Mandibular Reconstruction Prostheses Adaptation

Introduction

Craniofacial prostheses have been a topic of great medical interest in recent years, mainly due to the large impact that the various lesions in this area inflict to the patient, both physically and psychologically. Among the various existing craniofacial injuries, there is a clear predominance of lesions in the mandibular facial region, mainly due to the high propensity of this area to be affected by various types of accidents and diseases.

The most common and effective treatment of mandibular deformation lesions is the reconstruction surgery with the use of permanent implants. One of the biggest problems imposed to mandibular reconstruction surgeries, has to do with the adaptation of the prosthesis to the patient's jaw and specific features of the lesion. Today, surgeons resort to a 2 phase process in order to correctly adapt the prosthesis to the patient physiognomy. At a first stage, the prosthesis is adapted through the analysis of diagnostic images such as CAT, X-rays and MRI's. The second phase of adaptation occurs already during the surgery, where surgeons carry out minor modifications to the prosthesis in order to adapt it to the structure of the patient's face.

The current status of corrective jaw surgery suffers from two fundamental problems. On the one hand, the amount of time spent on the adaptation of the prosthesis is very high, leading to very low numbers of patients being treated per day with this procedure. It should also be noted that the current procedure requires the patient to be subjected to a longer period of time under anesthesia. The second most important problem is the margin of error associated with the current process of adapting the prosthesis to a specific patient case. This leads to final results which are not always optimal, both in terms of physical and aesthetic.

By resorting to modern 3D scaning techniques, image processing, 3D reconstruction and virtual simulation, it is possible to greatly improve this medical procedure, mitigating current problems and opening new horizons of results for this kind of surgeries.

Objectives

The objective of this PhD proposal is to develop an automatized process for the adaptation of mandibular prostheses, based on both regular medical imaging assets, such as CAT's and MRI's, and 3D scanning techniques.

An important aspect of the process to be developed is its capacity to perform virtual simulations of the several phases of the mandibular reconstruction procedure. The virtual simulation will be advantageous before surgery, allowing the surgeon to manipulate the model and to find the best prosthesis adaptation to the specific anatomy and condition of the patient. Still before surgery, the virtual simulation will allow the patient to better understand the results of the procedure, and perceive the aesthetic results. During surgery, the virtual simulation should also guide the surgeon in the appliance of the prosthesis.

The automatized adaptation process should also be able to generate 3D models of the adapted prosthesis, allowing for future mechanization of the manufacturing of real prosthesis.

Bibliography

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