

Digital transformation in nose surgery

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Digital transformation in nose surgery



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Content

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

Aim and goals of work^{[1][2]}

- **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**^[3]
 - **rhinoplasty**^[4].

[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

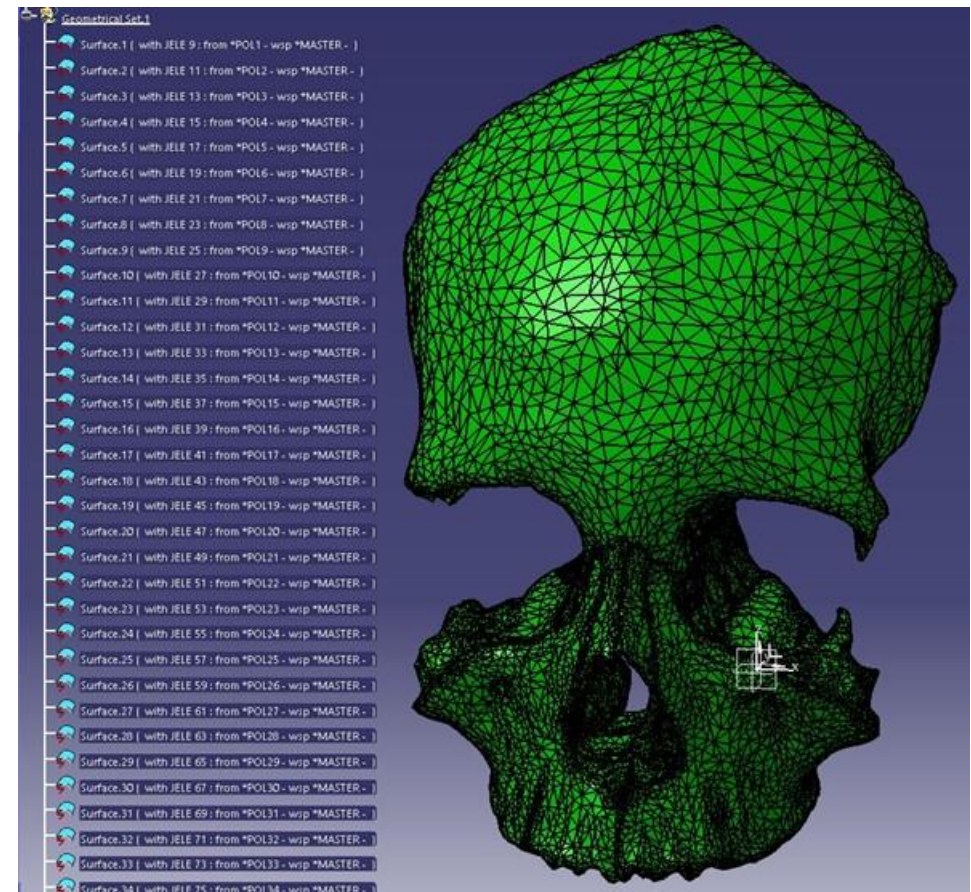
Antunović Bartol

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Inferior nasal turbinates surgery in CAD

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

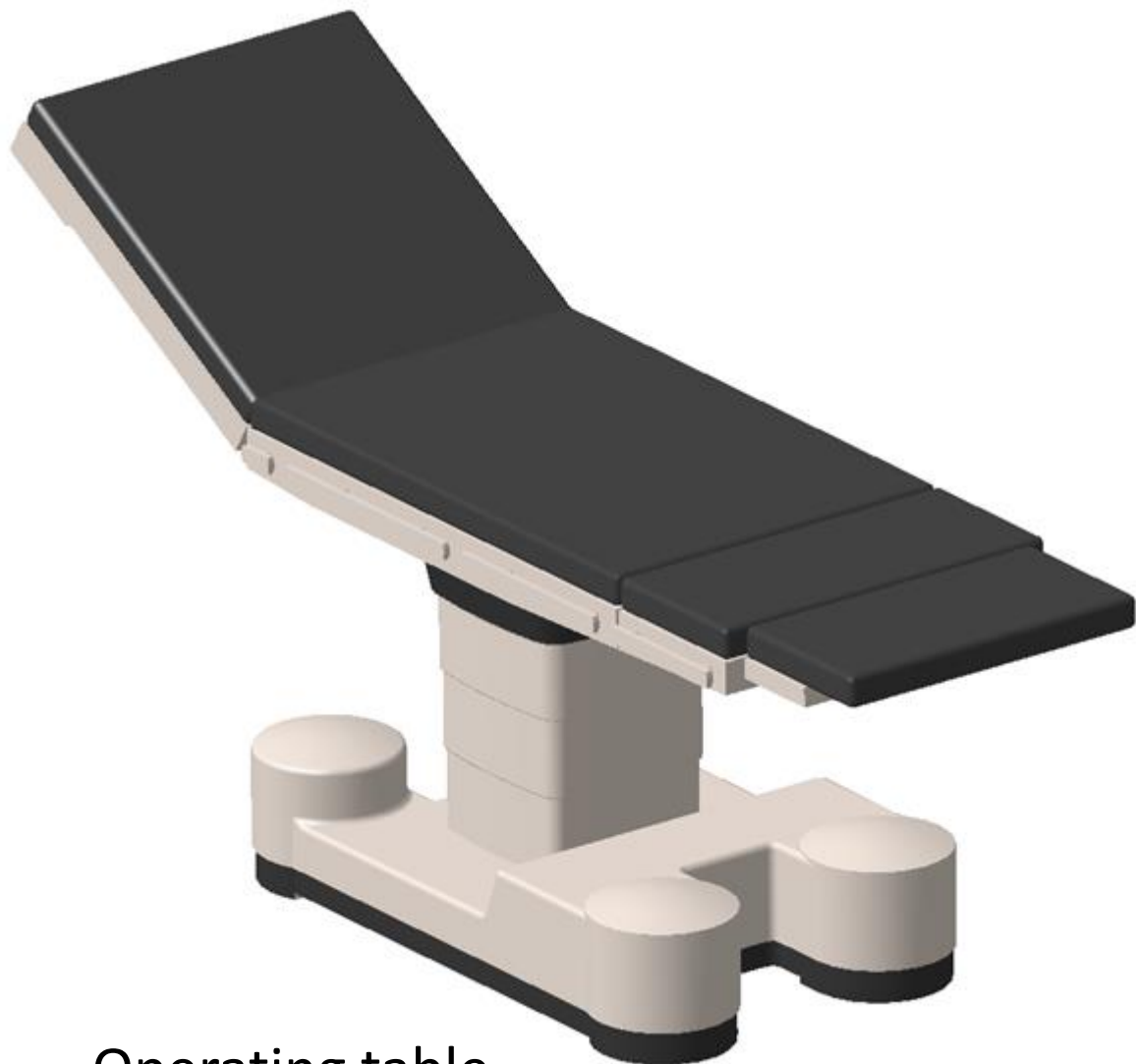
HEAD AND TISSUE design – complexity and simplifications



