International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2019; 5(3): 684-691

www.orthopaper.com
Received: 16-05-2019
Accepted: 19-06-2019

Dr. Savith V Shetty
Assistant Professor, Department of Orthopaedics, Yenepoya Medical College, Mangalore, Karnataka, India

Dr. Mohammed Azhruddin A
Research Scholar, Department of Orthopaedics, Yenepoya Medical College, Mangalore, Karnataka, India

Dr. Deepak Rai
Professor, Department of Orthopaedics, Yenepoya Medical College, Mangalore, Karnataka, India

Dr. Akbar Ali AM
Research Scholar, Department of Radiology, Yenepoya Medical College, Mangalore, Karnataka, India

Correspondence
Dr. Savith V Shetty
Assistant Professor, Department of Orthopaedics, Yenepoya Medical College, Mangalore, Karnataka, India

Comparison of overall component alignment and functional outcome between navigation and conventional total knee arthroplasty

Dr. Savith V Shetty, Dr. Mohammed Azhruddin A, Dr. Deepak Rai and Dr. Akbar Ali AM

DOI: https://doi.org/10.22271/ortho.2019.v5.i3l.1614

Abstract
Aim: of the study was to compare the functional outcome in patients undergoing navigation and conventional total knee replacement. secondly to compare the component alignment in patients undergoing navigation and conventional Total Knee Replacement.
Materials and methods: Total 80 patients were included in study out of which 40 patients were in each group. All the surgeries were done by single surgeon and subvastus approach was used for all the total knee replacements.
Pre-operative functional assessment was done by KSS score14. Preoperative radiological grading of osteoarthritis was done using AHL back. Post operatively all patients were followed upto 1,3 and 6 months and at the end of 6 months radiological assessment of the components was done by measuring Alpha, beta, gamma and sigma angles.
Conclusion: Navigation TKR significantly improves the alignment of both femoral and tibial components when compared with the conventional TKR. However there was no significant difference in functional outcome between the two methods. Probably a long term study might highlight on if navigation has a role in improving the longevity of the implant.

Keywords: TKR- Total knee replacement, SV- Subvastus, KSS- Knee Society Score

Introduction
Total Knee Arthroplasty (TKR) has evolved since the total condylar knee was introduced in 1973. A procedure performed for severe disability from pain and deformity of Osteoarthritis, Rheumatoid Arthritis and other form of knee arthritis [3]. Outcome of TKR depends on various factors, viz. alignment of the prosthesis, soft tissue balancing and the post op rehabilitation [3]. Among these factors the alignment and positioning of the prosthesis can be improved by the use of navigation system. In Conventional TKR usually an intramedullary rod and extramedullary jig for femur and tibia respectively is used for distal femur and proximal tibial cuts. Here there could be some error in the alignment and placement of prosthesis as it is not precise like navigation system.
The survival of a total knee arthroplasty depends on the precise placement of the components to obtain the ideal mechanical axis and patella tracking [4, 5]. This in turn, depends on the accuracy of the bone cuts and careful soft tissue balancing [3]. Computer navigation can aid the surgeon in the better placement of these components. Initial navigation systems were computed tomography (CT)-based which required a preoperative CT scan which added to the cost of the surgery and exposed the patient to radiation from the CT scan [1]. Current technology allows for kinematics-based navigation which does not require a preoperative CT scan [3]. This imageless system utilizes an infrared camera which detects markers which are placed at the articular surface of the tibia and the femur. Previous navigation system the trackers were placed on the shaft of the tibia and the femur which in some patients lead to stress fractures at the site of the insertion of the pins for mounting navigation trackers. With the advent of articular surface navigation system this complication is avoided. Also the additional advantage of the navigation system is there is no need to drill intramedullary for the femoral component.

The Purpose of the Study

To compare the component alignment and functional outcome following navigation and conventional Total Knee Replacement.

Objective of the Study

- To compare the functional outcome in patients undergoing navigation and conventional total knee replacement.
- To compare the component alignment in patients undergoing navigation and conventional Total Knee Replacement.

Hypothesis

Navigated Total Knee Replacement would have been better component alignment and would give better functional outcome.

Methodology

Study Design: Retrospective study

Materials and Methods

The medical records of the patients from December 2016 to December 2018 who underwent Total knee arthroplasty with or without navigation were utilised to collect the data of the patient from the yenepoya and allied hospital.

All the surgeries were done by single surgeon and subvastus approach was used for all the total knee replacements.

