00575 Design of a 3rd Generation Modular Mandible Endoprosthesis for the Repair of Segmental Mandible Defects

Liu Yuchun[1], Nattharee Chanchareonsook[1], Rebecca Lim[1], Edwin Liu[1], Jansen John[2], Goh Bee Tin[1]

[1]National Dental Centre Singapore, [2]Radboud University Medical Center

Aims: Current gold standard for mandible reconstruction using the fibula free flap is associated with disadvantages such as donor site morbidity, long hospitalization stay and rehabilitation. We aim to design and evaluate a titanium modular mandible endoprosthesis to provide stable reconstruction of a segmental mandible defect. The load-bearing capability of the endoprosthesis will be evaluated using a finite element model prior to in vivo implantation in a preclinical Macaca fascicularis mandible model.

Methodology: To design the dimensions of the endoprosthesis, mandibles from euthanized Macaca fascicularis were harvested and measured using a vernier caliper. Functional performance of the implanted endoprosthesis within the mandible defect was simulated under an average bite force of 100N. The endoprosthesis was implanted within the resected right mandibular body of Macaca fascicularis and monitored over 4months. Radiological imaging of the entire mandible and bone volume analysis around endoprosthesis stems using micro-CT analysis were performed.

Result: Computational simulations showed a maximum relative movement of 20um at the interface of the implanted endoprosthesis stem within the mandibular stump, predicted to be favorable for osseointegration to occur. At harvest, preclinical investigations showed no swelling, infection or endoprosthesis failure (n=10). No dehiscence was noted in n=4, whereas n=6 showed dehiscence at the superior aspect of either the body module, anterior stem module or posterior stem module. Five were stable throughout implantation, whereas n=5 showed initial stability in the first 4 weeks with slight mobility at the anterior bone by Week12 due to screw loosening. The endoprosthesis study group showed an average of 88.8±10.7% bone volume around the endoprosthesis stems compared to non-operated mandible control group.

Conclusion: Preliminary evaluation of our modular endoprosthesis (PCT/SG2017/050139) showed that our current design can perform adequately without permanent deformation. If proven successful, this solution will have significant impact on public health and likely to disrupt the field of oral-maxillofacial reconstruction.