Tourniquet use in TKR: A Potential Predictor of Postoperative Pain Scores in Males and Females

Hazem Z Hassouna*, Umer Butt, Bushra Kamal, Rudy Appado, Amir Qureshi and Neil Bradbury

Department of Trauma and Orthopaedics, Circle Bath, Foxcote Avenue Peasedown St John, Bath, UK

*Corresponding Author: Hazem Z Hassouna, Department of Trauma and Orthopaedics, Circle Bath, Foxcote Avenue Peasedown St John, Bath, UK.

Received: July 06, 2017; Published: August 12, 2017

Abstract

The aim of this study is to examine the effect of limited use versus full use of tourniquet on patients undergoing total knee replacement, on the post-operative pain score, length of stay, muscle function and blood loss.

One hundred and fifty consecutive patients who underwent TKRs were included.

Patients were allocated to two groups, Group A, with the limited use of tourniquet and Group B, with tourniquet applied for the duration of the surgery.

Flexion was recorded twice daily until discharge.

The difference between the two groups was not thought to be significant.

Pain scores were taken on daily basis, using the visual analogue score 0 - 3, 0 indicated no pain, 1 mild pain, 2 moderate and 3 severe pain.

This demonstrated that the difference found on the first two days post operatively is of significant value. Day 3 pain scores had a p value of 0.4500 and therefore are not thought to be significant.

Length of stay (LoS) was also recorded in both groups. The difference in LoS was not thought to be significant.

Haemoglobin was also measured pre and post-operative. Statistically, the difference was not significant, with a p value of 0.6287.

Our results have demonstrated that the limited use of tourniquets for primary total knee arthroplasty surgery is safe and provides the benefit of a reduced pain score, particularly in males with no increase in overall blood loss.

Keywords: Tourniquet; TKR; Post-Operative Pain Score

Introduction

Total Knee arthroplasty (TKA/TKR) is a common orthopaedic intervention for the treatment of end stage osteoarthritis of the knee. In the United Kingdom, a total of 87,500 total knee replacements procedures were carried out in 2014 [1].

The use of tourniquet is accepted as a standard technique to obtain control of bleeding and aid visualization of the knee.

Several theories have been postulated regarding the detrimental effect of tourniquet use such as nerve injury, muscle damage, delayed recovery and increased pain scores. All these can cause a delay in discharge following TKR.

TKR with a limited tourniquet application during cementation, is thought to reduced length of stay, reduced pain scores and improved quad function.

The aim of this study was to compare two groups of patients that have undergone a TKR. To look at specifically the effect of limited versus tourniquet use and the effects on the post-operative pain score, length of stay and muscle function.

We undertook a prospective trial to compare our results of a limited tourniquet use only during cementation and tourniquet use throughout the procedure.

Patients and Methods

We prospectively reviewed 150 patients who had TKRs performed at Circle Bath Hospital, Bath, BA2 8SQ, from January 2014 to May 2015. All the TKR's performed had the Styker Scorpio CR implanted, with patella resurfacing. All data was retrieved from patient’s notes specifically looking at the documentation from physiotherapists and the relevant medical team.

Patients were allocated to two groups, Group A, with the limited use of tourniquet and Group B, with tourniquet applied for the duration of the surgery.

Group A consisted of 103 patients, with 46 males and 57 females. The patient’s age’s ranged between 42 and 89, with an average age of 69 (+/- 9.59) years. Mean Body Mass Index (BMI) of the patients in, group A was 28.8 (+/- 4.76).

Group B consisted of 48 patients, with 16 males and 32 females. Mean age of group B was 69 (+/- 9) years, with a range between 45 to 86 years. Mean BMI of 29.3 (+/- 4.2) was recorded for the full tourniquet group.

Group A had a tourniquet pressure of 300 mmHg and applied only once the implants were ready for cementation.

The procedure was performed by two senior surgeons, Mr N Bradbury (NB) and Mr U Butt (UB). Precautions were taken that same standard protocol was followed by both surgeons. All patients were admitted on the day of surgery, all had a spinal Anaesthesia augmented with PKUS. All patients had a urinary catheter placed in the anaesthetic room and removed in 24 hours. Antibiotic prophylaxis was given pre operatively with Flucloxacillin 1 gram at induction and 3 post op doses. Gentamycin was also given according to patient renal function according to local guidelines.