Pre-operative functional assessment was done by KSS score [14]. Preoperative radiological grading of osteoarthritis was done using AHL back. Post operatively all patients were followed upto 1,3 and 6 months and at the end of 6 months radiological assessment of the components was done by measuring Alpha, beta, gamma and sigma angles. These angles were calculated by a radiologist who was blinded about the patient information (ie conventional or navigated TKR).

To reduce the inter observer bias all the angles were reassessed by the author. Post operatively at 6 months functional outcome was also assessed using the KSS score [14].

The choice of navigation was given to all the patients but those who had affordability issues conventional TKR was done in them.

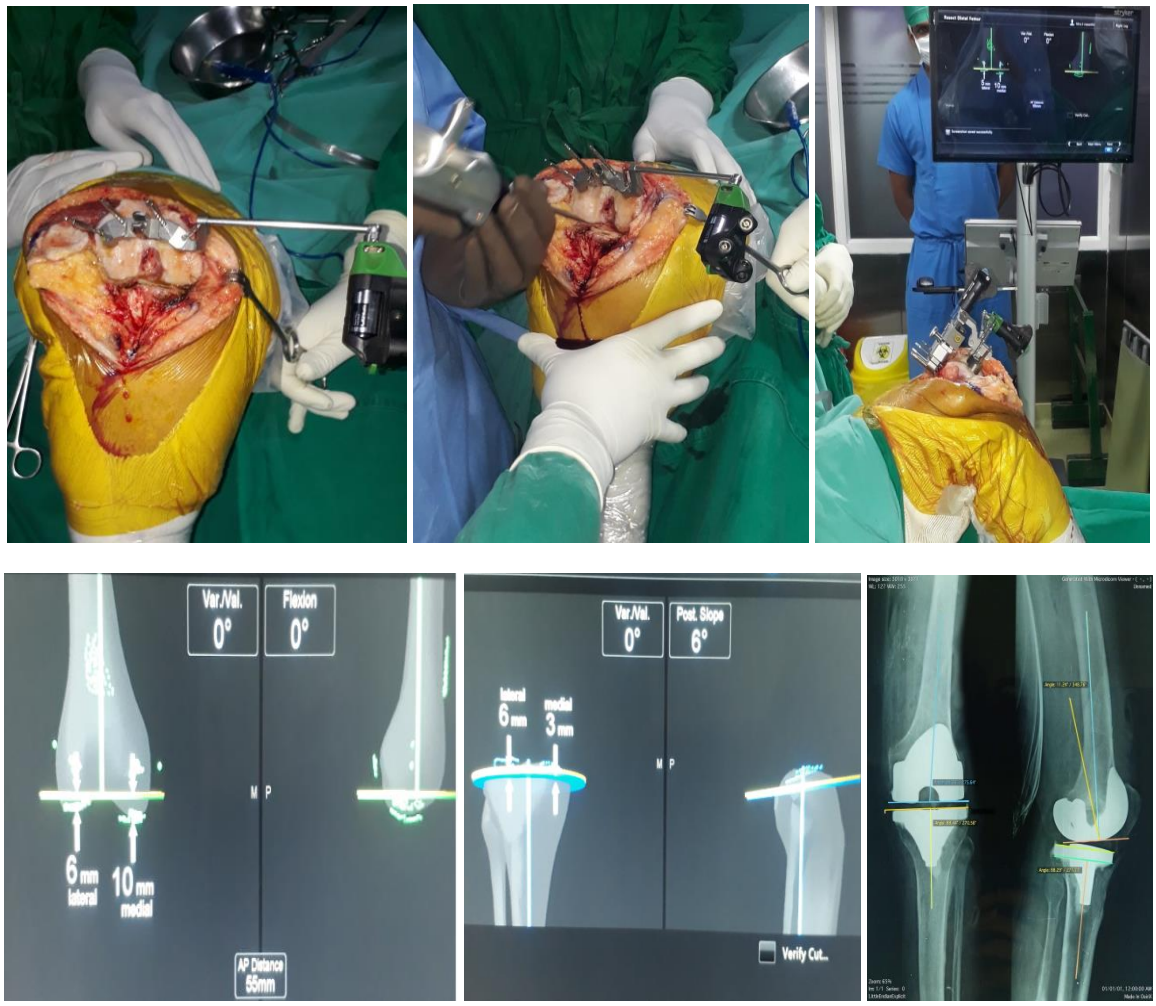

Fig 1: a) Femoral tracker placed over the articular surface. b) Pointer placed over the articular surface of the tibia c) tracker placed over the articular surface of the femur and the tibia. d) Appropriate distal femur cuts taken by navigation e) Appropriate proximal tibial cuts taken by navigation. F) Component alignment of femur and tibia in coronal and sagittal planes.

