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RESEARCH ARTICLE
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COMPARATIVE STUDY OF USE OF TOURNIQUET APPLICATION DURING CEMENTATION VERSUS USE OF FULL TIME TOURNIQUET APPLICATION DURING TOTAL KNEE ARTHROPLASTY.

Dr. Pranesh E[1*], Prof. Dr. Pugazhendhi G[2] , Dr.Vasanth Kumar [3] , Dr.Shiva shankaran [4]

[1*]Post graduate in Dept. Of orthopaedics Sree balaji medical. College and hospital
[2]Professor in dept of orthopaedics Sree Balaji Medical College and hospitals
[3] Associate professor in Dept.Of orthopaedics
Sree balaji medical college and hospital
[4] Assistant professor in Dept.Of. orthopaedics Sree Balaji medical college and hospital

[*]**Corresponding Author:** Dr. Pranesh E
[*]Post graduate in Dept. Of orthopaedics Sree balaji medical. College and hospital

Abstract

Background: Application of Tourniquet in TKA(total knee arthroplasty) surgeries is being used by many orthopedic surgeons all over the world. However, there are many debates and controversy on the usage of timing of application of tourniquet in the total knee replacement surgery. The aim of this Comparative Study was to compare the advantages and disadvantages of tourniquet application only during cementation in the total knee replacement surgery versus full time tourniquet application in the TKA.

Methods: This study is done at our institution between July 2022 and July 2024. 50 Patients (out of which 30 were men and 20 were women) were included in this Study. In the 50 patients taken, 1st Group (25 patients = 14 men and 11 women) were done . TKA surgery with the application of tourniquet only during Cementation procedure rather than full time tourniquet application. 2nd Group (25 Patients = 16 men and 9 women) were done total knee replacement with the full-time application of tourniquet.

Results Tourniquet application only during cementation procedure during total knee replacement surgery does not increase operation time and the need for blood transfusion postoperatively. Tourniquet application only during cementation procedure during total knee replacement surgery decreases pain over operated site on post-operative day 1 (POD 1), decreases time needed to raise the straight leg in the operated side, and decreases complications following total knee replacement surgery. According to the immediate pain relief and early post operative functions of the 50 patients taken under this study, the results suggested that there was a less significant amount of intraoperative blood loss and total blood loss during full time tourniquet application than during limited tourniquet usage.

Conclusions: Application of tourniquet only during cementation procedure in the total knee replacement surgery might reduce the rate of complications during the post operative period and might have faster recovery of normal functions during the immediate rehabilitation time following Total Knee Replacement Surgery compared to the full-time tourniquet application in the TKA

Keywords: TKA(total knee arthroplasty), cementation procedure, blood loss, transfusion, tourniquet application, rehabilitation time

Introduction:

TKA is a well-accepted procedure for reducing the knee pain in old age patients associated with end stage tricompartmental Osteoarthritis knee and it also helps in the restoration of knee functions in old aged patients with tricompartmental end-stage osteoarthritis knee. According to reports, TKA can result in massive blood loss and, on occasion, blood transfusions within the first few days following surgery1. Though tourniquet application during TKA is still very controversial2, it has become common and is used widely by orthopaedic surgeons worldwide during these procedures due to its ability to improve cementation procedures, reduce intraoperative blood loss, and provide good visualization of the surgical field.

Application of tourniquet during TKA can be associated with major complications like pain over the thigh region, swelling of the operated limb, re-perfusion trauma, injuries to nerves and arteries, subcutaneous thigh fat necrosis, stiffness over the operated site, reduced recovery time of quadriceps strength, wound dehiscence, wound closure failure, Pulmonary embolism and deep vein thrombosis (DVT)3 .

In this Study, we evaluate the differences in functional recovery and pain scores between limited tourniquet use and tourniquet used throughout the TKA procedure.

