"COMPARATIVE ANALYSIS OF INFLUENCE OF EPIDURAL INJECTION AND ADDUCTOR CANAL BLOCK VERSUS EPIDURAL INJECTION AND PERIARTICULAR INFILTRATION VERSUS EPIDURAL INJECTION ALONE ON PAIN RELIEF AND KNEE RANGE OF MOVEMENTS AFTER TOTAL KNEE ARTHROPLASTY" – A PROSPECTIVE NON-RANDOMISED STUDY

By

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LIST OF ABBREVIATIONS

TKR	TOTAL KNEE REPLACEMENT
MPI	MULTIMODAL PERIARTICULAR INFILTRATION
ACB	ADDUCTOR CANAL BLOCK
PIA	PERIARTICULAR INFILTRATION ANALGESIA
FNB	FEMORAL NERVE BLOCK
TKA	TOTAL KNEE ARTHROPLASTY
POD	POST OPERATIVE DAY
PO8th	8^{th} HOUR POST OPERATIVELY
VAS	VISUAL ANALOG SCALE
PI	PERIARTICULAR INFILTRATION
LOS	LENGTH OF HOSPITAL STAY
1^0	PRIMARY
2^0	SECONDARY
BMI	BODY MASS INDEX
OKS	OXFORD KNEE SCORE
KSKS	KNEE SOCIETY KNEE SCORE
ROM	RANGE OF MOVEMENT
ASA	AMERICAN SOCIETY OF ANESTHESIOLOGISTS
QOL	QUALITY OF LIFE
LIA	LOCAL INFILTRATION OF ANALGESIA
NRS	NUMERIC RATING SCORE
PCI	POSTERIOR CAPSULE INFILTRATION
IAEC	INTRAARTICULAR EPIDURAL CATHETER
PLI	PERIARTICULAR LOCAL INFILTRATION
iPACK	INFILTRATION BETWEEN POPLITEAL ARTERY AND POSTERIOR CAPSULE OF KNEE
AUC	AREA UNDER CURVE
MRC	MEDICAL RESEARCH CENTER

TABLE OF CONTENTS

ABSTRACT

Introduction: Postoperative pain after total knee arthroplasty (TKA) is a significant determinant of early rehabilitation and postoperative recovery in the patient. The last two decades have seen a significant improvement in the management of postoperative pain, with increase in popularity of multimodal analgesia regimens which include the use of both regional anesthesia and systemic analgesics.

Aims: To compare the influence of epidural injection and adductor canal block versus epidural injection and periarticular infiltration versus epidural injection alone on pain relief and functional outcome of patients quality of life post total knee arthroplasty

Materials and method: The present study was a Prospective Study. This Study was conducted for 1 year at Dr. Prabhakar Kore Hospital and Medical Research Centre and Charitable Hospital. Total 90 patients were included in this study.

Result: In the adductor canal, 15 (50.0%) patients were left TKR and 15 (50.0%) patients was right TKR. In epidural, 16 (53.3%) patients were left TKR and 14 (46.7%) patients was right TKR. In periarticular, 16 (53.3%) patients were left TKR and 14 (46.7%) patients was right TKR. Association of intervention with treatment was not statistically significant (p=0.9564). In Adductor canal, the mean VAS Score POD0 (mean± s.d.) of patients was 6.6000 ± .6215. In Epidural, the mean VAS Score POD0 (mean± s.d.) of patients was 8.0000 ± .7428.

Conclusion: In conclusion, this prospective non-randomized study demonstrates that combining an epidural injection with either an adductor canal block or periarticular infiltration significantly improves pain relief and knee range of motion after total knee arthroplasty compared to using an epidural injection alone. Among the two combination approaches, the adductor canal block was found to be marginally more effective in enhancing early postoperative outcomes. These findings suggest that incorporating regional anesthesia techniques alongside epidural injections can be a valuable strategy in optimizing postoperative recovery for patients undergoing total knee arthroplasty. Further randomized controlled trials are warranted to confirm these results and refine pain management protocols in this context.

Keywords: Epidural Injection, Pain Relief, Adductor Canal Block and Total Knee Arthroplasty

INTRODUCTION

The study investigates post surgical analgesia strategies following arthroplasty of knee(TKR), comparing the outcome of three approaches: epidural analgesia alone with epidural and subsartori-al/adductor canal block and epidural analgesia combined with multimodal periarticular infiltrations (MPIs). Over the past two decades, advancements in pain management have focused on multimodal analgesia regimens, integrating regional anesthesia and systemic analgesics to improve patient outcomes. While TKA is a crucial surgery for patients with severe arthritis, postoperative pain remains a significant challenge, impacting sleep, rehabilitation, and hospital stays. The study aims to address this issue by evaluating whether combining ACB with MPIs provides superior pain relief and facilitates earlier functional recovery compared to using ACB alone. This research is essential given the estimated rise in demand for primary arthroplasty of knee procedures in the near future and the importance of effective pain management in enhancing patient satisfaction and outcomes.After arthroplasty of knee(TKR), a variety of methods have been used to manage postoperative pain. These methods include intravenous opioids and regional anesthetic techniques like "periarticular infiltration analgesia (PIA), adductor block, peripheral nerve blocks, femoral nerve block (FNB)," and "epidural analgesia." Every one of these strategies has some advantages as well as possible drawbacks.For instance, FNB offers targeted analgesia but carries the risk of nerve injury and impairment of quadriceps function. On the other hand, Periarticular infiltration analgesia (PIA) entails the administration of various analgesic agents directly into the surgical site during the operation. This method offers effective pain relief during the immediate postoperative period. However, its duration of action is typically limited, necessitating additional pain management strategies for sustained relief.In contrast, aductor canal block is gaining popularity as a versatile option that effectively manages pain while preserving function. As the medical community continues to refine its approach to pain management, selecting the most suitable combination of techniques becomes crucial for optimizing patient comfort and recovery.

Recent studies comparing the benefitz of the ACB and PIA methods have yielded conflicting results.

AIMS AND OBJECTIVE

This study aims to evaluate and compare the outcome of three different pain management techniques for patients undergoing TKA. Specifically, the research focuses on evaluating the pain relief and functional outcomes provided by epidural injection alone, epidural injection combined with ACB, peri-articular infiltration, and a combination of these injections.

By evaluating these three approaches, the study seeks to determine which method provides the most favorable results in terms of analgesia and patient prognosis following TKA. This research will contribute valuable insights into optimizing postoperative pain management strategies for TKA patients, ultimately enhancing their recovery and overall well-being.

ANATOMY AND BASIC SCIENCES

Anatomy and Physiology

The Spinal Cord and Epidural Space

The adult spinal cord is approximately 45 cm shorter than the spinal canal. The spinal cord ends at the L1 vertebra in 50% of adults and at the L2 vertebra in about 40%. Although it was previously believed that the newborn's spinal cord extended to the L2 or L3 vertebrae, recent studies have shown that the average neonate's conus medullaris is also at the L2 vertebra. Below this level, the lumbar and sacral nerves converge to form the cauda equina. The spinal cord is suspended in cerebrospinal fluid and surrounded by the arachnoid mater. The arachnoid mater and subarachnoid space extend caudally to S2 in adults, S3 in children, and S4 in newborns. The arachnoid mater is closely approximated to the dura mater, which is attached to the spine by its outer endosteal portion. The arachnoid mater envelopes the brain intracranially and the spinal cord and extends through the foramina intervertebral to the epineural connective tissues of the spinal nerves.[13]

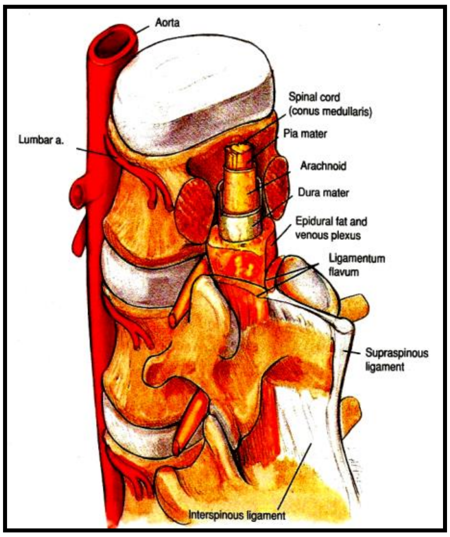


Figure 1: Vertebral Column

The spinal epidural space extends from the foramen magnum at the base of the skull to the sacral hiatus and contains fatty and connective tissues, blood vessels, and lymphatics. The blood vessels may dilate with pregnancy or ascites, increasing the risk of a traumatic or bloody puncture. The epidural space is further divided into the anterior and posterior epidural spaces. The anterior epidural space contains the ventral spinal nerves, the basivertebral veins, and the internal vertebral venous plexus. In contrast, the posterior epidural space contains the dorsal spinal nerves, the intervertebral veins, and the sinuvertebral nerves.[16]

The boundaries of the epidural space are formed by the dura mater and arachnoid mater internally, the ligamentum flavum and the vertebral periosteum externally, and the intervertebral foramina laterally.[16] The distance between the skin and the spinal epidural space is variable. Depending on a patient's age and amount of subcutaneous fat, this distance can range from 4 cm in normal BMI adults to >8 cm in obese patients. The dorsal border of the spinal epidural space is the ligamentum flavum. Moving superficially, the remaining layers are the interspinous ligament located between the spinous processes, the supraspinal ligament situated on the surface of the spinous processes, subcutaneous tissue, and the skin.[13]

Relevance to Epidural Anesthesia

The anatomy of the epidural space is of paramount importance to the administration of epidural anesthesia. By targeting specific spinal segments and structures within the epidural space, anesthesiology clinicians can achieve targeted pain relief and minimize the risk of complications. In addition, understanding the anatomical variations and the location of blood vessels, spinal nerves, and other structures within the epidural space is essential for safe and effective epidural catheter placement.[17]

Techniques to Locate the Epidural Space

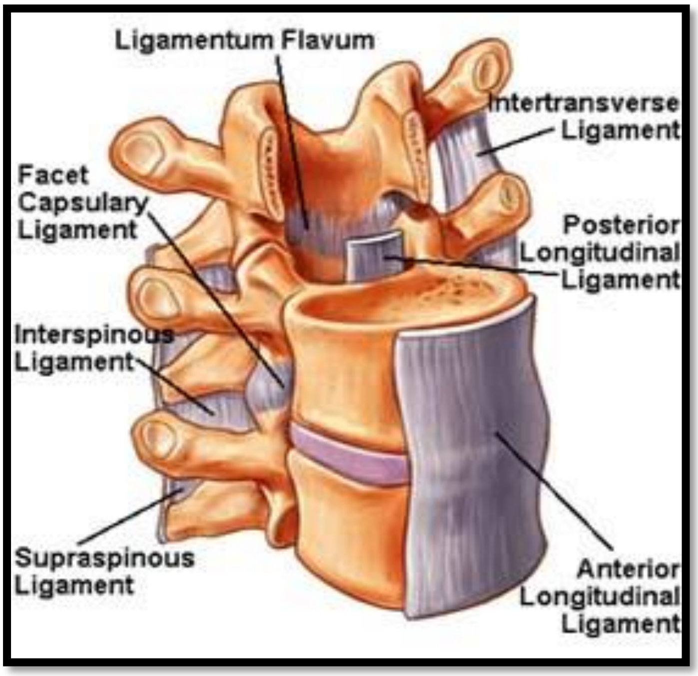
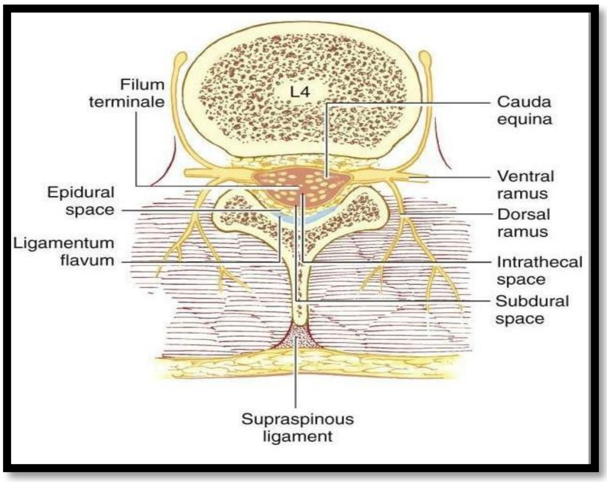


Figure 2 :Vertebral ligaments

Various techniques have been developed to locate and access the epidural space safely and accurately. The traditional landmark-based approach relies on identifying anatomical landmarks, including the spinous processes, interspinous spaces, and the midline, to guide epidural needle insertion.[17] In addition, the loss-of-resistance technique is commonly employed to confirm the location of the epidural space, which involves feeling resistance to the gentle injection of air or saline with the epidural needle when not in the epidural space and the sudden loss of resistance when the space is entered.[17]

The caudal epidural block is a specific technique that involves the administration of local anesthetic agents into the caudal epidural space located at the sacral hiatus. This technique is often used in pediatric anesthesia and specific lower extremity and perineal procedures in adults. The most common shape of the sacral hiatus is an inverted U shape, seen in both males and females. The length from the apex of the sacral hiatus to the first sacral spine is slightly longer in females compared to males; however, the sacral cornua's width is similar in both sexes. Understanding these morphometric parameters is crucial for successful epidural anesthesia procedures. Variations in the sacrum can contribute to lower backache and may impact surgical procedures. The sacral canal is formed by the union of the pedicle and lamina of the 5 sacra and contains important structures such as the cauda equina and sacral nerves.[18] Correct needle placement can only be achieved by identifying anatomical landmarks (eg, the sacral cornu, the lateral sacral crests, and the apex of the sacral hiatus). Even with identifying anatomical landmarks, clinicians fail to place a caudal epidural block 30% of the time, secondary to anatomical variations; often, ultrasound is used to guide placement.[19] Therefore, clinicians must have a good understanding of the anatomy of the sacral region to have any chance of successfully administering a caudal epidural block.

Figure 3 : Epidural Space



Indications

The primary indications for epidural anesthesia include obstetrical anesthesia during labor and surgical anesthesia for thoracic, major intra-abdominal, or spine surgeries, provided there is no need for muscle relaxation. Epidural anesthesia may also be used as an adjunct in intraoperative or postoperative pain management. Patients at higher risk for postoperative complications, such as those affected by ischemic heart disease, have demonstrated increased benefits (eg, decreased postoperative pulmonary complications and faster intestinal return to function) with epidural anesthesia in the past.[20]

Contraindications

Epidural anesthesia is considered relatively safe for most patients; however, alternative types of anesthesia may be more appropriate for some individuals.

Absolute Contraindications

Patient refusal

Local infection at the puncture site

Increased intracranial pressure

Traumatic spinal cord injury [22]

Relative Contraindications

Hemodynamic instability

Obstructive cardiomyopathy

Uncorrected coagulopathy or therapeutic anticoagulation

Thrombocytopenia

Inability to maintain positioning for epidural placement

Anatomic spinal abnormalities

Equipment

Epidural Needles

Multiple types of epidural needles have been designed (eg, Tuohy, Hustead, Crawford, and Weiss). However, the Tuohy epidural needle is most often used. These epidural needles are usually 17 G or 18 G and are 3.5 in long; epidural needles up to 6 in are available and can be used in patients with increased subcutaneous adiposity.[23]

Loss of Resistance Syringe

Loss of resistance syringes are made of glass or plastic and have very low friction between the plunger and the barrel to detect the change in resistance at the epidural space. Syringes may be loaded with air, saline, or both; the injected medium does not affect the success of identifying the epidural space, nor does it change the complication rate.

Figure 4 : Loss of Resistance Technique

Epidural Catheters

Epidural catheters are used for continuous epidural anesthesia or analgesia. The catheters may be flexible or stiff and may have single or multiple perforations for the perfusion of the analgesic agent. In most commercially available kits, syringe-catheter connections (eg, Luerlock or Luer-slip connectors) are also included.

Epidural Procedure Site Preparation

Aseptic technique when placing an epidural catheter and dressing the insertion site is critical for infection prevention. Supplies required include:

Sterile gloves

Surgical cap and mask

Sterile draping

Individualized skin preparation solution packet (eg, chlorhexidine with or without alcohol or povidone-iodine with or without alcohol)

Sterile occlusive dressing [24]

Medications

The preference of anesthesiology clinicians will dictate which medications are used in a patient's epidural anesthesia. preferably local anesthetic (eg, bupivacaine, ropivacaine). IV fluids are also typically administered before an epidural is performed to prevent hypotensive episodes. Additionally, IV ephedrine or phenylephrine should be available to treat hypotension during neuraxial anesthesia.[25]

Preparation

Before an epidural anesthesia procedure, the patient should be positioned and the area prepared appropriately. Emergency equipment and medications need to be readily available in the room. Furthermore, intravenous access must be placed for fluid and medication administration. Standard American Society of Anesthesiologists (ASA) preanesthesia guidelines should be followed (eg, preoperative testing, hemodynamic monitoring). The patient may be positioned in a sitting or lateral decubitus position; back arching is advised for better exposure to intervertebral interspaces. Aseptic technique and field preparation must be used throughout epidural placement.[26]

With any technique used to place an epidural, the patient should be positioned, prepped, and draped in the standard sterile fashion. The correct intervertebral space is then identified using anatomic landmarks, a loss of resistance needle, and sometimes ultrasound guidance. A systematic review of random controlled trials to evaluate preprocedural lumbar neuraxial ultrasound compared to the traditional landmark-based approach demonstrated that ultrasound guidance reduced the number of needle passes, attempts, and traumatic procedures.

Technique or Treatment

The clinician's approach to performing epidural anesthesia depends on which area of the spine the epidural space will be accessed. Due to the difficult angulation of the thoracic spinous processes, epidural anesthesia performed above the T11 vertebra generally uses the paramedian approach. Those performed below the T11 level typically use the midline approach.[27,28]

Medial and Paramedian Approach

In the medial (ie, midline) approach, the needle insertion site is midline between the spaces created by the vertebral spinous processes. Upon locating the desired spot, lidocaine 1% must be injected into the skin and underlying tissues to decrease the discomfort with the advancement of the epidural needle. Once localized anesthesia is achieved, the epidural needle is advanced with a stylet in place and with its bevel point cephalad, ultimately guiding the epidural catheter to the proper location. The epidural needle must be advanced through the skin, subcutaneous tissue, supraspinous, and interspinous ligaments. Once there, the stylet is removed, and the loss of resistance syringe that is filled up with saline, air, or both must be attached to the needle. As the needle advances, the clinician applies pressure to the plunger so that once the ligamentum flavum is pierced, a loss of resistance pressure is noted, confirming entry into the epidural space. On average, the distance from the skin to the ligamentum flavum is approximately 4 cm. The anesthesiology clinician will usually inject 5 to 10 cc of saline to expand the epidural space and decrease the risk of vascular injury.[29]

In the paramedian approach, the needle insertion site is 1 cm lateral to the vertebral interspace. Local anesthetic is injected along the predicted path of the epidural needle as described for the medial approach. The epidural needle is then advanced through the paraspinal tissues. Given this location, the needle will not transverse the supraspinous or interspinous ligaments. The advancement of the needle must stop upon feeling the engagement in the ligamentum flavum. The loss-of-resistance syringe is attached, and the epidural space is located similarly to the median approach.

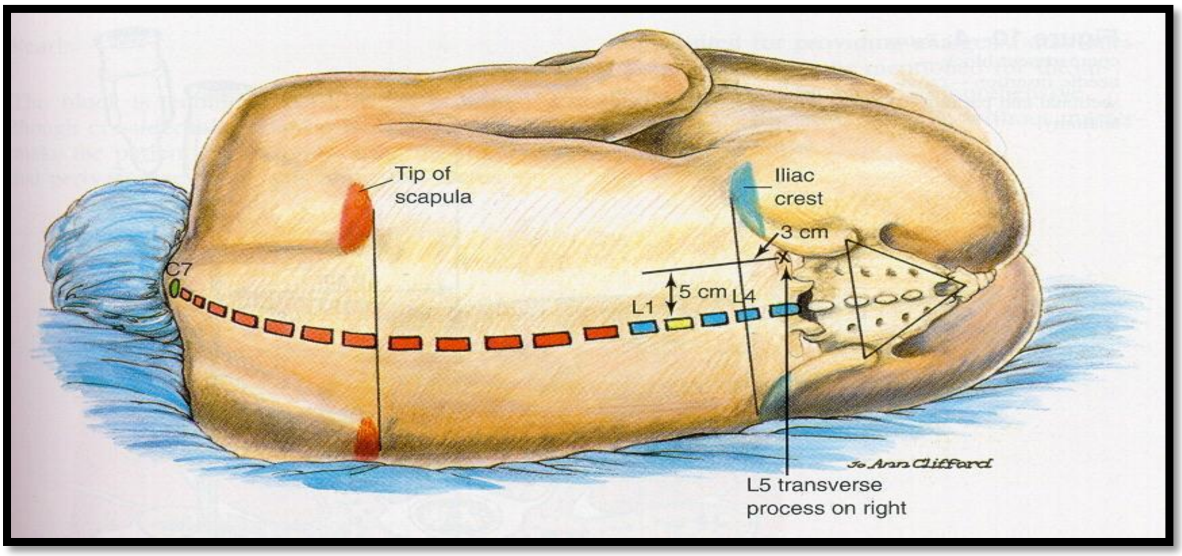


Figure 5: Topographical line of Tuffier

Complications

Spinal cord injuries (SCI) resulting from anesthesia procedures are rare but significant concerns for surgical patients. These injuries can have devastating effects on the quality of life and may even lead to mortality. Complications associated with anesthesia-induced SCI include temporary or permanent neurological symptoms, epidural hematoma or abscess, direct traumatic spinal injury, and adhesive arachnoiditis. These complications can manifest as motor deficits, sensory loss, pain, paraesthesia, and even permanent paralysis or anesthesia.