Statistical Analysis

Analysis collected data was summarized by mean and standard deviation of Functional score, KSS score, Alpha angle, Beta angle, Gamma angle and Delta angle. Categorical data such as Age, Gender was summarized by frequency and percentage comparison of group A and group B at various time point and for various parameters unpaired t test was performed. To compare the change with the group was done

by repeated measures a nova followed by Bonferroni post HOC analysis.

Inclusion criteria

All patients who underwent Total knee replacement by conventional method and computer assisted navigation will be included in this study.

Knee society score (KSS) [14] will be utilised for functional outcome and plain x-rays are used for mechanical alignment

Surgical technique

Anterior midline incision, Subvastus approach was used, medial soft tissue release done and lateral genicular artery cauterised. Osteophytes were excised and remnants of medial meniscus ACL and PCL were resected out. Lateral meniscus resected and tibia subluxated forward, Femoral tracker applied to the articular surface and distal resection jig applied after navigating the distal femur with nav-3 stryker navigation. Appropriate bone cuts were taken medially and laterally. Tibial tracker applied on the articulating surface of the tibia and resection of the proximal tibia was done. Need for the intramedullary jig was not there as the femur is computer navigated. Extension gap stable and trial prosthesis was put and patella tracking was done. Final implantation done and wound closed in layers over drain.

Post operatively the rehabilitation was started on the day of the surgery in the evening, all patients were made to walk on the same day and knee bending and SLR was started.

Results

Table 1: 35% of the respondent in Group A belong to the age group 45-60 and 65% belongs to Above 60 Whereas in Group B 45% of the respondent belongs to the age group 45-60 and 55% belongs to the age group Above 60.

Group A consist of 15 males and 25 females whereas in Group B 8 males and 32 females. However there was no significant difference between age and sex distribution.

		Group			
		Group A		Group B	
		Count	Column N %	Count	Column N %
Age	45 - 60	14	35.0%	18	45.0%
	Above 60	26	65.0%	22	55.0%
	Total	40	100.0%	40	100.0%
Sex	M	15	37.5%	8	20.0%
	F	25	62.5%	32	80.0%
	Total	40	100.0%	40	100.0%
Side	B/L	1	2.5%	0	.0%
	LT	15	37.5%	20	50.0%
	RT	24	60.0%	20	50.0%
Diagnosis	B/L OA	7	17.5%	1	2.5%
	OA	32	80.0%	38	95.0%
	RA	1	2.5%	1	2.5%

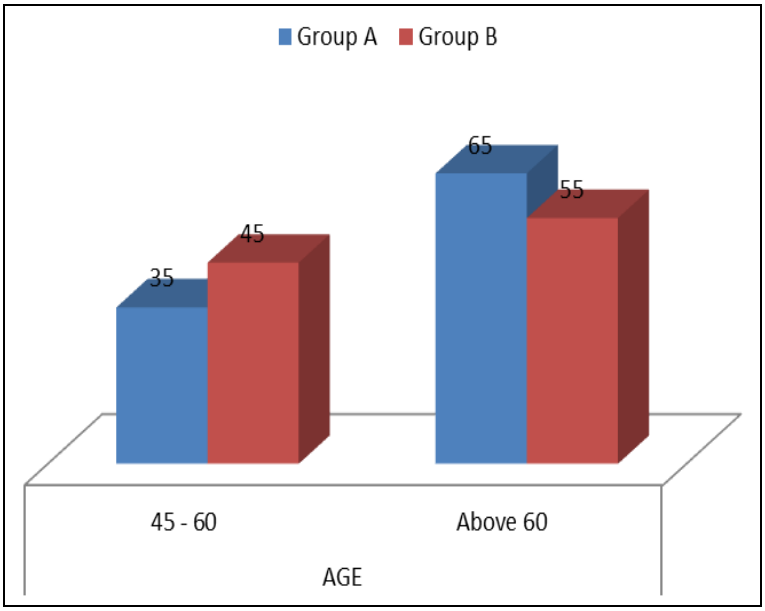

Fig 1: Bar Chart of Age distribution

Table 2: p value shows no significance between both groups

	chi square/Fishers exact test p	
Age	0.361	NS
Sex	0.084	NS
Side	0.354	NS
Diagnosis	0.082	NS

