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Research Article

Anatomo-Clinical Results of Total Knee Arthroplasty After High Tibial Osteotomy - 8

**Rohimpitiavana HA^{1*}, Rogero JM¹, Marsili E¹, Mondon D¹, Ratsimandresy D²,
and Razafimahandry HJC³**

¹Departement of orthopaedics of Mont de Marsan Hospital, France

²Departement of orthopaedics of Bayonne Hospital, France

³Departement of orthopaedics of Joseph Ravoahangy Andrianavalona University Hospital,
Antananarivo, Madagascar

***Address for Correspondence:** Rohimpitiavana HA, Departement of orthopaedics of Mont de Marsan Hospital, France, Tel: +002-613-468-05029; E-mail: amboararohimpiti@gmail.com

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ABSTRACT

The Principle of high tibial osteotomy is to reduce the stresses of the internal compartment of the knee by valgizing the tibia. The total knee arthroplasty on this tibia with a "malunion" presents technical difficulties related to the initial approach, the presence of osteosynthesis material, the presence of malunion and the change of bone density. The objectives of this study are to determine the clinical and radiographic results of patients undergoing Total Knee Arthroplasty (TKA) after High Tibial Osteotomy (HTO). This is a retrospective descriptive study including patients undergoing Total Knee Arthroplasty (TKA) after an High Tibial Osteotomy (HTO) at the Hospital of Mont de Marsan (France) from 2008 to 2017 with a minimum follow-up of 12 months. Thirty knees (27 patients) were recruited. The sex ratio was 1.72. The average age was 70.33 years (54years-88years). The average time between High Tibial Osteotomy (HTO) and Total Knee Arthroplasty (TKA) was 10.83 years (1 year-26 years). The medial opening was 63.33% and lateral closure for the rest. Clinical improvement was observed, with an average gain of 24.97 points for pain, 1 point for stability, 1 point for knee mobility and 5 points for walking distance. The clinical result was perfect in 13.33%, excellent in 42% and medium in 36.67% of cases. The alignment was obtained in 76.67% of cases ($p = 0.0039$). The posterior tibial slope, epiphyseal varus, patellar height were corrected in 80% of cases respectively ($p = 0.000011$, $p = 0.44$, $p = 0.15$). Residual pain was observed in 26.66%, joint stiffness in 16.66%, skin healing disorder in 16% and infection in 6.66% of cases. Total knee arthroplasty made it possible to recover the failure of an high tibial osteotomy.

Keywords: High tibial osteotomy; Total knee arthroplasty; Results

INTRODUCTION

High Tibial Osteotomy (HTO) is a procedure performed frequently in young patients less than 60 years old [1] for degenerative osteoarthritis or post-traumatic osteoarthritis [2-4]. Its purpose is to avoid or delay the placement of a prosthesis. But after one or two decades, the effect of the osteotomy can be exhausted and the patient's symptoms reappear. At this time, it is necessary to have Total knee Arthroplasty (TKA). The principle of tibial valgus osteotomy is to reduce the stresses of the internal compartment of the knee by valgizing the tibia. The placement of a prosthesis on a tibia with a "malunion" has some technical peculiarities or difficulties related to the initial approach, the presence of material, and the change in bone density. From the technical point of view, the existence of a prior osteotomy can modify the planning of the surgical procedure, not only in the approach but also in the technical realization, whether bone cuts, ligament balance, the need for a particular implant, even customized [5-7]. The results of Total knee Arthroplasty (TKA) after High Tibial Osteotomy (HTO) are variously appreciated in the literature [8-10]. The objective of this study is to determine the anatomical and clinical results of a Total knee Arthroplasty (TKA) after High Tibial Osteotomy (HTO).

PATIENTS AND METHOD

The study was conducted in the department of Orthopedic Surgery of Layne Hospital of Mont de Marsan. This is a descriptive and analytic retrospective study of patients undergoing total knee arthroplasty after a tibia valgization osteotomy. The study was conducted over a period of 10 years (2008 to 2017) with a decline of 1 year. Included were all patients operated on a total knee arthroplasty procedure having a tibia valgus osteotomy on the same side as antecedent. Non-inclusion criteria included femoral osteotomies, unicompartmental prosthesis osteotomy, and osteotomy. Incomplete files were excluded. For the evaluation of the knee, the International Knee Society Score (IKS Knee Score) was used. The results were ranked according to the score in:

- Perfect: 100
- Excellent: 80-100
- Medium: 60-100
- Bad: < 60

Regarding the evaluation of the function, we do not have all the elements to establish the IKS score. We evaluated only the walking perimeter that will be rated according to the IKS function from 0 to 50. The results were classified into:

- Excellent: Unlimited time
- Good: > 1km
- Medium: 500m-1km
- Bad: < 500m

The anatomical results were analyzed pre and postoperatively on a pangenogram for the alignment with Hip Knee Ankle measurement (HKA) and for the epiphyseal varus on a radiograph of the knee in profile incidence for the posterior inclination of tibial articular surface and patellar height by the Caton index.

