



Development of Infrared marker for Thermoplastic immobilization tool

Yong-Jin Kim¹, Tae-Ho Kim² and Tae- Suk Suh¹

¹Department of Biomedicine & Health Sciences and Research Institute of Biomedical Engineering, College of Medicine, The Catholic University of Korea, Seoul, 06591, Republic of Korea
²Proton Therapy Center National Cancer Center, Republic of Korea

Introduction

- ❖ In radiation therapy, high dose fractions delivered over a short period of time have more potent biological effect than expected for the same total dose delivered through conventional fractionation. However, such dose intensification can also substantially increase the risk of normal tissue toxicities. Therefore, accurate patient setup and patient position maintenance became more important.
- ❖ The immobilization tool is one of the widely used methods for preventing patient positions errors. Especially, thermoplastic immobilization tool has been used as an immobilization tool in various sites (head and neck, thorax, abdomen, etc.) and has proven its clinical usefulness.
- ❖ However, When using thermoplastic as an immobilization tool, there is a problem that it is difficult to monitor the surface of the patient when using conventional real-time monitoring equipment, especially optical based monitoring equipment (e.g. RPM, AlignRT, ExacTrac). Therefore, we want to develop IR marker for thermoplastic to enable real-time monitoring of the patient's surface movement even if thermoplastic is used as an immobilization tool.

Aim and Objectives

- ❖ The purpose of this study is to develop the IR marker for thermoplastic immobilization tool that can detect the movement of the patient surface inside the thermoplastic immobilization tool by using 3D printing technique.

Materials and Methods

A. 3D modeling

- Modeling of IR maker was performed using 3D modeling software called Fusion 360.
- The structure of the IR marker was consisting of (1) spherical marker, (2) cylindrical marker posts to be attached to the skin, and (3) a disk-shaped marker base between a spherical marker and cylindrical marker posts.

