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Clinical profile of patients undergoing total knee replacement (TKR) –case based series

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Abstract: *Osteoarthritis is not an immediate lethal disease by itself but has led to rise in global years lived with disability. Cases of arthritis who have undergone total knee replacement (TKR)in past one decade were collected from the medical record department and were studied thoroughly on the age, gender, along with its association with other diseases to find out its risk factors. A total of 731 cases were studied. Statistical analysis was done to find if there is any significant association between the above parameters and osteoarthritis (OA). The commonest indication for TKR was found to beOA. There was a strong positive correlation between increased number of cases and rising year trend (r 0.934). A strong positive correlation was also found between – (1)* I*ncrease in OA cases and female sex (r 0.998) and male sex (r 0.9822). (2) Increase number of OA cases with age(r 0.994). (3) OA and varus deformity (r 0.991, p<0.0001); rheumatoid arthritis (RA) and valgus deformity (r 0.570, p 0.0475). (4) Hypertension and OA cases undergoing TKR (p<0.0001, r 0.9843). (5)We also found an association between OA and past history of hysterectomy in patients who had undertaken TKR (r 0.9843).*

Keywords*: Arthritis, Osteoarthritis, Rheumatoid, Valgus, Varus.*

I. Introduction

Over the past one decade the indication for knee replacement has increased tremendously. The primary reason being improvement of the overall functioning ability of the pre-operative painful knee. The beneficial outcomes of total knee replacement can be reduction of pain score, improvement of functional mobility, and realignment of the knee. However the data regarding TKR as a mode of treatment in terms of trials and studies to compare with other interventions is very scarce. Nevertheless the report by Patient Outcomes Research Team (PORT) have proven that TKR is quite efficacious in terms of improving the disability and pain score (1) and thus the reason for increased utilization and subjection to TKR.

Osteoarthritis (OA) of the knee is one of the most common bone disorders. Osteoarthritis OA) has been claimed to be the second most common rheumatological problem and is the most frequent joint disease with prevalence of 22% to 39% in India.(2)Worldwide estimates indicate that 9.6% of men and 18% of women ≥ 60 years have symptomatic OA(3). In England and Wales between 1.3 and 1.75 million people have symptomatic OA(4). Approximately 3.6 million to 4.4 million adults in the U.S. are estimated to currently live with a total knee replacement, which represents 4.2% of the population fifty years of age or older(5).However, little data are available in Indian population, more specifically in relation to knee arthritis and total knee replacement.

Osteoarthritis is a degenerative joint disease wherein there is disturbance in the homeostasis between destruction of joint cartilage and regeneration of new bone at the joint surface margin (6,7). In addition to there is hypertrophy of bone at the margins, subchondral sclerosis and range of biochemical and morphological alterations of the synovial membrane and joint capsule (2,6) There is degeneration of matrix and cartilage regardless of the cause which results in active chondrocyte replication along with enhanced biosynthesis(2,6) This results in a state of equilibrium , known as compensated OA, in which both repair and degeneration are balanced.(2,6,7) After a few years there is imbalance in this equilibrium resulting in thickened capsule, cyst formation and sclerosis in subchondral bone, shelving fibrillated cartilage, osteophyte lipping, and synovial hypertrophy resulting in an uneven contour of bone(1,10). The term osteoarthritis was coined by John Spendon and is a misnomer ,the right term being osteoarthrosis or degenerative joint disease(6). The other term used is degenerative arthritis, and it commonly affects the hands, feet, spine, and large weight-bearing joints, such as the hips and knees(2,6) .

Pain is the chief complaint patients present. Pain is of dull - aching character(2,6,7). This is due to stimulation of capsular pain fibres, mechanoreceptors, periosteal nerve fibres(6,8,9).

The other complaints are stiffness in the knee generally in the morning (2,6,7). Coarse crepitus, due to loose bodies and uneven bony articular surface, can also be present(2,6,7).Other signs are bony enlargement resulting in mild knee swelling due to osteophytes. Instability, Varus or valgus deformity are noted in advanced cases(2,6–8).

