ASSESSMENT OF KNEE DEFORMITIES IN OSTEOARTHRITIS IN INDIAN POPULATION UNDERGOING TOTAL KNEE ARTHROPLASTY

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Abstract

Osteoarthritis has a multifactorial etiology. It may be primary (idiopathic) or secondary to trauma, infiltrative disease, or connective tissue disease. Age, obesity, trauma, female gender, labour activities, heavy sports are the risk factors for OA. The risk of developing osteoarthritis increases with each decade after 45 years of age. 500 patients were diagnosed with knee OA (Osteoarthritis) were included in the study. The study includes all patients who underwent total knee arthroplasty, who have fulfilled the inclusion criteria. Preoperative long leg standing radiographs (Scannogram) by CR (computed Radiography) technique were taken for each patient. A statistically significant difference between the mean age of male and female patients when they opt to undergo total knee arthroplasty ($P<0.05$). Females were affected by osteoarthritis at a comparatively younger age than males.

Keywords

Varus deformity, Total knee arthroplasty, osteoarthritis, Scannogram, Computed radiography based scanography

Introduction

Osteoarthritis is a degenerative condition of joints characterized by progressive softening and disintegration of articular cartilage accompanied by the new bone formation in form of osteophytes. The term osteoarthritis comes from three Greek words which means bone, joint, and inflammation. The risk of developing osteoarthritis increases with each decade after 45 years of age.[1]

Being the most prevalent form of arthritis in the Indian population, osteoarthritis affects more than 15 million adults yearly. In the last few decades, more and more Indians in the age- group of 30 to 50 years are getting diagnosed to have osteoarthritis of the knees. By the year 2025, India is likely to notice the endemic of osteoarthritis in the elderly population above the age of 65, with almost 80 % of

them suffering from wear and tear effects in their joints. And 40 % of these patients are likely to suffer from severe osteoarthritis of the knees, which will disable them from performing activities of daily living and occupational activities. The increasing longevity of the Indian population may be the reason behind the onset of such an epidemic of osteoarthritis in India.

Osteoarthritis affects both weight-bearing and non-weight bearing joints. Among all the reported sites for OA in upper and lower limbs, the most common region involved is the medial compartment of the knee joint. Aetiological factors involved in knee OA development include mechanical, structural, genetic, and environmental factors.

Acute or chronic insults, including degenerative wear and tear, old age, obesity, and joint injury lead to an imbalance between matrix synthesis and matrix degradation in healthy cartilage. Ultimately it promotes chondral loss and prevents cartilage self-repair mechanism.

Femoral and tibial condyles are normally covered by 0.5 – 1 cm thick articular cartilage which acts as a shock absorber. In osteoarthritis first, wear and tear occur in cartilage leading to erosion of cartilage in load bearing areas[2]. Thus degradation of cartilage with associated bony remodeling occurs in response to an insult to chondrocytes of articular cartilage and inflammatory cells in the surrounding tissue. With release of enzymes from these cells, the breakdown of collagen and proteoglycan molecules occurs, which destroy the articular cartilage. Resultant exposure of underlying subchondral bone leads to bony sclerosis. This leads to reactive remodeling in bone with osteophyte formation and subchondral bone cyst formation. The bony edges around the loading areas grow outwards, forming bony spurs which are called osteophytes. Also the synovium produces extra fluid leading to knee effusion. The knee joint capsule and associated ligaments gradually thicken and contract.

All tissues in the joint become hyperactive, as the body initiates repair mechanisms in response to damage caused by wear and tear. These changes are partly the result of the inflammatory process in and around the joint.[3] Joint space is lost gradually. Affected tibial condyles gradually become flattened. The medial tibial condyle is much more affected because the weight-bearing line passes medially in the knee and it becomes depressed leading to varus knee deformity.

Many patients in India seek orthopedic consultation for knee osteoarthritis late and it is very common to see patients with severe varus knee deformities. Total knee arthroplasty in such OA patients with severe varus deformity is challenging surgically. It requires the meticulous technique of medical release to create a balanced flexion and extension gap, depending upon the severity of pre-operative deformity and laxity. Total knee arthroplasty is valuable in OA patients as it provides pain relief and improved functional status of a patient which in turn leads to a better quality of life.

