

# Digital transformation in nose surgery

---

**Kunica, Zoran; Poje, Gorazd; Mlivić, Denis; Knežević, Mario; Antunović, Bartol**

**Conference presentation / Izlaganje na skupu**

*Permanent link / Trajna poveznica:* <https://urn.nsk.hr/urn:nbn:hr:235:331985>

*Rights / Prava:* [In copyright](#)/[Zaštićeno autorskim pravom.](#)

*Download date / Datum preuzimanja:* **2024-10-19**

*Repository / Repozitorij:*

[Repository of Faculty of Mechanical Engineering  
and Naval Architecture University of Zagreb](#)





Zoran Kunica, Gorazd Poje\*, Denis Mlivić, Mario Knežević, Bartol Antunović

# Digital transformation in nose surgery



University of Zagreb Faculty of Mechanical Engineering and Naval Architecture

\* University Hospital Centre Zagreb; Department of Otolaryngology, Head and Neck Surgery



# Content

- **Aim and goals of work**
- **Inferior nasal turbinates surgery in CAD**
- **Rhinoplasty in Virtual Reality**
- **Future work**

# Aim and goals of work<sup>[1][2]</sup>

- **Digital integration** of the whole nose surgery process:  
from the diagnosis and state of a specific patient, through surgery itself till wider health-care and social context.
- **better understanding – new knowledge**
- **normization – increased efficiency**
- **new tools, mechanization and automation**

[1] [Towards virtualization and optimization of sinus surgery planning and execution](#)

Kunica Zoran, Poje Gorazd, Mlivić Denis, Topolnjak Jan  
Medica Jadertina 52 (Suplement 1), 17-17, 2022

[2] [Conceptualisation of Virtual Reality Experiments for Optimised Sinus Surgery Planning and Execution](#)

Kunica Zoran, Poje Gorazd, Mlivić Denis, Topolnjak Jan  
International journal of industrial engineering and management 14 (1), 13-24, 2023

- Two surgery procedures observed in the work:
  - **inferior nasal turbinate surgery**<sup>[3]</sup>
  - **rhinoplasty**<sup>[4]</sup>.

[3] [Virtualizacija kirurških zahvata na nosu](#)/Virtualization of nose surgery

Knežević Mario

University of Zagreb Faculty of Mechanical Engineering and Naval Architecture 2023

[4] [Primjena virtualne stvarnosti u radnom okruženju](#)/Application of virtual reality in a work environment

Antunović Bartol

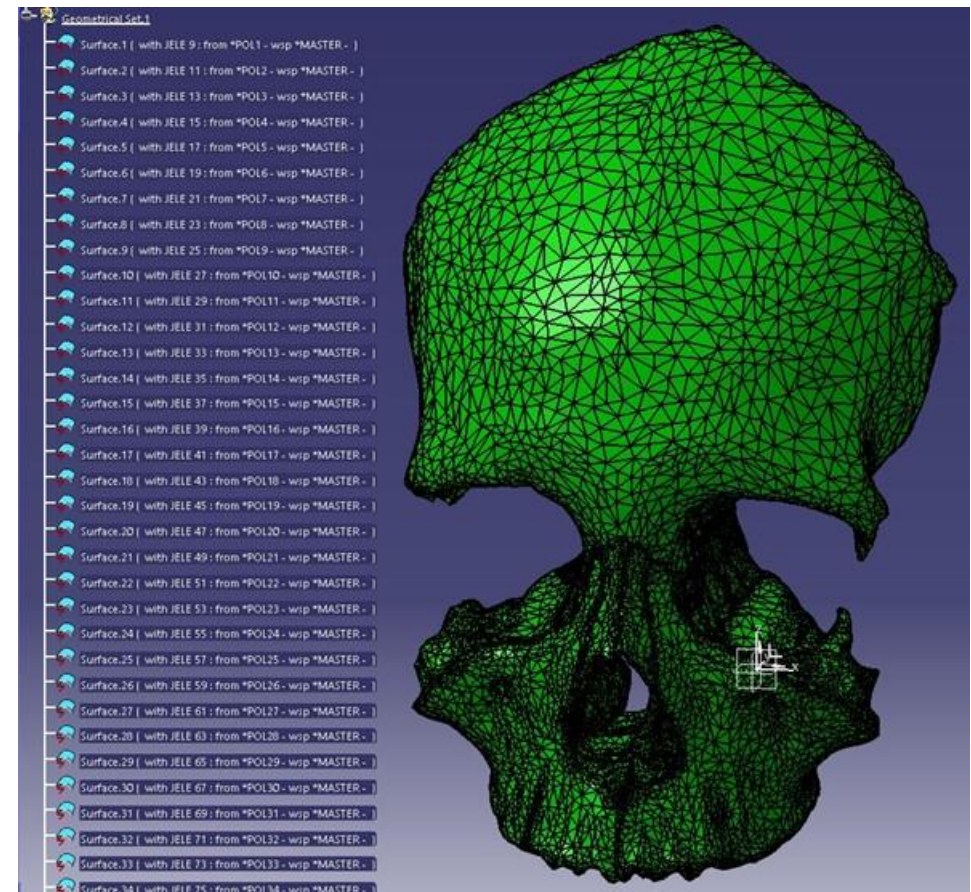
University of Zagreb Faculty of Mechanical Engineering and Naval Architecture 2023

# Inferior nasal turbinates surgery in CAD

- designed and simulated in CATIA Delmia V5 software
- design stages:
  - head and tissue
  - tool and work environment
  - process