High-risk patients for anesthesia-induced SCI include those with spinal canal malformations, extremes of age, obesity, diabetes, immunocompromised or critically ill individuals, and those with previous neurological diseases. It is essential to carefully evaluate these patients preoperatively to identify any clinical conditions that may increase the risk of complications associated with neuraxial techniques. However, managing traumatic SCI patients in emergency rooms can be challenging due to existing tissue damage. Other complications associated with epidural anesthesia include:

Hypotension

Nausea and vomiting

Bronchoconstriction

Postpuncture headache after dural perforation [30]

Transient neurological syndrome

Nerve injury with possible neuropathy; paralysis is rare

Epidural hematoma

Epidural abscess

Meningitis

Accidental intrathecal injection with total spinal anesthesia

Osteomyelitis

FEMORAL NERVE BLOCK

For years, femoral nerve block (FNB) has been considered as the main peripheral nerve block for postoperative analgesia following knee surgery. However, quadriceps weakness as the major downside of FNB led to searching for alternative nerve blocks. In recent years, adductor canal block (ACB) has been introduced as a pure sensory nerve block for postoperative analgesia following knee surgery. The rationale behind the ACB is that saphenous nerve (sensory nerve) and part of the obturator nerve traveling through the adductor canal of thigh and injecting local anesthetics in the canal will provide adequate analgesia by blocking these nerves.

There are growing literature regarding efficacy of ACB and available evidence indicating ACB is as effective as FNB in providing postoperative analgesia after knee surgery. In addition, ACB carries the advantage of preserving or minimally affecting quadriceps strength. Preserving quadriceps strength will facilitate ambulation and postoperative rehabilitation.

ACB technique is relatively easy and is performed under ultrasound guidance. Kirkpatrick and colleagues have previously described the technique in details [31]. Briefly the ultrasound transducer is placed transversely on the medial thigh, at the midpoint between the inguinal crease and the medial condyle of femur to visualize femoral artery that is located deep to the sartorius muscle. Under ultrasound guidance, the needle tip is positioned anterolateral to the artery and slightly deep to the posterior fascia of the sartorius muscle and local anesthetic is injected. Intravascular injection, failed nerve block, systemic toxicity of local anesthetics, nerve injury, infection and allergic reaction to local anesthetics are some of the potential complications of ACB. In the case of failed block, if maximum dose of local anesthetics has not yet injected, the block can be repeated.

It seems that single shot of ACB provides pain relief comparable to femoral nerve catheter and facilitate discharge of patients after total knee arthroplasty. In a small randomized controlled trial, Sztain et al showed that there is not a statistically significant difference between continues ACB and continues FNB regarding median number of hours to overall discharge readiness following unicompartment knee arthroplasty however, ACB was associated with a lower number of discrete days until discharge readiness [32]. Machi et al also found that continuous ACB compared to continuous FNB decreases the time until adequate mobilization but not overall time to discharge readiness [33]. Decision about perfroming continuous ACB is basically based on the anesthesiologist's judgment, required duration of analgesia and the use of adjunct pain medications.

Regarding amount of local anesthetic injection, a recent study by Jæger et al showed that injecting 10 to 30 cc of 0.1% ropivacaine provides adequate pain relief while does not cause motor weakness [34]. However, lower dose of 0.2% ropivaciane has also been used for ACB with satisfactory results.

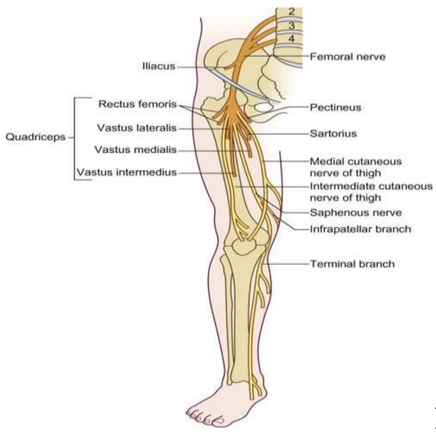


Figure6:AnatomyofAdductor Canal Block

Knee arthroplasty

Knee arthroplasty is a reconstruction of the knee joint. It is more commonly referred to as a total knee replacement and is a very reliable procedure with predictable results. Total knee arthroplasty (TKA) is an excellent treatment option for individuals with symptomatic osteoarthritis in at least 2 of the 3 compartments of the knee and who have failed conservative treatment. Additionally, partial knee arthroplasty (PKA) is an excellent treatment option for individuals with symptomatic osteoarthritis localized to 1 compartment of the knee and who have failed conservative treatment.[35] The primary goal of either surgery is durable pain relief with the improvement of functional status.

Anatomy and Physiology

The knee is a synovial hinge joint with minimal rotational motion. It is comprised of the distal femur, proximal tibia, and the patella. There are 3 separate articulations and compartments: medial femorotibial, lateral femorotibial, and patellofemoral. The stability of the knee joint is provided by the congruity of the joint as well as by the collateral ligaments. The capsule surrounds the entire joint and extends proximally into the suprapatellar pouch. Articular cartilage covers the femoral condyles, tibial plateaus, trochlear groove, and patellar facets. Menisci are interposed in the medial and lateral compartments between the femur and tibia which act to protect the articular cartilage and support the knee.

The mechanical axis of the femur, defined by a line drawn from the center of the femoral head to the center of the knee, is 3 degrees valgus to the vertical axis. The anatomic axis of the femur, defined by a line bisecting the femoral shaft, is 6 degrees valgus to the mechanical axis of the femur and 9 degrees valgus to the vertical axis. The proximal tibia is oriented to 3 degrees of varus. The varus position of the proximal tibia, along with the offset of the hip center of rotation, results in the weight-bearing surface of the tibia being parallel to the ground. The sagittal alignment of the proximal tibia is sloped posteriorly approximately 5 to 7 degrees. The asymmetry of the natural bony anatomy maintains the alignment of the joint and ligamentous tension.

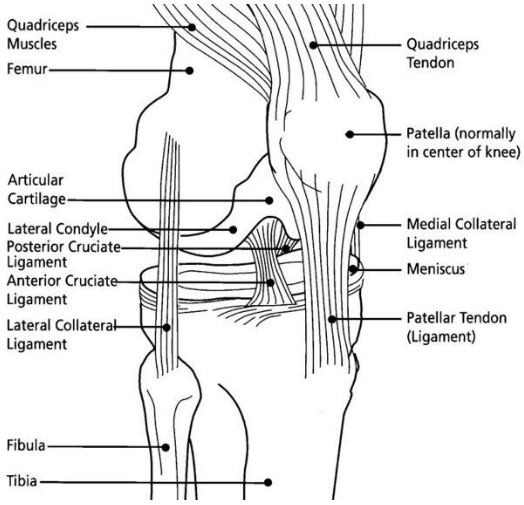


Figure 7:Anatomy of Knee Joint

Indications

TKA is a well-described treatment option for patients suffering from knee pain secondary to osteoarthritis who have failed conservative treatment measures. It is a reliable procedure that provides pain relief and improves the patient's functional status. Furthermore, the need for correction of a significant or progressive deformity at the knee with evidence of osteoarthritis can also be an indication for a TKA. A patient with persistent knee pain without radiographic evidence of knee osteoarthritis should have further workup to exclude other possible sources of their pain.

Clinical symptoms of osteoarthritis include:

- Knee pain
- Pain with activity and improving with rest
- Pain gradually worsens over time
- Decreased ambulatory capacity

Clinical evaluation includes:

- Full knee exam including range of motion and ligamentous testing.
- Knee radiographs include standing anteroposterior, lateral, 45-degree posteroanterior, and skyline view of the patella

Radiographic evidence of osteoarthritis include[37]:

- Joint space narrowing
- Subchondral sclerosis
- Subchondral cysts
- Osteophyte formation

Conservative treatment includes:

- Non-steroidal anti-inflammatory medication
- Weight loss
- Activity modification
- Bracing
- Physical therapy
- Viscosupplementation
- Intra-articular steroid injection

Contraindications

Absolute

- Active or latent (less than 1 year) knee sepsis
- Presence of active infection elsewhere in body
- Extensor mechanism dysfunction
- Medically unstable patient

Relative

- Neuropathic joint
- Poor overlying skin condition
- Morbid obesity
- Noncompliance due to major psychiatric disorder, alcohol, or drug abuse
- Insufficient bone stock for reconstruction
- Poor patient motivation or unrealistic expectation
- Severe peripheral vascular disease

Equipment

A TKA system will consist of instrumentation that helps the surgeon prepare the ends of the femur, tibia, and patella to receive an implant. The instrumentation will be specific to the brand and type of implant being used with each company and model having specific intricacies.

In general, the instrumentation will consist of:

1. Intramedullary femoral guide to help establish the distal femoral alignment
2. Distal femoral cutting guide
3. Femoral sizing guide
4. 4-in-1 femoral cutting guide
5. Extramedullary or intramedullary tibial guide
6. Proximal tibial cutting guide
7. Patella sizing guide
8. Femoral component trial
9. Tibial baseplate trial
10. Patellar button trial
11. Trial plastic bearing

The final implants will come in individual sterile packages and will consist of:

1. Femoral component, typically made of cobalt-chrome
2. Tibial component, typically made of cobalt-chrome or titanium
3. Tibial polyethylene bearing, made of an ultra high molecular weight (UHMW) polyethylene
4. Patellar button, made of UHMW polyethylene

Personnel

- Anesthesia team
- Operating room nurse
- Operating Surgeon & team

Preparation

- Full medical and drug history before surgery
- Appropriate pre-surgical workup, clearance, and optimization
- Pre-operative radiographs of the affected knee
- Pre-operative templating of the affected knee to estimate the component size
- Primary TKA system of choice
- Have various final implant sizes ready and available in the hospital
- Have increasing prosthesis constraint options ready and available in the hospital
- Have revision total knee replacement system of choice ready and available if needed +/- antibiotic cement, surgeon preference

Technique or Treatment

The goal of TKA is the same regardless of surgeon, implant, or technique. The variability in the procedure lies in the technique. Some of the variations in operative technique for TKA are listed below.

- General anesthesia versus regional anesthesia
- Standard versus patient-specific instrumentation
- Standard versus patient-specific implants
- Measured resection versus gap balancing
- Cruciate-retaining implant versus cruciate stabilized the implant
- Resurfaced versus non-resurfaced patella
- Cement versus cement-less (press fit) TKA

Complications

- Potential complications include:[38,39]
- Infection, superficial and deep
- Blood clot
- Pulmonary embolism
- Fracture
- Dislocation
- Instability
- Osteolysis resulting in component loosening
- Pain
- Stiffness
- Vascular injury
- Nerve injury

Anatomy and Physiology

The knee comprises 2 distinct joints—the tibiofemoral and patellofemoral joints. These joints work together to facilitate smooth movement and support weight-bearing activities of the knee.

Patellofemoral Joint

The patellofemoral joint increases the extensor mechanism's lever arm. The patella transmits the tensile forces generated by the quadriceps tendon to the patellar tendon. The maximum contact force between the patella and femoral trochlea occurs at a knee flexion of 45°, and joint reaction forces reach up to 7 times the body weight in the position of deep squatting.

- The quadriceps muscles provide dynamic stability to the patellofemoral joint, and passive anatomic restraints include:
- Medial patellofemoral ligament: This is the primary passive restraint against lateral translation at 20° of flexion.
- Medial patellomeniscal ligament: This contributes 10% to 15% of the total restraining force.
- Lateral retinaculum: This provides 10% of the total restraining force.

Tibiofemoral Articulation

The tibiofemoral articulation transfers body weight from the femur to the tibia and generates joint reaction forces of 3 and 4 times body weight during walking and climbing, respectively. Movement primarily occurs in the sagittal plane, ranging from 10° of hyperextension to approximately 140° to 150° of hyperflexion. However, extreme flexion is often limited due to direct contact between the posterior thigh and calf. With increased flexion, the tibiofemoral contact point and femoral center of rotation shift posteriorly to optimize knee flexion before impingement. In normal gait, the required range of motion is up to 75°.

Knee stability in the coronal plane is provided by the lateral collateral ligament, which resists varus stresses, and the medial collateral ligament, which resists valgus stress forces. In addition, the anterior and posterior cruciate ligaments offer resistance to anteriorly and posteriorly directed forces at the knee, respectively. The posterolateral corner structures provide resistance to external rotatory forces.

Indications

Once considered suitable mainly for the older and low-demand patient groups, primary TKA is now offered more frequently and provides consistent positive outcomes, even in younger cohorts of patients. Generally, the most common underlying diagnosis associated with performing TKAs across all patient age groups is primary, end-stage, and tricompartmental osteoarthritis.[38,39,40]

TKA is an elective procedure that is, in most cases, reserved for patients experiencing chronic, debilitating symptoms that continue to persist despite exhaustion of all conservative and nonoperative treatment modalities. Patients usually opt for TKA when their symptoms significantly affect their quality of life and daily activities.

Contraindications

- TKA is contraindicated in the following clinical scenarios:
- Local knee infection or sepsis.
- Remote (extra-articular), active, ongoing infection or bacteremia.
- Severe cases of vascular dysfunction, which may compromise healing and recovery.

Cruciate-Retaining

The cruciate-retaining TKA prosthesis relies on an intact posterior cruciate ligament to provide stability in flexion, making it unsuitable for patients with preexisting or intraoperatively recognized posterior cruciate ligament insufficiency. Caution is warranted with patients exhibiting at least moderate instability in any plane of motion, especially those with instability in posterolateral corner structures. Instability in posterolateral corner structures instability predisposes the native posterior cruciate ligament in a cruciate-retaining TKA to abnormally high stresses and forces, ultimately leading to early failure and needing revision. Therefore, cruciate-retaining TKA is contraindicated in patients with inflammatory arthritic conditions due to the increased risk of early posterior cruciate ligament attenuation, such as rheumatoid arthritis.

Proposed advantages of the cruciate-retaining TKA design include:

Prevention of tibial post-cam impingement and dislocation.

Resemblance of more normal knee kinematics and anatomy, theoretically.

Preservation of bone stock (less distal femur resected compared to posterior-stabilized TKA prosthesis).

Retention of native posterior cruciate ligament proprioception.

Proposed disadvantages of the cruciate-retaining TKA design include:

A tight posterior cruciate ligament that leads to early or accelerated polyethylene wear.

A loose or ruptured posterior cruciate ligament that results in flexion instability and possible subluxation or dislocation.

Multiple meta-analyses have demonstrated satisfactory survivorship and similar outcomes when comparing the cruciate-retaining and posterior-stabilized TKA prosthesis designs. Additionally, cruciate-retaining TKA may be preferred in patients with higher functional demands and those involved in activities requiring an increased range of motion.

Posterior-Stabilized

The posterior-stabilized TKA design is slightly more constrained and requires the surgeon to sacrifice the posterior cruciate ligament. The femoral component contains a cam designed to engage with the tibial polyethylene post during knee flexion.

Proposed advantages of the posterior-stabilized TKA design include:

Overall knee balancing in the setting of an absent posterior cruciate ligament.

Better knee flexion, theoretically.

Lower ranges of axial rotation and condylar translation

Proposed disadvantages of the posterior-stabilized TKA design include:

Potential cam jump due to a loose flexion gap or knee hyperextension.

Risk of patellar clunk syndrome.

Possibility of tibial post-wear or fracture.

Constrained Nonhinged Design

The constrained nonhinged prosthesis incorporates a more extensive tibial post and deeper femoral box, providing increased stability and constraint (within 2° to 3°) in both varus-valgus and internal-external rotatory planes. Indications include collateral ligament attenuation or deficiency, flexion gap laxity, and moderate bone loss in neuropathic arthropathy. However, the drawbacks of this design include an increased risk of earlier aseptic loosening due to increased intercomponent constraint and the need for additional femoral bone resection to accommodate the components.

Constrained Hinged Design

The constrained hinged design consists of linked femoral and tibial components. Rotating hinge options allow the tibial bearing to rotate around a yoke, theoretically mitigating the risk of aseptic loosening but at the expense of increasing levels of prosthetic constraint. Indications include global ligamentous deficiencies, resections in the setting of tumors, and massive bone loss in neuropathic joint conditions.

Other Component Considerations

Modularity and mobile bearing designs are other noteworthy additional prosthetic design considerations. Mobile bearing designs allow polyethylene rotation on the tibial baseplate. Although this design concept remains controversial in generating reproducibly superior patient-reported outcome measures, proponents advocate for its use and specific indications in younger patient demographics due to enhanced wear rates. However, a notable disadvantage includes the potential for bearing spin-out, particularly in a loose flexion gap.

All-polyethylene tibial base plates differ from the traditional metal tray with polyethylene inserts (ie, tibial component modularity), allowing surgeons more flexibility in intraoperative adjustments for fine-tuning TKA stability. Surgeons can adjust the polyethylene size (ie, upsize or downsize) after final tibial implant fixation between the metal implant and cement (or bone) interfaces. This allows for a final check and balance step, which many TKA surgeons appreciate. In contrast, proponents of all-polyethylene base plates highlight significant cost savings and reduced rates of osteolysis in TKA cohorts, particularly among older patients undergoing TKA.[41,42]

Preparation

Preparation for TKA is crucial for achieving optimal outcomes in patients undergoing this procedure. This involves a comprehensive evaluation of the patient's medical history, physical condition, and readiness for surgery. Preoperative assessments aim to identify and address potential risk factors or medical conditions that could affect the surgical outcome or recovery process. Additionally, preparation for TKA involves patient education, optimizing medical management, and planning for postoperative care.

Preoperative Evaluation

Clinical examination: A comprehensive history and physical examination are required before performing a TKA on any patient. Patients should be questioned about previous interventions and treatments, including joint replacements, arthroscopic procedures, or other knee surgeries. Surgical scars from previous procedures should be considered, as they may affect the planned surgical approach. Patients with prior injuries or procedures may also exhibit mechanical axis deformities, retained hardware, or knee instability in various planes. These factors can significantly influence the selection of the most appropriate TKA prosthesis for the patient.

Every patient undergoing elective TKA surgery should receive a comprehensive medical evaluation with any appropriate medical optimization tests performed before the TKA procedure. Surgeons must consider the risks and potential benefits of performing TKA on a case-by-case basis.

During the physical examination, assessing the overall mechanical axis of the limb is crucial. Notably, it is essential to rule out or at least consider hip pathology before conducting any knee surgery. In addition, the vascular status of the limb should also be assessed by observing the skin for any chronic venous stasis changes, cellulitis, or even wounds or ulcerations that may be present on the extremity. Distally, ensuring symmetric and palpable pulses is essential.

In the preoperative setting, any patient presenting with peripheral vascular disease should be considered for consulting a vascular surgeon. Surgeons should also be aware of the potential for peripheral vascular disease to present as knee pain out of proportion in the setting of relatively benign radiographs.

Before surgery, the preoperative range of motion should be assessed at the knee and adjacent joints (hips and ankles). Soft tissues should be examined for signs of gross atrophy, overall symmetry, and ligamentous stability in all planes of the knee joint. In addition, it is crucial to document the presence of any laxity in the varus or valgus plane and the ability to correct deformities. These parameters help the surgeon anticipate any necessary soft tissue releases to facilitate mechanical axis correction and plan for potential additional bone resection in cases of significant contractures.

Radiographs: Preoperative radiographs, including a weight-bearing anteroposterior view, are evaluated for overall mechanical alignment, the presence of deformity, and bone loss (see Image 1. Anteroposterior View of a Periprosthetic Distal Femur Fracture). The tibiofemoral angle can help estimate the magnitude of coronal deformity. The femoral resection angle is calculated as the difference between the mechanical and anatomic axis of the femur. In addition, the lateral view of the knee is essential for appreciating the native posterior slope of the proximal tibia as well as the presence of posterior osteophytes on the femoral condyles (see Image 2. Lateral View of a Periprosthetic Distal Femur Fracture).

Although the patellofemoral radiographic view is unnecessary for TKA templating, it allows surgeons to evaluate the magnitude of patellofemoral arthritis and deformity. In cases of advanced patellofemoral deformity, osteophyte removal may be necessary before attempting to evert the patella during the procedure. In addition, a surgeon can plan for a possible lateral release to improve patellar tracking.

Technique or Treatment

TKA involves replacing damaged or diseased knee components with artificial parts to alleviate pain and enhance function. The technique has evolved significantly, with advancements in surgical approaches, implant designs, and perioperative care.

Surgical Approaches

The most common approaches for the standard primary TKA procedure include the medial parapatellar, midvastus, and subvastus approaches. The medial parapatellar approach is commonly utilized and entails proximal dissection through a medial cuff of the quadriceps tendon to facilitate superior tissue quality closure after the procedure. Distally, a meticulous, continuous medial subperiosteal dissection sleeve is performed while maintaining close proximity to the proximal tibial bone. The extent of dissection is typically determined by the anticipated degree of deformity correction needed. This medial release is generally more aggressive in cases of severe varus deformity and less extensive in cases of moderate to advanced valgus knee deformity. Additionally, the medial meniscus is resected along with this sleeve of soft tissue.

Alternatives to the standard medial parapatellar arthrotomy include the midvastus and subvastus approaches. In the midvastus approach, the quadriceps tendon is spared, and dissection is directed towards the superomedial aspect of the proximal pole of the patella, preserving the vastus medialis obliquus muscle belly. The subvastus approach also spares the quadriceps tendon and lifts the muscle belly of the vastus medialis obliquus off the intermuscular septum. While it maintains the patella's vascularity, caution is warranted as it may restrict exposure in challenging cases or in patients with obesity.

TKA Techniques

Gap balancing versus measured resection: Achieving a well-balanced symmetric flexion and extension gap is paramount in TKA. Precise bony cuts and accurate soft tissue balancing determine femoral component rotation. Malrotation of the femoral component may result in anterior knee pain, patellofemoral joint instability, flexion gap instability, or arthrofibrosis.[44,45]

Gap balancing: Gap balancing involves ligament releases to correct any fixed deformities and align the limb to the most approximate correct alignment before making bony cuts. There are 2 approaches to gap balancing that are commonly used—flexion gap first or extension gap first—followed by balancing the flexion gap based on a balanced extension gap.

