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Analysis of factors influencing outcome following primary total knee arthroplasty

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Abstract
Introduction: Osteoarthritis is a chronic and painful disease which causes pain and loss of movement in the knee that lead to difficulty in performing daily activities. In this study, we analyze various factors like age, sex, BMI, waist/hip ratio, tourniquet time, KL grade of OA knee, use of preoperative tranexamic acid, affecting the outcome post total knee arthroplasty surgery in osteoarthritic patients. Outcome till 6 month was evaluated by mean knee range of motion, Knee society score, SF12 score.
Results: In our study, 12 patients (40%) had osteoarthritis knees according to K-L grade III, and 18 patients (60%) had osteoarthritis knees according to K-L grade IV. There were 18 (60.0%) females and 12 (40.0%) males in our study, showing a slight preponderance of females. Leftsided affection was slightly more than right.
In our study 16 patients (around 53%) were with BMI ranging from 29 to 32 with mean BMI of 31+_2.3 and Mean Waist Hip ratio was 80.7+-6.
Average duration of surgery was around 125.2+-16.26 minutes.
The postoperative Knee Society Score at the end of our follow up study at 6 Month is 79.30
Conclusion: We have provided an overview of factor-related progress to the scientific community, but also present time-specific effects to be able to better understand the importance of these factors for Total Knee replacements in the clinic. We conclude tourniquet time, total time of surgery, total blood loss had insignificant effect on functional outcome of patient over a follow up period of 6 months. Excellent results can be expected in patient of younger age and with low BMI & Waist: Hip Ratio, with no comorbidity. Preoperative functional outcome was significant following early KL grade 3 OA knee patients undergoing Total Knee Replacement compared to KL grade 4 knee initially, but over the period of 6 month follow up outcome was found comparable.

Keywords: Arthroplasty, osteoarthritis, knee joint

Introduction
Osteoarthritis is a painful, debilitating condition for which there is no recognised medical solution. Osteoarthritis impairs knee movement and produces pain, making it challenging to carry out regular tasks. Although they help reduce discomfort, medications cannot treat the underlying condition. Most knees with arthritis exhibit some instability, deformity, contracture, or a combination of these conditions.
Soft tissue interposition arthroplasty and surface replacement arthroplasty are two surgical approaches to managing osteoarthritis. To address the complex kinematics of the knee joint, various types of prostheses were created for surface replacement arthroplasty.
The goals of Total Knee Arthroplasty include - Pain relief, Restoration of normal limb alignment. Restoration of the functional range of movement.
The success of the procedure depends not only on the accuracy of the surgical technique, the soundness of the implant design and kinematics, and the selection of the right materials, but also on the proper use of other tourniquets, intraoperative cocktail use, drain usage, preoperative patient characteristics, and the patient's compliance with rehabilitation.
In this study we analyze various factors like age, sex, BMI, waist / hip ratio, tourniquet time, Kellgren Lawrence grade of OA knee, use of preoperative tranexamic acid, affecting the outcome post total knee arthroplasty surgery in osteoarthritic patients.

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Outcome till 6 month was evaluated by mean knee range of motion, American knee society score, SF12 score.

In this study, we made efforts to classify related factors, present them as they occur in different individuals and also the long-term effects of certain factors that may function over years in patients.

Materials and Methods
This is an observational type of study at SAMC & PGI Indore, from April 2021 to September 2022. Knee Society Score and SF12 Scoring was used to evaluate the outcome. The study was carried out on 30 knees of 30 patients of OA knee, operated with Total Knee Arthroplasty. Information on the patients was compiled from clinical details, case files and operation theatre records who were followed up for the duration of 6 months.

Inclusion Criteria involves Patients with age group 35 and above and Patients with knee osteoarthritis KL grade 3, 4 and we excluded Patients with knee osteoarthritis KL grade 1, 2. Patients with active infection around knee. Patients with Revision Total Knee Arthroplasty

Postoperatively patients were monitored continuously in the perioperative ward. Epidural analgesia consisting of 0.125% Bupivacaine was given. The patients were made to ambulate full weight bearing from the second postoperative day with the help of walker. Quadriceps strengthening and knee bending exercises as tolerated were also started from the 1st postoperative day. Skin staples were removed between 10th and 14th postoperative days.

