

Comparison of robotic-assisted and conventional acetabular cup placement in THA: a matched-pair controlled study

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Background

Improper acetabular component orientation in THA has been associated with increased dislocation rates, component impingement, bearing surface wear, and a greater likelihood of revision. Therefore, any reasonable steps to improve acetabular component orientation should be considered and explored.

Questions/purposes

This study sought to compare THA with a robotic-assisted posterior approach with manual alignment techniques through a posterior approach, using a matched-pair controlled study design, to assess whether the use of the robotic system made it more likely for the acetabular cup to be positioned in the safe zones described by Lewinnek et al. and Callanan et al.

Methods

Between September 2008 and September 2012, 160 THAs were performed by the senior surgeon. Sixty two patients (38.8%) underwent THA using a conventional posterior approach, 69 (43.1%) underwent robotic-assisted THA using the posterior approach, and 29 (18.1%) underwent radiographic-guided anterior-approach THAs. From September 2008 to June 2011, all patients were offered anterior or posterior approaches regardless of BMI and anatomy. Since introduction of the robot in June 2011, all THAs were performed using the robotic technique through the posterior approach, unless a patient specifically requested otherwise. The radiographic cup positioning of the robotic-assisted THAs was compared with a matched pair control group of conventional THAs performed by the same surgeon through the same posterior approach. The safe zone (inclination, 30° – 50°; anteversion, 5° – 25°) described by Lewinnek et al. and the modified safe zone (inclination, 30° – 45°; anteversion, 5° – 25°) of Callanan et al. were used for cup placement assessment. Matching criteria were gender, age ± 5 years, and (BMI) ± 7 units. After exclusions, a total of 50 THAs were included in each group. Strong intraobserver and inter-observer correlations were found for all radiographic measurements ($r > 0.82$; $p < 0.001$).

Results

One hundred percent (50/50) of the robotic-assisted THAs were within the safe zone described by Lewinnek et al. compared with 80% (40/50) of the conventional THAs ($p = 0.001$). Ninety-two percent (46/50) of robotic-assisted THAs were within the modified safe zone described by Callanan et al. compared with 62% (31/50) of conventional THAs ($p = 0.001$). The odds ratios for an implanted cup out of the safe zones of Lewinnek et al. and Callanan et al. were zero and 0.142, respectively (95% CI, 0.044, 0.457).

Conclusions

Use of the robotic system allowed for improvement in placement of the cup in both safe zones, an important parameter that plays a significant role in long-term success of THA. However, whether the radiographic improvements observed will translate into reductions in component impingement, acetabular wear, and prosthetic dislocations, or in terms of improved longevity-remains unproven.