Anterior versus posterior referencing: The correct positioning and sizing of the femoral component ensure proper kinematic function in TKA. Anterior and posterior referencing are the 2 main strategies for setting the center of rotation and sagittal plane balancing in TKA, based on the reference used to determine the size and geometry of distal femur resection. In anterior referencing, the anterior femoral cortex is the reference, whereas the resection of the posterior femoral condyle varies, posing challenges in flexion space balancing. Anterior referencing helps reduce the risk of AFC notching and patellofemoral joint overstuffing. However, it increases the risks of flexion gap instability with excessive posterior condylar resection or femoral offset reduction.[46]

In posterior referencing, the posterior femoral condyles are the reference, whereas the anterior femoral cut varies. This approach ensures precision in resecting the exact thickness from the posterior femoral condyles, maintaining posterior femoral offset and enabling deep knee flexion. However, this technique increases the risk of anterior femoral notching or overstuffing of the patellofemoral joint.[47]

Mobile bearing versus fixed bearing: The design of the polyethylene inserts in TKA has been a subject of debate in the literature. The 2 types of inserts include:

Fixed bearing inserts: These inserts are rigidly fixed with the tibial component and have been shown to offer satisfactory outcomes and long survivorship. However, implant loosening is believed to be due to high contact stresses and polyethylene wear rates.

Mobile bearing inserts: These inserts simulate native knee kinematics by providing better conformity, lower contact stresses, and lower implant loosening rates. However, these inserts carry the unique risk of bearing dislocation.

Other Considerations

Topical tranexamic acid is the preferred application while the cement is fully hardened before the tourniquet is dropped. Other controversial technical modalities in TKA include using a tourniquet and cementing the patella, femoral, and tibial components, as well as incorporating a betadine soak to the wound as part of the copious saline irrigation that is applied before the closure of the arthrotomy and surgical wound. However, preferred techniques involve using a tourniquet, cementing all components, and employing copious pulsatile saline irrigation before closing the arthrotomy.

GALLERY

Starting Clockwise(Figure 8:Periarticular infiltration of ropivacaine;Fig 9-USG Guided Adductor canal block;Fig 10- Ultrasound image of adductor canal;Fig 11- Retinaculum infiltration of analgesia)

REVIEW OF LITERATURE

The purpose of this trial is to assess and compare the effectiveness of three different pain management techniques for patients undergoing TKA. Specifically, the research focuses on evaluating the pain relief and functional outcomes provided by epidural injection alone, epidural injection combined with ACB, peri-articular infiltration, and a combination of injections**.**All surgeries were performed with standardized preoperative workup, surgical techniques, and postoperative management protocols..In order to determine blood loss, patients' pain levels were measured using a VAS score at “6th, 12th, and 24th” hours interval post surgery. Haemoglobin levels were also measured before and after surgery on day 1. Hospital stay, time spent applying a tourniquet, duration of surgery, and problems following surgery were evaluated by a third party observer who was not aware of the participants' group assignment. Patients werematched according to deformity, age, gender, and “American Society of Anesthesiologists” grade.

The visualanalog scores of “6th, 12th, and 24th” hours after surgery revealed statistically significant changes between PAI and ACB, with higher ratings in the ACB group at all times. The PAI group underwent a considerably longer tourniquet and surgical time than the ACB group. During the research period, no noteworthy variations in hospital stays were noted, and no problems transpired. The results imply that in individuals receiving unilateral TKA, PAI offers superior pain management than ACB.

Ma J et al [49](2016) showed that The outcome of combining aductor canal block (ACB) with peri-articular infiltration (PI), known as “ACB + PI”, relative to PI alone for analgesia after total knee arthroplasty (TKA) have been subject to debate. To address this, a meta-analysis was conducted, examining studies from journals that compared “ACB + PI” with PI alone in knee arthroplasty subjects.Pain rating assessment, during rest or activity, was the primary objectives. The assessment of walking distance, duration of hospital stay, and complications following surgery were the secondary outcomes. Using Rev.Man v5.3, data from 3 investigations of 337 pts in total were examined.

This meta analysis revealed on postoperative day 1, patients who received ACB + PI walked longer distances compared to those who received PI alone. The assessment of pain ratings during rest or activity, and assessment of knee range of movements, were the primary objectives. The assessment of walking distance, duration of hospital stay, and complications following surgery were the secondary outcomes.

The results indicate that using a combination of ACB and PAI may help patients start moving sooner after a TKR without sacrificing pain relief in the early days after surgery. However, because the studies reviewed have some differences, we can't make definitive conclusions yet. More research is needed to fully understand how effective and safe ACB combined with PAI is compared to PAI alone for managing pain after a TKR.

Ma J et al [50](2016) found that Following total knee arthroplasty (TKA), aductor canal analgesia (ACB) & periarticular infiltration (PI) have both shown promise in lowering postoperative pain without leading to motor blockage. The relative safety and efficacy of “ACB with PI (ACB + PI)” vs PI for post-TKA analgesic, however, is still up for debate. In order to address this problem, a meta analysis was carried out to analyse the effects of PI alone against ACB plus PI on pain treatment following TKA.An all round analysis of databases done to locate trials evaluating "ACB + PI with only PI" in TKA pts. The 1^0 outcomes examined the pain ratings during activity or at rest; the 2^0 outcomes were walking distance, LOS, and post-operative adverse effects.

The meta analysis revealed that patients who received combined ACB with PI walked longer distances on post-operative day1 compared to those who received PI alone. However, there were no discernible differences between the two groups in terms of pain intensity, length of hospital stay, or surgical site complications.

All things considered, the results imply that PI with ACB may enable patients to walk sooner following total knee arthroplasty (TKA) without sacrificing analgesia in the initial postoperative phase. However, it is impossible to make definite conclusions because of the differences across the included research. To fully comprehend the safety and comparative effectiveness of “ACB + PI” vs PI alone for the treatment of pain following arthroplasty of knee,;more study is required.

Chen JY et al [51](2017) The study looked at how BMI affects various outcomes after TKA. It focused on factors such as hemoglobin (Hb) levels after surgery, LOS, 30-day readmission rates, functional recovery, quality of life, and survival rates over ten years. The research involved 7,733 patients, with an average age of 67, who had a single TKA between 2001 and 2010. Patients were divided into three BMI categories: “normal (BMI < 25.0 kg/m²)”, “obese (BMI 25.0 - 39.9 kg/m²)”, and “severely obese (BMI > 40.0 kg/m²)”.

The findings revealed that the severely obese group had higher 30-day readmission rates and stayed in the hospital one day longer than the normal and obese groups. However, they experienced a slight reduction in post-op Hb levels & showed greater improvements in the “Oxford Knee Score (OKS)” and “Knee Society Knee Score (KSKS)” after two years. Additionally, there were not much signi-ficant differences in the 10 yrs survival rates among the three BMI groups.

Despite longer hospital stays and higher readmission rates, severely obese patients had notable enhancements to functional results and quality of life after TKA, with long-term survival rates comparable to moderately built individuals.

Sankineani SR et .al., [52](2018) found that The objectiveof the research was to determine if ACB plus multimodal peri-articular infiltration (MPI) was more effective than ACB alone at managing pain following TKA. A prospective non-randomized study of 200 consecutive patients who had unilateral TKA was conducted from July to Dec 2015. Group 1 comprised 100 patients who got ACB alone, whereas Group 2 comprised 100 patients who received ACB+MPI.

"Visual Analog Scale (VAS)" measures pain levels at "8, 24, and 48 hours" following surgery. After 48 hours, knee range of motion (ROM) was measured. After eight hours following surgery, the patients in the ACB + MPI group had significantly higher VAS ratings than those in the ACB group., but there was no substantial change at 24 or 48 hours. After 48 hours, however, individuals in the ACB + MPI group showed substantially improved knee range of motion.

In conclusion, patients who received "ACB + MPI exhibited improved VAS scores in the immediate postoperative period", but did not exhibit a discernible improvement at the time of release compared to those who received ACB alone. These findings suggest that the combination of ACB with MPI may offer benefits in early pain relief and knee ROM following TKA.

Lange JK et al [53](2018) This study compared large, age-differentiated, thoroughly matched cohorts in an effort to fill a vacuum in the literature on satisfaction rates after total knee repalcement (TKR). In patients between the ages of 18 and 55 or 65 and 75, the investigation identified as primary TKAs done for non inflammatory arthritis, resulting in 529 younger & 2001 older patients. Results as stated by the patient were documented both before and two years after surgery.

529 patient pairs were acquired for comparison using 1:1 propensity score matching based on many criteria, include 12 Mental Health Component score, gender, BMI," ASA grade", Charlson Comorbidity Index(;CCI), and 91% of older patients and 86% of younger Patients expressed satisfaction with their knee replacement procedures, with the distribution of satisfaction answers favoring older patients' higher levels of satisfaction. Furthermore, older patients demonstrated a superior degree of improvement in their QOL overall and in their QOL as it related to their knees after procedure.

Younger patients reported increased knee-related discomfort and unhappiness following surgery, while having higher levels of self-reported activity both before and after surgery, even though satisfaction rates in both age groups exceeded 85%. The two age groups' post-operative global health-related quality of life, however, was comparable.

All things considered, younger patients had higher knee-related dysfunction and unhappiness after total knee arthroplasty (TKA) despite being more active both pre and post procedure. Overall, patient satisfaction after knee surgery was good.

Tong QJ et al [54](2018) discovered that The study aimed to figure out the benefits of using ACB along with LIA for pain relief, preserving quadriceps strength, and promoting early rehabilitation after TKA. Between January 2014 and October 2015, 40 patients with ASA classifications I to III were randomly assigned to receive a single-dose spinal anesthetic during their initial TKA.
Within the LIA group, the surgeon delivered 75 milliliters of intraoperative local infiltration containing 150 mg of ropivacaine; 30 mg of ketorolac; 10 mg of normal saline, and 200 mcg of adrenaline to the patients. After surgery, 30 milliliters of 0.5% ropivacaine were given to the ACB group by one of the research investigators as

postoperative ACB.
The findings demonstrated that, in comparison to the LIA group, the ACB group had much lower total morphine intake after 24 and 48 hours. Other secondary outcomes, however revealed no statistically significant alterations, indicating that the functional outcomes of the two TKA patient groups were comparable.

In summary, ACB outperformed LIA in the initial 24 and 48 hours following surgery while maintaining similar functional outcomes in TKA patients.

Kulkarni MM et al [55](2019) examined that In individuals undergoing unilateral primary total knee arthroplasty (TKA) for symptomatic osteoarthritis, the study sought to examine the effectiveness of ACB and PAI in controlling postoperative pain and their effects on early functional results.
Two groups consisting of one hundred patients each were created: the ACB group (Grp A) and the PAI group (Grp B). Under spinal anesthesia, TKA was performed on each patient without patella resurfacing.

Both groups had similar preoperative evaluations, surgical techniques, and postoperative care. Numerous indicators, including as hemoglobin levels, hospital stays, tourniquet times, operating times, and postoperative problems, were evaluated by an unbiased observer who was blind to group assignment. Six, twelve, and twenty-four hours post surgery, pain measurement was done by VAS.

The findings showed that the ACB group's VAS scores were consistently higher than those of the PAI group. In addition, the PAI group's tourniquet and surgical times were noticeably longer than those of the ACB group. Nevertheless, there was no discernible variation in hospital stays between the two cohorts, and no issues emerged during the research duration.

In summary, for patients having unilateral total knee arthroplasty, PAI outperformed ACB in terms of analgesia. The durati0n of hospital stay was unaffected by the higher procedure times linked to PAI.

Goytizolo EA et al [56](2019) The aim of the research was to ascertain if peri-articular injection in combination with ACB was superior than periarticular injection alone in terms of fulfilling DC following TKA surgery. In order to conduct the experiment, 56 participants who underwent peri-articular inj and 55 pts who also had ACB were recruited. Different prescription analgesics and surgical neuraxial anesthesia were administered to both groups. The key outcome, which is the amount of time needed to fulfill the discharge requirements, did not show any appreciable difference between the two groups. Secondary outcomes, assessed on postoperative days 1 and 2, included pain scores, and patient-reported outcomes using the PAIN OUT questionnaire The results showed that patients who received both ACB and periarticular injection experienced less severe pain and greater pain relief 24 hours after anesthesia compared to those who only received the periarticular injection. Other secondary outcome variables, including as, and pain levels on a numerical rating scale, did not show any significant differences In conclusion, individuals who received periarticular injection alone experienced lesser pain 24 hrs after anesthesia than ACB alone. , even though discharge requirements was the same for both groups. The ‘groups' differences were not statistically significant according to other secondary outcome measures.

Sardana V et al [57](2019) observed that The purpose of the study was to assess the" efficacy of periarticular injection (PAI) and aductor canal block (ACB) in treating patients having total knee replacement (TKR)" for short-term postoperative pain and opioid usage. A comprehensive examination and meta-analysis were carried out, mining many sources for randomized controled trials spanning the years 1946 to Aug' 2018.
Six papers were added in the meta-analysis as those satisfied the inclusion-criteria. B/n the PAI and ACB groups, there was noteworthy change (P =.001) in the decline in combined VAS pain scores. PAI group saw a higher drop in scores. Subgroup analysis conducted at key postoperative time points—24 and 48 hours in particular—showed that the PAI group had lower VAS ratings during both rest and movement. Furthermore, The PAI group consumed less opioids overall, with statistically significant differences (P =.03). A tendency toward reduced opioid usage was also seen in the PAI group, according to subgroup analysis, with 13.25% less opioids used at 48 hours and 9.5% less at 24 hours after surgery.

Xing Q et al., [58] "This meta-analysis aimed to compare the safety and effectiveness of adding an ACB to peri-articular infiltration versus using peri-articular infiltration alone for reducing pain after total knee arthroplasty (TKA)".

The NRS for pain at days 0–2 postoperatively was the primary outcomes evaluated. Significant changes in the NRS scores at POD 0, POD 1, and POD 2 following TKA were found between the two groups by meta-analysis.

In particular, the group who had both peri-articular infiltration and simultaneous adductor canal block had lower NRS ratings and used fewer opioids.
compared to the peri-articular infiltration alone group. Furthermore, combined group showed few post-operative complications.

Zuo W et al [59](2019) showed that "The purpose of this meta-analysis was to determine if "aductor canal block (ACB) plus local infiltration analgesia (LIA) improved postoperative pain management following total knee arthroplasty (TKA) better than ACB alone".

The main outcomes evaluated were pain scores, measured by VAS, along with adverse event rates and postoperative range of motion (ROM). The findings revealed that on the first two days after procedure, patients in the "ACB + LIA" group reported lower pain levels while at rest compared to those in the ACB alone" group. Additionally, the ACB + LIA group showed significantly better postoperative range of motion.. Crucially, there was no apparent variation in the frequency of unfavorable incidents between the two cohorts..

Zhang LK et al [60](2019) showed Following TKA, patients frequently have severe pain that necessitates the use of "periarticular infiltration analgesia (PIA)", both intravenous PCA and FNB.
Comparisons between PIA and adductor canal block (ACB) have surfaced recently, but it's still unclear how safe and effective either procedure is in comparison.

We included 400 participants from five studies that met our criteria. The research showed “no significant difference between the ACB and PIA groups in terms of pain levels (measured by the visual analog scale) at rest and during movement, quadriceps muscle strength, complications, or length of hospital stay”. This indicates that both methods provide equally effective pain relief. Our findings suggest that while ACB does not significantly differ from PIA in terms of pain scores, muscle strength, functional tests, complications, or LOS.

Wang Q et al [61](2019) showed In this study, In order to manage postoperative pain after TKA, we sought to assess the “efficacy of adductor canal block (ACB) in conjunction with posteri0r capsular infiltration (PCI) against multimodal periarticular infiltration analgesia”. This experiment, which took place between January 2018 and January 2019, had patients receiving unilateral primary total knee arthroplasty at our facility. Patients were randomly alloted to receive ACB with PCI or periarticular infiltration analgesia.

The VAS was used to quantify postoperative pain. Functional recovery markers such as quadriceps strength, daily walking distance, and knee ROM were secondary outcomes. The duration of hospital stay and any negative consequences following surgery were also taken into account.

The findings showed that patients who received PCI and ACB had lower VAS ratings when at rest (8 &24 hrss after surgery) and when moving (in the first 48 hours after surgery). Crucially, no appreciable variations were seen in terms of the hospital stay, the frequency of adverse events, or the functional recovery. All things considered, ACB with PCI proved to be a successful strategy for early management of pain following surgery following total knee arthroplasty (TKA) without sacrificing functional recovery.

Goh GS et al [62](2020) This study examined the This study explored how preoperative mental health affects ‘long-term functional outcomes, quality of life, and patient satisfaction’ following TKA, with a minimum follow-up of 10 years. The research included 122 patients who had their first unilateral TKA in 2006. The outcome measures used to evaluate the patients before surgery and at 2 and 10 yrs post-surgery were the “Knee Society-Knee Score (KSKS)”,” Knee Society Function- Score (KSFS)”,” Oxford Knee:Score (OKS)”, & “Mental & Physical Component Summary scores” from the 36-Item Short-Form Health Survey (SF-36).As per their mental health status before to surgery, patients were split into two groups: those who had psychological distress (Mental Component Summary score < 50) and those who did not (Mental Component Summary score ≥ 50). The study's goal was to ascertain if individuals with psychological distress experienced distinct long-term outcomes from those without it. Regression analysis was utilized to adjust for any confounding variables.

The findings demonstrated that, at two or ten years after TKA, there were no statistically significant variations in “functional outcomes, quality of life metrics, or patient satisfaction” between the 2 groups. Comparable satisfaction ratings and attainment of clinically significant gains in functional scores were shown by both groups. It's interesting to note that from preoperative to final follow-up, the percentage of patients reporting psychological distress dropped, suggesting a possible improvement in mental health after TKA.Finally, it should be noted that TKA patients with poor mental health can eventually improve their “function and quality of life to levels comparable to those without psychological distress”.

Dannana CS et al [63](2020 In the first experiment, For pain treatment following TKA, the effectiveness of combining ACB with intra-articular epidural catheter -(IAEC) and multimodal periarticular infiltration (MPI) was examined. The study included 206 individuals receiving primary unilateral TKA..; “Group 1 consisted of 106 individuals, whereas Group 2 consisted of 100 patients allocated to the ACB + MPI + IAEC group”. The 1^0 outcome measure was pain, which was measured using the VAS at various intervals up to 48 hours following surgery. The length of hospital stay, the requirement for rescue analgesics, and the necessity for a repeat ACB were additional secondary outcomes.The study found that the VAS ratings of the ACB + MPI + IAEC group were considerably lower at 12, 24, and 48 hrs compared to the ACB + MPI group. They also needed shorter hospital stays, less repeat adductor canal blocks, and rescue analgesics.These results imply that intermittent ropivacaine infusion via an IAEC is a useful technique for managing breakthrough pain following the wear-off of ACB and MPI combination in the the first 48 hours post surgery

The second research “ compared effectiveness of epidural analgesia (EA) and adductor canal block (ACB) in managing pain during the early postoperative period after primary TKA”. The main measure of success was the pain levels recorded on the VAS during the initial postoperative period.Knee range of motion, hospital stay duration, degree of activity during physical therapy, and postoperative painkiller use were secondary outcomes. The study hypothesised that traditional ACB would be equally beneficial as EA for managing pain following TKA. Given that the data collection for the project will take place between August 2020 and December 2021., the outcome was anticipated.

Rajkumar N et al [65](2021) showed This study evaluated the “effectiveness of periarticular local infiltration (PLI), adductor canal block (ACB), and their combination (ACB + PLI) for pain management following TKA”. Primary u/l TKA patients were the subjects of this prospective, randomized, controlled, double-blind trial. Three groups consisting of fifty patients each were randomized at random: ACB + PLI, PLI alone, and ACB alone.

Pain was the main objective measured using the VAS on postoperative days 1 and 2. Secondary outcomes were the duration of hospital stay, the need for rescue analgesics, knee range of motion, and walking abilities.
According to the study, the mean VAS scores of the combined ACB+PLI group were considerably lower on POD 1 and 2 both at rest and after mobilization than those of the ACB alone or PLI alone groups ($p < 0.001$). Furthermore, the combined group outperformed the other groups in terms of knee ROM and ambulation ability ($p = 0.004$ and $p = 0.04$, respectively). The hospital stay duration was insignificant among the groups ($p = 0.12$).These results imply that, in patients following total knee arthroplasty, adductor canal block alongside periarticular local infiltration offers superior pain management, enhanced ROM, faster rehab ilitation, than either approach alone.

Et T et al [66](2022) found This double-blinded randomized controlled trial compared the effectiveness of three different pain relief techniques for TKA patients: adductor canal block (ACB) alone, a combination of infiltration b/w popliteal artery &iPACK with ACB, and a combination of periarticular infiltration (PAI) with ACB.

The trial had 105 patients in all, each of whom got spinal anesthesia and one of the three analgesic treatments. The primary outcome that was measured was the AUC of the NRS for pain ratings 48 hours following surgery. The 2^0 outcomes were the length of hospital stay, mobility range, patient satisfaction, adverse events, additive post surgical analgesic usage within 48 hours, and performance on timed up-and-go tests. The study found that the "PAI + ACB" and ACB alone groups had significantly higher 48-hour "AUC/area under curve" movement NRS ratings than the iPACK + ACB group ($p < 0.05$)". In addition, the 48-hour "opioid consumption of the iPACK + ACB group was significantly lower than that of the ACB alone&PAI+ACBgroups". Overall, ACB's addition of an iPACK block ,was found to enhance pain relief, enhance functional performance, and decrease hospital stay duration in patients undergoing total knee arthroplasty.

Simsek F et al [67](2023) showed that In this prospective study, researchers compared the "effectiveness of two postoperative pain relief techniques in 58 patients undergoing unilateral TKA". The study involved two groups: one group of 28 patients received a combination of ACB with infiltration b/W the popliteal artery and IPACK, while the other group of 30 patients received epidural analgesia (EA). The patients were randomly assigned to each group to evaluate which technique provided better pain management.

The study used visual analogue scale (VAS) ratings to quantify pain levels during either passive or active physical therapy movements throughout the postoperative eighth hour (PO8th) POD1, POD2, and during ambulation. Additionally, it recorded the amount of analgesic used, the time it took to walk, how frequently they walked, and the amount of time it took to do assisted squats.
The results showed that, although negligible difference in VAS ratings b/wthe 2 groups' on POD1 and POD2, the ACB + IPACK group scored better on the VAS at the PO8th hour ($p = 0.038$). The VAS ratings while walking and the groups' usage of analgesics were similar. However, compared to the EA group, the ACB + IPACK group exhibited faster ambulation speeds (139.65 ± 57.12 sec vs. 188.66 ± 77.95 sec, $p = 0.023$) and higher ambulation rates (78.5% vs. 53.3%, $p = 0.043$). The strength of the quadriceps in the two groups was similar.