Post operative radiograph (Anteroposterior and lateral) view were taken to see the prosthetic positioning in both sagittal and coronal planes. Follow up was done at 2 weeks, 1 month, 3 months, 6 months.
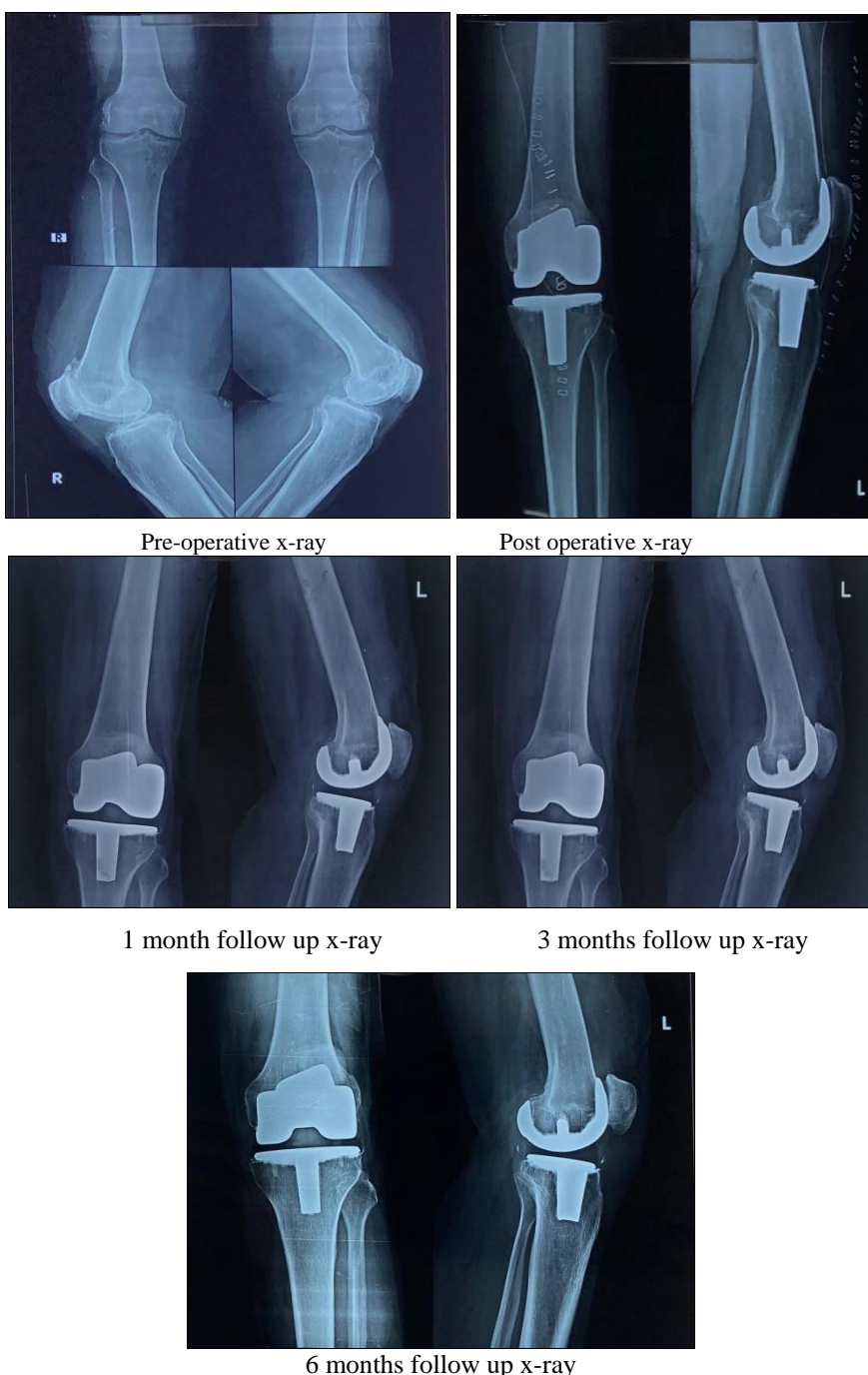
Pre-operative clinical images

Pre-operative x-ray

Post operative x-ray

1 month follow up x-ray

3 months follow up x-ray

6 months follow up x-ray

Fig 1: 6 months follow up clinical image

Observation and Results

There were 13 (43%) patients in the age group 55-65years and 10 (33%) patients in the age group for more than 45-55 years. The mean age of patients in our study group was 55.9±9.5 years. There were 18 (60.0%) females and 12 (40.0%) males in our study, showing a slight preponderance of females. Left sided affection was slightly more than right.

