Science Journal of Clinical Medicine
2018; 7(6): 41-46
http://www.sciencepublishinggroup.com/j/sjcm
doi: 10.11648/j.sjcm.20180706.11
ISSN: 2327-2724 (Print); ISSN: 2327-2732 (Online)

Knee Flexion Deformity in Osteoarthritis Assessment: Functional Outcome and Association to Certain Parameters

Uqba Nafea Yousif[1], Rayan Mohammad Maree Altaee[2]

[1]Deparmtment of Medicine, Faculty of Rheumatology, Tikrit University, Salahaldin, Iraq

[2]Alshikhan General Hospital, Rheumatology Unit, Nenavah Health Directorate, Nenavah, Iraq

Email address:
Okynafy@yahoo.com (U. N. Yousif), rayan_mm1976@yahoo.com (R. M. Altaee)

To cite this article:
Uqba Nafea Yousif, Rayan Mohammad Maree Altaee. Knee Flexion Deformity in Osteoarthritis Assessment: Functional Outcome and Association to Certain Parameters. *Science Journal of Clinical Medicine*. Vol. 7, No. 6, 2018, pp. 41-46. doi: 10.11648/j.sjcm.20180706.11

Received: October 14, 2018; **Accepted**: November 26, 2018; **Published**: December 20, 2018

Abstract: To assess the functional outcome of Knee flexion deformity which was a real complication of 154 joints measured by Plastic goniometer and collected from 81 patients with knee Osteoarthritis as independent cases in this Case-series study. Statistical analyses revealed that the percentage of Flexion deformities higher and increase with age of the patient and there is high significance correlation of flexion deformity and its degree with LYSHOLM Knee Questionnaire Scale altering the normal pattern and the biomechanics of normal knee function and walking.

Keywords: Osteoarthritis, Flexion Deformity, Lysholm Knee Questionnaire

1. Introduction

Osteoarthritis (OA) is the most common joint disorder in the world and it is prevalent in all racial groups [1-2]. OA is a highly prevalent disease with markedly increasing impact worldwide because of the aging of populations [3-4]. Osteoarthritis currently affects more than 20 million individuals in the United States, and this number is expected to increase [5]. OA results in 68 million lost workdays/year and 4 million hospitalizations/year. Approximately 100,000 patients in the United States are unable to walk from their bed to the bathroom because of OA [6].

Primary OA is the most common form of arthritis in North America and Western Europe [6], and strongly associated with ageing and is a major cause of pain and disability in older people [2]. Studies show that 9.6% of men and 18.0% of women aged ≥60 years in the world have symptomatic osteoarthritis [7] and it is the second most common rheumatological problem [8].

Osteoarthritis importance derives from its economic impact, in terms of both productivity (single greatest cause of days lost from work) and cost of treatment [9].

This is particularly problematic given that only limited therapies have proven effective in reducing symptoms, the mainstays of treatment being non-steroidal anti-inflammatory drugs, nonspecific physical therapy interventions, local corticosteroid injection, and ultimately, when these are ineffective, total joint replacement [10].

In recent years, there has been a growing body of data supporting the notion that biomechanics are important in the pathophysiology of knee OA, with research showing that static and dynamic alignment are potent predictors of progression [11-12].

Knee flexion deformity (FD) or contracture is a term that describes a pathological situation where a joint cannot be fully extended “Figure 1”. FD of the knee is a feature of many orthopedic problems and has an adverse effect on the functional performance of the joint [13].

Figure 1. *Fixed Flexion Deformity.*

Fixed knee flexion contracture is thought to be common among patients with degenerative joint disease, especially in association with varus deformity [14].

OA is one of the commonest morbidities in older people and the most common reason for restricted activity in their daily life. Evidence reported that death rates were higher than expected in persons with radiographic knee OA and this increased mortality was attributed in some studies to cardiovascular and gastrointestinal disorders. Possible factors in excessive mortality include reduced level of physical activities, presence of co-morbid conditions and adverse effects of medications such as non-steroidal anti-inflammatory drugs (NSAIDS) [15].

The course and prognosis of osteoarthritis has also been measured by radiographic progression. The majority of studies based on knee OA, shows that the radiographic progression occurred in the majority of cases, was more common in women than in men, and correlated with worsening symptoms and deformity. Other several recent studies reported that radiographic progression did not correlate with symptomatic changes.