Overall, the research indicates that the use of IPACK in conjunction with ACB for total knee arthroplasty patients' postoperative analgesia (TKA) is beneficial for early ambulation and rehabilitation, and is helpful in lowering postoperative pain.

MATERIALS AND METHODS

Source of data-Data will be accumulated from patients who will undergo total knee arthroplasty in Dr Prabhakar k0re H0spital & MRC, Belagavi over a period of 1 year from 1st May, 2022-30th April,2023.

Study Design: Pr0spective Study

Study Peri0d: 1year

Sample Sizze: THE SAMPLE SIZZEs IS 30 IN EACH GROUP AND HENCE THE TOTAL SAMPLE SIZE OF MY STUDY IS 90.

Sampling technique: Using the mean and standard deviation as a basis, the minimal sample size formula is

(z□ □ z□)2(s 2 □ s 2)

n = 1 2

(X1 □ X2)2

where the power is associated with $z\beta$ and the significance level with $z\alpha$.

At the 5% significance level, $z\alpha = 1.96$ and $z\beta = 0.84$ for the 80% power of the test.

Theparameter considered in the calculation is ROM.

The first group's mean (74.8) is expressed by X1, and the second group's mean (81.5) is defined by X2. The first group's standard deviation (10.4) is represented by S1, and the second group's standard deviation (8.0) is described by S2.
These numbers lead to a sample size of thirty.

There will be two groups, each including thirty instances.

Inclusion Criteria: Age >18years

Exclusion Criteria: Post-Operative day >3 days

Paralysed lower limbs

Acute Flaccid Paralysis

Neurological disorders

Study protocol: All patients undergoing Total Knee Arthroplasty and following up till Post-Operative Day 5.

All patients who fulfill the inclusion critera will be advised to under Total Knee Arthroplasty at KLES Dr. prabhakar k0re Hosptal And MRC , Belagavi over a 1 year.

Data collection procedure: All patients who undergo total knee arthroplasty at KLE DR. Prabhakar Kore hospital, Belagavi will be evaluated for pain relief and knee range of movements post intraoperative administration of epidural injection or epidural injection and adductor canal block or epidural injection and periarticular infiltration.

Statistical Analysis:

1. **Data Management and Analysis Software**: MS Excel was used to collect data and then interpreted using statistical software packages such as SPSS (version 27.0) and GraphPad Prism (version 5).

2. **Data Summary**: While counts and percentages were used to summarize categorical variables, mean and standard deviation were used to summarize numerical variables.

3. **Statistical Tests**:

- Two-sample t-tests: Used for comparing means of unpaired samples.

- Paired t-tests: Used for comparing means of paired samples, provide more power than single-test analyses.

- "Chi-squared test ($\chi 2$ test)": Used for comparing proportions in categorical data. Pearson's chi-squared test is commonly used, and Under the null hypothesis, the test statistic's sample distribution has a chi-squared distribution.

- Fisher's exact test: Used for comparing unpaired proportions when sample sizes are small or when chi-squared assumptions are not met.

4. **Calculation of Test Statistic and Degrees of Freedom**: Equations for test statistics that resemble a t-distribution under the null hypothesis or that follow one closely are given, together with the relevant degrees of freedom for each test.

5. **Interpretation of Results**: A significance threshold (usually 0.10, 0.05, or 0.01) is chosen for statistical significance. The alternative hypothesis is accepted and the null hypothesis is rejected if the computed p-value is less than this cutoff.

6. **Statistical Significance**: P-values less than 0.05 were regarded as statistically significant. in my study.

This provides a clear overview of the statistical methods used in my analysis, ensuring transparency and reproducibility of my findings..

RESULT AND ANALYSIS

Table1 : Age distribution in group

Age in group	frequency	Percent
<50	4	4.4%
51-60	21	23.3%
61-70	40	44.4%
71-80	25	27.8%
Total	90	100.0%

Of the patients in our research, 4 (4.4%) were under 50 years old, 21 (23.3%) were between 51 and 60 years old, 40 (44.4%) were between 61 and 70 years old, and 25 (27.8%) were between 71 and 80 years old.

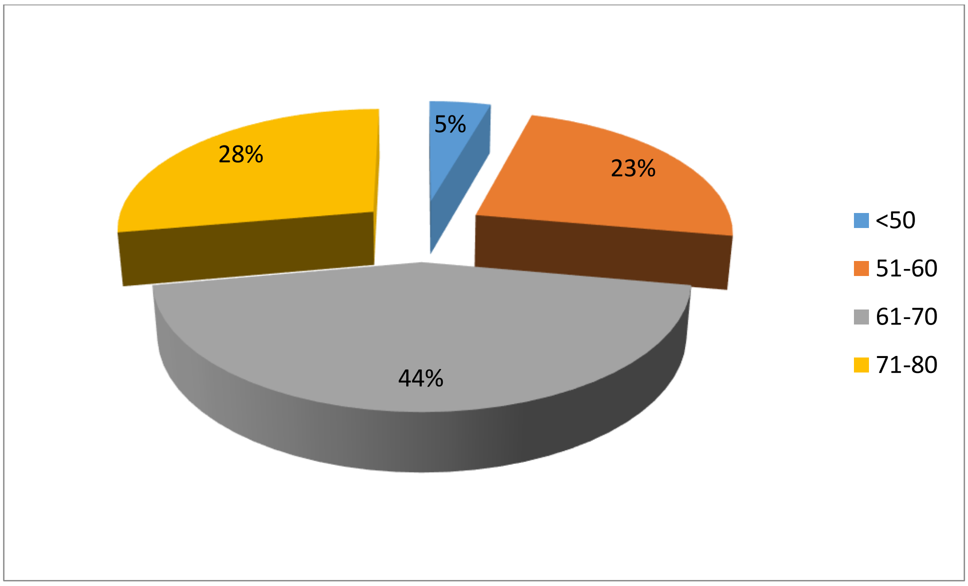


Table 2: distribution of gender

Sex	Frequency	Percent
Female	60	66.7%
Male	30	33.3%
Total	90	100.0%

Thirty-three (33.3%) patients were male and sixty (66.7%) patients were female in our research.

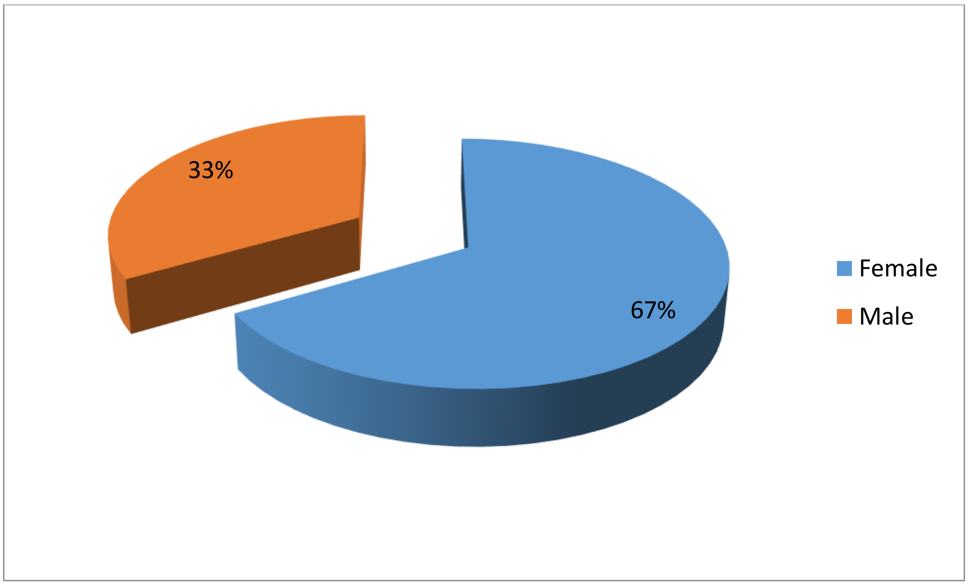


Table 3: Distribution of Group

Group	Frequency	Percent
Adductor canal	30	33.3%
Epidural	30	33.3%
Periarticular	30	33.3%
Total	90	100.0%

In our study, 30 (33.3%) patients had Adductor canal, 30 (33.3%) patients had Epidural, and 30 (33.3%) patients had Periarticular.

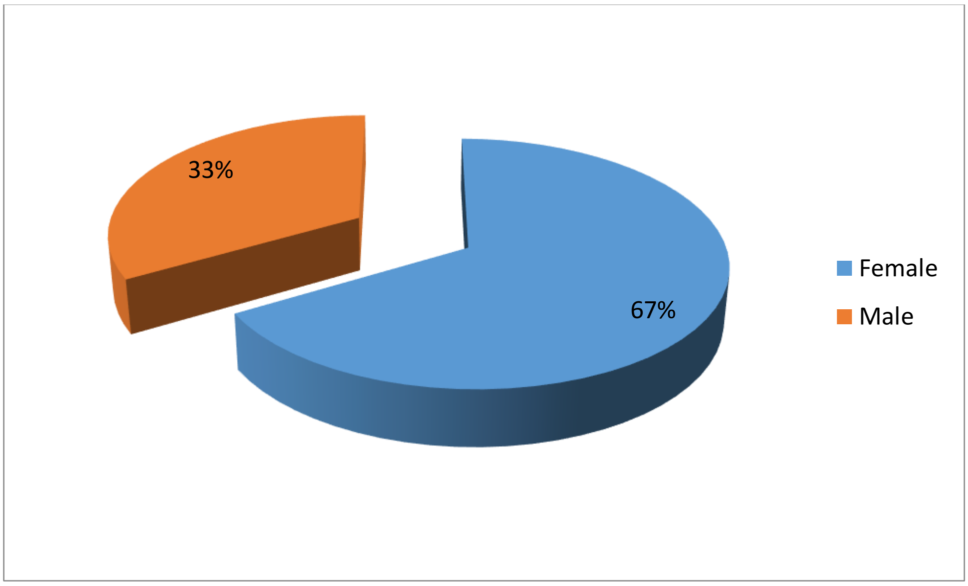


Table 4: Distribution of Intervention

Intervention	Frequency	Percent
LEFT TKR	47	52.2%
RIGHT TKR	43	47.8%
Total	90	100.0%

In our study, 47 (52.2%) patients had LEFT TKR and 43 (47.8%) patients had RIGHT TKR

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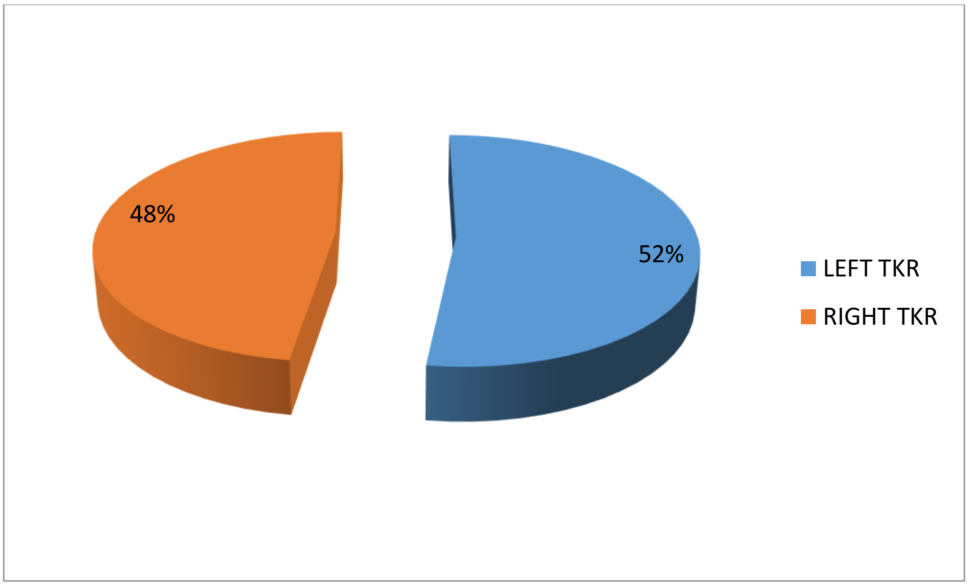


Table 5: distribution of mean age

	number	Mean	S D	Minimum	Maximum	Median
Age	90	64.8333	8.0256	42.0000	78.0000	66.0000

here, It revealed that the patients' mean age (mean±s.d.) was 64.8333 ± 8.0256.

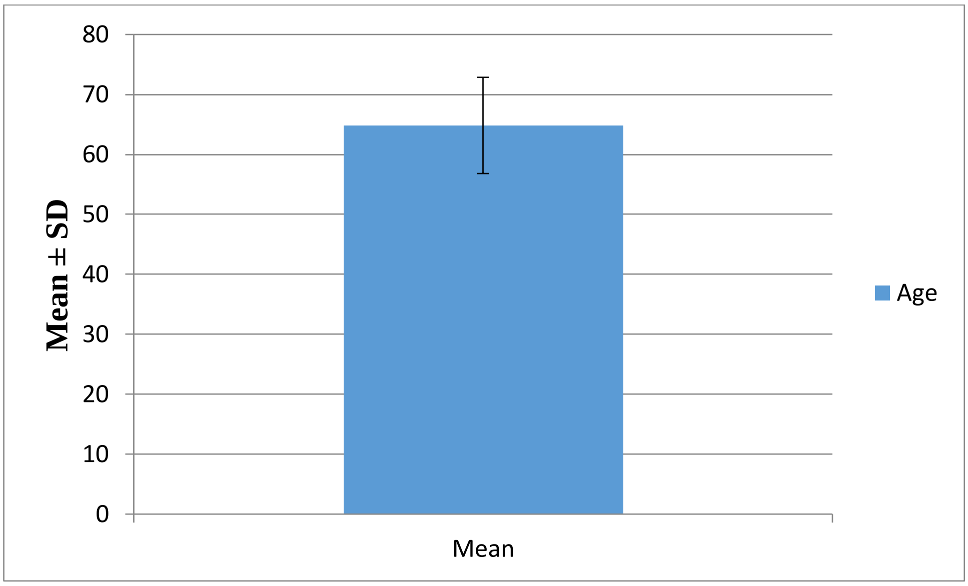


Table 6: Distribution of mean VAS Score POD0

	number	Mean	SD	Minimum	Maximum	Median
VAS Score POD0	90	7.3444	.8889	6.0000	9.0000	7.0000

Here, The data indicated that the patients' mean VAS Score POD0 (mean±s.d.) was 7.3444±.8889.

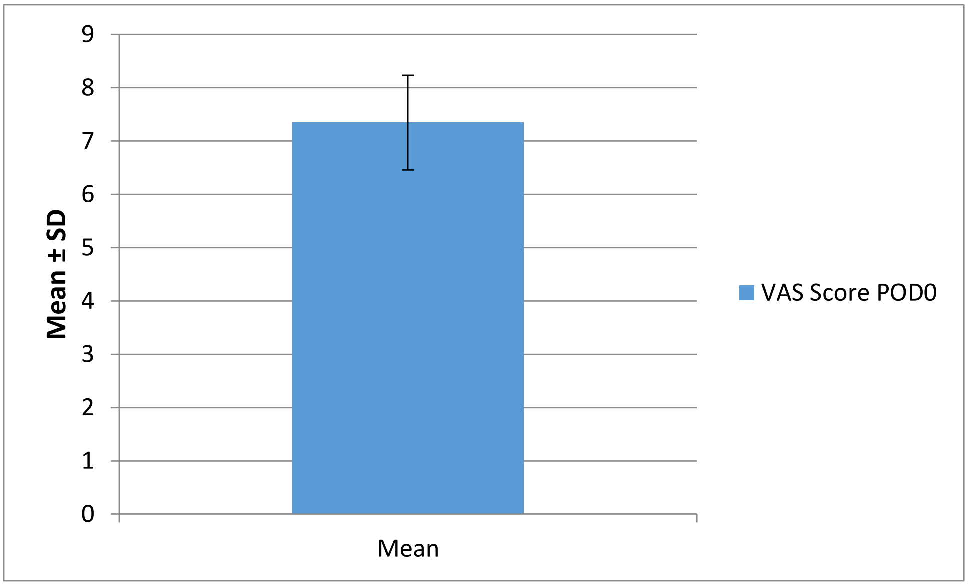


Table 7: "Distribution of mean VAS Score POD1"

	NumbErs	Mean	S.D	Min	Max	Median
VAS Score POD1	90	6.7444	.9429	4.0000	9.0000	7.0000

So, the mean VAS Score POD1 (mean±s.d.) of patients was 6.7444± .9429

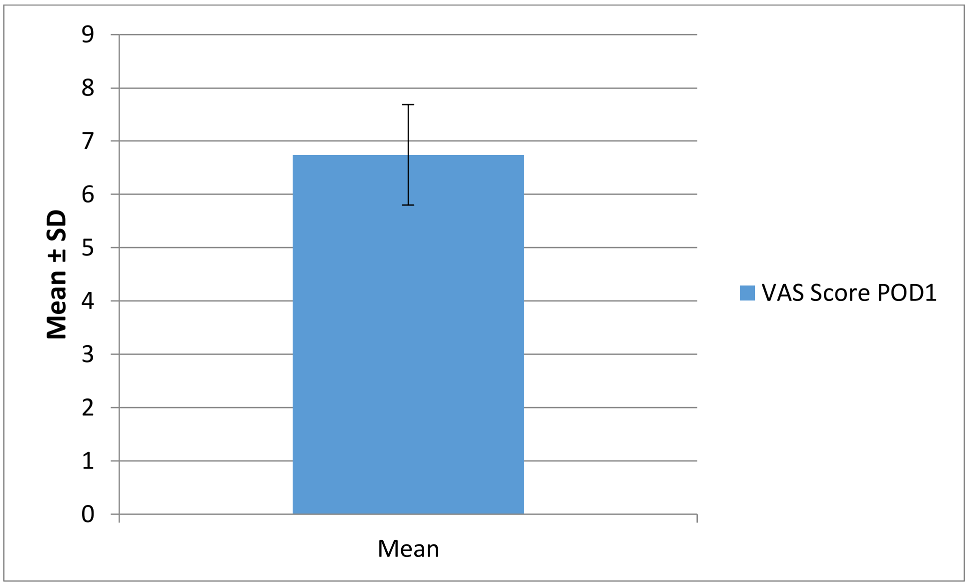


Table 8: "Distribution of mean VAS Score POD2"

	Numbe rS	Mean	S D	Minimu m	Maximu m	Median
VAS Score POD2	90	5.8444	.8983	3.0000	8.0000	6.0000

Hence, the mean VAS Score POD2 (mean±s.d.) of patients was 5.8444 ± .8983

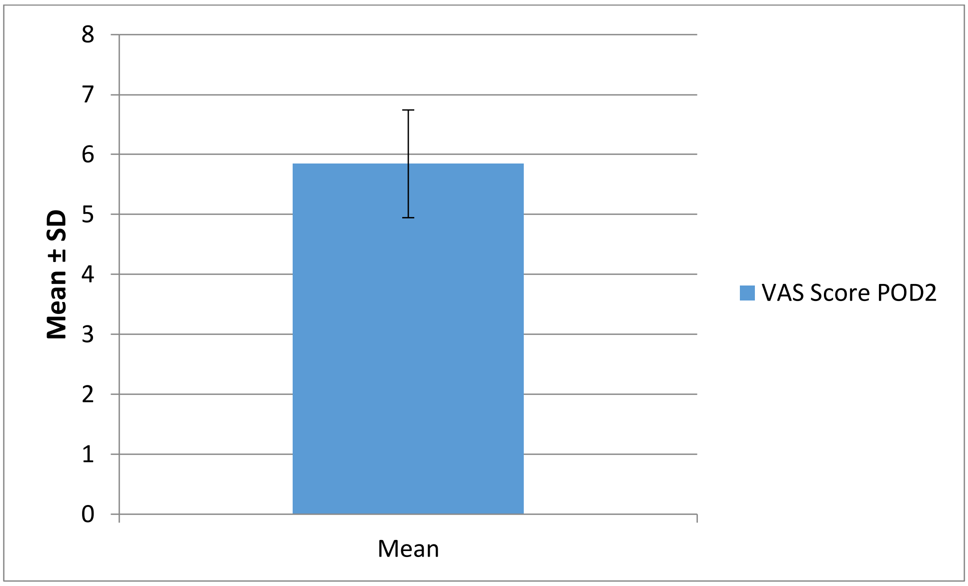


Table 9: Distribution of mean VAS Score POD3

	Values	Mean	S D	Minimum	Maximum	Median
VAS Score POD3	90	5.3111	1.0016	2.0000	7.0000	5.0000

Hereby, the mean VAS Score POD 3 (mean±s.d.) of patients was 5.3111 ± 1.0016.

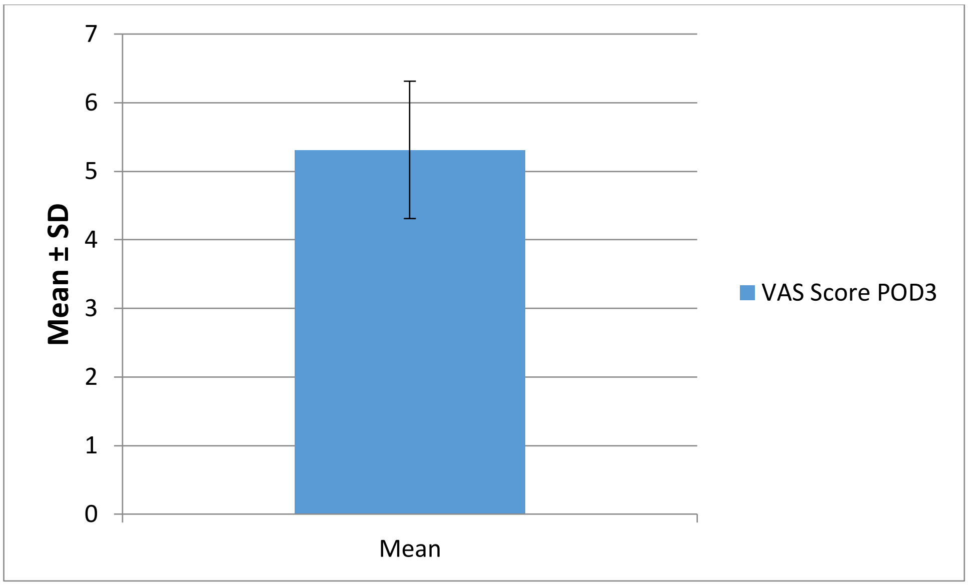


Table 10: Distribution of mean POD 0 Flexion ROM

	number	Mean	SD	Minimum	Maximum	Median
POD 0 Flexion Range Of Motion (in degrees)	90	35.0556	6.5982	20.0000	50.0000	35.0000

In above table showed that the mean POD 0 Flexion Range Of Motion (in degrees) (mean±s.d.) of patients was 35.0556 ± 6.5982.