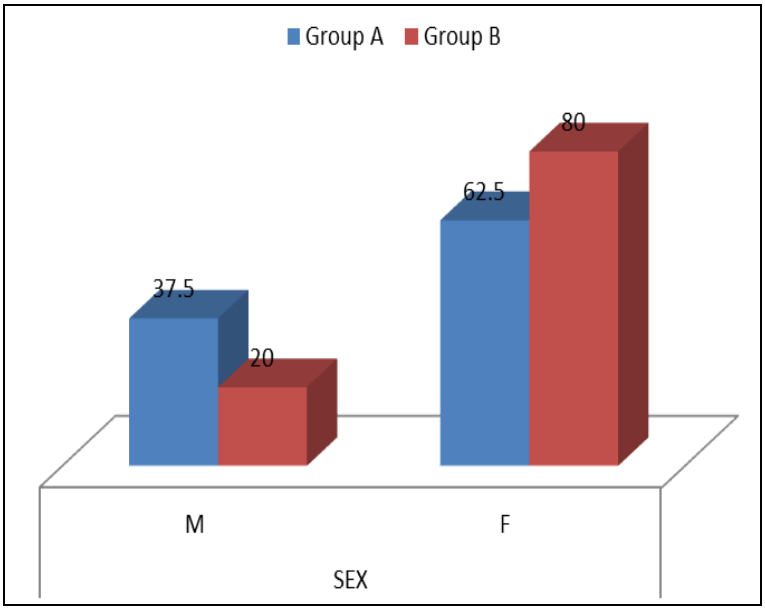

Fig 2: Bar Chart of Sex distribution

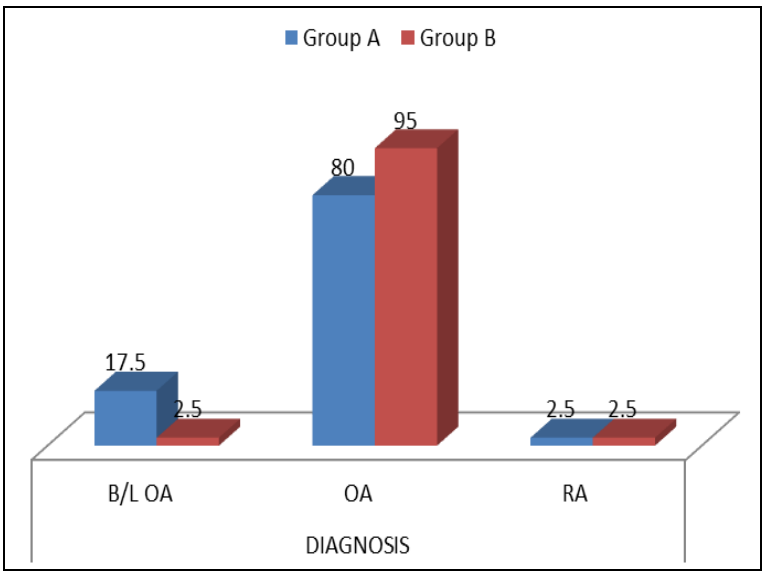

Fig 3: Bar Chart of side distribution

Table 3: Comparison between the groups

						95% Confidence Interval for Mean			
			N	Mean	Std. Deviation	Lower Bound	Upper Bound	t test p value	
Functional	PRE OP	Group A	47	52.38	14.824	48.03	56.74	.786	NS
		Group B	41	51.59	12.249	47.72	55.45		
	3 Months	Group A	47	72.98	7.985	70.63	75.32	.378	NS
	Group B	41	71.59	6.561	69.51	73.66			
	6 Months	Group A	47	84.47	7.463	82.28	86.66	.056	NS
	Group B	41	81.59	6.368	79.58	83.60			
KSS	PRE OP	Group A	47	65.51	12.409	61.87	69.15	.522	NS
Group B	41	63.63	14.936	58.92	68.35				
3 Months	Group A	47	64.89	7.891	62.58	67.21	.012	sig	
Group B	41	61.12	5.496	59.39	62.86				
6 Months	Group A	47	70.04	6.118	68.25	71.84	.035	sig	
Group B	41	67.44	5.182	65.80	69.07				
ROM	PRE OP	Group A	47	92.34	15.067	87.92	96.76	.449	NS
Group B	41	94.39	8.958	91.56	97.22				
3 Months	Group A	47	96.38	6.733	94.41	98.36	.092	NS	
Group B	41	98.78	6.401	96.76	100.80				
6 Months	Group A	47	109.79	8.206	107.38	112.20	.151	NS	
Group B	41	112.20	7.250	109.91	114.48				

