ORIGINAL RESEARCH PAPER

Orthopaedics

FUNCTIONAL OUTCOME AND ROTATIONAL ALINGMENT OF FEMORAL COMPONENT IN UNNAVIGATED TOTAL KNEE ARTHROPLASTY

KEY WORDS:

Dr. M. R. Rajasekar	MBBS, MS(ORTHO), Chennai-40,
Dr. Radhakrishnan P*	MBBS, MS(ORTHO), Chennai- 600085 *Corresponding Author
Dr. Deepika	MBBS, Chennai-20

INTRODUCTION :

Arthritisis a joint disease of painful inflammation resulting in stiffness.This is frequently associated with arthralgia.The forms range from those related to wear and tear of cartilage (such as Osteoarthritis) to those associated with inflammation as a result of overactive immune system (such as in SLE and Rheumatoid arthritis).Arthritis may result as a result of abnormal metabolism(such as in Gout and Pseudogout), infection (such as in Lyme disease).According to an epidemiological study done by Chandra Prakash pal et al ;in 2016,the overall prevalence of knee OA was found to be 28.7%.The associated factors were found to be female gender(prevalence of 31.6%) (p=0.007), obesity(p=0.04), age(p=0.001) and sedentary work

O.A STATUS	PARTICIPANTS	PERCENTAGE
No O.A	3497	71.3
O.A	1412	28.7
Total	4909	100

10OA has a multifactorial etiology and can be considered the factor of an interplay between systemic and local factors. Oldage, femalegender, overweight, kneeinjury, decreased bone density, muscle weakness and joint laxity all play role in the development of OA knee.

The incidence of osteoarthritis is increasing with increase in the ageingpopulation. Osteoarthritis causes pain and loss of movement in the knee joint that leads to difficulty in performing activities of daily living. Medicines cantemporarily relieve the pain in the early stages but they cannot cure the underlying pathology. In most arthritic knees, some degree of instability, deformity, contracture or a combination of these elements, can be found.[1,2,3]

The concept of improving the knee function by modifying the articular surface has received the attention since the 19^{th} century. Though there are many advances in biomedical technology in last 20 years, persons with deranged joints by osteoarthritis find renewed hope after Total Knee Arthroplasty surgical intervention.

The surgical management of Osteoarthritis varies from soft tissue interpositionarthroplasty to surface replacement arthroplasty. In surfacere placementarthroplasty different types of prosthesis were developed to address the complex kinematics of the knee joint.

Various systems are available with specific features regarding the geometry of the components, the degree of conformity of the articulating surface and the anchoring technique. Various implant designs such as cruciate substituting and cruciate retaining prosthesis are available to improve the functional outcome.

The goals of Total Knee Arthroplasty include :

1. Painrelief.
2. Restoration of normal limb alignment.
3. Restoration of the functional range ofmovement.

A successful outcome needs precise surgical technique, sound implant design and kinematics with appropriate materials and compliance of patient withrehabilitation programme.

The use of accurate instrumentation and an coherent understanding of the basic principles inherent to the instruments are necessary to implant reproducibly well-aligned prostheses. Computer-assisted navigation is being hyped by some surgeons to try to improve the reproducibility of component alignment.[4]While performing the Total Knee Arthroplasty, the rotational alignment of femoral and tibial components play a crucial role in determining the functional outcome and in dictating polyethylene wear.[5]Range of motion and stability are the two key factors in the success of total knee arthroplasty. Both features relate intimately to the kinematics of the knee joint.[6-7]

Primary malalignment and inappropriate positioning of the femoral component, in particular may lead to[8]:

1. Patellarmaltracking.
2. Anterior knee pain.
3 Knee Flexioninstability.

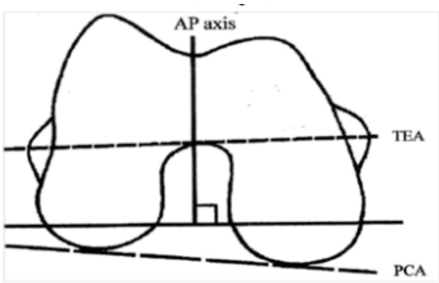
The rotational alignment of the femoral component can be measured post- operatively by :

1. Conventionalradiographs.
2. Axial two-dimensional (2D) CT scan.
3. Axial three-dimensional (3D) reconstructed Ctscan.

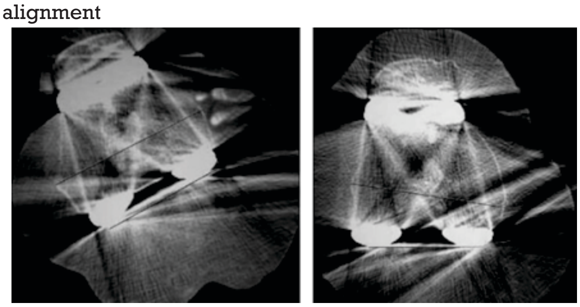
It is measured post-operatively by the angle between transepicondylar axis of femur and posterior condylar line of the prosthesis.[9]

KANEKASU'S RADIOLOGICAL TECHNIQUE TO MEASURE THE ROTATIONAL ALIGNMENT OF THE FEMORAL COMPONENT:

CT SCAN SHOWING THE ROTATIONAL ALIGNMENT OF THE FEMORAL COMPONENT



A schematic diagram showing the posterior condylar axis ,trans epicondylar axis and the anteroposterior axis .the TEA is identified by connecting a line between the epicondylar peaks.The AP axis is identified as a line connecting the deepest portion of the trochlear groove with the midpoint of the posterior intercondylar notch.Then a line perpendicular to the AP axis is drawn as the axis of proper rotational alignment

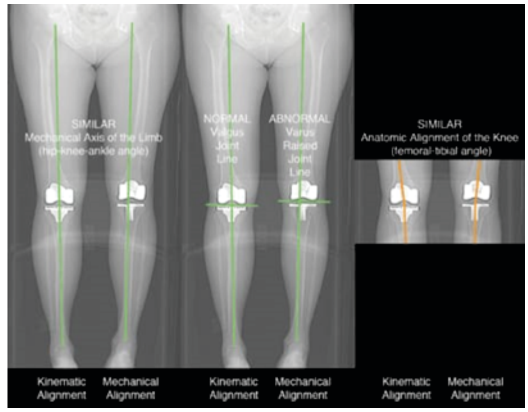


Mechanical alignment considers only the two-dimensional (2D) alignment of the limb and knee in the coronal or frontal plane. Devotees of navigational instruments strive to cut the distal femur perpendicular to a line drawn from the center of the femoral head to the center of the knee the mechanical axis of the femur and cut the proximal tibia perpendicular to a line drawn from the center of the knee to the center oftheankle;the mechanical axis of the tibia. Most surgeons using conventional instruments place an intramedullary rod in the distal femur set at a fixed angle (usually 5° to 6°) to make the distal femoral cut and use an extra-medullary guide to make the 'classic tibial cut' perpendicular to the mechanical axis of the tibia.

