



Short versus standard duration tourniquet use during Total Knee Replacement A pilot study

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We performed a prospective, randomized, controlled trial to know whether a short duration of tourniquet application affects surgical time, post-operative swelling, pain, early rehabilitation and complications compared to standard use of tourniquet throughout the procedure. Sixty knees were randomized. There were no differences in terms of surgical time and pain experienced between the two groups. Patients in the short duration tourniquet group had significantly less thigh swelling (3.7 ± 1.6 versus 4.8 ± 2.35 $p < 0.01$). There were no differences in the early rehabilitation between the groups. Soft tissue complications were higher in standard duration group. The use of tourniquet only during cementation of the implants reduces the thigh swelling and soft tissue complications associated with tourniquet use throughout the procedure.

Keywords : total knee replacement ; tourniquet.

blood loss, it might protect patients from regional complications. The likelihood of complications including neurological dysfunction increased with the total tourniquet time (6).

Thus, there is good evidence to suggest that application of tourniquet for shorter duration might reduce the regional complications and might help in early rehabilitation of TKR patients. Our aim was to know whether a short duration of tourniquet application (from cement mixing to cement setting) affects surgical time, limb swelling, pain relief and early rehabilitation compared to a standard duration of tourniquet application (from surgical incision to closure).

A pilot study was used to assess the research hypothesis.

INTRODUCTION

Tourniquet is commonly used during TKR surgery to provide a bloodless field to improve visualization and dry bone preparation for better cementation of implants. Whether the tourniquet used or not, the total blood loss will be the same (14,15,18). The timing of tourniquet release (i.e. prior to or after the wound closure) has been the subject of many randomized controlled trials and still is controversial (9). The meta-analysis by Rama *et al* (9) concluded that, whilst early release may increase the

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Table I. — Patients demography

	Standard TQ n = 30	Short TQ n = 30	
Male/Female	17/13	13/17	
AGE, Mean (SD)	69 (8.5)	66.7 (8.5)	
BMI, Mean (SD)	31.5 (5.5)	31.9 (6.2)	
ASA	2.5	2.5	
Pre-op haemoglobin	13.7 (1.7)	13.7 (1.2)	
Duration of tourniquet	76.7 (19)	14 (4)	<i>p 0.001</i>
Surgical time (min)	76.7 (19)	73.5 (13)	<i>p 0.23</i>

PATIENTS AND METHODS

All patients (Table I) under one surgeon's (NP) waiting list at Warrington district general hospital were included. Inclusion criteria were primary or secondary osteoarthritis. Exclusion criteria were inability to give informed consent and those who declined to participate in the study. Local committee permission was obtained to conduct this pilot study.

Consecutive patients were randomly allocated to either group in the operating theatre once patients were anaesthetized. Sealed envelope method was used for randomization. The nurse practitioner informed the operating surgeon to which group the patient belongs. All patients remained in their randomized group. As there were no previous studies to calculate the sample size we included 30 knees in each group as suggested by American Society for Testing and Materials standards for randomization.

The straight pneumatic tourniquet was applied on the thigh of all patients whilst positioning for the operation. In the standard duration group, the tourniquet pressure was raised prior to the skin incision without exsanguination and released after the wound closure. In the short duration group, the tourniquet pressure was raised once cement mixing had commenced and released once the cement had set. The tourniquet pressure used was 250 mmHg in all patients.

There were 60 knees randomized to either group. Five patients had bilateral procedure and were randomized to either group. Patient's demography is shown in table I.

The operations were performed between August 2010 to September 2012 by the senior surgeon or his trainees under his supervision and scrubbed. All operations were done under spinal or general anesthesia (as per anesthetist's preference). Twenty five patients had general anaesthetic, 25 had general and spinal anaesthetic remain-

ing 10 patients had only spinal anesthesia. The medial parapatellar approach was used to expose the knee. We used the Nexgen LPS knee prosthesis (Zimmer). Pulse lavage was used in all cases. The prosthesis were cemented with Palacos R (40 gm Palacos and 0.5 gm gentamicin). No drain system was used in either group. Wound was closed in layers. Non-adhesive wound dressing and wool and crape were used in all the patients. Wool and crape bandage was reduced the next day morning. All patients were prescribed regular paracetamol and NSAID's. For break through pain codeine phosphate and tramadol were prescribed. Rivaroxiban (Bayer) was used for the first 10 postoperative days for thromboprophylaxis in all patients. All patients had standard in-patient physiotherapy as per the hospital standard protocol. Patients, physiotherapist and surgical practitioners were blinded to the randomization.

Limb girth was measured 10cms distal (calf swelling) and 25 cms proximal (thigh swelling) to the tibial tuberosity. Post-operative leg swelling was recorded on the first post-operative day. Straight leg raise and range of movements were recorded every day until they first achieved SLR and 90 degrees of knee flexion. Pain was assessed by visual analog scale (VAS 0-10). Patients were asked to mark the average of the pain they had during the first post-operative day. The findings were recorded by the nurse practitioner (VC). The post-operative haemoglobin was measured after 24 hours. Blood transfusion was noted and incidence of readmission and thromboembolism were also recorded. Hospital protocol is to transfuse blood if haemoglobin level is less than 8.0 g/dl. Wound complications were defined as wound oozing more than three days requiring extended hospital stay, regional blisters, infection and wound problems requiring surgical intervention. The student t-test was used to compare data between the two groups. The level of significance was set at $p < 0.05$.

