Project Title

Development of A Pseudo TPUS* Probe to Improve Consistency of Patient Positioning During MRI

**TPUS: Transperineal Ultrasound*

Project Lead and Members

- EPP Pang
- YK Lim
- KSK Heng
- CH Tan
- YA Lin
- JWS Chan
- GK Low
- JKL Tuan

Organisation(s) Involved

National Cancer Centre Singapore, SingHealth Duke NUS Institute

Healthcare Family Group(s) Involved in this Project

Allied Health, Medical

Applicable Specialty or Discipline

Diagnostic Radiography, Radiotherapy

Aim(s)

- Aim to develop an MRI compatible pseudo TPUS probe to reproduce patient position during MRI to facilitate image fusion and prostate gland contouring during treatment planning.

Background

See poster appended/ below

Methods

See poster appended/ below

Results

See poster appended/ below

Conclusion

See poster appended/ below

Additional Information

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Project Category

Technology

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Keywords

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Name and Email of Project Contact Person(s)

Name: Pang Pei Ping Eric

Email: singaporehealthcaremanagement@singhealth.com.sg

Development of a pseudo-TPUS probe to improve consistency of patient positioning during MRI

EPP Pang[1], YK Lim[2], KSK Heng[2], CH Tan[3], YA Lin[3], JWS Chan[1], GK Low[1], JKL Tuan[1]

[1]National Cancer Centre Singapore, Division of Radiation Oncology,
[2]SingHealth Duke-NUS Institute for Patient Safety & Quality;
[3]National Cancer Centre Singapore, Department of Oncologic Imaging, Singapore

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National Cancer Centre Singapore SingHealth

SingHealth DukeNUS Academic Medical Centre Institute for Patient Safety & Quality

Introduction

Locally, patients undergoing prostate radiotherapy are monitored for prostate displacement using an autoscan 4D transperineal ultrasound (TPUS) probe during treatment. However, the existing TPUS probe and autoscan probe kit (ASPK) are not MRI-compatible due to use of metal components (Figure 1).

This project aims to develop an MRI-compatible pseudo TPUS probe to reproduce patient position during MRI to facilitate image fusion and prostate gland contouring during treatment planning.