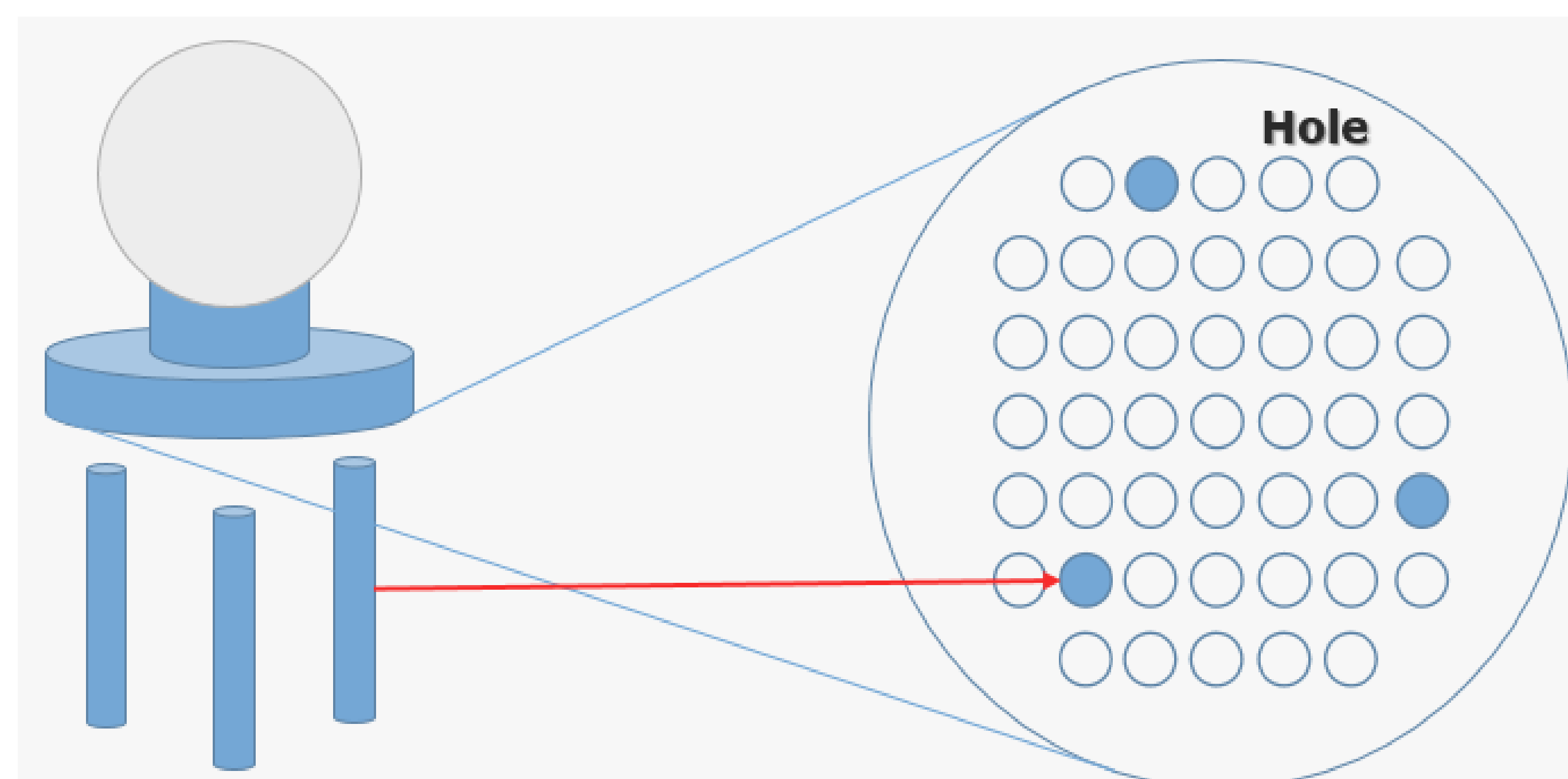


Figure 1. Diagram of IR marker for thermoplastic immobilization tool

- The disk-shaped marker base has a number of holes to be combined with the cylindrical marker posts. This design of disk-shaped marker base is to free position of the cylindrical marker posts so that there is no interference when placing the IR marker on the surface on the body.

- The modeled IR marker is converted to STereoLithography (STL) file and output to the 3D printer.

B. Application

- Whether there is interference with the thermoplastic immobilization tool was confirmed by placing the IR marker on the back of the hand.
- The IR marker was attached to the skin using double-sided medical adhesive tape.

Results

A. Infrared (IR) marker

- IR marker for thermoplastic was developed to detect patient surface movement in thermoplastic immobilization tool.
- The IR marker was modeled using 3D modeling software and the structure was printed using a 3D Printer. This IR marker was designed to be freely placed on the immobilization tool without interference.