# HEAD AND TISSUE design – complexity and simplifications

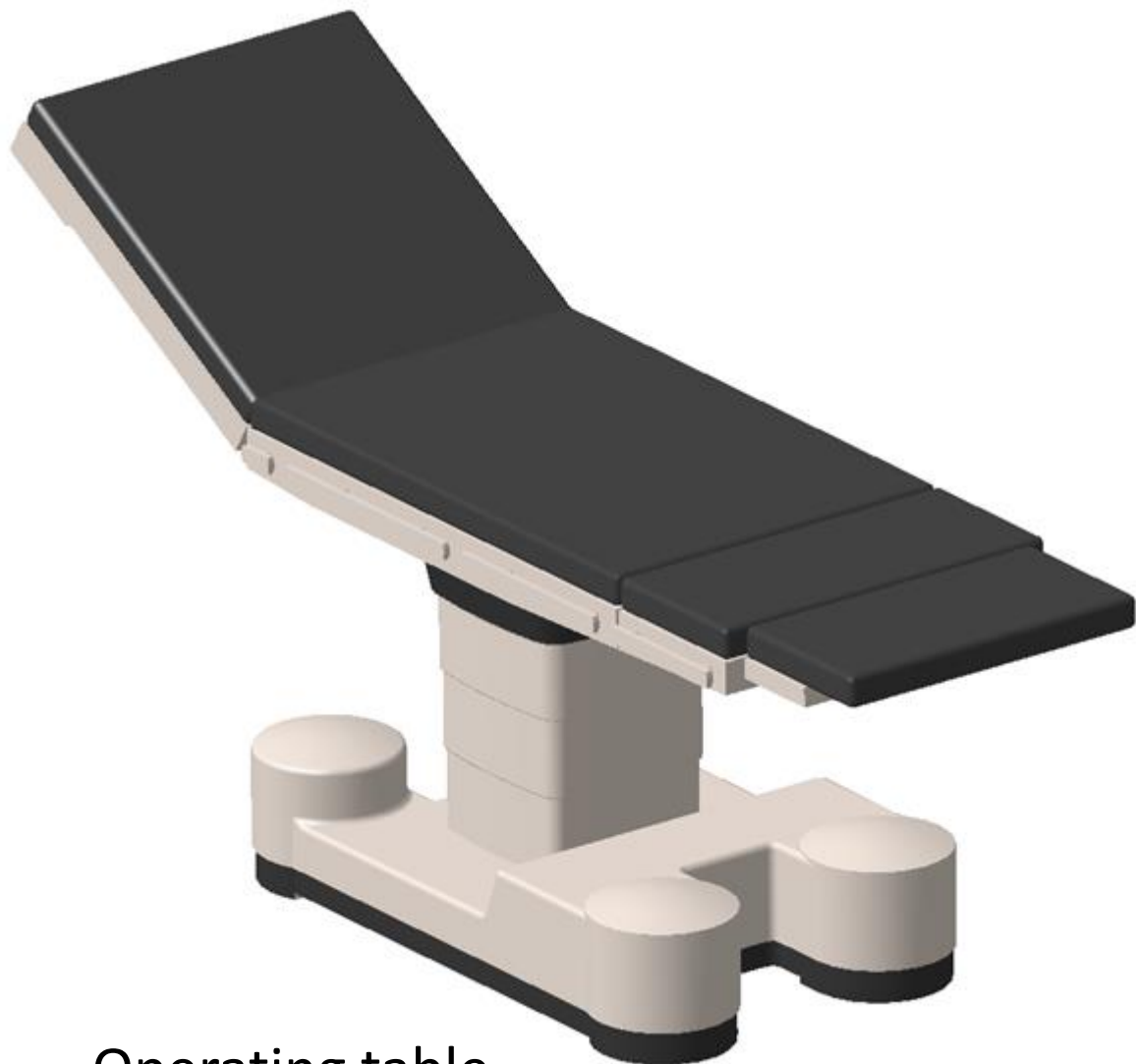
---



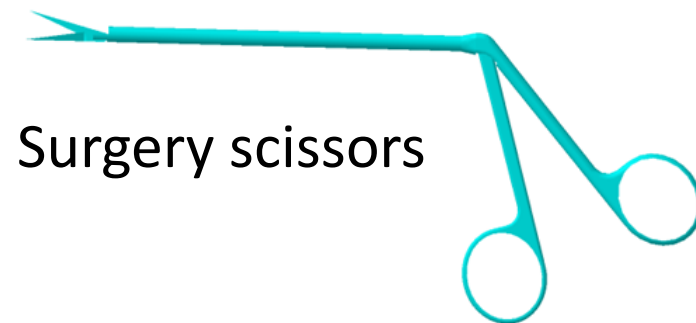
Preparation of the model of the head:

1. collecting CT scans
2. conversion into CAD models (STL format)
3. repairing with Blender

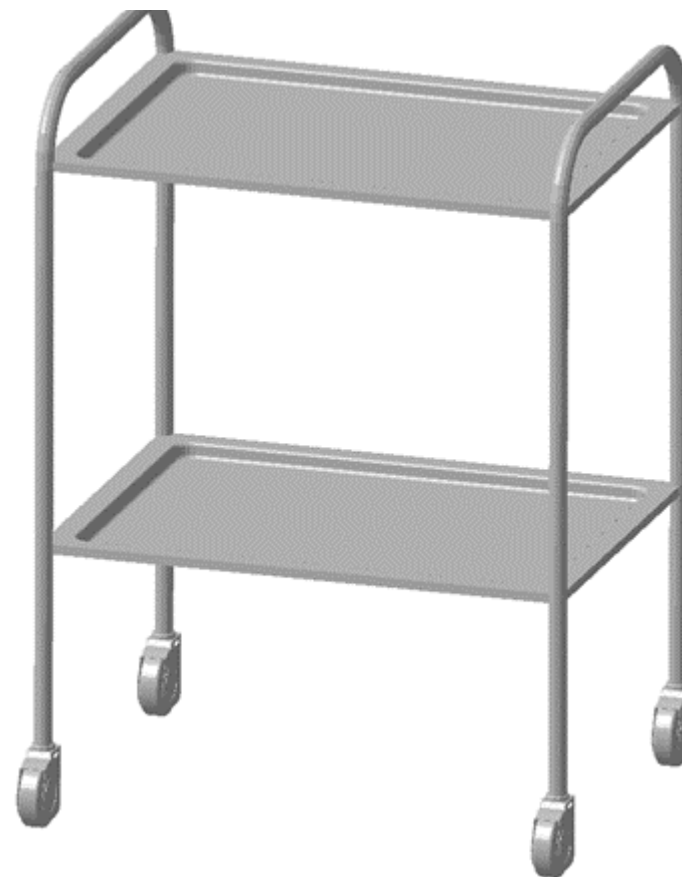
# TOOL AND WORK ENVIRONMENT design



Operating table



Surgery scissors



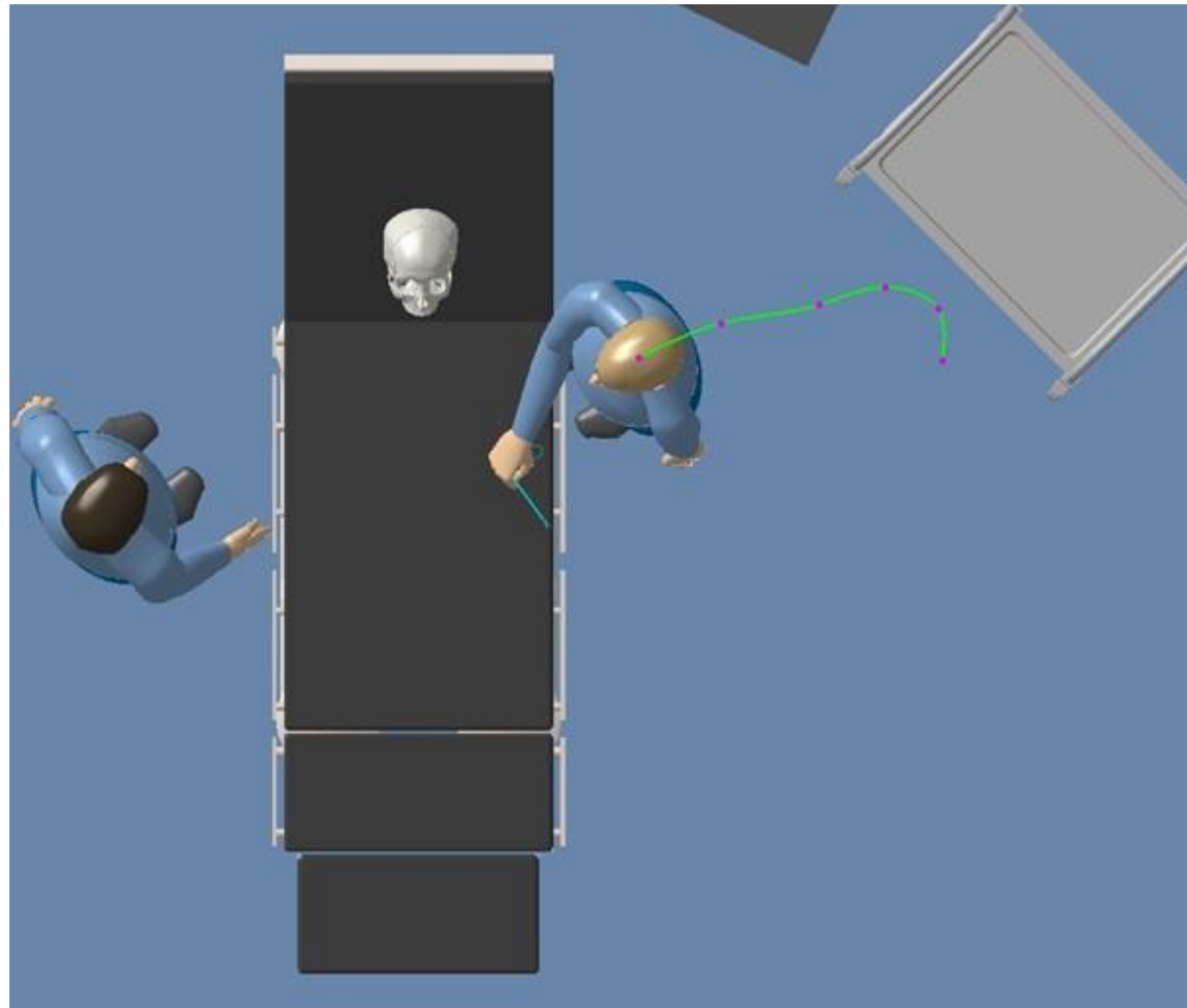
Operating tray (cart)



