



4D (3D+t) virtual dissection of the neck based on surface laser scanning: a new tool for Anatomy learning and Surgical training

Mohamed Akkari^{1, 2}, Benjamin Moreno³, Gérard Subsol⁴, François Canovas^{1,5}, Guillaume Captier^{1,6}

¹Anatomy Laboratory, Faculty of Medicine of Montpellier-Nîmes, University of Montpellier, Montpellier, France

²ENT and Head and Neck Surgery Department, University Hospital Gui de Chauliac, Montpellier, France

³SARL IMA Solutions, Toulouse, France

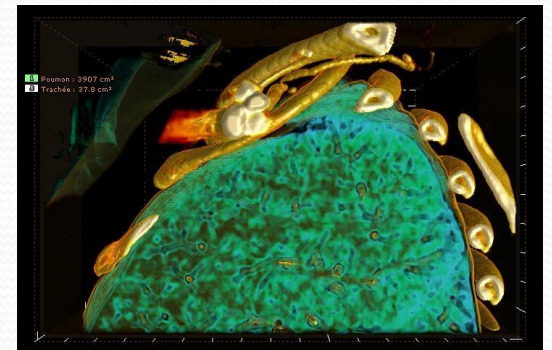
⁴ICAR Team Project, LIRMM, CNRS/University of Montpellier, France

⁵Orthopaedic and Traumatologic Surgery Department, University Hospital Lapeyronie, Montpellier, France

⁶Orthopaedic and Plastic Pediatric Surgery Department, University Hospital Lapeyronie, Montpellier, France

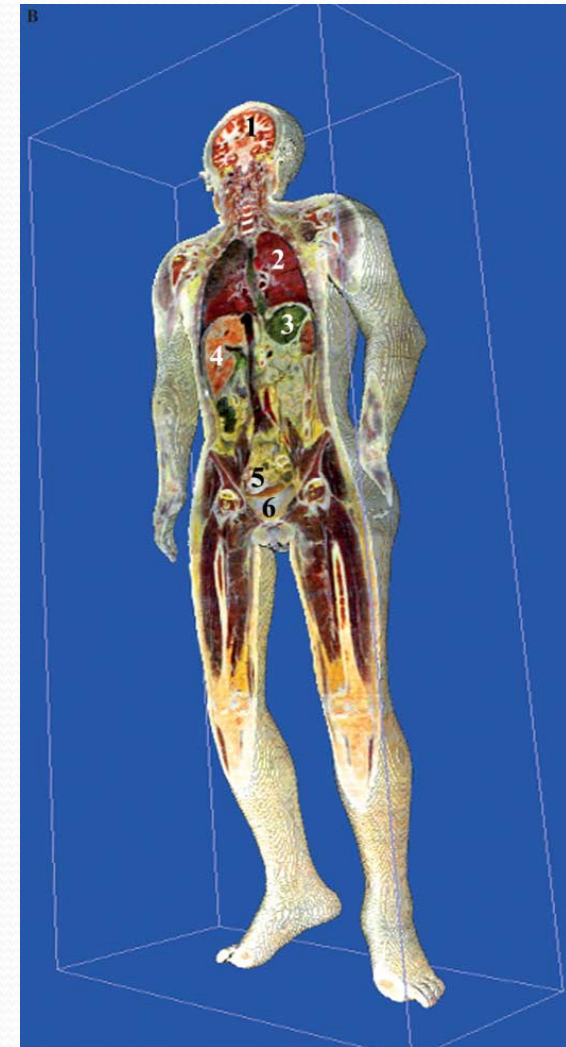
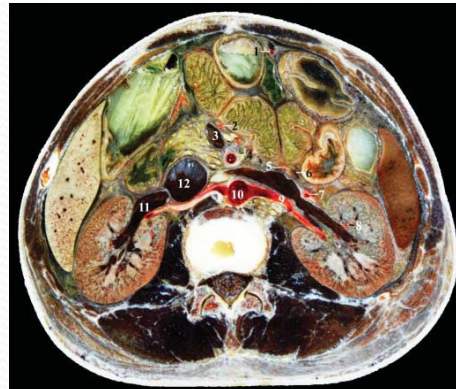
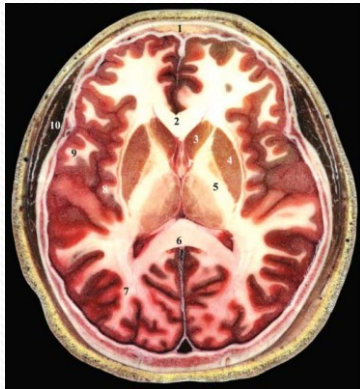
INTRODUCTION