The radiological criteria of Kellen and Lawrence scale is based on the overall grades of severity from 0 to 4 and are related to reduction in joint space, presence of loose bodies, subchondral sclerosis, and bony deformity (7,10) Other features like effusions, osteophytes and subchondral cysts, joint alignment, subluxation, are also noticed.(6, 7, 10–12).

Primary osteoarthritis is mostly related to aging(2). In the Framingham Study, the prevalence of radiographic knee OA was 19.2%in patients more than 45 years old and, 43.7% in patients more than 80 years indicating that the disease was more common in the elderly(13). In India 5.3% of males and 4.8% of females are aged more than 65 years(14) . During old age there is oxidative damage, thinning of cartilage, muscle weakening, reduction in proprioception, decline is tissue homeostasis leading to an inadequate response to stress or joint injury and resultant joint destruction, loss of cartilage, thinning of capsule and altered contour of bone(7) The other known risk factors are obesity, valgus and Varus deformity of the knee, intra articular fractures and trauma, rheumatoid arthritis, syringomyelia, neurological disease like diabetes, occupation involving excessive use of knee joint, smoking, hormonal imbalances, emotional stress, osteoporosis, improper postural habits(6).

II. Methodology

This is primarily a record based study. Cases were taken from the medical record department. Each of the cases were studied in terms of age, gender, type of deformity, as well the associated co-morbid conditions to know the significant risk factors.

The variables studied were:

Hypertension: -a) with a past history of hypertension and on treatment, b) who were newly diagnosed on admission in the in- patient department and started on antihypertensive therapy before undergoing TKR.

Alcohol consumption: - defined as who were alcoholic from personal history on admission.

Smoking: - defined as who were smoking from personal history on admission.

Hysterectomy:- with a past history of having undergone hysterectomy with reason unknown.

Diabetes:- a) with past history of diabetes and on treatment, b) who were newly diagnosed on admission in the in-patient department and started on antidiabetic medication before undergoing TKR

The diagnosis of osteoarthritis was based on clinical history and radiological (x ray knee) findings.

Rheumatoid arthritis was diagnosed from clinical history, radiological finding(x ray knee), and rheumatoid factor.

Cases of ankylosing spondylitis were defined from case history, x ray knee.

Traumatic arthritis cases were those giving past history of trauma.

Diagnoses of post infective arthritis was made from history of fever, pain and discharge from the knee joint, raised total and differential WBC counts, culture sensitivity result of the discharge.

All cases admitted in the in-patient department for undergoing TKR were studied from 2004 to 2013. The study was conducted according to protocols of the ethical committee of the institution. Consent was taken from the medical record department.

All the results were tabulated based on the above differences. For quantitative purpose frequency intervals were made for age column i.e. 21-40(young age), 41-60(middle age) 61-80(old age). Statistical analysis was done according to graph pad prism SPSS version 6.05**.**Analyses was done using chi square test, student paired t test,one way ANOVA (non-parametric) and Karl Pearson product moment.Values below p ≤ 0.05 were considered significant, $p \leq 0.01$ very significant and $p \leq 0.0001$ very highly significant.

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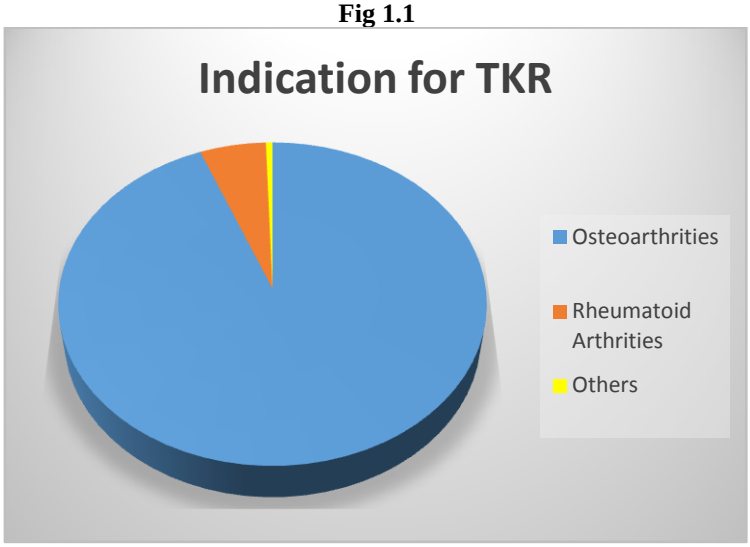
III. Results

