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Original research article

Analysis of Posterior Tibial Slope on Range of Movements and Functional Outcome Following Total Knee Arthroplasty

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Abstract

Background: To evaluate the influence of posterior tibial slope on range of movements following a total knee Arthroplasty. To assess the functional outcome following a total knee Arthroplasty according to KneeSociety Score**.**

Methods: In this study 30 patients with OA knee were studied. All the cases were treatedat department of orthopaedics at NMCH, Patna Study duration of Two years. The duration of follow up ranged from 3 weeks to 6 months. All the cases in this study were Primary OA knee. No post traumatic or pathologicalknees were taken into the study. Post operatively all patients will be subjected to x-ray imaging and evaluated clinically at 3 weeks, 3 months and 6 months for the range of movements and Knee Society Score.

Results: Average flexion in this study at the end of 6 months was about 115^0 with an average KSS of 77. Good results were seen in about 80% patients according to the functionaloutcome-KSS. 2 patients had late onset post-operative infection.

Conclusion: Achieving optimal PTS in CR-TKA is an important variable in obtainingmaximal flexion range of motion. The findings in this study suggest that PTS provides for improved flexion range of motion by limiting posterior tibiofemoral impingement via increased rollback. Although flexion and rollback may be improved with initial increases ofPTS up to 5°, our data suggest that further increases in PTS above 5^0 may fail to improve flexion and rollback.

Keywords: TKA, PTS.

Introduction

The primary indication for TKA is to relieve pain caused by severe arthritis, with orwithout significant deformity. Other sources of knee and leg pain must be sought and systematically excluded.

These include:

*Radicular pain from spinal disease,
*Referred pain from ipsilateral hip,
*PVD,
*Meniscal pathology, and
*Bursitis of the knee.

Radiographic findings must correlate with a clear clinical impression of knee arthritis.Before surgery is considered, conservative treatment measures should be exhausted. These including:

*Anti-inflammatory medications,
*Activity modifications, and

*The use of cane for ambulation.

Patients who do not have complete cartilage space loss before surgery tend to be less satisfied with their clinical result after TKA[1]. Because knee replacement has a finite expected survival that is adversely affected by activitylevel, it generally is indicated in older patients with more sedentary lifestyles. It also is clearly indicated in younger patients who have a significant functional impairment from osteoarthritis or from other pathologic causes such as systemic arthritis with multiple joint involvement or osteonecrosis with subchondral collapse of a femoral condyle. Severe pain from chondrocalcinosis and pseudo gout in an elderly patient is an occasional indication for Arthroplasty in the absence of complete cartilage space loss. Rarely, severe patellofemoral arthritis in an elderly patient may justify total knee Arthroplasty because the expected outcome of Arthroplasty is better than that of patellectomy in these patients. Newer,less constrained versions of patellofemoral Arthroplasty have been introduced and now have mid-term clinical results that are better than those reported with earlier, more constrained designs. Deformity can become the principal indication for Arthroplasty in patients with moderate arthritis and variable levels of pain when the progression of deformity begins to threaten theexpected outcome of an anticipated Arthroplasty. As flexion contracture progresses beyond 20 degrees, gait is significantly hampered and difficulty with regaining extension may warrant surgical intervention. Similarly, as type of prosthesis may be necessary to prevent subsequent coronal plane instability. Intervening before this degree of laxity is present allows the use of aprosthesis that lacks coronal plane constraint and has a more favourable expected survivorship. Absolute contraindications to TKA include recent or current knee sepsis; a remote source of ongoing infection; extensor mechanism discontinuity or severe dysfunction; recurvatum deformity secondary to neuromuscular weakness; and the presence of a painless, well- functioning knee arthrodesis. Relative contraindications are numerous and debatable and include medical conditions that compromise the patient's ability to withstand anaesthesia, the metabolic demands of surgery and wound healing, and the significant rehabilitation necessary to ensure a favourable functional outcome[2].

A severely osteoarthritic ipsilateral hip joint also should be considered for Arthroplasty before the symptomatic osteoarthritic knee, because rehabilitation is easier with a total hip Arthroplasty and an osteoarthritic knee than with a TKA and an osteoarthritic hip joint. Other relative contraindications include significant atherosclerotic disease of the operative leg, skin conditions such as psoriasis within the operative field, venous stasis disease with recurrent cellulitis, neuropathic arthropathy, super-obesity (BMI≥50), recurrent urinary tract infections, and a history of osteomyelitis in the proximity of the knee[3]. This list is not all inclusive, and any preoperative condition thatcan adversely affect the patient's outcome can be considered a relative contraindication.

