ACCURACY OF CUP ALIGNMENT USING A MODULAR MECHANICAL NAVIGATION GUIDE BASED ON PATIENT-SPECIFIC THREE-DIMENSIONAL CT IMAGING

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INTRODUCTION

Previous studies have reported that the satisfactory accuracy of cup alignment using mechanical navigation guide in collaboration with three-dimensional (3D) preoperative planning software for THA (Steppacher 2011) (Nakasone 2014) (Inoue 2015). However, its use has not been widely adopted in Japan because of paid license for use. We developed a modular mechanical navigation guide by attaching some modular components to acetabular socket guide for free license (Fig 1.). The purpose of this study was to compare the accuracy of cup alignment between using free-license modular mechanical navigation guide and conventional mechanical navigation guide.

PATIENTS AND METHODS

We compared the accuracy of cup alignment using a modular mechanical navigation guide (study group) (Fig.2) and conventional mechanical navigation guide (control group) (Fig.3) for THA through a direct anterior approach with supine position. In the study group, 16 hip of 16 patients who underwent THA were examined. In the control group, 29 hip of 26 patients were examined.

A modular mechanical navigation guide was consist of the body, three modular adjustable arms and alignment indicator, which can attach the measure on the body for imput the distance of the line passing the point of bilateral anterior superior iliac spine (ASIS) by 3D planning software (Fig 2). On the other hand, conventional mechanical navigation guide were elaborate and simple instrument (Fig. 3).

The both instruments is adjusted for each patient based on patient-specific anatomical pelvic plane (APP) from the 3D-CT imaging. There are three differences between the mechanical navigation guide and conventional navigation guide, length measurement method by manually or automatically, cup alignment guide were indicated by anatomical definition or radiographic definition and use for free licence or paid licence.

To determine the accuracy of cup inclination or anteversion angles, the preoperative planning were compared with postoperative measured values using a validated 3D/ 3D matching method.

RESULTS

In the study group, the mean cup inclination and anteversion angles were 38.9°± 2.9 (SD) (range, 32.0°-42.3°) and 17.7°± 4.0(SD) (range, 10.4 °- 22.8°), respectively. In the control group, the mean cup inclination and anteversion angles were 40.7°± 3.0 (SD) (range, 32.9°-46.6°) and 17.2°± (SD) (range, 3.8 °- 24.4°), respectively.

There were no significant differences in the absolute error for inclination angle between the study and control group (1.7°±2.1 versus 2.4°±2.1, P＝0.14). Nor were there any significant differences in the error for anteversion angle (3.9°±3.0 versus 2.9°±2.0, P=0.09).

DISCUSSION

The accuracy of cup alignment for the modular mechanical navigation guide was no difference compared with conventional mechanical navigation guide.

The modular mechanical navigation guide for free license was a useful patients specific instruments, although it was a little complicated due to measure the parameters manually and be skilled with method for three dimensional preoperative planning.

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DISCLOSURES

Author and co-authors have no COI.

Fig.1 Acetabular socket guide

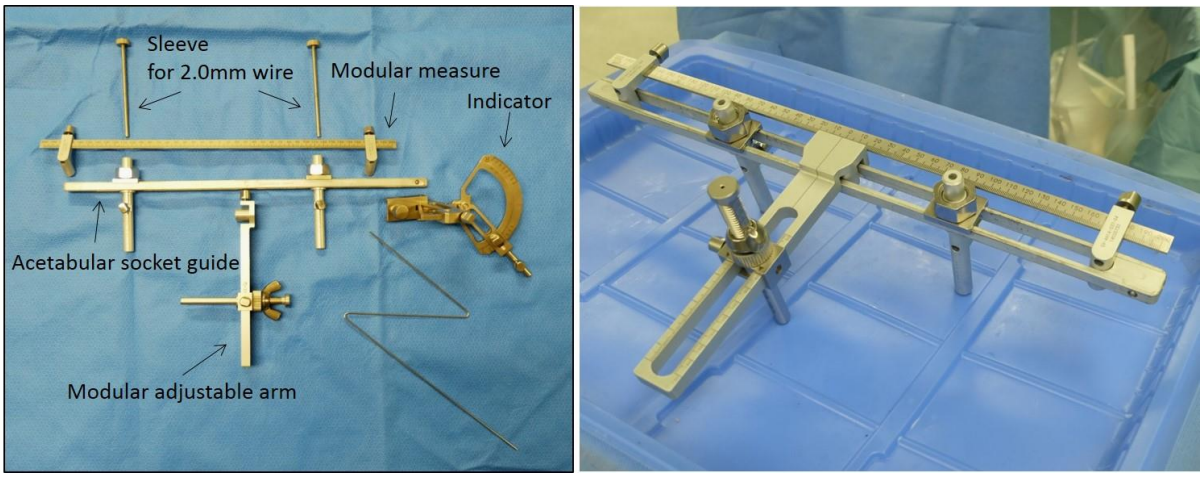

Fig.2 Modular mechanical navigation guide

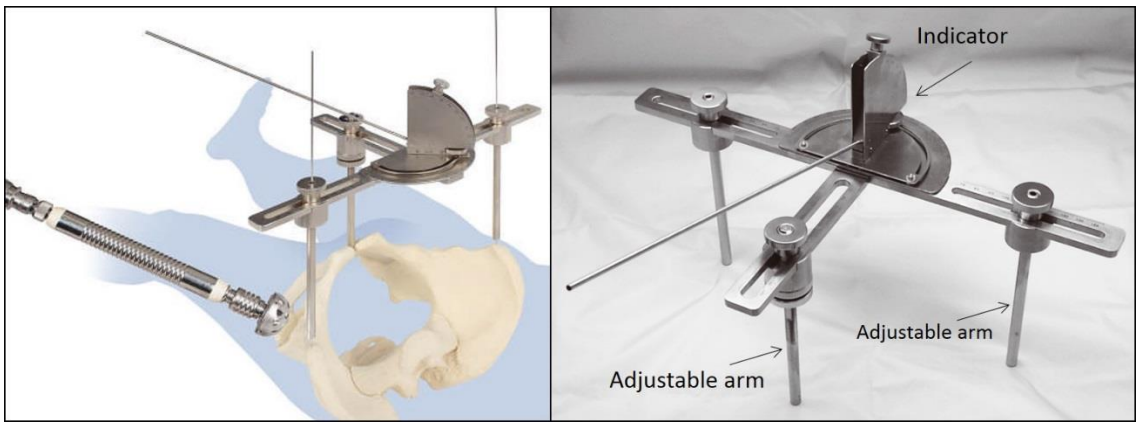

Fig.3 Conventional mechanical navigation guide (Hip COMPASS®, Lexi, Tokyo)

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