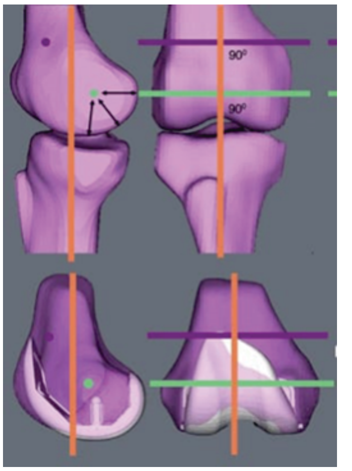
In most patients, mechanically aligning the limb and components to a neutral or 0° hip-knee-ankle angle changes the obliquity and raises the joint line from normal. These changes in the joint line require a compensatory change in the axial rotation of the femoral component to minimize the inevitable imbalance of the collateral and retinacular ligaments. However, placing the femoral component at a different obliquity and level of joint line from normal, alters the patello-femoral and tibio-femoral kinematics, which can cause patello-femoral pain, instability, and loss of motion.

These changes in the joint line result from referencing the center of the femoral head and ankle and are caused by the wide variability and unrelated longitudinal shapes of the femur and tibia in a given limb. The variability and unrelated longitudinal shapes of the femur and tibia explains why only 2% of normal limbs have a 0° hip-knee-ankle angle. Changing the obliquity and level of the joint line from normal often requires releases of the collateral and lateral retinacular ligaments and is believed to lead to increased wear and explain the 18% to 25% prevalence of patients not satisfied with their total knee arthroplasty (TKA)

Kinematic alignment considers the 3D alignment of the components with respect to the knee instead of the 2D alignment of the components with respect to the center of the femoral head and ankle. The intent of kinematic alignment is the restoration of the normal 3D orientation of the three axes that describe normal knee kinematics.



Standing radiographs comparing the mechanical axis (right), joint line (center), and anatomic alignment (right) of bilateral knee replacements performed with kinematic and mechanical alignment.



Recreation of the knee pre- and postoperative :

Demonstrating the three kinematic axes. The orange vertical lines demonstrate the longitudinal axis; the purple horizontal lines represent the transverse axis about which the patella flexes and extends and the green horizontal lines represent the transverse axis about which the tibia flexes and extends.

By definition, the three kinematic axes are a transverse axis in the femur about which the tibia flexes and extends, a transverse axis in the femur about which the patella flexes and extends, and a longitudinal axis in the tibia about which that tibia internally and externally rotates on the femur. The parallel and orthogonal relationships between these three axes do not vary between knees.

In TKA, the two parallel transverse axes in the femur about which the tibia and patella flex and extend are re-established by surface or shape-fitting a femoral component with symmetric, single-radius condyles on the articular surface of the femur after correcting for wear.Intra-operatively, kinematic alignment is performed with patient-specific guides. Kinematic alignment of the femoral component is confirmed when the thickness of the two distal and two posterior bone resections plus the thickness of the wear (typically 1 mm to 2 mm) plus the thickness of the kerf from sawing the bone (typically 1 mm to 1.5 mm) equals the thickness of the femoral component. For a typical varus knee reconstructed with 8 -mm thick distal and posterior femoral condyles on the femoral component, the thickness of the distal medial resection should be 5 mm, the posterior medial resection should be 6 mm, and the distal and posterior lateral resections should be 7 mm. If the femoral component is 10-

mm thick then each bone resection should be 2-mm thicker than the cuts for an 8-mm thick femoral component. For a typical valgus knee, the pattern of the bone resections should be reversed with the thinner resections lateral and the thicker resections medial. Rarely is additional removal of bone from the distal femur required to correct a flexion contracture.

CLINICAL CORRELATION :

Surprisingly, the coronal alignment of the limb ;the hip-knee-ankle angle and the alignment of the knee ; the femoral-tibial angle are the same in kinematically and mechanically aligned TKA. The main difference is in the alignment of the components with respect to the weight-bearing line connecting the centers of the femoral head and ankle. Kinematic alignment restores the obliquity and level of the joint line anatomically so the femoral component is slightly more valgus (1° to 2°) and the tibial component is slightly more varus (1° to 2°) than mechanically aligned components. Mechanically aligning the TKA changes the obliquity and level of joint line from normal requiring a compensatory change in the axial rotation of the femoral component to minimize the inevitable imbalance of the collateral and retinacular ligaments.The alignment of the limb and knee are important for the longevity of the prosthesis.Thekinematic and mechanical alignment methods dictate rates of wear, loosening, and survival.

The functional outcome of Total knee Arthroplasty can be assessed by using the Knee Society Score System. The Knee Society Scoring system is sub-divided into a knee score that rates only the knee joint and a functional score that rates the patient's ability to walk,climb stairs and the need or not of walking aids.This dual rating system eliminates the problem of declining knee scores associated with patient infirmity.[10]This actually aims to correlate the Rotational alignment of the femoral component in TKR and the functional outcome of the knee.

AIM OF THE STUDY

The aim of this prospective study is to analyze the "functional outcome and rotational alignment of the femoral component in conventional Total Knee Arthroplasty" reporting at the Department Of Orthopaedics and Traumatology, Sree Balaji Medical College and Hospital,Chrompet,Chennai.The study shall begin in February 2017 and the recruitment of patients shall continue till January 2018.There shall be a follow-up for a minimum period of 9 months,till October 2018 (Range 9 to 20 months).

MATERIALS AND METHODS

This prospective study was carried out at Sree Balaji Medical College and Hospital, Chrompet from February 2017 to October 2018.The recruitment of patient was for 12 months till January 2018 ; so that there would be a minimum follow-up period of 9 months (range:9 to 20 months).

INCLUSION CRITERIA :

Our patients were selected based upon following criteria

1. Both male and female in the age group of 51 to 70 years were included.
2. Patients with Grade III and Ivosteoarthritis.
3. RheumatoidArthritis.
4. Post-TraumaticArthritis.