# The real-world and virtual inferior nasal turbinate surgery

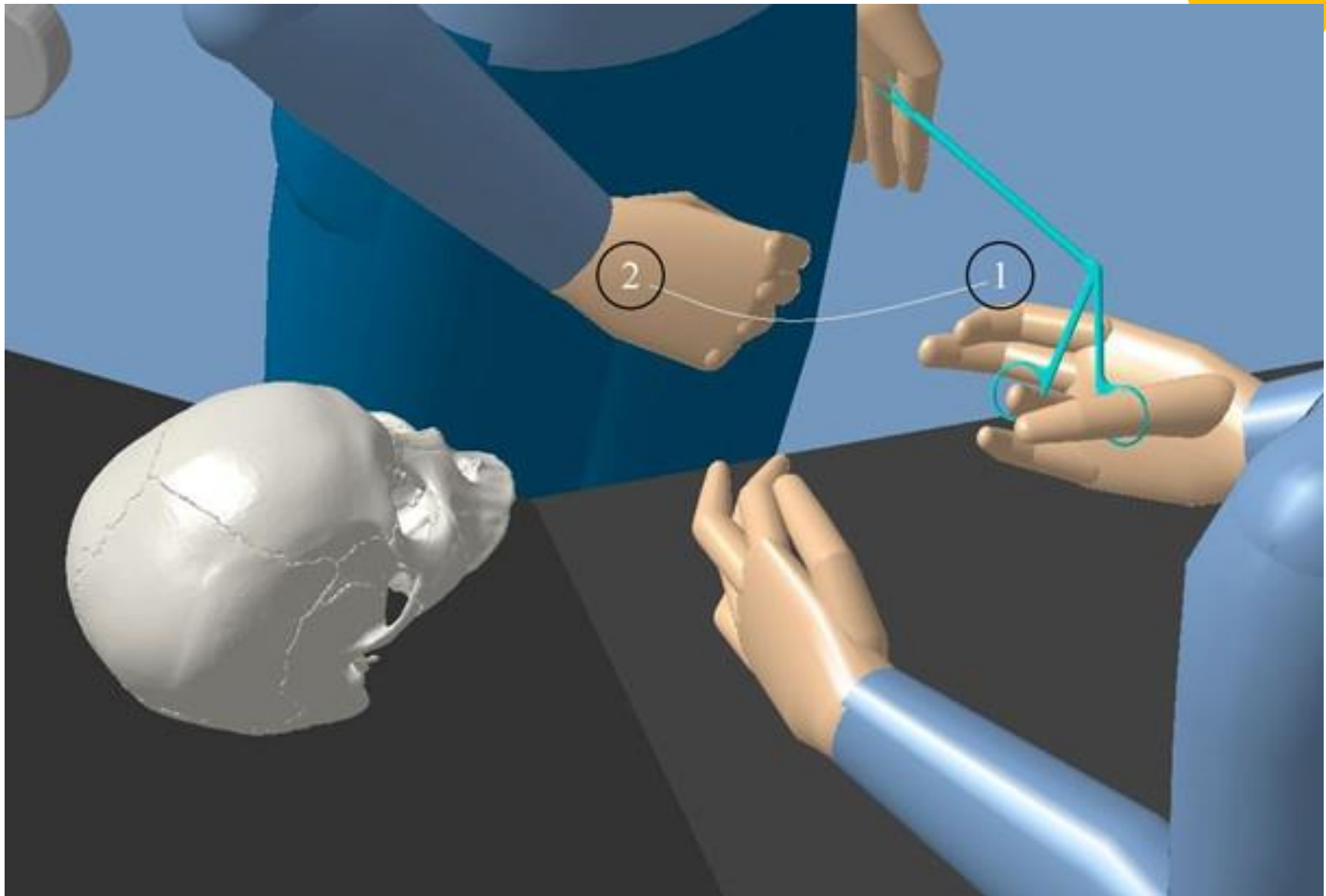


# PROCESS design: work of the surgeon and the instrument technician



The path of the instrument technician shown

*Stages  
of  
cutting  
process*

