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Use of Image Free Robotic-Assisted System for Total Knee Arthroplasty Associated with Improved Knee Society Function Score Compared to Manual Instrumentation, A Retrospective Multi-center Study

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Abstract

Robotic-Assistance (RA) in total knee arthroplasty (TKA) has gained popularity due to its ability to improve accuracy and facilitate patient specific techniques. However, the reported influence on clinical outcomes is inconsistent. This study assessed the influence of the recently introduced VELYS Robotic-Assisted Solution on the Knee Society Function Score (KSFS) at early follow up. A retrospective review of a prospective company sponsored registry was conducted to assess KSFS at first post-operative follow up for all ATTUNE primary TKAs. RA-TKAs were differentiated from MI-TKA. The mean KSFS was compared between groups. Pre-operative demographic information including sex, age, BMI and pre-operative KSFS scores were compared and an ANCOVA was used on post-operative KSFS scores to account for any differences. There were 553 RA-TKAs and 6,710 MI-TKAs with KSFS reported at first post-operative follow-up. The proportion of females was similar between the groups but the RA-TKA group was older (69.37 Vs. 66.37, $p<0.0001$), had slightly lower BMI (29.90 Vs. 30.79, $p<0.0001$) and had post-operative follow up at an earlier time point (87.43 Vs. 116 days, $p<0.0001$). The mean post-operative KSFS was significantly higher for the RA-TKA group than the MI-TKA group (79.59 Vs. 76.44, $p=0.0001$ and 78.15 Vs. 74.05 following ANCOVA adjustment). In this study, KSFS was improved for RA compared to MI at first follow-up. These findings suggest that RA combined with patient specific techniques can improve patient outcomes. Further investigation with longer-term follow-up is required.

1 Introduction

Robot-Assistance (RA) in total knee arthroplasty (TKA) has gained popularity due to its ability to improve accuracy of component positioning and facilitate patient specific techniques . However, the reported influence on Patient Reported Outcomes (PROMs) is inconsistent [1, 2]. The VELYS Robotic-Assisted Solution (VRAS) has recently been introduced and an early study identified that it was associated with a reduced rate of intra operative soft tissue releases [3]. This is likely due to the adoption of patient specific techniques whereby the angle and positions of the bone resections are altered in the planning phase with the goal of proactively balancing the knee reducing the need for soft tissue releases during the trialing phase. The same study reported that avoiding soft tissue releases was associated with improved Knee Society Function Scores (KSFS) [3]. Therefore, it was hypothesized that the use of VRAS will be associated with improved KSFS.

2 Study Design & Methods

A retrospective review of a prospective company sponsored standard of care registry was conducted to assess PROM data at the first post operative follow up visit for all ATTUNE primary TKA procedures. Subjects who had surgery completed using VRAS RA were differentiated from those who had surgery completed with manual instrumentation. The VRAS RA procedures were predominantly from four contributing surgeons and includes data from their learning phase following adoption of the system. The mean KSFS and sub scores were compared between the groups. Pre-operative demographic information including sex, age, BMI and pre-operative KSFS scores were compared between groups and an ANCOVA was used on post-operative KSFS scores to account for any differences. The Knee Society Score Knee Score (KSS) was also captured, however in analysis it was identified that there were significant inconsistencies in how the alignment information was entered between contributing sites. This prevented the total KSS score from being compared, but the subcomponents were reported and compared between the treatment groups.

3 Results

KSFS was reported for 553 RA procedures and 6,710 manual procedures at first post operative follow up visit and for 86 RA procedures and 4,216 manual procedures at the 1 year follow up visit. The proportion of females was similar between the groups (55.22% Vs. 56.53%) but the VRAS group was older (69.37 Vs. 66.37, $p<0.0001$), had a lower BMI (29.90 Vs. 30.79, $p<0.0001$) and had their post-op follow up at an earlier time point (mean follow up of 87.43 days Vs. 116 days, $p<0.0001$) (Table 1).