Functional limitation, bony enlargement, coarse crepitus, FD and reduced flexion range of motion appear to be relatively strong indicators for knee osteoarthritis; and varus malalignment, palpable effusion, bony enlargement, flexion deformity and lower knee flexion range of motion tended to be associated especially with tibio-femoral osteoarthritis [16]. In the knee osteoarthritis, the degenerative changes developed within articular cartilage and those changes as erosion and/or osteophytes would be likely to accompany a knee flexion deformity [17], and then full extension may be prevented if contracture and adhesions develop in the posterior capsule, the hamstring muscles and possibly the cruciate ligaments. Weight-bearing may put an excessive load on the back of the femoral condyles, and cause them to sink into the back of the tibial condyles, ultimately causing contact between the femoral intercondylar notch and the tibial intercondylar eminence, and so creating a further mechanical block to extension, so knee FD is likely to be progressive [18].

Knee flexion deformities fall into three grades based on the degree of deformity. Grade one represents mild knee FD which is ten degrees or less. Grade two knee FD is of moderate severity, approximately ten to thirty degrees. Grade three is a severe knee FD of more than thirty degrees [13].

Knee FD has an adverse effect on function [18]. Knee FD significantly alter the kinematics of walking and dramatically reduce the comfort and efficiency of walk [19].

The position of full extension of the lower limb is mandatory for the weight bearing and stability without undue muscular action. The opposite however, is true when the knee is flexed; weight bearing requires considerable expenditure of energy by the quadriceps; with consequent increase in the forces across patello-femoral and tibio-femoral joints. Standing is thus a considerably tiring activity for patient with such deformity. Walking is even a more tiring situation for those patients, as it requires a straight leg in part of the gait. The extreme difficulty however is during climbing up and going down stairs or slopes when full knee extension and maximum quadriceps performance are needed [13].

The presence of knee FD may impair function in patients with osteoarthritis, and impaired function may result from increased energy requirements and earlier fatigue of the quadriceps, causing functional impairment, limping gait, decreased walking distance or problems with sporting or leisure activities. Knee FD causes increased forces across the patello-femoral joint, predisposing the patient toward anterior knee pain and quadriceps fatigue pain. It may also lead to abnormal loading of the posterior femoral condyles and the posterior tibial plateau during the stance phase of gait [14].

Fully extended, the knee can bear weight and remain stable without sustained muscular action, but to hold it under load while flexed requires considerable expenditure of energy by the quadriceps, with consequent increases in the forces across the patello-femoral and tibio-femoral joints. Walking, which requires a straight or nearly straight leg in part of the cycle, and standing are therefore likely to be abnormally tiring activities for patients with a FD of the knee; walking up and down stairs or slopes is even more tiring. If the knee FD is unilateral the resulting imbalance has to be compensated, so that strain and fatigue are also felt elsewhere in the body [18].

2. Material and Methods

The present study was performed during the period between the 1st. of Mar. 2012 and the 1st. of June 2012 in the rheumatology outpatient department in Ibn Sina teaching hospital in Mosul.

The patients enrolled in this study were 81 patients (20 male and 61 female) who had unilateral or bilateral knee OA as follow:

Twenty males (3 patients unilateral knee OA and 17 patients bilateral Knee OA) (i.e. 37 joints)

Sixty one female (5 patients unilateral knee OA and 56 patients bilateral Knee OA) (i.e., 117 joints)

Each diagnosed joint was considered as an independent item, so the total studied sample was 154 joints. A fully extended knee (180°) was given an angle of (0°) FD. And the sample was divided into two groups according to the goniometric measurement of the angle of knee FD. The first group was patients with FD, who's had reading more than 0° (presence of FD). The second group was patients without FD, who's had reading equal to 0° (absence of FD). These two groups were compared regarding (age, gender, BMI and knee functional outcome by Lysholm questionnaire).

2.1. Study Design

Case-series study (descriptive clinical study).

2.2. Subjects

Patients with Knee Osteoarthritis (OA)Eighty one patients aged 40-78 years (20 males and 61 females) complaining

from knee pain (unilateral or bilateral) who were diagnosed as knee osteoarthritis patients according to the clinical classification criteria of idiopathic knee OA of the American College of Rheumatology (ACR) (20). Patients divided into 4 subgroup according to the age; Subgroup A (40-50year), B (50-60year), C (60-70year) and D (more than 70year).