EXCLUSION CRITERIA :

1. Patients with Grade I and Iiosteoarthritis.
2. Post-septic arthritissequelae.
3. Any co-morbidity that prevents the patient from earlymobilization.

PRE-OPERATIVE EVALUVATION :

All our patients were evaluated with detailed history and clinical examination. The preoperative medical evaluation was done for all to prevent complications. Perioperative guidelines have not been well- established for the use of DMARDs in rheumatoid arthritis.

The current British Society for Rheumatology guidelines suggest that TNF- inhibitor therapy should be withheld for 2 to 4 weeks prior to any major surgical procedure. Prospective randomized controlled trial by Grennan et al ; suggested that there was no increased risk of infection or other postoperative complications in patients with rheumatoid arthritis who continued MTX. However, in elderly frail patients with comorbidities and some degree of renal impairment, it may be prudent to withhold MTX a week prior to surgery ,as MTX is renallyexcreted.

In the clinical examination, we looked for varus, valgus and fixed flexion deformities. The extensor mechanism was assessed for any quadriceps contracture. We also assessed for any ligmentous instability and laxity. Any limb length discrepancies were noted. The knee function was assessed pre-operatively by using knee societyscore.

Routine pre-operative laboratory evaluations including complete blood cell count, electrolytes, urine analysis, blood grouping, ECG, chest roentgenogram and coagulation studies were done.We obtained opinions from oto-rhino-laryngology, dermatology, dental surgery, and carried out appropriate investigations to rule out the septic foci elsewhere in the body.

RADIOLOGICAL EVALUVATION :

Standard guidelines were utilized to get knee radiographs – weight bearing antero-posterior view, lateral view.The patellar tracking was assessed with tangential patellar view. The mechanical axis and the alignments of both lower limbs were studied by taking the X-rays including the hip, knee andankle.

Angle between mechanical axis of femur and tibia determines the valgus or varus deformity. Any collateral ligament laxity, subluxation of tibia, presence of osteophytes, any bone defects and the quality of bone is assessed. Sizing of the femoral and tibial components was done.

The goal of preoperative radiological evaluation is to :

1. Confirm the diagnosis for surgicalintervention,
2. To determine the anatomical relationship of the femur and tibia, and
3. To restore the joint anatomy andbio-mechanics during the surgery .

SURGICAL PROCEDURE :

POSITION

The patient is placed in supine position on the operating table.Two stoppers were kept on the operating table with one in 30^0 of knee flexion and another one at full available flexion. With strict aseptic precautions, painting and draping of the lower limb was done. Pre operative antibiotics were given just before the skin incision. All cases were done under tourniquet control.

APPROACH :

We used anterior midline approach for the skin. 10 cm incision was made centering the patella and extending up to the tibial tuberosity. Medial parapatellar arthrotomy was done to expose the knee joint. The advantage of using the medial para-patellar approach was to prevent the fibrosis on the lateral retinaculum, which may predispose to the dislocation of the patella. Post operative arthrofibrosis can be prevented by excising the retro-patellar fat pad.

The knee is extended and the patella is everted along with thereleaseofthelateralpatella-femoralplica.

TheanteriorcruciateligamentIs divided along with the anterior horn of the lateral meniscus to facilitate the eversion of thepatella.

In knees with varus deformity there is sequential release of superficial collateral ligament, deep collateral ligament, pes tendons and semi-membranous muscle from the postero-medial corner of tibia. (Fig.27)

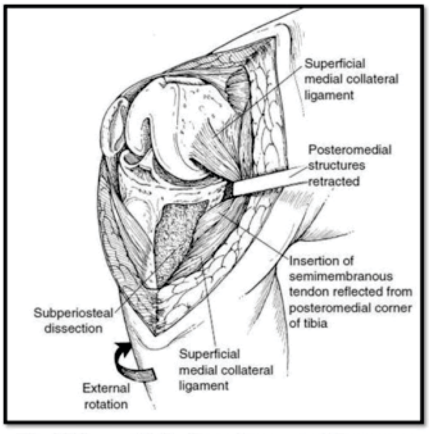


Fig.27.Sequential release to correct the varus deformity.

In knees with valgus deformity, lateral release begins with transverse cutting of the postero-lateral structures (arcuate ligament, posterolateral capsule and reinforcing ligaments) just below the popliteus tendon from the posterolateral corner of the cut surface of the tibia. In severe cases piecrust" release of the iliotibial tract and LCL is performed with a 15 blade by making multiple horizontal incisions in theiliotibial tract. (Fig.27)

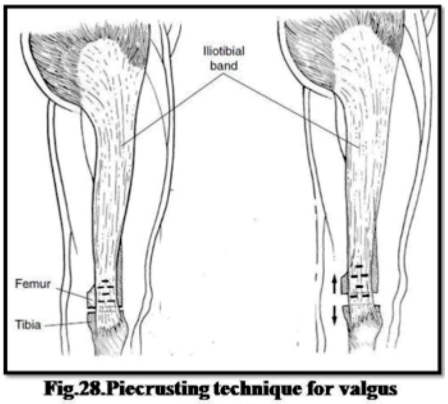


Fig.28.Piecrusting technique for valgus deformity.

The knee is again flexed, the marginal osteophytes removed completely along with the removal of anterior horns of both medial and lateral meniscus. The tibia can now be subluxated anteriorly and externally rotated. The patellar fat pad is partially excised and the everted extensor mechanism is retracted with a levering-type of retractor to expose the lateral tibial plateau.

FEMORAL PREPARATION :

Femoral preparation is done using intra-medullary alignment jig. The Whiteside line and Trans-epicondylar line was made over the femoral condyles after exposing the condyles. The vertical line cutting through the middle of distalfemoral sulcusis the white side line. The horizontal line linking the medial and lateralepicondyle is the Trans- epicondylarline. Atthe intersection between these two lines, the starter hole is created. With the help of 9.5mm diameter drill bit, medullary canal was opened.

Intra-medullary jig was introduced in to the femur along with the valgus alignment guide with the pre-determined external rotation of three degrees. The distal resection guide was assembled and standard resection was done, which provides a 9mm distal femoral cut. The distal femoral cut should be perpendicular to the mechanical axis of the femur. After ensuring that the resection block is flushed against the femur, anterior and posterior chamfer cuts are made. We have used both cruciate retaining and cruciate substituting prosthesis. For cruciate substituting prosthesis intercondylar box cut was made to accommodate the post and cam mechanism.