Collected data was entered on Microsoft Word and Microsoft Excel and processed by Epi info 7. The results are significant for a value of $p < 0.05$. This study was approved by Institutional Review Board.

Characteristics of the series

This is a series of 30 knees (27 patients) undergoing Total knee Arthroplasty (TKA) after High Tibial Osteotomy (HTO). A male predominance was observed with a sex ratio of 1.72 (19 men and 11 women). The average age of our patients was 70.33 years (54 years - 88 years). The average age of the patients at the time of their osteotomy was 54.85 years (39 - 71 years). In most cases, it was a right knee (63.33%). Three bilateral cases were listed. The average time between High Tibial Osteotomy (HTO) and Total knee Arthroplasty (TKA) was 10.83 years (1 year - 26 years). The medial opening High Tibial Osteotomy (HTO) was 63.33% and lateral closure for the rest. An unconstrained Total knee Arthroplasty (TKA) are used.

RESULTS

Clinical results

Pain: Regarding pain, a clear improvement was observed with an average gain of 24.97 points according the IKS score (Figure 1).

- Pre-operative SD +/- 5.64
- Post-operative SD +/- 6.39

Mobility: An increase in knee mobility was obtained at 1 year postoperatively with a gain of 1 point (Figure 2).



- Pre-operative SD +/- 4.12
- Post-operative SD +/- 1.91

Stability: Stability has been improved after arthroplasty. The difference is not important because the majority of the knees were stable before the intervention. We an average of 23.83 preoperative points to 25 points post-operatively. All knees were stable after arthroplasty (Figure 3).

- Pre-operative SD +/- 2.84
- Post-operative SD +/- 0

Knee IKS: Clinical examination of the knee was better after arthroplasty. The result was excellent in 42% of the cases, “perfect” and “medium” respectively in 13.33% and 36.67% of the cases (Table 1). The pain is significantly improved. We have an average gain of 31.91 points.

Perimeter of march: After intervention, 36.37% of cases have an unrestricted perimeter of march. More than half of the cases happen to walk more than 1 km (63.33%). Compared to the perimeters of walking preoperatively, a clear improvement was observed (Figure 4).

- Pre-operative SD +/- 4.0115
- Post-operative SD +/- 2,39

Anatomical results

Alignment: An improvement in knee alignment was observed at 1 year postoperatively. They are normalized in ¾ cases. In 20% of cases, knees remain in varus and valgus in 3.33% of cases. Two cases showed significant deformity > 10°C postoperatively. One case of deformity was due to a knee injury resulting loosening of the femoral implant.

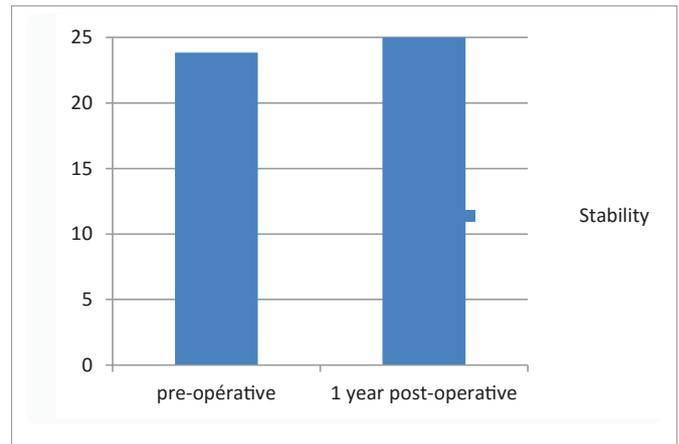


Figure 3: Evolution of stability 1 year postoperative.

Table 1: Case distribution according to IKS knee pre and 1 year postoperative.

