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Clinical Utility of Cruciate Retaining Total Knee Arthroplasty with Four-pegged Tibial Baseplate in the Valgus Knee: A Concise Minimum 4 Year Follow-up

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Abstract

Introduction: The four pegged tibial base plate in the cruciate retaining (CR) total knee is a modern design used in the treatment of gonarthritis. This design allows preservation of host bone, smaller incisions, and ease with removal of implant in the revision setting. In this study, we investigate the outcome of the four pegged tibial base plate in the treatment of valgus knee.

Methods: We performed a retrospective review of 39 TKA who had a four pegged TKA in 38 consecutive patients with an average of 68 month follow-up (52-98 months). There were 29 females and 9 males, with mean age of 67 (range 27 to 89 years old). Radiographs, clinical notes, and functional scores were evaluated.

Results: The average postoperative range of motion was 119 ± 9 degrees, which increased compared to the pre-operative range of motion of 101 ± 14 degrees ($p<0.0001$). Postoperative knee function scores were 95 ± 5, (range 82 to 100). Additionally, the knee scores were 91 ± 14, (range 45 to 100). Survivorship for this cohort with endpoint of revision was 94.8% at a minimum of 4 years. All patients had good coronal and anterior posterior stability postoperatively. There were two complications; one patient was revised for patellar mal-tracking and the other for an incompetent posterior cruciate ligament.

Conclusions: To our knowledge, this is the first study reviewing retrospectively the four pegged CR TKA in the treatment of valgus gonarthritis. Our results support the use of the four pegged tibial base plate in valgus knee.

Keywords: Valgus knee arthritis; Four pegged tibial base plate; Cruciate retaining; Total knee arthroplasty

Level of Evidence: Level IV

Introduction

The valgus knee accounts for approximately ten percent of Total Knee Arthroplasties (TKA's). When encountered, it presents a unique challenge to the surgeon. Correction of the valgus deformity involves consideration of both the soft tissue and bony anatomy. The goals of TKA include returning the knee to an anatomic angle of five degrees of valgus through both bony cuts and soft tissue release.

The four pegged tibial base plate is a modern design that is less frequently used in TKA. The advantages of the four pegged tibia include host preservation of bone, facilitates use of minimally invasive surgical technique, and ease of removal in the revision setting [1]. Additionally, this base plate allows for more flexibility in placement of the tibial tray especially in patients with asymmetric positioning of medullary canal relative to tibial cut surface [2]. The four pegged tibial base plate is also best suited for patients with extra-articular deformity of the tibia, most commonly in post high tibial osteotomy patients. Barrington et al. studied the use of the four pegged tibial plate in CR TKA and found that the theoretical concern of decreased resistance to torsional and shear stress was unfounded with excellent results at 10 year follow-up [1].

To our knowledge, there is no published data of the role of the four pegged cruciate retaining design for treatment of valgus knee arthritis. This study evaluates the survivorship and outcomes of a low-profile four-peg tibial base plate without intra-medullary extension in TKA for the valgus knee.

Methods

After Institutional review board approval, a retrospective analysis of all total knee replacements performed by from January 2001 and December 2004 yielded 38 patients (29 females with 30 TKAs and 9 males with 9 TKAs) who had 39 Total Knee Arthroplasties (TKA) with preoperative valgus deformity greater than 10 degrees. These patients were implanted with the Zimmer Nex Gencruciate retaining total knee with a four pegged tibial base plate and followed for an average of 68 months (52-98 months). Exclusion criteria included patients who underwent revision TKA or were under the age of 18. The mean age and standard deviation at the time of surgery for the entire cohort was 67 ± 13 years (27 to 89 years). The preoperative diagnosis for 36 patients was osteoarthritis and for 2 patients rheumatoid arthritis. The youngest patients in our cohort had a preoperative diagnosis of rheumatoid arthritis.

Two senior surgeons performed a standard medial parapatellar arthrotomy on all study patients. All surgical operative notes were reviewed to determine surgical approach and ligamentous release. For

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each case, femoral and tibial bony resections were performed, and both surgeons, subsequently, assessed flexion and extension gaps. If these gaps were trapezoidal and not rectangular, we sequentially released the iliotibial band, popliteus, a portion of lateral collateral ligament, and the posterior capsule. Twenty-two of the 39 TKA procedures had ligamentous releases to achieve proper coronal balance (Table 1). Postoperatively at each follow up visit during the study period, all patients were assessed by the operating surgeon manually for stability to varus and valgus stress and anterior-posterior translation.