2.3. Inclusion Criteria

Any male or female, 40 years in age or older who fulfil the ACR criteria.

2.4. Exclusion Criteria

(1) New and old major trauma affecting the knee.
(2) Inflammatory condition.
(3) Neoplasm.
(4) Endocrine diseases.
(5) Root pain
(6) Age less than 40 years.

2.5. History

Full history was taken from patients for diagnostic purposes. A questionnaire form was filled which included information from both history and physical examination.

2.6. Clinical Examination

The clinical examination that was done for the patients included weight and height measurement to derive body mass index (BMI) by this equation: BMI = (weight in kg) / (height in m) 2 [21].

Were patient in supine position, clinical examination of the knee joint included carful detection of findings required for the ACR criteria (crepitus on active motion, bony tenderness, enlargement and no palpable warmth of synovium).

Then knee flexion deformity (FD) measurement was done using a goniometer. Measurement was done in supine position, with the knees extended by the patient as far as possible. The fulcrum of goniometer is aligned with the lateral epicondyle of the femur. The stationary arm is aligned with the midline of the femur toward the greater trochanter of femur, while the moving arm with the midline of the fibula toward the lateral malleolus of fibula.

LYSHOLM Knee Questionnaire or Scale is a knee outcome scale for assessment of knee disability in various chondral disorders of the knee, it contains eight domains: limping, locking, pain, stair-climbing, support, instability, swelling, and squatting with a score for each one. An overall total score of 0 to 100 is calculated, with 95 to 100 indicating an excellent result and <65, a poor result.

The Lysholm knee scale originally designed to assess ligament injuries of the knee, it has been used for a variety of knee conditions, including chondral disorders [22].

2.7. Instruments and Equipments

The instruments used in this study were:
Weight and height scale (SECA - Germany).

X-RAY Equipment MULTIX Swing model (SIEMENS - Germany).

Plastic goniometer “Figure 2”

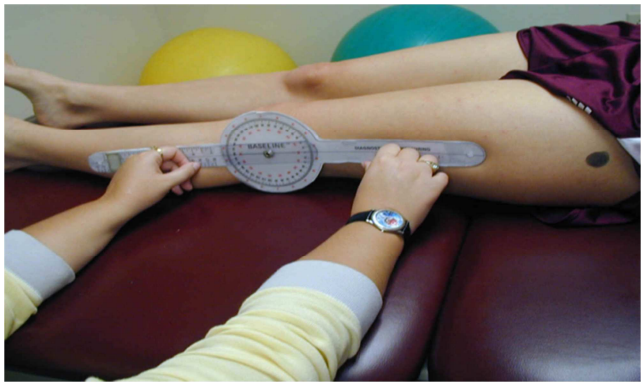

Figure 2. *Plastic goniometer.*

2.8. Investigations

X-Ray is the only investigation that was done for the patients, with standing position, anterior-posterior view of the both knees taken for all patients and assessed by the same radiologist for diagnosis of osteoarthritis by determination of joint space narrowing, subchondral bone sclerosis, osteophyte formation and existing of bone cyst.

3. Results

Eighty one patients (n=81). aged 40-78 years (20 males and 61 females). The number of joints were 154 (n=154) (Table 1).

Table 1. *The age, sex and BMI table of the Sample (Patients) (n=81).*

Age (Mean±SD.)	**57.43 ± 9.02***
Male / Female Ratio	0.33 : 1
BMI (Mean±SD.)	33.54 ± 5.46*

* Unpaired t-test.

The distribution of cases (as joints) according to the measurements of knee flexion deformity showed that (79) joints (51.3%)has 0° (no flexion deformity), (52) joints (33.8%)has 1° – 10°, (22) joints (14.3%)has 10° – 20° and only (1) joint (0.7%) has above 20°(Table-2).