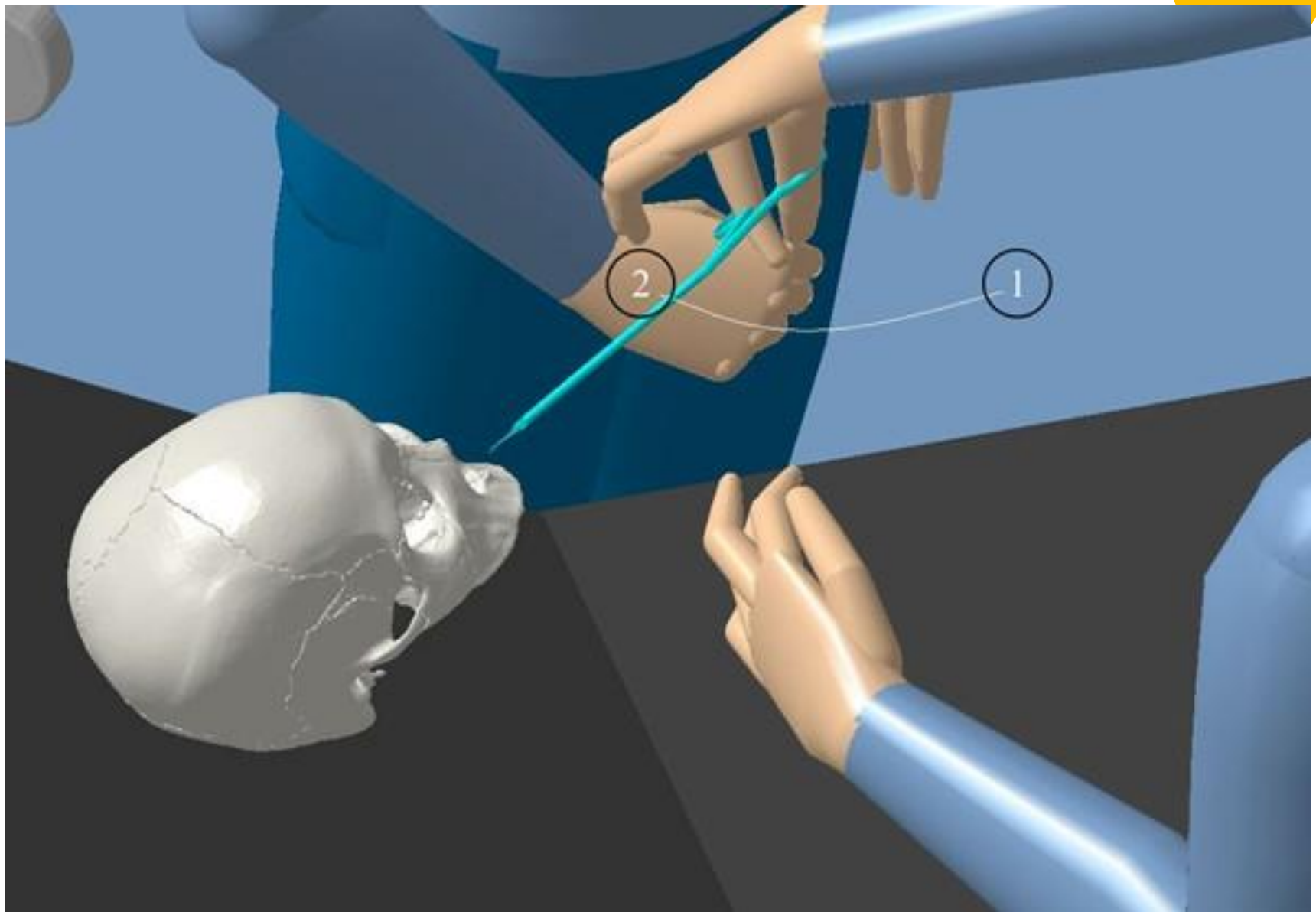


**1 – starting position**

2 – approaching the inferior nasal turbinate

3 – cutting

*Stages  
of  
cutting  
process*

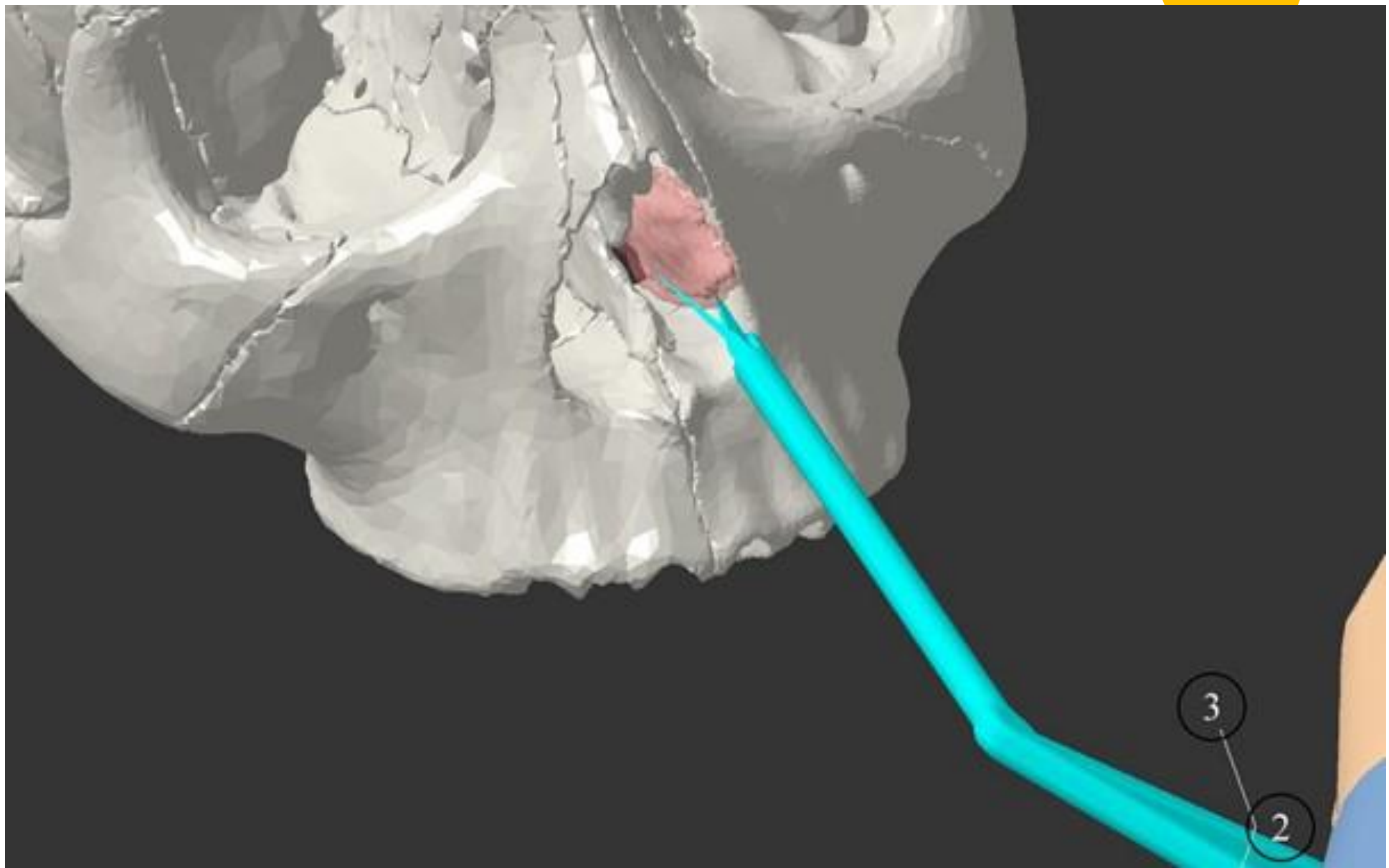


1 – starting position

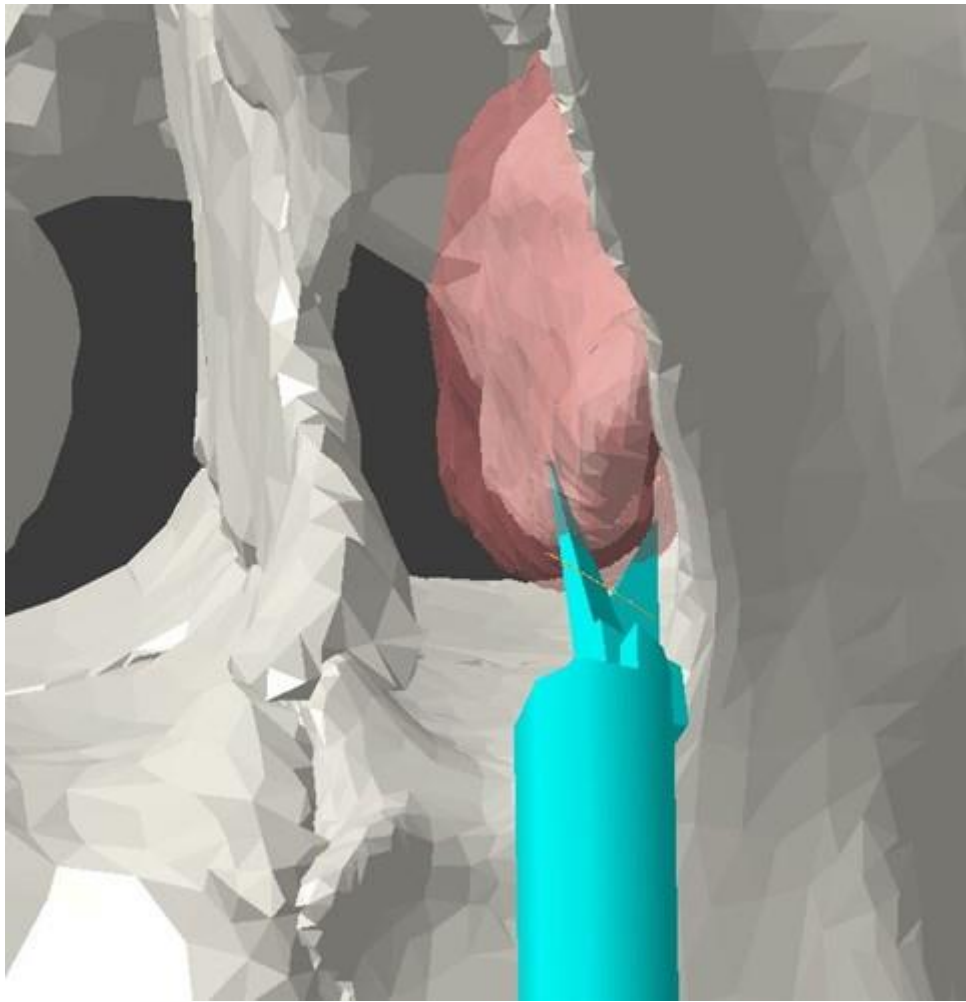