TIBIAL PREPARATION :

The extra-medullary tibial guide was assembled composing of the cross head with pin, resection guide and ankle yoke. The tibial is guide fixed in such a way, which provides the tibial cut perpendicular to the mechanical axis with slight posterior angulation. The resection slot is attached proximally and flushed to the tibial condyle just below the articular surface. The stylus was used to check the tibial cut, with 2mm on the defective side or 10mm on the normal side as a reference. The tibialcutwas completed by using the osteotome to prevent the popliteal artery injury.

LIGAMENTOUS BALANCING :

The flexion and extension gaps are checked by using the spacer blocks. The varus and valgus instability were corrected with medial and lateral release. The osteophytes that tent the collateral ligaments and the capsule are removed completely. The flexion and extension gaps should be rectangular and equal.

The tight extension gap can limit the extension, which can be corrected by removing the excess bone from the distal femoral cut or by the release of the posterior capsule. Similarly, the tight flexion gap can limit the post operative flexion, which can be corrected by removing the excess bone from the posterior condyle of the femur. In cases where the flexion and extension gaps are equal but the space is not enough for the prosthesis, the excess bone is removed from the tibia. Since, the tibial cut affects the flexion and extension gapsequally.

The limb alignment is then checked by using the alignment rod. Normally it should pass through the handle from the second toe to the anterior superior iliac spine. The tibial trial base is then placed at medial oneto avoid the medial overhanging. The entry hole for the tibial stem is marked and drilled with the oversized reamer. The tibial punch is designed to engage its rim with the tibial trial base and has the marking to indicate the depth to which it should be impacted. After satisfactory reduction, the patella was denervated circumferentially using the electrocautry.

COMPONENT IMPLANTATION

The trial prosthesis for tibia and femur is fixed with the articular insert, the ligamentous balancing and patellar tracking is assessed. The trial components are removed and bony ends are cleaned with saline. The tibial tray is implanted first with the bone cement. Excess cement is removed from the periphery of the component.

The femoral component is cemented in a similar fashion with a few additional considerations. Usually, all components are cemented simultaneously with one batch (40 g) of cement. The press fit articular insert is then fixed to the tibial tray.

Tourniquet is then released. Complete hemostasis achieved. Wound wash isgiven.Woundis then closed in layers with the knee in 30 to 40 degrees of flexion with suction drain. Sterile dressing is done.The average tourniquet time was 1 hr and 50 minutes with average blood loss of 180ml.

POST-OPERATIVE PROTOCOL :

In the immediate post operative period compression bandage was applied. Intravenous antibiotics were given for 48 to 72 hours. Epidural analgesia is continued for 48 hours post operatively. Subcutaneous low molecular weight heparin was given as DVT prophylaxis.

On day of surgery, patient was started on CPM in the recovery room for at least 4 hours. A towel roll is placed under the ankle once the CPM is stopped.

POD1, Increase the CPM by 10^{0}, Static quadriceps strengthening exercise were taught, Patient was ambulated using standard walker with toe touchwalking.

POD 2, the dressing along with drainage tube was removed and wound inspected. Continuous Passive Motion was continued and full weight bearing was allowed with walker.

POD 4, patient was taught dynamic quadriceps exercises and active knee flexion up to 90^{0}.

Patient continues supervised physiotherapy till discharge and sutures were removed on POD 12.Patient were advised to increase the active knee flexion to attain full range of knee movement by the end of 6 weeks and allowed stairs climbing at the end of one month.

FOLLOW UP :

Patients were followed up with post-operative CT scan to assess the rotational alignment of the femoral component using the trans-epicondylar axis and posterior-condylar line of the femoral component and followed up clinically and functionally at 3 months, 6 months and 1 year using the Knee Society Score.

Patients were analyzed with 3mm CT (Siemens Somatom volume zoom, 4 slice detector) at 2 weeks of follow up. CT images were obtained in a leg holder to minimize the motion of the lower extremity. The scan direction was aligned at 90° to the tibial axis. A slice in which both lateral and medial epicondyles were clearly visualized was chosen for measurements.

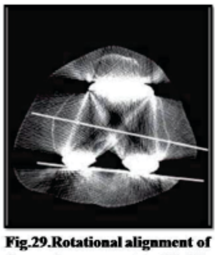


Fig.29.Rotational alignment of femoral component in 2D-CT.

OBSERVATION AND RESULTS :

AGE AND SEX DISTRIBUTION :

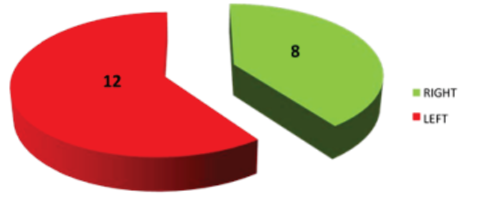
Our patients were in the age group of51 to 70 years with an average of 61.6years. Most of our patients were between 61 to 65 years

AGE IN YEARS	SEX		TOTAL PATIENTS "n"
	MALE	FEMALE	
51-55	1	2	3
56-60	2	3	5
61-65	3	5	8
66-70	2	2	4
TOTAL	8	12	20

SIDE DISTRIBUTION :

In our series left side was more commonly operated upon.Left to Right ratio was 3:2.

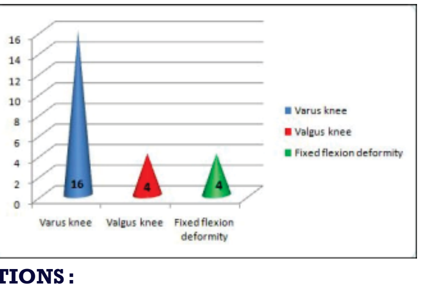
SIDE	FREQUENCY
RIGHT	8(40%)
LEFT	12(60%)
TOTAL	20(100%)



DEFORMITY :

In our study 80% of cases had varus deformity, 20% had valgus deformity and 20% had fixed flexion deformity.

