

Original Research Article

Comparative study of early functional outcome between cruciate retaining knee and 3D knee: who is more satisfied?

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ABSTRACT

Background: With growing demand on quality of life, there is drastic increase in total knee arthroplasty (TKA) surgeries and accordingly there is increase in research on TKA design to get the best possible outcome. Commonly known TKA designs are PCL substituting or retaining, fixed bearing or mobile bearing. Now the scientific research shifted to center of rotation of angulation (CORA) of knee i.e. medial or lateral pivot. 3D knee is based on lateral pivot system and designed to match the natural knee. The purpose of this study is to compare 3D knee with cruciate retaining (CR) knee functionally and also to assess the patient's level of satisfaction.

Methods: 20 patients each included in 3D knee and CR knee group from June 2016 to June 2018 who satisfied the inclusion and exclusion criteria. Patients were followed up for 1 year. Their functional outcome assessed using knee society score (KSS) part 1 and 2. Also patient's knee range of motion documented separately.

Results: Postoperatively there is improvement in knee society score in both the groups. 3D knee showed significant better KSS score than CR knee groups in first 3 months but as the patients followed up for 1 year both groups reached similar KSS score and also similar knee range of motion.

Conclusions: 3D knee showed satisfactory outcome when compared with CR knee and definitely provides a step ahead in search of natural knee.

Keywords: 3D knee, Cruciate retaining knee, Lateral pivot, Knee society score

INTRODUCTION

The primary goal of total knee arthroplasty (TKA) is to relief pain and to improve the quality of life. Outcome of various studies are typically very good.¹⁻³ But quite a few times patient do not get satisfactory range of motion and functional outcome. A variety of prosthesis have been designed with most of the implants either substituting a resected PCL or allow for its preservation.^{4,5} During recent times, in addition to cruciate substituting or retaining, mobile or fixed bearing, there are studies regarding rotation of pivot, centre of rotation (COR) of the knee joint.⁶⁻¹⁰ Implants were designed with COR in

the medial compartment which was explained by high congruity of femoral epicondyle with concave medial tibial plateau and has been accepted in literature for years.¹¹⁻¹³

But more recently studies suggested that during dynamic activities and walking COR found to be lateral compartment of knee joint but during kneeling and squatting COR shift to the medial side.¹⁴⁻¹⁹

The effect of lateral COR on TKA's functional outcome and patient's satisfaction is still missing in the literature. So current study is initiated to gather evidence of this

new TKA articular design concept that incorporates programme congruency in bilateral compartment (3D knee) aiming to provide inherent antero-posterior knee stability and recreates the motion pattern of natural knee and to compare its functional outcome and patients satisfaction with cruciate retaining(CR) knees.

METHODS

This prospective study done in shashwat hospital pune from June 2016 to June 2018. Total 40 patients were included in the study (20 patients in 3D knee group and 20 patients in CR knee group). Inclusion criteria were age >60 years; moderate to severe knee pain which disturb the daily routine activities; patient with tricompartmental osteoarthritis knee with less than grade III varus deformity and up to 20 degree FFD. Exclusion criteria were age >80 year; inflammatory arthritis; valgus knee, Charcot joints; previous surgery, infection; severe comorbid conditions; severe varus- grade IV, FFD more than 20.

All patients operated at same centre by single surgeon. Well informed, written consent taken before the surgery. All patients operated under spinal/epidural anaesthesia on standard OT table. All aseptic precautions taken like modular OT setup, body exhaust system to minimise infection. Standard anterior midline incision, medial Parapatellar approach used for all the cases (Figure 1). Other steps almost same in both the system with only two main difference. (1) In CR knee PCL is preserved but in 3D knee PCL can be maintained or excised depending on its integrity; (2) in CR knee soft tissue balancing done with usual measured resection technique but in 3D knee balancing achieved with gap balancing technique where extension gap is matched with flexion gap using gap balancer jig. Post op pain management includes nerve blocks, NSAIDS (COX-2 inhibitors), gabapentin, cryotherapy, CPM.

Patient discharged on DAY 4 with FWB walking with walker, knee exercises, commode training and suture removal done on 15th day. All patients followed up every month and knee society score calculated on 1, 2, 3, 12 months post-surgery.

Principle questions related to satisfaction consists of asking the patient regarding overall function of the knee,

ability to perform normal activities of daily living, satisfaction with degree of pain relief and categorised as very satisfied, somewhat satisfied, somewhat dissatisfied, very dissatisfied.

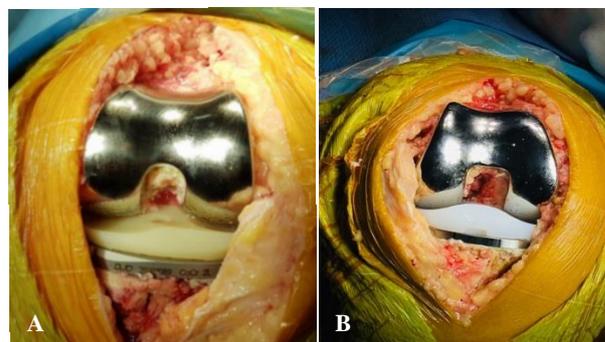


Figure 1: (A) 3D knee; B) CR knee.