Table II. — Results comparing the two groups with statistical significance

	Standard TQ n = 30	Short TQ n = 30	
Thigh swelling	4.8 (2.35)	3.7 (1.6)	<i>p</i> 0.01
Calf swelling	2.8 (3.0)	3.2 (2.0)	<i>p</i> 0.29
Surgical time (min)	76.7 (19)	73.5 (13)	<i>p</i> 0.23
HB difference	3.22 (1.1)	3.22 (0.9)	<i>p</i> 0.49
LOS, Mean (SD)	6.5 (3)	5.4 (2)	<i>p</i> 0.07
SLR	3.35 (3.5)	2.5 (2)	<i>p</i> 0.15
90° flexion	4.4 (2.7)	4 (2.1)	<i>p</i> 0.33
Thigh pain	5.3 (2.7)	4.7 (2.2)	<i>p</i> 0.1
Knee pain	6.7 (2.1)	6.4 (2.2)	<i>p</i> 0.2
Complications	6	0	<i>p</i> 0.01

RESULTS

The demographic data was similar in both groups. There was no statistical difference in the drop of haemoglobin in both groups (average 3.22 g/dl). No patients required blood transfusion.

In the standard tourniquet group, tourniquet time was significantly longer compared to the short tourniquet group (average 77 minutes versus 14 minutes $p < 0.001$). There was no significant difference in surgical time between the two groups (p 0.23).

There was a statistically significant difference in the thigh swelling between the groups. The short tourniquet group had less swelling than the standard tourniquet group (p 0.01) (Table II).

Thigh pain was less in the short tourniquet group though not statistically significant. Knee pain and calf pain were similar in both groups.

Patients with short tourniquet group achieved straight leg raise and 90 degree flexion slightly earlier and length of stay was less compared to the standard tourniquet group, but the difference was not statistically significant.

Six patients in standard tourniquet group had wound problems (wound oozing more than 3 days and local blisters). None of them required any surgical intervention and settled eventually. No infections in either group.

Analyzing the data of 5 patients with bilateral procedure, there was a similar trend in these patients as well (Table III). These patients said had less thigh

pain on the side of the study knee compared to the control knee.

DISCUSSION

The significant finding of our study is, performing the TKR with tourniquet only during cementation of implants had less thigh swelling. Patients who had tourniquet only while cementation had no regional wound complications compared to standard duration tourniquet group.

The use of tourniquet gives a bloodless field. Numerous studies have shown that total blood loss was similar with or without tourniquet during TKR (10,12,15). In our study there was no difference in the post-operative haemoglobin drop level between the two groups and none required blood transfusion.

The average tourniquet time in short duration group was 14 minutes and in standard duration group was 77 minutes in our study. Many studies found higher incidence of wound haematomas, nerve palsies and blisters in tourniquet group (5,12). Horlocker *et al* concluded likelihood of neurological dysfunction increased with total tourniquet time (6). We also found similar findings ; patients in the standard duration group had more wound complication such as prolonged wound leakage and blisters.

The time of tourniquet release has been debated in the literature and is still controversial (9,11). The

Table III. — Bilateral TKR (5 patients 10 knees)

	Standard TQ n = 30	Short TQ n = 30
Thigh swelling	4.9	2.7
SLR	3	2
90° Flexion	4.5	3.5
Thigh pain	6	4.5

tourniquet, if released before wound closure may increase blood loss (4,9) and increase operation time (4,9,16,19). There was no difference in the operating time between the two groups in our study. In a recent study by Tarwala *et al* found no difference in surgical time, pain, pain medication, haemoglobin change and range of movements between operative tourniquet group and cementation tourniquet group (14).

Worland *et al* reported thigh pain was a common complaint in the early post-operative period in patients undergoing TKR with tourniquet (18). In a study by Wakanker *et al* there was no difference in pain or leg swelling at one week or later between the use of tourniquet or no tourniquet (17). In another study there was less pain in the first few hours to first three days in no tourniquet group (1). In a recent RCT by Tai *et al* the non-tourniquet group had less thigh and knee pain by post-operative day 4 (13). In our study we also found no difference in post-operative thigh or knee pain between the two groups. We feel this could be due to the standard post-operative analgesia given to all patients. The patients who had bilateral procedure mentioned they had less thigh pain on the side where they had tourniquet for cementation only.

The majority of patients in the short tourniquet group achieved 90 degrees of flexion and straight leg raise slightly earlier than the standard tourniquet group. Patients in the short tourniquet group discharged earlier. This was probably due to significantly less thigh swelling and no wound complications in these patients. However to know the significant difference between the groups we needed more than 250 patients in each group. Other RCTs have also showed short-term increase in

range of movements, less stiffness in no tourniquet group (1,17). In a recent RCT, showed less pain and increased range of movement, which were maintained at two years in no tourniquet group (7). In the recent RSA studies comparing tourniquet or no tourniquet on fixation of the implants found no differences (7,8).

Meta-analysis have showed increased thromboembolism in the tourniquet group (1,9,10,12). There was no incidence of thromboembolism in both groups in our study. It was probably due to the routine use of thromboprophylaxis and rapid rehabilitation protocol followed at our trust.

Drawbacks of our study were we did not measure the pre-operative pain scores and range of movements, which might have affected the post-operative findings. We also did not measure the analgesic consumption.

The use of a tourniquet during TKR is routine for many surgeons. It is believed to facilitate dissection and reduce intraoperative bleeding which helps better cementation of prosthesis (2). Our tourniquet time in the shorter duration group was average of 14 min (ranged from 10-20 min). With the tourniquet only during cementation bloodless field can be achieved, improving visualization of surgical field and helping cementation without increasing the risks associated with standard duration tourniquet. From the findings of our study we now recommend using the tourniquet only during the cementation of implants.

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