EXTRACAPSULAR EXTENSION ON NEUROVASCULAR BUNDLES DURING ROBOT-ASSISTED RADICAL PROSTATECTOMY PRECISELY LOCALIZED BY 3D AUTOMATIC AUGMENTED-REALITY RENDERING

Porpiglia F., Checcucci E., Amparore D., Piana A., Piramide F., Volpi G., De Cillis S., Manfredi M., Fiori C., Piazzolla P., Vezzetti E.

Precision Surgery era

Nowadays, in uro-oncological surgical procedures, **functional** and **oncological outcomes** are equally important.

New technologies have allowed to pursue these two objectives **personalizing surgical interventions**

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the Journal of Cancer Surgery

EJSO xx (2017) 1–16

www.ejso.com

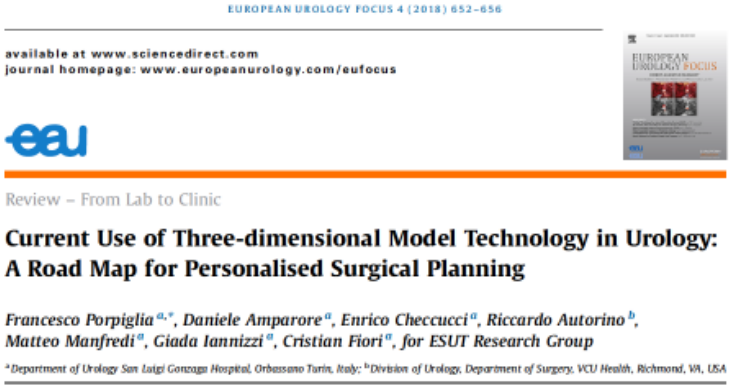
Precision surgery and genitourinary cancers

R. Autorino [a,*], F. Porpiglia [b], P. Dasgupta [c], J. Rassweiler [d], J.W. Catto [e], L.J. Hampton [f], E. Lima [g], V. Mirone [h], I.H. Derweesh [i], F.M.J. Debruyne [j]

Limits of 2D imaging

Standard 2D imaging remains the basis for **preoperative planning** and **intraoperative decision making**, but requires an important ”building in mind” process.

3D reconstructions allow to overcome this limitation.



EUROPEAN UROLOGY FOCUS 4 (2018) 652–656

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Review – From Lab to Clinic

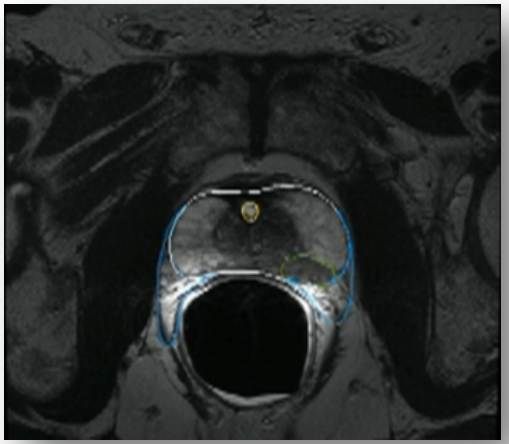
Current Use of Three-dimensional Model Technology in Urology: A Road Map for Personalised Surgical Planning

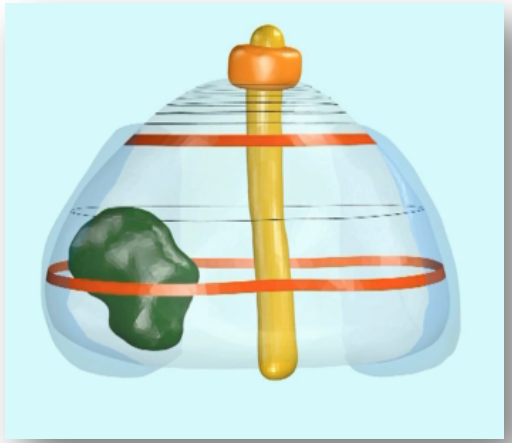
Francesco Porpiglia[a,], Daniele Amparore[a], Enrico Checcucci[a], Riccardo Autorino[b], Matteo Manfredi[a], Giada Iannizzi[a], Cristian Fiori[a], for ESUT Research Group*

