]) were determined electronically by 2 independent observers twice each using the software (Fig 2). These measurements were made with a 1-week interval between them to test the precision and reproducibility of the results obtained. The statistical analysis was carried out with parametric *t* tests and 2 determined variables (glabella and anterior nasal spine).

RESULTS

Table 1 summarizes results obtained. There was no statistically significant difference between interobserver and intraobserver measurements. The mean was found to be 3.83 mm (G-Fs) and 11.83 mm (Ns-Nf), respectively. To calculate standard errors of measurement (SEM), confidence intervals were constructed with the acceptance of coefficients of 95%. The standard deviations of the 2 linear measurements (2.40 mm for G-Fs and 4.23 mm for Ns-Nf) were considered low, demonstrating that those measurements were highly precise. The largest error was found to be 0.50 mm (G-Fs) and 0.84 mm (Ns-Nf), respectively. There was no difference at the significance level of 5% either for intraobserver measurements ($P = .917$) or between observers ($P = .876$).

DISCUSSION

According to Cavalcanti and Vannier,[5] computerized graphical technology associated with present-day workstations has shown to be an excellent clinical application system for craniofacial measurements. The methodology used was similar to that used in the present study, ie, imaging tools were used with CT data. The authors established the precision and accuracy of linear measurements from glabella to opisthocranion (G-Op) and nasoespinhale to nasion (Ns-N) using 2D CT. These results corroborate the present findings; there was no statistically significant difference between observers or between measurements by the same observer, which demonstrates the high precision level of the methodology.

Schlieper et al[8] strongly recommended the use of CT for planning implant-fixed facial prostheses in the orbital area when little bone is available or in the cases that are difficult because of anatomical relationships.

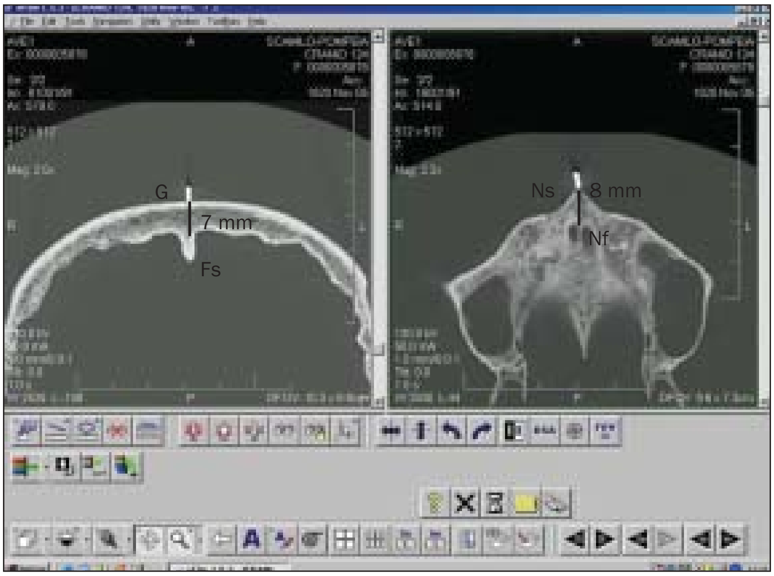

Fig 2 Screen within the image-viewing program showing the G-Fs and Ns-Nf regions marked with copper wire.

Table 1 Summary of G-Fs and Ns-Nf Measurements in Millimeters

Measurements	Mean	SD	95% CI	Intraobserver error: Error 1	Intraobserver error: Error 2	Interobserver error
G-Fs	3.83	2.40	2.29–5.82	0.50	0.49	0.49
Ns-Nf	11.83	4.23	10.20–13.45	0.84	0.83	0.83

Verdonck et al[9] and Proussaefs[10] emphasized the importance of CT images before the surgery in complex cases of craniofacial rehabilitation. They also confirmed that CT scans have the capacity to indicate the best points with respect to bone volume for the use of craniofacial implants. In another study by Cavalcanti et al,[6] measurements for soft tissue and bone protocols between the porion and nasal spine (Po-Ns); porion and nasion (Po-N); and nasion and nasal spine (N-Ns) were validated using 3-dimensional CT. They also found no statistically significant difference between observers or for measurements by the same observer for either protocol.

Through the measurements of 2 preestablished craniometric anatomic points (glabella and anterior nasal spine), the software used enabled linear measurements of bone tissue to verify whether they would be potential points for locating implants. Both craniometric points presented values that indicated they could be utilized for implantation, especially the anterior nasal spine, in concurrence with the research of Granstrom et al[11] and in partial agreement with the findings of Nishimura et al,[12] who obtained excellent results from implantation in the floor of the nasal fossa but a high failure rate in the glabella region. Jensen et al[13] also considered the anterior region of the nasal fossa the most suitable location for implants, due to high bone capacity. In the case of defects or rehabilitation of complete loss of the nose, Matsuura et al[14] measured craniofacial bones of cadavers and reached the conclusion that the median area of the frontal bone and the nasal bone were particularly suitable for implantation.

In the present study, analysis of variance was used to test for intraobserver interference (measurements 1 and 2 for the same examiner) and interobserver interference (disagreement between the 2 examiners). There was no difference in the measurement, at the significance level of 5%, between the 2 times for either examiner ($P = .917$) or between the 2 examiners ($P = .876$). These results concur with a study by Cavalcanti et al,[15] who also did not find significant intraobserver or interobserver difference.

In conclusion, in the measurements for both the anterior nasal spine and the glabella, the results were considered precise and reproducible, thus demonstrating that the methods used are appropriate for craniofacial applications. The mean measurements obtained for the glabella and anterior nasal spine allow these points to be recommended for the placement of craniofacial implants.

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