Standard medial para-patella approach was utilized; intramedullary rod alignment for the Femur and Tibia was used in all patients. All patients had the patella resurfaced.

All wounds were closed using 2 Vicryl to capsule, 2.0 Vicryl to fat, and an undyed subcuticular 2.0 Vicryl to the skin. All patients had a local anaesthetic epidural catheter inserted into the lateral gutter, which was activated in recovery for the period of 48 hours. Post-operatively all patients were given prophylaxis to reduce the incidence of venous thromboembolism, in the form of Enoxaparin 40mg whilst an inpatient. Rivaroxaban 10mg orally was provided for 14 days after discharge as per the NICE guidance.

Physiotherapy commenced and SLR, ROM and mobility were documented twice a day. Pain scores and Length of stay of patients was also recorded.

Results

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of TKRs</td>
<td>n = 103</td>
<td>n = 48</td>
</tr>
<tr>
<td>Males</td>
<td>46</td>
<td>16</td>
</tr>
<tr>
<td>Females</td>
<td>57</td>
<td>32</td>
</tr>
<tr>
<td>Age range</td>
<td>42-89</td>
<td>45-86</td>
</tr>
<tr>
<td>Mean age (+/- SD) BMI</td>
<td>69 (+/- 9.59)</td>
<td>69 (+/- 9.00)</td>
</tr>
<tr>
<td></td>
<td>28.8 (+/- 4.76)</td>
<td>29.3 (+/- 4.2)</td>
</tr>
</tbody>
</table>

Table 1: Demonstrating study population in both cohorts.

The mean tourniquet pressure was 300mmHg (+/- 46.13), with a range between 300 to 400 mmHg. Mean duration of the tourniquet application was 11.61 (+/- 5.38) minutes, with a range between 0 and 25 minutes. Operative time was recorded as ranges and not specific values, this lead to the modal value of 45 - 90 minutes.
Group B application of the tourniquet was for a mean duration of 61.04 (+/- 16.12) minutes, with a mean pressure of 311.45 (+/- 21.23) mmHg. The range of tourniquet pressure was between 300 to 350 mmHg. Again the operative time was recorded as ranges and not specific times, the modal value of 45 - 90 minutes was recorded.

Days to dryness was defined as the time taken for the dressing to remain dry for a period of 12 hours, our results from Group A demonstrated a mean value of 2.55 (+/- 1.02) days to dryness. Group B demonstrated a mean 2.18 (+/- 0.86) days to dryness.

In Group A, pre-operative Haemoglobin (Hb) was measured in every patient undergoing TKR procedure, with a mean value of 139.38 (+/- 11.22) g/l. Post-operative mean Hb was measured as 112.71 (+/- 11.22) g/l. Mean change in Hb was 24.97 (+/- 9.18)g/l. Group B demonstrated, a mean Hb of 140.13 (9.62) g/l pre-operatively. Post of Hb was 113.43 (+/- 12.86). Mean change in Hb was 25.78 (+/- 9.84) g/l. Statistically, the difference was not significant, with a p value of 0.6287.

Flexion was recorded twice daily until discharge. In Group A, day 1 am mean ROM was 68.8 (+/- 20.2) degrees. Day 1 pm, 72.25 (+/- 17.01) degrees and Day 2 am, 78.11 (+/- 13.1) degrees. Day 2 pm, 81.21 (+/- 11.08) degrees and Day 3 am 84.34 (+/- 7.7) degrees. Day 3 pm mean flexion was 82.5 (+/- 6.34) degrees. In Group B, mean flexion day 1 am, was 68.15 (+/- 17.93) degrees. Day 1 pm mean flexion 76.58 (+/- 15.42) and day 2 am, 79.76 (+/- 13.38) degrees. Day 2 pm, mean flexion was 84.84 (+/- 7.12) degrees. Day 3 am, mean flexion was 82 (+/- 9.92) degrees and pm was 85.90 (8.60) degrees. The difference between the two groups when analyzed was not thought to be significant, when the data was interrogated.

