

Assessing the precision of posttraumatic orbital reconstruction through 3D-3D “mirror” orbital superimposition: 3D surface point-to-point distance versus volume

Daniele Gibelli¹, Alberto Tagliaferri², Giulia Andrea Guidugli, Alberto Bozzetti², Davide Sozzi², Chiarella Sforza

¹ Department of Biomedical Sciences for Health, Università degli Studi di Milano

² Maxillofacial Surgery Department of Medicine and Surgery - School of Medicine, University of Milano-Bicocca

Posttraumatic orbital fractures are mainly reconstructed through orbital meshes. The most frequently used method to assess the success of orbital reconstruction is based on the comparison of orbital volumes [1]. However, the modern techniques of 3D elaboration enable to perform innovative procedures of comparison, such as the 3D-3D registration and quantification of point-to-point distances.

Ten patients who underwent to orbital reconstruction through titanium meshes in the Department of Maxillofacial Surgery, University of Milano-Bicocca, were recruited (patients group), together with a ten patient control group. Volumes of orbits were segmented on CT scans and automatically calculated. The 3D model from the unaffected orbit was then flipped according to the sagittal plane in order to obtain a “mirror” image of the contralateral orbit, and automatically registered on the reconstructed one. Point-to-point RMS (Root Mean Square) distance between the 3D models was then calculated. The same procedure was applied also to the CT-scans from unaffected patients. Possible statistically significant differences in volume and surface RMS distance were assessed through Student’s t-test ($p < 0.05$).

On average difference in volume between the unaffected and reconstructed orbit in patients was not discordant from the difference between the right and the left side in the control group ($p > 0.05$); on the other side, mean RMS value was significantly higher in the former group than in the latter one (0.78 mm versus 0.59 mm, $p < 0.05$). Discordant areas are more frequently observed on the floor of the orbital cavity where the titanium mesh is applied.

The present study highlights the use of 3D surfaces point-to-point distance as a parameter for assessing anatomical success of orbital reconstruction: the next studies will verify the relation of this parameter with clinical signs reported by patients.

References

- [1] Zimmerer et al. (2016) A prospective multicenter study to compare the precision of posttraumatic internal orbital reconstruction with standard preformed and individualized orbital implants. *J Cranio-Maxillo-Facial Surg* 44:1485-97

Keywords

Orbital reconstruction, volume segmentation, CT-scan, mirroring