

# Robotic-assisted vs. manual total hip arthroplasty – patient reported outcome measures at twelve months

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## Introduction

Robotic-assistance enhances the accuracy of component positioning in total hip arthroplasty (THA) [1]. We aimed to explore the consequential impact on patient outcomes. The objectives of this study were to compare robotic-assisted against manual THA for the following patient reported outcome measures (PROMs) at two-to-three and twelve months post-operatively:

- Oxford Hip Score (OHS)
- EQ-5D-3L
- EQ-VAS

## Methods

Between 1st May 2021 and 30th June 2022, 272 patients who underwent 275 primary THAs were identified from the local registry database and confirmed to be suitable for a complete case analysis. Data were prospectively collected, and included patient demographics, Body Mass Index (BMI), American Society of Anaesthesiologists (ASA) grade, surgical approach, robotic-assistance, OHS, EQ-5D-3L and EQ-VAS pre-operatively, at two to three months and at twelve months post-operatively.

We analysed the data using the software package SPSS 22 (Chicago, Illinois, USA). Shapiro-Wilk test was used to determine whether the data was parametric or non-parametric. The Chi-Squared test, Mann-Whitney U test, Kruskal-Wallis test and Spearman's Correlation were used. Variables identified with a *p*-value of less than 0.1 were included in the multivariate ordinal regression to identify the independent predictors of post-operative OHS. Significance was accepted at a *p*-value of less than 0.05.

## Patient Characteristics

	Robotic-Assisted	Manual	<i>p</i> -value
<b>Patients</b>	121	151	
<b>Total Hip Arthroplasties</b>	122	153	
<b>Age</b>	69 (64 – 74)	70 (62 – 79)	0.114
<b>Sex (Female vs. Male)</b>	74 (61) vs. 48 (39)	90 (59) vs. 63 (41)	0.758
<b>ASA</b>	2 (2 – 2)	2 (2 – 2)	0.944
<b>BMI</b>	28 (26 – 32)	29 (26 – 33)	0.399
<b>Indication (OA vs. Other)</b>	118 (97) vs. 3 (2)	146 (95) vs. 7 (5)	0.358
<b>Surgical Approach</b>			<b>&lt; 0.001</b>
<b>Direct Anterior</b>	20 (16)	4 (3)	
<b>Anterolateral</b>	26 (21)	78 (51)	
<b>Posterior</b>	76 (62)	71 (46)	

Table 1: Summary of patient characteristics.

Data representative of number (percentage) or median (interquartile range)