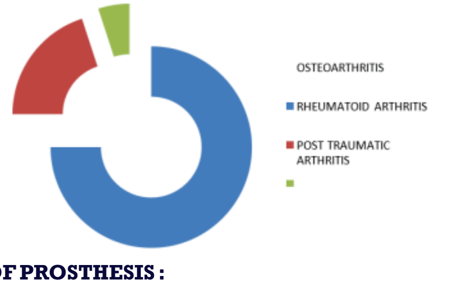
DEFORMITY OF KNEE	FREQUENCY'n'(%age)
VARUS KNEE	16(80%)
VALGUS KNEE	4(20%)
FIXED FLEXION DEFORMITY	4(20%)



INDICATIONS :

Osteoarthritis was the most common indication in our series ,followed by Rheumatoid arthritis and post- traumaticarthritis

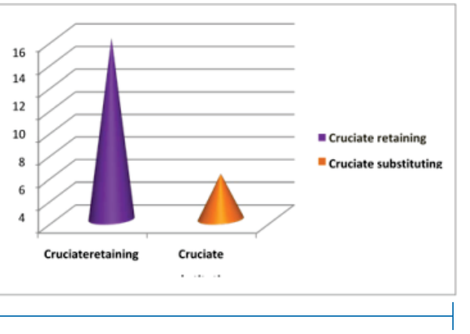
INDICATION FOR TKR	NO OF PATIENTS "n"	%age
OSTEOARTHRITIS	15	75
RHEUMATIOD ARTHRITIS	4	20
POST TRAUMATIC ARTHRITIS	1	5



TYPE OF PROSTHESIS :

Cruciate retaining prosthesis were more commonly than cruciate substituting prosthesis.

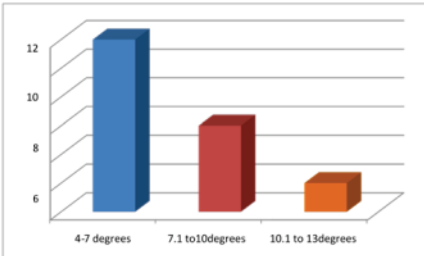
TYPE OF TKR PROSTHESIS USED	NO: OF PATIENTS "n"	%age
CRUCIATE RETAINING	16	80
CRUCIATE SUBSTITUTING	4	20



Volume-8 | Issue-7 | July-2019 | PRINT ISSN No. 2250 - 1991

ROTATIONAL ALIGNMENT OF THE FEMORAL COMPONENT:

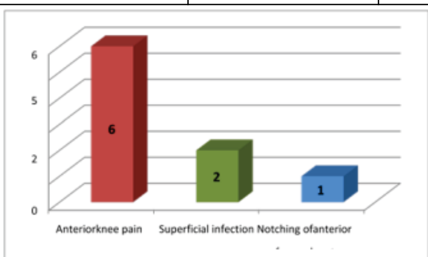
ROTATIONAL ALIGNMENT OF THE FEMORAL COMPONENT IN EXTERNAL ROTATION	FREQUENCY "n"	%age
4 -7 degrees	12	60
7.1 -10 degrees	6	30
10.1 -13degrees	2	10



COMPLICATIONS:

In our study knee pain was encountered in 30 % of cases (n=6), superficial infection in 10 % of cases (n=2) and notching of anterior femoral cortex in 5 % ofcases (n=1).

COMPLICATIONS	FREQUENCY "n"	%age
Anterior knee pain	6	30
Superficial infection	2	10
Notching of anterior femoral cortex	1	5



KNEE CLINICAL SCORE:

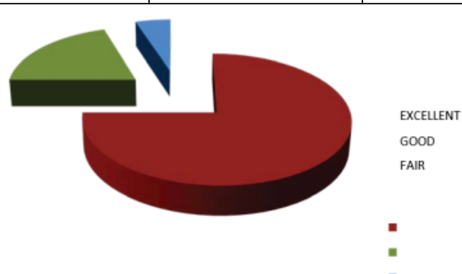
Status	'n'	Mean	Median	Mode	Standard Deviation	Minimum	Maximum
Pre-op	20	27.15	28	28	7.45	14	38
Post-op	20	91.6	92	98	7.34	75	99

Theaveragepre-operative Knee Clinical Scorewas 27.15 inourstudy, which improved to an average post-opscoreof 91.6.

Grading of knee clinical score:

According to the Knee Society Clinical scoring system out of 20 patients, 75% patients (n=15) had excellent results,20%patients (n=4) had good results and 5%patient (n=1) had fairresults.

	FREQUENCY	PERCENT
EXCELLENT	15	75
GOOD	4	20
FAIR	1	5
TOTAL	20	100



KNEE FUNCTIONAL SCORE:

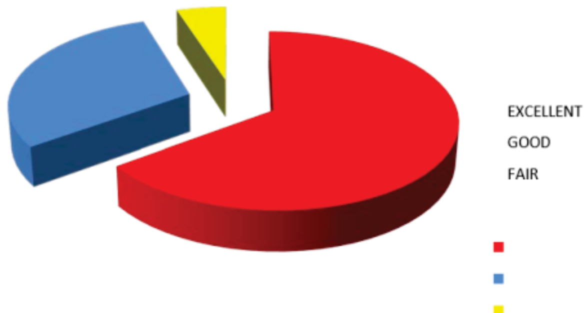
Status	"n"	Mean	Median	Mode	Standard Deviation	Minimum	Maximum
Pre-op	20	37.25	45	45	11.5	20	50
Post-op	20	86	90	90	5.98	70	90

The average pre- operative Knee Functional Score was 37.25 in our study, which improved to an average post op score of 86.

Grading of knee functional score:

According to the Knee Society Functional Scoring system out of 20 patients,65% patients (n=13) had excellent results,30% patients(n=6) had good results and 5% patient (n=1) had fair results.

	FREQUENCY	PERCENT
EXCELLENT	13	65
GOOD	6	30
FAIR	1	5
TOTAL	20	100



KNEE CLINICAL SCORE AND KNEE FUNCTIONAL SCORE CROSS-TABULATION

	Knee Functional Score			
Knee Clinical Score	Excellent	Good	Fair	Total
Excellent	13	2		15
Good		4		4
Fair			1	1
%age	65	30	5	100

Out of the 15 patients who had Excellent Knee Clinical Scores, 13 patients (86.5%) had Excellent Knee Functional Scores, 2 patients (13.5%) had Good Knee Functional Scores.

Out of the 4 patients who had good Knee Clinical Scores, 4 patients (100%) had Good Knee Functional Scores.Out of 1 patient who had fair knee clinical score also had a fair knee functional score (100%).

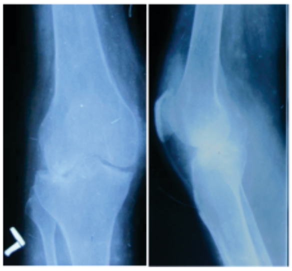
COMPARISON BETWEEN PRE-OP AND POST-OP KNEE CLINICAL AND FUNCTIONAL SCORES:

INDICATORS	PAIRED DIFFERENCE		T	df	'P' Value
	MEAN	STANDARD DEVIATION			
Pre –OP KCS – Post OP KCS	64.45	7.31	39.436	19	<0.001
Pre- OP KFS – Post –OP KFS	48.75	11.3	19.224	19	<0.001

The difference between the mean's of pre – op KCS and post – op KCS was 64.45 (67.87 to 61.03, 95% CI). The P value was significant (<0.001) when the pre – op and post – op Knee Clinical Scores were compared.

