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Original research

OUTCOMES OF TOURNIQUET - LESS TOTAL KNEE ARTHROPLASTY

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ABSTRACT

Introduction: *Tourniquet use in total knee arthroplasty (TKA) provides a bloodless field to improve visualization; however, the arguments for improving cement fixation, decreasing operative time, and decreasing overall blood loss have not been supported by the literature. Tourniquetless TKA is gaining popularity with the reported less postoperative pain and improved knee function in addition to no evident increased risk compared to tourniquet use. This study assessed the outcomes of tourniquetless TKA surgery in Hue Central Hospital.*

Methods: *35 patients with end - stage knee osteoarthritis undergoing tourniquetless TKA surgery were included in this study. Demographic data, physical examination, and radiographic parameters were collected pre - and post-operatively. Intra - and postoperative complications were also reported. The patient's knee function and clinical outcomes were reassessed at the 1 - month and 3 - month follow - up times.*

Results: *Tourniquetless TKA showed significant improvements regarding knee pain, knee alignment, and knee function. No significant complications were reported post - operatively.*

Conclusion: *Tourniquetless TKA can be safely performed on a routine basis on end - stage knee osteoarthritis patients with relatively no significant complications.*

Keywords: *Total knee arthroplasty, tourniquet, mechanical alignment, KOOS, knee osteoarthritis.*

I. INTRODUCTION

It has been a widely used practice to utilize a tourniquet during total knee arthroplasty (TKA). There were proposed advantages of providing better visualization, reducing intraoperative blood loss, improving cement fixation, and decreasing operation time [1 - 3]. However, significant hazards associated with the use of tourniquets have been brought to attention, such as venous ischemia, amplified pain, venous thromboembolisms, nerve impairment, and infection [4 - 6]. There is a trend of performing TKA surgeries without the use of tourniquets in the orthopedic society. At the poll regarding current practice patterns conducted at the 2020 Annual Meeting of the American Association of Hip and Knee Surgeons (AAHKS), tourniquets were used by 24% of surgeons in all cases, a decrease from 37% in 2009, while 47% used them in all cases except those involving vascular concerns. 16% of surgeons only used tourniquets during exposure and cementation (compared to 5% in 2009), and 13% chose not to use them at all [7]. There were multiple studies demonstrating the benefits of tourniquetless TKA including avoiding tourniquet-specific complications [6, 8], decreased postoperative pain [9, 10], reduced analgesic use [9, 11], less swelling [10], improved postoperative knee range of motion and function [11 - 13], and enhanced outcome scores [11, 14]. Despite still being controversial, tourniquetless TKA has been gaining momentum in the literature challenging the conventional use of tourniquets in TKA procedures. At our national orthopedic center, we have been consistently utilizing the tourniquetless TKA technique since 2018 with a committed process of the entire surgical team. Our study was to assess

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the outcomes of tourniquetless TKA surgery at Hue Central Hospital, Vietnam.

II. MATERIALS AND METHODS

35 patients with Kellgren Lawrence stage 4 [15] knee osteoarthritis who were admitted to our orthopedic center from December 2021 to February 2023 were included in this study. All the patients underwent medical history inquiry, clinical examination, radiographic investigation, and elective tourniquetless total knee arthroplasty surgery by two senior orthopedic surgeons. The standard medial parapatellar approach and mechanical alignment technique were used in all TKA surgeries. Tourniquets were not used at all, in addition, 1 gram of intravenous tranexamic acid was administered pre - operatively. Deep venous thrombosis prophylaxis started 12 hours post-operatively. A consistent protocol, as recommended by Stronach et al [5], was followed in all TKA procedures, as detailed in Table 1. We also recorded demographic data, pre - and post - operative Knee Injury and Osteoarthritis Outcome Score (KOOS) [16], and other research variables including time of operation, intra - operative blood loss, hospital stays, complications and KOOS score at 1 - month and 3 - month follow up for data analysis. Statistical analysis was performed using IBM® SPSS® software version 25.0. The study garnered approval from the Institutional Review Board (IRB) of Hue Central Hospital, which served as the primary location for all research - related activities.

Table 1: Recommended Techniques for Tourniquetless TKA

• Screen for and correct preoperative anemia
• Give tranexamic acid in perioperative setting (oral, IV, and/or local administration)
• Do not apply tourniquet to the extremity
• Have a sterile tourniquet available if needed
• Preemptive analgesia and multimodal pain control are recommended
• Hypotensive anesthesia (mean arterial pressure of 60) helps minimize intraoperative blood loss
• Keep the knee flexed for most of the procedure
• Coagulate the genicular arteries on joint entry
• Complete hemostasis of all small bleeding vessels is not necessary
• Place anterior chamfer fragment in femoral canal as bone plug (if intramedullary guide used)
• Multimodal periarticular injection used to assist in hemostasis
• Prepare bone for cementation in deep flexion
• Thoroughly irrigate all exposed bone surfaces to remove lipid marrow
• Use a laparatomy sponge and suction all bone surfaces to clean before cementation
• Place cement on implant and bone surfaces
• Cement tibia first followed by femur and patella
• Continue to keep all interfaces dry before implants are placed
• Once components are implanted, avoid motion of the knee during cementation
• Allow cement to cure with knee in extension

III. RESULTS

Of the 35 patients included in the study, there were 9 males (25.7%) and 26 females (74.3%), with a mean age of 63 ± 9.7 and mean body mass index (BMI) of 24.3 ± 2.7. Regarding radiographic alignment, neutral alignment was defined as 0 ± 3°, while mild valgus/varus was defined as 3 - 6° and severe valgus/varus was defined as > 6°. All TKA surgeries utilized mechanical alignment technique. Table 2 shows the results of preoperative and postoperative numbers of patients and their respective knee alignments.

