

Improvements in iPad-assisted renal surgery

Optimised software, patient setting, and intraoperative use of iPad



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The first clinical experiences with iPad-assisted puncturing of the collecting system prior to a percutaneous nephrolithotripsy were described by Rassweiler et al. in 2012.¹

To puncture the collecting system, we placed radiopaque markers from the radiotherapy on the patients' skin around the kidney. A preoperative multi-slice CT with a low dose and a late-contrast phase was taken in prone position on a specific PCNL-cushion, as it is used during surgery. The markers – as well as all needed organs such as kidney, stone, bowel, liver etc. – are segmented with the MITK (medical interactive tool kit) software.

For the surgery the patient is placed in the same position as for the CT and the radiopaque marker are replaced with coloured markers in two rows. The iPad is used as a camera, computer, and display to transfer the data to a central server or laptop connected to Wi-Fi. The puncture is then performed by using 2D-digital fluoroscopy as a real-time imaging mode.

In the last year we worked on many different facts to improve this new puncturing technique. Not only the software, but also the patient setting and the intraoperative use of the iPad was optimised. The computer scientists of the DKFZ (German Cancer Research Centre) improved the MITK software so that an easy, fast, and intuitive segmentation and navigation is possible. There is no need of a computer scientist during the procedure or the preoperative preparations.

Another improvement could be done according to the coloured markers. At the beginning we needed pellets, which were difficult for sterilisation. Then we put coloured, round stickers on the radiopaque markers. After evaluation, blue and yellow proved to be the best colours because they do not interfere with the colours in the operating room, such as green (cover), red (blood) or orange (human skin).

Next, we reduced the size of the markers from a 24 to a 12 mm calibre. To show the virtual reality directly on the patient, the iPad has to be held over the patient's body to visualise the coloured markers. First we needed an assistant to hold the iPad, then we used an

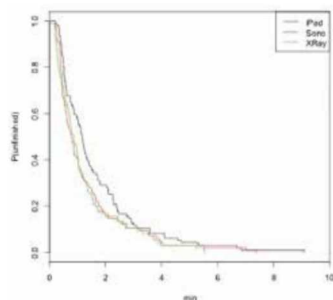


Fig. 4: Puncture time for iPad, ultrasound (sono) and fluoroscopy (XRay) guided punctures

iPad holder, which could be attached to the operating table and guaranteed single-surgeon use.

One of the major problems at the initial clinical cases seemed to be the light source in the operating room. If the light was not focused on the markers or it was too dark in the endourological operating room, the markers and colours could not be detected to show the kidney in the right way. To solve this problem, we used a LED-light at the back-face of iPad to guarantee optical visibility of all markers (Figure 1).

"A clinical study comparing iPad-assisted versus standard fluoroscopy-guided puncture of the renal pelvis has been started to show the benefit of this technique in cases with complex nephrolithiasis."

Based on experimental studies using an ex-vivo model with porcine kidneys embedded in ballistic gel (Figure 2 and 3), we tested the feasibility of this new technique focussing on success, puncture time, and radiation exposure compared to fluoroscopy and

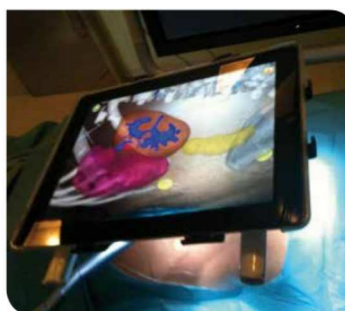


Fig. 1: iPad with LED-lights

ultrasound guidance. Five trainees and three experienced endourologists performed 12 punctures per technique. All together, the ultrasound-guided punctures were 30% faster than the iPad, which shows the perfect use of the gel model for ultrasound. X-ray was 36% faster than the iPad puncture.