Varus deformities are the commonest type of knee deformities noted in OA knee patients. A severe varus deformity of more than 20 degrees poses a challenge in terms of the type and extent of soft tissue release required to correct pronounced deformity with total knee arthroplasty depending upon deformity and soft tissue laxity. Additional long stems, wedges, bone grafts, constrained or hinged types of prosthesis for knee replacement might often be required, which are expensive and increase the cost of surgery by at least two to three folds.[4]

Total knee arthroplasty (TKA) is one of the most successful surgeries in the field of orthopaedics till date. The surgery is predictable with long-lasting results. Today

the survival rates reported in various studies have been 95% and above at average 15 years follow-up. Furthermore, improvement in the quality of life, reported by various scoring systems has been excellent. Total knee arthroplasty is indicated in cases with significant pain, substantial deformity, instability, functional loss with the restricted range of motion. The main indication in most of the patients undergoing this surgery is the osteoarthrosis of the knees [5]. The reported incidence of the OA knees is 96-98% in all large series.[6] Rheumatoid arthritis patients undergoing knee replacement has been significantly reduced due to improved results of the medical line of treatment.

Inspite of successful outcomes of total knee arthroplasty, it is common to see patients presenting with severe knee deformities in India. Ignorance, fear of surgery, lack of expert medical care, the expense of surgery and seeking care from alternative forms of medicine could be the reasons for the delayed presentation of such cases. Thus such cases present with profound knee deformity, unyielding knee contractures and bony defects.

Restoring knee alignment to the anatomical norm of 5^0-7^0 valgus may be difficult and may require intraoperative ligament releases and/or ligament tensioning to achieve proper soft tissue balancing. Failure to realign knees surgically will subsequently lead to premature loosening and implant failures.[7] The study aimed to address deformity particularly knee varus in osteoarthritis patients which are undergoing total knee replacement.

Material and methods

500 patients were diagnosed with knee OA (Osteoarthritis) were included in the study. The study includes all patients who underwent total knee arthroplasty, who have fulfilled the inclusion criteria. Preoperative long leg standing radiographs (Scannogram) by CR (computed Radiography) technique were taken for each patient. The single exposure low radiation technique was used. Three 14 by 17-inch cassettes with scanogram stand were utilized to prepare scanogram and radiographs will be taken from 6 ft distance. Gonadal shields were used to prevent radiation hazards to the patients. A strict radiological protocol was used after training all the technician staff who were involved in the study. The most important key point was to keep the proper rotational alignment of legs which reduces errors in the measurement of these deformities. After capturing the images, they were processed through the computer and with digital stitching method full length full-size scanogram was prepared. AGFA software was used to measure the angle of varus deformity between the mechanical axis of the femur and tibia. Data are expressed as M±SD. $P<0.05$ is considered statistically significant.

Results:

Age and gender:

Overall mean age was 61.35±7.35 years. The minimum age in study patients was 29 years and the maximum age was 85 years. The mean age among the males was 62.4±6.6 years, whereas in females mean age was 60.3 ±8.1 years (Table-1). The statistically significant difference between the mean age of male and female patients when they opt to undergo total knee arthroplasty ($P<0.05$). So, females were affected by osteoarthritis at a comparatively younger age than males.

Table 1: Age wise distribution of patients

Gender	Mean Age	SD	P value
Male (n=175)	62.4	6.6	p <0.05.
Female (n=325)	60.3	8.1	
Overall mean age	61.35	7.35	

Table 2: Age group wise distribution of the patients

Age group	No. of patients	Percentage
21-30	2	0.4%
31-40	5	1%
41-50	25	5%
51-60	171	34.2%
61-70	211	42.2%
71-80	81	16.2%
81-90	5	1%

42.2% of the patients with osteoarthritis were from the 61-70 years age group followed by the 51-60 years age group (34.2%). Only a few patients were from 21-30 years and 31-40 years groups. From the table-2, we can say that with increasing age there was an increase in the prevalence of osteoarthritis.

Angle of varus knee deformity

Hip-Knee-Ankle-angles (HKA) were calculated with help of scanograms for all the patients pre-operatively. All of the patients were distributed according to measured HKA angle of varus deformity, into 5 groups with 5-degree intervals: Group A, 0-5 degree varus; Group B, >5-10 degrees varus; Group C, >10-15 degrees varus; Group D, >15-20 varus; Group E, >20 degrees varus.

Table 3: Varus deformity (angle) distribution among patients.