Pain scores for Group A were taken on daily basis, we utilised the visual analogue score 0 - 3, 0 indicated no pain, 1 mild pain, 2 moderate and 3 severe pain. Mean Day 1 scores of pain was recorded as 0.71 (+/- 0.63), day 2 0.96 (+/- 0.85) and day 3 0.83 (+/- 0.79). Day 4, 0.49 (+/- 0.53) and day 5 0.30 (+/- 0.46). Group B, mean pain score for Day 1 was 1.21 (+/- 1.06) and day 2 1.52 (+/- 0.50). Day 3 pain scores demonstrated a mean of 1.00 (+/- 0.65) and Day 4 1.12 (+/- 0.64). Analyzing day 1 scores demonstrated a p value of 0.0011, day 2 a p value of 0.001 was found. This demonstrated that the difference found on the first two days post operatively is of significant value. Day 3 pain scores had a p value of 0.4500 and therefore are not thought to be significant.

![Figure 1](image-url): Total knee replacement (TKR) with Tourniquet results in increase post-operative pain. Figure showing representative graph bars. A significant difference was found on the day 1 (A) p < 0.05 and day 2 p < 0.01 (B) post-operative of TKR. No difference was observe on day 3 (C).

**Figure 2:** Total knee replacement (TKR) with Tourniquet results in increase post-operative pain in males as compared to females. Figure showing representative graph bars. A significant difference was found in males on the day 1 (Ai) $p < 0.05$ as compared to females (Bi) post-operative pain scoring of TKR.

**Figure 3:** Total knee replacement (TKR) with Tourniquet results in significant increase in pain score in males (A) on post-operative day 1 and 2. Female (A) showed a significant high pain score on day 2. Figure showing representative graph bars. A significant difference was found in males on the day 1 and day 2 (Ai) $p < 0.05$ while in females (B) it is the second post-operative day that they showed increase in pain scoring of TKR.

Length of stay (LoS) following a TKR in Group A, demonstrated a mean LoS of 3.341 days (+/- 0.246). In Group B, the mean LoS was recorded as 3.396 (+/- 0.096) days. With statistical interrogation the p value of 0.8024 was found. Therefore, the difference in LoS was not thought to be significant.

<table>
<thead>
<tr>
<th>Modality</th>
<th>Group A</th>
<th>Group B</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion Day 1</td>
<td>68.15 (+/- 2.644)</td>
<td>66.11 (+/- 2.012)</td>
<td>0.5483</td>
</tr>
<tr>
<td>Flexion Day 2</td>
<td>79.76 (+/- 2.066)</td>
<td>78.11 (+/- 1.381)</td>
<td>0.5043</td>
</tr>
<tr>
<td>Flexion Day 3</td>
<td>82.00 (+/- 2.218)</td>
<td>69.29 (+/- 6.355)</td>
<td>0.1086</td>
</tr>
<tr>
<td>Change in Hb</td>
<td>25.79 (+/- 1.519)</td>
<td>24.94 (+/- 0.9518)</td>
<td>0.6287</td>
</tr>
<tr>
<td>Length of Stay</td>
<td>3.341 (+/-0.2460)</td>
<td>3.396(+/- 0.0965)</td>
<td>0.8024</td>
</tr>
</tbody>
</table>

*Table 2: Demonstrating the other modalities measured and compared between the 2 cohorts of patients.*

**Discussion**

The use of a tourniquet is a traditional long standing technique in Total Knee Arthroplasty, naturally changes to such an established practice may well cause anxiety. However, to date there have been no reports in the literature of an adverse outcome due to the lack or limited use of a tourniquet.

Potential benefits cited include reduced post-operative pain, reduced soft tissue envelope blistering and potential early discharge.

Olivecrona, et al. [2] demonstrated the use of Tourniquets in excess of 100 minutes had a correlation with increased complications. Interestingly they also demonstrated that females were at higher risks of complications than males, though this difference was not thought to be significant.