The commonest indication for TKR was OA with 93.98 %, RA (rheumatoid arthritis)ranked the second with 5.47% over the past 10 years.Others were ankylosing spondylitis, traumatic arthritis,and post infective arthritis with overall frequency together of 0.54%.

Fig 1.1



The above pie chart denotes the percentage of OA, RA and Others(ankylosing spondylitis, traumatic arthritis, and post infective arthritis)cases in patients undergoing TKR in past 10 years.

The frequency with which TKR was done for OA has gone up to 6.8 times from2004 to 2013, while that of RA went up 4 times. Statistically it showed that there was a strong positive correlation (r 0.934) between increased number of cases of OA and the rising year trend, with no much correlation with RA cases.

TABLE 1.1Mean of OA cases subjected to TKR-gender difference (past 10 years)

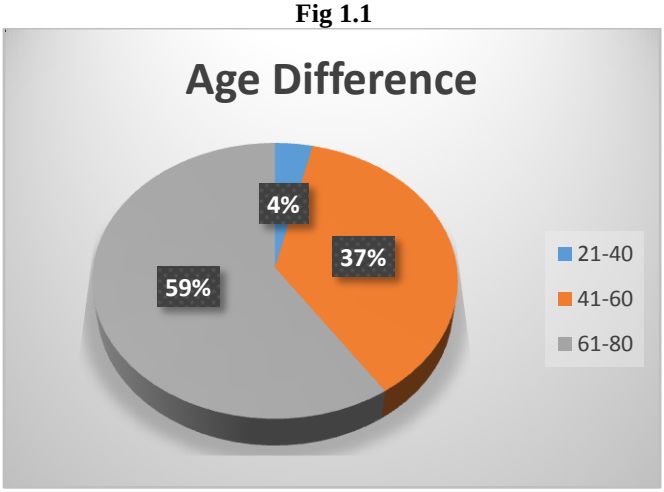
males	females
15.6±9.24	53.1±30.66

The frequency with which males were subjected to TKR for OA went up to 8 times and females went up to 6.5 times in last decade. The total male and female number of cases of OA was 22.8 % and 72.12 % respectively over the past 10 years. There has been a strong positive correlation (r 0.998)) between increase in OA cases and female sex; and male sex(r 0.982) .Using student paired t test we noted there was significant difference between rise in females and males frequency with p 0.0004.The overall ratio of male: female was approximately 15:53 over the past 10 years. Initially it was almost 3:14 in 2004 while in 2014 it was 2:7. Considering the different age group this ratio was 1:4in young age, nearly11:20 in middle age while in old age the approximate ratio was 4:13 in past one decade.

TABLE 1.2Mean of OA cases undergoing TKR - age differences (past 10 years)