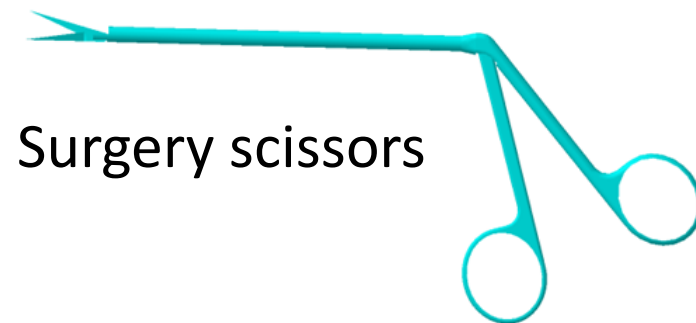
Preparation of the model of the head:

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

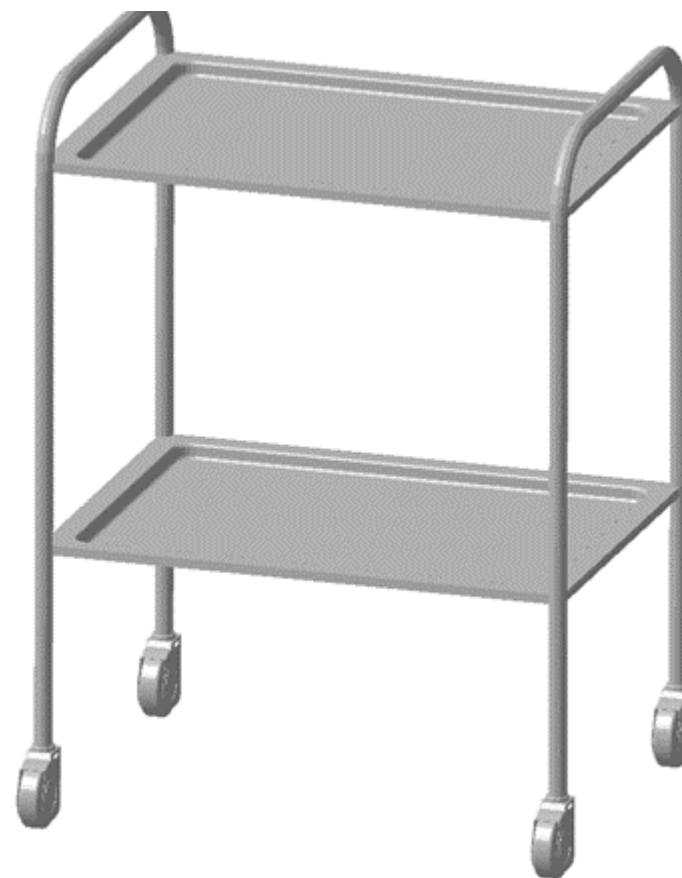
TOOL AND WORK ENVIRONMENT design



Operating table



Surgery scissors

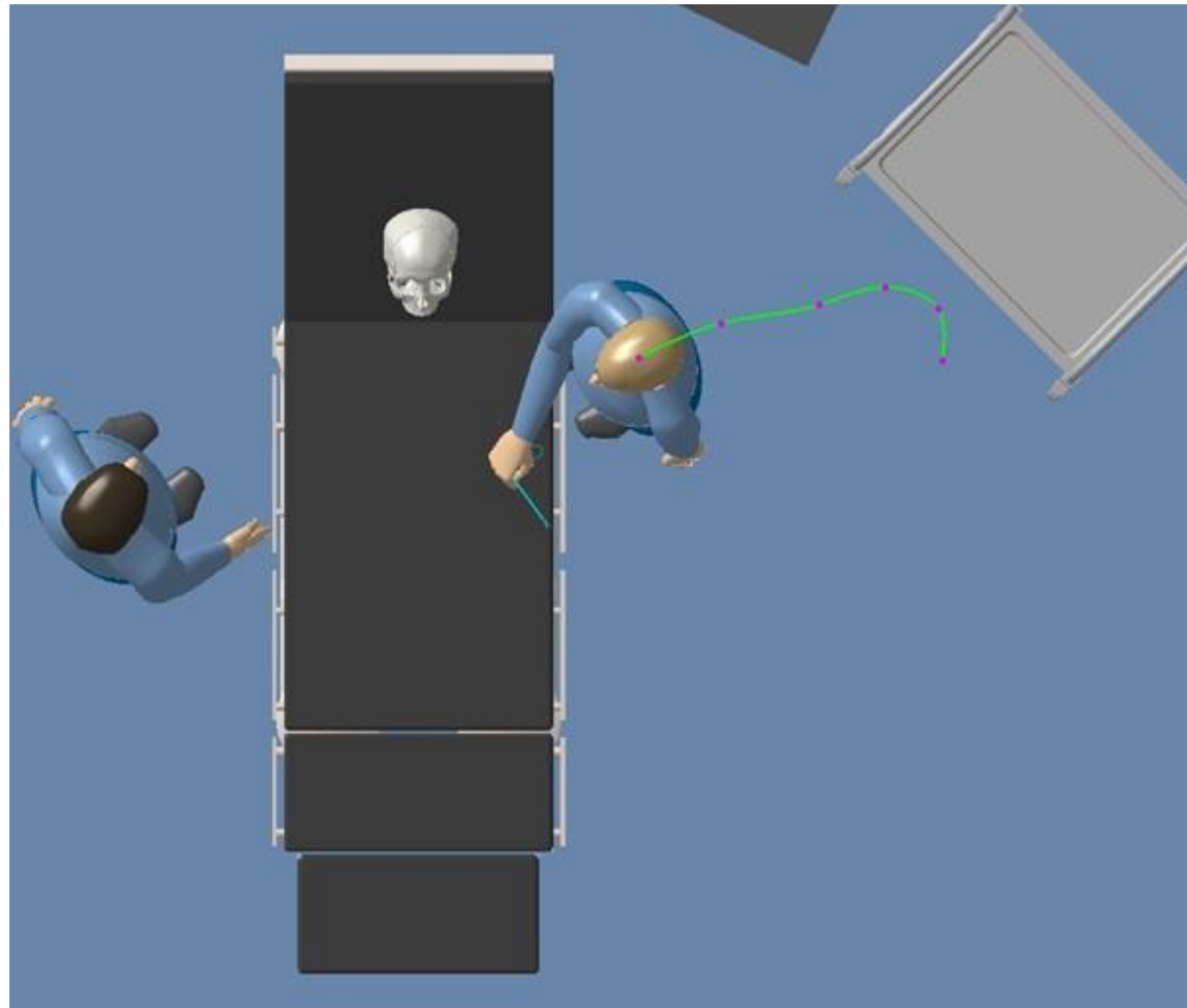


Operating tray (cart)

