International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2018; 4(2): 485-491

www.orthopaper.com
Received: 14-02-2018
Accepted: 19-03-2018

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Prospective study of correlation of pain and radiological feature of OA knee

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DOI: https://doi.org/10.22271/ortho.2018.v4.i2h.74

Abstract
Aim of study was to assess the relationship between disability and defining features of osteoarthritis knee (Radiological findings and pain) To identify predictors of disability in patients where radiological evidence of deformity and pain occurs differentially.
Material and Method: This Study is conducted in Department of Orthopaedics, Netaji Subhash Chandra Bose Medical College & Hospital, Jabalpur (M.P.) India from 1st March 2015 to 30th September 2016. This Prospective study between OA knee pain and radiological correlation is done on 300 subjects (396 knees). Patients with Chronic knee pain (>3 months), Age between 40 – 80 years, Nontraumatic knee pain, Non - radicular knee pain, Deformity (Varus & Valgus deformity <100),are included in the study.
Osteoarthritis with recent trauma of knee or surgery, Patient with ligament injury of knee less than 3months, Unwilling patient, Non ambulatory patient, Any chronic medical condition other than osteoarthritis known to be associated with disability (eg. inflammatory rheumatic diseases, symptomatic cardiac and pulmonary disease, diagnose mental illness etc.) are not included in the study.
Observation & Result: For assessment of pain authors used VAS score.For functional assessment we use WOMAC score and for assessment of radiological features we were use KL score, Joint space narrowing and osteophyte count. In our study clinical features like pain and functional limitation were strongly correlated with KL score, joint space narrowing, and osteophyte count. In our study we were identify that when Q angle decreases there is increasing severity of radiological features. The mean age of presentation for osteoarthritis is 56.17 ± 9.776 years. 53.33% cases of osteoarthritis knee were female and 46.67% cases were male. Crepitus (tibio- femoral and patella femoral joint) was present in 10.1% case of osteoarthritis knee. Fixed flexion deformity (FFD) was present in 30.1% knees. 38.60% knees had synovial thickening. 61.7% cases of knee osteoarthritis knee having radiographic joint space narrowing. There was significant correlation between functional WOMAC score & KL. There was significant correlation between functional WOMAC score & Joint Space Narrowing. There was significant correlation between Pain &KL Score. There was significant correlation between Pain & No. of osteophytes. There was significant correlation between functional Pain & joint space narrowing. There was significant correlation between functional WOMAC score &pain. There was distribution of KL score according to sex is not significant.

Keywords: OA knee, Osteoarthritis, osteophytes, joint space narrowing

Introduction
Osteoarthritis is a chronic disorder of synovial joint due to impaired balance between cartilage degeneration and regeneration in which there is progressive softening and disintegration of articular cartilage along with growth of new cartilage and bone at joint margins, cyst formation and sclerosis in the subchondral bone, mild synovitis and capsular fibrosis [1]. Osteoarthritis is the second most common joint problem and it is the most frequent joint disease with a prevalence of 22% to 39% in India [2]. OA is more common in women than men, but the prevalence increases dramatically with age [3]. Nearly, 45% of women over the age of 65 years have symptoms while radiological evidence is found in 70% of those over 65 years [3]. OA of the knee is a major cause of mobility impairment, particularly among females [4]. OA was estimated to be the 10th leading cause of non fatal burden [4]. Osteoarthritis is mainly disease of later age onset which is around 50 to 60 years of age.

In osteoarthritis pain is most common symptom seen in patient of knee joint which is slowly progressive in nature for which weight bearing standard radiograph in two planes, anteroposterior and lateral view, will usually confirm the diagnosis. If the radiographs are inconclusive other imaging studies like MRI and CT SCAN should be done. Diagnosis can also be strengthened by arthroscopy which shows cartilaginous damage even before x-ray changes appear [5]. OA is a complex disease of the whole joint, it is important to assess all intraarticular structures to further understand disease pathogenesis and progression. Ideally, one imaging modality would enable sensitive and specific depiction of all components of the joint without utilizing intravenous contrast or ionizing radiation and with little dependence on machine operator. Currently, non-CE MRI permits visualization of multiple joint structures. However, in some tissues, additional supplemental imaging modalities may be necessary to enhance depiction, especially in the synovium and in the absence of full thickness articular cartilage defects [6].

Fig 1: Osteoarthritis of the knee (A) Anteroposterior view of the left knee shows medial joint space narrowing. (B) Lateral view of the left knee shows sclerosis with marked osteophyte formation(C) shows marked osteoarthritic changes with medial joint space narrowing (D) Subchondral cysts

Stages of OA

There are five stages of OA

Stage 0 - Classified as normal knee.