In our study 16 patients (around 53%) were with BMI ranging from 29 to 32 with mean BMI of 31+_2.3 and Mean Waist Hip ratio was 80.7+-6.1.
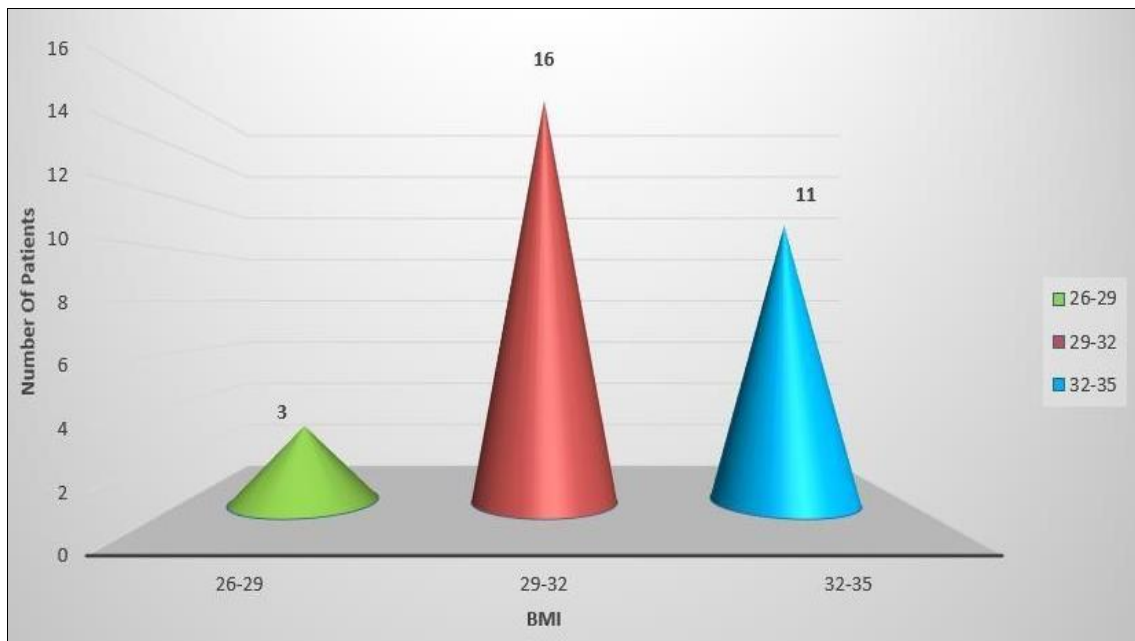

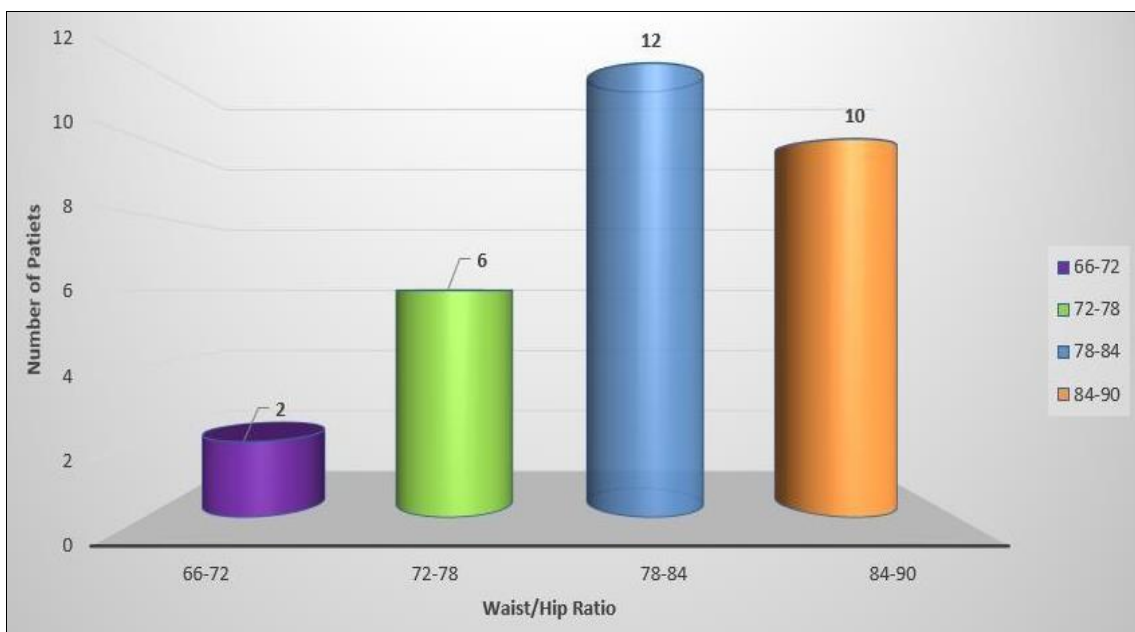**Fig 2:** Distribution of patients according to BMI