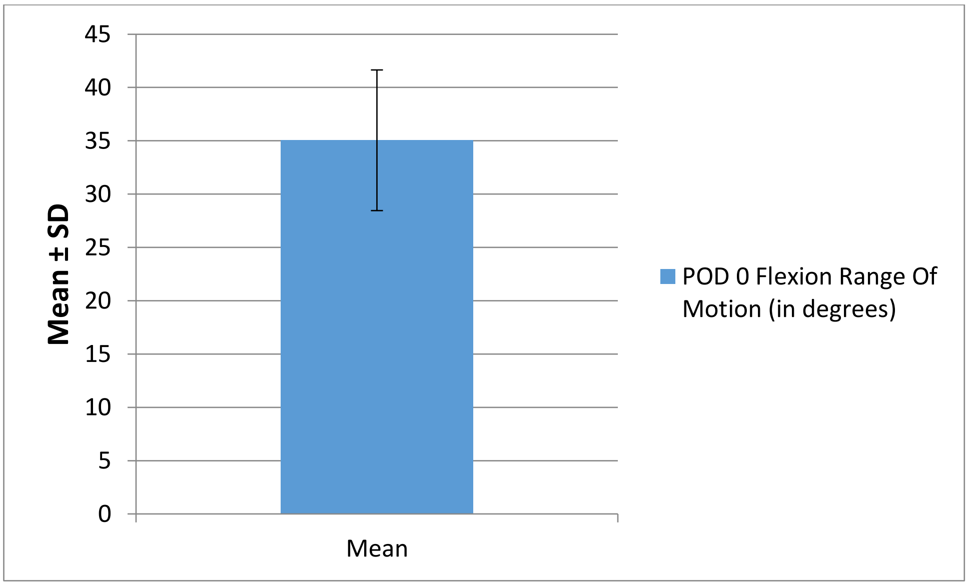


Table 11: Distribution of mean POD 0 Range of Motion for Extension

	Values	Mean	SD	Minimum	Maximum	Median
POD 0 Extension Range Of Motion (in degrees)	90	1.6667	2.7025	0.0000	10.0000	0.0000

In above table showed that the mean POD 0 Extension ROM (in degrees) (mean±s.d.) of patients was 1.6667 ± 2.7025

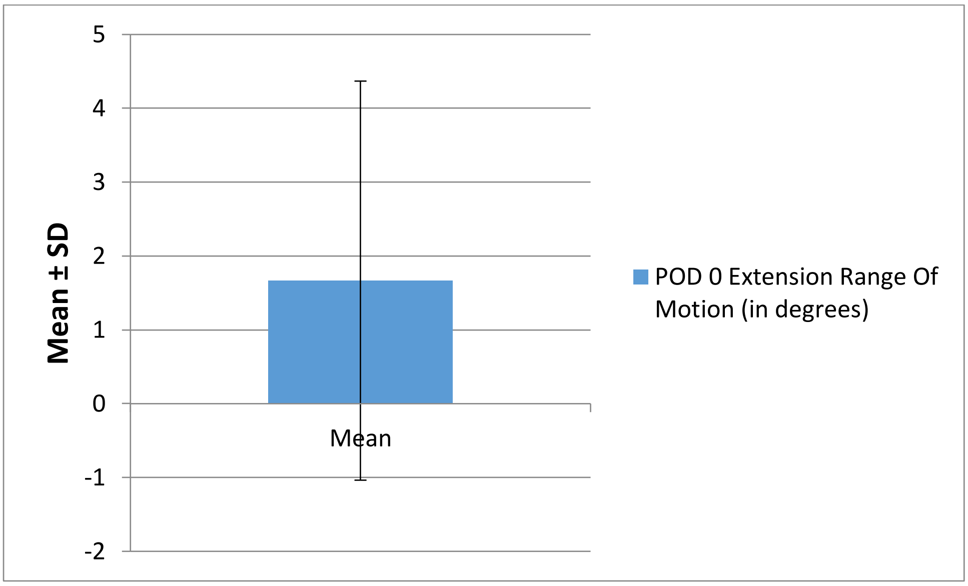


Table 12: Distribution of mean POD1 ROM for Flexion

	Numbers	Mean	S D	Minimum	Maximum	Median
POD1 Flexion Range Of Motion (in degrees)	90	42.7667	7.3071	25.0000	65.0000	42.0000

Henceforth, the mean POD1 Flexion ROM (in degrees) (mean±s.d.) of patients was 42.7667 ± 7.3071.

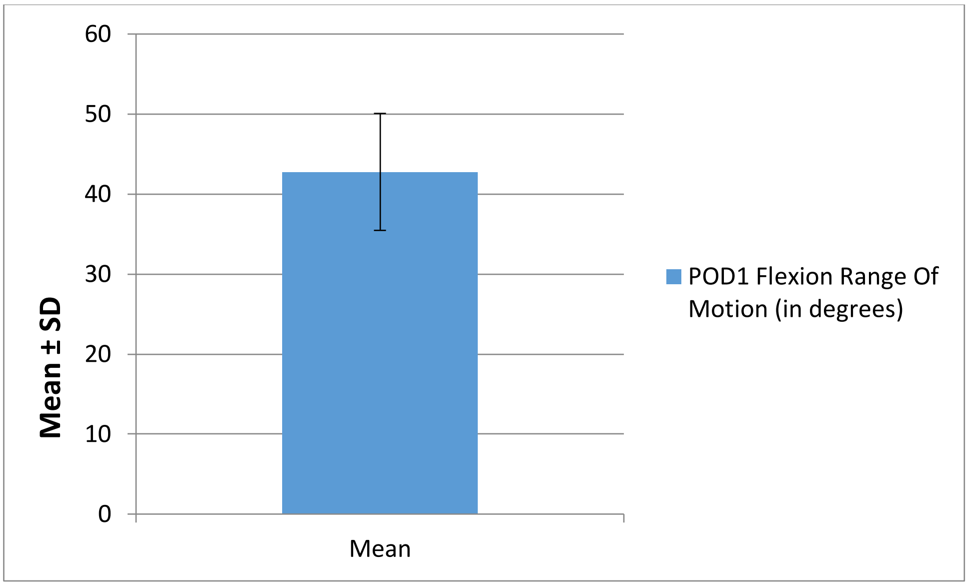


Table 13: Distribution of mean POD1 Extension ROM

	Numbers	Mean	SD	Minimum	Maximum	Median
POD1 Extention ROM (in degrees)	90	1.5333	2.6445	0.0000	10.0000	0.0000

Hence-forth, the mean POD1 Extension Range Of Motion (in degrees) (mean±s.d.) of patients was 1.5333 ± 2.6445

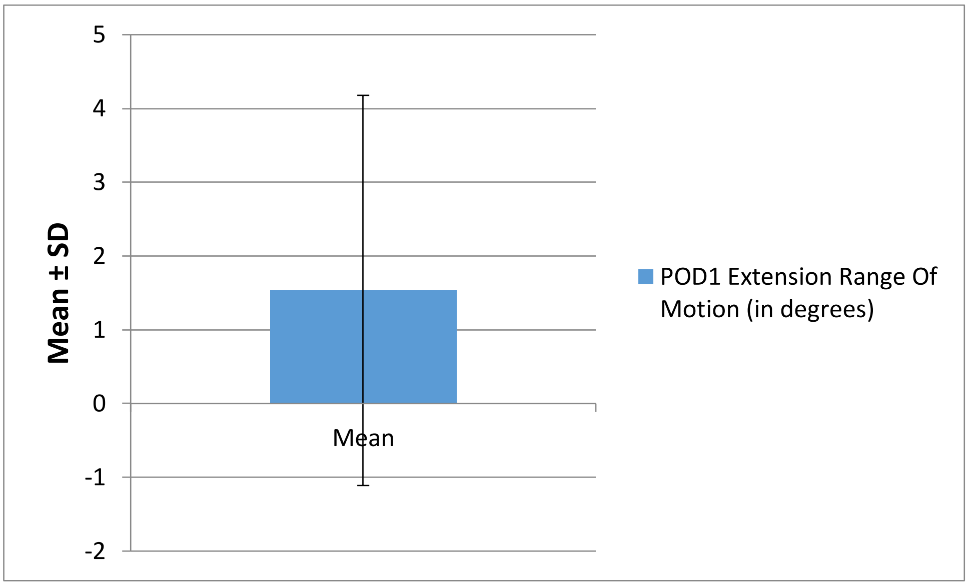


Table 14: Distribution of mean POD2 Flexion ROM (in degrees)

	number	Mean	SD	Minimum	Maximum	Median
POD2 Flexion Range Of Motion (in degrees)	90	54.6667	11.1879	35.0000	90.0000	55.0000

Gradually, the mean POD2 Flexion Range Of Motion (in degrees) (mean±s.d.) of patients was 54.6667 ± 11.1879.

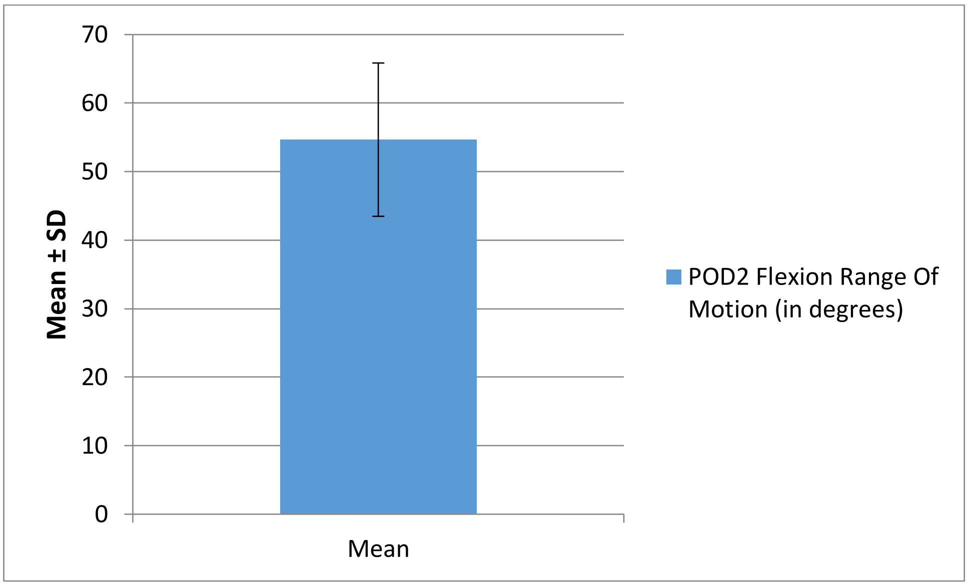


Table 15: Distribution of mean POD2 Extension ROM(in degrees)

	number	Mean	SD	Minimum	Maximum	Median
POD2 Extension Range Of Motion (in degrees)	90	1.2556	2.5243	0.0000	10.0000	0.0000

Gradually, the mean POD2 Extension Range Of Motion (in degrees) (mean±s.d.) of patients was 1.2556 ± 2.5243.

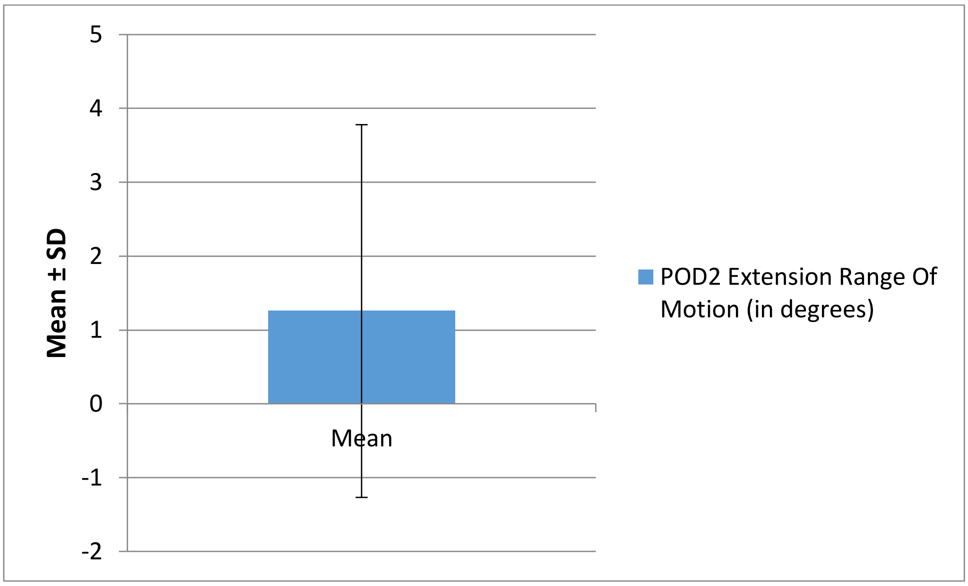


Table 16: Distribution of mean POD3 Flexion ROM (in degrees)

	Values	Mean	SD	Minimum	Maximum	Median
POD3 Flexion Range Of Motion (in degrees)	90	74.1667	10.9967	55.0000	95.0000	75.0000

So, the mean POD3 Extension ROM (in degrees) (mean±s.d.) of patients was 74.1667 ± 10.9967.

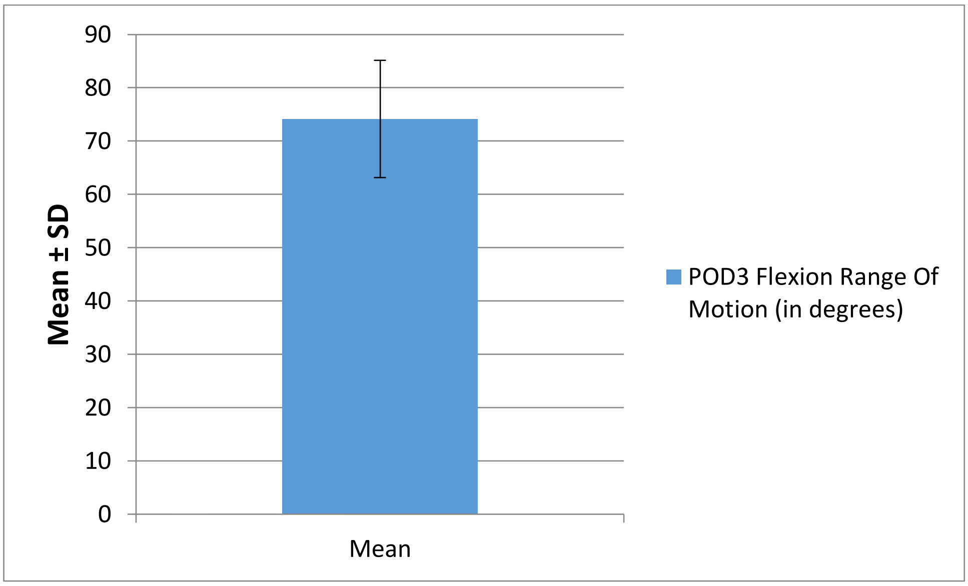


Table 17: Distribution of mean POD3 Extension ROM (in degrees)

	number	Mean	SD	Minimum	Maximum	Median
POD3 Extension Range Of Motion (in degrees)	90	1.0111	2.2511	0.0000	10.0000	0.0000

Henceforth, the mean POD3 Extension Range Of Motion (in degrees) (mean±s.d.) of patients was 1.0111 ± 2.2511.

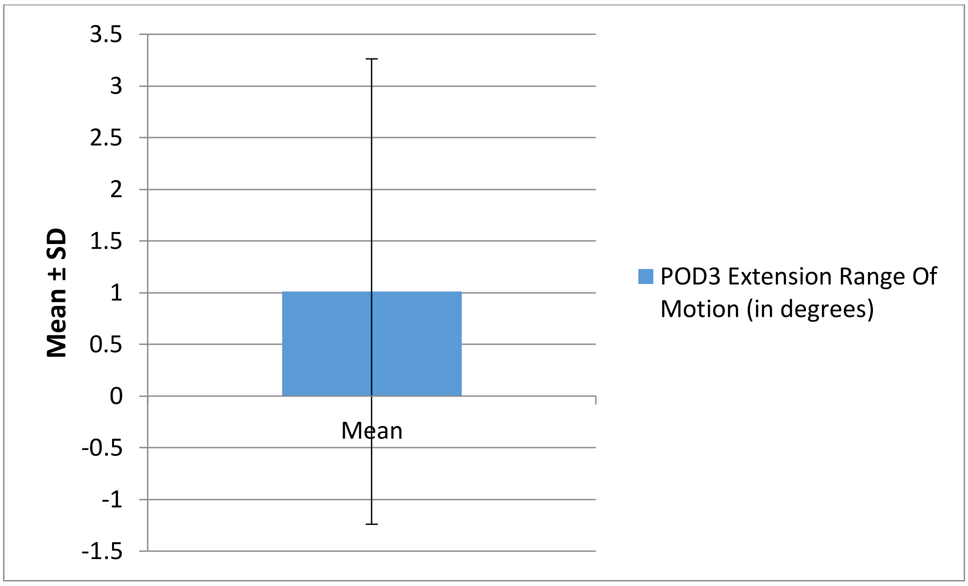


Table 18: Association between Age in group: Group

Chi-square value: 9.1671; df:6 **p-value:** 0.1644

Within the Adductor canal, there were 3 patients (10.0%) under the age of 50, 8 patients (26.7%) aged within 51 and 60, 14 patients (46.7%) between the ages of 61 and 70, and 5 patients (16.7%) between the ages of 71 and 80.
Among the patients receiving epidural therapy, 1 (26.7%) had an age under 50, 5 (16.7%) had an age between 51 and 60, 11 (36.7%) had an age between 61 and 70, and 13 (43.3%) had an age between 71 and 80.
Eight (26.7%) of the patients in Periarticular were between the ages of 51 and 60, fifteen (50.0%) were between the ages of 61 and 70, and seven (23.3%) were between the ages of 71 and 80.

Age in a group did not significantly correlate with group (p=0.1644)

GROUP

Age in group	Adductor canal	Epidural	Periarticular	TOTAL
<50	3	1	0	4
Row %	75.0	25.0	0.0	100.0
Col %	10.0	3.3	0.0	4.4
51-60	8	5	8	21
Row %	38.1	23.8	38.1	100.0
Col %	26.7	16.7	26.7	23.3
61-70	14	11	15	40
Row %	35.0	27.5	37.5	100.0
Col %	46.7	36.7	50.0	44.4
71-80	5	13	7	25
Row %	20.0	52.0	28.0	100.0
Col %	16.7	43.3	23.3	27.8
TOTAL	30	30	30	90
Row %	33.3	33.3	33.3	100.0
Col %	100.0	100.0	100.0	100.0

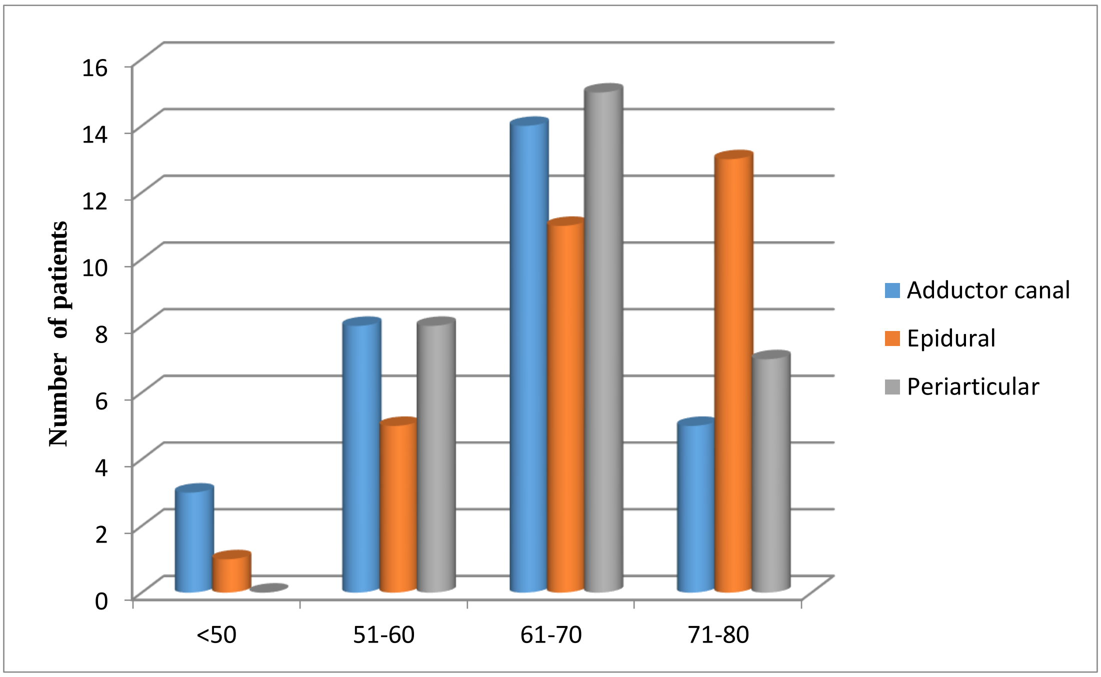

Number of patients
0
2
4
6
8
10
12
14
16
<50
51-60
61-70
71-80
Adductor canal
Epidural
Periarticular

Table 19: Association between Sex: Group

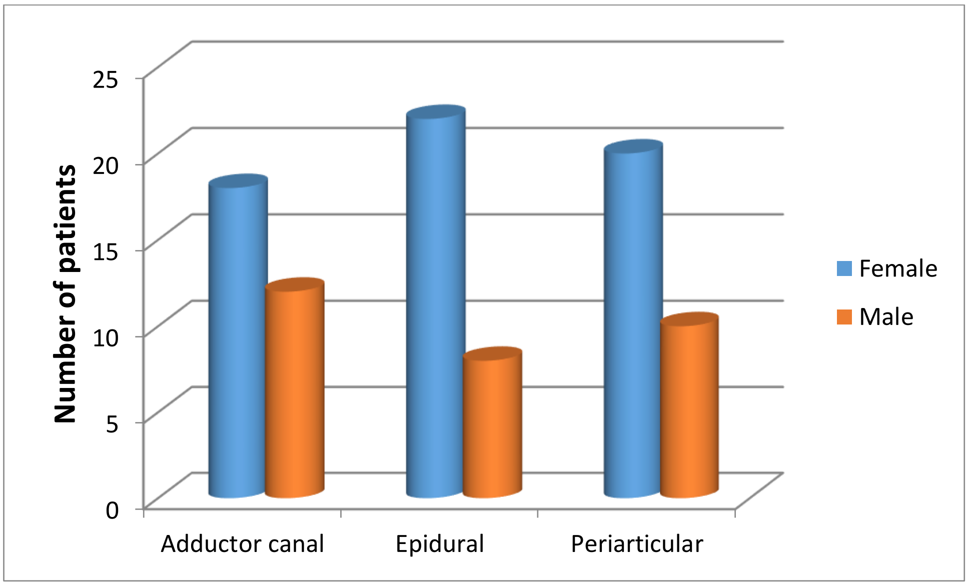
Chi-square value: 1.2000; df:2 **p-value:** =0.5488

In Adductor canal, 31 (56.4%) patients were Female and 24 (43.6%) patients were Male.