	Preoperative		Postoperative	
	n = 30	Percentage	n = 30	Percentage
Perfect	0	0%	4	13.33%
Excellent	5	16.66%	21	42%
Medium	11	36.66%	5	36.67%
Bad	14	46.66%	0	0%

	Preoperative		Postoperative	
	n = 30	Percentage	n = 30	Percentage
Perfect/excellent	5	16.66%	25	33.33 %
Medium/ Bad	25	83.33%	5	16.66 %

p = 0.0000002

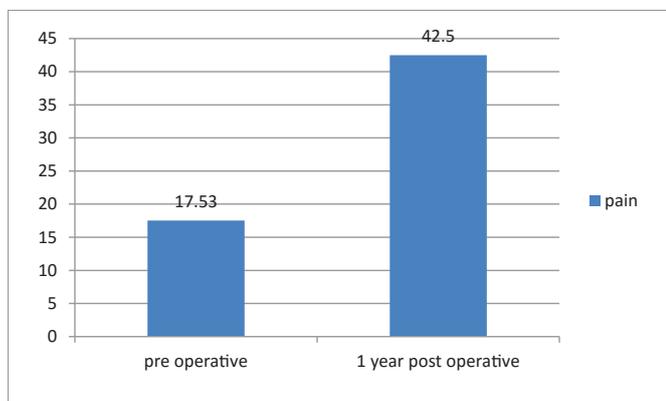


Figure 1: Evolution of pain 1 year postoperative.

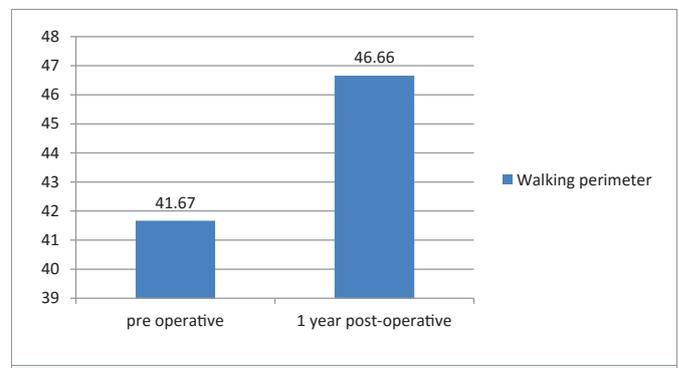


Figure 4: Evolution of walking perimeter 1 year postoperative.

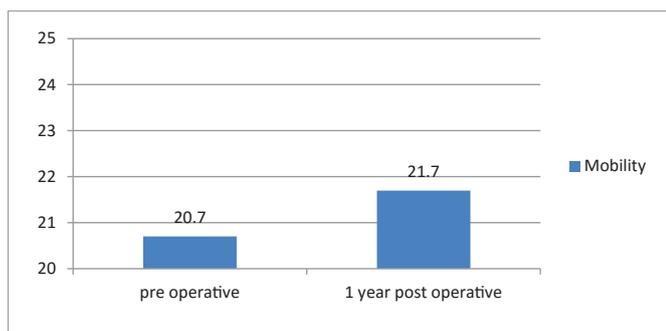


Figure 2: Evolution of mobility 1 year post-operative.

It was resumed but beyond the first year of arthroplasty where we evaluated the result. The other case was observed in a patient with a flossum maintained by a contralateral flossum. The measurement could be influenced by this flossum (Table 2).

Tibial posterior slope: We found that the majority of patients experienced a significant posterior inclination of tibial articular surface before the surgery (76.67%). This important posterior inclination of tibial articular surface has been corrected postoperatively by Total Knee Arthroplasty (TKA) (Table 3).

Epiphyseal varus: The epiphyseal varus was corrected in 80% of the cases after the intervention. Before the intervention, the deformity concerned half of the cases (p = 0.44).

Patellar height: Patellar height was normal in 80% of cases after

Table 2: Distribution of cases according to alignment before and 1 year postoperatively.

	Preoperative		Postoperative	
	n = 30	Percentage	n = 30	Percentage
Varus	13	43.33%	6	20%
Normal	12	40%	23	76.67%
Valgus	5	16.67%	1	3.33%

	Preoperative		Postoperative	
	n = 30	Percentage	n = 30	Percentage
Varus/ Valgus	18	43.33%	7	20%
Normal	12	40%	23	76.67%

$p = 0.0039$

Table 3: Distribution of cases according to the modification of the posterior inclination of tibial articular surface.

	Preoperative		Postoperative	
	n = 30	Percentage	n = 30	Percentage
0°-3°	7	23.33%	24	80%
3°	23	76.67%	6	20%

$p = 0.00001124$

surgery. The arthroplasty made it possible to raise the height of the patella, of which 26.67% of the cases were low before the intervention ($p = 0.15$).

