

# Intramedullary Versus Extramedullary Alignment Guide for the Accurate Sagittal Tibial Prosthesis Alignment in Total Knee Replacement Arthroplasty.

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## Summary:

**Background:** long term survivorship in total knee arthroplasty is significantly dependant on prosthesis alignment, several studies have correlated poor outcome with malalignment of the components. The debate on the optimal system for femoral alignment is now largely resolved, but there is still controversy about whether intramedullary or extramedullary systems are better for the tibial side.

**Objecives :** is to determine whether intramedullary or extramedullary tibial alignment guide is better for accurate sagittal tibial prosthesis alignment in total knee replacement arthroplasty.

**Patients and methods:** Of 65 patients recruited, only 48 patients (55 knees) were met the inclusion criteria of this study (32 female and 16 male) with an average age of 62.2 years ranging from 57 to 70 years who had attended the outpatient clinic in medical city-orthopedic and trauma consultation unit and private work, during the period from October 2010 till March 2012. All patients were diagnosed to have severe osteoarthritis of their knees and we performed total knee replacement arthroplasty for them. Patients were divided into two groups, group A, were 22 patients (25 knees) in which we used intramedullary alignment guide for the preparation of proximal tibia, and group B, were 26 patients (30 knees) in which we used extramedullary alignment guide for the preparation of the proximal tibia. Three months postoperatively, a standing long leg proper lateral plain X-ray (digital software) was taken and the sagittal tibial slope was measured for each case.

**Results:** Accurate alignment of sagittal posterior slope of tibial prosthesis was found in 80% (20 out of 25 knees) in group A, and in 43.3% (13 out of 30 knees) in group B. By using Student t test, the P value was less than 0.001 which was very significant.

**Conclusion:** we concluded that the intramedullary tibial alignment guide is statistically more accurate than extramedullary tibial alignment guide, in the sagittal positioning of the tibial component.

**Key words:** intramedullary, versus, extramedullary, tibial guide, total knee replacement.

Fac Med Baghdad  
2013; Vol.55, No. 3  
Received: April, 2013  
Accepted July, 2013

## Introduction:

Appropriate alignment of the prosthesis in total knee arthroplasty has been well documented as a major contributor to the longevity and success of the procedure (1, 2, 3, and 4). Intramedullary alignment has been considered superior to extramedullary alignment for making the femoral cut and arriving at an accurate and reproducible placement of the respective component (5, 6, and 7). However, there is still much controversy about which guide provide better reliability and reproducibility of the proximal tibial cut (8). Most knees are amenable to either technique, but extramedullary jigs are unreliable in patients with abnormal anatomy of the ankle and an excess of soft tissue, and intramedullary systems are inappropriate when there is excessive tibial bowing, previous fracture or retained hardware (9, 10). Intramedullary instrumentation also carries the proposed risk for thrombotic phenomena, postoperative hypoxia, increased blood loss, and intraoperative complications (11, 12).

After total knee arthroplasty, the posterior tibial slope affects anteroposterior stability, range of motion and contact pressure within the tibiofemoral joint (13, 14, 15). Furthermore, an

inappropriate cutting angle of the posterior tibial slope results in polyethylene wear, component loosening and posterior cruciate ligament strain (in cruciate retaining knee design), (16, 17, 18, 19). Few studies examined accuracy in the sagittal plane (20).

We have undertaken this study to determine the most accurate and reliable method for alignment of a tibial prosthesis in sagittal plane.

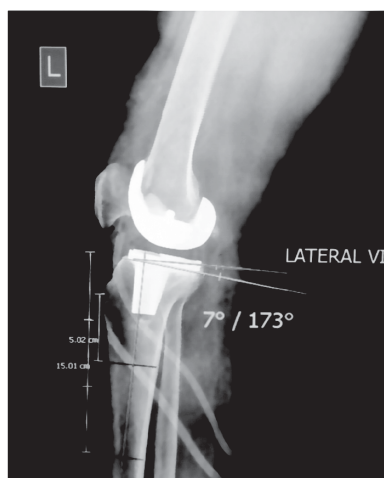
## Patients and methods:

This study was carried out on 48 patients (55 knees), (32 females and 16 males) with an average age of 62.2 years, ranging from 57 to 70 years who had attended the outpatient clinic in medical city-orthopedic and trauma consultation unit and private section, during the period from October 2010 till March 2012. All patients were diagnosed to have severe osteoarthritic changes in their knee joints and needed total knee arthroplasty, (35 right knees and 20 left knees).

