



# Pattern of Motion Restriction in Nigerian Patients with Knee Osteoarthritis

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## SUMMARY

In the Western population, knee osteoarthritis (OA) has been shown to present a characteristic passive motion restriction pattern, called the capsular pattern (extension restriction to flexion restriction ratio ranging from 0.03 to 0.50). The pattern of motion restriction of Nigerian patients with OA has not been previously reported. This study was conducted to determine the pattern of motion restriction in Nigerian patients with knee osteoarthritis.

Participants were 50 patients with knee OA (OA Group/OAG), recruited consecutively from two secondary health institutions and 50 age and sex-matched controls (Control Group/CG) without symptoms of OA. Goniometric measurements of passive and active knee motion of participants were taken. Data was analysed using the independent t-test.

The OAG, aged  $58.1 \pm 10.7$  years has had OA for  $4.0 \pm 4.5$  years. The CG was aged  $55.9 \pm 10.3$  years. Mean active extension ( $1.5 \pm 5.2^\circ$ ) of the OAG differed significantly ( $P < 0.05$ ) from that of the CG ( $0^\circ$ ), but the two groups did not differ significantly in passive extension (OAG =  $1.2 \pm 4.4^\circ$ ; CG =  $0^\circ$ ). The CG ( $125.9 \pm 4.6^\circ$ ) had significantly higher ( $P = 0.0001$ ) active knee flexion than the OAG ( $99.9 \pm 15.5^\circ$ ). Passive knee flexion of the CG ( $134.5 \pm 5.0^\circ$ ) was significantly higher ( $P = 0.000$ ) than that of the OAG ( $110.4 \pm 14.8^\circ$ ). Mean active extension and flexion restriction of OAG was  $2.1 \pm 5.7^\circ$  and  $26.0 \pm 15.4^\circ$  respectively. Mean passive extension restriction was  $1.2 \pm 4.4^\circ$  and passive flexion restriction was  $24.0 \pm 14.8^\circ$ , giving a ratio of 0.05 for OAG.

Our findings suggest that the passive motion restriction pattern seen in Nigerian patients with knee osteoarthritis is the capsular pattern.

**KEY WORDS:** motion restriction, patients, knee osteoarthritis

## INTRODUCTION

Osteoarthritis (OA) is the most common joint disease in the elderly and a leading cause of disability in the world (Yeomans, 2000). It affects 60-70% of the population older than 60 years (Lane, 1997). The most frequently affected joint in Nigerian patients is the knee (Ogunlade et al., 2003; Akinpelu et al., 2007). The prevalence estimate of symptomatic knee OA in Nigerian rural community dwellers aged  $\geq 40$  years is 19.6% (Akinpelu et al., 2009).

One of the features of osteoarthritis is motion restriction (Ward and Tidswell, 1985). Cyriax (1978) observed the patterns of passive motion restriction in various joints of the body. He proposed the theory that, at every joint affected by inflammatory or degenerative disease, the proportion that the limitation or restriction of motion in one direction bears to that in other directions conforms to a standard which indicates whether arthritis is

present or not. This proportional limitation Cyriax (1978) called a 'capsular pattern'. For the knee, he defined the capsular pattern as a gross limitation in flexion (e.g.  $90^\circ$ ) and a slight limitation in extension (e.g.  $5^\circ - 10^\circ$ ). According to Cyriax (1978), non-capsular patterns of motion restriction are associated with ligamentous adhesions, internal derangement and extra-articular lesions. Orthopaedic Medicine Teachers in the United Kingdom also defined capsular pattern for the knee as much greater loss of flexion range than extension without recourse to figures (Ellis, 1995). The concept of capsular pattern has been used over time by clinicians to evaluate joints. However, Cyriax (1978) did not supply any evidence to support this concept (Fritz et al., 1998). This probably prompted a few studies, conducted with the view to seek evidence in support of the capsular pattern concept, but results have been conflicting. Hayes et al. (1994) evaluated