In Epidural, 27 (60.0%) patients were Female and 18 (40.0%) patients wereMale.

In Periarticular, 27 (60.0%) patients wereFemale and 18 (40%) patients were male.

Gender relation to Group was of negligible significance (p=0.5488).



GROUP

Sex	Adductor canal	Epidural	Periarticular	TOTAL
Female	18	22	20	60
Row %	30.0	36.7	33.3	100.0
Col %	60.0	73.3	66.7	66.7
Male	12	8	10	30
Row %	40.0	26.7	33.3	100.0
Col %	40.0	26.7	33.3	33.3
TOTAL	30	30	30	90
Row %	33.3	33.3	33.3	100.0
Col %	100.0	100.0	100.0	100.0

Table 20: Association between Intervention: Group

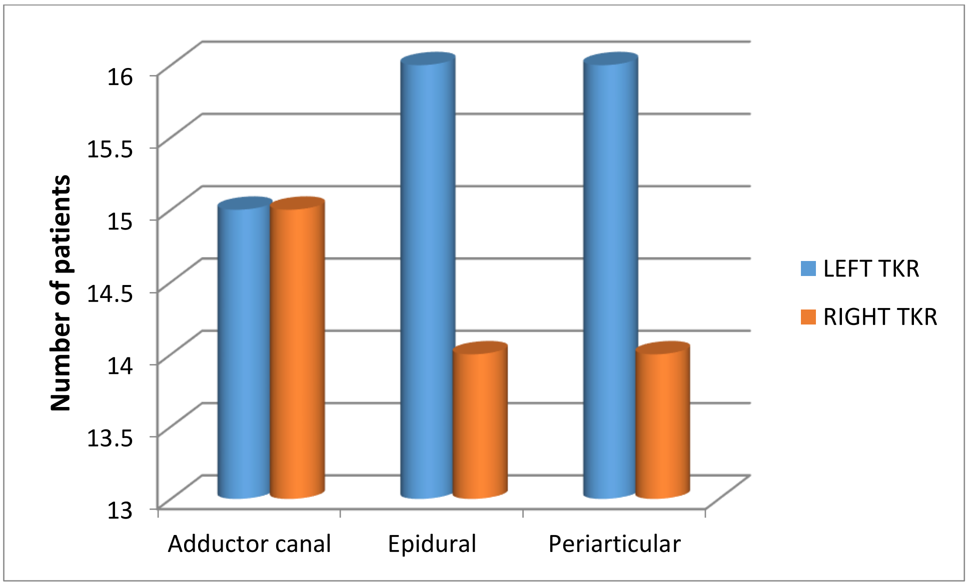
Chi-square value.0891; df:2 **p-value:** =0.9564

In adductor canal, 15 (50.0%) patients was left TKR and 15 (50.0%) patients was right TKR.

In epidural, 16 (53.3%) patients was left TKR and 14 (46.7%) patients was right TKR.

In periarticular, 16 (53.3%) patients was left TKR and 14 (46.7%) patients was right TKR.

Association of intervention with treatment was statistically insignificant (p=0.9564).



	GROUP			
Intervention	**Adductor canal**	**Epidural**	**Periarticular**	**TOTAL**
LEFT TKR	15	16	16	47
Row %	31.9	34.0	34.0	100.0
Col %	50.0	53.3	53.3	52.2
RIGHT TKR	15	14	14	43
Row %	34.9	32.6	32.6	100.0
Col %	50.0	46.7	46.7	47.8
TOTAL	30	30	30	90
Row %	33.3	33.3	33.3	100.0
Col %	100.0	100.0	100.0	100.0

Table21 : Distribution of mean Age: Group

		Number	Mean	SD	Minimum	Maximum	Median	p-value
Age	Adductor canal	30	62.9333	8.7845	42.0000	77.0000	64.5000	0.2526
	Epidural	30	66.3000	7.6930	49.0000	77.0000	68.5000	
	Periarticular	30	65.2667	7.4275	51.0000	78.0000	65.5000	

In Adductor canal, Patients' mean age (mean± standard deviation) was

62.9333 ± 8.7845.

The typical age (mean± standard deviation) of patients in epidural 66.3000 ± 7.6930.

The mean age (mean± SD) of the patients in Periarticular was 65.2667 ± 7.4275.

The group's mean age distribution was not statistically significant. (p = 0.2526).

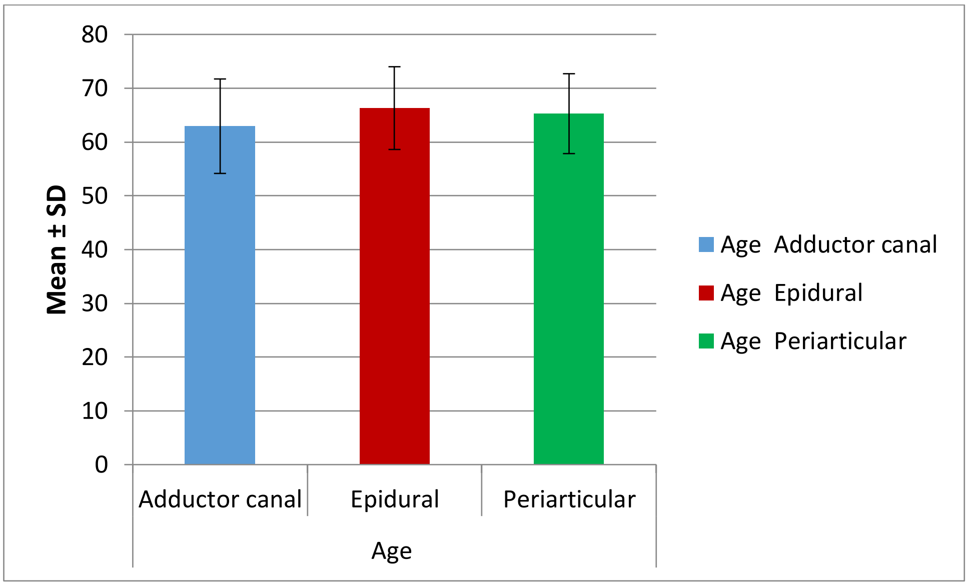


Table 22: Distribution of mean VAS Score POD0: Group

		numbers	Mean	SD	Minimum	Maximum	Median	p-value
VAS Score POD0	Adductor canal	30	6.6000	.6215	6.0000	8.0000	7.0000	<0.0001
	Epidural	30	8.0000	.7428	7.0000	9.0000	8.0000	
	Periarticular	30	7.4333	.6789	6.0000	9.0000	7.0000	

The mean VAS Score POD0 (mean± s.d.) of patients in the adductor canal was 6.6000 ± .6215.

The mean VAS Score POD0 (mean± s.d.) of patients receiving epidural 8.0000 ± .7428.

In Periarticular, the mEan VAS Score POD0 (mean± s.d.) of patients was 7.4333 ± .6789.

Statistically significance(p <0.0001) was seen on VAS score on POD0

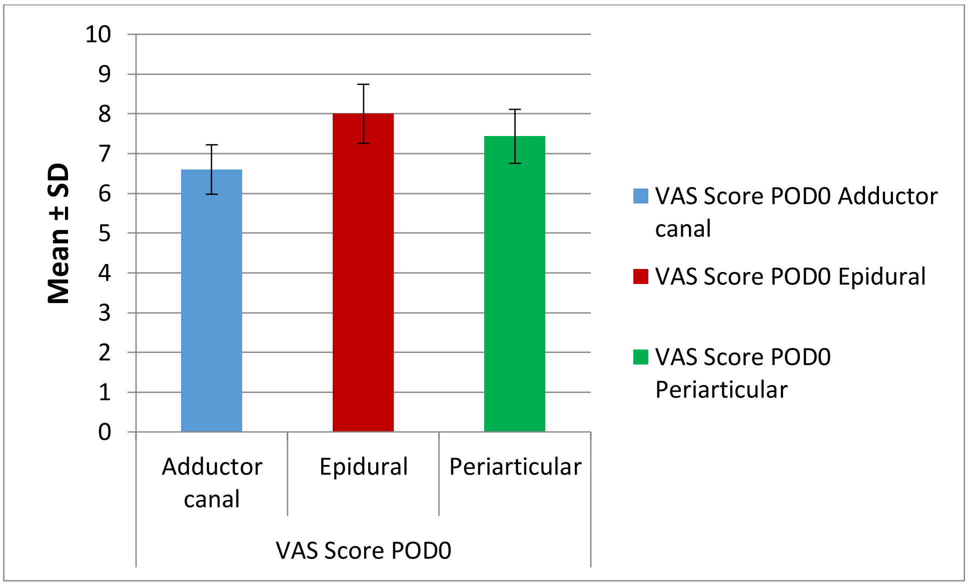


Table 23: Distribution of mean VAS Score POD1 : ‘ Group

		number	Mean	S D	Minimum	Maximum	Median	p-value
VAS Score POD1	Adductor canal	30	6.3000	.7022	5.0000	8.0000	6.0000	0.0029
	Epidural	30	6.8333	.9855	4.0000	8.0000	7.0000	
	Periarticular	30	7.1000	.9595	5.0000	9.0000	7.0000	

The mean VAS Score POD1 (mean± s.d.) for patients in the adductor canal was 6.3000± .7022.

The mean VAS Score POD1 (mean± s.d.) for patients receiving epidural 6.8333 ± .9855.

The mean VAS Score POD1 (mean± s.d.) of the patients in Periarticular was 7.1000 ± .9595.

Distribution of mean VAS Score POD1 with Group was statistically significant (p =0.0029).

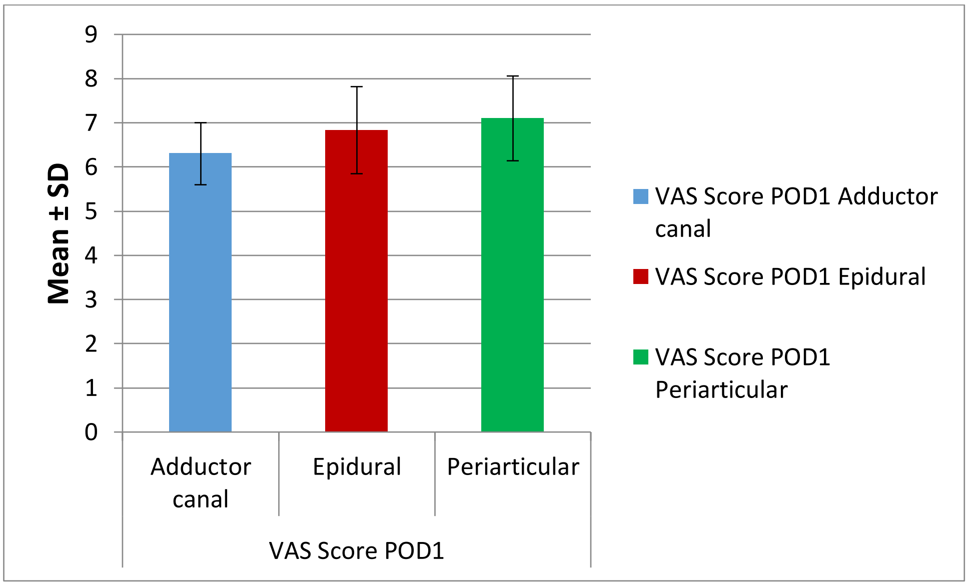


Table 24: Distribution of mean VAS Score POD2: ‘ Group

		number	Mean	S D	Minimum	Maximum	Median	p-value
VAS Score POD2	Adductor canal	30	5.4333	.6789	4.0000	7.0000	5.0000	0.0019
	Epidural	30	5.8667	1.0743	3.0000	8.0000	6.0000	
	Periarticular	30	6.2333	.7279	5.0000	8.0000	6.0000	

The mean VAS Score POD2 (mean± s.d.) of patients in the adductor canal was

5.4333 ± .6789.

The mean VAS Score POD2 (mean± s.d.) for patients receiving epidural
5.8667 ± 1.0743.

The mean± standard deviation of the patients' Mean VAS Score POD2 in Periarticular was
6.2333 ± .7279.

Distribution of mean VAS Score POD1 with Group was statistically significant (p =0.0019).

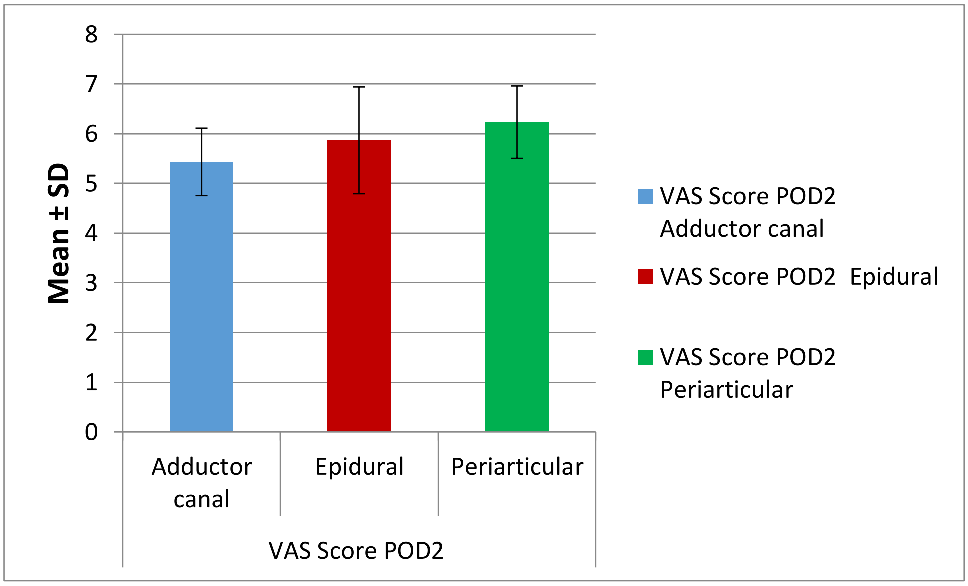


Table 25: Distribution of mean VAS Score POD3: Group

		number	Mean	SD	Minimum	Maximum	Median	p-value
VAS Score POD3	Adductor canal	30	5.0667	.6915	4.0000	6.0000	5.0000	0.0038
	Epidural	30	5.0667	1.3629	2.0000	7.0000	5.0000	
	Periarticular	30	5.8000	.6103	5.0000	7.0000	6.0000	

The mean VAS Score POD3 (mean± s.d.) of subjects in the adductor canal was 5.0667 ± .6915.

The patients' mean VAS Score POD3 (mean± s.d.) in Epidural 5.0667 ± 1.3629.

The mean VAS Score POD3 (mean± s.d.) of the patients in Periarticular was 5.8000 ± .6103.

Distribution of mean VAS Score POD3 with Group was statistically significant (p =0.0038).

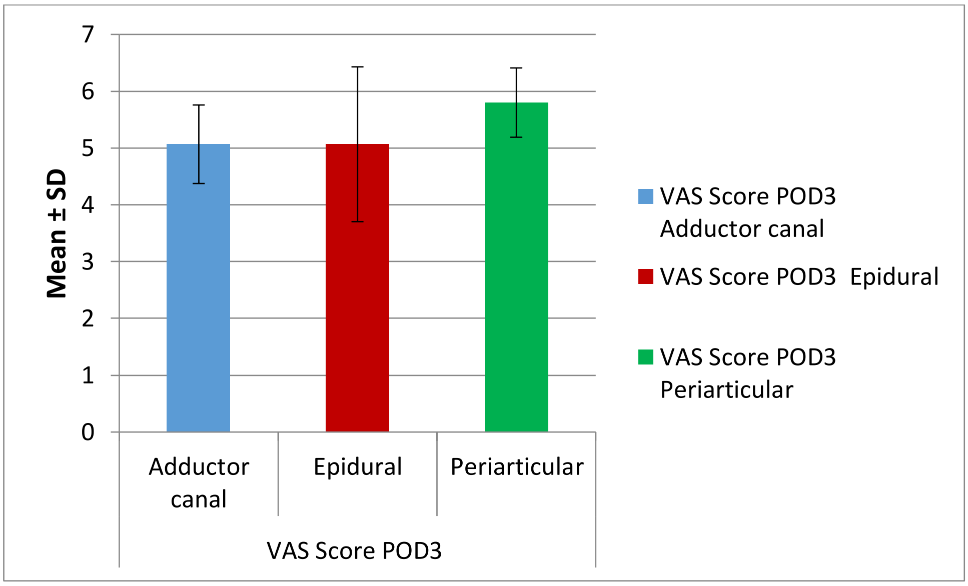


Table 26: Distribution of mean POD 0 Flexion Range Of Motion : " Group

		Numbers	Mean	SD	Minimum	Maximum	Median	p-value
POD 0 Flexion ROM (in degrees)	Adductor canal	30	39.0000	4.9827	30.0000	50.0000	40.0000	0.0002
	Epidural	30	33.3333	6.2053	20.0000	45.0000	32.5000	
	Periarticular	30	32.8333	6.7828	20.0000	45.0000	32.5000	

The mean POD 0 Flexion ROM (in degrees) (mean± s.d.) for patients in adductor canal was 39.0000 ± 4.9827.
The mean POD 0 Flexion ROM (in degrees) (mean± s.d.) for patients receiving epidural was 33.3333 ± 6.2053.
The patients in Periarticular had a mean POD 0 Flexion Range of Motion (in degrees) of 32.8333 ± 6.7828 (mean± s.d.).

Distribution of mean POD 0 flexion ROM (in degrees) with Group was statistically significant (p =0.0002).

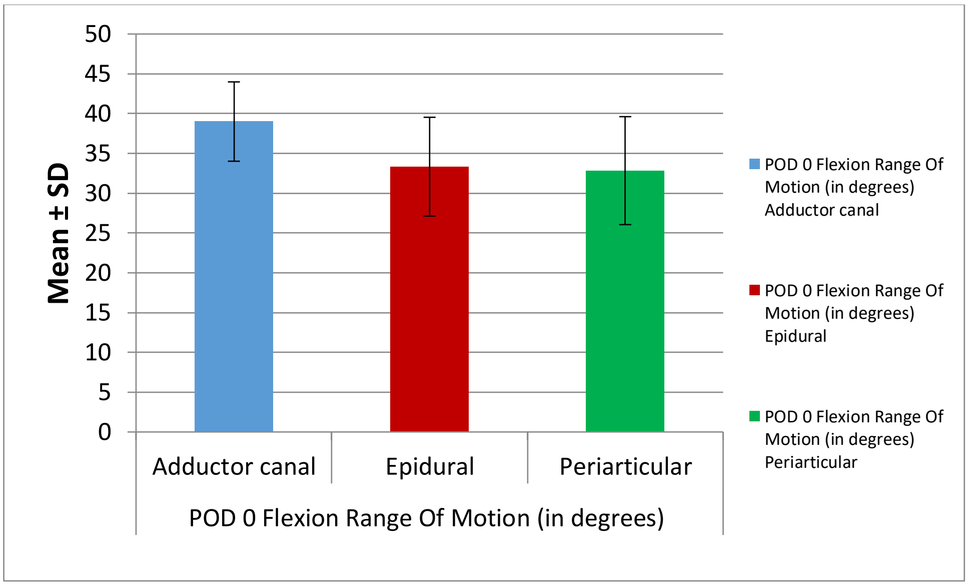


Table 27: Distribution of mean POD 0 Extension ROM : Group

		Numbers	Mean	SD	Minimum	Maximum	Median	p-value
POD 0 Extension ROM (in degrees)	Adductor canal	30	1.0000	2.0342	0.0000	5.0000	0.0000	0.2288
	Epidural	30	2.1667	2.8416	0.0000	10.0000	0.0000	
	Periarticular	30	1.8333	3.0747	0.0000	10.0000	0.0000	

The mean POD 0 Extension ROM(in degrees) (mean± s.d.) for patients in the adductor canal was 1.0000 ± 2.0342.
The mean POD 0 Extension ROM(in degrees) (mean± s.d.) for patients receiving epidural was 2.1667 ± 2.8416.
The mean POD 0 Extension ROM (in degrees) (mean± s.d.) of the patients in Periarticular was 1.8333 ± 3.0747.

Distribution of mean POD 0 Extension ROM (in degrees) with Group was statistically INsignificant (p =0.2288).