21-40 years	41-60 years	61-80 years
35.8±4.04	54.58±5.01	68.35±5.39

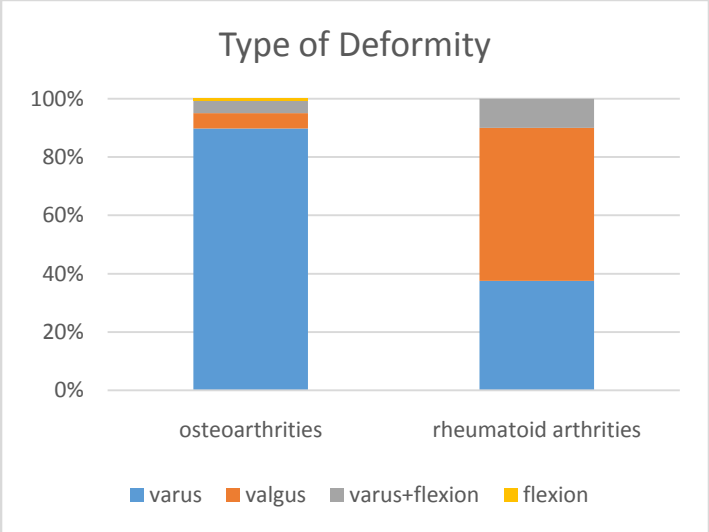
Fig 1.1



The above pie chart denotes the age difference in OA cases undergoing TKR (past one decade) in percentage in past one decade.

There has been statistically significant age difference in number of OA cases undergoing TKR in past 10 years using one way ANOVA (non-parametric test)($p<0.0001$). Also it was found that there was a significantly strong association between increase numbers of OA cases with age(r 0.994).Another noticeable feature was, the frequency in old ageincreased from 43.75% to 59.82 % while in middle age it decreased from 56% to 35.04 % over the past 10 years.

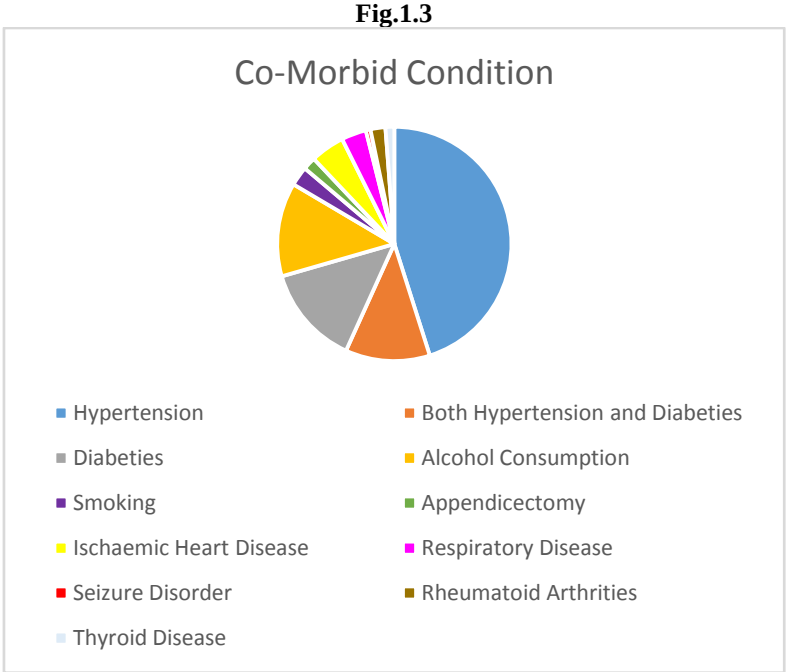
Fig 1.2



The above bar graph denotes the association of different deformities (Varus, Valgus, Varus+ flexion, flexion) in OA and RA in TKR undergoing patients in past 10 years.

The percentage of Varus deformity in TKR undergoing patient was 89.81%(mean 61.70±35.57) in OA cases and 37.5% in RA, while valgus deformity was 5.24 % cases in OA and 52.5 % in RA(mean 2.625±2.20). There has been a strong correlation between OA and Varus deformity with (r 0.991, $p<0.0001$) while a strong positive correlation between RA and valgus deformity(r 0.570, p 0.0475) using chi square test.

Fig.1.3



The above pie chart denotes the associated co-morbid conditions among OA cases undergoing TKR in past one decade.

There was a very strong positive correlation (r 0.9843) between hypertension and OA cases undergoing TKR in past 10 years. The frequency of hypertension as a coexisting disease with OA in TKR undergoing

patients was 85.29%. The percentage of hypertension among OA undergoing TKR in 21-40 age group was approximately 28% while it was 73.22%in 41-60 and 84.23% in 61-80 and this association was statistically significant with p<0.0001in last one decade.