Degree of Varus deformity	Number of patients	%
A. $0\text{-}5^0$	38	7.6%
B. $>5\text{-}10^0$	172	34.4%
C. $>10\text{-}15^0$	177	35.4%
D. $>15\text{-}20^0$	100	20%
E. $>20^0$	13	2.6%

Maximum of patients were in group C with varus deformity of >10- 15^0, followed by group B. Among 500 patients group A, B, C, D, E had 38, 172, 177, 100, 13 patients respectively. Very few (2.6%) patients had a varus angle of more than 20^0 (group E). 290 patients out of 500 patients, had an angle of varus deformity of more than 10 degrees (Table-3).

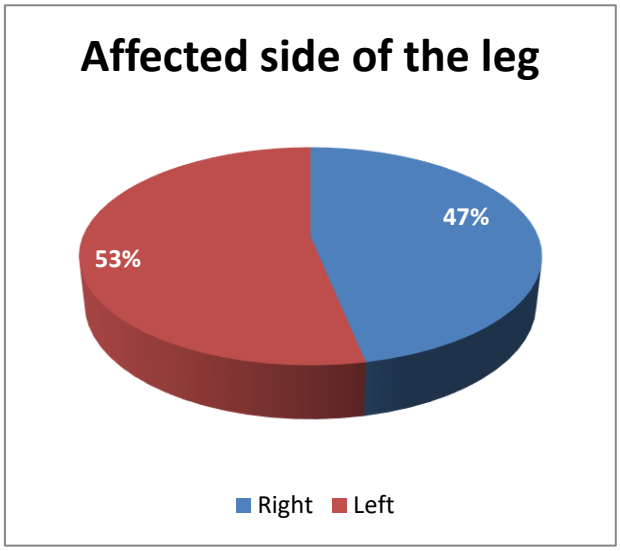
53.2% of the patients had their right

leg more affected, while 46.8% of the patients had left leg more affected with OA (Graph-1). So both sides were almost equally affected and equally getting operated. No major difference was noted laterality-wise.

Varus deformity and age

As shown in the graph-2 there was an increase in the mean angle of varus deformity as there is an increase in age. So, elderly patients had higher varus knee deformity as compared to younger patients.

Graph-1: Leg to be operated by TKA



Graph-2:- age group wise varus deformity- mean angle

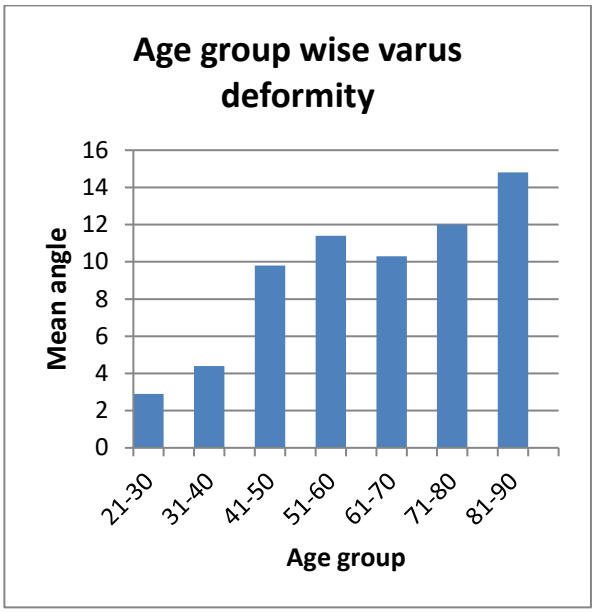


Table 4: Gender wise difference in varus deformity angle

Gender	Mean	SD
Male	9.9	3.7
Female	13.7	2.4
p <0.0001		

In males, the mean angle of varus deformity was 9.9 ± 3.7 degrees, whereas in female patients mean varus deformity was 13.7 ± 2.4 degrees (Table-4). Statistically significant difference between the gender with varus deformity ($P<0.05$). Indian females had more angular varus deformity of knees than the males when they planned to undergo TKA.