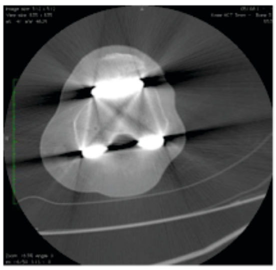
The difference between the mean's of pre – op KFS and post – op KFS was 48.75 (54.06 to 43.44, 95%CI). The P value was significant (<0.001) when the pre - op and post – op Knee Functional Scores were compared.

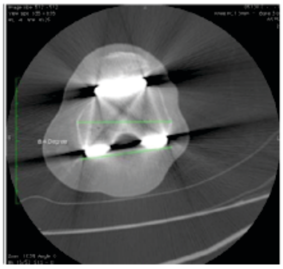
CASE ILLUSTRATION : 1.



PRE-OPX-RAY.

POST OPX-RAY.





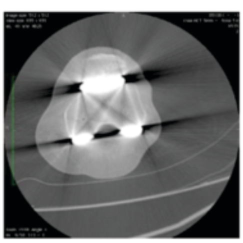
ROTATIONAL ALIGNMENT OF THE FEMORAL COMPONENT.

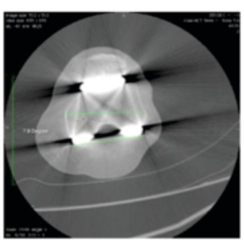
FUNCTIONAL OUTCOME AT ONE YEAR FOLLOW

CASEILLUSTRATION : 2.

PRE OPX-RAY.

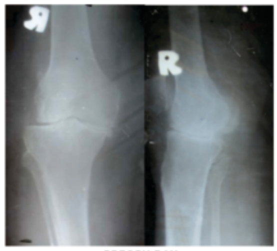
POST OP X-RAY.



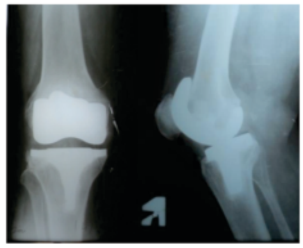


ROTATIONAL ALIGNMENT OF FEMORAL COMPONENT.

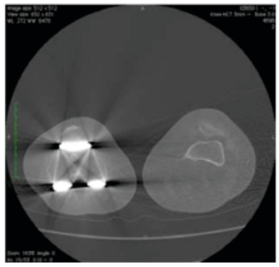
CASEILLUSTRATION : 3 .

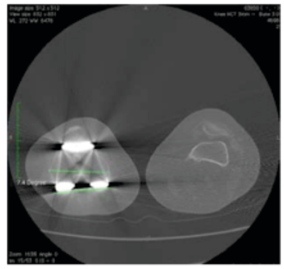


PREOPX-RAY.



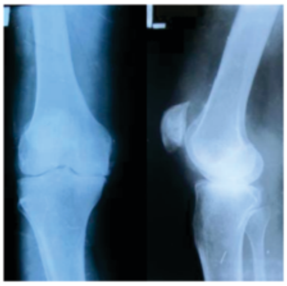
POST OPX-RAY.





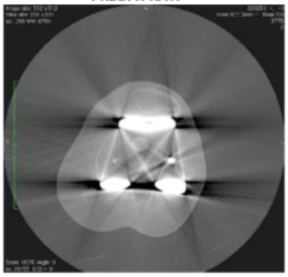
ROTATIONAL ALIGNMENT OF FEMORAL COMPONENT.

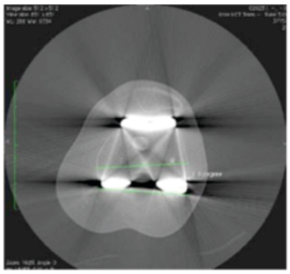
CASEILLUSTRATION :4.



PREOPX-RAY.

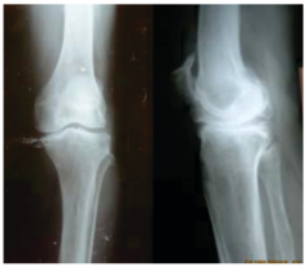
POST OP X-RAY.





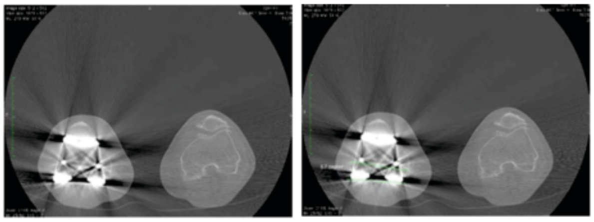
ROTATIONAL ALIGNMENT OF FEMORALCOMPONENT.

CASE ILLUSTRATION :5.



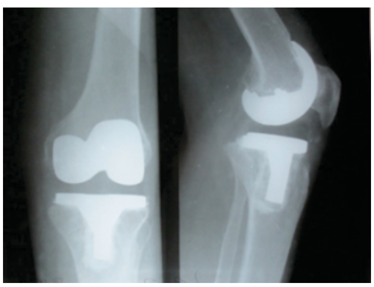
PREOPX-RAY.

POST OPX-RAY.



ROTATIONAL ALIGNMENT OF FEMORAL COMPONENT.

COMPLICATIONS :



NOTCHING OF ANTERIOR FEMORAL CORTEX.

SUPERFICIAL INFECTION

DISCUSSION

Total Knee Arthroplasty done for patients suffering with arthritic knee provides the patient with considerable medium to long term benefits in terms of the quality of life (QOL),pain relief and function.

In most arthritic knees, some degree of instability, deformity, contracture or a combination of these elements, can be found.[44-46] The common causes of arthritis of the knee include osteoarthritis (OA), rheumatoid arthritis (RA), juvenile rheumatoid arthritis(JRA), post traumatic arthritis or secondary osteoarthritis and other types of inflammatory arthritis.Osteoarthritis (OA) is a chronic degenerative joint disease and a major cause of disability in the elderly people.[47] The rapid increase in the prevalence of this disease with increase in human logitivity suggests that OA already has and will continue to have a growing impact on health care and public health systems in the near future.[48]

The concept of improving knee joint function by modifying the articular surfaces has received attention since the 19th century.The surgical techniques had varied from soft tissue interposition arthroplasty to resection arthroplasty to surface replacement arthroplasty. In surface replacement arthroplasty different types of prosthesis were developed to address the complex knee kinematics.

