BoneReconstructionPlanner

**A 3D Slicer extension for virtual surgical planning of mandibular reconstruction
with vascularized fibula free flap and generation
of patient-specific surgical guides.**

2021

Initial development as final project: Mauro I. Dominguez,

Supervision: PHD. Andras Lasso

Clinical advice: Dr. Manjula Herath

2022-2025

Maintenance and Improvements: Mauro I. Dominguez

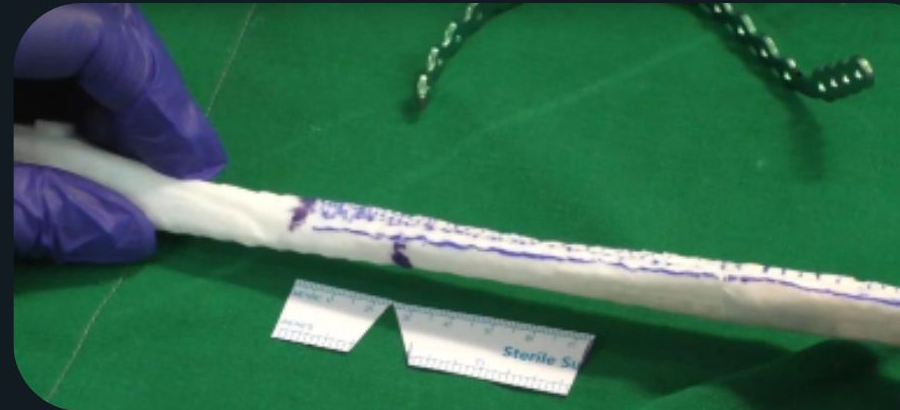**Corresponding paper**: ScienceDirect

EYEBALLING, THE TRADITIONAL PAPER-RULER METHOD

1 Bend reconstruction plate according to resected mandible

2 Cut the rectangular paper ruler to pieces that match the reconstruction plate

3 Align the paper pieces along the grafted fibula and mark the closing-wedge osteotomies
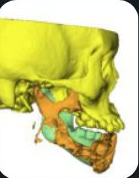
Source: Video tutorial of surgery
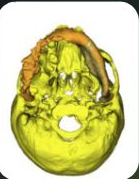
VIRTUAL SURGICAL PLANNING, THE DIGITAL WAY

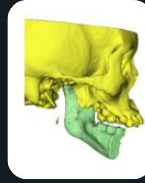**A** — Segmentation of mandible and cranium

E — Lateral view post-resection

B — Lateral view of the segmentations
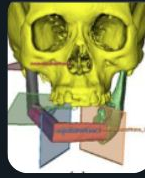
F — Placement of mandibular cutting planes and reconstruction.

C — Bottom view of segmentations
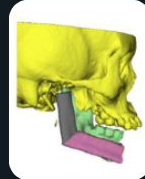
G — Lateral view post-reconstruction

D — Tumour resection is done virtually.
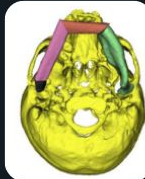
H — Bottom view post-reconstruction

FIBULA CUTTING GUIDE GENERATION

1 Fibula bone segmentation with automatic placement of fibula planes

2 Generation of fibula cutting guide.

3 Fibula cutting guide in STL format.

4 3D printed fibula cutting guide using PLA materials.

5 3D printed reconstructed mandible.