Stage 1 - Very minor bone spur growth usually patient is asymptomatic at this stage.

Stage 2 - Considered as mild stage, x-rays will reveal greater bone growth cartilage likely to remain healthy patients start experiencing symptoms - usually on and off type.

Stage 3 - Classified as moderate Osteoarthritis, Cartilage and bone shows damage Joint space starts narrowing. Patients frequently experiences pain, Joint swelling may be seen.

Stage 4 - Considered as severe. Patient will have severe pain even at rest. Cartilage is almost completely eroded and Joint space dramatically reduced. Joint is stiff and almost immobile.

Classification

There are two types of osteoarthritis of knee joint [7, 8].

1. Primary osteoarthritis
2. Secondary osteoarthritis

1. Primary: when the cause is unknown then it is called primary osteoarthritis. It is more common than secondary osteoarthritis. It is seen particularly in elderly patients without any previous pathology. It is mainly due to wear and tear changes occurring in old age mainly in weight bearing joints.
2. Secondary: when the cause is known it is called as secondary osteoarthritis. There can be various causes as injury to joint, previous infection, pre-existing deformity of joints mostly varus deformity of knee, obesity, hyperthyroidism, osteoporosis and joint dysplasias. About 40% of population above the age of 40 years have radiological signs of osteoarthritis and 50% of them have symptoms [4]. Miners have high rates of osteoarthritis knee. Workers whose jobs require regular knee bending and lifting or carrying heavy loads have a high rate of knee osteoarthritis. One reason why workers may get disease is that during long days at work, their muscles may gradually become exhausted, no longer serving as effective joint protectors [5]. There is significant increase in the prevalence of osteoarthritis in the first degree relatives of patients with osteoarthritis as compared with

control [8].

Pathology

Cardinal features of Osteoarthritis are as below [9]

1) Progressive cartilage destruction. 2) Sub articular cyst formation. 3) Sclerosis of surrounding bone. 4) Osteophyte formation. 5) Capsular fibrosis.

1. Progressive cartilage destruction

Initially there is softening, fraying or fibrillation of normal smooth glistening cartilage. Damage to collagen results in exposure of tightly bound negatively charged proteoglycans. This results in ionic attraction of water and cartilage swelling, making it more prone to injury. As there is progressive disintegration of cartilage bone becomes exposed. Some times small tuft of fibrocartilage may be seen growing out of bony surface [10].

2. Sub articular cyst formation
3. Sclerosis of surrounding bone [11]. Destruction of cartilage leads to activation of leucocytes, increase in pro- coagulants activity, vascular occlusion and bone necrosis resulting in sclerosis of bone and cyst formation.

Material and Methods

This Study is conducted in Department of Orthopaedics, Netaji Subhash Chandra Bose Medical College & Hospital, Jabalpur (M.P.) India from 1st March 2015 to 30th September 2016. This Prospective study between OA knee pain and radiological correlation is done on 300 subjects (396 knees).

Patients with Chronic knee pain (>3 months), Age between 40 – 80 years, Nontraumatic knee pain, Non - radicular knee pain, Deformity (Varus & Valgus deformity <100), are included in the study.

Osteoarthritis with recent trauma of knee or surgery, Patient with ligament injury of knee less than 3months, Unwilling patient, Non ambulatory patient, Any chronic medical condition other than osteoarthritis known to be associated with disability (eg. inflammatory rheumatic diseases, symptomatic cardiac and pulmonary disease, diagnose mental illness etc.) are not included in the study.

We took standing AP and lateral xrays for radiological assessment. In our study there were two main point, first one was correlation between pain and radiological features in osteoarthritis knee and second was to identify predictors of disability in osteoarthritis knee joint. After completion of the study we are able to correlate pain and radiological features in osteoarthritis knee and able to identify predictors of disability. For assessment of pain we were use VAS score, and for assessment of functional limitation we were use functional WOMAC score and for assessment of radiological features we were use KL score, joint space narrowing and osteophyte count. Many results of our study are comparable with previous studies. In our study clinical features like pain and functional limitation were strongly correlated with KL score, joint space narrowing, and osteophyte count. In our study we observed that when Q angle decreases there is increasing severity of radiological features. Depression in patients cause increase in pain score but we had not include in our study, due to that reason pain and KL score became strongly correlate. Lack of sky line view of knee joint is main fallacy of our study

Observation and results

Pain is major clinical symptom in osteoarthritis of knee and a key determinant for seeking medical care. Pain related to osteoarthritis of knee not only contributes to functional limitations and reduced quality of life but is also the leading cause of impairment of mobility in the elderly population [12, 13]. There is modest association between radiographic features of osteoarthritis and knee pain. Several investigations have shown discordance between these two features of osteoarthritis. People with abnormal joint radiographs may have no or only mild pain, whereas in others pain may not have radiographic picture of osteoarthritis [14-16].

