Pre-Operative Planning for Anterior Skull Base Reconstruction using Pericranial Flaps: A Cadaveric Study on Radiologic Measurements

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Objective

This study aims to assess the reliability of radio-anatomic measurements of pericranial flaps to inform pre-operative planning for anterior skull base reconstruction.

Background

The anterior skull base is reconstructed by using free flaps, synthetic tissues, as well as vascularized grafts such as the nasoseptal flap. The length of required reconstruction is often estimated intraoperatively. In revision cases when a localized flap cannot be used, the pericranial flap could help with reconstruction. In such situations, having a preoperative measurement could be useful. This cadaveric study compares if radiologic measurements mimic measured dissection length of the pericranial flap.

Methods and Materials

Five high-resolution head CT scans from cadaveric donors were analyzed. Using InVivo 7, a three-dimensional DICOM viewer platform, eight radiologic variables were measured in coronal and sagittal views, including frontal sinus-based distances to the cribriform late, clivus, nasopharynx, and external landmarks. Two independent raters performed all measurements using standardized distance and polyline tools at predefined anatomic points. Inter-rater reliability was assessed using intraclass correlation coefficients (ICC).

Results

Measurement	Mean ± SD (mm)
Inter-frontal sinus distance	25.7 ± 3.6
Glabella to coronal suture	114.0 ± 8.1
Frontal sinus to superior cribriform plate	15.3 ± 2.9
Frontal sinus to inferior cribriform plate	44.1 ± 2.8
Frontal sinus to anterior wall of clivus	92.8 ± 8.2
Frontal sinus to posterior wall of clivus	94.1 ± 9.7
Frontal sinus to nasopharynx	121.3 ± 10.6
Distance between eyebrows	60.8 ± 4.1

Table 1 – Rater 1 InVivo Flap Length Measurements
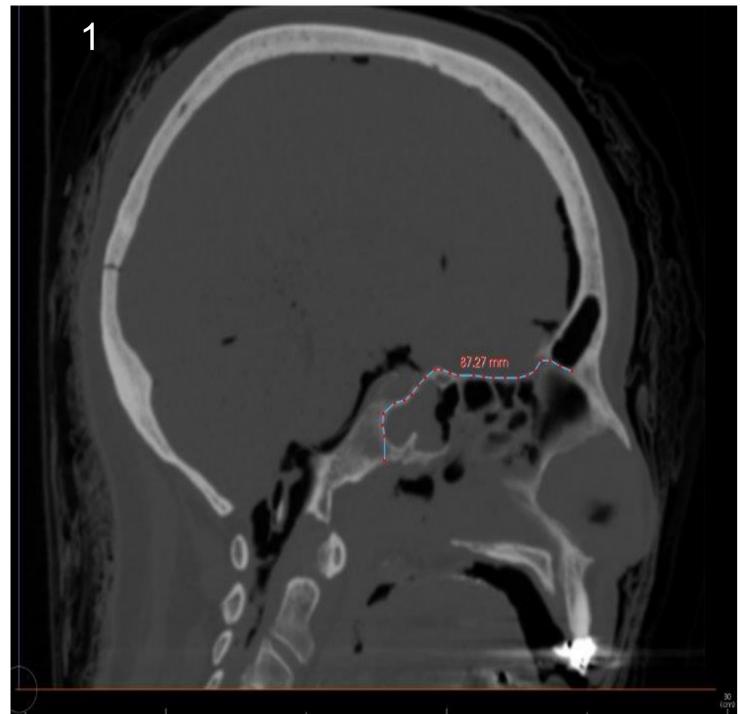
Illustrative sagittal CT-based measurements.
Figure 1 - Frontal sinus to anterior wall of clivus.

Measure	Intraclass Correlation (ICC)	95% CI Lower Bound	95% CI Upper Bound	p-value
Single Measures	0.999	0.999	1.000	<0.001
Average Measures	1.000	0.999	1.000	<0.001

Table 2 – Correlation table measurements between raters

Conclusions

CT-based measurements of craniofacial landmarks can assist with preoperative reconstructive planning following endoscopic skull base surgery to ensure enough length is obtained for the pericranial flap. To our knowledge, this cadaveric study is the first to produce CT-based measurements and can serve as preliminary groundwork for further studies evaluating the role of image-based planning for skull base reconstruction.

Future Work

Future studies are needed to determine how close intra-operative and pre-operative radio-anatomical measurements are to one another. In addition, more research is needed to identify the impact of these findings on surgical efficiency and outcomes, such as potentially decreasing operative time and reducing unnecessary dissections.

ACKNOWLEDGEMENTS

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