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J Oral Hyg Health 2018, Volume 6
DOI: 10.4172/2332-0702-C1-009

Three-dimensional surgical modeling with an open-source software protocol: Study of precision and reproducibility in mandibular reconstruction with the fibula free flap

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Statement of the Problem: Many studies generate a high level of interest in computer-assisted surgical planning using bio models and surgical guides in oral and craniomaxillofacial surgery. However, very few surgical teams currently use total independent and free solutions for mastering three-dimensional (3D) surgical modeling for osseous free flaps in reconstructive surgery and oral surgery. We assessed the feasibility and technical reproducibility of our 3D surgical modeling protocol with open-source software in mandibular reconstruction with fibula free flaps and its surgical guides and present multiples used of this technology.

Methodology: Feasibility was assessed through millimetric (mm) accuracy determination between the 3D surgical modeling and the 3D-printed reconstructed mandible, although before and after sterilization process. Reproducibility was assessed in 3 surgical cases through volumetric millimetric value comparison between the 3D surgical modeling and the real patient reconstruction.

Result: A difference less than 0.1mm was observed between the 3D surgical modeling and 3D-printed surgical guides or reconstructed mandibles using Computerized Tomography (CT) scan. Almost no deformations (<0.05mm) were found after autoclave sterilization of our 3D-printed surgical tools. In the 3 cases, the modeling precisions of fibula free flaps were 0.3-0.5 mm and precisions of the complete reconstructed mandibles were around 0.8mm.

Conclusion & Significance: We demonstrated a good accuracy of the open-source software protocol and satisfactory results were obtained without complications. However, the precision of the surgical case is based on the precision of the 3D surgical modeling made by the surgeon. Therefore, surgeons need to be trained on the use of our 3D modeling protocol before using it in patients, which is a limit of this technology. On the other hand, it helps the surgeon to be more precise and aware about his surgical case and allow him to refine his procedure.

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