Age - In presented study the mean age of presentation for osteoarthritis is 56.17 ± 9.776 years. 23.33% cases in our study belongs to age group 40-49 years, 33.33% belongs to 50-59 years, 33.67% belongs to 60-69 years and rest 9.67% belongs to age >70 years. In a similar study by Lan T *et al*. (2014) in which they have analyzed 170 men and 488 women of age > 40 years of osteoarthritis knee and reported that 8% belonged to 40-49 years, 30% in 50-59 years and 61.1% belonged to age group > 60 years, mean age of presentation for osteoarthritis knee was 55.9±12.6 years [17]. In a similar study by Cubukcu *et al*. (2012) in which they reported mean age of presentation in osteoarthritis knee was 56.98±8.28 years [18].

Distribution of Cases According To Age

Age	No. of cases	Percent
40-49	70	23.33%
50-59	100	33.33%
60-69	101	33.67%
>70	29	9.67%
Total	300	100%

In our study the mean age of presentation for osteoarthritis is 56.17 ± 9.776 years.

Sex- In our study 53.33% cases of osteoarthritis knee were female and 46.67% cases were male. Study reported by Lan T *et al*. (2014) stated that 74.2% of osteoarthritis knee were female and 25.8% were male with female to male ratio was 3: 1[17]. In our study we have found almost similar presentation of both male and female with slight female preponderance, because there is hormonal effects on bones in which decrease in estrogen level after 45 years (Menopause) causes early induced osteoporosis which causes worsening of symptoms like pain and functional disability in women. There is also women have higher Body mass index than men which is positively associated with Osteoarthritis knee.

Distribution of Cases According To Sex

Sex	No of cases	Percent
Female	160	53.33%
Male	140	46.67%

Crepitus - Crepitus (tibio- femoral and patella femoral joint) was present in 10.1% cases of osteoarthritis knee and absent in 89.9% case.

OA and pain on walkin

Distribution of Knees According To Pain on Walking

Grade	No.of knees	Percent
0(No pain)	00	0
1(Mild pain)	97	24.5%
2(Moderate pain)	148	37.4%
3(Severe pain)	108	27.30%
4 (Extreme pain)	43	10.90%
Total	396	100%

In our study 24.5% knees had pain on 6 minutes walking without any difficulty, 37.4% knees having moderate pain which goes off after taking pain killers, 27.3% knees having severe pain and not relieved by any meditation and 10.9% knees can‟t walk for 6 minutes.

Tenderness – In our study 353 knees had medial joint line tenderness, 183 knees had lateral joint line tenderness, 177 knees had patello femoral joint tenderness and 188 knees had tenderness on varus/valgus strain on knee joint.

Distribution of Knees According To Tenderness Present

Tenderness (n=396)	No. of knees	Percent
Medial Joint line	353	89.1%
Lateral joint line	183	46.2%
Patellofemoral tenderness	177	44.7%
Varus / valgus strain	188	47.5%

Lateral joint line tenderness

Medial joint line tenderness

Fixed Flexion Deformity – In our study, fixed flexion deformity (FFD) was present in 30.1% knees (50-900). Tew M. and Forster I.W *et al.* (1987) reported a study flexion deformity of osteoarthritis knee and found 55.4% cases had fixed flexion deformity [19].

Distribution of Knees According To Ffd

FFD	No. of knees	Percent
Absent	277	69.9%
Present	119	30.1%
Total	396	100%

In our study, fixed flexion deformity (FFD) was present in 30.1% knees and was absent in 69.9% knees. In a similar study by Perry and associates (1975) in which they found that FFD was present in 50% of patients with osteoarthritis knee [20].

Active Pain Free Range of Movement - In our study pain free active flexion of 0^0 to 60^0 was present in 2.3% knees, 60^0 to 90^0 flexion was present in 3% knees, 90^0 to 120^0 flexion present in 47.2% knees and > 120^0 flexion was present in 47.5% knees. In a similar study by Escalante *et al.* (1999) in which they found that>90 degree of flexion was present in 619 patients (90%) out of 687 patients of osteoarthritis knee [21]. In our study we found that 94.7% cases of osteoarthritis knee had flexion of > 90 degree because more no. of patients were <70 years so muscle power of knee were good and more no. of patients were in radiologically grade 1 and grade 2 and grade 1 joint space narrowing.