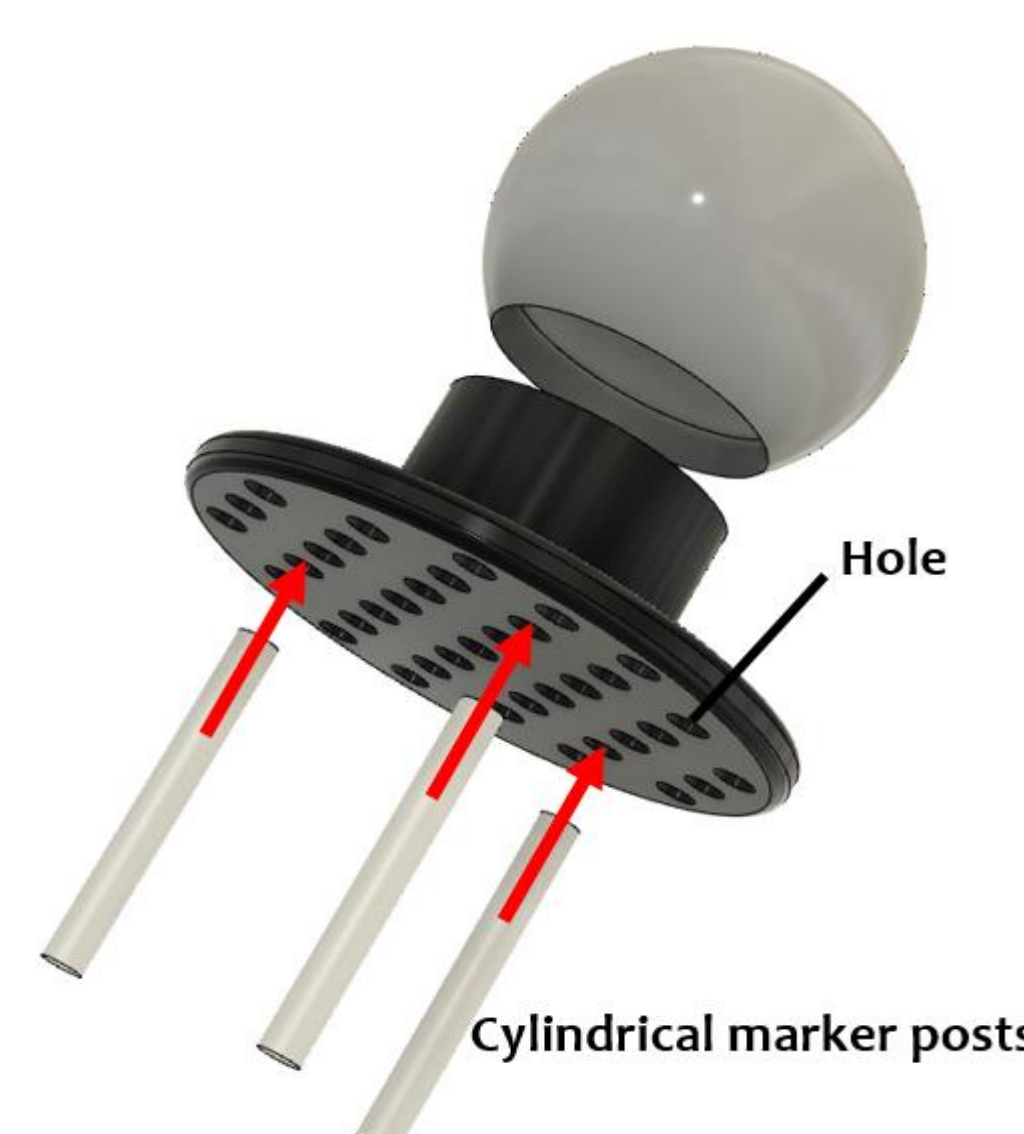


Figure 2. Design of IR marker that can be placed without interference on the immobilization tool



Figure 3. IR marker for thermoplastic immobilization tool

B. Application

- We confirmed that it is well located on thermoplastic immobilization tool without any other problems.

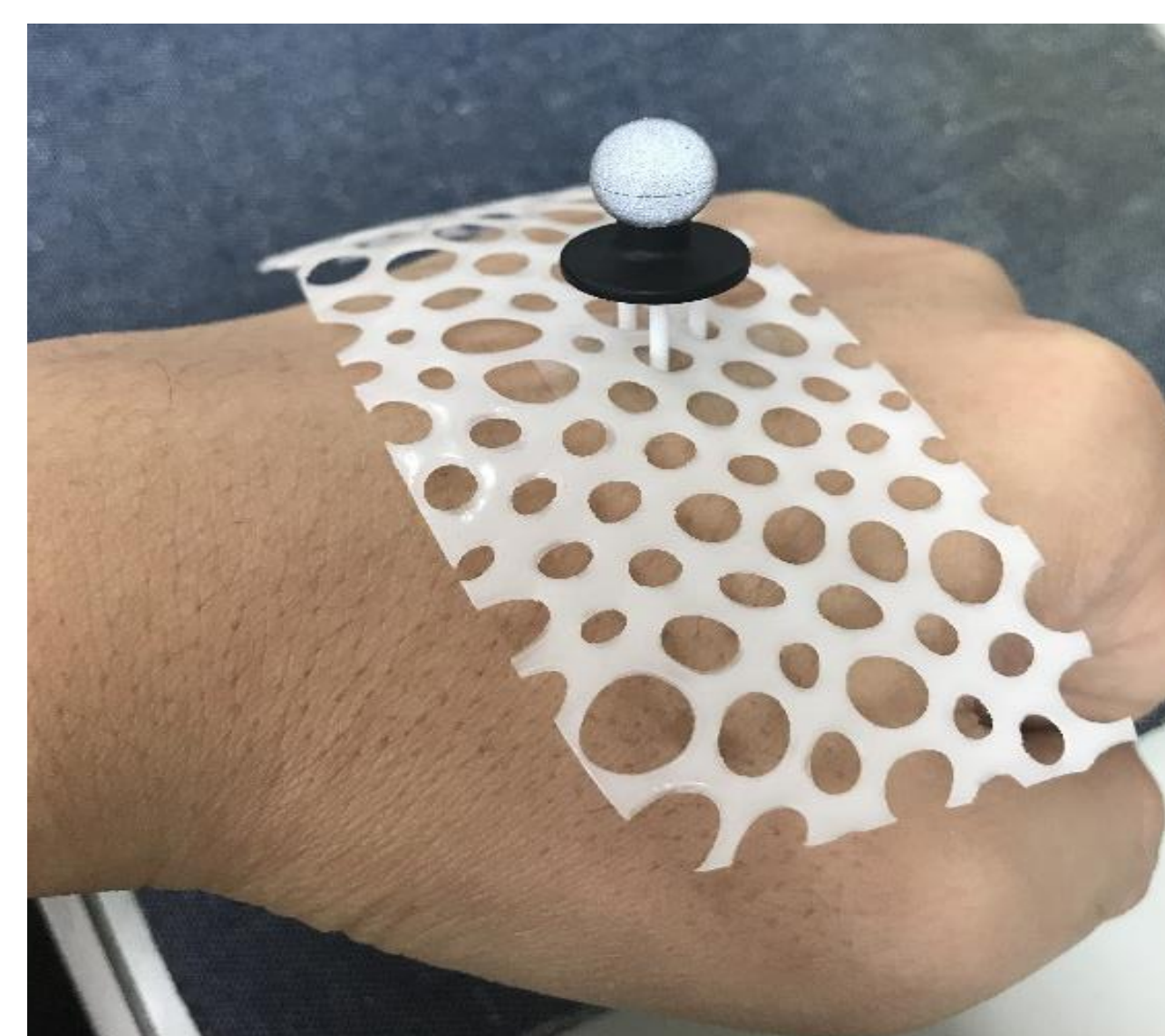


Figure 4. IR marker attached to the skin surface with thermoplastic immobilization tool