Discussion

In today's era, primary osteoarthritis is one of the most common musculoskeletal diseases seen. [8] It is an irreversible and progressive disease commonly seen in the elderly.[9] Overall in the whole world about 3.8% of the population suffer from symptomatic osteoarthritic knees[10], and it is estimated that approximately 277 million

people are living with knees affected with OA worldwide. [11] The prevalence of knee OA is expected to increase as the population ages, especially in developing countries of the world.[12] The prevalence of knee OA in rural parts of India is 3.9% whereas in urban parts of India it is 5.5%. The burden of the patients with OA knees is increasing day by day and it will result in major physical, psychological, and socio-economic strains. It's been noted that OA is the 2nd most costly condition that is being billed to Medicare and also to private insurance firms in the United States in recent years.[13] Thus necessary interventions need to be taken to decrease the incidence of OA knee cases and to provide a better quality of life i.e. disability-free life to such patients. Ultimately, society, as well as the country, will be benefited with the betterment of socio-economic status in the long term.[13]

Patients presenting with OA knee who opt for surgical intervention are most commonly of 5th to 6th decades in India.[14] Majority of such patients present with symptoms of knee pain, restricted range of movements, inability to climb stairs, inability to squat, and inability to get up from the floor without support. Clinically some degree of varus deformity is noted in all of these patients. Knee osteoarthritis is a commonly noted cause of knee pain and disability in the community. Surgical intervention in form of total knee arthroplasty provides great relief to such osteoarthritic patients with severe symptoms. [15]

Severely deformed knees are rare in western countries but in India and other Asian countries, it is commonly noticed. Population in Rural areas often consults with their family doctors or quakes who are not specialists and so they are offered several conservative lines of treatments more often for symptomatic relief.[16] Several different modalities of conservative treatment have been suggested in such patients like general exercises, knee caps, weight reduction, footwear modification, walking aids, non-steroidal anti-inflammatory drugs, intra-articular injections of hyaluronic acid (HA), etc.

Patient to seek orthopaedic consultation depends upon various factors like – health awareness, social class, the economic condition of the family, ethnicity, traditional medicine, cost of treatment, accessibility, pain tolerance, physical activity level and co- morbidities[17]. So, patients with less access to medical care present with a more severe form of osteoarthritis. Some patients think that their symptoms of osteoarthritic knees as a part of the aging process, which it is uncontrollable and so such patients are likely to delay their treatment.[18] Fear of surgical interventions also plays a major role as many patients such that have not been undergone any operations till they get aged.[19] Interestingly mood also affects the pain perception of patients. So, patients with negative affection or depression are likely to seek medical help earlier compared to others[20]. The result of these all factors may be, to seek medical treatment, to make treatment delayed, or to reject any such professional consultation.[21]

In the present study mean age was 61.35±7.35. The minimum age of the patients was 29 years and the maximum age was 85 years. The mean age among the males was 62.4±6.6 years, whereas in females mean age was 60.3 ±8.1 years. Females were affected by osteoarthritis at a comparatively younger age than males. In Arun Mullaji et al study the mean age of these patients was 66.6 years. [22] In Emmanuel et al study the mean age was 67 ± 10 years. [23]

In the present study, 53.2% of the patients had their right leg more affected, while 46.8% of the patients had left leg more

affected with OA. So both sides were almost equally affected and equally getting operated. No major difference was noted laterality wise. Yan et al study the patients diagnosed with primary osteoarthritis of knees undergoing TKA 589 (51%) patients were left-sided and 568 (49%) were right-sided. [24] Arun Mullaji et al study, 247patients left-sided and 256 patients right-sided TKRs. [25]

In the present study maximum of patients were with varus deformity of >10-15^0, followed by 5-10^0. Among 0-5^0, 5-10^0, 10-15^0, 15-20^0, >20^0 groups had 38, 172, 177, 100, 13 patients respectively. Very few (2.6%) patients had a varus angle of more than 20^0. 290 patients out of 500 patients, had an angle of varus deformity of more than 10 degrees.

In Sidhu et al study 27 patients had varus knee alignment of 0-20 degrees, 40 had varus alignment of 11-20 degrees and the remaining 7 cases had 21- 30 degrees varus knee alignment.[26] Ranganatha B Thimmegowda et al they studied 75 primary severe varus (more than 20 degrees) knees in 52 OA patients who underwent total knee arthroplasty (TKA) surgery in India. [27]

Obese patients with OA knees were more prone to have severe varus deformity poor knee scores. Hypertension was the most commonly associated risk factor with knee OA, followed by DM. Patients undergoing total knee replacements need proper radiographic and clinical evaluation for pre-operative planning. Many of these patients have different deformities in the proximal femur and proximal tibia which may add to the surgical challenge to get an accurate alignment. With recent advancements, CR-based scanography has become a versatile and gold standard technique for identifying the magnitude of deformity and associated abnormalities around the knees. It has minimal radiation hazards and is a cost-effective technique. In terms of radiological measurements, it has been an accepted technique with a high level of accuracy, but the position of the limb is crucial.

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