Distribution of Knees According To Active Pain Free Range Of Movement

Degree of active flexion	No. of Knees	Percent
0^0-60^0	9	2.3%
60^0-90^0	12	3%
90^0-120^0	187	47.2%
120^0-calf touching to back of thigh	188	47.5%
Total	396	100%

Further pain free possible flexion- In our study 56.6% knees had further pain free passive possible flexion between 00 – 50, 39.6% knees had further pain free possible flexion between 60 – 100, 2.3% knees had further painfree possible flexion between 110-150and 1.5% knees had further pain free possible flexion between 160-200.

Distribution of Knees According To Further Pain Free Possible Flexion

Degree of further flexion	No. of knees	Percent
0^0-5^0	224	56.6%
6^0-10^0	157	39.6%
11^0-15^0	9	2.3%
16^0-20^0	6	1.5%
Total	396	100%

Extension Lag - In our study 71.2% knees had no extension lag, 4.5% knees had extension lag between1^0-5^0, 17.9% knees had extension lag between 6^0-10^0 and 6.3% knees had extension lag between 11^0-15^0.

Distribution of Knees According To Extension Lag

Degree of extension	No.of knees	Percent
0^0	282	71%
1^0-5^0	18	4.5%
6^0-10^0	71	17.9%
11^0-15^0	25	6.3%
Total	396	100%

Synovial Thickening - In our study 38.60% knees had synovial thickening and in 61.4% knees, there was no synovial thickening. In a similar study by Scanzello *et al.* (2012) in which they reported that synovial thickening was present in 50% cases of osteoarthritis knee [22].

Joint Space Narrowing (JSN) - In our study 38.4% knees had no joint space narrowing, 60.4% knees had grade 1 JSN, 0.8% knees had grade 2 JSN and 0.5% knees had grade 3 JSN. In a similar study by Joanna Ledingham *et al.* (1993) in which they have analyzed 470 cases of knee osteoarthritis [23]. The reported that 305 knees (65%) had joint space narrowing on x ray. We have reported 61.7% cases of osteoarthritis knee

having radiographic joint space narrowing.

Correlation between Functional WOMAC Score and KL Score

Womac Score	KL score					Total
	1	2	3	4	5	
31-40	18	62	01	00	00	81
41-50	04	66	144	04	00	218
51-60	00	02	05	82	02	91
>60	00	00	00	03	03	06
Total	22	130	150	89	05	396

(P value =0.0001)

In our study there is significant correlation between functional WOMAC score & KL score (chi square test was applied and P = 0.0001 which is < 0.05 so, it is statistically significant).

In our study there is significant correlation between functional WOMAC score & KL score (chi square test was applied and P = 0.0001 which is p< 0.05. so, it was statistically significant). Barker *et al.* (2004) stated that there is poor correlation between functional WOMAC score and KL score[24]. On radiographic assessment five (4%) were graded 2 on the KL scale, 35 (28.5%) grade 3 and 83 (67.5%) grade 4, showing that the group was mostly categorized as severe for radiographic changes. The inter-rater agreement for scoring the radiographs was high (kappa 0.88). Within the group of patients scoring the same KL grade there was considerable variation in the measures of function. There were no statistically significant differences for these variables between the three radiographic groups. Sixty-six of the sample were female (53.7%) and 57 male (46.3%). 29 patients (24%) a had flexion deformity. Measures of association between the radiographic score and the measures of function, no significant associations were found p>0.05. In our study there were 300 cases (396 knees) of osteoarthritis knee. On radiographic assessment 150 (37%) were graded 2 on the KL scale, 89 (22.47%) grade 3 and 5 (1.26%) grade 4. There were 160 female (53.33%) and 140 male (46.67%). In 119 patients (30.1%) had a flexion deformity. These results are contradictory with the findings of our study in which we have found significant correlation functional WOMAC score & KL score p<0.05.

Correlation Between Functional Womac Score and Joint Narrowing (JSN) - In our study there is significant correlation between functional WOMAC score & Radiological Joint Space Narrowing. (Chi square test was applied and P = 0.0001 which is < 0.05 so, it is statistically significant).In our study there were 176 knees of male sex in which 12 knees could not do squat, 123 knees had difficult squatting and 41 knees had normal squatting. There were 220 knee of female sex in which 15 knees could not do squat, 169 knees had difficult squatting and 36 knees had normal in squatting. In a similar study by Tuhina Neogi *et al.* (2009) in which they have analyzed 696 cases of osteoarthritis knee and they also reported that joint space narrowing is strongly associated with WOMAC score (p< 0.05) [25].