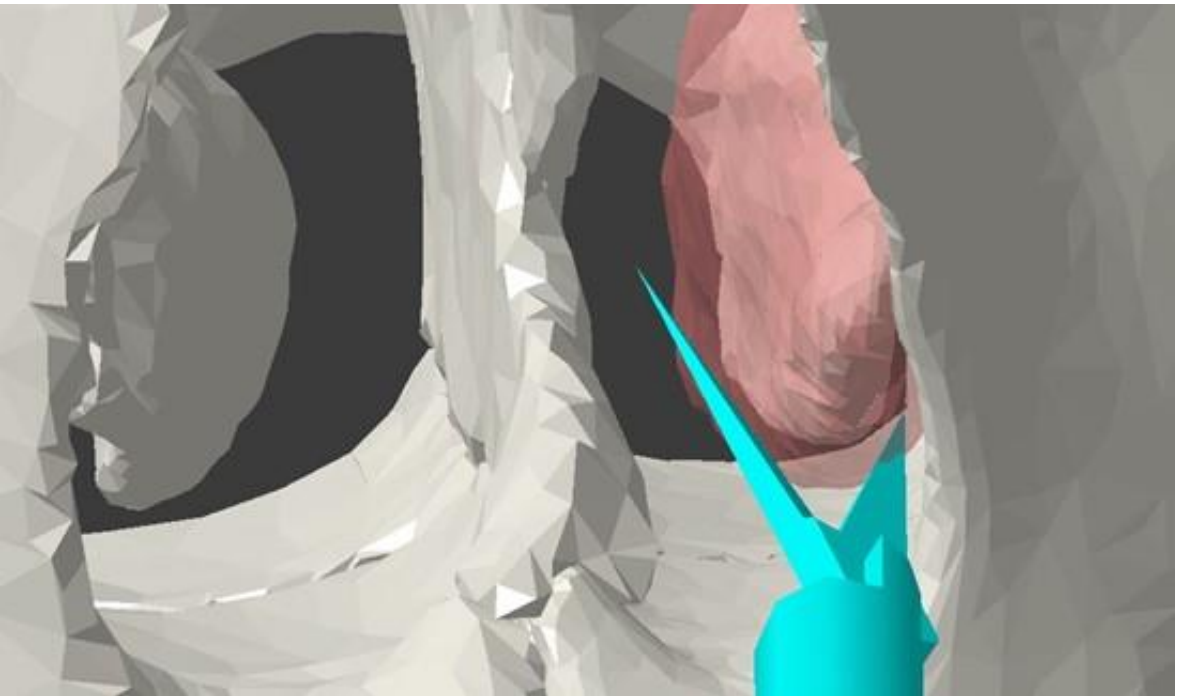
**2 – approaching the inferior nasal turbinate**

3 – cutting

*Stages  
of  
cutting  
process*



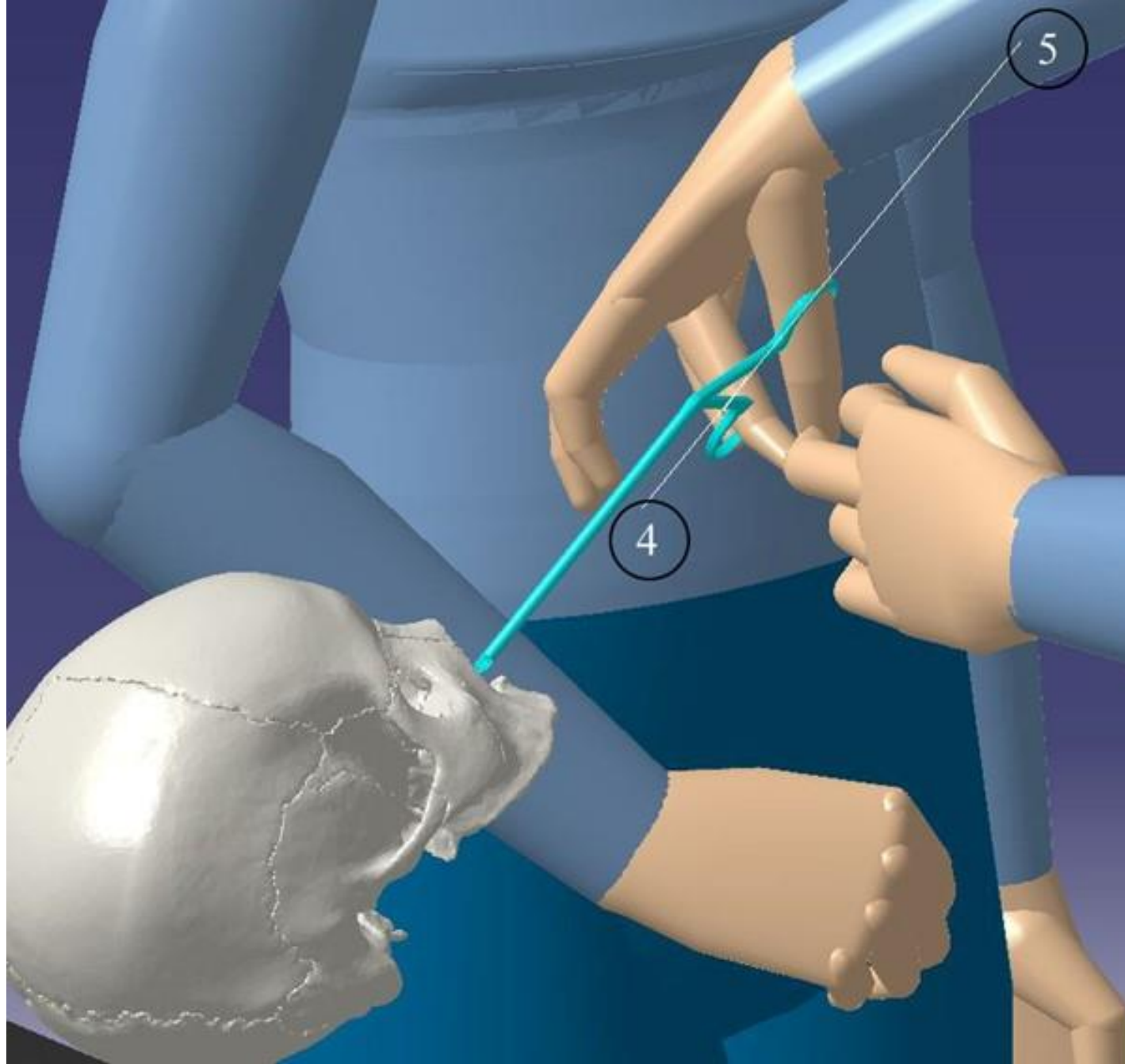
- 1 – starting position
- 2 – approaching the inferior nasal turbinate
- 3 – cutting**