Inclusion Criteria:

1. Patients of age group above 50 years were included in this study.
2. Patients who come under the kellgren-Lawrence Classification Grade 4.
3. Patients who were diagnosed with degenerative/inflammatory osteoarthritis knee.
4. Patients with decreased co morbidities conditions were included in this study.
5. Patient in whom the knee society score is less than 60points were included in this study. (Severe osteoarthritis)
6. Patients in whom the oxford knee score is less than 20 points were included in this study. (Severe osteoarthritis)

Exclusion Criteria:

1. Patients who were diagnosed with osteoarthritis at the early age
2. Patients who come under the kellgren Lawrence Classification less than grade 4
3. Patients in whom the oxford knee score is more than 20points were not-included in this study.
4. Patients who are bed ridden were not-included in this study.
5. Patients who are in the coma were not-included in this study.
6. Subject associated with medical diseases affecting rehabilitation
7. Patient who has active systemic infection or infection near the knee joint

Methods:

This study is done at our institution between July 2022 and July 2024. 50 Patients (out of which 30 were men and 20 were women) were included in this Study. 50 Patients are divided into 2 groups based on the different criteria. All patients included were in the age group of 50yrs and above. In the 50 patients taken, 1st Group (25 patients = 14 men and 11 women) were done Total Knee Replacement Surgery with the application of tourniquet only during Cementation procedure rather than full time tourniquet application. 2nd Group (25 Patients = 16 men and 9 women) were done total knee replacement with the full-time application of tourniquet.

Prior to skin incision, the tourniquet in Group 1 was inflated to 350 mmHg using an Esmarch wrap, and it was deflated after cementation. Group 2 underwent continuous tourniquet application from the point of incision to its closure. A mid line skin incision and a medial parapatellar approach5 were

used in both groups. Electrocautery was used to maintain hemostasis, and tranexamic acid was given both before and right before closure.
Using SPSS software, an independent analyst conducted the statistical analysis. Hemovac drain output, total blood loss, knee flexion, hemoglobin levels, intraoperative blood loss, and pain scores were among the perioperative outcomes that were compared using the Student's t-test. Preoperative and postoperative pain levels were assessed using the Oxford Knee Society Score[FIGURE 3], which demonstrated a notable improvement in pain.

Results: [TABEL 1]
In a study involving 50 patients diagnosed with osteoarthritis of the knee, 30 were men and 20 were women. These patients were divided into two groups, each comprising 25 individuals.
Group 1 (14 men, 11 women) underwent total knee replacement (TKR) surgery with a tourniquet applied only during the cementation phase, while **Group 2** (16 men, 9 women) had the tourniquet applied throughout the entire procedure. All surgeries were performed at Sree Balaji Medical College and Hospital by a single chief orthopaedic surgeon. Patients in both groups received identical anesthesia: epidural (1% ropivacaine without narcotics), intravenous propofol, and the epidural catheter was removed in the recovery room4.
This study was undertaken for comparing the hemodynamic and functional outcomes of tourniquet use throughout the entire TKA procedure versus only during the cementation phase. No statistically significant differences between the two methods were seen in the measured parameters.

Intra-Operative Blood Loss:
The mean intra-operative blood loss in patients where a full-time tourniquet was applied throughout the surgery was 180 ± 53 ml, while for patients whose tourniquet use was limited only to the cementation phase, the mean intra-operative blood loss was 260 ± 83 ml. Here, the P-value is 0.39, which means that the difference in intra-operative blood loss between the two groups is not statistically significant. Hence, there was not found any statistically significant difference between the two groups regarding intra-operative blood loss.

Total Blood Loss: [FIGURE 1]
For patients in whom the tourniquet was applied throughout, the total blood loss for both the intra-operative and postoperative phases was 469 ± 183 ml, while for those for whom this was confined to only the cementation phase, it was 584 ± 157 ml. The P-value for this comparison was 0.56, which means the result is not significant. Hence, the total blood loss in both groups is comparable.

Preoperative Hemoglobin:
The average pre-operative hemoglobin level in patients who had a full-time tourniquet applied was 11.8 ± 2.3 g/dL, while that for those with cementation-only tourniquet was 11.5 ± 2.1 g/dL. The P-value for this comparison was 0.725; thus, no significant differences were noted in the pre-operative hemoglobin levels in these patients between the two groups.