Fig 3: Distribution of patients according to waist/HIP ration

In our study 21 patients (70%) had tourniquet time of 80-100 minutes with mean tourniquet time of 95.3+- 3.98 minutes and mean average blood loss was 774.3+- 102.6ml with an Average duration of surgery was around 125.2+-16.26 minutes.

In our study use of tranexamic acid preoperatively caused average blood loss of 751.43ml

And patients without use of tranexamic acid preoperatively caused average blood loss of 850.71ml
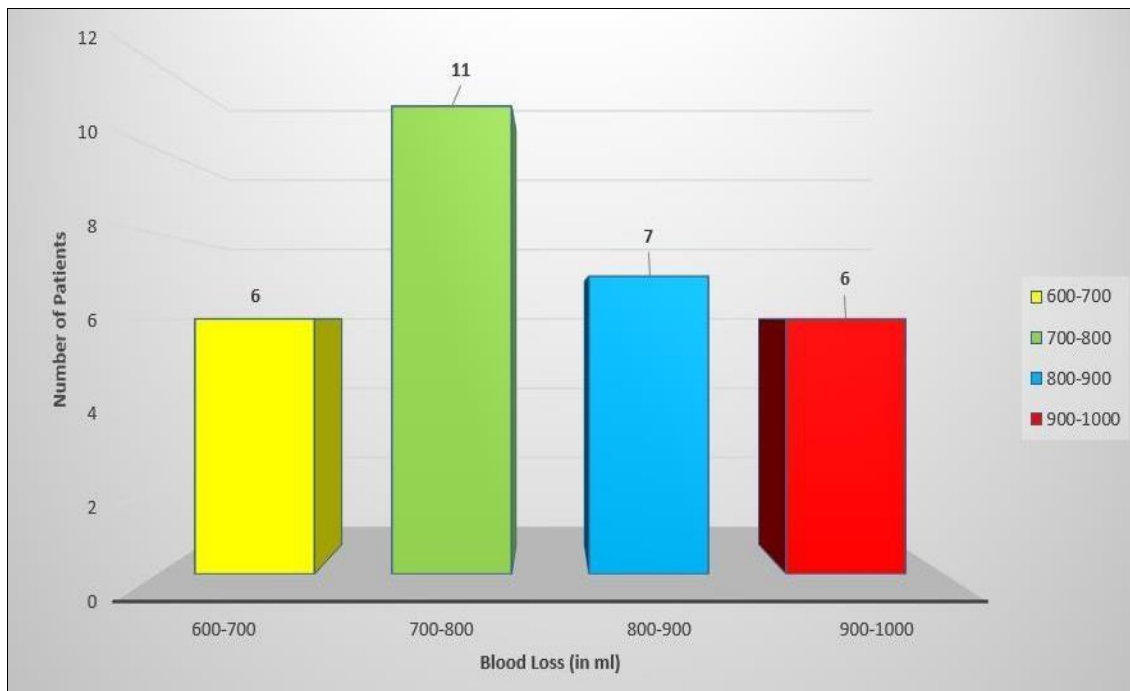
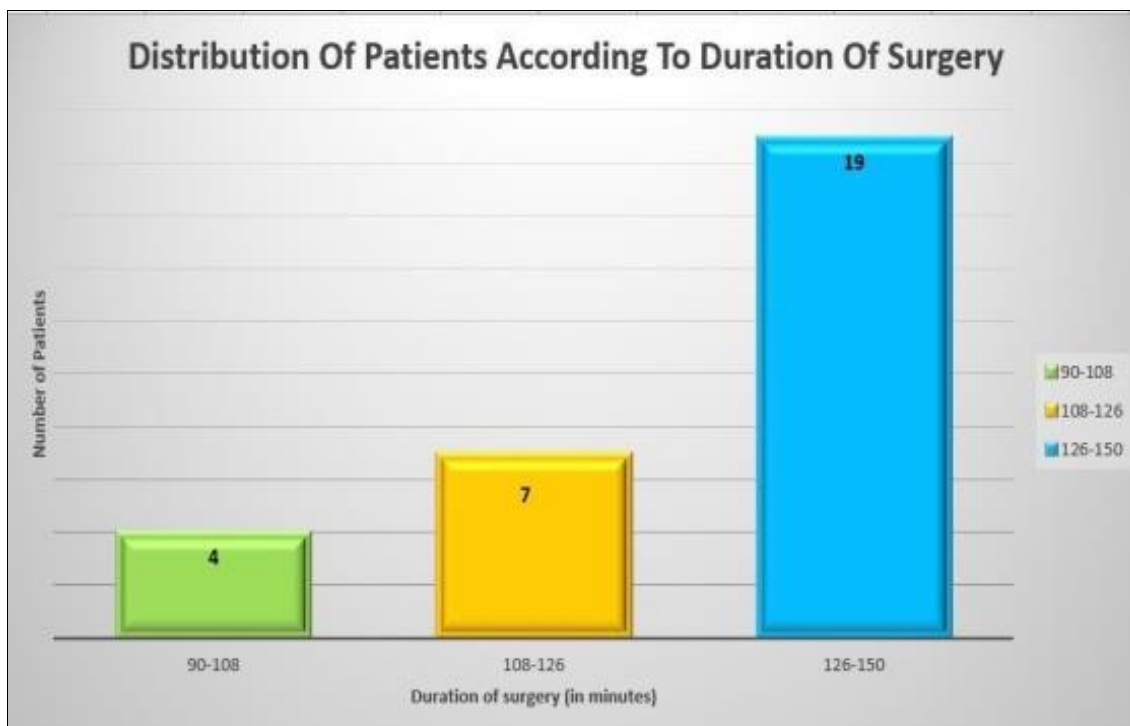**Fig 4:** Distribution of patients according to blood loss