Virtual cutting (opening and closing of scissors) of the inferior nasal turbinate

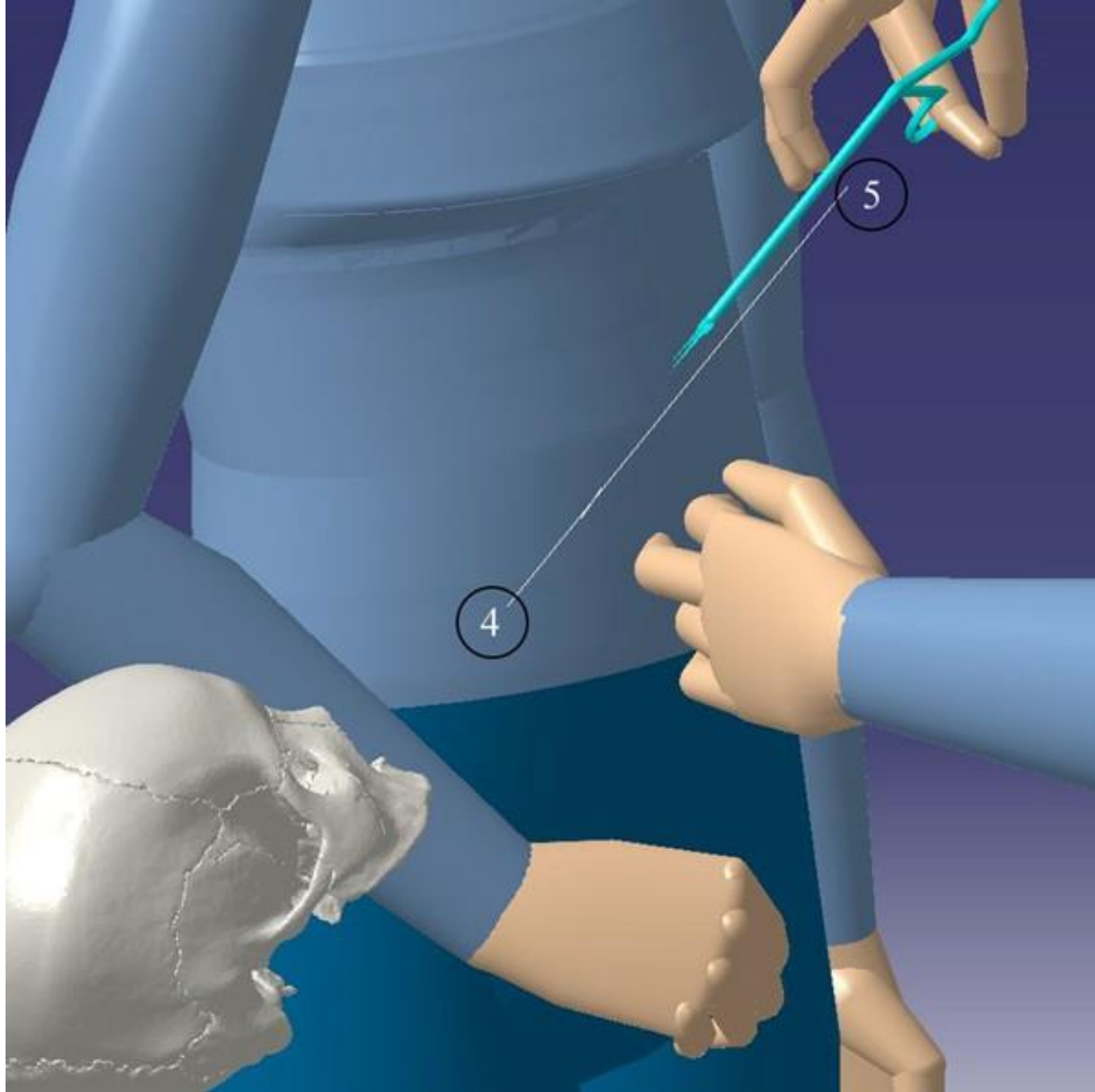


*Stages  
of  
cutting  
process*



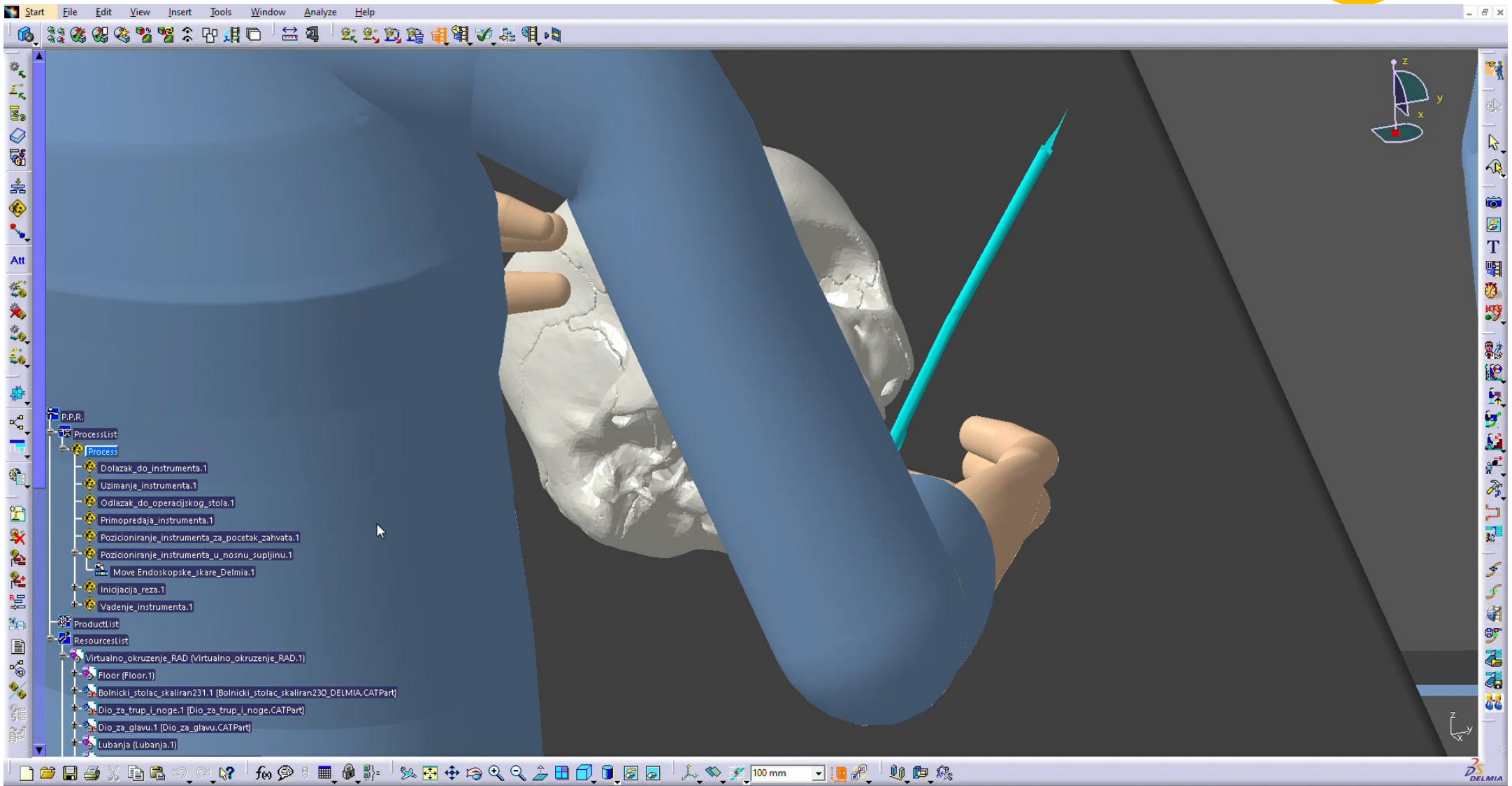
4 and 5 represent starting and final points of the extraction of tool