6 3D printer

INTRA OPERATIVE PHOTOS

1 Preparing pedicle and fibula graft to place the cutting guide.

2 Fitting of fibula cutting guide at the antero-lateral aspect of the fibula.

3 Osteotomy cuts made. The fibula bone is cut into 3 segments.

4 Miniplates were fixed onto the fibula segments. Pedicles are still attached at this moment.

5 The main tumour was resected

6 Fibula segments were fixed onto the native mandible to form the neo-mandible
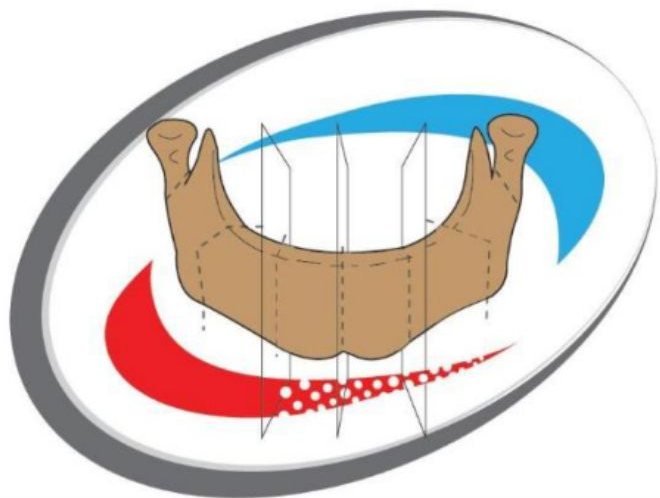
CLINICAL PHOTOS

A — **Pre-operative facial appearance**

C — **Pre-operative orthopantomogram**

B — **1-month post-operative facial**

appearance.

D — **1-month post-operative orthopantomogram**

VIDEO DEMO

# VIRTUAL SURGICAL PLANNING, THE VIRTUAL WAY

Benefits

- **less operation time**
- **less ischemic time**
- **less hospital stay after surgery**
- **better osteotomies accuracy**
- **better neomandible contour, more aesthetic**

VIRTUAL SURGICAL PLANNING, THE DIGITAL WAY

Cons

- **Software: ~$15K/year for commercial licenses (Free with BoneReconstructionPlanner)**
- **3D Printing: Requires printer, biocompatible material, and sterilization (in-house or outsourced).**
- **Regulatory: Needs IRB or FDA approval.**
- **Planning Time: ~30 min pre-op planning; still saves net OR time.**
- **Training: Learning curve; may need biomedical engineer or trained technician.**

AROUND 100 SURGERIES
INFORMALLY DOCUMENTED
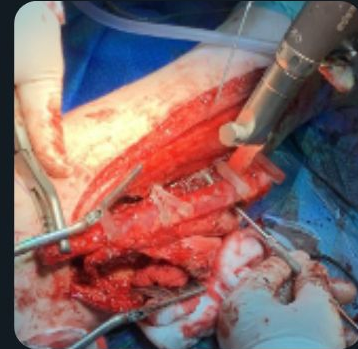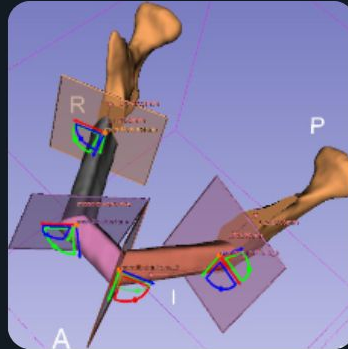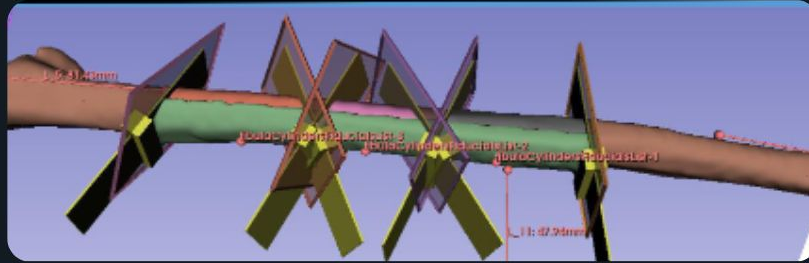
[Review more examples (link)](link)

BONERECONSTRUCTIONPLANNER SOFTWARE ARCHITECTURE

Used features currently available on Slicer:

- **Markups (lines, curves, planes, points)**
- **Segmentations (created from the segment editor)**
- **3D models**
- **3D operations (algorithms, filters)**
- **Registrations (transforms)**

In top of that:

- **Virtual osteotomies and virtual reconstruction**
- **Generation of personalized surgical guides**

CONTACT

Developer: Mauro Dominguez

Linkedin: https://www.linkedin.com/in/engineerdominguez/

GitHub: https://github.com/mauigna06

Project: https://github.com/SlicerIGT/SlicerBoneReconstructionPlanner/