About (mean of 53.1±30.66) females who had undergone TKR with OA in past one decade, 13.20% had a past history of hysterectomy being done with reason not known. The percentage has increased from 23.07 %in 2004 to 25.27% in 2013. Interestingly this correlation between OA and hysterectomy was also significant (r 0.668).

With respect to diabetes being the coexisting disease with OA, there has been strong positive association between the two over the past 1 decade (r 0.971).It has been noted that the frequency was 26.05% in OA and 25% in RA. The percentage has increased from 25 % to 26.27 %in OA patients undergoing TKR over the past 10 years

Alcohol consumption was noticed among 24.5 % patients. And r value between OA and alcohol consumption cases 0.9253 . Smoking prevalence was comparatively less, around 5.04 % in patients with OA, while about 22.70% of the patients had both hypertension and diabetes. Other coexisting diseases that were noted with OA cases who had undertaken TKR were Respiratory diseases like bronchial asthma and other chronic obstructive pulmonary diseases (6.5%), ischaemic heart disease (8.9%), associated RA (3.9%), Appendectomy (3.37%), Thyroid Disease (2.3%), and Seizure disorders (1.2%).

IV. Discussion

The study carried out by Manusco et al in 1996 suggested that there is no clear indication for TKR. As the most common reason being severe pain and disability score, radiological evidence, and moreover on the agreement of patients to undergo TKR(15) . This can be combined with financial security and assistance due to high cost for surgery, patients reach out of facilities in addition to the patient awareness and literacy rate. However this has been according to the viewpoint of Orthopaedic surgeons, but the data based on patients need to undertake TKR is not known. In the present study we found that the commonest indication for TKR was OA with 93.58 %frequency and the next being RA with a highly significant correlation. The reason for increased incidence of TKR surgeries in the recent times as compared to the past can be due to increased awareness among people relating to its benefits.

On comparing the gender difference we noticed that there was a rising incidence of both males and females with OA ultimately undergoing TKR, however the ratio of female: males has always remained higher i.e. 15:53 and the overall incidence in females and males being 22.8 % and 72.12 % respectively. A study on risk factors of knee OA found women to be higher in terms of prevalence of OA as compared to men (65.7% vs. 34.3% respectively)(16).while another study also had the same result reporting female-to-male ratios to be between 1.5:1 and 4:1(7). A study in the year 2003 in the Indian settings particularly in urban area reported the prevalence of osteoarthritis in elderly female to be 30%(17) so also a study in Vietnam, found that women have higher prevalence of radiographic knee OA than men(18). Prevalence of osteoarthritis is reported to increase in females during perimenopausal age and remains high throughout menopause as compared to males suggesting that OA is hormonally based(19) Studies have proved a protective effect of oestrogen or hormone replacement therapy (HRT) on radiographic knee and hip OA or progression to joint replacement(7) Another study has also proved the beneficial effect ofoestrogen in OA(20), another study on women health project Melbourne also supported the same(21).

An analysis of the ROAD study, conducted in Japan, demonstrated that occupations involving squatting or kneeling more than 2 h per day resulted in an approximately two-fold increased risk of moderate to severe OA(22) It was found that men had more occupational knee bending compared to women (40% vs. 23.9%)(16)and this suggests that between 5% to 20% of all symptomatic knee OA may result from occupations involving repetitive knee use(7,22).Indian culture involve more of squatting in day to-day activities like squatting on Indian latrines involving acute bending, bending of the knees for prayers and squatting on the floor. Indian women use more of squatting on the floor while doing the household activities and thus can be one of the reason for higher prevalence in women as compared to men.

In the present study we noted that the prevalence of OA cases increased with increase in age. A study in rural areas of Bangalore found that the corresponding prevalence of OA were 17% and 5.6% in the adult population and 54.1% and 16.4% in the elderly(23). In a cross sectional study in Dharwad India it was observed that the percentage of people with osteoarthritis increased as the age increases(16). Older people are found to have rapid radiological progression due to the reasons explained above(24) It was also found that there was a percent decrease in prevalence from 56% to 35.04% in the middle age. This could be due to increased awareness and early interventions and also improvement in the medical interventions available.

