

A Randomized Comparative Study Of Long Duration Tourniquet Versus Short Duration Tourniquet In Total Knee Arthroplasty

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Abstract:

Background: Total knee Arthroplasty (TKA) is the mainstay of treatment for patients with end-stage osteoarthritis. It can be done with or without tourniquet. We conducted a prospective comparative study to analysis the advantages and disadvantages of tourniquet, either long duration tourniquets or short duration tourniquets, during TKA and provide evidence-based conclusions on the use of tourniquet in TKA.

Materials and Methods: We conducted a prospective randomized comparative study on 60 patients (120 knees) who operated for bilateral TKA between December 2019 and March 2023. Sixty knees were operated using long duration tourniquet and other 60 knees operated using short duration tourniquet. During follow-up, total blood loss, mean surgery duration pain, range of movements, KSS score, KOOS score and TEGNER score evaluated and compared.

Results: TKA using short duration tourniquet significantly improves functional outcome and decreases post-operative pain, incidence of thromboembolism, and wound complications in the immediate post-operative period as compared to long duration tourniquet. However, use of short duration tourniquet associated with more blood loss and more operating time.

Conclusion: Rational thinking is required in every case of TKA for the routine use of long duration tourniquet, considering its adverse effects in early postoperative period compared to short duration tourniquet.

Keywords: Total knee arthroplasty, Long duration tourniquet, Short duration tourniquet, KSS Score, KOOS Score.

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I. Introduction:

Total knee Arthroplasty (TKA) is one of the most common orthopaedic surgeries being performed these days. It is the mainstay of treatment for patients with end-stage osteoarthritis of the knee when conservatives treatments have failed [1,2]. It provides significant pain relief, correction of deformity and improvement in function [3]. Some surgeons uses pneumatic tourniquet during TKA surgery because the tourniquet reduces intra-operative blood loss and provides bloodless field for better visualization in the surgical field and better bone-cement interdigitation [4,5]. However, other surgeons performed TKA without tourniquet because the use of tourniquet increases the postoperative pain, reactive hyperaemia, risk of venous thromboembolism, and also prolong the recovery time [5]. Thus, the routine use of tourniquet is still controversial.

Based on the current conflicting evidence, we conducted a prospective comparative study to analysis the advantages and disadvantages of tourniquet, either long duration tourniquets or short duration tourniquets, during TKA and provide evidence-based conclusions on the use of tourniquet in TKA.

II. Materials And Methods:

We conducted a prospective randomized comparative study on 60 patients (120 knees) who operated for bilateral TKA between December 2019 and March 2023. The patients age range was 55-70 years (avg. 65 years). All patients were presented with persistent knee pain and KL Grade IV osteoarthritis in which all measure of conservative treatment were failed. All patients were undergoes bilateral TKA. Patients with any haematological diseases, unilateral TKA, revision TKA, infected knee, taking immunosuppressive medicines, peripheral neurovascular disease, inflammatory arthritis, or metabolic disorders were excluded. The minimum follow-up was 12 months. All knees divided randomly into 2 groups; Group 1 consists 60 knees and were operated using long duration tourniquet whereas, Group 2 consists 60 knees and were operated using short duration tourniquet. All the patients were operated by the same surgeon using modified Insall's surgical technique and Stryker Scorpio Knee System implants were used. During surgery, knee was randomly allocated to one of the two groups, one knee was operated using long duration tourniquet whereas other knee was operated using short duration tourniquet. In long duration tourniquet group, the tourniquet was inflated initially before taking the skin incision and was deflated after hardening of cement during implantation, whereas, in short duration tourniquet group, the tourniquet was inflated after taking proximal tibial cut and distal femoral cut and trial of implant and deflated after hardening of cement during implantation. IV antibiotics were given 30 minutes prior to skin incision and continue for 48 hours postoperatively. The pain management was done by using IV analgesics and an epidural analgesia. Immediate postoperative knee X-ray was taken to check the position of the implant. Physiotherapy was started from day 1, static Quadriceps and Hamstring muscle exercises, Calf muscle exercises and ankle movement were started. Drain removal and dressing was done on postoperative day 2. To prevent deep vein thrombosis (DVT), Low Molecular Weight Heparin (Enoxaparin injection) given during hospitalization and tablet Ecospirin 75mg once daily started after discharge for six weeks. Most of the patients were discharged on 5th or 6th post-op day. Stitches were removed on post-op14th day. All patients were followed-up at 1 month, 3 months, 6 months and 12 months after the surgery. At each follow-up, pain, range of movements, ambulatory status, signs of DVT and pulmonary embolism, any wound complications, and functional outcome of patients using Knee Society Score (KSS score), TEGNER scores, KOOS score (Knee injury and Osteoarthritis Outcome Score) were evaluated. Statistical analysis was performed with the SPSS version 21.0 (SPSS Inc., Chicago, IL, USA). The Mann-Whitney test or z-test was used to determine the significance of data. A p-value of < 0.05 were considered to indicate statistical significance.

