Early Muscle Recovery following Robotic-Assisted Unicompartmental Knee Arthroplasty

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BACKGROUND

Enhanced implantation accuracy has been demonstrated in robotic-assisted UKA, and this is suggested to lead to lower revision rates and improved functional outcomes through reduced surgical trauma, improved joint kinematics and optimal soft tissue balancing.

Robotic-assisted arthroplasty is still in its infancy though, and detailed clinical outcomes and for these procedures remains comparatively scarce. Rapid early post-operative recovery has been suggested in ra-UKA, however there have been no reports of muscle performance in this patient group. Muscle performance is a sensitive metric and 30% deficits have been reported at 1-year in manual UKA compared to health controls[1].

METHODOLOGY

Patients undergoing ra-UKA for medial compartment osteoarthritis at a single independent provider (Spire Murrayfield Hospital, Edinburgh) were recruited with informed consent and assessed pre-operatively, and then at 6- and 12-weeks post-operatively.

Surgical intervention

The MAKO robotic-assisted knee system was used to implant a cemented Restoris MCK implant (Stryker) in all cases [Fig 1]. Three fellowship trained arthroplasty surgeons performed all procedures.

Outcome measures

The primary outcome was maximal muscle strength, evaluated by biodex system-3 isokinetic testing (con/con knee flexion/extension at 60 degrees/sec). Muscle strength (peak torque) was assessed in quadriceps and hamstring groups using a standardised protocol. Functional (10m walk and timed-get-up-and-go), clinical (range of motion), and patient reported outcomes (Oxford Knee Score, Forgotten Joint Score-12, and 0-10 NRS pain scale) were additionally collected at all timepoints.

Statistical Analysis

Primary analysis was overall difference between repeated measures across the 3-timepoints using Friedman's 2-way ANOVA, with post-hoc pairwise comparisons using Wilcoxon Signed Rank tests. Significance was accepted at p<0.05

RESULTS

12 participants were recruited, 2 (17%) were female and 10 (83%) male, mean age was 66.6 (SD 7.62), mean weight was 81.17Kg (SD 15.62).

Maximal muscle strength changed over time in quadriceps (p=0.006) and hamstrings (p=0.018) in the operated limb, with no change observed in the uninvolved limb [Table 1].

By 12-weeks quadriceps strength was 70% and hamstrings 83% of the values achieved in the un-operated limb. This reflects 16% and 25% deficits compared to previously published health controls.

Substantial improvement was seen in all other measures over time, with sequential positive changes between assessments; TUG, 10m walk test, knee flexion and across the PROMs [Table 2]

Patient reported outcome scores showed significant and clinically meaningful improvements from baseline to 12-weeks assessment. A 33-point improvement in FJS-12 and 10-point change in OKS was observed which is approximately 3x the MCID of each score. Mean Oxford Knee Score for this cohort at only 3-months following robotic-assisted UKA (OKS 40.5) are comparable to 6-month scores typically reported for manual procedures (OKS 37.7)[2].