COMPLICATIONS

Thirteen cases (43.33%) had complications whose pain predominated (26.66%), followed by joint stiffness (16.66%). Of these, two cases benefited from mobilization under general anesthesia. Two skin necroses were observed. For this, we realized an internal gastrocnemius flap associated with a skin graft.

DISCUSSIONS

High Tibial Osteotomy (HTO) is an effective solution for the treatment of medial isolated knee osteoarthritis in young patients [11]. By changing the mechanical axis of the lower limb, the medial compartment of the knee is discharge, providing patients with reliable relief of pain [12,13]. However, about 24% of these osteotomies were resumed before 10 years, regardless of the initial technique used [14]. This High Tibial Osteotomy (HTO) for it to be effective is at the origin of a “malunion” of the proximal epiphysis of tibia. The good results are observed significantly when there is a valgus overcorrection of at least 3° of the global axis of the lower limb. This corresponds to an epiphyseal valgus of more than 2° [14]. In preoperative, the objectives of the surgeon are to replace the knee joint by correcting this malunion and ensuring stability of the knee.

This study showed that total knee arthroplasty improve the clinical manifestations and radiographic signs of the knee of our patients. A marked improvement of the pain was observed with a gain of 25.17 points. VanRaaij, et al. [15] using the Analog Visual Scale (VSA) have found an improvement of pain. An increase in the articular amplitude of the knee with an average gain of 1 point or 5° compared to the preoperative state. According to the literature, the ideas are diparates. Van Raaij, et al. [15] found an increase in the average amplitude of 10°. On a study of Eymar [16], Meding, et al. [17], they showed that there is no significant modification in pre and post-operative. All knees remained stable at 1 year of operation. Retrospective series confirm improved clinical scores, but at the cost of relatively high rates of complications, revision and alignment default [18,19]. Gupta and al. observed a gain of 50 points for the IKS

score, with a flexion gain of 32° [20]. In our study, we had 13.33% of perfects IKS, 42% of excellent IKS and 36.67% of medium IKS. In comparison, Eymar and al had 86,1% excellent (IKS Knee score > 80) and perfects in 34,5% (IKS Knee score = 100) [16].

To ensure stability, soft tissue balance should be considered. During open-wedge High Tibial Osteotomy (HTO). The superficial Medial Collateral Ligament (MCL) and/or pes anserinus are usually released, and these can cause valgus laxity or instability. Pape, et al. [21] performed biomechanical testing, and reported that the anteriorfibres of the superficial Medial Collateral Ligament (MCL) play a crucial role in maintaining valgus stability; thus, the release of the superficial Medial Collateral Ligament (MCL) for open-wedge High Tibial Osteotomy (HTO) should be maintained to prevent the potential of late valgus instability. Medial instability can also occur after plate removal during the Total Knee Arthroplasty (TKA) conversion due to the required medial release. Because the distal Medial Collateral Ligament (MCL) is usually released in open-wedge High Tibial Osteotomy (HTO), the proximal Medial Collateral Ligament (MCL) release in converting to Total Knee Arthroplasty (TKA) can affect the distal Medial Collateral Ligament (MCL), which can cause medial instability. Therefore, the elevated distal portion of the Medial Collateral Ligament (MCL) should be placed in situ on the graft bone, and pes anserinus, if released, should be repaired during open-wedge High Tibial Osteotomy (HTO) to prevent medial instability. Many surgeons usually release the superficial Medial Collateral Ligament (MCL) subperiosteally distal to the osteotomy site, or completely cut it at the osteotomy site without repair when performing open-wedge High Tibial Osteotomy (HTO) [10]. Similarly, the higher rates of lateral release following a lateral closing wedge High Tibial Osteotomy (HTO) are most likely due to postoperative scarring that occurs on the lateral side of the knee following osteotomy [22].

The majority of patients (63.33%) managed to walk more than 1000 meters and 36.66% of cases had an unlimited walking distance. The result of our study was consistent with that of Burdin, et al. [9] on a series of 189 knees at an average follow-up of 4.3 years and with that of Heejune, et al. [8]. In contrast, most studies have shown a lower quality of outcome than first intention Total Knee Arthroplasty (TKA) [10,23]. While other authors have reported that a conversion to Total Knee Arthroplasty (TKA) after High Tibial Osteotomy (HTO) is not clinically different from a Total Knee Arthroplasty (TKA) performed without prior High Tibial Osteotomy (HTO) [24].