Objectives

*To evaluate the influence of posterior tibial slope on range of movements following atotal knee Arthroplasty.

*To assess the functional outcome following a total knee Arthroplasty according to Knee Society Score.

Materials and methodology

In this study 30 patients with OA knee were studied. All the cases were treated at department of orthopaedics at Nalanda Medical College and Hospital Patna, Bihar. Study duration of Two Year**s.** The duration of follow up ranged from 3 weeks to 6 months. All the cases in this study werePrimary OA knee. No post traumatic or pathological knees were taken into the study. Post operatively all patients will be subjected to x-ray imaging and evaluated clinically at3 weeks, 3 months and 6 months for the range of movements and Knee Society Score.

Inclusion criteria

*All patients of either sex undergoing primary Total Knee Arthroplasty (TKA) in the department of Orthopaedics at NMCH Patna.
*All patients with grade 3 or above as mentioned in the above classificationMethods were taken into the study.

Exclusion criteria.

*Patients who did not undergo pre-operative x-ray imaging.
*Patients who have got pre-operative fixed Valgus/Varus deformity of $>30^0$.
*Patients previously undergone surgery in this study.
*Patients planned for revision of previously operated Arthroplasties.
*Patients who are expected to be unable to follow instructions given inconnection to the study.
*Patients with $<90^0$ pre-operative ROM, traumatic or
Infectious arthritis, patellar resurfacing, and >Outer bridge grade III in morethan 50% of the patellofemoral joint. All patients were subjected to Titanium based Knee systems of PCL-retainingtype. The limb to be operated was prepared. 1gm of 3rd generation cephalosporin was injected thenight before the surgery and early morning on the day of the surgery before shifting the patient to the operation theatre. To assess the range of movements, functional outcome with the help of Knee Society Score atthe end of 6 months following surgery.

Result

Table 1: Age distribution.

AGE IN YEARS	OA KNEE	%
41-50	3	10%
51-60	14	46.6%
61-70	9	30%
71-80	3	10%
81-90	1	3.33%
TOTAL	30	100%

Table 2:Sex distribution

SEX	OA KNEE	%
MALE	12	40%
FEMALE	18	60%
TOTAL	30	100%

Table 3: Side affected.

SIDE	OA KNEE	%
RIGHT	7	23.3%
LEFT	1	3.3%
BILATERAL	22	73.3%
TOTAL	30	100%

Table 4: Relationship between age & oa knee.

AGE	OA	
	NUMBER	%
>50 YEARS	2	6.6%
<50 YEARS	28	93.3%
TOTAL	30	100%

Table 5: COMPLICATIONS.

COMPLICATIONS	NUMBER
POST-OP INFECTION (IMMEDIATE)	-
LATE ONSET POST	2
IMPLANT FAILURE	-
FLEXION CONTRACTURE	-

Table 6: Posterior tibial slope

PTS	NUMBER	%
3°	27	90%
4°	2	6.6%
5°	1	3.3%
TOTAL	30	100%

Discussion

Present study comprised of 30 patients in which a total of 39 knees were operated byTKA. Overall final outcome was assessed in terms of ROM and knee function according to Knee Society Score. Out of the 30 patients in the study, 12 patients were male and 18 patients were female. Thismay suggest that the prevalence of OA knee was most commonly seen in females when compared to males[4]. When seeing the relationship between age and progression of disease it was found thatmajority of the patients were above the age of 50. Maximum number of cases were of Kellgren- Lawrence grade 2 to grade 3 type, with a fewfalling to grade 4 maybe because of negligence on the patient aspect. Total Knee Arthroplasty was considered after patients general and medical conditions wasstabilized. The average operating time was 105 mins[5]. Average flexion in this study at the end of 6 months was about 115^0 with an average KSS of77. Good results were seen in about 80% patients according to the functional outcome-KSS.2 patients had late onset post-operative infection. Small increases in PTS in the range of 1° to 5° appear to significantly increase knee flexion. For example, 5-10° of additional flexion can be achieved by increasing the PTS from 1° to 4°(2.3° improved flexion per degree increase of PTS). Bellemans et al[6] found a similar increase in total flexion of 1.7° per 1° increase in PTS. However, our findings conflict in that we observed a plateau effect on flexion past 5° of PTS. This may be explained by the differing methods of achieving flexion between Bellemans' study and our application of sufficient force to the midshaft tibia to achieve bony impingement vs consistent load applied to the hamstrings, respectively. Li et al suggested that muscle forces are important to create knee translation and rotation[7]. Because previous studies have suggested that tibiofemoral translationand rotation are important in achieving maximal flexion via a rollback phenomenon, we feel that achieving flexion via application of force to the native knee flexor muscles (hamstrings) may allow for a more physiologic method to assess PTFT and flexion[8].

