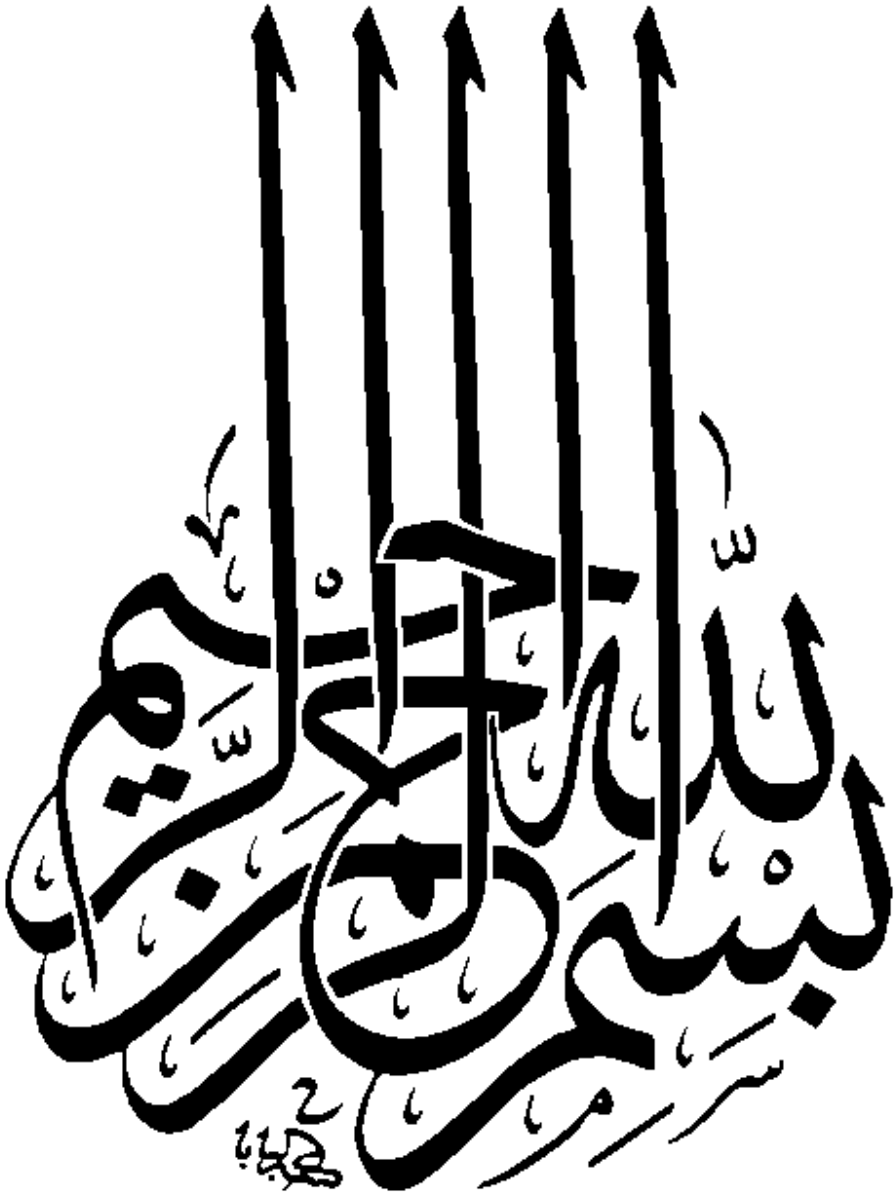

اللهم أعزنا بالإسلام و أعز الإسلام بنا...
اللهم اجعله فى ميزان حسناتنا

Computer-Guided Segmental Mandibular Reconstruction Using Personalized Silica Calcium Phosphate Blocks

Thesis

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List of Abbreviations

3DP	Three dimensional printing
ACS	Absorbable collagen sponge
ALP	Alkaline phosphatase
BMP	Bone morphogenetic protein (Body morphogenetic protein)
BMSC	Bone marrow stromal cells
CAD	Caomputer-aided design
CAD/CAM	Computer-aided design/computer-aided manufacturing
CCB	Cancellous cellular bone
CNC	Computerized numerical control
CRM	Compression resistant matrix
CT	Computed tomography
DBM	Demineralized bone matrix
D-CaS	Dense Calcium Sulfate
DICOM	Digital imaging and communications in medicine
FDA	Food and drug administration
FDM	Fused deposition modelling
HA	Hydroxyapatite
HCPLGA	Heparin-conjugated poly(lactic-co-glycolic acid)
MIC_{90}	Minimum bacterial inhibitory concentration
MRP	Mandibular reconstruction plate
OC	Osteocalcin
OP	Osteopontin
PCBM	Particulate cancellous bone and marrow
PCL	Polycaprolactone

PDLLA	Poly(D,L-lactide)
PGS	poly-D, L-lactide-co-glycolic acid-coated gelatin sponge
phBMP-2	Purified human bone morphogenetic protein-2
pQCT	Peripheral quantitative computed tomography
PRP	Platelet-rich plasma
PTFE	Polytetrafluorethylene
rhBMP-2	Recombinant human bone morphogenetic protein-2
rhBMP-7	Recombinant human bone morphogenetic protein-7
RP	Rapid prototyping
Runx-2	Runt related transcription factor 2
SCPC	Silica Calcium Phosphate Nanocomposite
SEM	Scanning electron microscope
Si , SiO_2	Silica
Si-CaP	Silica Calcium Phosphate
Si-TCP	Silica Tricalcium Phosphate
SLA	Stereolithography
SLS	Selective laser sintering
STL	Stereolithography file format
TCP	Tricalcium phosphate
TGF-β	Transforming growth factor – beta
THORP	Titanium hollow screw reconstruction plate
TMJ	Temporomandibular joint
VBFF	Vascular bone-containing free flap

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Introduction

Reconstruction of mandibles after ablative surgery for benign tumours still poses a challenge for the profession. The resulting defects are rather big, but usually would not require composite flaps because the soft tissues are not resected along with the mandible. These defects would best be treated with bone grafts, preferably immediately following the resection. Most patients suffering from odontogenic tumours are also relatively young as compared to the group of patients suffering from malignant tumors. The need for adequate primary reconstruction is, therefore, even more pressing since most of the patients are in the midst of their active life. Different techniques of reconstruction of the mandible have been performed with various levels of success. The use of particulate cancellous bone and marrow (PCBM) and allogenic scaffolds has for a long time been applied to reconstruct mandibles in oncology patients with good results. The problem with this technique remains to be the donor site morbidity associated with graft harvesting. The search for other less morbid means of reconstruction continued, but it was not until the introduction of bone morphogenetic proteins that the idea of a totally alloplastic mandibular reconstruction came true.

There are numerous publications describing personal favorable experiences, and yet a truly flawless reconstructive result is not easy to attain. First, it is difficult to replicate the complex three-dimensional conformation of the mandible. Second, any aberration in its structural alignment may very likely lead to functional disturbance like malocclusion or temporomandibular joint (TMJ) syndrome. Situations like extensive bone resection, temporomandibular joint involvement, or severely distorted bony contour would add to the difficulties in a reconstructive task. The advent of

computer-guided surgical planning based on CT data and by the aid of rapid prototyping techniques allowed for virtual preoperative planning of different surgical scenarios. This allowed for customization of the surgical procedure, reconstruction plates and bone grafts to save intraoperative time and obtain an excellent functional and esthetic reconstruction.

Our work presents a trial to combine both computer-guided surgical techniques together with tissue engineering to obtain a highly individual method of reconstructing segmental mandibular defects with minimal morbidity.