The real-world and virtual inferior nasal turbinate surgery

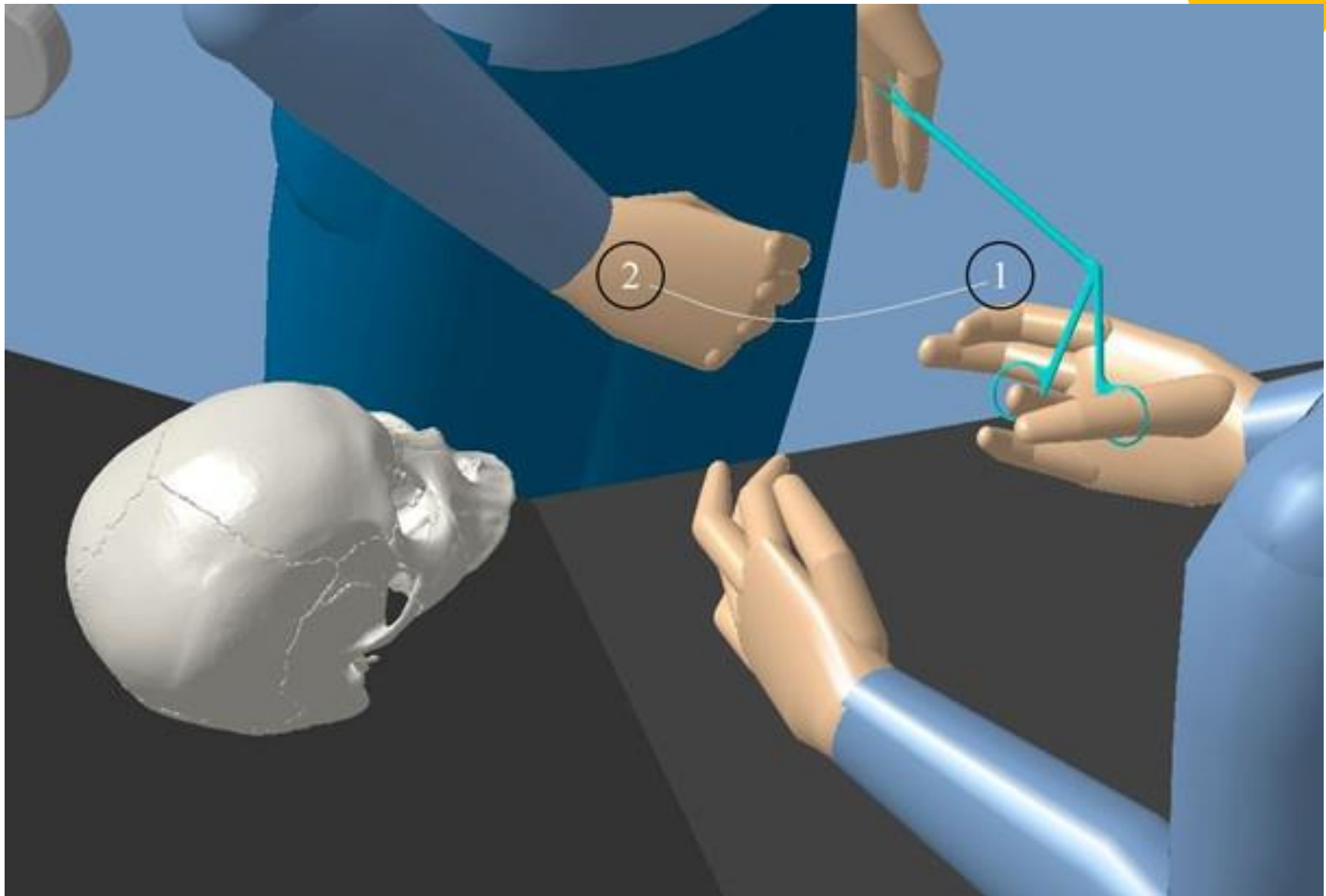


PROCESS design: work of the surgeon and the instrument technician



The path of the instrument technician shown

*Stages
of
cutting
process*

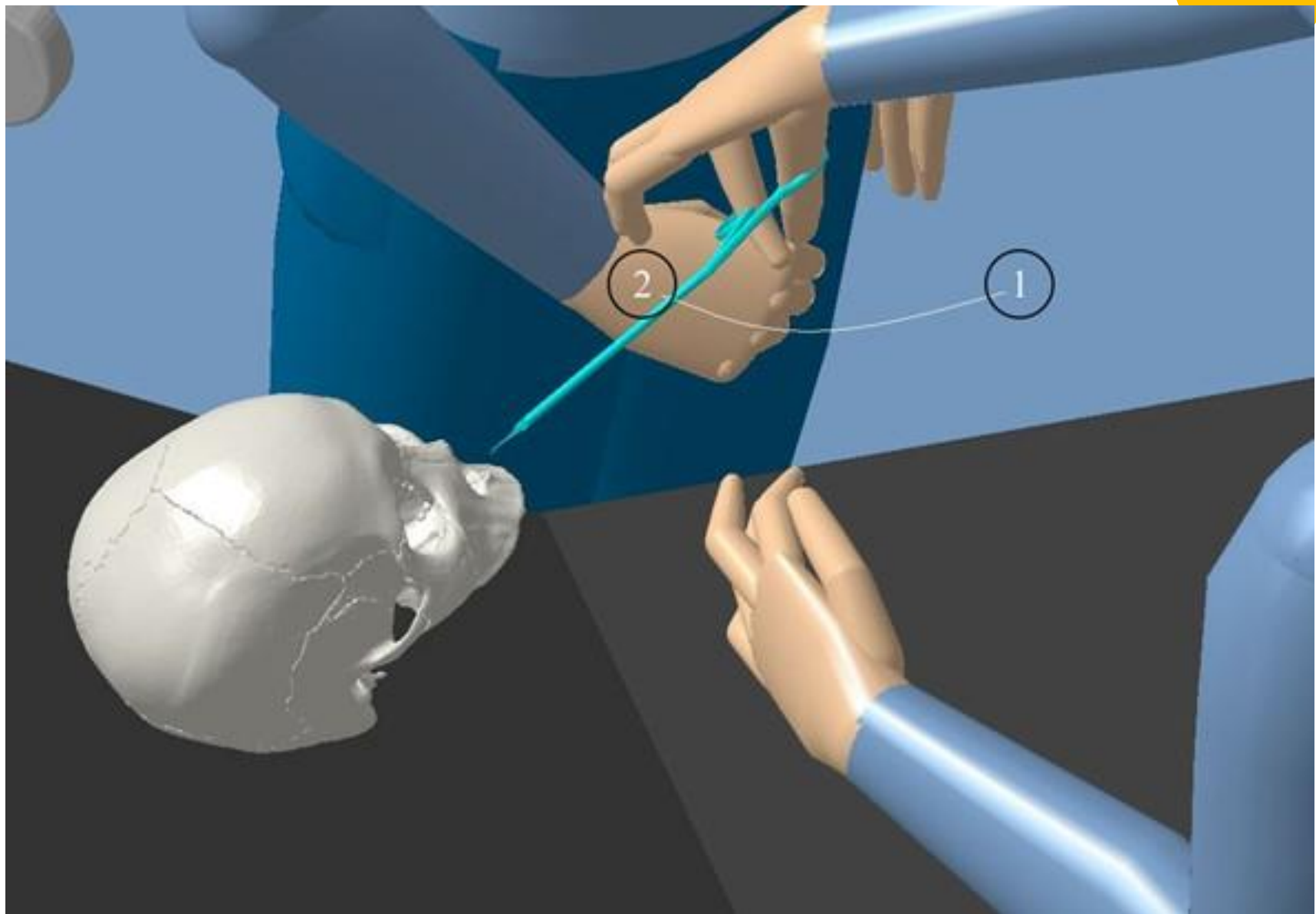