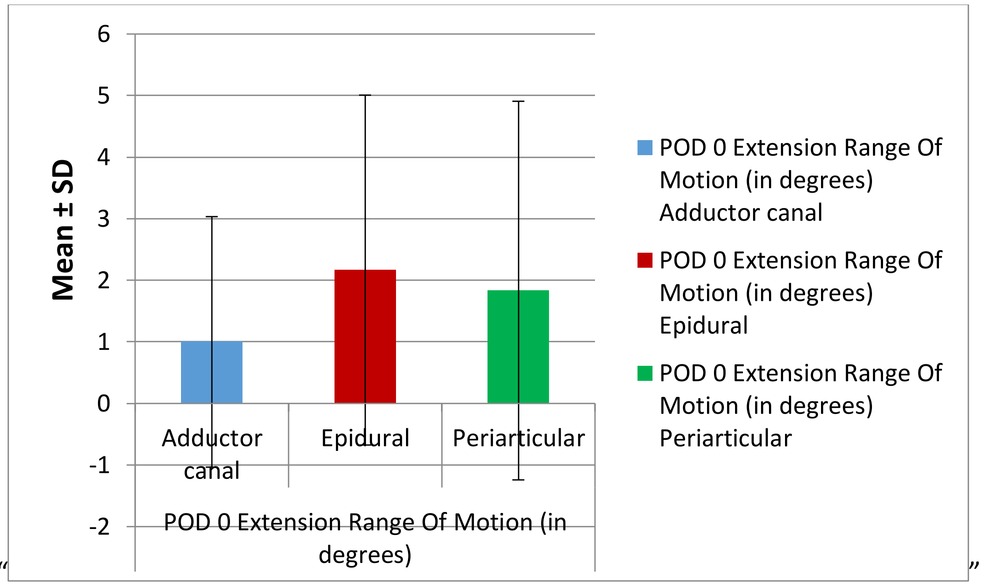


Table 28: Distribution of mean POD1 Flexion ROM (in degrees) : " Group

		numbers	Mean	SD	Minimum	Maximum	Median	p-value
POD1 Flexion Range Of Motion (in degrees)	Adductor canal	30	40.4667	5.1175	30.0000	52.0000	40.0000	0.0330
	Epidural	30	45.3333	8.7033	30.0000	65.0000	45.0000	
	Periarticular	30	42.5000	7.0405	25.0000	55.0000	40.0000	

The mean POD1 Flexion ROM (in degrees) (mean± s.d.) for patients in the adductor canal was 40.4667 ± 5.1175.
The patients' mean POD1 Flexion ROM (in degrees) (mean± standard deviation) was 45.3333 ± 8.7033 in the epidural setting.
The POD1 Flexion ROM (in degrees) (mean ± s.d.) of patients in Periarticular was 42.5000 ± 7.0405.

Mean distribution
POD1 Flexion ROM (in degrees) with Group was statistically significant (p =0.0330).

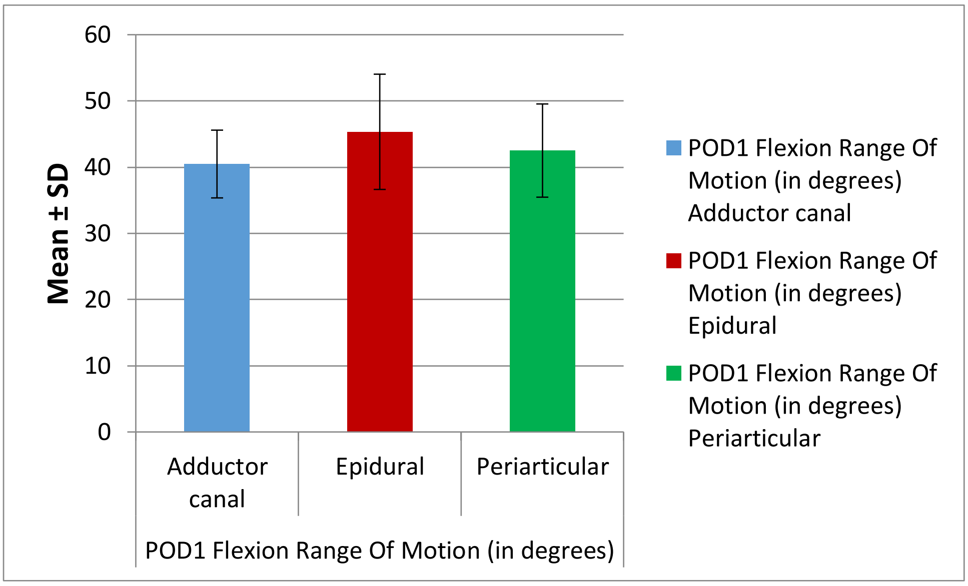


Table 29: Distribution of mean POD1 Extension ROM: Group

		Number	Mean	SD	Minimum	Maximum	Median	p-value
POD1 Extension Range Of Motion (in degrees)	Adductor canal	30	.9333	1.9286	0.0000	5.0000	0.0000	
	Epidural	30	2.1667	2.8416	0.0000	10.0000	0.0000	0.1963
	Periarticular	30	1.5000	2.9798	0.0000	10.0000	0.0000	

The mean POD1 Extension ROM (in degrees) (mean± s.d.) of the patients in the adductor canal was.9333 ± 1.9286.
Patients with Epidural had a mean POD1 Extension ROM (in degrees) of 2.1667 ± 2.8416 (mean± s.d.).
The POD1 Extension ROM (in degrees) (mean ± standard deviation) for patients in Periarticular was 1.5000 ± 2.9798.

Distribution of mean POD1 Extension ROM (in degrees)with Group was statistically not significant (p =0.1963).

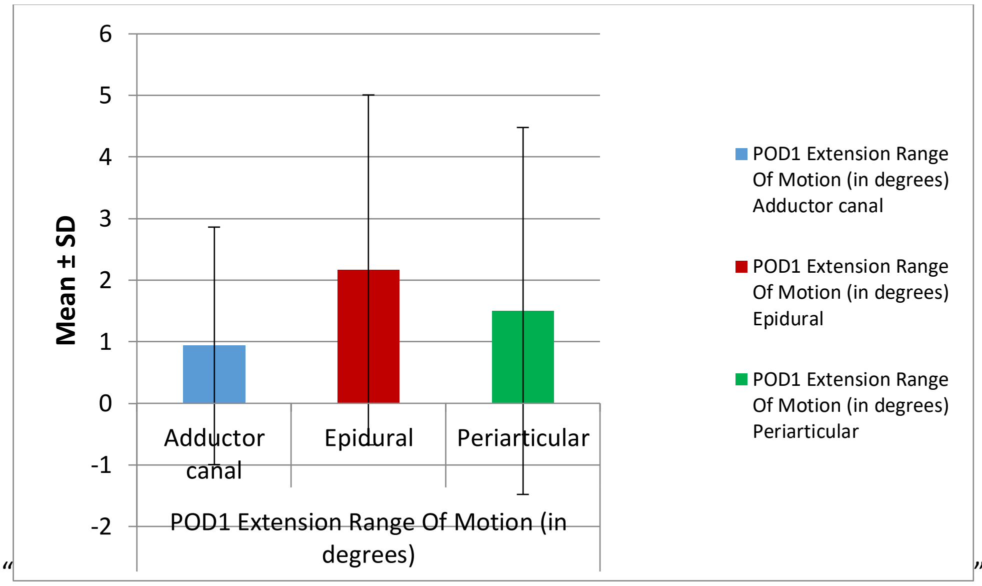
“”

Table 30: Distribution of mean POD2 flexion ROM : Group

		Number	Mean	SD	Minimum	Maximum	Median	p-value
POD2 Flexion Range Of Motion (in degrees)	Adductor canal	30	46.6667	7.3500	35.0000	60.0000	45.0000	0.0000
	Epidural	30	55.8333	9.0099	40.0000	70.0000	55.0000	
	Periarticular	30	61.5000	11.5333	40.0000	90.0000	60.0000	

The mean POD2 Flexion ROM (in degrees) (mean± s.d.) for patients in the adductor canal was 46.6667± 7.3500.
The POD2 Flexion ROM (in degrees) for individuals receiving an epidural was 55.8333 ± 9.0099 on average (mean± s.d.).
Patients in Periarticular had a mean POD2 Flexion ROM (in degrees) of 61.5000 ± 11.5333 (mean± s.d.).

Distribution of mean POD2 Flexion ROM (in degrees) with Group was statistically significant (p <0.0001).

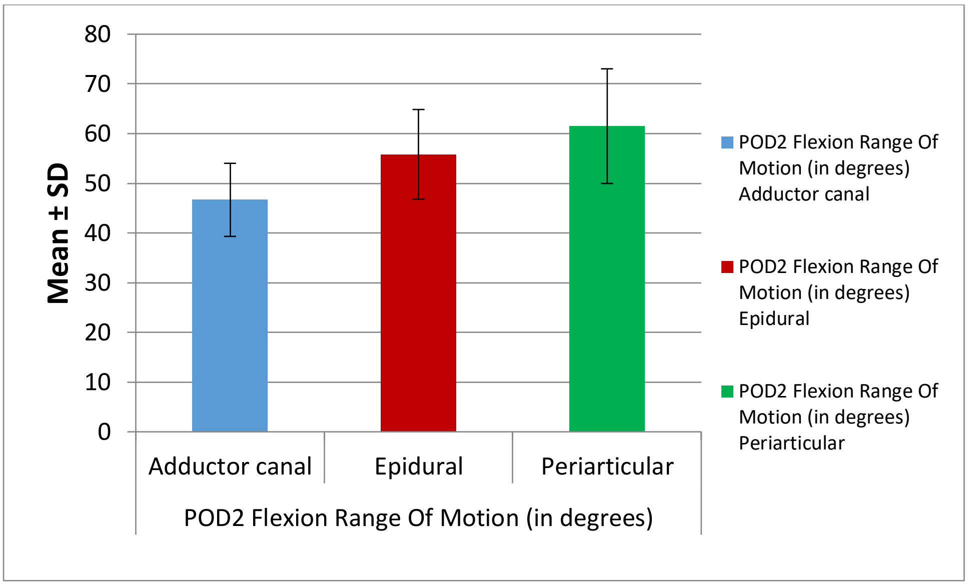


Table 31: Distribution of mean POD2 extension ROM (in degrees) : Group

		number	Mean	SD	Minimum	Maximum	Median	p-value
POD2 Extension Range Of Motion (in degrees)	Adductor canal	30	.6000	1.5888	0.0000	5.0000	0.0000	0.1640
	Epidural	30	1.8333	2.7803	0.0000	10.0000	0.0000	
	Periarticular	30	1.3333	2.9165	0.0000	10.0000	0.0000	

The mean POD2 Extension ROM (in degrees) (mean± s.d.) of the patients in the adductor canal was.6000 ± 1.5888.
Patients with Epidural had a mean POD2 Extension ROM (in degrees) of 1.8333 ± 2.7803 (mean± s.d.).
The POD2 Extension ROM (in degrees) (mean± standard deviation) for patients in Periarticular was 1.3333 ± 2.9165.

Distribution of mean POD2 Extension ROM (in degrees) with Group was statistically not significant (p= 0.1640).

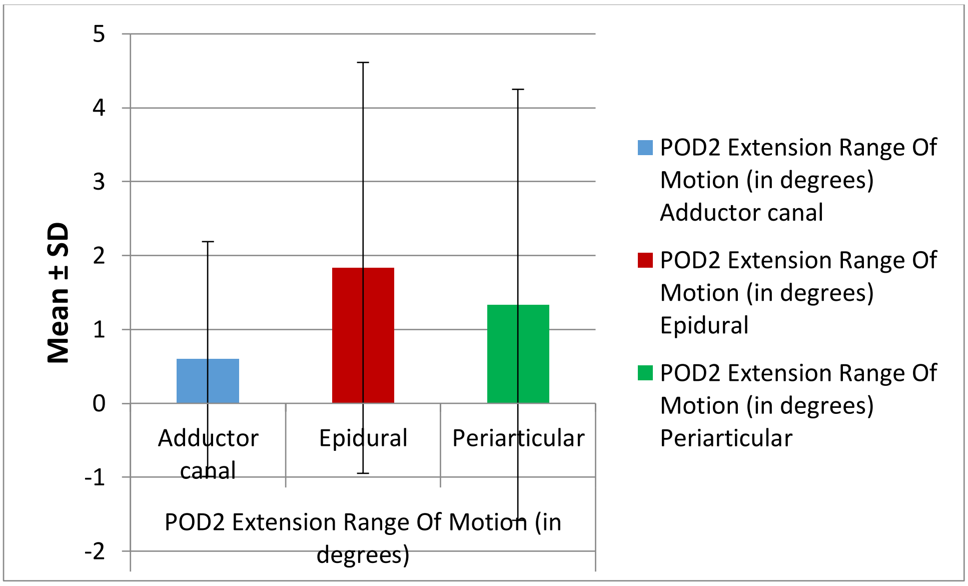


Table 32: Distribution of mean POD3 flexion ROM: Group

		Number	Mean	SD	Minimum	Maximum	Median	p-value
POD3 Flexion Range Of Motion (in degrees)	Adductor canal	30	71.0000	13.6078	55.0000	95.0000	65.0000	0.0018
	Epidural	30	71.6667	6.3427	60.0000	85.0000	72.5000	
	Periarticular	30	79.8333	9.7806	60.0000	95.0000	80.0000	

The mean POD3 Flexion ROM (in degrees) (mean± s.d.) for patients in the adductor canal was 71.0000± 13.6078.
The POD3 Flexion ROM (in degrees) (mean± standard deviation) for individuals undergoing epidural was 71.6667± 6.3427.
The POD3 Flexion ROM (in degrees) (mean± standard deviation) for patients in Periarticular was 79.8333± 9.7806.

Distribution of mean POD3 flexion ROM (in degrees) with Group was statistically significant (p= 0.0018).

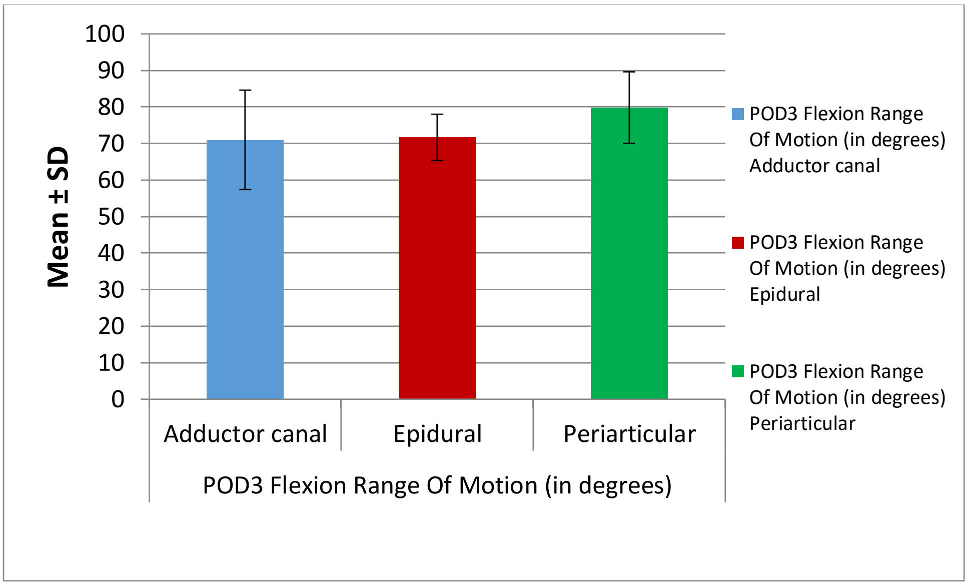
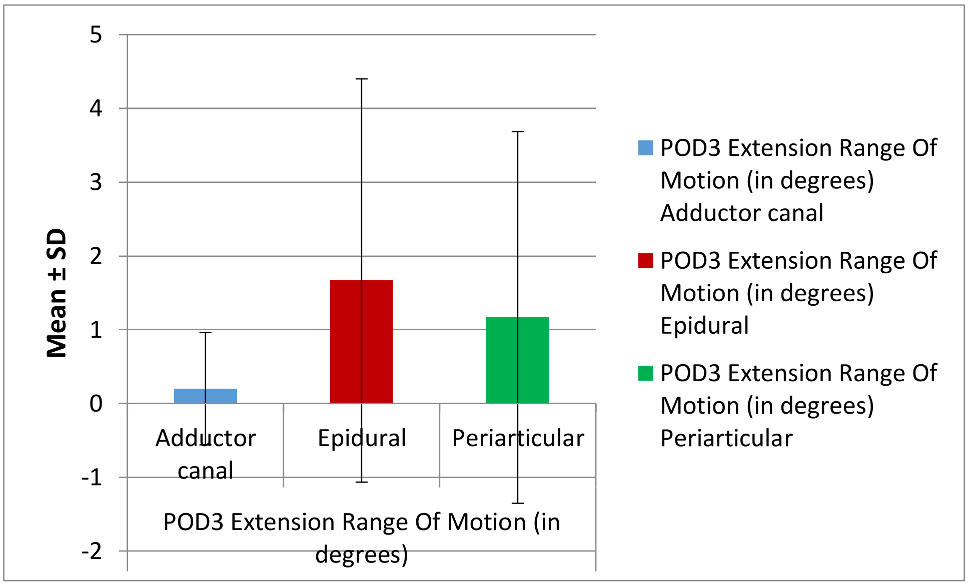


Table 33: Distribution of mean POD3 Extension ROM : Group

		Number	Mean	SD	Minimum	Maximum	Median	p-value
POD3 Extension Range Of Motion (in degrees)	Adductor canal	30	.2000	.7611	0.0000	3.0000	0.0000	0.0353
	Epidural	30	1.6667	2.7334	0.0000	10.0000	0.0000	
	Periarticular	30	1.1667	2.5200	0.0000	10.0000	0.0000	

The mean POD3 Extension ROM (in degrees) (mean± s.d.) of patients in the adductor canal was.2000±.7611.
The POD-3 Extension ROM (in degrees) (mean± standard deviation) of patients receiving epidural was 1.6667± 2.7334.
The mean POD3 Extention ROM (in degrees) (mean± s.d.) of the patients in Periarticular was 1.1667 ± 2.5200.

Distribution of mean POD3 Extention ROM (in degrees) with Group was statistically significant (p= 0.0353).



DISCUSSION

This Prospective Study was conducted for 1 year at Dr Prabhakar Kore Hospital and MRC, Belagavi. Total 90 patients were selected

Group-1- 30 in Adductor canal Group

Group-II- 30 in EpiduralGroup

Group-II- 30 in Periarticular Group

Out of the 90 patients in this study, 40 (44.4%) were between the ages of 61 and 70, yet (p=0.1644), this was statistically invalid.

Chen JY et al [51](2017) It seems like you conducted an analysis of the gender distribution among patients categorized by BMI groups. Here's a breakdown of your findings: - **Total Population**: There were 1421 males and 6312 females in the study population. - **Gender Distribution in BMI Categories**: - In the normal BMI group (< 25.0 kg/m²), there were 60 males and 30 females. - In the obese BMI group (25.0 - 39.9 kg/m²), there were [insert numbers here] males and [insert numbers here] females. - In the morbidly obese BMI group (≥ 40.0 kg/m²), there were [insert numbers here] males and [insert numbers here] females. - **Male-Female Ratio**: The male-female ratio was calculated to be 2:1 overall, but this ratio varied across the BMI categories. - **Statistical Analysis**: A chi-square test was conducted to determine if the observed gender distribution across the BMI categories was statistically significant. The p-value elicited from the test was 0.5488, indicating that there;was no statistically insignificance in gender distribution across the BMI categories.In summary, the study you conducted indicates that although there is a variation in the distribution of gender across the BMI categories, it is not statistically significant.

Most patients in the study had left TKR interventions, with 16 patients (53.3%) in both the Epidural and Periarticular groups, and 15 patients (50.0%) in the Adductor Canal group. However, this difference wasn't statistically significant (p=0.9564).

The age of the Epidural [66.3000 ± 7.6930] was higher than that of the Adductor canal [62.9333 ± 8.7845] and Periarticular [65.2667 ± 7.4275], although the difference was statistically insignificant (p=0.2526).

Sankineani SR et al [52](2018) conducted a study on patients, who received a combination of multimodal periarticular infiltration (MPI) and ACB compared to another group that received a different pain management method.

The ACB + MPI group showed better pain relief based on Visual Analog Scale scores on POD0. Nevertheless, there was no discernible change in pain ratings between the

ACB + MPI group and the control group at the time of discharge. This implies that although ACB + MPI may provide better pain management just after surgery, its benefits gradually wear off. The VAS Score POD0 was of statistically significance (p<0.0001) to be higher in Epidural [8.0000 ±.7428] than in Adductor canal [6.6000 ±.6215] and Periarticular [7.4333 ±.6789].

In our study, VAS Score POD1 was higher in Periarticular [7.1000 ± .9595] compared to Adductor canal [6.3000± .7022] and Epidural [6.8333 ± .9855] but At p = 0.0029, this was statistically significant.

Sardana V et al [57](2019) observed the study revealed that patients in the periarticular infiltration (PAI) group tended to experience lower pain levels, as demonstrated by Visual Analog Scale (VAS) ratings, particularly those obtained 24 and 48 hours following surgery, as compared to the controls. Moreover, the PAI group expreszed significantly reduced overall opioid consumption, highlighting the effectiveness of this approach in managing postoperative pain.but we found that, VAS Score POD2 was higher in Periarticular [6.2333 ± .7279] compared to Adductor canal [5.4333 ± .6789] and Epidural [5.8667 ± 1.0743] but at p-value=0.0019,it was statistically significant.

In comparison to Adductor canal [5.0667 ±.6915] and Epidural [5.0667 ± 1.3629], we observed that Periarticular [5.8000 ±.6103] had a higher VAS Score POD3, although At p = 0.0038, this difference was statistically noteworthy.

Xing Q et al [58](2019) "The meta-analysis revealed significant differences between the groups in terms of opioid use on postoperative days (POD) 0, 1, and 2 after total knee arthroplasty (TKA), as well as pain ratings on the Numeric Rating Scale (NRS) on POD 0. Additionally, in the previously mentioned study, the Adductor Canal group showed a significantly better range of motion in knee flexion on POD 0 compared to the Epidural and Periarticular groups (p=0.0002)".