the capsular pattern in patients with knee OA and concluded that the validity of capsular pattern for identifying patients knee OA was questionable. These authors suggested that a proportional definition of a capsular pattern should be abandoned, but the concept of a pattern of range of motion loss may be useful. On the other hand, Fritz and colleagues (1998) in addition to demonstrating the capsular pattern in osteoarthritis of the knee also provided a proportional and objective definition based on the ratio of the loss of passive extension to loss of passive flexion. These authors concluded that a proportion of passive extension loss or restriction to passive flexion restriction between 0.03 and 0.50 best differentiated between individuals with and without arthritis.

The pattern of motion restrictions has not been studied in Nigerian patients. The aim of this study was therefore to determine the pattern of motion restrictions in Nigerian patients with knee OA.

## MATERIALS AND METHODS

The Ethical Committee of the Federal Medical Centre, Makurdi, Nigeria approved the study. Fifty patients diagnosed with unilateral or bilateral knee osteoarthritis (OA group) by the referring surgeons/physicians and 50 age and sex-matched controls without pain or other symptoms of knee osteoarthritis (control group) participated in the study. Patients with knee OA were recruited consecutively from physiotherapy and surgical outpatient clinics of the NKST Rehabilitation Hospital, Mkar and the Federal Medical Centre, Makurdi, both in Benue State, Nigeria. Diagnosis of OA was based on clinical signs and radiological findings. The controls were members of staff of the two hospitals and relations of patients. Participants did not have any other musculoskeletal or neurological problem, such as chronic low back pain, hip OA and hemiparesis.

The procedure was explained to participants and each gave his/her consent. Participants were interviewed to obtain their biodata and clinical history was obtained through interviews and from their hospital files. Weight and height were measured. Passive range of motion was measured on the affected knee or the more affected knee in patients with bilateral knee osteoarthritis, using a pliable universal goniometer (Olfen™). Goniometric measurement of knee motions was taken according to the American Academy of Orthopaedic Surgeons' (AAOS) protocol (AAOS, 1965). Knee flexion was measured with participants in prone position, while extension was

measured with the subject lying prone, but with the legs extended over the end of the plinth, such that the patellae was free in space over the end of the plinth and lower parts of the femurs supported (Edwardson, 1992). The goniometer was placed on the lateral aspect of the knee with the fulcrum over the lateral epicondyle. The stationary arm of the goniometer was aligned with the mid-line of the femur towards the greater trochanter and the movable arm aligned with the mid-line of the fibula towards the lateral malleolus. The axis of the goniometer and the two ends of the arms were marked on the knee, thigh and leg respectively, with a marker to ensure accuracy. Each participant was asked to perform the test motion actively or the motion was passively performed by the tester. Three measurements were taken for each motion and the average of the three readings was recorded as the value for the movement. Active motions were measured before passive motion (AAOS, 1965). In order to calculate values of passive knee extension and flexion restriction of participants in the OA group, the mean passive extension and flexion of the control group was taken as normal values and each participant's passive extension/flexion was subtracted from the corresponding mean value.

Data was summarized using descriptive statistics (mean, standard deviation and ratio). Independent student t-test was used to compare the active and passive knee motion and motion restrictions of the two groups. P value was set at 0.05.

## RESULTS

The age of the OA group (23 males, 27 females) ranged from 40 to 80 years and the mean was  $58.1 \pm 0.7$  years. For the control group (23 males, 27 females), it ranged from 40 to 73 years, with a mean of  $55.9 \pm 10.3$  years. The duration of osteoarthritis averaged  $4.0 \pm 4.5$  years. Most of the participants were civil servants and farmers (table 1). In the OA group, 27 participants (10 males, 17 females) had bilateral knee involvement, 14 (7 males, 7 females) were affected on the left and 9 (6 males and 3 females) had right knee affected. Left and right knees were assessed in 26 and 24 participants respectively. The two groups did not differ significantly in age (table 1).