1 – starting position

2 – approaching the inferior nasal turbinate

3 – cutting

*Stages
of
cutting
process*

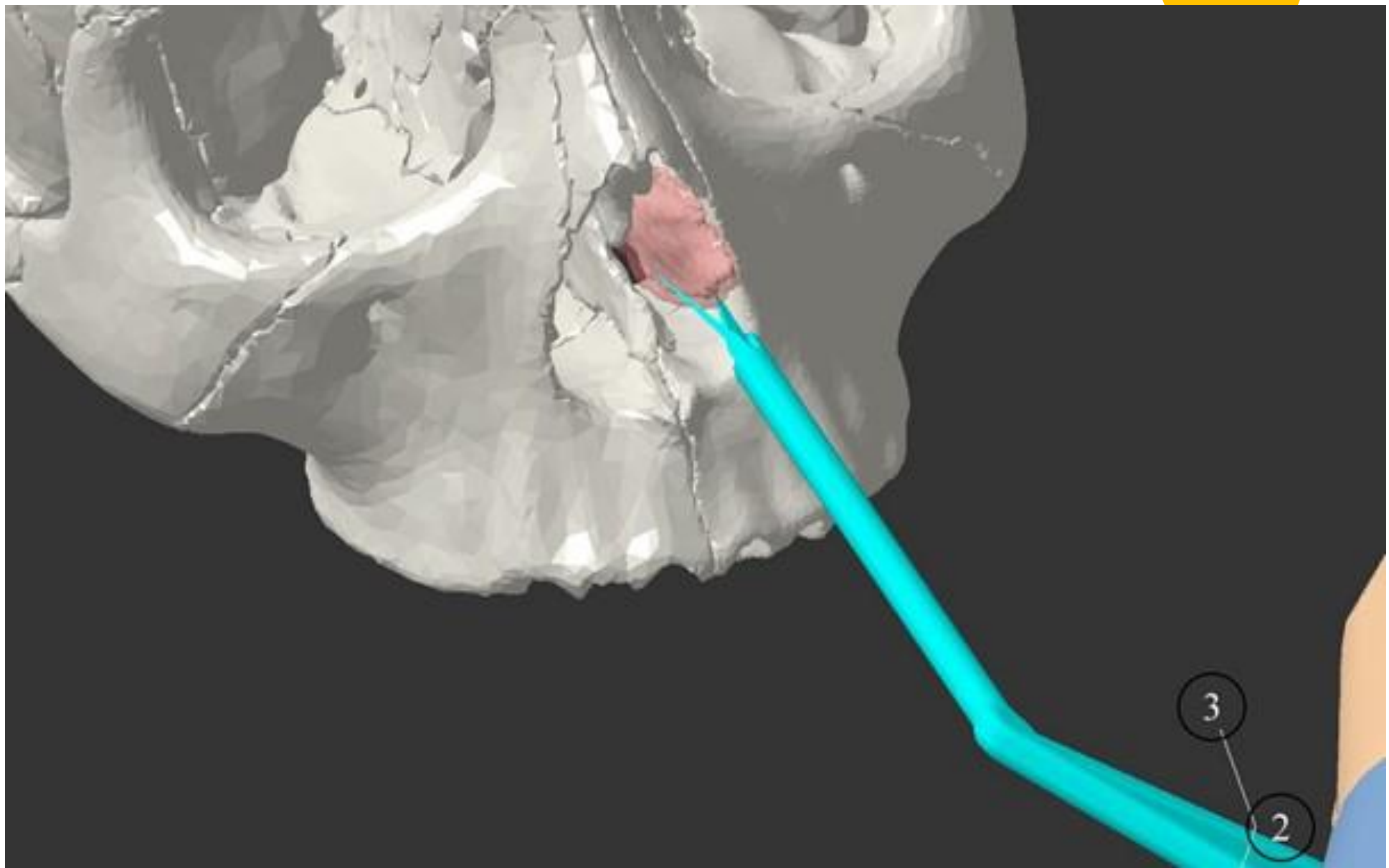


1 – starting position

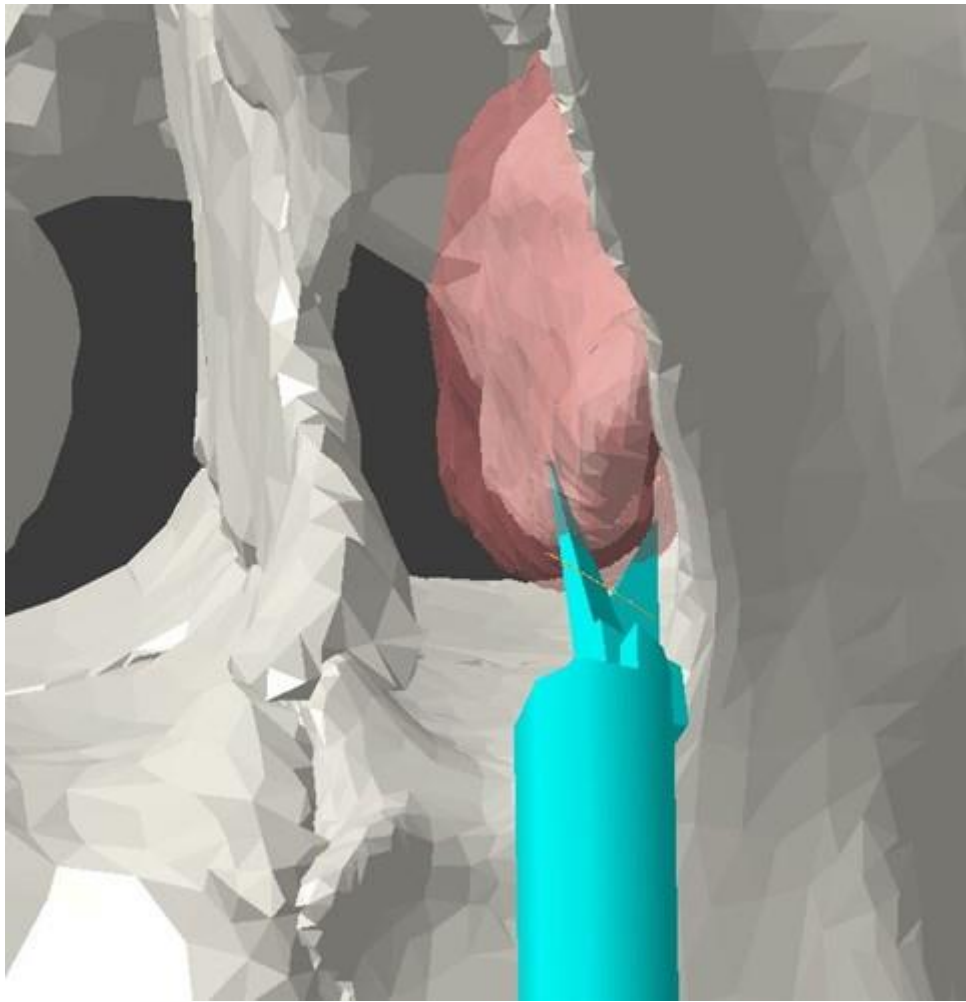
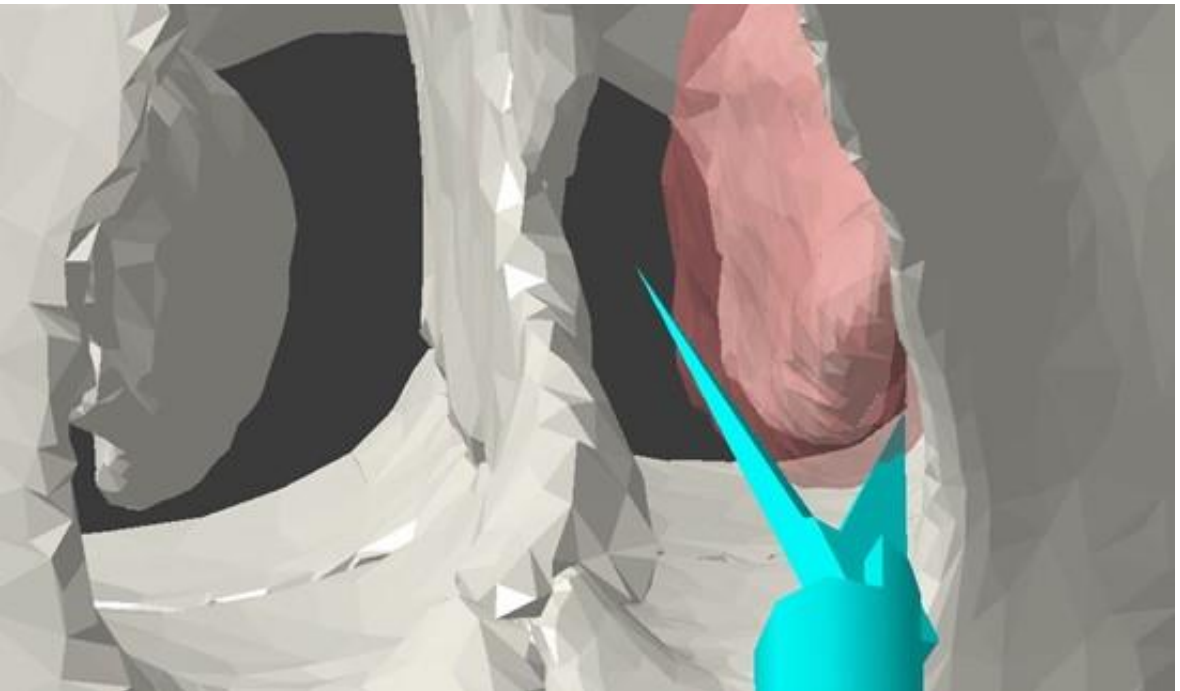
2 – approaching the inferior nasal turbinate