The 3D knee incorporates a hemispherical lateral condyle and tibial articulation to provide definitive AP translational control while providing for proper axial rotation. The asymmetric femoral component incorporates a constant sagittal radius from -15° to 80° while providing progressively decreasing articular constraint with higher flexion to allow femoral condyle rollback.

Statistical analysis

Data statistically analysed using Fisher's exact test for categorical variables and student's T test for continuous variables. Two tailed P value of less than 0.05 considered to be significant.

RESULTS

The demographic data is given in Table 1. The mean ages of both the groups of patients were comparable. There was no statistically significant difference in the age, sex, pre-operative deformity, pre-operative Range of motion, pre-operative knee society score ($p>0.05$) among both the groups.

Assessment of knee society score part I,II done for both groups and means calculated at 4th week, 8th week, 12th week, 1 year and compared at each follow. 3D knee group patients showed better knee society score at the end of 12th weeks ($p<0.05$) but at the end of 1 year both groups showed similar scores ($p>0.05$) (Table 2, Figure 2).

Table 1: Preoperative parameters of patients in both groups.

	3D knee	CR knee	P value
Age (mean)	69.5±4.0years	68.4±4.6years	0.381
Sex (F:M)	14:6	15:5	>0.999
Preoperative knee society score (mean)			
Part 1	39.50±11.33	37.25±13.19	0.566
Part 2	33.25±16.08	30.5±16.58	0.885
Preoperative knee ROM (mean)	116 ⁰ ±10 ⁰	117 ⁰ ±9 ⁰	0.676
FFD	5.50±5.38	5.25±5.25	0.882
Varus deformity	8.15±3.56	8.10±3.58	0.964

M-male, F-female, ROM –range of motion, FFD-fixed flexion deformity.

Table 2: Comparison of postoperative knee society score of both groups.

	KSS1			KSS2		
	3D knee	CR knee	P value	3D knee	CR knee	P value
4 weeks	68.05±8.82	62.25±7.52	0.031	63.25±7.48	57.75±5.50	0.011
8 weeks	74.70±7.79	67.75±6.97	0.005	69.50±8.41	62.75±5.25	0.004
12 weeks	79.30±7.61	73.40±7.80	0.020	76.75±5.91	70.75±7.30	0.007
1 year	94.20±3.19	94.60±2.91	0.681	94.25±5.20	94.00±3.84	0.864

KSS –knee society score, CR – crciate retaining

Table 3: Comparison of post-operative knee range of motion in both groups.

Knee ROM	3 D Knee	CR Knee	P value
4weeks	91.75±6.34	86.00±7.88	0.015
8 weeks	105.50±8.57	99.00±8.37	0.020
12 weeks	115.25±7.69	109.50±8.41	0.030
1 year	123.25±6.74	124.25±6.74	0.641

ROM- range of motion

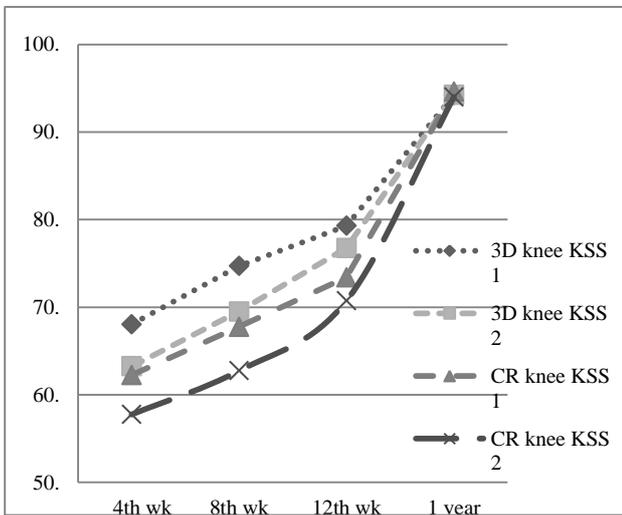


Figure 2: Comparative improvement in KSS in both the groups.

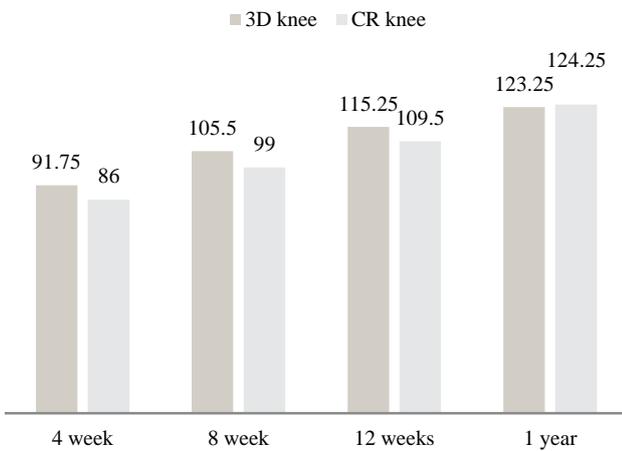


Figure 3: Comparison of knee range of motion between both groups.