Table 4: Comparison within the Group

						95% Confidence Interval for Mean			
			N	Mean	Std. Deviation	Lower Bound	Upper Bound	Repeated measures Anova p value	
Functional	Group A	Pre-op	47	52.38	14.824	48.03	56.74	.000	HS
		3 Months	47	72.98	7.985	70.63	75.32		
		6 Months	47	84.47	7.463	82.28	86.66		
	Group B	Pre op	41	51.59	12.249	47.72	55.45	.000	HS
		3 Months	41	71.59	6.561	69.51	73.66		
		6 Months	41	81.59	6.368	79.58	83.60		
KSS	Group A	Pre OP	47	65.51	12.409	61.87	69.15	.000	HS
3 Months		47	64.89	7.891	62.58	67.21			
6 Months		47	70.04	6.118	68.25	71.84			
Group B	Pre-OP	41	63.63	14.936	58.92	68.35	.000	HS	
	3 Months	41	61.12	5.496	59.39	62.86			
	6 Months	41	67.44	5.182	65.80	69.07			
Rom	Group A	Pre op	47	92.34	15.067	87.92	96.76	.000	HS
3 Months		47	96.38	6.733	94.41	98.36			
6 Months		47	109.79	8.206	107.38	112.20			
Group B	Pre-op	41	94.39	8.958	91.56	97.22	.000	HS	
	3 Months	41	98.78	6.401	96.76	100.80			
	6 Months	41	112.20	7.250	109.91	114.48			

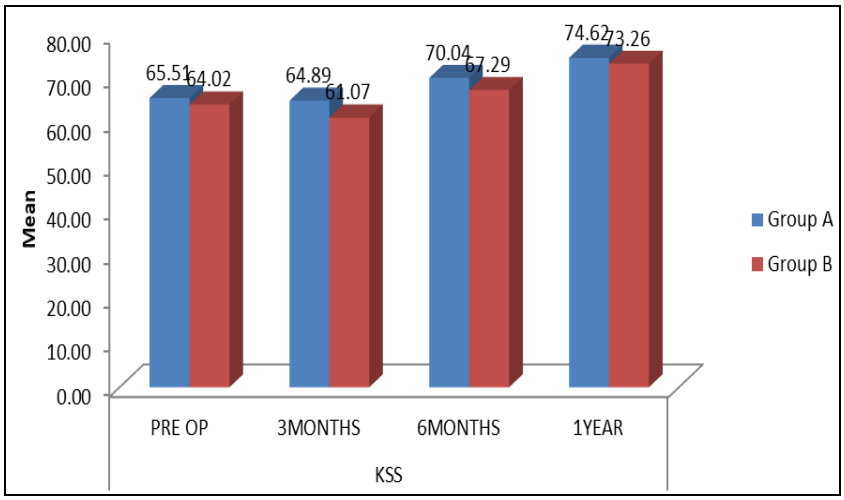

Fig 5: Group A and Group B shows significant improvement in KSS score

Table 5: Post hoc analysis

				Mean difference	S.D of difference	Bonferroni p value	
Functional	Group A		Pre Op – 3 months	-20.596	13.113	.000	HS
			Pre OP - 6 months	-32.085	14.768	.000	HS
			3 Months – 6 Months	-11.489	4.026	.000	HS
	Group B		Pre op - 3 Months	-20.000	11.079	.000	HS
			Pre op - 6 Months	-30.000	11.435	.000	HS
			3 Months – 6 Months	-10.000	2.236	.000	HS
Kss	Group A		Pre Op - 3months	.617	12.451	.736	NS
		Pre op – 6 Months	-4.532	11.749	.011	Sig	
		3 Months – 6 Months	-5.149	3.470	.000	HS	
Group B		Pre op - 3 Months	2.512	14.905	.287	NS	
		Pre op - 6 Months	-3.805	14.980	.112	NS	
		3 Months - 6 Months	-6.317	3.771	.000	HS	
Rom	Group A		Pre Op - 3months	-4.043	12.625	.199	NS
		Pre op - 6 Months	-17.447	12.418	.000	HS	
		3 Months - 6 Months	-13.404	5.224	.000	HS	
Group B		Pre op - 3 Months	-4.390	8.077	.001	HS	
		Pre op - 6 Months	-17.805	10.127	.000	HS	
		3 Months – 6 Months	-13.415	5.296	.000	HS	
Functional				Mean Difference	S.D Of Difference	T Test P Vallue	
		Pre Op - 3months	Group A	-20.596	13.113	.820	NS
			Group B	-20.000	11.079		
		Pre OP - 6 Months	Group A	-32.085	14.768	.466	NS
			Group B	-30.000	11.435		
		3 Months – 6 Months	Group A	-11.489	4.026	.039	Sig
			Group B	-10.000	2.236		
		Pre OP - 3 Months	Group A	.617	12.451	.518	NS
		2.512	14.905				