3 – cutting

*Stages
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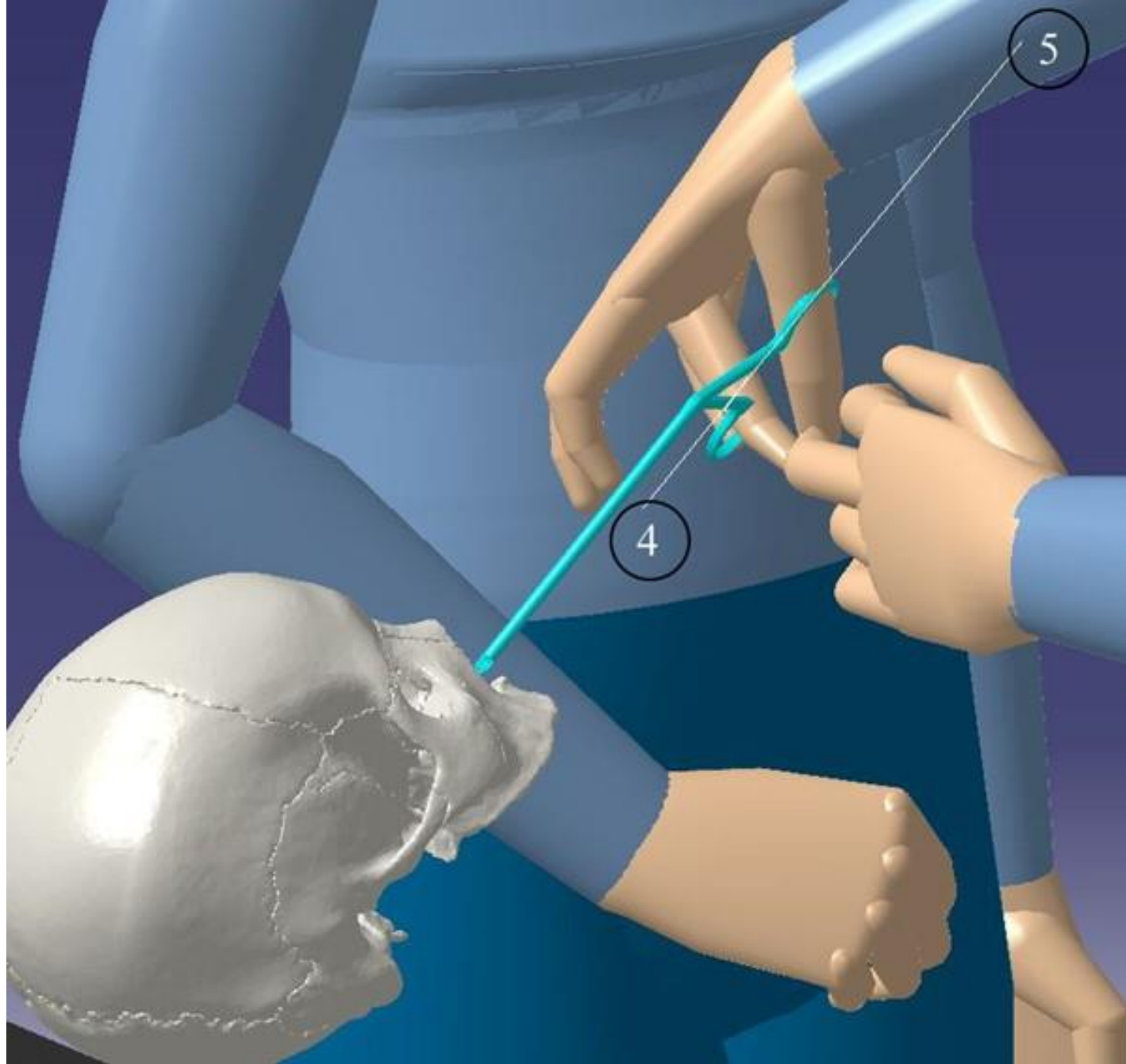


- 1 – starting position
- 2 – approaching the inferior nasal turbinate
- 3 – cutting**



