Public Summary

Development and optimisation of a fibular cutting guide for mandibular reconstruction surgery

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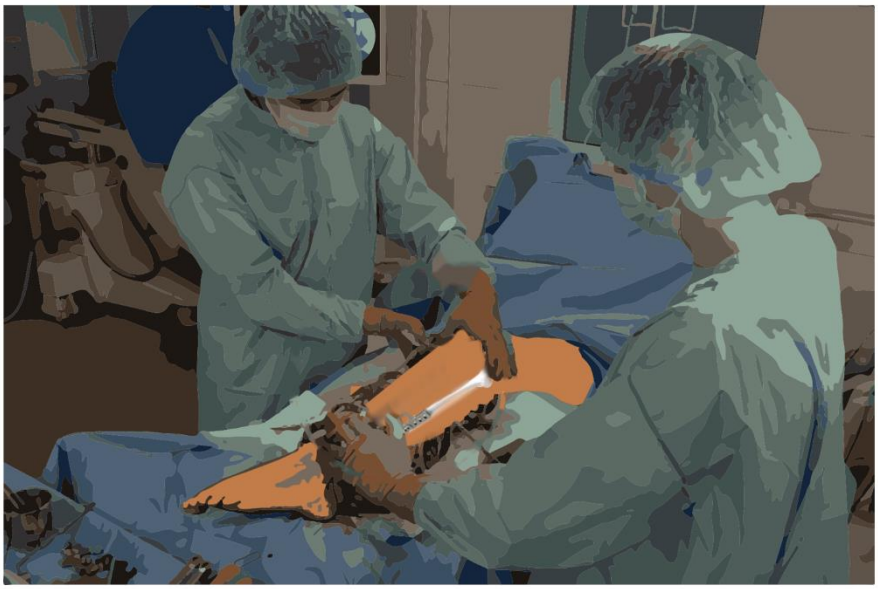

Introduction

In 12-56% of the patients with oral cavity cancer (OCC) the mandibular bone is invaded by the tumour. In this case, the patient is treated with surgical excision of the tumour and mandibular resection: a segmental mandibulectomy. To reconstruct the mandibula the fibula bone is used.

The current technique to obtain grafts from the fibula employs 3D-printed cutting guides (3D-CG) designed with cutting slots, affixed atop the fibula to facilitate precise incisions. The surgeon will use a saw blade and go through these cutting slots to create fibula grafts that will later be used to reconstruct the jawbone. However, producing these guides is a costly and time-consuming procedure and has several disadvantages. To address these limitations, a proposed solution involves developing a universal fibula-cutting guide adaptable to different patients, which dynamically indicates incision locations with software assistance and prior CT scans. This guide would allow for real-time modifications, ensuring precise adjustments during surgery.

This bachelor thesis is carried out in cooperation with The Netherlands Cancer Institute (NKI-AvL), a leading clinical research institute dedicated to understanding cancer biology, genetics, immunology, and therapy advances. Its researchers work on contributing to the medical field on subjects such as oncology, tumour biology, and personalised medicine (The Netherlands Cancer Institute, n.d.). The ongoing research on this topic has led to the development of several prototypes, hence the research question of this thesis is:

How can we find a solution to improve the current state of art problems:
a) What constitutes the principal challenge in the current prototype?

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b) What elements from prior prototypes and research efforts should be retained?
c) What alternative mechanisms are available to improve the current one?

Approach

An analysis of the current state of the art was performed to answer the research question. Relevant information was gathered about the stakeholders, the surgical environment, and potential constraints. This research concluded with a set of requirements that had to be met for this project step. Several concepts were developed, and one was selected based on its compatibility with the requirements list.

Although the final product should be made from biocompatible, durable, and strong materials, the prototype was developed in 3D-printed resin as a proof of concept.

Results

The prototype was successfully created, demonstrating a more user-centred approach compared to previous prototypes. A simple mechanism allows the surgeon to use the tool intuitively and precisely. This simplicity is crucial in the surgical environment, where long procedures and the use of multiple tools mean the surgeon should not spend too much time assembling the device.

Conclusion & Recommendations

In conclusion, while the prototype represents a step forward in this ongoing research, further development and investigation are needed. Additionally, the feasibility of manufacturing the final product should be studied.