	Pre OP - 6 Months Group B	Group A	-4.532	11.749	.799	NS	
		-3.805	14.980				
	3 Months – 6 Months Group B	Group A	-5.149	3.470	.134	NS	
		-6.317	3.771				
KSS		Pre OP - 3 Months	Group A	-4.043	12.625	.880	NS
Group B		-4.390	8.077				
	Pre OP - 6 Months Group B	Group A	-17.447	12.418	.884	NS	
		-17.805	10.127				
	3 Months – 6 Months Group B	Group A	-13.404	5.224	.993	NS	
			-13.415	5.296			

Table 6: Parameter A: ALPHA

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		t test p value
				Lower Bound	Upper Bound	
Group A						
42	90.23	3.02	89.29	91.17	.000	HS
Group B	39	93.33	2.17	92.63	94.04	
Total	81	91.72	3.06	91.05	92.40	

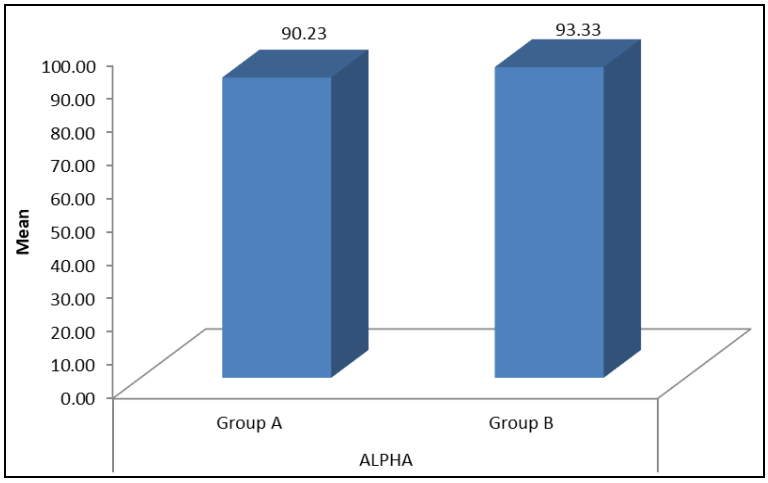

Fig 6: Coronal Femoral component alignment between groups (Alpha angle)

Table 7: Parameter A: Beta

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		t test p value
				Lower Bound	Upper Bound	
Group A						
43	90.85	2.89	89.96	91.74	.007	HS
Group B	43	92.54	2.78	91.69	93.40	
Total	86	91.70	2.95	91.06	92.33	

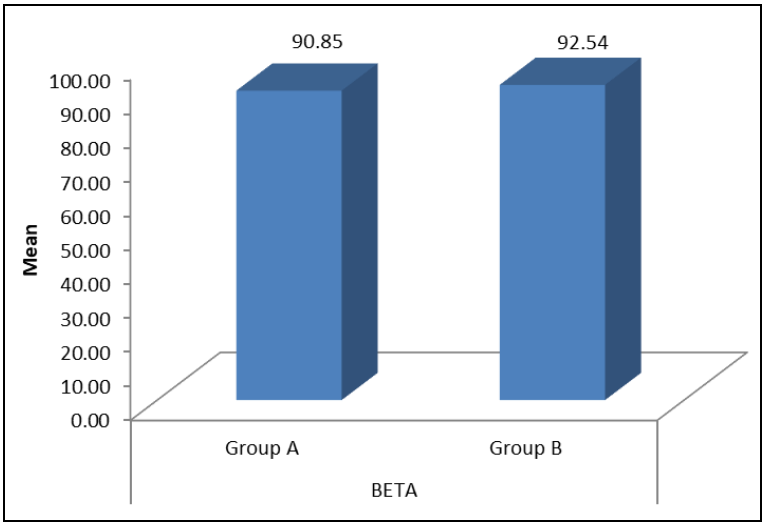

Fig 7: Coronal tibia alignment between both groups (Beta angle)

Table 8: Parameter A: Delta

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		t test p value
				Lower Bound	Upper Bound	
Group A						
41	3.23	1.02	2.91	3.56	.000	HS
Group B	41	4.68	1.08	4.34	5.02	
Total	82	3.96	1.28	3.68	4.24	