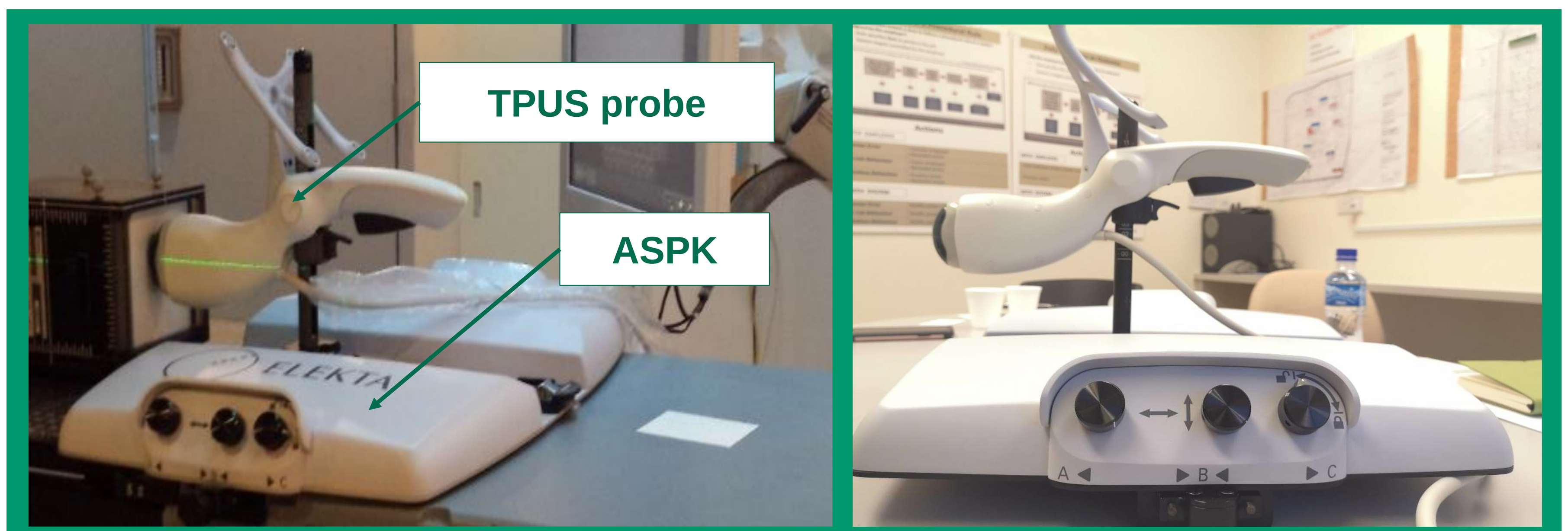


Figure 1: Illustration of a commercial TPUS probe (non-MRI compatible) and ASPK setup in treatment room.

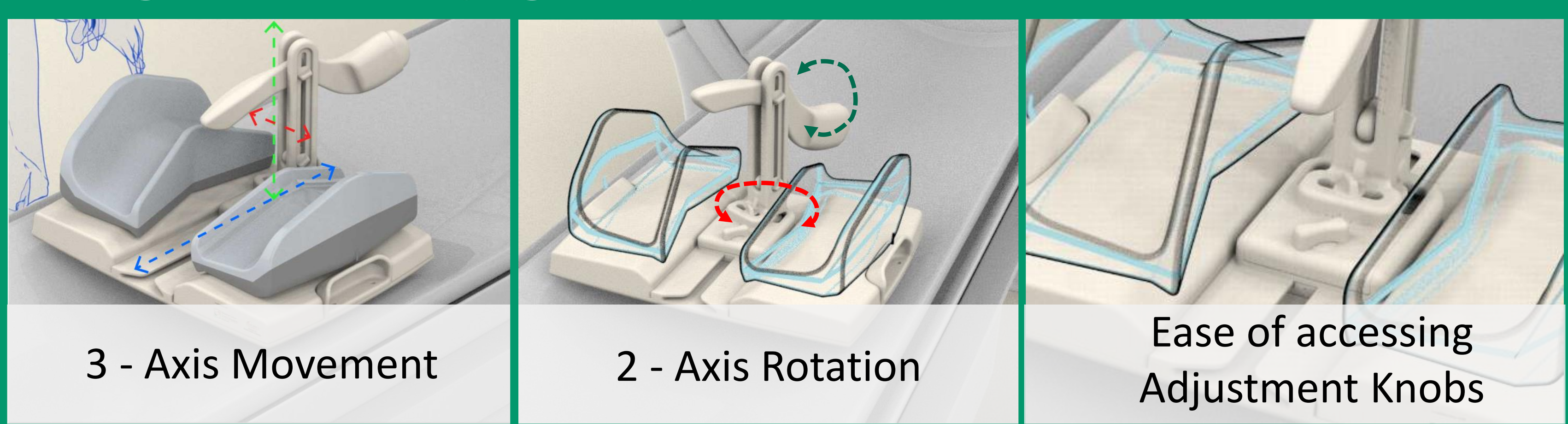
Methodology

The MRI-safe pseudo probe and ASPK were designed and produced in components with certain parts required to provide mechanical functions for angulation and height adjustments with similar accuracy to the existing probe used during treatment (Figure 2). The components used are MRI-safe materials and can be disassembled for cleaning and disinfection.

Materials and production considerations:

1. No magnetic field interference
2. Material: High rigidity, strain resistance, waterproof, heat and chemically resistant
3. Production: High accuracy, high precision, extreme low deformation rate and smooth surface finishing.

Design Features (Figure 2)



The unique assembly feature offers easy disassembly of parts for **cleaning and disinfection.** The distinctive well-sized knob design and placements allow staff to make quick adjustments when needed.