Total knee arthroplasty (TKA) is now a reliable treatment for severe arthritis. Various systems are available with specific features regarding the geometry of the components, the degree of conformity of the articulating surface and the anchoring technique. Total joint replacement (TJR) for the management of OA is considered to be one of the most cost-effective operations performed, with well-documented improvements in patient benefits, reducing pain and improving physical function.[49-53]

Significant advances have occurred in the type and quality of the metals, polyethylene, and more recently in the ceramics used in the prosthesis manufacturing process, leading to improved prosthesis longevity. As with most techniques in modern medicine, more and more patients are receiving the benefits of total knee arthroplasty (TKA).[54-55] These advances in the knee implant design and the surgical techniques for total knee replacement achieved successful results in reducing the pain and providing with a stable joint.

Certainly,total knee replacement (TKR) is recommended for people with osteoarthritis for whom less invasive treatments (such as physiotherapy, analgesics, anti-inflammatory drugs, intra-articular steroids, hyaluronic acids, and arthroscopic surgery) have failed.

The selection of prosthesis for each patient depends on the anatomical status of the knee joint. The functional outcome following Total knee Arthroplasty depends upon various parameters including the surgical technique, soft tissue balancing, near anatomical rotational alignment of the femoral and tibial components, and cementation of theprosthesis.

Definition of ligament balancing :
Correct ligament balancing results in a "balanced knee." A balanced knee comprises the following characteristics[56-60]:

A full range of movement.

Symmetrical medial-lateral balance at full extension and 90 degrees of flexion resulting in a rectangular tibio-femoral gap.

Correct valgus/varus alignment in both flexion and extension.

Balanced flexion-extension gap without medial-lateral tightness or laxity.

A well-tracking patella during full motion.

Maximal flexion occurring with the patella reduced and without excessive roll-back of the femur on the tibia.

Correct rotational balance between the tibial and femoral components.

Purpose of ligament balancing:

The arthritic process leading to a total knee replacement causes joint deformity and osteophytes. This joint deformity can cause both irreversible ligament shortening on the collapsed side and elongated ligaments on the convex side. Osteophytes can cause tightness by tenting the ligaments resulting in restriction of movement and flexion contractures.[61] Ligament balancing attempts to counter these changes. This is achieved usually by removing osteophytes and lengthening and dissecting the tight ligaments in a sequence. Tightening lax ligaments, albeit more difficult and rarely used, also can play a role.[62,63]

Advantages of ligament balancing :

A balanced knee has many post-operative advantages, and this is supported by the literature,[61-63] although randomized control studies of ligament balancing are limited.

Alignment :

Ligament balancing has been shown to be important in producing better limb alignment.[64] A series of normally aligned knees that went on to develop early medial insert wear progressing to varus malalignment pointed toward inadequate medial compartment ligament balancing as a possible cause.[67] In addition, not fully balancing a valgus knee can result in the medial collateral ligaments remaining lax. As these do not tighten over time, the knee can revert to a valgus deformity.[68]Patello-femoral joint mechanics also rely on correct alignment.[69] Malalignment may result in lateral tracking and tilting of the patella and, rarely, patellar dislocation if severe.[70] Correct alignment can help prevent component loosening,[71] improve tibio-femoral kinematics,[72] and decrease shear forces.[73] Ligament balancing leading to correct alignment can prevent late instability[74] and prosthetic failure.[64]

Stability :

Ligament balancing is a recognized key determinant of post-operative stability,[73-75] and has been described as a possible preventable cause of the 27% of early knee revisions owing to instability.[76] Instability and malalignment at the time of the operation are recognized as preventable causes for a revision.[76,77]Ligament incompetence can cause both early and late instability if not accounted for by using an appropriate prosthesis.[73] The role of ligament balancing in stability is even more pertinent with cruciate retaining prostheses. In such knees, an excessive flexion gap and late failure of the posterior cruciate ligament (PCL) is an often unrecognized cause of flexion instability.[78] With posterior stabilizing knee prostheses, a lax collateral ligament can cause a loose and asymmetrical flexion gap leading to flexion instability. Recurrent dislocations can occur as a result.[68] An aggressive ligament release has been noted to be a risk factor for instability; but fear of creating instability leading to under-correction of a fixed angular deformity can cause an asymmetrical extension instability.[68]

Prosthetic wear :

Prosthetic wear and ligament balancing are linked intrinsically. In one study looking at polyethylene wear at revision, 12 of 14 knees with asymmetrical wear lacked ligament release during the index case.[79] Ligament imbalance leading to malalignment is a likely risk factor for increased wear.[65,67,80,81]Abnormal wear can be attributed to a tight PCL leading to increased loading.Wear can lead to osteolysis and prosthesis loosening owing to the production of debris.[82]

FEMORAL ROTATION :

To achieve the required rectangular flexion gap, femoral rotation must be considered while balancing the knee. Incorrect femoral rotations can result in a trapezoidal flexion gap, which can lead to patello-femoral tracking problems,[63,97]instability, dysfunctional overall biomechanics,[69,71,98-100]and anterior knee pain.[83] To achieve correct femoral rotation, two methods have been devised.[97] The first relies on the tibial cut being performed prior to the femoral cut. This method, termed the "classic method," relies on a tensed knee in flexion post-ligament balancing in extension, followed by an anteroposterior (AP) cut of the femur parallel to the cut surface of the tibia.[65,101] This method is especially useful for more severely malalignedknees as it adjusts for changes in laxity that occur post-ligament balancing and compensates for unexpected bone loss.[97] In a number of studies it has been shown to be a highly accurate method of determining rotation and producing a rectangular flexion-extension gap.[83,102]

The second method relies on osseous landmarks.This method has become popular as the majority of implant manufacturers base their AP cuts on these landmarks.[97] Three separate bony landmarks have been identified to aid with defining rotation. These include:

The posterior condylar axis, using a neutral or three degrees of external rotation cut.[103]

The epicondylar axis, using a parallel cut.[104]

Whiteside's line or the transverse axis of the femoral component, with the cut being made perpendicular to the line passing through the trochlear groove from the lateral edge of the PCL .[61,105]

VALGUS KNEE LIGAMENT BALANCING TECHNIQUES

Tight in flexion	Tight in extension	Tight in both		Pie-crusting technique	ar.
Popliteal tendon. LCL. Posterolateral capsule.	Iliotibial band. Posterolateral capsule.	Popliteus tendon. LCL. Posterolateral capsule. Balance in flexion. If still tight in extension then release iliotibial band.	Tightest structure first (usually the LCL, sometimes iliotibial band). Popliteal tendon. Posterolateral capsule. Gastrocnemius muscle. Iliotibial band. Reconstruct MCL.	Posterolateral capsule. Horizontal stab incisions laterally: usually beginning at iliotibial band then other tight structures.	Iliotibial band. Posterolateral capsule. Popliteal tendon. LCL.