Postoperative Day 3 Hemoglobin:
The third-day post-surgery average hemoglobin level in patients with a full-time tourniquet was 9.1 ± 1.9 g/dL and, after that, 9.2 ± 1.3 g/dL in patients with cementation-only tourniquet application. The P-value here would be 0.83, which shows there are no significant differences between postoperative hemoglobin levels in the groups.

Preoperative Range of Movements:
The patients who had a full-time tourniquet had an average pre-operative range of motion of 102 ± 20 degrees, with values ranging from 20 to 140 degrees. The same was obtained in patients with cementation-only tourniquet at 102 ± 19 degrees, with values ranging from 50 degrees to 125 degrees.

The P-value here is 0.64, which is not significant; hence, there is no statistically significant difference in the pre-operative range of motion between groups

Postoperative Range of Movements:
The full-time tourniquet group had a mean postoperative range of motion of 100 ± 25 degrees. For the cementation-only tourniquet group, the mean postoperative range of motion was 100 ± 28 degrees with values ranging from 70–130 degrees. The P-value of 0.82 proves there is no significant difference between the two groups regarding postoperative range of motion.

Hemovac Drain Output: FIGURE 2
he average drain output from the Hemovac was 240 ± 165 ml in the full-time tourniquet group versus 231 ± 132 ml in the cementation-only tourniquet group. For this p-value of 0.77, there is not a statistically significant difference in drain output between the two groups.

Discussion:
There are still debates and controversy theories on the time of tourniquet application during the TKA, which may have impact on the clinical outcomes following TKA . It is widely accepted that the full-time use of application of tourniquet during the TKA might be an important factor for complications in the early postoperative period , which suggests decreased blood supply for tissues6 for the long time which may lead to necrosis. Therefore, it is critical to cut down on the amount of time the tourniquet is applied during the TKA7. Some researchers come to the conclusion that applying a tourniquet just during total knee replacement cementation could lessen complications and speed recovery. According to Fan et al , there are benefits to using a tourniquet sparingly during total knee replacement surgery, such as a reduction in knee joint pain and swelling, a shorter recovery period after the procedure, and less blood loss8. In another study, tourniquet administration alone during cementation has been demonstrated by Wang et al. to decrease concealed and postoperative blood losses without raising the rate of allogeneic blood transfusion2. Furthermore, using a tourniquet alone during the cementation process will result in a quicker recovery and less pain during the initial phase of rehabilitation after total knee arthroplasty (TKA)9.
The study that application of tourniquet only during cementation procedure in the total knee replacement surgery may result in decreased knee pain, easier and faster recovery of lost functions during the immediate rehabilitation period, and less complications in the postoperative period10.
Our research shows that applying a tourniquet just during the cementation stage of total knee arthroplasty (TKA) can efficiently provide a bloodless environment for implant implantation while having no negative effects on recovery, perioperative morbidity, or intraoperative time. Although TKA may be successfully executed with the right tourniquet pressure and timing, our research indicates that restricting tourniquet use to cementation has a number of advantages. The following are among them: 1) no difference in the length of the surgery; (2) less discomfort and better knee range of motion following the procedure; (3) similar blood loss between intermittent and continuous tourniquet use; and (4) fewer consequences, like nerve damage, dysfunction of the quadriceps, and drainage problems. Our findings thus confirm the safety and effectiveness of applying the tourniquet alone during cementation, which is consistent with the results of applying the tourniquet continuously throughout the procedure.