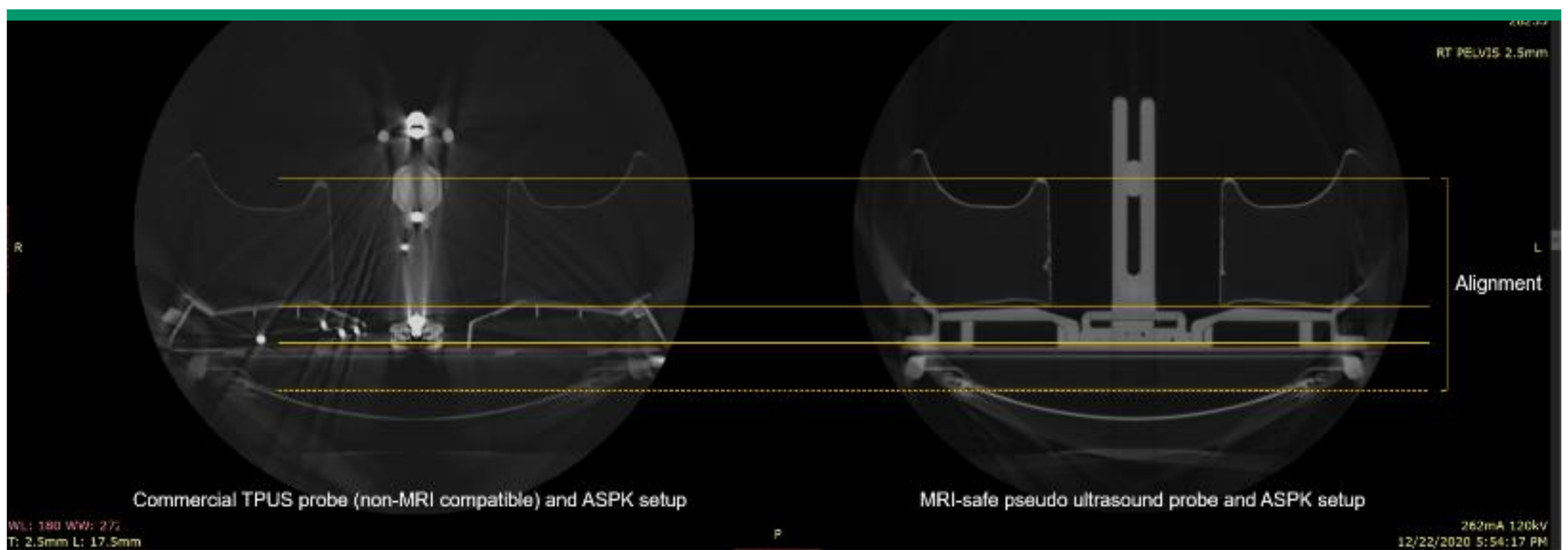


Figure 3: CT scan of final device vs commercial TPUS probe setup (Material passed MRI image test, accuracy and precision in dimension)

Results

Shortlisted various materials and subjected them to a series of studies and evaluations. Eventually, Acrylonitrile butadiene styrene (ABS) material was selected and passed both the image test and metal detector test.

- Test scans performed on the MRI scanner were found to be safe and artefact-free for target used cases (Figure 3).
- Figure 4 illustrates the positioning consistency during CT/TPUS/MRI image fusion.