Fig 5: Distribution of patients according to duration of surgery

In our study maximum number of surgeries were done in between 126min to 150 min with an average time of 125.20 minutes.

Table 1: Mean American knee society score

Parameters	No. Of Samples	Mean ± Std Deviation
BMI	30	31±2.3
Waist/Hip Ratio	30	80.7±6.1
Torniquet Time (in minutes)	30	98.2±32.98
Blood Loss (in ml)	30	774.3±102.6
Duration of Surgery (in minutes)	30	125.2±16.26

Average preoperative rom of KL grade 4 patients was 60.41 and that of KL grade 3 was 71.33 degree. Average postoperative rom of KL grade 4 patients was 110.57 and that of KL grade 3 was 111degree

There was a statistically significant improvement in the mean American Knee Society Score at all the time intervals in comparison to the preoperative value. In our study, the mean total score during the preoperative stage 61.23and during the postoperative stage was 66.87. The postoperative American Knee Society Score at the end of our follow up study at 6 Month is 79.30

Table 2: SF-12 Mental Score

Time Interval	SF-12 Mental Score [Mean ± SD]	"t" value	"p" value
Pre-Operative	49.29±3.75	0.36, df=29	3.58E-01
1 month	48.95±3.81		
1 month	48.95±3.81	(7.11), df=29	3.96E-08
3 months	54.78±3.37		
3 months	54.78±3.37	(0.95), df=29	0.173166556
6 months	55.25±3.62		

Table 3: SF-12 Physical Score

Time Interval	SF-12 Physical Score [Mean ± SD]	"t" value	"p" value
Pre-Operative	46.09±2.91	0.62, df=29	2.69E-01
1 month	45.67±2.67		
1 month	45.67±2.67	(5.64), df=29	2.10E-06
3 months	48.84±3.24		
3 months	48.84±3.24	(5.06), df=29	1.05258E-05
6 months	50.8±3.36		

Discussion

In our study, 12 patients (40%) had osteoarthritis knees according to K-L grade III, and 18 patients (60%) had osteoarthritis knees according to K-L grade IV. This finding is in consistent with the findings of two other studies from A Riis et al. [1] (2014), in which grade IV (74%) were the most common arthritic knee grades, followed by grade III (13 percent) and grade II (8.7%). Patients with grade IV OA knees were more common in our research because they took conservative management in initial stages and then approached tertiary centre for operative management.