Abbas, et al. [3] demonstrated that there was a significant difference when comparing the early release of tourniquet for haemostasis with delayed release following wound closure. They demonstrated a shorter length of stay (p = 0.001) in the cohort with the early release of tourniquets. Although we didn’t find any significant difference in length of stay during our current study.

Ejaz, et al. [4] demonstrated in their randomized study of 70 patients, that the non-tourniquet group had a better functional outcome and improved ROM in the early period of rehabilitation.

Yu Fan, et al. [5] conducted a RCT, comparing two cohorts of patients. One with full tourniquet use, and one with a limited tourniquet use during cementation and wound closure. The results of their study were similar to what we have obtained. They concluded that the limited use of a tourniquet in TKR provides the benefit of decreased limb swelling and knee joint pain while not compromising the operation time of blood loss and recovery.

Contrary to the results obtained from our study, Hartsen, et al. [6] concluded that there was no statistical difference, when comparing two groups of patients in a randomized controlled trial. They found that not using a thigh tourniquet during surgery was not superior in preserving knee-extension strength at the primary endpoint 48 hours following fast-track TKR, compared to using a tourniquet.

Interestingly a meta-analysis conducted by Zan, et al. [7], demonstrated that the early release of the tourniquet increased perioperative blood loss, and including total measured blood loss, calculated blood loss and postoperative blood loss in primary TKR. However, they also found that the early release of the tourniquet before wound closure decreased the risk of complications. Complications such as return to theatre for a further surgical procedure, wound complications, DVT, knee stiffness and infection induced by haematoma.
Lui, et al. [8] investigated the effects of tourniquet use on quadriceps function and pain in TKRs. Similar to our findings he found that the non-use of a thigh tourniquet demonstrated the benefits of less pain in the early postoperative period. There was no significant difference in the Oxford Knee Score, range of motion, swelling up to 12 months postoperatively. Surface EMG studies of the quadriceps function demonstrated a compromise for the first 6 months following surgery. Importantly they also found no difference in the cement mantle in the absence of a tourniquet. They concluded that it was safe and efficacious to routinely perform TKR without a tourniquet.

Ledin, et al. [9] conducted a randomized controlled study to investigate the use of tourniquets and its effect on the quality of fixation and final range of motion. They utilised radiostereometric analysis to predict future loosening and collected data regarding pain scores, total blood loss etc. The non-tourniquet group did have lower pain scores and an improved ROM which were statistically significant. They found that the tourniquet did not improve fixation of the implants.

A meta-analysis performed by Ta-Wei, et al. [10] in 2011, provide a valuable insight into the use of tourniquets in total knee arthroplasty. They investigated 810 articles, including eight randomized control trials and three high quality prospective studies. They concluded that tourniquet use did not offer any significant benefit with respect to total blood loss. However, it did ensure a shorter operative time.

Jose Hernandez, et al. [11] investigated the influence of tourniquet use and operative time on the incidence of deep vein thrombosis in total knee arthroplasty. A prospective study of seventy-eight consecutive patients who had a primary TKR performed underwent an ascending venography to evaluate the presence of deep vein thrombosis. In total, 42.3% of patients demonstrated a DVT of the proven DVTs 39.3% of these were proximal DVTs. They observed that those patients who had a surgery lasting longer than 120mins had an increased risk of proximal DVT. Interestingly they could not establish a significant relationship between tourniquet times and an increased incidence of DVTs.

Another systemic review and meta-analysis of randomized controlled trials performed by Wei, et al. [12] concluded that the release of tourniquet before wound closure for haemostasis reduced the rate of complications, and that they could not draw the same conclusions for other factors such as total blood loss.

Our study is consistent in finding that there were no adverse features of a limited tourniquet use. The biggest gain was in the postoperative pain scores, and in particular among the male cohort.

This finding is also strongly supported by the existing body of literature. That being said, further studies investigating the use of tourniquets during surgery are needed particularly looking at minor and major complications and the relationship with tourniquet pressure and time.

Conclusion

Our results have demonstrated that the limited use of tourniquets for primary total knee arthroplasty surgery is safe and provides the benefit of a reduced pain score, particularly in males with no increase in overall blood loss.

Bibliography