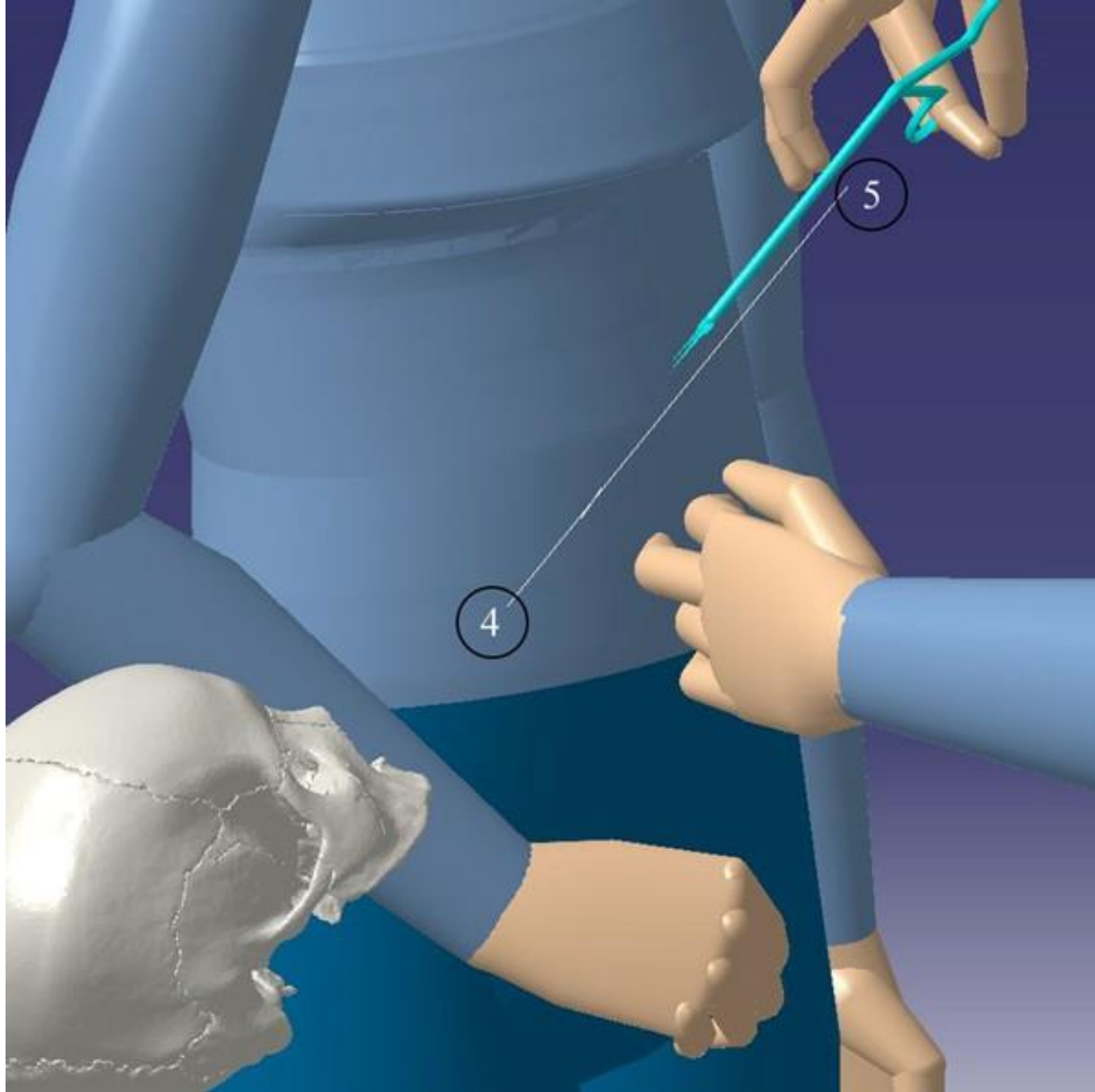
Virtual cutting (opening and closing of scissors) of the inferior nasal turbinate