The tourniquet was lifted before the start of the closure, which resulted in a mean tourniquet time in our study of 98.2 minutes and a mean surgery time of 125.2 minutes. Our research revealed that the use of a tourniquet did not result in a reduction in overall blood loss. This result differs from earlier findings, such as the study by Alcelik et al. [2], which found that using a tourniquet marginally increases blood loss. Nevertheless, using a tourniquet can offer a bloodless field of vision, and it might be advantageous for bone cement to be able to penetrate bone trabeculae, which may aid in increased prosthesis stability. These were the primary factors in our decision to apply a tourniquet.

Our study showed patient in which tranexamic acid was used preoperatively caused average blood loss of 751.43ml and patients without caused average blood loss of 850.71ml. Which was significant. Tranexamic acid being an antifibrinolytic, its local and systemic use preoperatively causes significant reduction in total average blood loss after TKR. Our findings were consistent with meta-analysis study by Marra F et al. [3] tranexamic acid is effective both locally and systematic in blood loss after TKR.

A periarticular cocktail of 90ml of normal saline,17.5 ml of 5%bupivacaine,2 ml of inj. ketorolac(30 mg) and 0.5 ml of adrenaline (total 110 ml) was given primarily at medial retinaculum, medial collateral ligament, posterior capsule, lateral collateral ligament, lateral retinaculum, patellar tendon and fat, and cut ends of quadriceps muscle and tendon. Our study showed average total blood loss of 730ml with use of periarticular cocktail and 810.53 ml without use of cocktail.no difference in average total blood loss in TKR but showed significant difference in relief of immediate post operative pain. Hence requirement of post operative epidural top up was

less. Similar observations were seen in study conducted by Nair S et al. [4] decrease in post operative pain and better early knee motions. And also, Velmurugan K et al. showed similar result. Although composition of cocktail slightly varies in all studies.

With average surgery time as 125.20 minutes, we concluded average blood loss of 743ml, Increase in duration of surgery causes more average loss of blood. Which is slightly more than various other study like P Narayan et al. [5] which had total average blood loss 663ml and 735ml in KR Sehat et al. study [6]. which might be due to place of study is a tertiary medical teaching centre where new residents are assisting in surgery, leading to more operative time and hence more blood loss.

Higher the preoperative KL grade of patients offers considerably less knee ROM immediately postoperatively, but over the course of 6 months gives comparable knee ROM between the two groups. The average 6 month postoperative ROM of KL grade 4 patients was 110.57 and that of KL grade 3 was 111. Our findings were in agreement with studies by Bade et al. [7] and Hauer et al. [8], which came to similar conclusions.

There was a statistically significant improvement in the mean SF12(MCS) at all the time intervals in comparison to the preoperative value Results of our study were comparable to other studies like clement ND et al. [9] and Yadegari I et al. (2019) [11]. There was a statistically significant improvement in the mean SF12 (PCS) at all the time intervals in comparison to the preoperative value.

There were no significant complications seen during our study, though there were incidence of local wound infection in one patient and periprosthetic fracture was seen in one patient. Both were managed for that postoperatively. Results of our study were comparable to other studies like Courage O et al. (2021) [12] and L rouquette et al. (2020) [10].

Conclusion

Knowing the potential factors that can affect each patient's surgical success is crucial given the rising number of individuals who undergo knee replacements each year. However, the two main reasons for our literature review are how the novel findings of the factors are related to surgical outcomes and how the variations should be assessed in different individuals. It is crucial to be aware of these factors when developing personalised treatments for patients in the clinic.

We have provided an overview of factor-related progress to the scientific community, but also present time-specific effects to be able to better understand the importance of these factors for Total Knee replacements in the clinic.

Excellent results can be expected in patient of younger age and with low BMI & Waist: Hip Ratio, with no comorbidity. Preoperative functional outcome was significant following early KL grade 3 OA knee patients undergoing Total Knee Replacement compared to KL grade 4 knee initially, but over the period of 6 month follow up outcome was found comparable.

We concluded tourniquet time, total time of surgery, total blood loss, had insignificant effect on functional outcome of patient over a follow up period of 6 month. There was significant decrease in post operative pain hence better functional outcome immediately in post op patients with the use of intra operative cocktail.

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