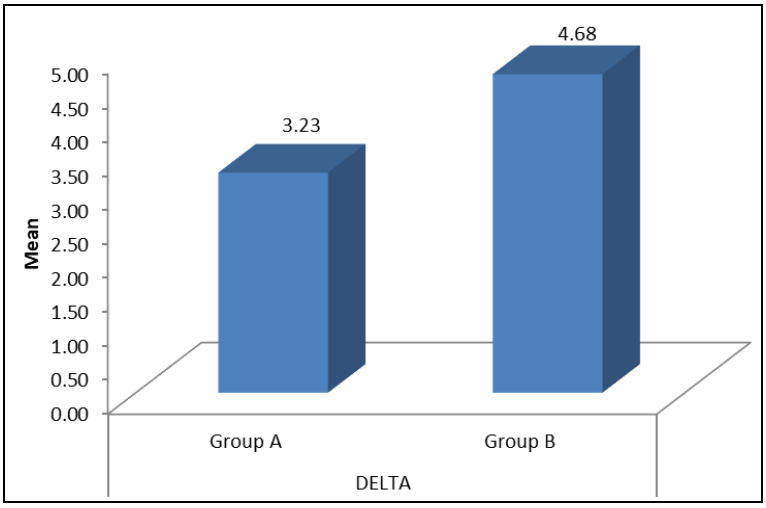

Fig 8: Sagittal Femoral component alignment between both the groups (Delta)

Table 9: Parameter A: Sigma

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		t test p value
				Lower Bound	Upper Bound	
Group A						
41	4.73	.90	4.45	5.01	.042	sig
Group B	41	5.02	.16	4.98	5.07	
Total	82	4.88	.66	4.73	5.02	

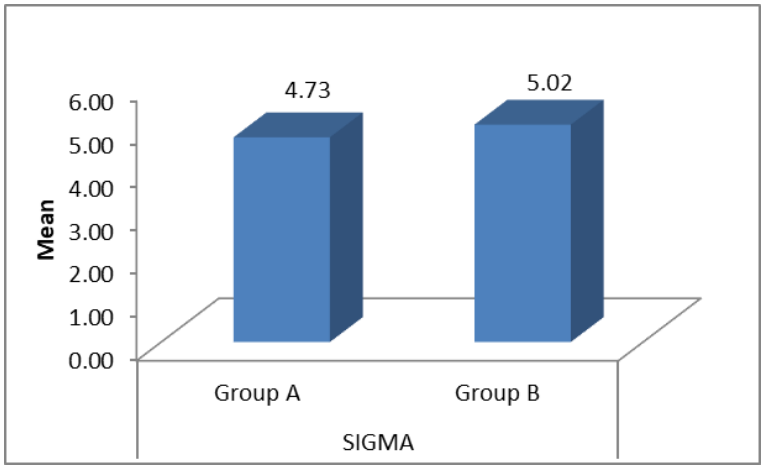

Fig 9: Sagittal tibial component alignment between bith the groups (Sigma)

Discussion

It has been reported that computer navigation improves the alignment in TKR and thereby increase the longevity of the implant. A well-aligned TKR is likely to function better whether it has been navigated or not. It might reasonably be assumed that a poorly aligned TKR might function less satisfactorily and might last for lesser duration. However, there have been no studies to indicate an improvement in functional outcome or rates of wear following the use of computer navigation. We found that after 6 months, there was no significant difference in functional outcome (Knee Society Score) and patient satisfaction between patients who underwent a computer-navigated or a conventional TKR. While the mean difference the both groups was not significant and further investigation is needed to confirm these results. However, at 6 month post-operatively the functional outcome between the computer-navigated and conventional groups appeared to be no different despite the better alignment achieved using the computer navigation technique.

Total knee replacement is a very successful operation with a high level of patient satisfaction and functional improvement. It may, therefore, be difficult for computer navigation to show a significant improvement in these variables in the short term. It is possible that improved alignment may decrease wear of the implant and improve the functional outcome in the long term, at least five to ten years after implantation. Therefore to

know if the navigation system has a role in improving the functional outcome and patient satisfaction a long term study would be needed.

Conclusion

Navigation TKR significantly improves the alignment of both femoral and tibial components when compared with the conventional TKR. However there was no significant difference in functional outcome between the two methods. Probably a long term study might highlight on if navigation has a role in improving the longevity of the implant.