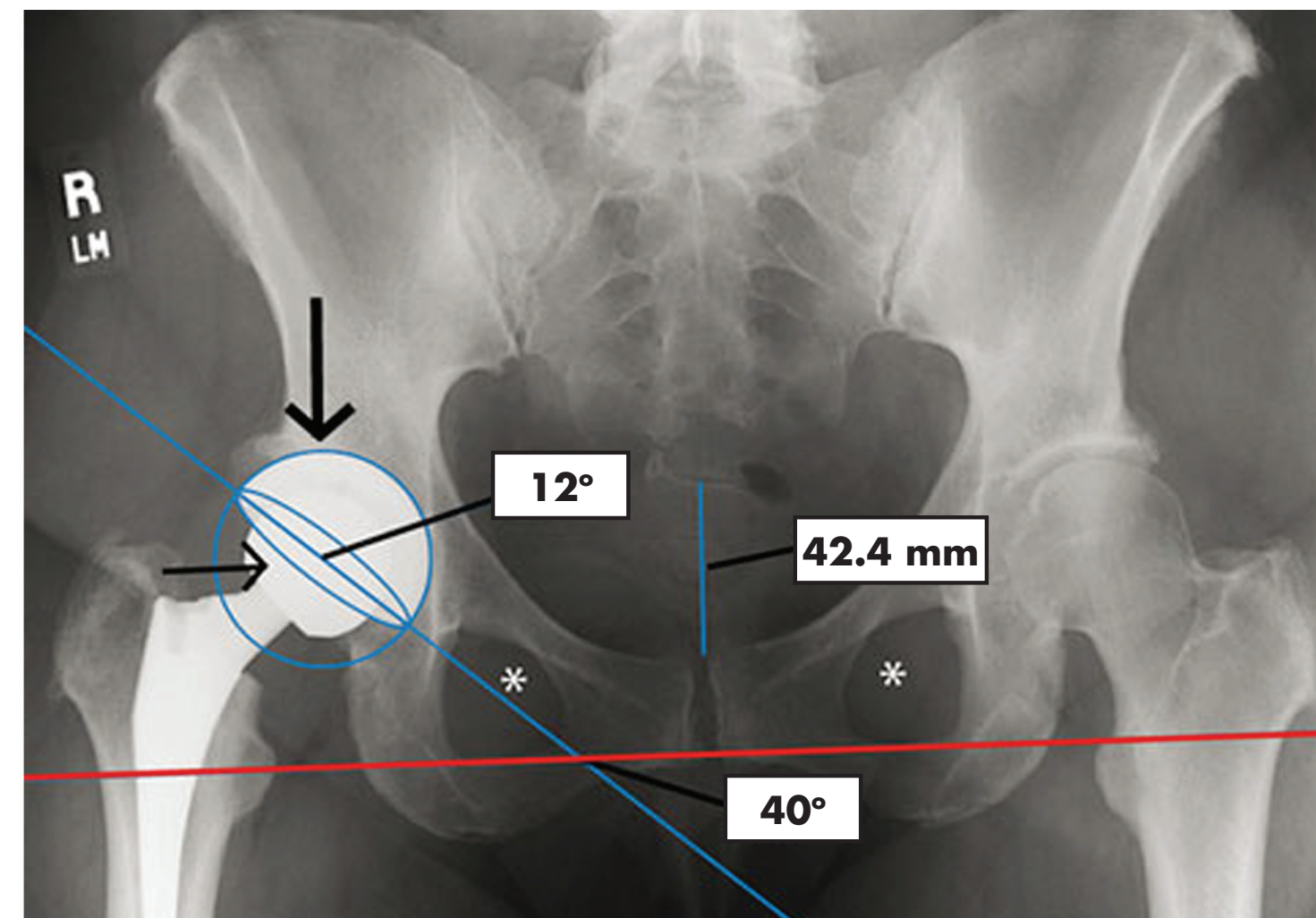


Fig. 1
 An AP radiograph shows the radiographic measurements of inclination and anteversion angles in a female patient. The coccyx is in line with the symphysis pubis and the obturator foramina are symmetric (asterisks). The distance from the sacrococcygeal junction to the top of the symphysis pubis is 42.4 mm. The angle formed by the intersection of the interobturator reference line (red) and the bisecting line (blue) is the inclination angle (40°). The concentric circle (large arrow) and ellipse (small arrow) measure the anteversion angle (12°).

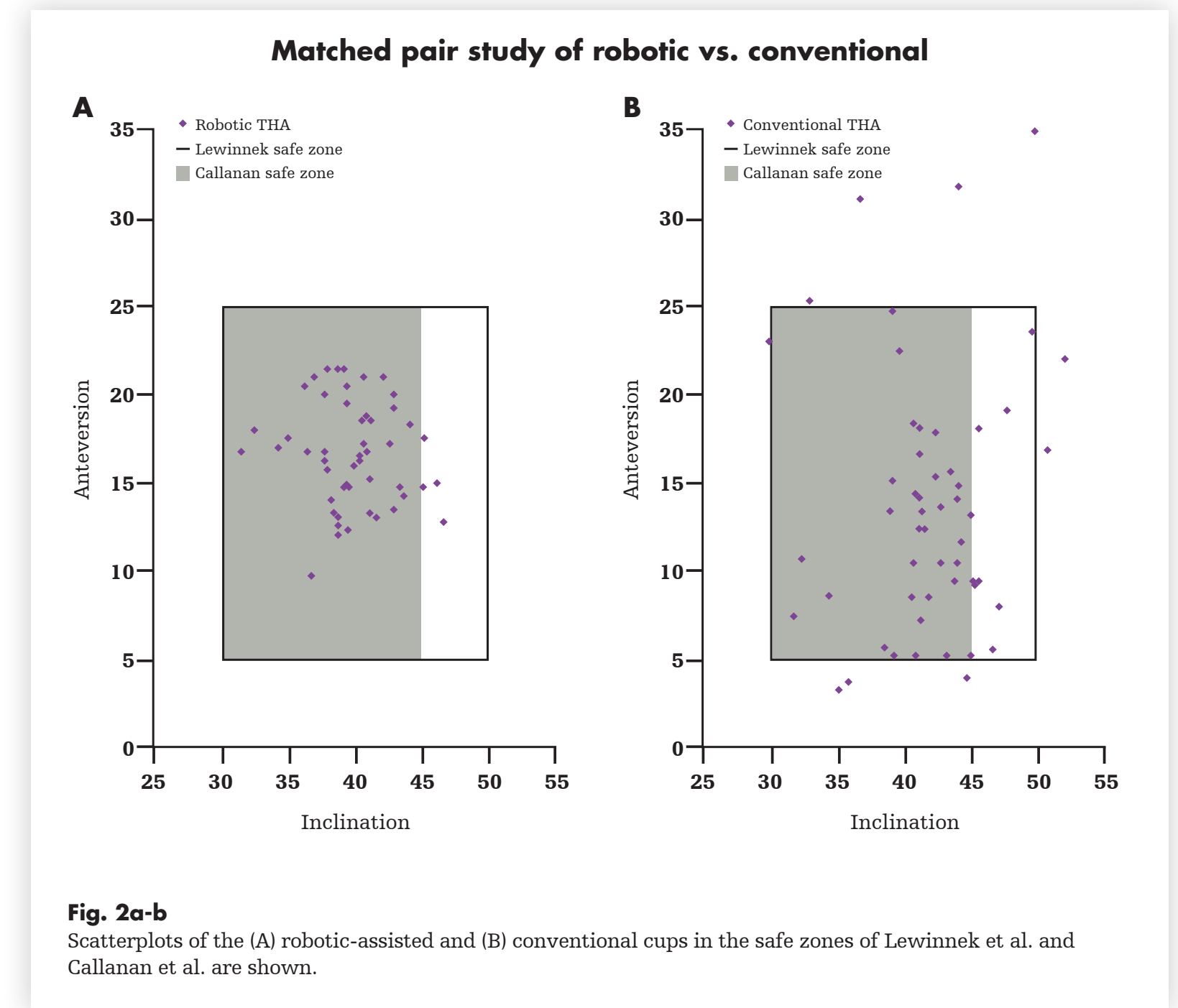


Fig. 2a-b
 Scatterplots of the (A) robotic-assisted and (B) conventional cups in the safe zones of Lewinnek et al. and Callanan et al. are shown.

Reference:
 Domb BG, El Bitar YF, Sadik BS, Stake CE, Botser IB. Comparison of Robotic-assisted and Conventional Acetabular Cup Placement in THA: A Matched-Pair Controlled Study. Clin Orthop Relat Res. 2014 Jan;472(1):329-36.
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