- Conventional cadaveric dissection
 - essential tool:
 - Anatomy learning
 - Surgical training
- Increasing number of Medicine students + limited number of available cadavers → reduction of dissection practice
- New learning tools? → 3D anatomical reconstructions



INTRODUCTION

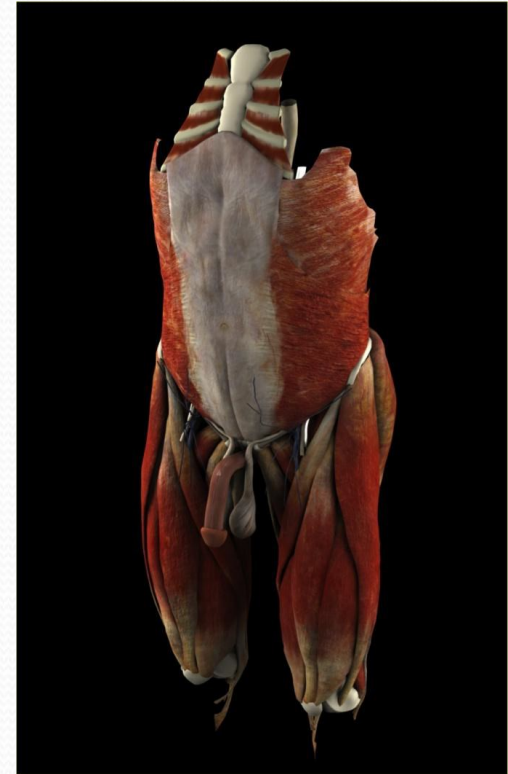
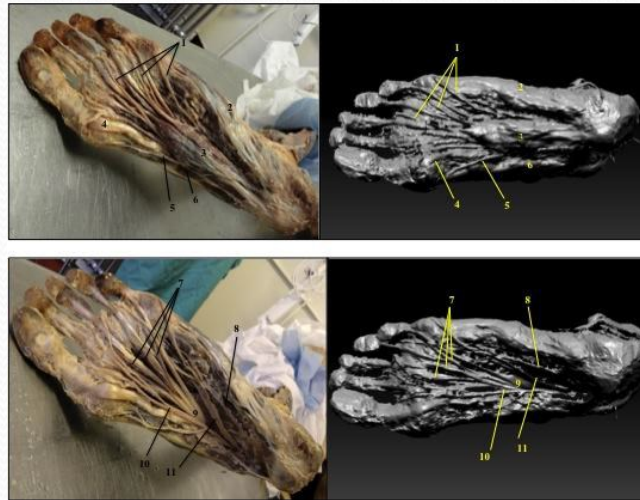
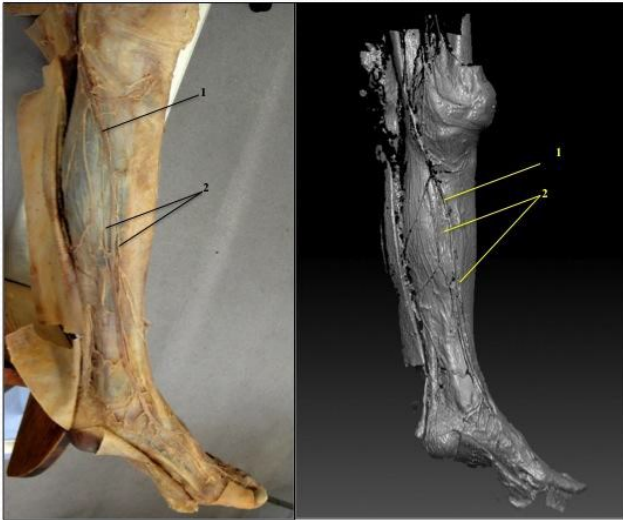
- From anatomical cross section (VHP, CVH, VKH):
 - Time consuming image segmentation
 - Poor colour differentiation
 - Tissue streaking across slices, data loss
 - Distortion of frozen and sliced tissues