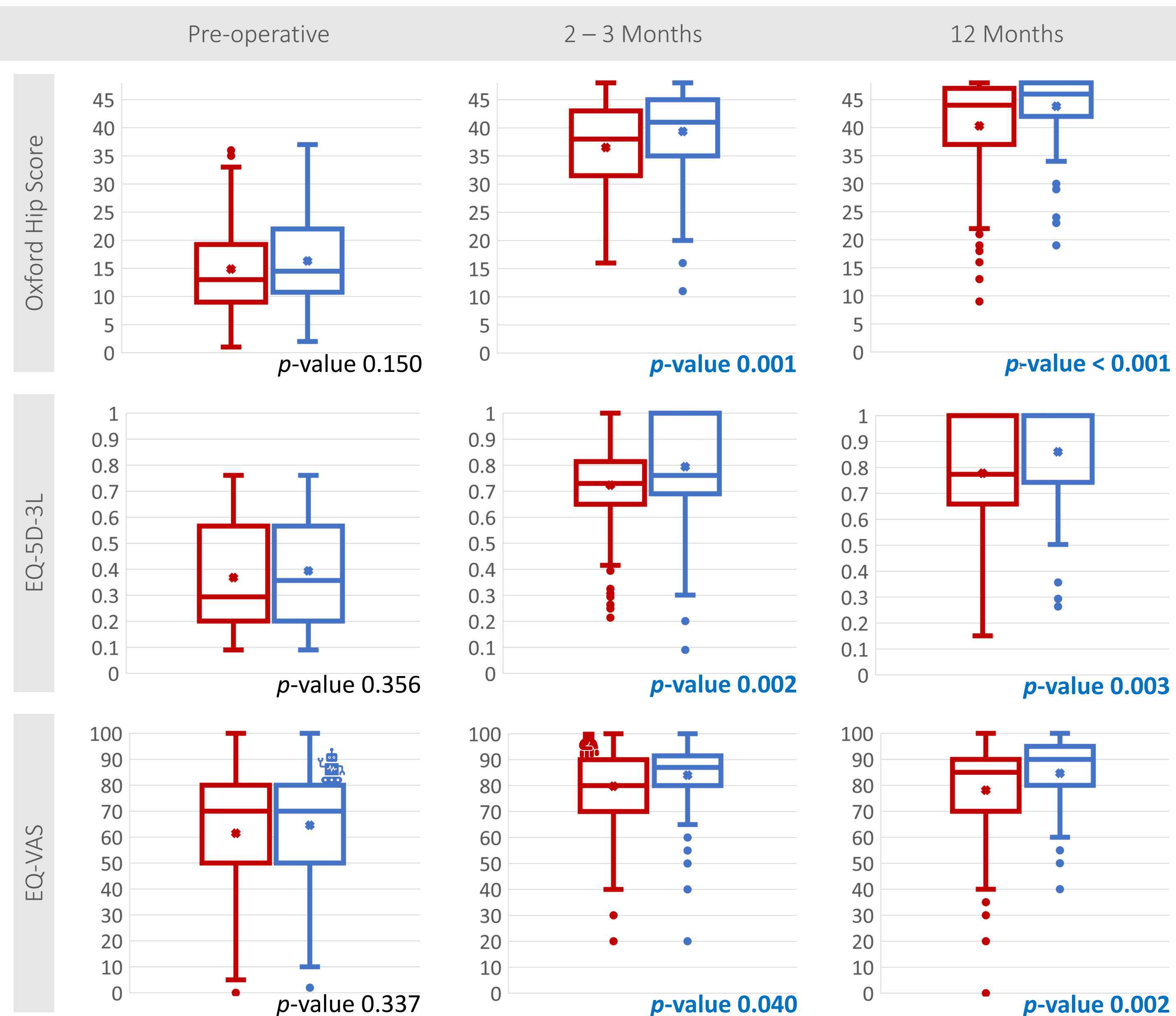


Figure 1: Patient-reported outcome measures for manual vs. robotic-assisted total hip arthroplasty.

## Results

Robotic-assistance, compared against manual THA, was associated with an enhanced OHS, EQ-5D-3L and EQ-VAS at two to three months and twelve months after surgery (Figure 1). Robotic-assistance was confirmed to be an independent predictor of a greater OHS at two to three months (*p*-value 0.008, Odds Ratio 1.965, 95% Confidence Intervals [CI] 1.193 – 3.226) and twelve months (*p*-value 0.002) on a multivariate ordinal regression analysis (Table 2).