Standard AP and lateral radiographs taken preoperatively and postoperatively at the final follow-up were collected for limb alignment assessment. These radiographs were reviewed separately by the two authors who recorded preoperative and postoperative overall limb alignment as well as postoperative tibial and femoral alignment using GE Centricity software. Paired *t*-tests were performed to assess inter-observer reliability of limb alignment measurements and to determine any significant difference in measurement of preoperative versus postoperative range of motion.

At a minimum of four year follow-up, clinical results were assessed with the American knee score that John Insall [3] modified in 1993 based on clinical parameters, and the knee function score. The American knee score has both a functional and clinical component, each scored out of 100 with a higher score signifying a better outcome. Follow-up information and knee scores were obtained postoperatively with a combination of telephone interviews for functional component and chart review for the clinical component of the knee score with all but one patient at an average of five year follow-up (Supplementary).

Results

In this cohort of 39 TKAs, the average postoperative range of motion was 119 ± 9 degrees, which increased compared to the preoperative range of motion of 101 ± 14 degrees ($p<0.0001$) (Tables 2a-2c). The average standing femoral-tibial preoperative alignment was 15.4 ± 4.4 degrees, (range 10 to 29 degrees) of valgus which decreased significantly ($p<0.0001$) postoperatively to 4.4 ± 2.8 degrees, (range 0 to 12 degrees). The postoperative posterior slope measured 4.6 degrees ± 0.4 degrees (range 1.5 to 7). Postoperative knee function scores were 95 ± 5, (range 82 to 100). Additionally, the knee scores were 91 ± 14, (range 45 to 100). Survivorship for this cohort was 94.8% at five years. All patients had good coronal and anterior posterior stability postoperatively.

Two patients underwent revision during the minimum of four year follow-up period. One patient had patellar maltracking and patella femoral impingement and underwent lateral retinacular release. The second patient underwent revision for laxity and pain with a diagnosis of incompetent non-tensed posterior cruciate ligament and some loosening noted on the lateral tibia intra operatively with no loosening of the femoral component. Figure 1 shows preoperative and postoperative radiographs. The patient was revised to a posterior cruciate substituting knee system. In these two patients, no specific releases were noted in the operative reports for the primary procedures. The preoperative valgus alignment was 11 and 17 degrees, respectively, and the postoperative valgus alignment was 4 and 8 degrees of valgus, respectively.

Type of Release	Number of Patients
Iliotibial Band Release	4
Iliotibial Band and Posterior Capsular Releases	2
Iliotibial Band and Popliteus Releases	12
Iliotibial Band, Popliteus, and Posterior Capsular Releases	2
Iliotibial Band, Popliteus, and Partial Lateral Collateral Releases	2
No Release	17

Table 1: Different types of ligamentous releases.

Patient Number	Preoperative ROM	Postoperative ROM
1	100	125
2	105	115
3	85	120
4	100	100
5	85	110
6	110	100
7	N/A	130
8	105	115
9	130	135
10	90	115
11	110	115
12	85	125
13	110	125
14	115	120
15	95	95
16	95	120
17	115	135
18	85	130
19	N/A	130
20	115	125
21	100	120
22	100	120
23	115	120
24	N/A	120
25	95	113
26	120	95
27	90	120
28	95	120
29	100	110
30	95	100
31	93	120
32	120	120
33	115	130
34	95	120
35	95	120
36	N/A	120
37	90	120
38	115	120
39	100	120

Table 2a: Preoperative and postoperative results.

Flexion Contracture in Degrees	Number of Patients
0	15
5	19
7	1
10	2
15	2

Table 2b: Data of the Flexion contracture.

Discussion

Choice of implant and implant type are important in the treatment of the valgus knee. In this series, we focused on the use of the four pegged tibia. In our series, only one patient had a revision secondary to aseptic loosening of implants. Our findings were concordant with those of Barrington et al. who had shown excellent results with this low profile tibial base plate in the CR TKA [1].