The mean 3-month KSFS was significantly higher for the RA group than for the manual group (79.59 Vs. 76.44, $p=0.0001$ and 78.15 Vs. 74.05 following ANCOVA adjustment). The mean KSFS at 1 year was also significantly higher for the RA group than the manual (90.12 Vs. 84.56, $p=0.001$) but this was with a limited samples size for RA (n=86) (Figure 1).

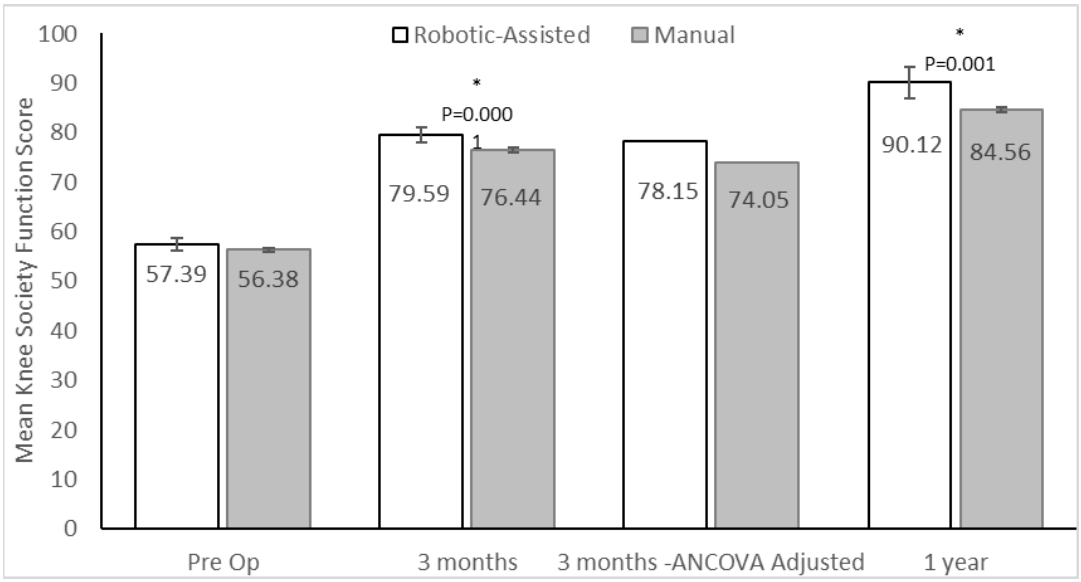

Figure 1: Comparison of Knee Society Function Scores Between RA and Manual Groups

Review of the sub-scores identified that the difference in the KSFS was driven by a difference in the walking sub-score (41.52 Vs. 38.74, p=0.0001) (Table 1). The reported sub-scores of the KSS Knee score including pain, stability and range of motion were similar between the RA and Manual groups (Table 1).

Table 1: Summary of subcomponent scores of KSFS and KSS Knee score at 3 months.

	Robotic-Assisted N=553	**Manual N=6705**	**P-value**
KSFS (total)	79.59	76.44	0.0001
Walking	41.52	38.74	>0.0001
Stairs	39.67	39.44	0.571
Use of support (deduction)	1.60	1.00	0.0004
KSS Knee Score*	-	-	-
Pain	42.22	42.05	0.685
Mediolateral stability	15.00	14.94	<0.0001
Anterior-posterior stability	9.98	9.93	0.0002
Range of Motion	23.58	23.47	0.239
Extension leg deductions	0	0.19	<0.0001

* Total KSS knee score is not reported due to identified inconsistencies in how the Alignment information was captured between sites.

4 Discussion

This study is the largest study to date on the VRAS system and the positive clinical outcomes reported are consistent with the results of previous studies with smaller sample sizes [4, 5]. This study found that KSFS was improved for VRAS RA TKA compared to Manual instrumentation at the first follow up visit. The improvements in KSFS are likely due to the use of RA being associated with adoption of patient specific techniques and reduction in soft tissue releases [3, 6]. These findings support the hypothesis that RA combined with patient specific techniques can improve patient outcomes in TKA. However, this analysis is exploratory and therefore subject to limitations, and further prospective studies with longer-term follow-up are required.

5 References

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