3D PLANNING FOR TOOTH AUTOTRANSPLANTATION AND 3D PRINTING OF SURGICAL TEMPLATES

Mostafa EzEldeen, DDS, MScD
Jan Wyatt, DDS, MScD
Prof. Constantinus Politis MD, DDS, MHA, MM, PhD
Prof. Reinhilde Jacobs, DDS, MScD, PhD
Tooth Auto-Transplantation
Why 3D planning and tooth replica for Tooth Auto-Transplantation (TAT)

- **Planning**
  - Surgical feasibility
  - Best new position for the donor tooth → esthetics and function

- **Tooth replica**
  - Optimal bone fit
  - Reduces extra-alveolar time

- Preserving periodontal ligament and pulp vitality
- Reducing risk for necrosis and resorption

Shahbazian, M et al., 2010 and Shahbazian, M et al., 2013
Work flow

Image acquisition (CBCT)

Tooth segmentation

Virtual TAT

3D printing of tooth replica

Surgery

Post-op

Multidisciplinary team

Oral Radiology
Orthodontics
Pediatric dentistry
3D Lab.
Oral Surgery
Endodontics
Restorative dentistry
**Image acquisition**

- Cone Beam CT (CBCT)
- Machine selection
  - Required resolution
  - Reason for transplantation
- FOV selection
  - Donor and recipient sites
  - Minimize dose $\rightarrow$ minimize FOV as possible
Tooth segmentation

- Interactive Live-Wire boundary extraction (dedicated tool EzEldeen et al., 2015)
- Live-wire computes the shortest path (minimal cost path) using dynamic programming (F*-algorithm)
Tooth segmentation
Virtual TAT

Impacted element 23 (Case 1)

Lost element 21 due to trauma (Case 2)
Virtual TAT

Case 1
Suggested donor tooth (element 15)

Case 2

Virtual position (region 21)
Case 3

- Overlap with elements 22 and 24
- Insufficient coronal space (-0.77 mm)
- Ortho. advice needed
- Surgery postponed
Case 4

- Overlap with elements 43 and 45
- Insufficient coronal space (-1.5 mm)
- Further space opening
- Surgery postponed
Case 5

- Severe bone loss and infection
- TAT is not possible
3D printing of tooth replica

Full cure 720
Validation of cone beam computed tomography—based tooth printing using different three-dimensional printing technologies

Wael Khalil, DDS, MSc, Mostafa Ezeldeen, DDS, MSc, Elke Van De Casteele, MSc, PhD, Eman Shaheen, MSc, PhD, Yi Sun, Eng, PhD, Maryam Shahbazian, DDS, MSc, PhD, Raphael Olszewski, MD, DDS, PhD, Constantinus Politis, MD, DDS, MHA, MM, PhD, and Reinhilde Jacobs, DDS, MSc, PhD

Connex 350 volume deviation of + 1.9%
Median deviation < 0.2 mm
Case 6

Wyatt J
EzEldeen M
Van Gorp G
Post-Op

(Case 1)
Planned vs. Realized

Prof. Politis C
Theys L

4 weeks after TAT
6 months after TAT
(Case 2)
Planned vs. Realized

Wyatt J
EzEldeen M
De Greef L

2 weeks after TAT
6 months after TAT
(Case 6) Planned vs. Realized

Wyatt J
EzElddeen M
Van Gorp G

2 weeks after TAT
6 months after TAT