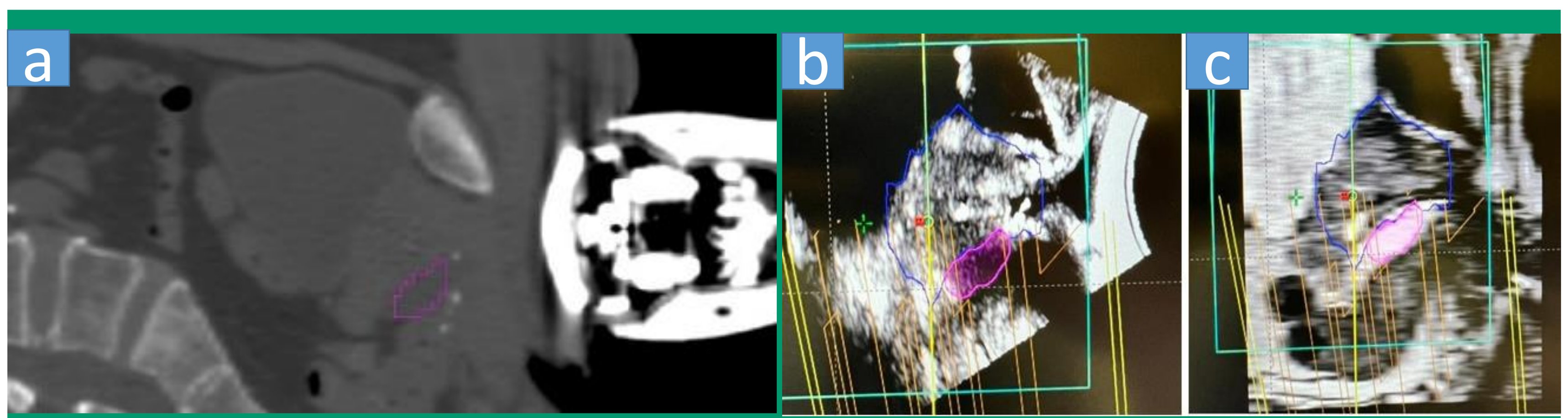
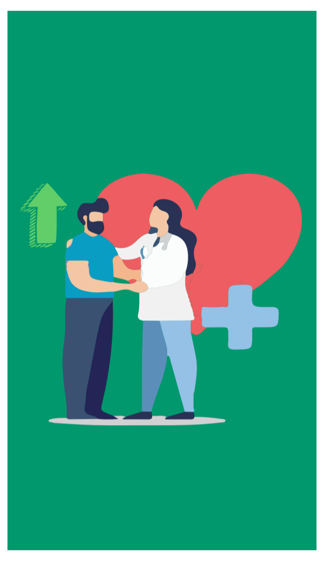
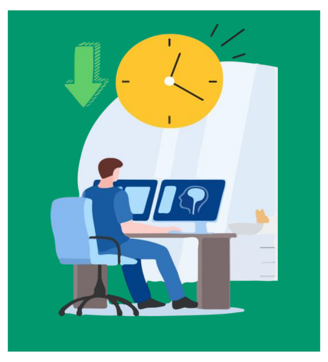


Figure 4: Sagittal views to illustrate consistency of patient positioning during CT/TPUS (a & b) and MRI (c) (Magenta contour: hydrogel spacer).



Improving patient's operation outcome: Quality of image fusions and consequently the accuracy of target delineation and treatment delivery will be improved. Eventually, enabling future prostate patients to be scanned in the same treatment position to facilitate image fusion for contouring and subsequent tracking of intra-fraction prostate motion during treatment delivery. With potential benefit to reduce radiation-induced toxicity and related treatment costs – radiation proctitis etc.

Reducing operation cost: In terms of scalability, this allows further development during proton beam therapy or before MRI linacs become mainstream. This project knowledge and potential contributions may also catalyse applications and support development of other probes/anatomical sites (pancreas/liver).



Potential optimising manpower operation requirements: The improved consistency of patient positioning during MRI scans to facilitate image fusion for contouring during radiotherapy treatment planning will potentially help reducing original overall operation time and improved manpower.

Conclusion

The MRI-safe pseudo ultrasound probe provides an improved consistency of patient positioning during MRI, addressing the clinical needs on reproducing the treatment positioning during MRI scan (Figure 5).

Moving forward, the effectiveness of this gadget on the reproducibility of patient position during MRI will be assessed in this novel clinical workflow for prostate cancer patients that can also be used for patient education to improve compliance during setup.

Figure 5. Development processes of the Final Prototype