Table 2: Radiographic alignment pre - and post - operatively

	Severe valgus N (%)	**Mild valgus N (%)**	**Neutral N (%)**	**Mild varus N (%)**	**Severe varus N (%)**
Pre - Op	2 (5.7%)	7 (20.0%)	11 (31.4%)	15 (28.6%)	5 (14.3%)
Post - Op	0 (0%)	1 (2.8%)	29 (82.9%)	5 (14.3%)	0 (%)

In our study, regarding clinical outcomes of patients who underwent tourniquetless TKA surgery, the mean time of operation was 101 ± 17.2 minutes, with an intra - operative blood loss estimation of 360 ± 211ml and hospital stays averaging 5 ± 1.1 days. No major complications and no infections were recorded at

the time of discharge and 3 - month follow up. There was one patient with non - displaced longitudinal tibial fracture after a falling at home, who was then admitted to the hospital and treated with cast immobilization.

With respect to KOOS Score, significant improvements were observed over time, specifically from pre-op to discharge, as well as the 1 - month and 3 - month follow up assessments. Table 3 presents the normalized score for the 5 subscales of KOOS Score at four distinct time points.

Table 3: KOOS normalized score over time

	Pre - op	**Discharge**	**1 - month**	**3 - month**
Pain	41	82	89	93
Symptom	60	82	90	94
ADL	58	82	86	89
Sport/Rec	15	22	21	22
QoL	23	81	80	85

IV. DISCUSSION

In this study, we conducted the tourniquetless TKA surgeries for end-stage osteoarthritis patients and evaluated the short outcomes of the techniques. Our sample's baseline characteristics closely resembled those in previous studies conducted by Alexandersson et al [17] and Ejaz et al [11], including parameters such as sample size, mean age, and BMI. However, it is worth noting that the gender distribution in our study was notably skewed, with nearly 3 females to 1 male. This pattern resembles the predominant numbers of female in the article by Miyamoto et al [18].

In the realm of knee alignment principles and surgical techniques, there exist three primary categories [19]. The traditional Systematic Alignment, incorporates techniques such as mechanical alignment [20 - 22], with the primary objective of Systematic Alignment is the restoration of the knee's neutral alignment, irrespective of any preoperative deformities. In contrast, the Patient - Specific Alignment, includes approaches like Kinematic Alignment [23], which seeks to preserve the patient's native alignment and joint line inclination. Finally, the Hybrid Alignment, encompasses a variety of methods such as adjusted mechanical alignment [24, 25], restricted kinematic alignment [26], inverse kinematic alignment [25, 27], and functional alignment. Within this category, the target alignment is set at $180^{o} \pm 3^{o}$ [19]. These distinct categories provide a comprehensive framework for addressing alignment issues in knee surgery, however, they remain subjects of controversy, with a lack of consensus on which alignment provides best results. In our study, we implemented the traditional mechanical alignment as our sole technique with the standard medial parapatellar approach. All our patients achieved postoperative knee alignment within the range of neutral or mild varus/valgus, with 82.9% achieving neutral alignment, and 14.3% and 1.8% displaying mild varus and mild valgus, respectively. There is substantial agreement among authors that a slight under-correction of preoperative varus deformity knees can yield comparable or even superior outcomes compared to neutral alignment [24, 28, 29]. While not as widely reported as varus alignment, there have been articles to suggest a slight under-correction in preoperative valgus knees can result in similar outcomes compared to those achieved with neutral alignment [30, 31].

Mean operating time of our study was 101 ± 17.2 minutes, slightly longer than previous studies by Ledin et al [32], Aglietti et al [2], Ayik et al [33], but the difference was not significant. Intra-operative blood loss in our study was similar to several previous studies by Dong et al [34], Tai et al [35], and significantly lesser than Goel et al [36], Pfitzner et al [37], however, the difference of blood loss was largely altered by the method of calculation employed by authors. Length of hospital stay in our study was also similar to the study by Huang et al [10], with 5 ± 1.1 and 5.12 ± 0.4 days, respectively. The above clinical parameters were frequently

evaluated by studies comparing outcomes between tourniquet and non-tourniquet TKA surgeries. A systematic review and meta-analysis conducted by Ahmed et al demonstrated that there was no differences in overall blood loss between TKA surgeries with and without tourniquet. Tourniquet TKA surgeries was associated with a shorter duration of surgery but a longer hospital stay compared to tourniquetless surgeries [38]. The debate regarding the use of tourniquet in TKA procedures keeps going hot in literature, there is a trend of surgeons transition away from a tourniquet in their TKA surgeries. Recommendations for a process aimed at optimizing the benefits and minimizing the drawbacks of tourniquetless TKA procedures was also reported and put into practice [5].

When assessing tourniquetless TKA outcomes with the KOOS score, our findings indicated notable improvements from the pre-operative stage to discharge, with scores consistently progressing positively during the 1-month to 3-month follow-up period. These findings are in accordance with Ejaz et al [11], who found that not only significant advancements were achieved in early stage of postoperative but also these enhancements were superior when compared to the group that used tourniquet during surgery. No major complications or infections were reported during our study period, nevertheless, for a more comprehensive assessment of potential complications, a longer follow-up duration should be considered.

V. CONCLUSION

Tourniquetless TKA can be safely performed on a routine basis on end-stage knee osteoarthritis patients with relatively no significant complications.

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