In terms of anatomical results, this study showed that knee arthroplasty restore alignment, posterior inclination of tibial articular surface, epiphyseal varus and patellar height. Regarding alignment, two cases showed significant deformity > 10° postoperatively. One case of deformity was due to a knee injury resulting loosening of the femoral implant. It was reoperated but beyond the first year of arthroplasty where we evaluated the result. The other case was observed in a patient with a flossum maintained by a contralateral flossum. The measurement could be influenced by this flossum. Van Raaij, et al. [18] showed an amelioration of alignment (optimal 6° valgus) and an increase of patella height postoperatively. There is no significant differences for alignment and patellar height between primary Total Knee Arthroplasty (TKA) after osteotomy. The tibial component was placed with significantly ($p = 0.025$) less posterior slope after Total Knee Arthroplasty (TKA) after osteotomy group, respectively 7° (range 0 to 12°) and 12° (range 2 to 20°) after primary Total Knee Arthroplasty (TKA) [15]. Other studies have shown that medial osteotomy is a provider of low patella infera and external

osteotomy changes the morphology of the upper extremity of the tibia [25-27]. Recently, open-wedge High Tibial Osteotomy (HTO) has become more popular than closed wedge High Tibial Osteotomy (HTO) due to advantages that include easier correction of deformity, proximal bone preservation and the ability to avoid peroneal nerve injury [28].

Concerning anatomical changes, the tibial obliquity may have changed to valgus; thus, the medial plateau may be positioned higher than the lateral plateau. If the tibial bone cutting is performed perpendicular to the mechanical axis, it can cause an asymmetric resection that may result in resection laxity and thus increase the risk of imbalance [29]. The posterior tibial slope tends to be increased after an open-wedge High Tibial Osteotomy (HTO), and this change can cause anterior tibial translation and instability in flexion. In addition, this change can cause a large anterior tibial resection and defects in the posterior tibia, which can affect gap balancing during both flexion and extension [30]. These changes can cause difficulty in patellar eversion during the Total Knee Arthroplasty (TKA). Sometimes, an osteotomy of tibial anterior tuberosity is necessary.

In our study, only 13.33% of cases had an perfect result. Forty two percent had an excellent clinical outcome and 36.67% of the cases had a medium clinical outcome. Several factors not identified in this study could be the explanations for this results.

The complications were frequent. According to the literature, complications of Total Knee Arthroplasty (TKA) after osteotomy are more common than after first-intention Total Knee Arthroplasty (TKA) [31,32]. The pain predominated (26.66%). This pain was present on the anterior face of the knee, which for some patients was related to patellar tendinopathy, while in others it was associated with other complications such as cutaneous necrosis and infection. Other chronic pain has been observed in patients who have never been well after High Tibial Osteotomy (HTO). Joint stiffness accounted for 16.66% of cases. It was secondary to delayed healing (10%), cutaneous necrosis (6.66%) or infection (6.66%) that prevented or delayed functional rehabilitation sessions. According to the meta-analysis conducted by Beswick, et al. [31] in 2012, 17 to 31% of patients having benefited Total Knee Arthroplasty (TKA) suffered from chronic post-surgical pain. It is a complex phenomenon, involving multiple mechanisms whose predictive factors could be pre, per, or postoperative [32]. To prevent skin necrosis, the skin incision of the previous High Tibial Osteotomy (HTO) must be considered. If the previous incision cannot be used, the new incision should be at least six centimetres away from older incision [33].

However, the other complications observed in our study were more frequent compared with those of the other studies [34]. Burdin, et al. [9] on their study of a series of 263 cases reported 3.04% skin complications (2.28% cutaneous necrosis and 0.76% delayed healing), 0.76% cracks, 0.76% fractures, 0.76% hematoma.

Performing a Total Knee Arthroplasty (TKA) after High Tibial Osteotomy (HTO) requires careful surgical planning and caution owing to several anatomical changes that occur after High Tibial Osteotomy (HTO) [8,30,33].

CONCLUSION

Total Knee Arthroplasty (TKA) can recover the failure of a tibial osteotomy. However, the complications were frequent and the results were inferior to those of a Total Knee Arthroplasty (TKA) without previous osteotomy. In order to optimize the clinical outcome,

a study looking for the factors of poor results should be carried out. Identifying these factors would allow for planning to improve intervention techniques and strategies.

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