During the same interval increase in flexion from 1° to 5° of PTS, PTFT increased significantly by 3.1 mm. This is the first study to our knowledge that has shown a correlation between PTS and PTFT. These findings conflict with an in vivo study by Kim et al in which they did not find a correlation between rollback and PTS in 49 cruciate-retaining (CR) TKAs.Potential reasons for this difference may include different TKA implant manufacturers/designs, confounding variables such as soft tissue contractures and PCL integrity that are difficult to control in vivo, and sample size. Posterior tibiofemoral translation is important in TKA because it allows more flexion beforetibiofemoral impingement occurs. In addition, a more posterior tibiofemoral contact point atfull flexion improves the quadriceps moment arm and has been associated with improved Knee Society Function scores in CR-TKA. Proper balancing of the PCL is paramount in achieving maximal flexion in CR-TKA. Severaltechniques have been described including increased PTS and PCL recession. Although these techniques are often used in combination, Jojima et al showed that increased PTS was superior to PCL recession in correcting AP tightness, varus/valgus laxity, and rotational laxity in a knee that was tight in flexion. Excessive tightness of the PCL has also been thought to cause posterior polyethylene wear and may be a mode of early failure in PCR- TKA[9]. Conversely, excessive PTS may result in suboptimal outcomes due to flexion instability, decreased PTFT, and anterior micro motion/loosening of the tibial component. The optimal amount of PTS in PCR-TKA is debatable, and evidence regarding optimal PTS is limited[10]. Although some recommend matching the PTS of the patient's native knee, other reports suggest placing the tibial component in 0° to 10° of PTS regardless of native PTS. In this study, we did not find a correlation between native knee PTS and the degree of PTS atwhich optimal flexion was obtained. Although 30 patients were sufficient for determining changes in flexion and PTFT, this sample size is not sufficient to determine whether preoperative slope correlates with the postoperative slope that yields maximal flexion. This islikely because each specimen can no longer serve as its own control because the native knee PTS is a static variable that inherently cannot be changed[11]. As such, a different study design would be necessary to determine if preoperative PTS should be used as a guide for creating postoperative PTS in CR-TKA[12]. Given the findings in this study, we support a more individualized approach of determining optimal PTS, which relies on intraoperative assessment of flexion range of motion and flexion gap stability. If the knee is too tight in flexion, one may consider small increases ofPTS up to a slope of approximately 5° (not including the 3° of PTS inherent to the polyethylene). Beyond 5° of PTS, we feel that returns on flexion and PTFT are limited and other PCL balancing methods should be performed. Although this study aims to answer clinically relevant questions, several limitations may limit its widespread applicability. First,we only measured a static position of the tibiofemoral contact point at maximal flexion, and therefore, AP movement during the dynamic flexion process (rollback or roll forward) as described by Dennis et al was not assessed. In addition, these findings may be manufacturer specific and, therefore, may not be applicable to designs that differ in parameters such as polyethylene conformity or change in radii of curvature of the femoral component[13]. Despite these limitations, we feel that the findings in this study provide some additional informationfor the surgeon to consider in the intraoperative setting and may be of benefit in future investigations regarding rollback in CR-TKA[14].

Conclusion

Achieving optimal PTS in CR-TKA is an important variable in obtaining maximal flexion range of motion. The findings in this study suggest that PTS provides for improved flexion range of motion by limiting posterior tibiofemoral impingement via increased rollback. Although flexion and rollback may be improved with initial increases of PTS up to 5°, our data suggest that further increases in PTS above 5^0 may fail to improve flexion and rollback.Given

that this study is based on a limited number of patients, these findings may not be applicable to the clinical practice of most orthopaedic surgeons before intra-op confirmation.

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