*Stages
of
cutting
process*

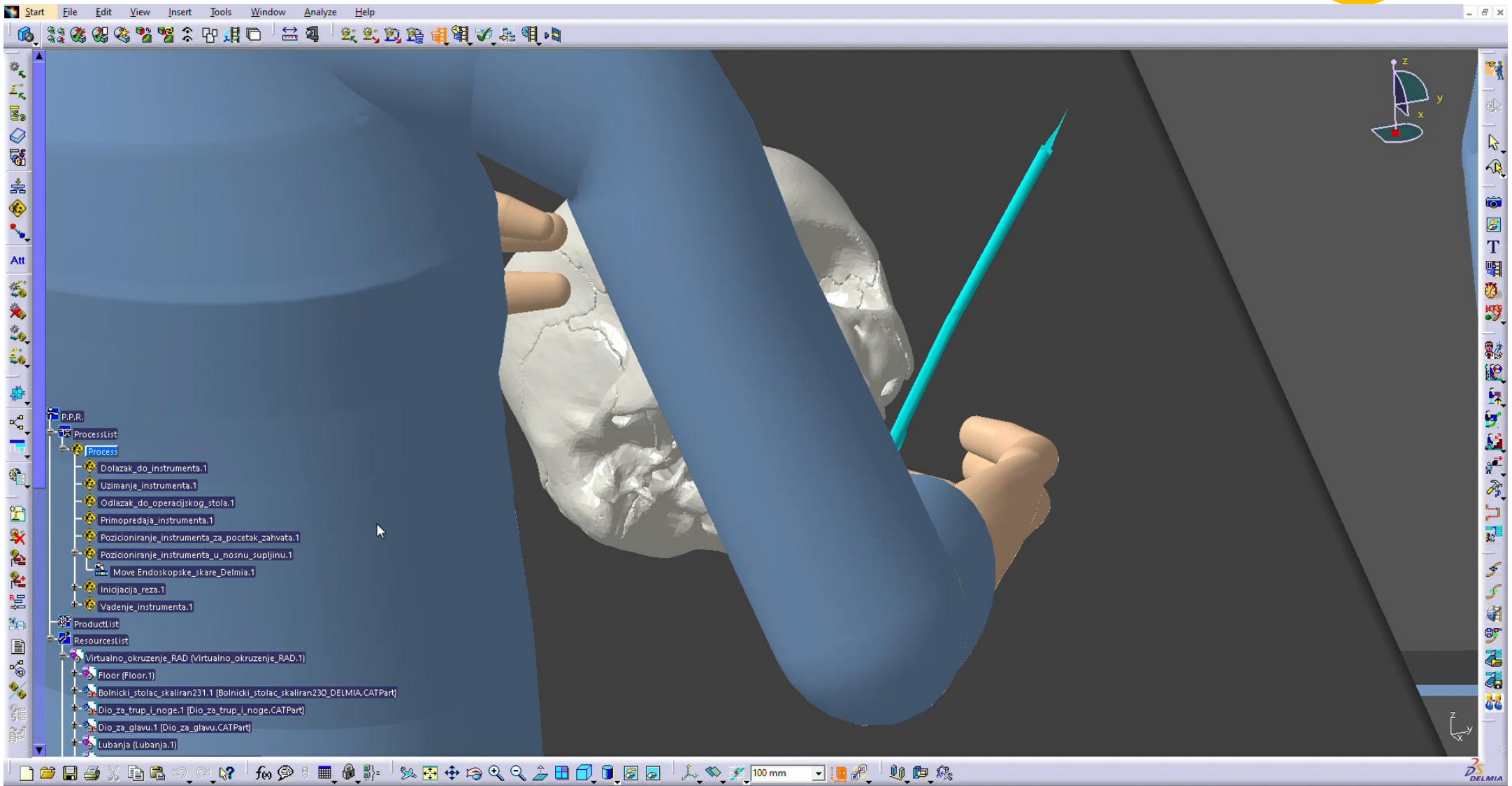


4 and 5 represent starting and final points of the extraction of tool

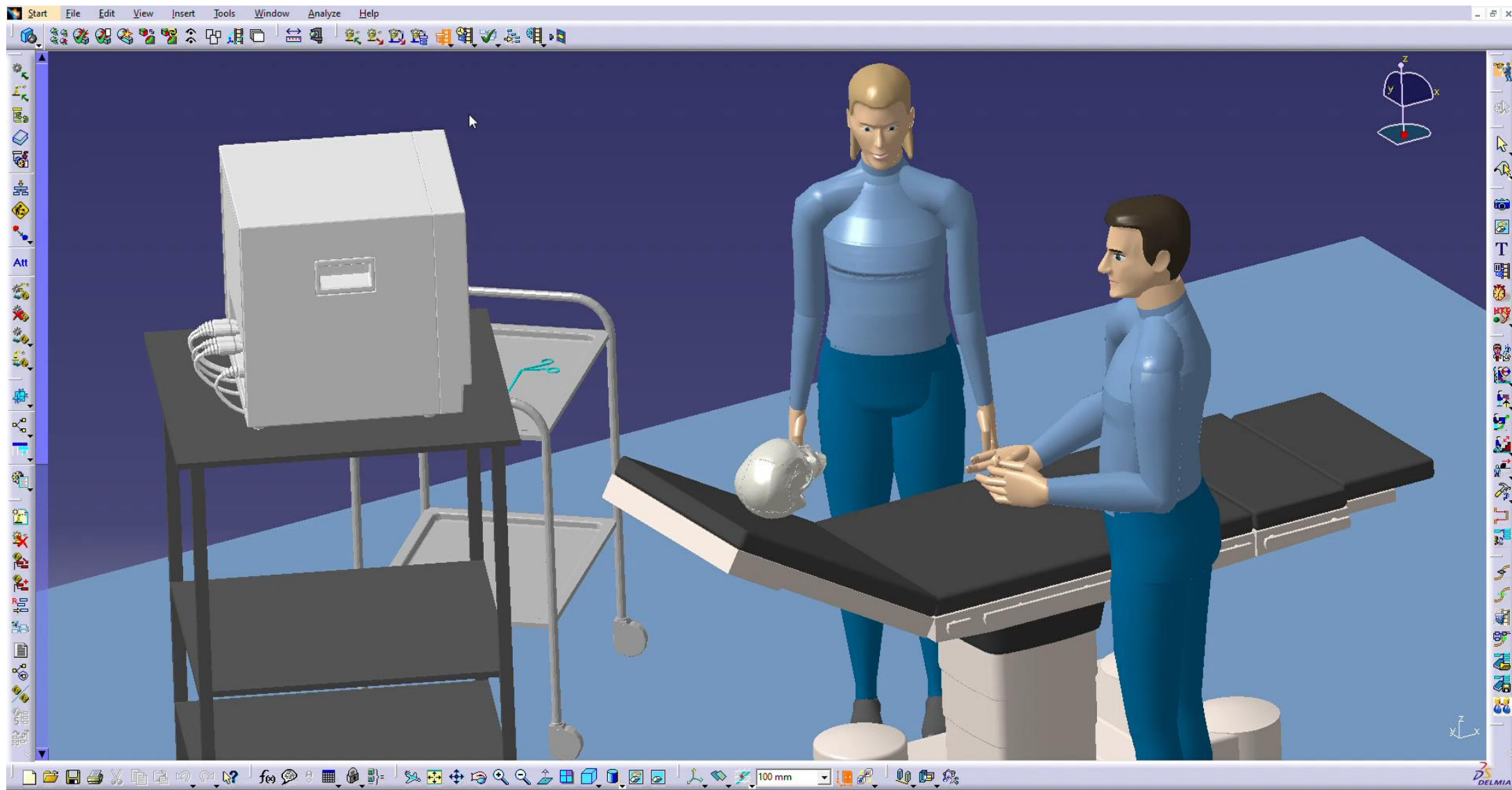
*Stages
of
cutting
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4 and 5 represent starting and final points of the extraction of tool