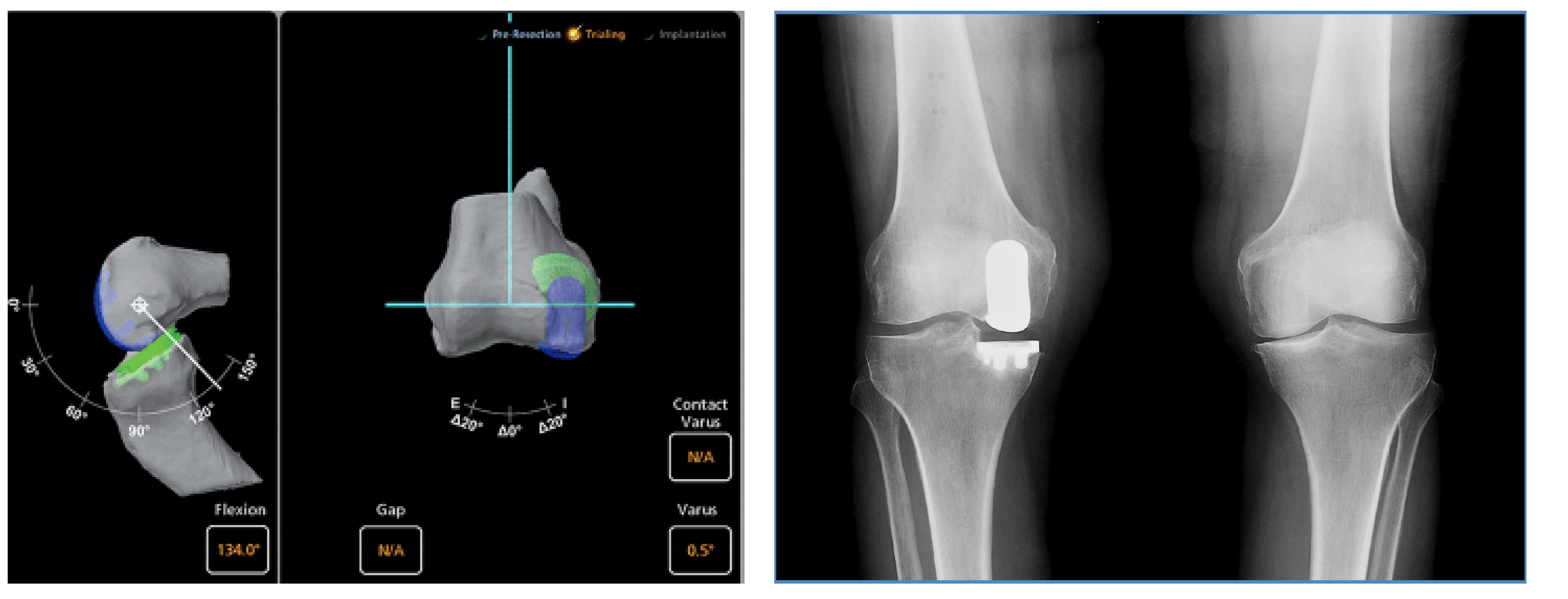

Figure 1. Robotic-assisted UKA planning and post-operative position

	Pre-op	6-weeks	12-weeks	Sig*
Operated limb				
Torque (ext.), Nm. Mean (SD)	88.52 (39.86)	74.47 (27.58)	90.41 (38.76)	**0.006**
Torque (flex.), Nm. Mean (SD)	62.45 (23.18)	54.12 (20.49)	55.07 (17.99)	**0.018**
Torque/BW (ext.), Mean (SD)	108.66 (44.04)	91.03 (27.76)	112.77 (36.43)	**0.010**
Torque/BW (flex.), Mean (SD)	65.28 (20.92)	56.95 (15.18)	68.63 (15.77)	**0.020**
Control limb				
Torque (ext.), Nm. Mean (SD)	121.48 (43.07)	125.28 (44.75)	129.11 (46.80)	**0.368**
Torque (flex.), Nm, Mean (SD)	62.45 (23.18)	62.53 (19.93)	65.53 (20.71)	**0.651**
Torque/BW (ext.), Mean (SD)	150.2 (51.32)	153.03 (51.39)	162.96 (62.89)	**0.370**
Torque/BW (flex.), Mean (SD)	76.11 (24.61)	76.32 (21.02)	82.26 (22.97)	**0.650**

Table 1. Isokinetic dynamometry

Ext = extension, flex. = flexion, BW = body weight. *Friedman's 2-way ANOVA

	Pre-op	6-weeks	12-weeks	Sig*
Functional tests				
Knee Flexion (deg), Mean (SD)	124.17 (7.33)	126.25 (10.61)	133.47 (8.34)	**0.016**
Knee Extension (deg), Mean (SD)	0.42 (3.34)	1.27 (3.79)	0.72 (2.56)	**0.717**
TUG (sec), Mean (SD)	9.03 (2.15)	7.25 (3.42)	6.02 (2.75)	**0.015**
10m walk test (sec), Mean (SD)	8.00 (2.18)	7.08 (3.14)	6.13 (2.55)	**0.021**
PROMS				
OKS, Mean (SD)	30.25 (6.90)	37.80 (4.44)	40.55 (5.89)	**0.019**
FJS-12, Mean (SD)	22.66 (14.75)	45.83 (29.00)	56.44 (35.97)	**0.042**
NPRS, Mean (SD)	4.00 (2.00)	2.68 (3.10)	1.18 (1.75)	**0.004**

Table 2. Functional outcomes

TUG = timed-up-and-go test, OKS = Oxford Knee Score, FJS-12 = Forgotten Joint Score 12, NRS = Numerical Pain Rating Scale. *Friedman's 2-way ANOVA

CONCLUSIONS

Compared to baseline, muscle strength (peak torque) declines by 6-weeks but rebounds by 12-weeks. This change occurs within substantial and sequential improvement in functional and clinical outcomes.

The outcomes seen here at 12-weeks reflect the longer-term outcomes typically reported for UKA.

This rapid recovery suggests that enhanced implant positioning / reduced surgical trauma may influence early physical recovery.

REFERENCES

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