Patient	Average Preoperative Femoraltibial Alignment (Degrees)	Average Postoperative Femoraltibial Alignment (Degrees)	Average Tibial Posterior Slope (Degrees)
1	13.5	2	3
2	13	4	5
3	12	4.5	4
4	13	5	4.5
5	10	2.5	5
6	10.5	2.5	4
7	12	2.5	3.5
8	29	8	3
9	11.5	4	4.5
10	14	1	5
11	17.5	6	5
12	22	3.5	5.5
13	17	6.5	4
14	13	4.5	6.5
15	15	0	5
16	14	3	3
17	12.5	6	3.5
18	13.5	1	6.5
19	12.5	3	5
20	20.5	2.5	6
21	15	4	3
22	15.5	3	3.5
23	15.5	5	3
24	13	9.5	3
25	11	4.5	5
26	21	7	6.5
27	22	8	6
28	13.5	5.5	5
29	12	0.5	3
30	10	2.5	4.5
31	18	5.5	3.5
32	19	8	7
33	18	4	6.5
34	18.5	4.5	6
35	15	6	4
36	9.5	4.5	6.5
37	15	4.5	6.5
38	15	6	1.5
39	28.5	6	2.5

Table 2c: Average alignments of Patients.

There has been concern regarding the use of the four pegged tibia due to torsion and shear forces experienced on the tibial base plate during the gate cycle. Albrektsson et al. [4] found that the stemmed tibial base plate better resisted varus-valgus and anterior posterior displacement. However, Miller and Pettygrow had studied the four pegged tibial base plate with 10.5 year follow-up demonstrating good to excellent results in 91% of patients and 1% aseptic revision rate [2]. Despite not having a stem, the four-pegged tibial base plate provides good clinical results while conferring the advantages of not having a stem.

At 4 year follow-up, patients were assessed for both anterior posterior and medial lateral stability. All patients were noted to have good stability. Additionally, average preoperative limb alignment was corrected from 15.4 degrees to 4.4 degrees. Both correction of coronal alignment and maintenance of coronal stability had been achieved without the use of a more constrained type of knee replacement. Although preoperative knee and function scores were not available,

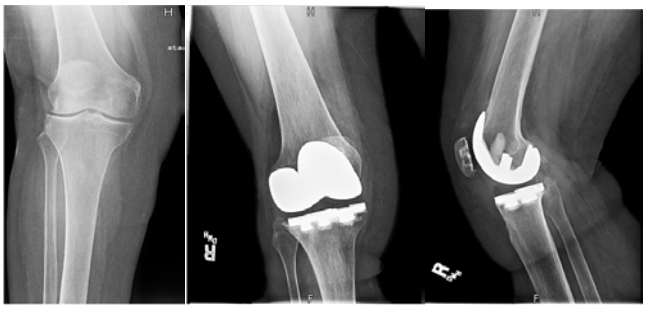

Figure 1: Preoperative and Postoperative Radiographs.

postoperative scores indicated that patient knee function as well as perception of knee function was excellent. Kubiak et al. [5] had a subgroup of 44 knees with greater than or equal to 20 degrees of valgus preoperatively treated with cruciate retaining TKA with 96.2% survivorship at 10 years. This series of patients was the next largest series of valgus treated with cruciate retaining prosthesis with a similar mean knee score of 92.

Two cases from this series were revised. One was for patella femoral impingment and patellar subluxation. Lateral retinacular release and small osteotomies on both medial and lateral aspects of the patella were performed with retention of implants. The second case was revised specifically for pain and laxity. Intra-operatively, the lateral tibial component was loose, and the posterior cruciate ligament was incompetent. The knee was revised to a cruciate substituting knee. In this patient, no specific releases were performed during the index procedure, and the patient had a preoperative valgus limb alignment of 17 degrees that was corrected to 8 degrees postoperatively. Fang et al. [6] reported a statistically increased rate of revision in patients with valgus alignment greater than 7.2 degrees. In this case, the greater amount of postoperative valgus led to increased forces through the lateral compartment loosening the lateral tibial component.

The limitations of this study include radiographic assessment based on short-standing AP knee radiographs reviewed by two orthopedic fellows and lack of preoperative knee scores. However, inter observer error was minimal since paired t-test comparing measurements between authors were statistically similar with $p<0.0001$. Another source of error could derive from the lack of long standing films at routine follow-up. However for the purposes of this study, we found these films adequate. Lastly, the lack of preoperative knee scores is a limitation in order to show improvement relative to postoperative scores. In lieu of preoperative knee scores, we compared our results to those seen in the literature.

Conclusion

Our results demonstrate excellent outcomes and survivorship at four years with the use of the four pegged cruciate retaining total knee system in the treatment of valgus knees. The four pegged cruciate retaining knee system may provide an effective alternative to the standard knee arthroplasty with the possible benefit of bone preservation and simpler revision.

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