Spitzer VM, Whitlock DG. *The Visible Human Dataset: the anatomical platform for human simulation.* *Anat Rec.* 1998 Apr;253(2):49-57.
Zhang SX, Heng PA, Liu ZJ et al. *The Chinese Visible Human (CVH) datasets incorporate technical and imaging advances on earlier digital humans..* *J Anat.* 2004 Mar;204(Pt 3):165-73.
Park JS, Chung MS, Hwang SB, Shin BS, Park HS. *Visible Korean Human: its techniques and applications.* *Clin Anat.* 2006 Apr;19(3):216-24.

INTRODUCTION

- Welsh et al (2014): topographical 3D laser scanning + high-resolution digital photography



- Anderson et al (2013): dental Anatomy and training

Welsh E, Anderson P, Rea P, A Novel Method of Anatomical Data Acquisition Using the Perceptron ScanWorks V5 Scanner. *International Journal on Recent and Innovation Trends in Computing and Communication* ISSN: 2321-8169 Volume: 2 Issue: 8

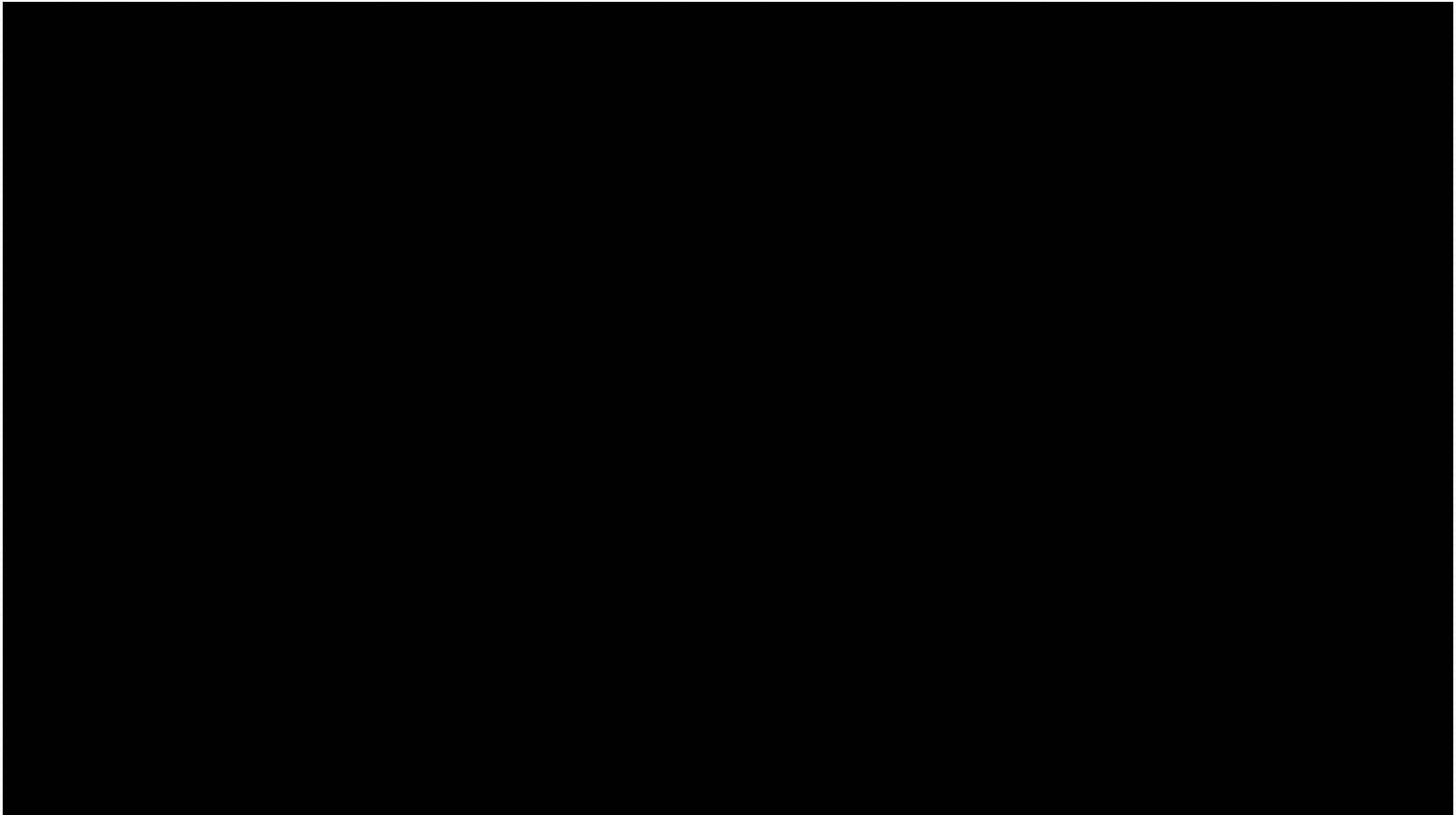
Anderson, P., Chapman, P., Ma, M., & Rea, P. (2013). Real-time medical visualization of human head and neck anatomy and its applications for dental training and simulation. *Current Medical Imaging Reviews*, 9(4), 298-308