On comparing between hypertension and OA we found that there was 85.29% frequency of hypertension in OA patients subjected to TKR concluding that it can be one of the highest risk factor leading to OA.This could be due to venous occlusion, stasis or micro emboli leading to episodic reduction in blood flow

through small vessels within the subchondral bone ultimately leading to the degenerative changes(7). There is evidence that there is significant association between hypertension and OA OR = 3.02 (1.51-6.06)(55) A ROAD study proved Association of knee osteoarthritis with the accumulation of metabolic risk factors such as overweight, hypertension, dyslipidemia, and impaired glucose tolerance(25) COX-2 is integrally involved in renal homeostasis, selective COX-2 inhibitors are associated with negative effects on kidney function similar to those seen with NSAIDsas electrolyte disturbances, oedema and hypertension have been correlated with the use of both drug classes(26). The adverse effect of all NSAIDs and COX-2 inhibitors on blood pressure may have the most clinical significance in the elderly, in whom the prevalence of arthritis, hypertension, and NSAID use is high(27).or we could hypothesize that some antihypertensive drug can have osteoarthritis as the side effect.

On comparing diabetes and OA prevalence the correlation between them was very strong. A study performed involving rats stated that there was a higher incidence of osteoarthritis noticed in type 2DM rats as compared to controls along with Cysts formation at the junction of the articular cartilage and subchondral bone(28). There is evidence of biological link existing between bone loss at subchondral bone plate in knee OA and hypertension and T2DM(29).

In this comparative study it was noted that valgus deformitywas more commonly noted with RA while Varuswas more commonly noted with OA. Rheumatoid knee commonly presents as valgus knee and although osteoarthritis knee may also present with valgus deformity,Varus deformity is more common(30).

Chronic heavy drinking, particularly during adolescence and the young adult years, can tremendously decrease bone quality and may increase osteoporosis risk(31). Also the effects of heavy alcohol use on bone cannot be reversed, even if alcohol consumption is terminated(31). In the Framingham study cohort there was a strong inverse relationship found between osteoporosis and osteoarthritis (OA) by evaluating the association between bone mineral density (BMD) and kneeOA(32)Chingford study also supported the same (33).This can explain alcohol being one of the strong risk factor in causing OA.

The overall percentage of OA cases with hysterectomy were found to be 13.20% with a increase since past 10 years. Thiscan be explained in either of two ways 1) due to higher prevalence OA in the perimenoupausal group and the incidence of hysterectomy being high in perimenopausal age 2) there is association between hysterectomy and OA and hysterectomy being one of the risk factor. A study on effect of hysterectomy on bone has claimed that hysterectomy is associated with decreased bone mineral density(34–36).In significance to this ,as stated above there is a strong correlation between osteoporosis and osteoarthritis(32,33). Thus this can be one of the reason to explain the higher association between hysterectomy and OA as what we found in the present study.

V. Conclusion

This study has provided us with interestingdata:-

1) The most common indication for TKR is osteoarthritis and increased frequency of TKR in the recent years.
2) Higher female: male ration in terms of OA cases undergoing TKR.
3) Increase in OA cases as age advances.
4) Frequency of OA in middle age (41-60) has been gradually declining due to improvementof medical interventions.
5) Varus deformity more common in OA, while valgus more in RA cases.
6) Hypertension ranks the first among the risk factors for OA.
7) Diabetes as the risk factor for OA, however more study is to be undertaken to prove it.
8) Hysterectomy can be one of the risk factor for the development of OA, however needs more research to prove it.
4) Strong association between alcohol and OA, thus alcohol can also be one of the risk factor in causing osteoarthritis, yet adequate study into it is required.

The burden of OA results in physical problems, psychological and socioeconomic strain.It has been witnessed that OA is the second-most costly condition billed to Medicare and private insurance in US(37). Thus necessary interventions should be taken to decrease the incidence of OA cases and provide a better living i.e. a life free of disabilities, which is the need of the moment. This can benefit the society as well as the country in terms of economics in the long term.

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