We performed 55 cemented total knee replacement arthroplasty (NexGen legacy LPS-flex fixed bearing knee implants), using a standard surgical technique. Intramedullary alignment guide

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was used for the preparation of the distal femur in all cases, but for the preparation of proximal tibia, we divided the patients into two groups, group A in whom we used intramedullary alignment guide (25 knees) and group B in whom we used extramedullary alignment guide (30 knees). Knees which were suitable only for one of the two methods of proximal tibial instrumentation were excluded at the stage of preoperative planning. Both intramedullary and extramedullary techniques were carried out in accordance with the manufacturer's instruments. The entry point of the intramedullary device was determined by the preoperative plan for the centre of the tibial mechanical axis. This was usually just anterior to the tibial attachment of the anterior cruciate ligament. The guide (8 millimeters in diameter) was passed to the level of the distal physal scar although this was not confirmed radiologically. For the extramedullary device, the central shaft of the resector was aligned parallel to the anterior tibial shaft and centered on the midpoint of the talus, 3 millimeters medial to the centre of the ankle. We used 7 degrees tibial cut guide (right and left) and this supposed to create a 7 degrees posterior tibial slope in all cases. (The tibial baseplate is sloping posteriorly by 7 degrees while polyethylene has no slope). We used tourniquet only during cementing and fixation of the prosthesis. Three months after operation, routine standing long leg proper anteroposterior and lateral plain radiographs (digital x-ray) were taken, and the tibial slope was measured by the digital software for each case (with a precision of one degree). The proximal tibial anatomic axis which demonstrates the best correlation with the tibial shaft anatomic axis was used as the reference (Cullu et al, 1999). Proximal tibial anatomic axis was assessed with the help of two median points (mid-points between the anterior and posterior tibial cortex) marked at 5cm distal to the tibial tuberosity and 15 cm distal to the joint line. The angle between the tibial mid diaphyseal line and the line parallel to the tibial baseplate was measured as the tibial slope (with a precision of one degree, i.e. accurate results considered to be from 6 to 8 degrees). Reliability, repeatability and reproducibility of this measurement was studied and found to be the best among different techniques (Cullu et al. 1999).



**Figure 1.**

**Results:**

-Using Student t test

-**In group A**, accurate alignment of sagittal posterior slope of tibial prosthesis was found in 80% of cases (20 out of 25 knees).table (1).

-Standard Deviation =**1.13**

-95% confidence interval for Mean =6.328 through **7.912**

-Mean =**7.12**

-**In group B**, accurate alignment of sagittal posterior slope of tibial prosthesis was found in **43.3%** of cases (13 out of 30 knees).table (1).

-Standard Deviation=**2.46**

-95% confidence interval for Mean =8.277 through **9.723**

-Mean =**9.00**

-**P value:**

**T= - 3.52**

The probability of this result, assuming the null hypothesis, is 0.0009

P value less than 0.001 which is very significant.

**Table (1).**

Group A ( Intramedullary)	Group B (Extramedullary).
7	6
8	11
9	8
5	8
7	13
8	4
7	10
8	9
7	8
8	10
8	11
7	7
8	6
7	8
6	10
5	12
6	8
7	13
8	11
5	6
6	6
7	9
8	10
9	11
7	6
	6
	13
	12
	8
	10

**Discussion:**

The significance of alignment in the success and longevity of total knee replacement has been repeatedly emphasized (1, 21). Lotke and Ecker, (1) who found that clinical results

of total knee replacement were positively correlated with radiographic alignment ( $P < 0.05$ ), created a radiographic index to assess overall total knee alignment. 50% of this score was contributed by the tibial component alone. The effect of the posterior tibial slope on subsidence or loosening of the tibial components, postoperative range of motion, flexion stability and knee kinematics has been reported (18, 19). Too great a posterior tibial slope exposes weak cancellous bone posteriorly. A proximal tibial cut perpendicular to the longitudinal axis of the tibia with zero degree of posterior tibial slope increases the chance of tibial loosening, because of the weaker anterior tibial bone (particularly in patients with greater anatomical posterior tibial slope) (22). Tibial slope changes from birth through skeletal maturity, ranging from 0 to 20°, and absolute average value depends on the population (23). The commonly reported posterior tibial slope in normal knees is 5°-10° (24, 25). The statistical results of this study showed that the intramedullary tibial alignment jig was significantly more accurate in sagittal positioning of the tibial components in total knee replacement than the extramedullary tibial alignment jig ( $P$  value = less than 0.001). For intramedullary guides, one of the reasons mentioned by surgeons for inaccuracy is the instability of intramedullary rod, usually the rod is thinner than tibial canal, which may cause a tilt of the rod inside the canal and hence a tilt in the cutting block alignment (26). This fact may explain few inaccurate results in our study in group A. One proposed disadvantage of intramedullary system is the risk of venous embolism. Parment et al (27), have addressed this issue and concluded that the incidence of a large venous embolism does not differ with the alignment technique and that release of the tourniquet is the key event. We have on cases of clinical thromboembolism in our study.

We didn't measure the accuracy in coronal plane for the tibial prosthesis in both techniques (intramedullary and extramedullary), this is because we don't have 7° posterior sloping polyethylene and zero posterior sloping tibial base plate in our setting. So we can only make our cuts in proximal tibia with 7° posterior slope alignment tibial cutting guide, and in this way, the malrotation of a posteriorly sloped cut will influence the varus-valgus alignment in the coronal plane.

#### **Conclusion:**

We concluded that the intramedullary tibial alignment jig is statistically more accurate than the extramedullary tibial alignment jig, for the sagittal positioning of the tibial components in NexGen legacy LPS-flex fixed bearing total knee replacement arthroplasty.

We would advocate the use of the intramedullary tibial alignment jig to optimize tibial components positioning.

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