[i] LCL, lateral colateral ligament; MCL, medial collateral ligament.

CONCLUSION :

Total Knee Arthroplasty improves the functional ability of the patient and the ability of the patient to get back to pre-disease state, which is to have a pain free mobile joint, as reflected by the improvement in the post-op Knee Clinical Score and Knee Functional Score.

There was significant association between the Knee Clinical Score and Knee Functional score.

It is possible to achieve the rotational alignment of the components correctly in unnavigated Total Knee Replacement with appropriate surgical techniques, so that the complications due to malalignment of the components can be avoided.

— Male, **F**-Female, **R**-Right, **L**-Left, **OA**- Osteoarthritis, **RA**-Rheumatoid arthritis, **CR**- Cruciate retaining, **CS**- Cruciate substituting, **KCS**- Knee Clinical Score, **KFS**-Knee Functional Score, **E**- Excellent, **G**-Good, **F**-Fair

S. No	Name	Age	Sex	Side	Indication	Knee Society Score				Type of prosthesis	Rotational alignment of Femoral component in external rotation (degrees)	Complication	Results	
						Pre Op		Post Op					KCS	KFS
						KCS	KFS	KCS	KFS					
1	K1	51	M	R	RA	36	30	97	90	CS	4.8	Anterior knee pain	(E)	(E)
2	G1	61	M	R	RA	34	50	90	90	CR	4.8	-	(E)	(E)

3	S1	58	F	L	OA	32	45	92	80	CS	7.2	-	(G)	(G)
4	M1	61	F	L	RA	26	45	97	90	CR	4.6	Anterior knee pain	(E)	(E)
5	K2	65	F	L	OA	14	20	80	70	CR	5.2	Superficial infection	(G)	(E)
6	J1	59	M	R	RA	28	30	98	90	CR	6.1	-	(E)	(E)
7	P1	62	F	L	OA	36	45	92	90	CS	5.4	-	(E)	(E)
8	M2	65	M	L	OA	22	45	90	90	CR	9.4	Anterior knee pain	(E)	(E)
9	F1	58	F	R	OA	31	30	80	80	CR	7.4	-	(E)	(E)
10	L1	62	F	L	OA	29	45	98	90	CR	8.1	Anterior knee pain	(E)	(E)
11	R1	52	F	L	OA	17	30	80	80	CR	6.8	-	(G)	(G)
12	P2	55	F	R	OA	28	50	97	90	CS	4.6	-	(E)	(E)
13	D1	66	M	L	PostTrau matic	26	20	99	90	CR	8.4	-	(E)	(E)
14	N1	69	M	R	OA	17	45	92	90	CR	7.8	Anterior knee pain	(E)	(E)
15	J2	56	F	L	OA	38	50	90	80	CR	4.3	-	(E)	(G)
16	S2	58	M	L	OA	28	50	98	90	CR	4.6	Superficial infection	(E)	(E)
17	M3	70	F	L	RA	26	45	92	80	CR	5	-	(E)	(G)
18	S3	63	M	L	OA	37	30	98	90	CR	6.4	-	(E)	(E)
19	K3	67	F	R	OA	14	20	75	80	CR	10.4	Femoral notching	(F)	(G)
20	D2	63	F	R	OA	24	20	97	90	CR	11	Anterior knee pain	(E)	(E)

REFERENCES

1. Vail TP, Lang JE. Insall and Scott surgery of the knee.4thed.Philadelphia: Churchill Livingstone,Elsevier;2006.p.1455-1521.
2. Insall J, Ranawat CS, Scott WN, Walker P. Total condylar knee replacement. Preliminary report. Clin OrthopRelat Res 1976;120:149-54.
3. Kim RH, Scott WN. Operative techniques: total knee replacement. Philadelphia:Saunders-Elsevier;2009.p.91-103.
4. Y.H.Kim, J.S.Kim, S.H.Yoon, from EwhaWomans University School of Medicine, Soeul, Korea, Alignment and Orientation of the Components in Total Knee Replacement with and without Navigation Support. J Bone Joint Surg [Br]Vol. 89-B,No.4,April2007.
5. Sharkey PF, Hozack WJ, Rothman RH, Shastri S, Jacoby SM. Insall Award paper. Why are total knee arthroplasties failing today? Clin OrthopRelat Res2002;(404):7-13.
6. Cloutier JM, Sabouret P, Deghrar A. Total knee arthroplasty with retention of both cruciate ligaments: a nine to eleven-year follow-up study. J Bone Joint Surg Am.1999;81:697–702.
7. LaPrade RF, Ly TV, Wentorf FA et al: The posterolateral attachments oftheknee:aqualitativeandquantitativemorphologic analysis of the bularcollateralligament, popliteus tendon.and lateral gastrocnemius tendon. Am.J.Sports Med.2003;854 860.
8. Banks SA, Fregly BJ, Boniforti F, Reinschmidt C, Romagnoli S. Comparing in vivo kinematics of unicondylar and bi-unicondylar knee replacements. Knee Surg Sports TraumatolArthrosc. 2005;13:551–556.
9. Berger RA, Rubash HE, Seel MJ, Thompson WH, Crossett LS. Determining The rotational alignment of the femoral component in total knee arthroplasty using the epicondylar axis. Clin OrthopRelat Res1993;286:40-7.
10. JohnNInsall,LawrenceDDorr,RichardDScott,W.NormanScott.Rationale of The Knee Society Clinical Rating System. Clin Orthop 1989 Nov 14-18.
11. Kim RH, Scott WN. Operative techniques: total kneereplacement. Philadelphia:Saunders-Elsevier;2009.p.91-103.
12. Campbell WC. Interposition of vitallium plates in arthroplasty of the knee: preliminary report. Am J Surg1940;47:639.
13. Walldius B. Arthroplasty of the knee joint using endoprosthesis. Acta OrthopScand1957;24:19.
14. MacIntosh DL. Arthroplasty of the knee. J Bone Joint Surg 1966;48:179.