The in-vitro study showed significantly longer times for experts to puncture the collecting system compared to ultrasound or fluoroscopy, whereas trainees significantly benefited from use of iPad with reduction of radiation exposure. The median puncture time for ultrasound, X-ray, and iPad was 0.45 min, 0.79 min, and 1.16 min respectively (Figure 4).

A clinical study comparing iPad-assisted versus standard fluoroscopy-guided puncture of the renal pelvis has been started to show the benefit of this technique in cases with complex nephrolithiasis. So far, in 11 of 17 cases, the collecting system was entered in a single attempt (average 1.5), with radiation exposure of 377.5 mGym².

Future improvements should focus on the needle tracking for precise and direct punctures. Otherwise the puncture planning with the software and the preoperative CT should be optimised. Most importantly the software has to be stabilised to guarantee good visualisation and navigation irrespectively of the OR setting or the light source.



Fig. 2: Ballistic gel ex vivo model



Fig. 3: Projection of the kidney on the ballistic model with the iPad

References:

- Rassweiler J et al Eur Urol. 2012 Mar; 61 (3): 628-31
- Müller M et al Int J Comput Assist Radiol Surg 2013 Jul; 8 (4): 663-75

Previous tool	Improvement
24 mm Marker (calibre)	12 mm Marker (calibre)
No light source	LED lights
Assistant to hold the iPad	iPAD holder
Computer scientist to use the software MITK	Trained urologist to use the software MITK
2D segmentation	3D segmentation
Stationary computer	High end laptop

Table 1: Improvements of the iPad guided puncture



EAU Section of Uro-Technology (ESUT)

Introducing Europa Uomo's 'Call to Action' on prostate cancer

An interview with Dr. Erik Briens, Europa Uomo Secretary

By Loek Keizer

The European Prostate Cancer Awareness Day (EPAD) information sessions at the European Parliament placed a clear emphasis on the concerns of patients. The session was hosted by Ms. Nessa Childers, MEP and featured EAU expert speakers and representatives from the patient organisation of Europa Uomo. We spoke to Europa Uomo's Secretary, Dr. Erik Briens (Hasselt, BE).

"We're grateful to have Ms. Childers host us today. She has hosted us on previous occasions, and has a great interest in promoting healthcare issues in Europe."

Healthcare is certainly of great concern to many members of the European parliament: there are still large gaps in care and mortality across the EU."

White paper

The EPAD session was a chance to present Europa Uomo's recent white paper on PCa, a "Call to Action" to improve care for patients across Europe. Dr. Briens: "Mortality remains high. We need to raise awareness of what the prostate is, and what can go wrong. We also need to identify patients at an early stage, when treatment can still be effective. Our white paper is for everyone, but today it mainly addresses policy makers. It's a document with a long shelf-life, that can be update with new data."

Dr. Briens was pleased with the morning's event: "I think today went well. We're going to send the documents to every MEP, so that they can read it at their own convenience. We want to emphasise that prostate cancer can be treated when it is identified sufficiently early. Not everybody has to be treated, we certainly don't want over-treatment, but you shouldn't demonise certain diagnostic processes."

"A biopsy is not pleasant and it can cause complications, but it's a crucial part of diagnosing a patient. But simply ignoring prostate cancer until it starts to cause symptoms means that the cancer can metastasize and by then it's too late. It becomes a case of palliative care."

The EAU and Europa Uomo

Dr. Briens on collaboration with the EAU: "The EAU statement, as presented by Prof Abrahamsson (see elsewhere) matches Europa Uomo's goals more closely now, calling for "intelligent use of PSA." A better policy starts with a better-informed patient."

"The EAU supports Europa Uomo as a patient organisation. We are supported by a grant, by its clinical trials, and its expert advice. We translate that to patients' needs. We represent patients' interests and we need to point out when some treatments are premature or too expensive."



Dr. Briens (R) and the panel of Europa Uomo and EAU experts at the EPAD.

Read the full "Call to Action" on the Europa Uomo website: <http://www.europa-uomo.org/>