Conclusion:
The current study compared the effect of limited versus full-time tourniquet use during TKA on several hemodynamic and functional parameters. No statistically significant differences were noted for the key measures between the two groups. Intra-operative blood loss and total blood loss were similar with P-values of 0.39 and 0.56, respectively. Preoperative hemoglobin levels with a P value of 0.725 and post-operative day 3 hemoglobin levels with a P value of 0.83 were not statistically

significant. Range of movements, both pre-operative and post-operative, were also similar with P values of 0.64 and 0.82, respectively. Hemovac drain output was also comparable with a P value of 0.77. These findings indicate that a TKA performed only with the tourniquet inflated for cementation would provide the same hemodynamic stability and functional recovery as full-time tourniquet application, most likely reducing long-term tourniquet use-associated risks.

TABEL 1:

Hemodynamic Comparision	**Torniquet during full time surgery**	**Torniquet only during cementation procedure**	**P Value**
Intra-operative blood loss	180 ± 53	260 ± 83	0.39
Total blood loss	469 ± 183	584 ± 157	0.56
Preoperative hemoglobin	11.8 ± 2.3	11.5 ± 2.1	0.725
Post-operative day 3 hemoglobin	9.1 ± 1.9	9.2 ± 1.3	0.83
Pre-operative range of movements	102 ± 20 (20 – 140)	102 ± 19 (50 – 125)	0.64
Post-operative range of movements	100 ± 25 (50–135)	100 ± 28 (70–130)	0.82
Hemovac drain output	240 ± 165	231 ± 132	0.77

FIGURE 1:

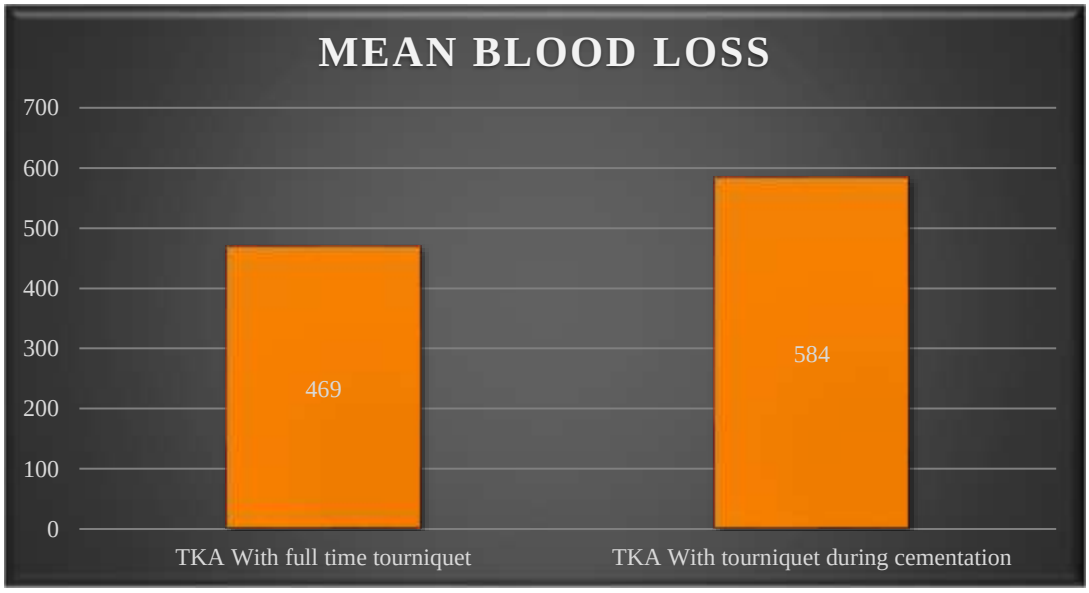

FIGURE 2:

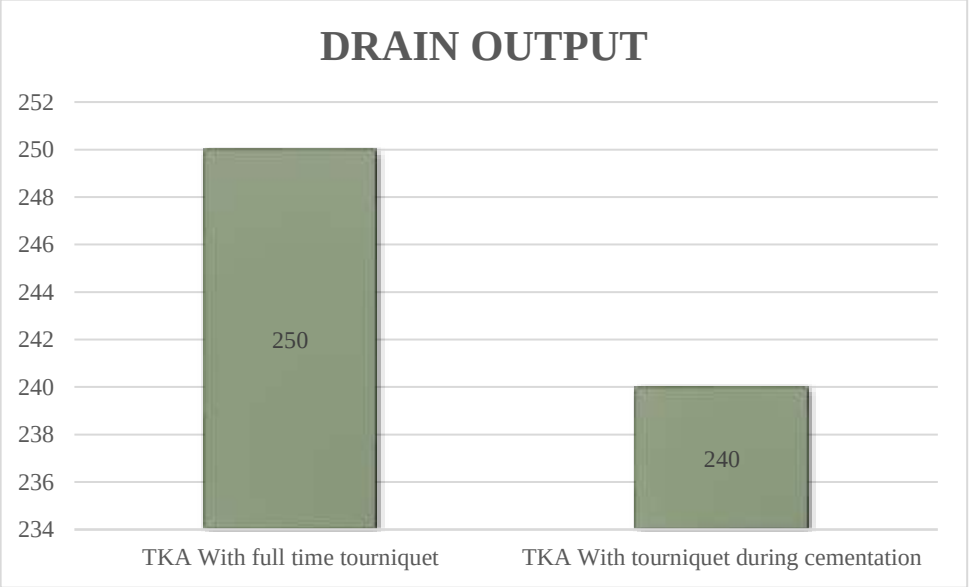

FIGURE 3:

Oxford KNEE Score

Patient's name: _____

Timeframe: pre op 3/52 6/52 3/12 6/12 12/12

Side L / R Appt date_____ Date of Birth:_____ Age:_____

Patient to complete. Tick (√) one box for every question

1.During the past 4 weeks **How would you describe the pain in your knee?** □ None □ Very Mild □ Mild □ Moderate □ Severe	**7. During the past 4 weeks** **Have you been limping when walking because of your knee?** □ Rarely/never □ Sometimes, or just at first □ Often, not just at first □ Most of the time □ All of the time
2.During the past 4 weeks **How long can you walk (with or without stick) before the pain in your knee becomes severe?** □ No pain/more than 30mins □ 16-30 mins □ 5-15 mins □ Around the house only □ Not at all/pain severe	**8. During the past 4 weeks** **Have you felt that your knee might suddenly "give way" or let you down?** □ Rarely/never □ Sometimes, or just at first □ Often, not just at first □ Most of the time □ All of the time
3.During the past 4 weeks **After a meal (sat at a table), how painful is the knee to stand up?** □ Not at all painful □ Slightly painful □ Moderately painful □ Very painful □ Unbearable	**9.During the past 4 weeks** **Could you kneel down and get up again afterwards?** □ Yes, easily □ With little difficulty □ With moderate difficulty □ With extreme difficulty □ No, impossible
4.During the past 4 weeks **Have you been troubled by pain from your knee in bed at night?** □ No nights □ Only 1 or 2 nights □ Some nights □ Most nights □ Every night	**10.During the past 4 weeks** **Have you had any trouble with washing and drying yourself (all over) because of your knee?** □ No trouble at all □ Very little trouble □ Moderate trouble □ Extreme trouble □ Impossible to do
5. During the past 4 weeks **How much has pain from your knee interfered with your usual work (including housework)?** □ Not at all □ A little bit □ Moderately □ Greatly □ Totally	**11. During the past 4 weeks** **Have you had any trouble getting in and out of a car or using public transport because of your knee?** □ No trouble at all □ Very little trouble □ Moderate trouble □ Extreme trouble □ Impossible to do
6. During the past 4 weeks **Could you walk down one flight of stairs?** □ Yes, easily □ With little difficulty □ With moderate difficulty □ With extreme difficulty □ No, impossible	**12. During the past 4 weeks** **Could you do the household shopping on your own?** □ Yes, easily □ With little difficulty □ With moderate difficulty □ With extreme difficulty □ No, impossible

Grading for the Oxford Knee Score	
Score 0 to 19	Poor
Score 20 to 29	Moderate
Score 30 to 39	Good
Score 40 to 48	Excellent

OXFORD KNEE SOCIETY SCORE

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