Table 2. *The joints distribution according to the degree of knee flexion deformity.*

The Degree of Knee Flexion Deformity	**Joints**	
	No.	**(%)**
0°	79	51.3
1° – 10°	52	33.8
10° – 20°	22	14.3
≥ 20°	1	0.7
Total	154	100.0

The percentage of the flexion deformity within the same age group show age group A (n=6)the FD (22.2%), group B (n=31)the FD (47%), group C (n=25)the FD (62%), group D (n=13)the FD (65%) that’s mean higher in older age group

(Table-3), the percentage of flexion deformity within same gender show that males (n=17) with flexion deformity (45.9%) while females (n=58)with flexion deformity (49.6%) so in female higher than male gender (Table-4).

Table 3. *The percentage of flexion deformity within same age group.*

Age (years)	Flexion Deformity	Total	Flexion Deformity %
	No.	No.	in age group
40 – 50	6	27	22.2%
50 – 60	31	66	47.0%
60 – 70	25	41	61.0%
≥ 70	13	20	65.0%
Total	75	154	48.7%

Table 4. *The percentage of flexion deformity within same gender.*

Sex	Flexion Deformity	Total	Flexion Deformity %
	No.	No.	in the same gender
Male	17	37	45.9%
Female	58	117	49.6%
Total	75	154	48.7%

The patients included in this study had a high BMI, and the majority (95.5%) of studied sample occur in the higher BMI group (BMI ≥ 25 kg/m2), with mean BMI for the studied sample was (33.69±5.47)The mean of BMI in both groups FD and without FD were (33.87±6.06) and (33.52±4.88) respectively, with no significant difference (table-5).

Table 5. *Flexion deformity distribution according to BMI.*

BMI (kg/m^2)	With Flexion		Without Flexion		Total		P–Value*
	No.	(%)	No.	(%)	No.	(%)	
Low BMI (< 18.5)	-----	-----	-----	-----	-----	-----	
Normal BMI (18.5 - 24.9)	4	5.3	3	3.8	7	4.6	NS
High BMI (≥ 25)	71	94.7	76	96.2	147	95.5	
Total	75	100.0	79	100.0	154	100.0	
Mean±SD.	33.87 ± 6.06		33.52 ± 4.88		33.69 ± 5.47		NS**

* Chi-square test.
** Unpaired t-test.

According to the score of each question limping, support, locking, instability, pain , swelling, stair up and squatting (Mean±SD.) as well as the total score of LYSHOLM knee questionnaire for both groups: group with FD & without.

The results were significant with all scores even total score of LYSHOLM except instability and swelling were not significant as shown in (Table-6).

Table 6. *(Mean±SD.) for the both groups (with flexion and without flexion) according to the score of each question as well as the total score of LYSHOLM knee questionnaire.*

Score For Each Question	With Flexion (n=75)	Without Flexion (n=79)	P–Value*
	(Mean±SD.)	(Mean±SD.)	
Q.1 Limp (0-5)	3.37 ± 1.75	4.15 ± 1.25	0.002
Q.2 Support (0-5)	4.52 ± 1.18	4.96 ± 0.34	0.002
Q.3 Locking (0-15)	12.00 ± 4.43	13.81 ± 2.79	0.003
Q.4 Instability (0-25)	19.93 ± 7.05	21.90 ± 5.79	NS
Q.5 Pain (0-25)	4.13 ± 3.22	5.63 ± 4.41	0.018
Q.6 Swelling (0-10)	6.76 ± 4.33	7.92 ± 3.73	NS
Q.7 Stair-up (0-10)	2.61 ± 2.59	4.47 ± 2.93	0.000
Q.8 Squatting (0-5)	1.92 ± 1.61	2.81 ± 1.73	0.001
Total Score (0-100)	55.30 ± 18.20	65.70 ± 14.00	0.000

* Unpaired t-test.

The result of Correlations of LYSHOLM score with age showing (p-value 0.043), with gender males (p-value 0.007), females (p-value 0.007), and with degree of flexion deformity (p-value 0.002)(Table-7).

Table 7. *Correlations of LYSHOLM score with age, gender, flexion deformity and degree of flexion deformity.*

Correlation of LYSHOLM Score with the follow:	r–Value	P–Value*
Age	- 0.163	0.043
Gender (Male)	0.218	0.007**
Gender (Female)	- 0.218	0.007**
Flexion Deformity	- 0.279	0.000**
Degree of Flexion Deformity	- 0.252	0.002

* Pearson Correlation
** Spearman's rho Correlation

The correlations of flexion deformity with age was significant (p-value 0.001), not significant with both male and female genders and LYSHOLM score the significance rate (p-value 0.000)(Table-8). The results of correlations of the degree of flexion deformity with age (p-value 0.000) , not significant with males, female and LYSHOLM score (p-value 0.002) (Table-9).