*Stages  
of  
cutting  
process*

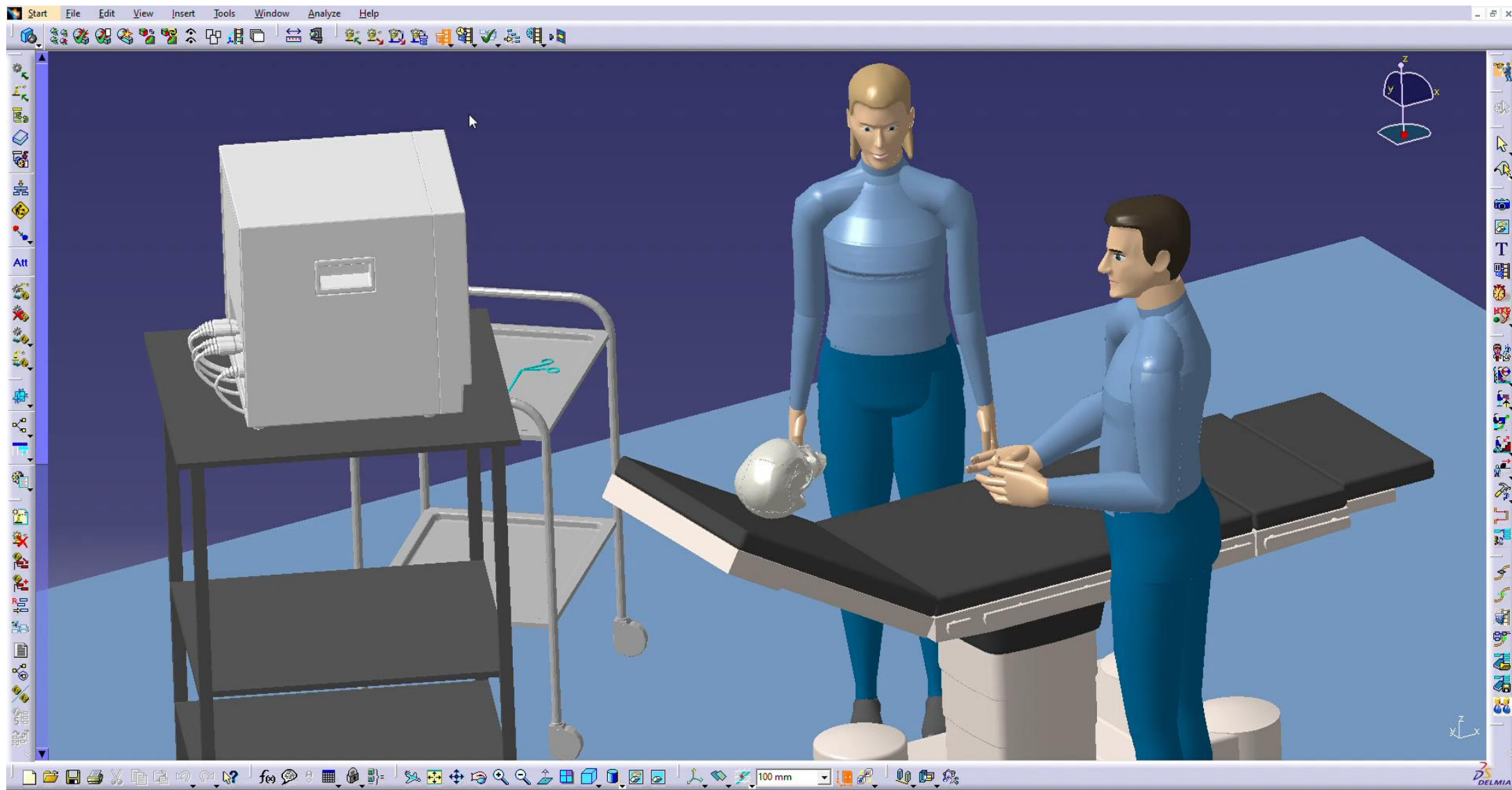


4 and 5 represent starting and final points of the extraction of tool





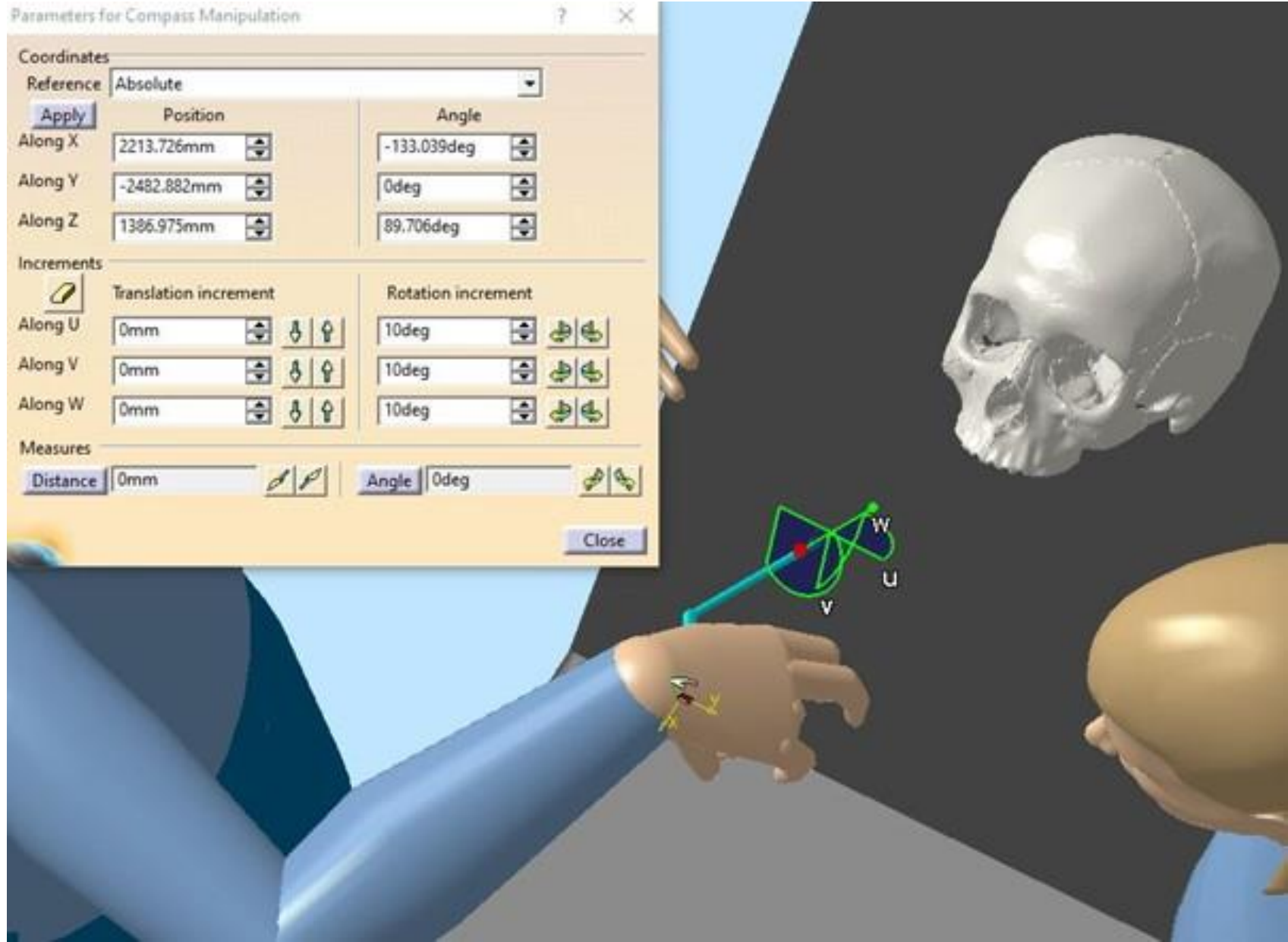
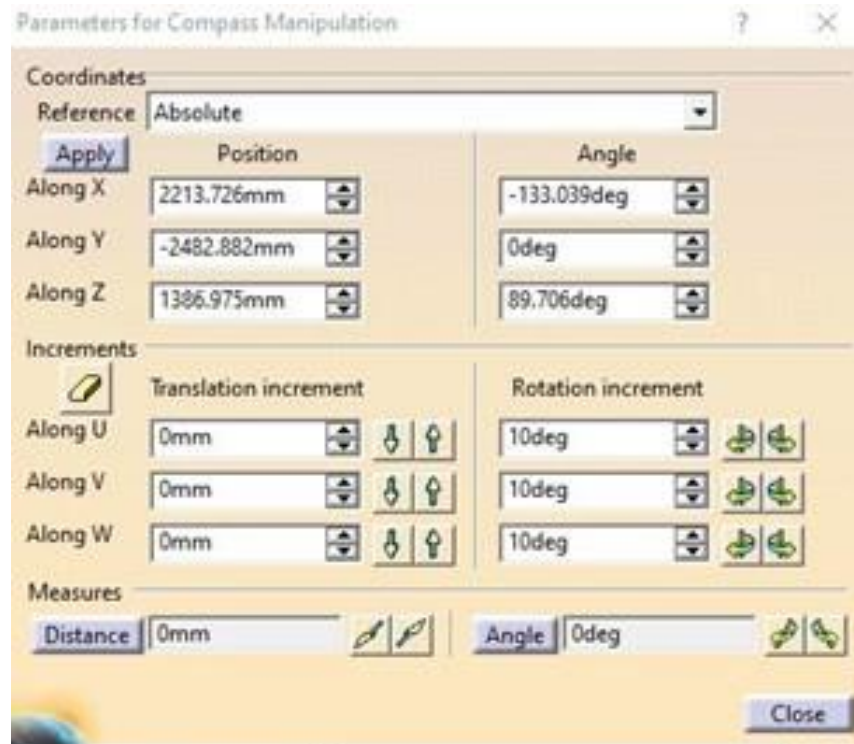
## Cutting process