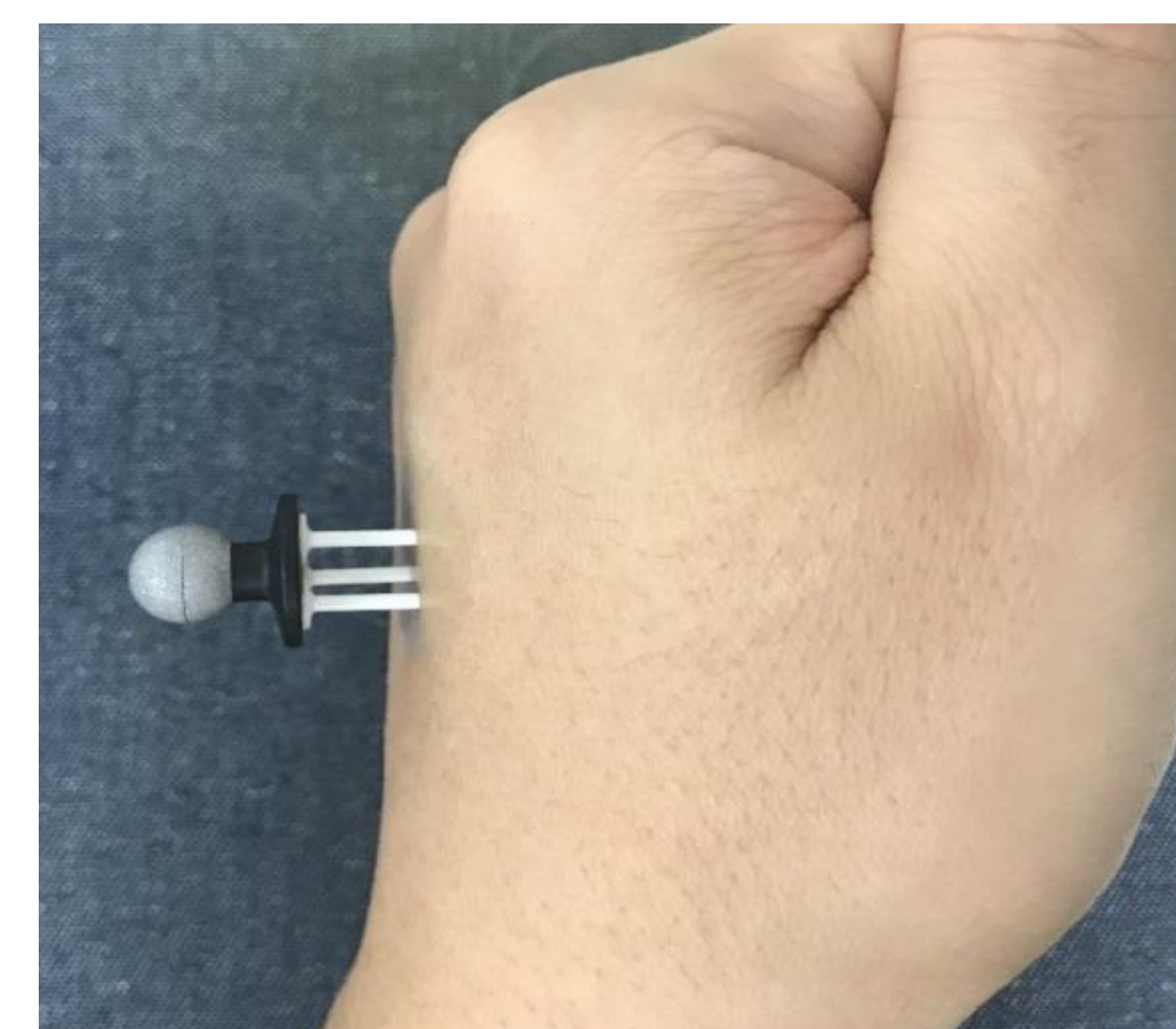


Figure 5. IR marker attached to the skin surface using double-sided medical adhesive tape

- We confirmed that it is well located on thermoplastic immobilization tool without any other problems.

Conclusion

- ❖ We have developed IR marker for thermoplastic immobilization tool and the IR marker was confirmed to be suitable for our purpose. Further study, we will verify with the stereo vision that the developed IR marker detects movement of the patient surface.

✉ Contact : deseitn@catholic.ac.kr