Table 8. *Correlations of flexion deformity with age, gender, and LYSHOLM score.*

Correlation of Flexion Deformity with the follow:	r–Value	P–Value*
Age	0.269	0.001
Gender (Male)	- 0.031	NS
Gender (Female)	0.031	NS
LYSHOLM Score	- 0.279	0.000

* Spearman's rho Correlation

Table 9. *Correlations of the degree of flexion deformity with age, gender and LYSHOLM score.*

Correlation of The Degree of Flexion Deformity with the follow:	r–Value	P–Value*
Age	0.409	0.000
Gender (Male)	- 0.010	NS**
Gender (Female)	0.010	NS**
LYSHOLM Score	- 0.252	0.002

* Pearson Correlation
** Spearman's rho Correlation

4. Discussion

Knee osteoarthritis (OA) is one of the most common causes of disability in old people [4]. and especially with knee flexion deformity (FD) which is a real complication of knee OA [14].

The present study was performed to assess the knee FD in a sample of 81 knee OA patients (154 knee OA joints)

In parallel to other risk factors such as age, gender, body mass index (BMI), association with functional outcome Lysholm questionnaires.

This study shows that the percentage of FD increases with age, and the higher FD percentage (65.0%) was found in older age group (≥ 70 years). Age also had a very high significant correlation with both FD and the degree of FD parameters (table-8) and (table-9) respectively. An association has been found between increasing age and physical impairment in knee OA [23]. This association may be partly explained by FD which increases with age.

In this study FD was present in higher percentage in female patients than male (49.6%) and (45.9%) respectively (table 4)and gender showed no significant correlation with both FD and degree of FD parameters (table-8))and (table-9)respectively. Female gender is a major predisposing factor of knee OA [24-25], and is reportedly associated with worse clinical manifestations of knee OA than in men [26-27]. Also women experience more severe clinical OA than men; and JSN and osteophytes were more severe in women than in men [28].

The mean of BMI in both groups FD and without FD were (33.87±6.06) and (33.52±4.88) respectively, with no significant difference (table-5))Obesity is a risk factor for both the development and progression of knee OA and increased BMI is well known to be associated with knee OA and disability [29].

Total Lysholm score had mean (55.30±18.20) and (65.70±14.00) in both groups of FD and without FD respectively, with a very high significant difference [6]. Lysholm also had a very high significant correlation with FD parameter and had a high significant correlation with the degree of FD parameter (table-7) in addition, this table showing further correlations of Lysholm with other parameters.

Furthermore, the quadriceps muscle is over worked in the presence of FD [30]. Fixed knee FD is thought to be common among patients with degenerative joint disease, especially in association with varus deformity [14], and it has been dealt with as part of malalignments and deformities in general [30]. Many authors found that BMI increases the risk of knee OA progression in which moderate malalignment exists [29]. Also valgus alignment was associated with a border line significant increase in development of knee OA, and varus alignment was associated with a 2-fold increased risk [31]. Stratification for BMI showed that this increased risk was especially seen in overweight and obese individuals but not in non-overweight persons. The paucity of studies which deal specifically with flexion deformity in knee OA, urge us to suggest that this subject needs further research, especially that flexion deformity is a major challenging problem when the patient need total arthroplasty [32]

5. Conclusion and Recommendations

Flexion deformity is a common complication in knee osteoarthritis.

An impressive finding in this study is that FD was associated with worsening measures of the individual functional outcome and the total score of the Lysholm questionnaire. Knee FD certainly alters the normal pattern and the biomechanics of normal knee function and walking; keeping in mind that full extension of the knee is part of the normal walking cycle that's giving the importance of conservation of the strengthening and stretching properties of quadriceps muscles Therefor some disability should be expected in the presence of FD and should be prevented as early as possible before reaching the stage of severe OA of the knee. However, once FD is established, it will add a burden on the knee which may accelerate the OA process.

Monitoring bilateral knee range of motion in patients with longer-duration OA could allow earlier intervention and reducing functional loss.

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