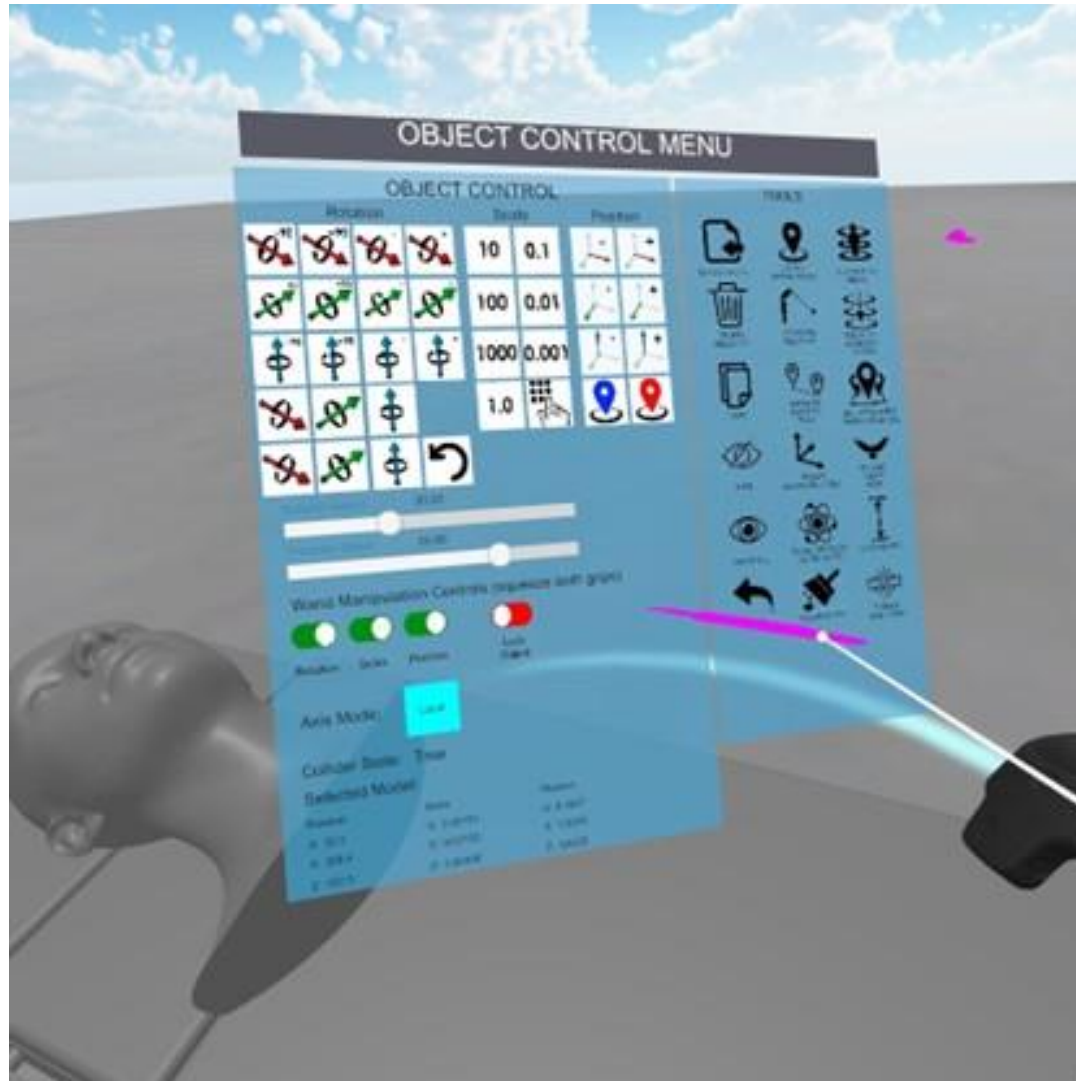
Simulation of the whole process

## Results:

- time of process
- precise angles and lengths of movements
- RULA ergonomics analysis



# Rhinoplasty in Virtual Reality



- HTC Vive headset system
- Tool Center Point (TCP) represents the tip of scalpel

## Results:

- precise angles and lengths of movements
- similar feel of control during movements
- delay up to 20 milliseconds



20

# Future work

- Both cases of nose surgery digital twinning give basis for future work, that may include:
- digital encompassing of **further details** of mentioned surgical procedures
  - recording of the **surgeon's actual movements** during the procedures and their transfer to a digital model
  - motion capture and comparing the work of **several surgeons**
  - implementation on a **larger sample of patients**
  - the introduction of virtual reality into **training** of surgeons
  - the introduction of **augmented reality** into surgical procedures.