## Approach

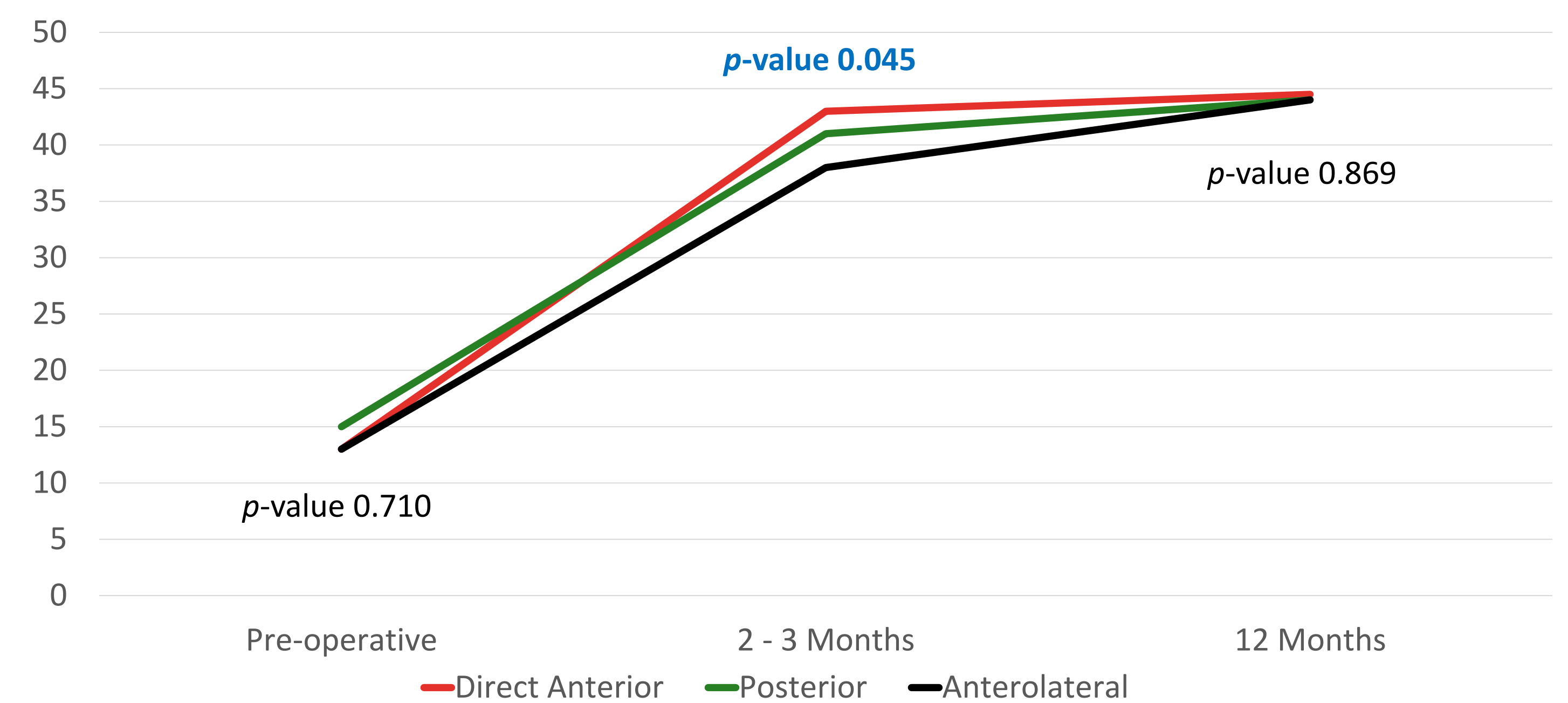


Figure 2: Oxford Hip Score for direct anterior, posterior and anterolateral approaches.

The Kruskal-Wallis test identified a significant difference in OHS between the three surgical approaches. The direct anterior approach (DAA) demonstrated a numerically greater OHS scores at two to three months, compared against the posterior and anterolateral approaches.

## Multivariate Ordinal Regression

Variable	<i>p</i> -value	Odds Ratio	95% CI
<b>Sex (Female vs. Male)</b>	0.592	0.853	0.476 – 1.527
<b>ASA</b>	0.160	0.700	0.426 – 1.151
<b>BMI</b>	0.177	0.962	0.909 – 1.018
<b>Pre-assessment OHS</b>	0.068	1.037	0.997 – 1.079
<b>Robotic-Assisted vs. Manual</b>	<b>0.002</b>	<b>2.463</b>	<b>1.374 – 4.405</b>

Table 2: Multivariate ordinal regression of Oxford Hip Score at twelve months.

## Discussion

The combination of the DAA and robotic-assistance in THA may enhance PROMs, both in the early post-operative period and in the long term. Robotic-assistance enhanced the OHS, EQ-5D-3L and EQ-VAS at two to three months, and at twelve months after primary THA. There was a preferential use for robotic-assistance in patients undergoing a DAA (Table 1) to ensure accurate acetabular component positioning, as this technique was relatively new at our institution. Robotic-assistance has previously been associated with greater functional outcomes, including the Harris Hip Score [1] and the Forgotten Joint Score [2]. However, there were no randomised controlled trials at the time. Recruitment for the Robotic Arthroplasty: a Clinical and cost Effectiveness Randomised controlled trial for Hips (RACER-HIP) ended towards the end of last year, and we are awaiting the results [3].

## Conclusion

Robotic-assistance was superior to manual THA in enhancing PROMs, including the OHS, EQ-5D-3L and EQ-VAS in the first twelve months after surgery. A greater sample size of DAA THA is needed to determine the superiority of this technique in enhancing PROMs early post-operatively.

## References

1. Ng N, Gaston P, Simpson PM, Macpherson GJ, Patton JT, Clement ND. Robotic arm-assisted versus manual total hip arthroplasty : a systematic review and meta-analysis. *Bone Joint J.* 2021 Jun;103-B(6):1009-1020. doi: 10.1302/0301-620X.103B6.BJJ-2020-1856.R1. PMID: 34058875.
2. Clement ND, Gaston P, Bell A, Simpson P, Macpherson G, Hamilton DF, Patton JT. Robotic arm-assisted versus manual total hip arthroplasty. *Bone Joint Res.* 2021 Jan;10(1):22-30. doi: 10.1302/2046-3758.101.BJR-2020-0161.R1. PMID: 33380216; PMCID: PMC7845457.
3. The National Institute for Health and Care Research. Robotic Arthroplasty: a Clinical and cost Effectiveness Randomised controlled trial for Hips (RACER-HIP). <https://www.fundingawards.nihr.ac.uk/award/NIHR131407> (date last accessed 30 April 2024).