III. Results:

A total of 60 patients included in the study. Out of total 60 patients, 36 (60%) were females, and 24 (40%) were males. The average age was 65 years (range: 55-70 years). The total blood loss, intraoperative blood loss and mean surgery duration were significantly more in short duration tourniquet group patients. The VAS score, KSS score, KOOS score and TEGNER score were significantly more in short duration tourniquet group at one month post-operatively but no difference at 3 months and 1 years post-op. Total of 3 patients developed sign of DVT and pulmonary embolism. On USG, source of embolism was found to be originating from the leg which was operated using long duration tourniquet. There were no signs of thrombo-embolism seen in short duration tourniquet group. Ten patients of long duration tourniquet group developed swelling, erythema, and wound complications as compared to three patients of short duration tourniquet group (Table 1).

Table 1: Variables compared between Group 1 (Long Duration Tourniquet) and Group 2 (Short Duration Tourniquet)

| | Group 1 (Long Duration Tourniquet) | Group 2 (Short Duration Tourniquet) | p-value |
|---------------------------------|------------------------------------|-------------------------------------|---------|
| Number of knees | 60 | 60 | |
| Total blood loss (ml) | 460.4 ± 4.5 | 565.5 ± 8.6 | <0.05 |
| Intraoperative blood loss (ml) | 175.1 ± 1.9 | 295.5 ± 3.4 | <0.05 |
| Postoperative blood loss (ml) | 285.3 ± 2.6 | 270 ± 5.2 | >0.05 |
| Mean surgery duration (minutes) | 40.2 ± 2.6 | 50.8 ± 6.8 | <0.05 |
| Range of movements (degrees) | | | |
| Pre-operative | 105.3 ± 8.3 | 105 ± 5 | >0.05 |
| At 1 month | 80 ± 5.2 | 90.2 ± 7.5 | <0.05 |
| At 3 month | 100 ± 6.2 | 105.8 ± 5.5 | <0.05 |
| At 12 months | 118.5 ± 4.8 | 120.5 ± 6.4 | >0.05 |
| Pain (VAS score) | | | |
| Pre-operative | 3.8 ± 0.6 | 3.8 ± 0.4 | >0.05 |
| At 1 month | 2.8 ± 1.3 | 2.4 ± 0.5 | <0.05 |
| At 3 month | 1.8 ± 0.6 | 1.7 ± 0.2 | >0.05 |
| At 12 months | 0.6 ± 0.02 | 0.5 ± 0.03 | >0.05 |
| Mean KSS score | | | |

| | | | |
|---------------------|------------|------------|-------|
| Pre-operative | 46.4 ± 2.4 | 47.5 ± 3.4 | >0.05 |
| At 1 month | 74.6 ± 1.2 | 76.8 ± 1.5 | <0.05 |
| At 3 month | 82.4 ± 1.6 | 82.5 ± 2.2 | >0.05 |
| At 12 months | 90.2 ± 1.5 | 91.4 ± 1.3 | >0.05 |
| Mean KOOS score | | | |
| Pre-operative | 46.5 ± 2.5 | 45.5 ± 1.6 | >0.05 |
| At 1 month | 68.5 ± 1.8 | 72.2 ± 1.3 | <0.05 |
| At 3 month | 79.5 ± 2.2 | 80.2 ± 1.7 | >0.05 |
| At 12 months | 86.4 ± 1.1 | 87.5 ± 2.1 | >0.05 |
| Mean TEGNER score | | | |
| Pre-operative | 47.2 ± 2.2 | 46.5 ± 1.5 | >0.05 |
| At 1 month | 71.5 ± 1.5 | 74.6 ± 2.3 | <0.05 |
| At 3 month | 78.6 ± 1.6 | 80.2 ± 1.1 | >0.05 |
| At 12 months | 86.5 ± 1.8 | 87.2 ± 1.3 | >0.05 |
| Thrombo-embolism | 3 | 0 | <0.05 |
| Wound complications | 10 | 3 | <0.05 |