Corelation between JSN score and No. of osteophyte

JSN	No. of Osteophyte				Total
	0	1-4	5-9	>10	
0(NO JSN)	23	129	00	00	152
1 (<3mm JSN)	00	151	88	00	239
2 (obliterated jt space)	00	00	00	03	03
3 (0-5 mm bone attrition)	00	00	00	02	02
Total	23	280	82	05	396

Correlation Between Pain And KL Score - In our study there is significant correlation between Pain &KL Score. (Chi square test was applied and P = 0.0001 which is < 0.05 so, it is statistically significant). In a similar study by Tuhina Neogi *et al.* (2009) in which they found that radiographic osteoarthritis (KL score) and severity of knee pain is positively associated [25]. Relation of severity of osteoarthritis knee to mild to moderate pain versus no pain (p< 0.001) as well as to severe to extreme pain versus mild to moderate pain (p < 0.001).

Correlation between pain and number of osteophytes- In our study there is significant correlation between Pain & No. of osteophytes. (ANOVA test was applied and P = 0.0001 which is < 0.05 so, it is statistically significant). In a similar study by Lanyon *et al.* (1998) in which they found that presence of osteophytes over patellofemoral joint was more sensitive but less specific than the tibiofemoral joint [26]. In this study there is strong correlation between pain and no. of osteophytes.

Correlation between pain and joint space narrowing (JSN) - In our study there is significant correlation between VAS Pain & joint space narrowing. (ANOVA test was applied and p = 0.0001 which is < 0.05 so, it is statistically significant) In a similar study by Cicuttini *et al.* (1996) they found that there is significant association between knee pain and increasing grade of narrowing in joint space (p < 0.001).This study is comparable with our study in which p < 0.05 [27].

Correlation between functional WOMAC score and pain- In our study there is significant correlation between functional WOMAC score &pain. (Chi square test was applied and P = 0.0001 which is < 0.05 so, it is statistically significant). Functional womac score was correlated with pain perception. The resultant graph showed that pain is increased in many fold when the womacscore crosses 50. Pain perception were almost static with extreme limitation of functional status in which womac score >60. In moderate to severe functional limitation pain perception was sudden increase because of pain in squatting, cross leg sitting and stair climbing is mainly affect functional status of patients. In a similar study by Duygu Cubukcu *et al.* (2012) in which they found that functional WOMAC score is significantly associated with pain, in which p < 0.001 [28].

Correlation Between Functional Womac Score And Pain

WOMAC score	No. of knees	Pain(mean)	Std Deviation
31-40	81	11.1	3.894
41-50	218	13.49	4.414
51-60	91	19.49	4.738
>60	6	20.17	2.229
Total	396	64.25	5.304

Correlation between Q angle and KL score

Q angle	KL Score					Total
	1	2	3	4	5	
0^0-5^0	0	5	0	0	0	5
6^0-10^0	13	48	80	17	05	218
11^0-15^0	09	76	70	18	00	173
Total	22	130	150	69	05	396

Correlation between KL score and sex distribution of knees- In our study for KL score 0 there is 9 female & 9 male, for KL score 1 there is 44 female & 54 male, for KL score 2 there is 66 female & 52 male, for KL score 3 there is 39 female & 23 male, for KL score 4 there is 2 female & 2 male and distribution of KL score according to sex is not significant. (Chi square test was applied and P = 0.240 which is > 0.05 so, it is statistically not significant). In a similar study by Glass N. *et al.* (2014) in which they found that distribution of man and women with knees at each KL grade was significantly different (p<0.001), with higher proportion of women knee (40% KL≥2) than men (38% KL≥2) [29]. This study is contradictory with our study in which p>0.05, which is showing that higher KL score in women is insignificant.

Conclusion

Pain and functional limitation in patients of osteoarthritis knee are the main predictors of disability. There is a significant correlation between functional WOMAC score clinically and KL score & presence of joint space narrowing radiologically. There is significant correlation between self-reported pain in osteoarthritis knee and radiological KL score, osteophyte count and joint space narrowing. There is a significant correlation between functional WOMAC score and self-reported pain in osteoarthritis knee.

There is no significant correlation between the radiological KL score with sex distribution in osteoarthritis knee. Osteoarthritis knee is a disease mainly affecting people in their old age with mean age of presentation 56 years and has slight female preponderance. Patients of osteoarthritis knee presents with fixed flexion deformity in one third of the cases.More than 90% cases had range of movement greater than 90 degree. Patients of osteoarthritis knee presents with synovial thickening in one third of the cases with joint space narrowing in two third cases. In patients of osteoarthritis knee joint when there is decrease in Q angle cause severity in radiological feature.

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