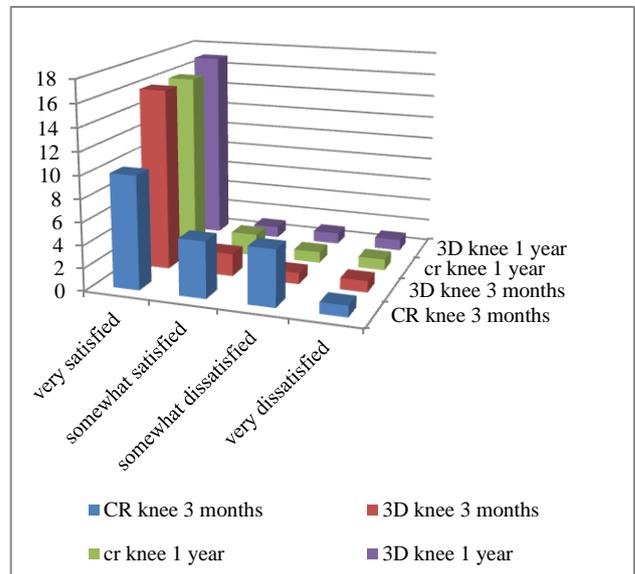


Figure 4: Patient’s level of satisfaction among both the groups.

Patients knee range of motion also documented separately at each visit and improvement noted at each visit and comparison done between both the groups. Again 3D knee group patient had significantly better knee range of motion during initial 3 months compared to CR knee group(p<0.05) but both groups showed similar range of motion at the end of 1 year (p>0.5) (Table 3, Figure 3).

Patients satisfaction was classified into very satisfied, somewhat satisfied, somewhat dissatisfied, very dissatisfied at 3 months and at the end of 1 years. 3D knee group patients showed better satisfaction in early post-operative period though insignificant (p=0.261)but by the end of 1 year both groups are equally satisfied (Figure 4).

DISCUSSION

The successful outcome of any TKA is not only dependent on proper preoperative planning but also partially dependent upon TKA design with suitable congruity and constraint to provide adequate knee joint stability not only during walking but also during daily activity like kneeling, squatting which give patient sense of normal knee.²⁰ There are several research articles to understand kinematics of knee joint. Few studies reports that COR of the knee is in the medial compartment^{13,21-25} but instantaneous COR does occur in the medial compartment in only about 25% of the stance. Medial pivoting motion is required during non-ambulatory activities such as squatting and during passive range of motions.²⁶ The studies by Andriacchi et al, Lawfortune et al, Banks et al, showed that COR of the knee is in lateral compartment for most of the time (70%) during stance phase of normal walking.^{27,28,20} Though ideal TKA design should permit both medial and lateral pivoting at different phase of stance but it is always a challenge to design a knee that mimic exactly the natural knee.

The principle question for any TKA design with or without PCL is to address the knee stability during dynamic activities like gait, stair climbing and whether the tibiofemoral articulation reduces unproductive AP sliding without compromising the knee range of motion. In this current TKA design (3D) knee PCL can be either meticulously maintained or summarily excised demonstrating the adaptability of this TKA design with any of the surgical technique.

The most common design accepted throughout the world to provide AP stability is cam and post design. But several complications like increased strain at prosthesis – bone interface and wear of tibial post has been documented with these designs.²⁹⁻³³ O’rourke et al reported osteolysis in 16% of PS knee, Mikulak et al reported osteolysis and 3% revision rate in PS knee, similarly Han et al reported 38% loosening rate in PS knee at 2-4 years follow up.³¹⁻³³ As 3D and CR knee design does not depend on cam and post mechanism, it definitely provide advantage in avoiding such complications associated with cam and post design.

In this study we compared CR knee with 3D knee because both design mimic more normal knee kinematics. CR knee have the advantage of preservation of bone, increased proprioception and greater stabilisation of the prosthesis. 3D knee as described earlier is based on lateral pivot system that is required during most of the stance phase. In literature there is hardly any study to compare the functional outcome of 3D knee and CR knee. We observed 3D knee patients outscoring CR knee patients in KSS, knee range of motion, level of satisfaction during first 3 month of operation. Reason can be 3D knee congruity mimic natural knee design which may give patient better sense of stability and confidence to rehabilitate early, CR knee

being bone preserving knee also provide same advantages with time. So both groups have similar functional outcome at the end of 1 year with good range of knee motion. Both groups of patients are equally satisfied at the end of one year.

CONCLUSION

3D knee and CR knee both being bone preserving design and closer to natural knee kinematics had similar functional outcome, knee range of motion and patient level of satisfaction at the end of 1 year, though 3D group showed better score during early postoperative period. The concept of lateral pivot definitely provides a good prospective for the search of natural knee.

Limitations

Sample size is small and Long term follow up is required to further study the complications, survivorship and end results

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Ethical approval: Not required

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