In POD 0 Extension Range of Motion (in degrees) was higher in Epidural [2.1667 ± 2.8416] compared to Adductor canal [1.0000 ± 2.0342] and Periarticular [1.8333 ± 3.0747] but this was not statisticallysignificant (p=0.2288).

Distribution of mean POD1 Flexion Range of Motion (in degrees) with Group has statistical significance ;(p =0.0330).

Simsek F et al [67](2023) showed "The VAS pain ratings on postoperative days (POD) 1 and 2 did not show significant differences between the groups. Additionally, the variation in the mean extension range of motion on POD 1 within the group was not statistically significant (p = 0.1893).

Simsek F et al [67](2023) showedAt eight hours following surgery, individuals grouped in the ACB + IPACK , scored markedly raised on the visual analog scale (VAS) than those in the control group ($p = 0.038$). VAS ratings were relatively similar between the two groups at postoperative days 1 (POD1) and 2, although POD2 Flexion ROM (in degrees) showed statistical significance with Group ($p <0.0001$)".

The mean POD2 Extension ROM (in degrees) was statistically insignificant across the groups (p=0.1640).
Compared to the ACB group (71.00 ± 13.61) and the Epidural group (71.67 ± 6.34), the Periarticular group had a higher VAS score on postoperative day 0 (79.83 ± 9.78). This difference was statistically noteworthy (p=0.0018).

The POD3 Extension ROM (measured in degrees) in our study was statistically significant (p=0.0353) and was larger in the Epidural [1.6667± 2.7334] than in the ACB [.2000±.7611] and PAI [1.1667 ± 2.5200].

SUMMARY AND CONCLUSION

- Out of 90 patients, the majority were between the ages of 61 and 70, yet this was statistically insignificant. It was discovered that there were more females than males in the populationMen to women made up 2:1 of the population, however this was not statistically significant.

- Compared to the Adductor canal group, our study revealed that the most of patients in the epidural and periarticular groups underwent LEFT TKR Intervention; however, this difference was valid.

- Age was higher in Epidural compared to Adductor canal and Periarticular but this was not statistically significant as per our analysis.

- In contrast to adductor canal and periarticular, we discovered that the VAS Score POD0 in epidural was greater, but this difference was statistically significant.
- In our study, VAS Score POD1 was higher in Periarticular versus Adductor canal and Epidural but this was statistically significant

- We found that, VAS Score POD2 was higher in Periarticular compared to Adductor canal nd Epidural but this was statistically significant

- We found that, VAS Score POD3 was higher in Periarticular compared to Adductor canal and Epidural but this was statistically significant

- In our study, POD 0 Flexion ROM (in degrees) was higher in Adductor canal compared to Epidural and Periarticular but this was statistically significant

- In our study, POD 0 Extension ROM (in degrees) was higher in Epidural compared to Adductor canal and Periarticular but this was not statistically significant

- Distribution of mean POD1 Flexion ROM (in degrees) with Group was statistically significant

- Distribution of mean POD1 Extension ROM (in degrees) with Group was statistically not significant

- Distribution of mean POD2 Flexion ROM (in degrees) with Group was statistically significant
- Distribution of mean POD2 Extension ROM (in degrees) with Group was statistically not significant
- We found that, VAS Score POD0 was higher in Periarticular compared to Adductor canal and Epidural but this was statistically significant
- hereby, POD3 Extension ROM (in degrees) was higher in Epidural compared to Adductor canal and Periarticular but this was statistically significant

In conclusion, this prospective non-randomized study demonstrates that combining an epidural injection with either an ACB or periarticular infiltration significantly improves pain relief and knee ROM after arthroplasty of the knee compared to using an epidural injection alone. The ACB was shown to be somewhat more successful than the other combination strategy in improving early postoperative outcomes. These findings suggest that incorporating regional anesthesia techniques alongside epiduralinjections can be a valuable strategy in optimizing postoperative recovery for patientsundergoing total knee arthroplasty. Further randomized controled trials are warranted to confirm these results and refine pain management protocols in this context.

LIMITATIONS

Acknowledging the limitations of your study is a crucial step in the research process. Here's a creative approach to addressing the shortcomings you've identified:

1. **Small Sample Size**: Transform this limitation into an opportunity for future collaboration. Consider reaching out to other researchers or institutions to form a collaborative network. By pooling resources and data from multiple sources, you can conduct a larger-scale study with greater statistical power.

2. **Single-Center Study**: Embrace the uniqueness of your single-center study by highlighting the advantages it offers. Single-center studies often provide a more controlled environment, allowing for meticulous data collection and standardized procedures. However, to enhance external validity, you could propose a follow-up study that replicates your findings across multiple centers.

3. **Tertiary Care Hospital Bias**: Turn this limitation into a strength by conducting a thorough sensitivity analysis. Explore how variations in hospital characteristics may influence your results. By transparently documenting these potential biases and their impacts, you can provide valuable insights for interpreting your findings.

In your manuscript, consider including a "Limitations and Future Directions" section that showcases your proactive approach to addressing these challenges. By framing limitations as opportunities for growth and collaboration, you demonstrate resilience and a commitment to advancing scientific knowledge.

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ANNEXURE I

PROFORMA

"COMPARATIVE ANALYSIS OF INFLUENCE OF EPIDURAL INJECTION AND ADDUCTOR CANAL BLOCK VERSUS EPIDURAL INJECTION AND PERIARTICULAR INFILTRATION VERSUS EPIDURAL INJECTION ALONE ON PAIN RELIEF AND KNEE RANGE OF MOVEMENTS AFTER TOTAL KNEE ARTHROPLASTY" – A PROSPECTIVE NON-RANDOMISED STUDY.

PATIENT NUMBER-

PATIENT NAME

AGE-

SEX-

ADDRESS-

DOA-

DOD-

PHONE NUMBER-

INTERVENTION-

PAIN RELIEF

VAS SCALE FOR POSTOPERATIVE PAIN

--
----

0 5
10

NO PAIN MODERATE PAIN
SEVERE PAIN

POSTOPERATIVE DAY 0

---

0 5
10

NO PAIN MODERATE PAIN
SEVERE PAIN

POD0 PAIN SCORE-____________

POSTOPERATIVE DAY 1

---

0 5
10

NO PAIN MODERATE PAIN
SEVERE PAIN

POD1 PAIN SCORE-_____________

POSTOPERATIVE DAY 2

____

0 5
10

NO PAIN MODERATE PAIN
SEVERE PAIN

POD2 PAIN SCORE-______________

POSTOPERATIVE DAY 3

____

0 5
10

NO PAIN MODERATE PAIN
SEVERE PAIN

POD3 PAIN SCORE-_______________

RANGE OF MOVEMENT FUNCTIONAL OUTCOME-

RANGE OF MOVEMENTS	POD0	POD1	POD2	POD3
FLEXION				
EXTENSION				

ANNEXURE II

KAHERs JNMC,BELAGAVI

INFORMED CONSENT FORM

"COMPARATIVE ANALYSIS OF INFLUENCE OF EPIDURAL INJECTION AND ADDUCTOR CANAL BLOCK VERSUS EPIDURAL INJECTION AND PERIARTICULAR INFILTRATION VERSUS EPIDURAL INJECTION ALONE ON PAIN RELIEF AND KNEE RANGE OF MOVEMENTS AFTER TOTAL KNEE ARTHROPLASTY" – A PROSPECTIVE NON-RANDOMISED STUDY.

Objective: To compare the influence of epidural injection and adductor canal block versus epidural injection and periarticular infiltration versus epidural injection alone on pain relief and functional outcome of patients quality of life post total knee arthroplasty.

Introduction: Postoperative pain after total knee arthroplasty (TKA) is a significant determinant of early rehabilitation and postoperative recovery in the patient. The last two decades have seen a significant improvement in the management of postoperative pain, with increase in popularity of multimodal analgesia regimens which includeThe use of both regional anesthesia and systemic analgesics. Peripheral nerve Block has been reported to deliver optimal postoperative pain relief and is Increasingly being preferred in patients undergoing orthopedic procedures.Furthermore, multiple studies have endorsed the efficacy of peripheral nerve Block in shortening the time of functional recovery and provide a quality of Analgesia and surgical outcome comparable to intravenous patient-controlled Analgesia (PCA) or epidural analgesia without the associated side effects.Adductor canal block (ACB) and multimodal periarticular infiltrations (MPIs) have become popular because they are able to preserve Quadriceps strength while providing similar postoperative analgesia Comparable to the traditional analgesia regimens. However, isolated ACB does not provide adequate analgesia to the posterior knee,Whereas MPI has a very short duration of analgesic effect leading to less than satisfactory pain relief. We therefore, hypothesized that adductor block plus periarticular cocktail infiltration may be a useful adjunct for early functional recovery and that it provides better postoperative analgesia than adductor block alone.Therefore, the present study aims to investigate and compare the efficacy of ACB alone versus ACB + MPI with respect to postoperative pain control and mobilization ability assessment.

Explanation of procedure:Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled.In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups.However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact: Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension

4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study **"COMPARATIVE ANALYSIS OF INFLUENCE OF EPIDURAL INJECTION AND ADDUCTOR CANAL BLOCK VERSUS EPIDURAL INJECTION AND PERIARTICULAR INFILTRATION VERSUS EPIDURAL INJECTION ALONE ON PAIN RELIEF AND KNEE RANGE OF MOVEMENTS AFTER TOTAL KNEE ARTHROPLASTY "– A PROSPECTIVE NON-RANDOMISED STUDY**. My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE III

LIST OF PICTURES

ANNEXURE IV

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Sl.no	Age	Age in grou	Sex	Group	Intervention	VAS Score POD	VAS Score POD	VAS Score POD	VAS Score POD	D0 Flexion Range Of Motion (in degr	D0 Extension Range Of Motion (in degr	D1 Flexion Range Of Motion (in degr	D1 Extension Range Of Motion (in degr	D2 Flexion Range Of Motion (in degr	D2 Extension Range Of Motion (in degr	D3 Flexion Range Of Motion (in degr	D3 Extension Range Of Motion (in
2	86	42	1.<50	Female	Adductor canal	RIGHT TKR	6	6	5	5	40	0	42	0	50	0	90	0
3	78	48	1.<50	Female	Adductor canal	RIGHT TKR	7	7	5	4	40	0	42	0	45	0	60	0
4	26	49	1.<50	Female	Epidural	RIGHT TKR	9	8	6	5	35	5	45	5	55	5	60	0
5	69	49	1.<50	Female	Adductor canal	RIGHT TKR	7	6	5	4	40	0	45	0	45	0	65	0
6	4	51	2.51-60	Female	Epidural	LEFT TKR	7	4	3	2	40	0	60	0	70	0	75	0
7	80	51	2.51-60	Female	Adductor canal	RIGHT TKR	7	7	6	6	45	0	45	0	55	0	70	0
8	25	52	2.51-60	Female	Epidural	LEFT TKR	8	7	6	5	35	5	45	5	45	5	65	5
9	81	52	2.51-60	Female	Adductor canal	RIGHT TKR	6	5	5	5	40	5	40	5	60	5	95	3
10	3	54	2.51-60	Female	Epidural	RIGHT TKR	7	5	4	3	45	5	55	5	65	0	70	0
11	12	54	2.51-60	Female	Epidural	RIGHT TKR	8	7	6	4	40	10	50	10	70	10	75	10
12	35	54	2.51-60	Female	Periarticular	RIGHT TKR	6	6	5	5	30	0	35	0	45	0	70	0
13	57	54	2.51-60	Female	Periarticular	RIGHT TKR	9	9	7	6	35	5	50	5	65	0	85	0
14	47	57	2.51-60	Female	Periarticular	RIGHT TKR	7	7	6	5	45	0	50	0	65	0	80	0
15	29	60	2.51-60	Female	Epidural	LEFT TKR	8	7	7	6	30	5	40	5	55	5	70	5
16	56	60	2.51-60	Female	Periarticular	RIGHT TKR	8	8	7	6	30	0	50	0	65	0	75	0
17	15	60	2.51-60	Female	Adductor canal	LEFT TKR	6	6	5	4	50	0	52	0	55	0	90	0
18	31	62	3.61-70	Female	Periarticular	RIGHT TKR	7	6	6	6	30	0	40	0	50	0	60	0
19	62	62	3.61-70	Female	Adductor canal	LEFT TKR	7	6	6	5	35	5	35	5	35	5	65	0
20	74	62	3.61-70	Female	Adductor canal	LEFT TKR	7	7	5	4	45	0	45	0	50	0	70	0
21	39	63	3.61-70	Female	Periarticular	RIGHT TKR	7	6	6	5	40	0	40	0	50	0	75	0
22	67	63	3.61-70	Female	Adductor canal	LEFT TKR	7	7	6	6	40	0	42	0	45	0	60	0
23	10	64	3.61-70	Female	Epidural	LEFT TKR	8	7	5	5	30	0	65	0	70	0	80	0
24	11	64	3.61-70	Female	Epidural	RIGHT TKR	7	6	5	4	40	5	45	5	55	5	75	5
25	19	64	3.61-70	Female	Epidural	LEFT TKR	9	8	7	7	30	0	35	0	40	0	65	0
26	43	64	3.61-70	Female	Periarticular	RIGHT TKR	7	7	6	6	35	0	50	0	90	0	95	0
27	53	64	3.61-70	Female	Periarticular	LEFT TKR	7	7	7	6	35	0	40	0	65	0	80	0
28	15	65	3.61-70	Female	Epidural	RIGHT TKR	7	6	6	6	25	0	30	0	40	0	65	0
29	66	65	3.61-70	Female	Adductor canal	RIGHT TKR	6	6	5	5	45	0	46	0	50	0	60	0
30	17	66	3.61-70	Female	Epidural	RIGHT TKR	8	7	7	7	20	5	30	5	45	5	75	5
31	55	66	3.61-70	Female	Periarticular	LEFT TKR	7	5	5	5	30	5	50	5	65	5	80	5
32	85	66	3.61-70	Female	Adductor canal	LEFT TKR	7	6	5	5	40	0	42	0	50	0	90	0
33	38	67	3.61-70	Female	Periarticular	RIGHT TKR	8	8	7	7	30	10	30	10	50	10	80	10
34	40	67	3.61-70	Female	Periarticular	LEFT TKR	7	7	6	5	45	0	50	0	65	0	80	0
35	43	68	3.61-70	Female	Periarticular	RIGHT TKR	8	7	7	6	35	0	40	0	60	0	90	0
36	52	68	3.61-70	Female	Periarticular	LEFT TKR	7	7	6	6	30	5	40	0	70	0	85	0
37	54	68	3.61-70	Female	Periarticular	RIGHT TKR	7	7	6	6	30	10	40	10	60	10	75	5
38	72	68	3.61-70	Female	Adductor canal	LEFT TKR	7	6	6	6	40	0	40	0	40	0	60	0
39	89	68	3.61-70	Female	Adductor canal	Left TKR	7	7	6	5	40	0	42	0	55	0	90	0
40	27	69	3.61-70	Female	Epidural	RIGHT TKR	8	7	6	5	30	5	45	5	60	0	85	0
41	64	69	3.61-70	Female	Adductor canal	RIGHT TKR	8	7	6	5	40	5	40	5	45	5	55	3
42	37	70	3.61-70	Female	Periarticular	LEFT TKR	7	6	6	6	35	5	35	0	50	0	75	0
43	8	71	4.71-80	Female	Epidural	RIGHT TKR	8	7	6	4	30	0	55	0	60	0	75	0
44	9	71	4.71-80	Female	Epidural	LEFT TKR	9	8	8	6	35	0	60	0	65	0	75	0
45	18	71	4.71-80	Female	Epidural	LEFT TKR	8	7	6	6	35	0	40	0	45	0	70	0
46	61	71	4.71-80	Female	Adductor canal	RIGHT TKR	6	6	5	5	30	0	30	0	35	0	60	0
47	2	72	4.71-80	Female	Epidural	RIGHT TKR	7	5	4	2	30	0	45	0	55	0	70	0
48	13	72	4.71-80	Female	Epidural	LEFT TKR	8	7	7	5	30	5	45	5	60	5	75	5
49	21	72	4.71-80	Female	Epidural	RIGHT TKR	8	7	7	7	30	5	45	5	50	5	65	5
50	23	72	4.71-80	Female	Epidural	LEFT TKR	7	6	5	5	30	0	35	0	50	0	75	0
51	24	72	4.71-80	Female	Epidural	LEFT TKR	7	6	5	5	30	0	45	0	50	0	70	0
52	34	72	4.71-80	Female	Periarticular	LEFT TKR	8	7	6	6	20	0	25	0	40	0	65	0
53	46	74	4.71-80	Female	Periarticular	LEFT TKR	7	7	6	6	40	0	45	0	60	0	95	0
54	30	75	4.71-80	Female	Epidural	RIGHT TKR	7	7	6	6	35	5	40	5	55	5	65	5
55	76	75	4.71-80	Female	Adductor canal	RIGHT TKR	7	7	6	6	35	0	30	0	45	0	60	0
56	1	77	4.71-80	Female	Epidural	RIGHT TKR	8	6	5	3	40	0	45	0	55	0	65	0
57	42	77	4.71-80	Female	Periarticular	RIGHT TKR	8	8	7	6	30	5	45	5	60	5	80	5
58	44	77	4.71-80	Female	Periarticular	LEFT TKR	7	7	6	5	40	0	40	0	60	0	85	0
59	50	77	4.71-80	Female	Periarticular	LEFT TKR	7	6	5	5	25	0	45	0	70	0	90	0
60	73	77	4.71-80	Female	Adductor canal	RIGHT TKR	6	6	5	5	40	0	40	0	40	0	60	0
61	79	53	2.51-60	Female	Adductor canal	RIGHT TKR	6	5	4	4	45	0	47	0	55	0	70	0
62	51	51	2.51-60	Male	Periarticular	LEFT TKR	8	8	7	6	20	0	40	0	70	0	90	0
63	45	55	2.51-60	Male	Periarticular	RIGHT TKR	8	8	6	6	35	5	40	5	60	5	80	5
64	82	56	2.51-60	Male	Adductor canal	RIGHT TKR	7	7	6	6	40	0	40	0	55	0	90	0
65	32	56	2.51-60	Male	Periarticular	LEFT TKR	7	7	6	5	20	0	40	0	50	0	65	0
66	48	59	2.51-60	Male	Periarticular	RIGHT TKR	8	8	6	6	30	0	50	0	80	0	95	0
67	90	59	2.51-60	Male	Adductor canal	Left TKR	7	6	5	5	45	0	48	0	60	0	90	0
68	83	60	2.51-60	Male	Adductor canal	LEFT TKR	6	6	6	5	35	0	37	0	45	0	75	0
69	36	61	3.61-70	Male	Periarticular	RIGHT TKR	7	6	6	6	40	0	40	0	50	0	75	0
70	59	62	3.61-70	Male	Periarticular	LEFT TKR	7	7	6	6	35	5	35	5	75	5	80	5

67	50	59	2.51-60	Male	Adductor canal	Left TKR	7	6	5	5	45	0	48	0	60	0	80	0
68	83	60	2.51-60	Male	Adductor canal	LEFT TKR	6	6	6	5	35	0	37	0	45	0	75	0
69	36	61	3.61-70	Male	Periarticular	RIGHT TKR	7	6	6	6	40	0	40	0	50	0	75	0
70	59	62	3.61-70	Male	Periarticular	LEFT TKR	7	7	6	6	35	5	55	5	75	5	80	5
71	70	64	3.61-70	Male	Adductor canal	LEFT TKR	6	5	4	4	40	0	40	0	45	0	60	0
72	7	65	3.61-70	Male	Epidural	LEFT TKR	9	8	6	6	30	0	50	0	65	0	80	0
73	60	65	3.61-70	Male	Periarticular	LEFT TKR	8	8	7	6	30	0	45	0	70	0	75	0
74	77	66	3.61-70	Male	Adductor canal	LEFT TKR	6	6	5	5	30	0	32	0	35	0	55	0
75	87	66	3.61-70	Male	Adductor canal	Left TKR	7	7	6	5	35	0	38	0	45	0	60	0
76	88	66	3.61-70	Male	Adductor canal	Left TKR	6	6	5	5	40	5	42	5	50	0	90	0
77	5	68	3.61-70	Male	Epidural	LEFT TKR	8	7	5	4	45	0	55	0	70	0	75	0
78	22	68	3.61-70	Male	Epidural	RIGHT TKR	8	7	6	5	35	5	40	5	50	5	65	5
79	58	68	3.61-70	Male	Periarticular	LEFT TKR	8	8	7	7	40	0	50	0	80	0	95	0
80	16	69	3.61-70	Male	Epidural	LEFT TKR	8	7	7	7	20	0	35	0	45	0	80	0
81	65	70	3.61-70	Male	Adductor canal	LEFT TKR	6	6	6	6	40	0	42	0	45	0	55	0
82	68	70	3.61-70	Male	Adductor canal	RIGHT TKR	8	8	7	6	35	5	40	3	45	3	60	0
83	14	72	1.71-80	Male	Epidural	LEFT TKR	9	8	6	5	40	0	45	0	55	0	70	0
84	28	72	1.71-80	Male	Epidural	LEFT TKR	9	8	7	6	30	0	40	0	60	0	75	0
85	33	72	1.71-80	Male	Periarticular	LEFT TKR	9	9	8	7	25	0	30	0	45	0	60	0
86	63	75	1.71-80	Male	Adductor canal	RIGHT TKR	6	6	6	6	30	0	32	0	35	0	60	0
87	71	75	1.71-80	Male	Adductor canal	LEFT TKR	6	6	5	5	30	5	30	5	35	0	65	0
88	20	76	1.71-80	Male	Epidural	LEFT TKR	9	8	6	6	35	0	40	0	50	0	60	0
89	41	78	1.71-80	Male	Periarticular	LEFT TKR	7	6	5	5	40	0	45	0	60	0	80	0
90	84	60	2.51-60	Male	Adductor canal	RIGHT TKR	7	7	6	5	40	0	40	0	50	0	80	0
91	6	62	3.61-70	Male	Epidural	RIGHT TKR	9	7	6	5	40	0	55	0	65	0	80	0
92																		