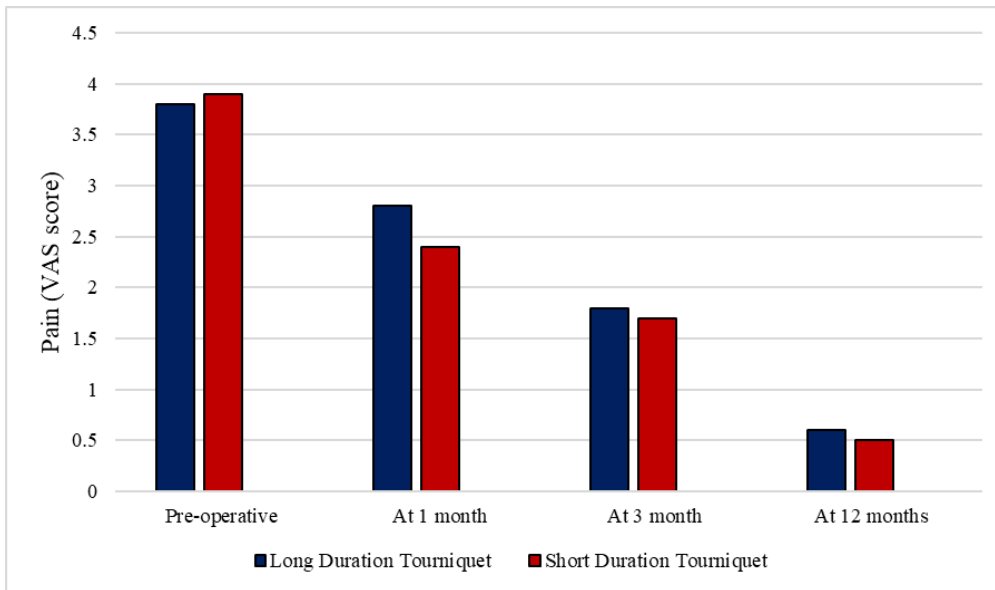


Figure 1: Comparison of mean values of VAS score pre operatively, at 1 month, at 3 months and at 12 months between long and short duration tourniquet.