OBJECTIVES

- To combine cadaveric neck dissection and 3D laser scanning
- To create a 4D virtual dissection model (3D+time) → better understanding of the 3D interaction between structures and the real time dissection technique

MATERIAL AND METHODS

- Bilateral neck dissection on a man's fresh cadaver
- Identification of 8 relevant anatomic planes for scanning



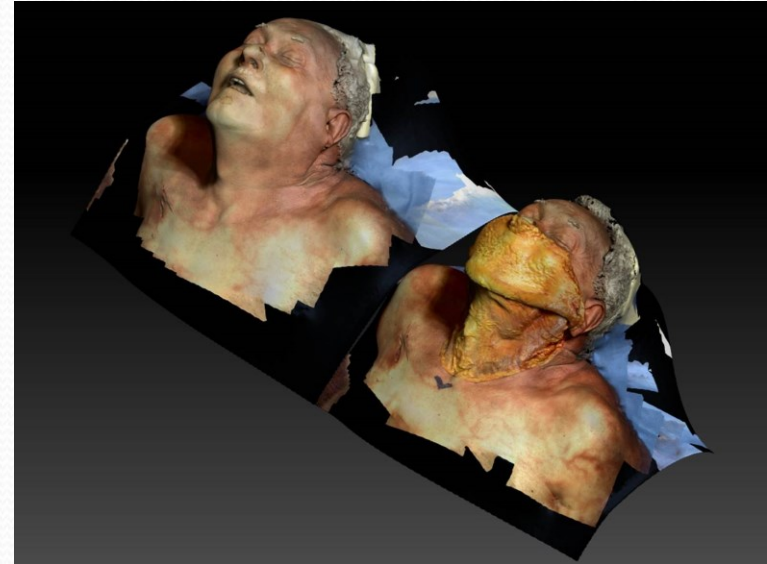
MATERIAL AND METHODS

- Scanning of each level using a topographical 3D laser scanner (Artec Spider™, Artec Group Luxembourg)
 - Geometrical accuracy 0.05 mm
 - High definition color discrimination
 - No need for markers



RESULTATS

- Acquisitions processing (Artec Studio 9.2.software)
- Superposition of the 8 resulting 3D color meshes
- Creation of an accurate and thorough 4D (3D+time) environment
- Possibility to add virtual selection and dissection tools
→real interactive training tool
- <https://skfb.ly/DsuK>



CONCLUSION

- Ability to repeat and record the training sessions
- Knowledge evaluation
- Assessment of the learning curve
- For surgery residents: evaluation of their surgical skills before getting to train on real cadavers
 - Cadavers sparing
 - Maximum security for patients