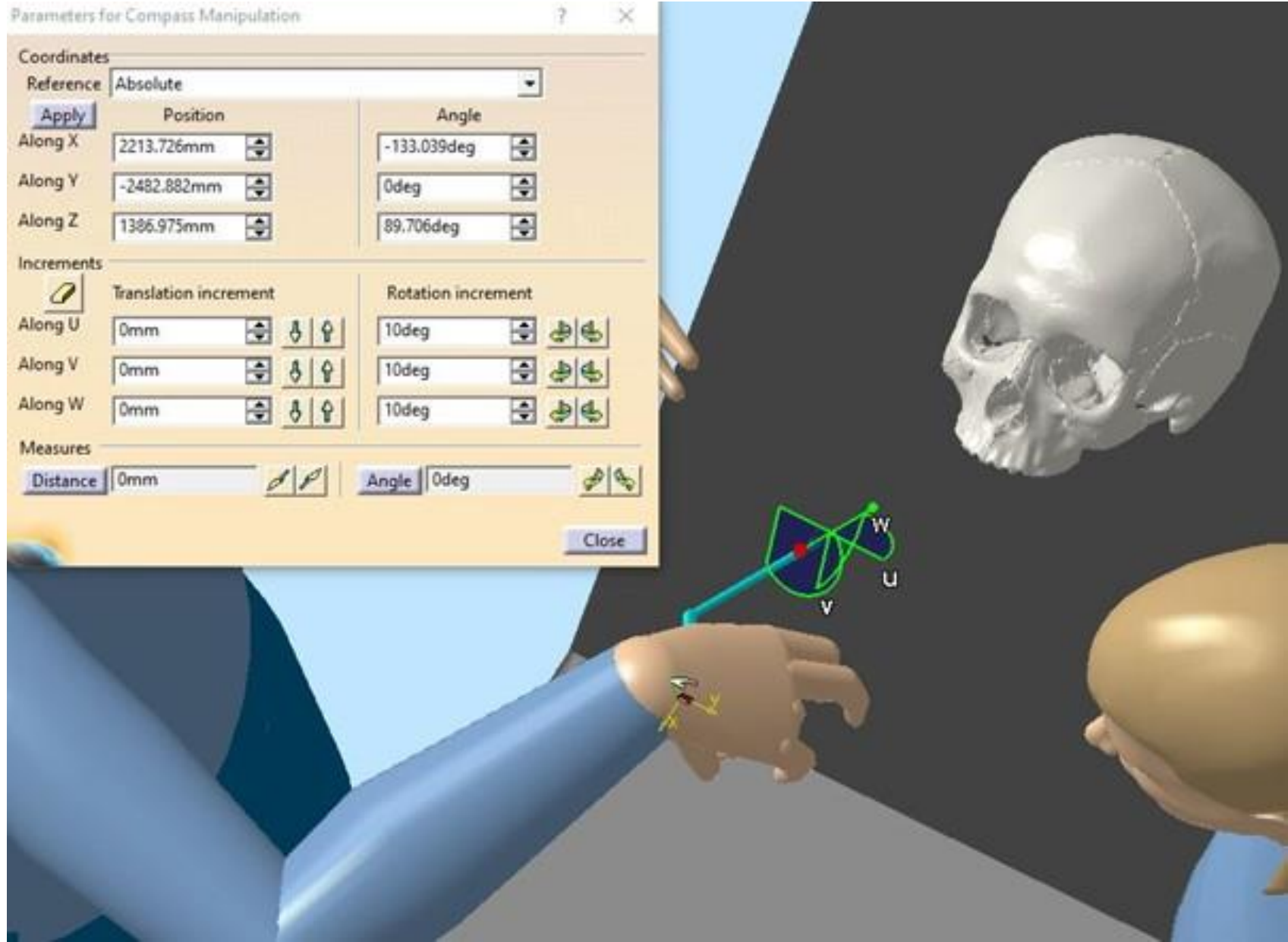
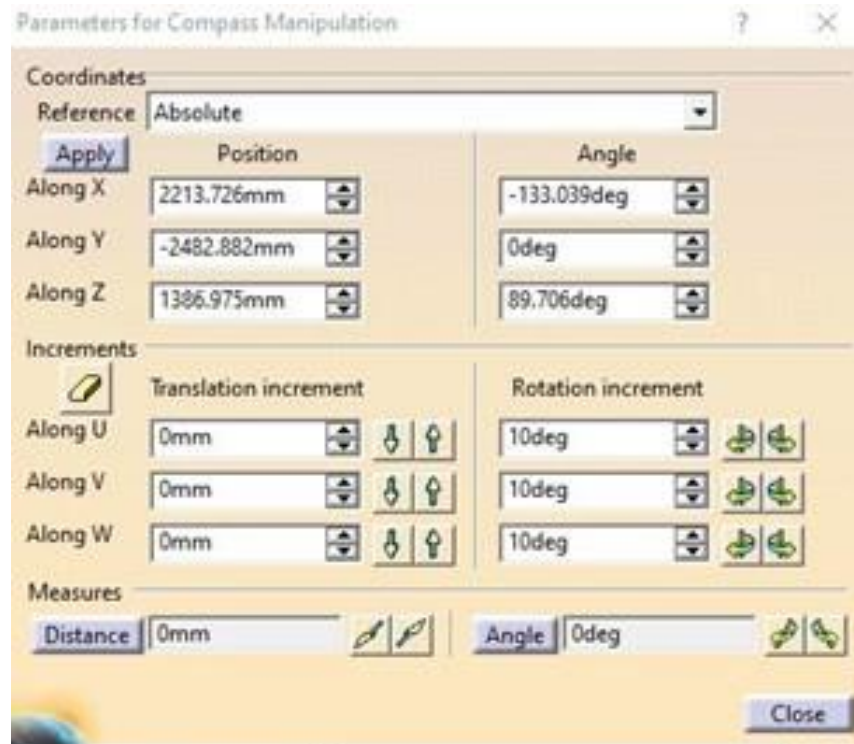
Cutting process



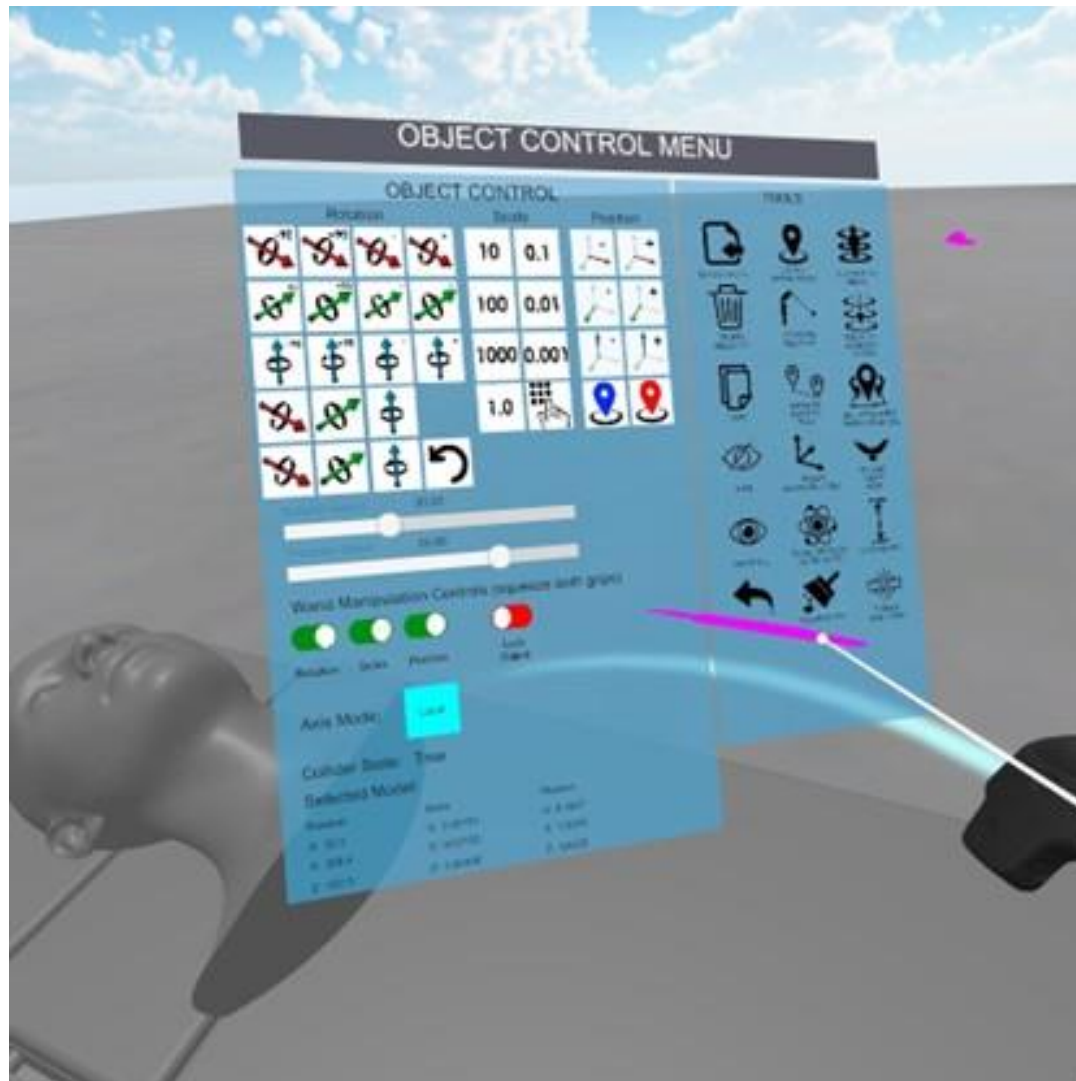
Simulation of the whole process

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



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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.