References

1. Bejek Z, Solyom L, Szendroi M. Experiences with computer navigated total knee arthroplasty. Int Orthop 2007; 31(5):617-22. Epub 2006 Nov 4.
2. Dev Krishan Sharma, Murtuza Rassiwala *et al*. Navigation assisted total knee arthroplasty - Evaluation of correction of clinico - Radiololgical parameters in substantial varus deformity. International Journal of Orthopaedics Sciences. 2017; 3(1):747-754.
3. Spencer JM *et al*. Computer navigation versus conventional total knee replacement. J Bone Joint Surg [Br] 2007; 89-B:477-80
4. Rajesh Malhotra. Newdelhi: Jaypee brother's medical publishers; Mastering Orthopaedic Techniques Total knee arthroplasty 2010; 17(1).
5. Clement ND *et al*. Articular surface mounted navigated total knee arthroplasty improves the reliability of component alignment. Knee Surg Sports Traumatol Arthrosc. 2018; 26:1471-1477.
6. Fehring TK. Rotational malalignment of the femoral component in total knee arthroplasty. Clin Orthop Relat Res. 2000; 380:72-9.
7. Lotke PA, Ecker ML. Influence of positioning of prosthesis in total knee replacement. J Bone Joint Surg Am. 1977; 59(1):77-9
8. Hoffart HE *et al*. A prospective study comparing the functional outcome of computer-assisted and conventional total knee replacement. J Bone Joint Surg Br 2012; 94-B:194-9.
9. Clemens Baier *et al*. Clinical, radiological and survivorship results after ten years comparing navigated and conventional total knee arthroplasty: a matched-pair analysis. International Orthopaedics (SICOT) DOI 10.1007/s00264-017-3509-z.
10. Yonghui Fu *et al*. Alignment outcomes in navigated total knee arthroplasty: a meta-analysis. Knee Surg Sports Traumatol Arthrosc, 2012; 20:1075-1082.
11. Dnyanesh G Lad *et al*. Component alignment and functional outcome following computer assisted and jig based total knee arthroplasty. Indian Journal of Orthopaedics 2013, 47.
12. Jawhar A *et al*. Joint line changes after primary total knee arthroplasty: navigated versus non-navigated. Knee Surg Sports Traumatol Arthrosc DOI 10.1007/s00167-013-2580-2.
13. Yogeesh D *et al*. Does computer navigation in total knee arthroplasty improve patient outcome at midterm follow-up. International Orthopaedics (SICOT). 2009; 33:1567-1570.
14. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical ratingsystem. Clin Orthop. 1989; (248):13-14.
15. Eth EK *et al*. Comparison of functional and radiological outcomes after computer-assisted versus conventional total knee arthroplasty: a matched-control retrospective study. Journal of Orthopaedic Surgery. 2008; 16(2):192-6
16. Jaap J *et al*. Computer Navigated Versus Conventional Total Knee Arthroplasty. J Knee Surg. 2012; 25:347-352.
17. Wei Ting Lee *et al.* Short-term outcome after computer-assisted versus conventional total knee arthroplasty: a randomised controlled trial. Journal of Orthopaedic Surgery 2015; 23(1):71-5.
18. Ritter MA, Davis KE, Meding JB, Pierson JL, Berend ME, Malinzak RA. The effect of alignment and BMI on failure of total knee replacement. J Bone Joint Surg Am 2011; 93:1588-96.
19. Huang NF, Dowsey MM, Ee E, Stoney JD, Babazadeh S, Choong PF. Coronal alignment correlates with outcome after total knee arthroplasty: five-year follow-up of a randomized controlled trial. J Arthroplasty 2012; 27:1737-41.
20. Zhang GQ, Chen JY, Chai W, Liu M, Wang Y. Comparison between computer-assisted-navigation and conventional total knee arthroplasties in patients undergoing simultaneous bilateral procedures: a randomized clinical trial. J Bone Joint Surg Am 2011; 93:1190-6.
21. Harvie P, Sloan K, Beaver RJ. Computer navigation vs conventional total knee arthroplasty: five-year functional results of a prospective randomized trial. J Arthroplasty 2012; 27:667-72.
22. Choi WC, Lee S, An JH, Kim D, Seong SC, Lee MC. Plain radiograph fails to reflect the alignment and advantages of navigation in total knee arthroplasty. J Arthroplasty 2011; 26:756–64.
23. Blakeney WG, Khan RJ, Wall SJ. Computer-assisted techniques versus conventional guides for component alignment in total knee arthroplasty: a randomized controlled trial. J Bone Joint Surg Am 2011; 93:1377-84.