[a]Department of Urology San Luigi Gonzaga Hospital, Orbassano Turin, Italy; [b]Division of Urology, Department of Surgery, VCU Health, Richmond, VA, USA

3D virtual models

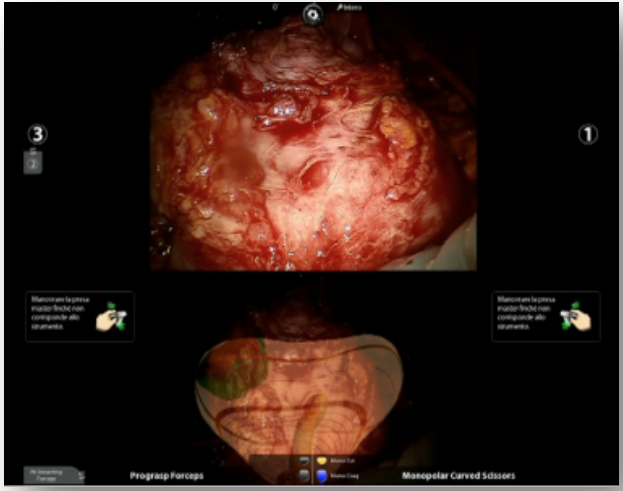
From standard 2D imaging, thanks to dedicated software, it's possible to obtain **3D virtual models**





3D rigid virtual models

- In these models **organs were reproduced in the same position of the pre-operative imaging**
- These virtual **models can be overlapped** to the endoscopic view during the surgical procedure
- They can only be used during **static phases of the procedure**



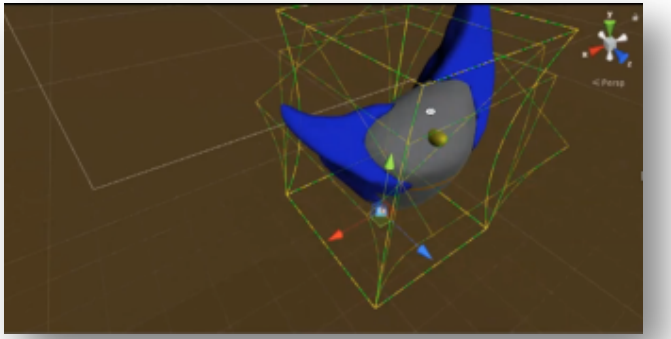
Augmented-reality robot-assisted radical prostatectomy using hyper-accuracy three-dimensional reconstruction (HA3D™) technology: a radiological and pathological study

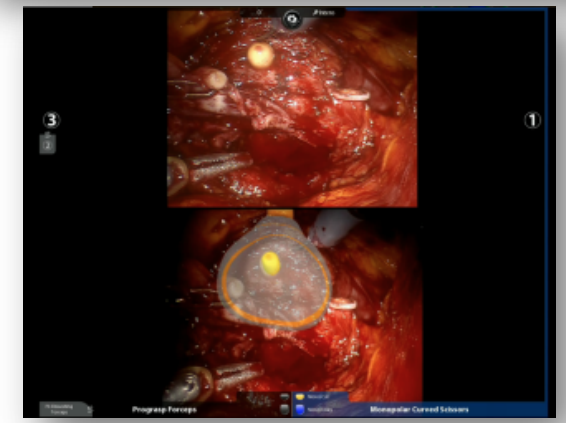
Francesco Porpiglia*, Enrico Checcucci*, Daniele Amparore*, Riccardo Autorino*, Alberto Piana*, Andrea Bellin*, Pietro Piazzolla*, Federica Massa‡, Enrico Bollito‡, Dario Gned§, Agostino De Pascale§ and Cristian Fiori*

3D elastic virtual models

- In order to **simulate tissue's deformation** during surgical procedures different software and engineering approaches were proposed

- Among the different techniques available we chose **non-linear parametric deformations** and we applied it to our rigid 3D models





Platinum Priority – Surgery in Motion
Editorial by XXX on pp. x–y of this issue

Three-dimensional Elastic Augmented-reality Robot-assisted Radical Prostatectomy Using Hyperaccuracy Three-dimensional Reconstruction Technology: A Step Further in the Identification of Capsular Involvement