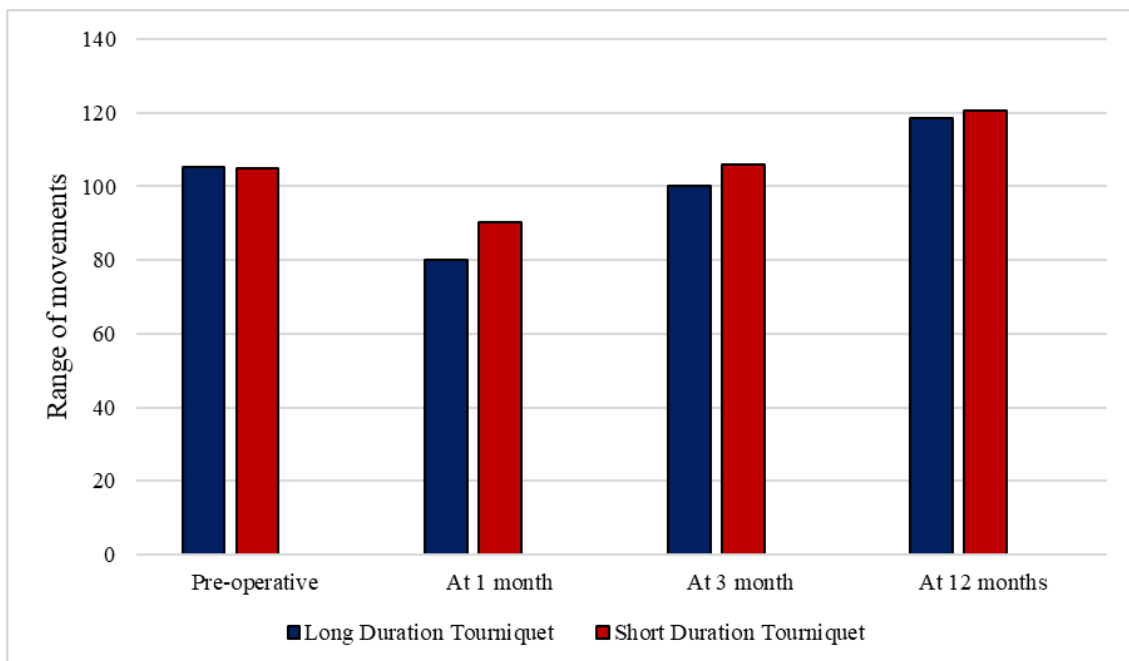


Figure 2: Comparison of mean values of range of movements pre operatively, at 1 month, at 3 months and at 12 months between long and short duration tourniquet.

IV. Discussion:

Osteoarthritis (OA) is the most common degenerative joint disease of the knee in the elderly. TKA is the most effective and successful treatment in advanced OA [6]. The tourniquet is routinely used in TKA to reduce the blood loss and provide better field of vision during surgery [7]. However, the use of tourniquet increases the risk of surgery-related complications, such as muscle damage, wound complications, thromboembolism, and cardiac arrest [8,9]. There is still controversy regarding the use of tourniquet during TKA. Thus, this study was conducted to analysis the advantages and disadvantages of tourniquet, either long duration tourniquets or short duration tourniquets and provide evidence-based conclusions on the use of tourniquet in TKA.

We found that there was significantly less intra-operatively blood loss in knee operated with long duration tourniquet compared to knee operated with short duration tourniquet. However, the postoperative blood loss was slightly more in knee operated with long duration tourniquet but it was statistically insignificant. The more postoperative blood loss in long duration tourniquet was because of the additionally hidden blood loss escapes into the joint space and the soft tissue that would result in limb swelling and more blood loss post-operatively [10]. Alcelik et al [5] and Vandebussche et al [9] also reported similar findings. The tourniquet provides bloodless surgical field leads to better visualization, and increases procedural efficiency. In short duration tourniquet group, additional time was taken to achieve haemostasis. In our study, the VAS score was less in knees operated using short duration tourniquet compared to knees operated with long duration tourniquet at one month, but there was no significant difference seen at 3 months and at 12 months. Worland et al [11] and Kohro et al [12] also reported less pain at 6 weeks post-operatively in knee operated with short duration tourniquet. We found no statistically significant differences at long term between the groups in terms of range of movements. The better range of movements at early post-operative period in short duration tourniquet group was may be because of post-operative swelling, hematoma, muscle injury in knees operated with long duration tourniquet group which leads to decrease movements. Once the inflammation subsides and patient start regular physiotherapy, then this difference in the range of motion decreases. At 12 months follow-up, there were no significant difference between two groups in terms of KSS score, KOOS score and TEGNER score.

In our study, total three patients developed breathlessness and sudden onset of difficulty in breathing on postoperative day 2. On examination they had signs of pulmonary embolism and blood tests were also favouring this finding. On USG, the source of embolism was found as thrombosis of deep vein of leg in which TKA done using long duration tourniquet. Parmet et al also found 5.33-fold greater risk of developing thrombo-embolism complications in patients who were operated using a long duration tourniquet compared with TKA without a tourniquet [13]. There is strong evidence present that indicates the use of tourniquet increases the risk of thromboembolic complications [14-16]. Total of 13 patients, 10 in long duration tourniquet group and 3 in short duration tourniquet group, developed wound and skin complications. There was significantly less incidence of wound complications occur in in short duration tourniquet group as compared to long duration tourniquet group. Parvizi et al also reported a significantly higher rate of wound complications in patients in which tourniquet was used during surgery [17].

The limitations of this study was small sample size, a single centre study and the sample quality may not be truly representative of all the patients suffering with knee osteoarthritis from different geographical regions of India.

V. Conclusion:

TKA using short duration tourniquet significantly improves functional outcome and decreases post-operative pain, incidence of thromboembolism, and wound complications in the immediate post-operative period as compared to long duration tourniquet. However, use of short duration tourniquet associated with more blood loss and more operating time. Thus, rational thinking is required in every case of TKA for the routine use of long duration tourniquet.

Conflicts of interest:

There are no conflicts of interest.

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