

Comparative Analysis Of Time Taken In Conventional vs Robotic Assisted Total Knee Arthroplasty

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INTRODUCTION

- Despite improvements in the implants and surgical techniques about 20% of Total Knee Arthroplasty (TKA) patients remain dissatisfied.
- Accurate implant size/ alignment and limb alignment are necessary for the long term implant survival and successful outcome.
- Implant overhang/ under sizing and limb mal-alignment is associated with suboptimal patient reported outcome measures and increased chances of revision.
- Use of robotic system for performing TKA is increasing. Robotic assisted Total Knee replacement (RA- TKR) has shown to improve the accuracy of the implant size. It also allows dynamic confirmation of the implant and limb alignment during the TKA procedure.
- The major inhibition of the Arthroplasty surgeon in adapting to the robotic assisted TKA is the extra time spent during the registration process and milling of the bone with the Robot.

AIMS AND OBJECTIVES

- The aim of the study was to ascertain the extra time spent during the twosteps of registration and milling of the bone as compared to the conventional TKA (C-TKA).

MATERIALS AND METHODS

- A prospective study involving 30 patients each in the C-TKA and RA-TKA operated by the same surgical team using posterior stabilized high flexion TKA implant.
- The sample size was estimated to be 28 patients in each group for anticipated 10 % increase in operation time with alpha error of 0.05 beta error of 0.2 and power of study being 80%.
- Patients were given a choice between the C-TKA and RA-TKA and consecutive 30 cases in each group were studied by an independent observer. RA-TKA group patients underwent a pre-operative 3 dimensional CT scan. After segmentation of the scan images a bone model was prepared. The operating surgeon along with system specialist did the preoperative planning as regards the implant size/ alignment and limb alignment on a computer with specialized software.

- After surgical exposure of the knee joint and insertion of tracker pins, the surgeon did registration of 40 points on the femur and the tibia. Once the actual anatomy of the patient matched with the CT generated bone model as judged by root mean square error < 1 , the robot was docked to the patients leg with external fixator pins. After confirming a clear path for milling of the tibia and femur, the fully automated active robot performed the femur and tibia cuts by milling of the bone utilizing high speed burr.
- In C-TKA group the time for the application of appropriate zigs and execution of the bone cuts and soft tissue release was recorded whereas in RA-TKA group the time taken for registration and bone milling with robot and required soft tissue release was measured.
- The statistical difference between the times of two groups was measured with student t-test and p-value < 0.05 was considered significant.

RESULTS

- The pre-operative patient characteristics namely age, BMI, pre-operative clinical diagnosis, preoperative degree of deformity, pre-operative range of motion and associated cardiac, renal and respiratory comorbidities were same in both the groups [Table 1] (p value > 0.05, statistically non-significant)
- Table 2 shows the time taken for application of zigs + bone cuts with saw and soft tissue releases in 30 conventional TKA patients.
- Table 3 shows the time taken for registration + robotic bone resection and soft tissue releases in 30 active robotic assisted TKA patients.
- The time taken in C- TKA and RA-TKA group (expressed as mean± standard deviation) was 24.77 ± 1.92 and 25.03 ± 3.27 respectively. The difference in these times is statistically non-significant (p value 0.7086).
- There were no intra-operative or post-operative adverse events in both CA-TKA and RA-TKA patient cohorts.

Parameters	Conventional TKA	Robotic assisted TKA	p value
Number of patients (n)	30	30	-
Mean Age (yrs.)	65.2±12.8	64.5±13.5	0.8374
Mean BMI (kg/m ²)	28.3±4.2	27.2±5.3	0.3766
Mean Preoperative VAS score	7.5±1.5	7.4±1.6	0.8037
Pre-operative Range of Motion	95.5±17.5	97.1±15.4	0.7083
Pre-operative Degree of Deformity (coronal plane deformity)	8.1±2.4	7.5±2.5	0.3469
Pre-operative Associated co-morbidity:			
Cardiac	n=8 (26.67%)	n=11 (36.67%)	0.4090
Renal	n=6 (20.0%)	n=8 (26.67%)	0.5447
Respiratory	n=2 (6.67%)	n=3 (10.00%)	0.6436
Pre-operative clinical diagnosis (%)			
OA	n=28 (93.33%)	n=27 (90.00%)	0.6436
RA	n=02 (6.66%)	n=03 (10.00%)	0.6425

Table 1: Comparison of pre-operative patient characteristics between conventional and robotic assisted TKA patients

Sr. no.	Side	Total time (minutes) taken for application of zigs + bone cuts and soft tissue releases
1	S B left	23
22	J B right	22
3	J K right	24
4	J K left	25
5	S K right	24
6	A K right	24
7	A K left	27
8	S K left	28
9	M M left	26
10	S B left	28
11	S P left	27
12	S A right	26
13	S P right	27
14	K V right	24
15	R A right	24
16	N L right	27
17	N L left	22
18	V P left	25
19	V K left	24
20	S P left	23
21	S P right	26
22	H I left	26
23	H I right	23
24	N P right	21
25	M M left	22
26	A R left	26
27	A B right	27
28	S P left	23
29	A B left	25
30	C R right	24

Table 2: Time taken for application of zigs + bone cuts with saw and soft tissue releases in conventional TKA

Sr. no.	Side	Time taken for registration	Time taken for bony resection and soft tissue releases	Total time taken
1	SP - right	0:06:00	0:17:00	0:23:00
2	AC - left	0:06:01	0:20:00	0:26:01
3	CB - left	0:07:00	0:16:00	0:23:00
4	PB - right	0:06:04	0:23:00	0:29:04
5	MS - left	0:06:04	0:16:04	0:22:08
6	PB - left	0:06:00	0:15:38	0:21:38
7	MS - right	0:05:01	0:16:04	0:21:05
8	AM - right	0:07:00	0:27:00	0:34:00
9	VK - right	0:05:01	0:19:00	0:24:01
10	SV -right	0:08:01	0:17:00	0:25:01
11	SV -left	0:08:00	0:23:00	0:31:00
12	MA - left	0:05:06	0:16:00	0:21:06
13	MA -right	0:06:00	0:17:00	0:23:00
14	AD - left	0:07:00	0:21:00	0:28:00
15	MD - right	0:05:01	0:18:00	0:23:01
16	KP -left	0:07:00	0:21:00	0:28:00
17	KP -right	0:06:00	0:21:00	0:27:00
18	VD - right	0:05:00	0:15:00	0:20:00
19	KD - right	0:10:00	0:15:00	0:25:00
20	TV - left	0:07:00	0:16:00	0:23:00
21	TV - right	0:06:00	0:16:00	0:22:00
22	VG - left	0:08:00	0:17:00	0:25:00
23	VG -right	0:06:00	0:17:00	0:23:00
24	PG - left	0:08:00	0:22:00	0:30:00
25	PG - right	0:06:00	0:21:00	0:27:00
26	VR - left	0:08:00	0:20:00	0:28:00
27	ST - right	0:10:00	0:16:00	0:26:00
28	ST - left	0:07:00	0:17:00	0:24:00
29	VR - right	0:08:00	0:19:00	0:27:00
30	NB - left	0:07:00	0:16:00	0:23:00

Table 3: Time taken for registration + robotic bone resection and soft tissue releases in Robotic assisted TKA

CONCLUSION

- The study findings show that RA-TKR does not take more time than a Conventional TKR.

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