Francesco Porpiglia [a,], Enrico Checcucci [a], Daniele Amparore [a], Matteo Manfredi [a], Federica Massa [b], Pietro Piazzolla [a], Diego Manfrin [a], Alberto Piana [a], Daniele Tota [b], Enrico Bollito [b], Cristian Fiori [a]*

Limit of rigid and elastic models

- The entire **overlap process** is **operator dependent**
- The virtual images are manually superimposed to the real organs thanks to a **3D mouse**

3D virtual models & prostate surgery

- Better identification of **tumour's location**
- The potential **involvement of the capsule** is clearly visible
- Intraoperative tailoring of the **nerve sparing strategy**

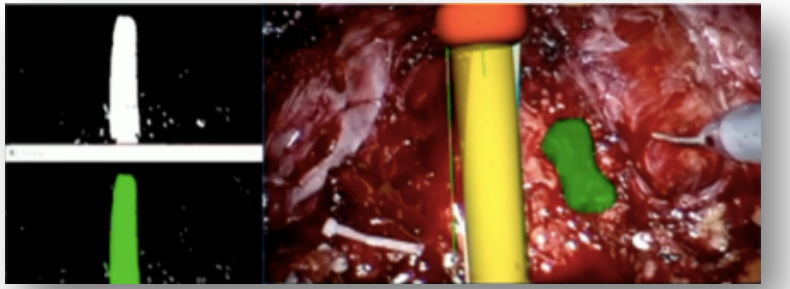
Automatic AR system

- **Aim of our study:** evaluate the accuracy of our new **Automatic AR system** in order to identify the tumour **extracapsular extension** at the level of preserved **neurovascular bundles**

- **Population:** **10 patients** with positive target biopsy performed on an index lesion with **suspicious ECE**

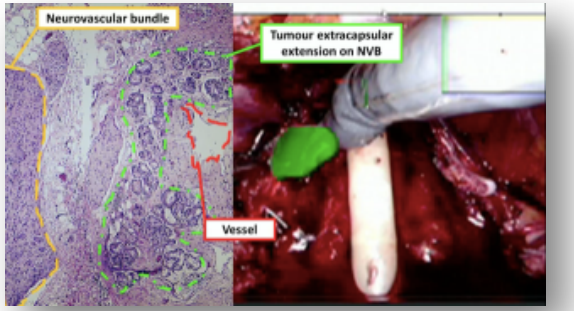
Automatic AR system

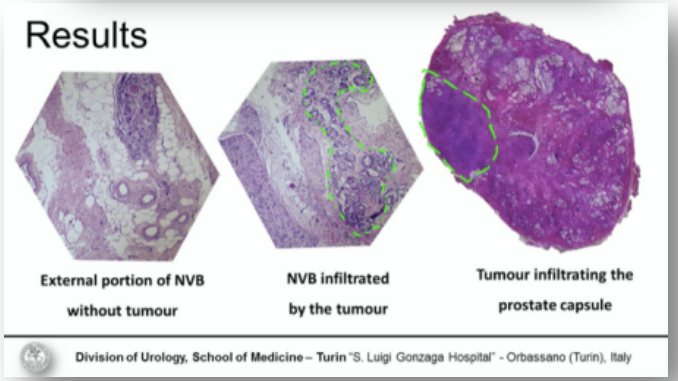
- We developed a new AR software able to **automatically identify the catheter**, overlapping automatically the 3D virtual model to the real anatomy
- A **metallic clip** was placed at the level of **suspected ECE** as indicated by the virtual images
- Finally, the **entire NVBs** with suspicious ECE were removed for pathological examination.



Results

- In **8 cases** the final pathology confirmed the **presence of ECE**
- The **presence of ECE** at the level of **metallic clip** was recorded in **100% of the cases**
- Microscopic evaluation confirmed the **cancer presence in all the cases** and revealed a mean length of **ECE of 4 mm**





Conclusions

- Our AR platform based on computer vision algorithm allows an **effective Automatic AR RARP**
- The 3D virtual images, automatically anchored to the catheter, are able to **correctly identify the location of ECE at the level of NVBs**
- This tool might be useful to **tailor the procedure** and the **nerve sparing strategy**