Mean active extension was  $1.5^\circ \pm 5.2^\circ$  for the OA group while it was  $0^\circ$  for the control group. Mean passive extension was  $1.2^\circ \pm 4.4^\circ$  for the OA group and  $0^\circ$  for the control group. For the OA group, mean active flexion was  $99.9^\circ \pm 15.5^\circ$  and for the control group, it was  $125.9^\circ \pm 4.6^\circ$ . Mean passive flexion was  $110.4^\circ \pm 14.8^\circ$  for the OA group

and  $134.5^{\circ} \pm 5.0$  for the control group. Mean active extension for the OA group differed significantly from that of the control group ( $P=0.05$ ) but there was no significant difference between the passive extension of both groups. The control group exhibited a significantly greater active knee flexion ( $P= 0.000$ ) and passive knee flexion ( $P= 0.000$ ) than the OA group.

**Table 1.** Sociodemographic characteristics of participants

	OAG	CG
Age (years)		
Mean	58.1	55.9
Standard deviation	10.7	10.3
Sex		
Male	23	23
Female	27	27
Height (cm)		
Mean	163.3	163.4
Standard deviation	6.3	6.7
Weight (kg)		
Mean	76.0	74.4
Standard deviation	12.0	8.4
Occupation		
Farmers	18	12
Traders	7	8
Civil servants	18	30
Others	7	-

OAG - OA group

OA - osteoarthritis

**Table 2.** Active and passive knee motions of participants

	OA Group		Control Group		t-value	p
	Mean	SD	Mean	SD		
Active knee extension ( $^{\circ}$ )	1.5	5.2	0.0	5.2	1.987	0.050*
Passive knee extension ( $^{\circ}$ )	1.2	4.4	0.0	0.0	1.876	0.064
Active knee flexion ( $^{\circ}$ )	99.9	15.5	125.9	4.6	-11.369	0.000*
Passive knee flexion ( $^{\circ}$ )	110.4	14.8	134.5	5.0	-10.861	0.000*

\* = significant difference ( $^{\circ}$ ) - degrees

OA - osteoarthritis SD - standard deviation

For the OA group, the mean restriction of active knee extension and flexion was  $2.1^{\circ} \pm 5.7^{\circ}$  and  $26.0^{\circ} \pm 15.4^{\circ}$

respectively. Majority (92%) of the participants in the OA group did not exhibit any restriction of passive knee extension. The passive knee extension restriction demonstrated by the remaining four participants in the OA group ranged from  $5^{\circ}$  to  $23^{\circ}$ . The mean restriction of passive knee extension for the group was  $1.2^{\circ} \pm 4.4^{\circ}$ . All participants in the OA group demonstrated restriction of passive knee flexion ( $4.5^{\circ}$  to  $59.5^{\circ}$ ) and the mean value was  $24.0^{\circ} \pm 14.8^{\circ}$ . The ratio of passive knee extension to flexion restriction was (1.2:24) 0.05.

**Table 3.** Passive knee motion restrictions of OA group

	Range	Mean	SD
Passive knee extension restriction	5-23	1.2	4.4
Passive knee flexion restriction	4.5-59.5	24.0	14.8

( $^{\circ}$ ) - degrees SD - standard deviation

## DISCUSSION

The mean age ( $58.1 \pm 10.7$  years) of the OA group in this study is within the range reported by previous studies (Hannan et al., 1993; Lohmander et al., 1993; Zhang et al., 1995). Their gender distribution (27 females and 23 males) also supports the female bias reported by previous studies on pattern of OA in Nigeria (Ogunlade et al., 2005; Akinpelu et al., 2007).

The mean passive flexion ( $134.5 \pm 5.0^{\circ}$ ) of the control group is very close to the normal value ( $135^{\circ}$ ) published by the American Academy of Orthopaedic Surgeons (AAOS, 1965). The finding that almost all participants in the OA group recorded full passive knee extension ( $0.0^{\circ}$ ) is inconsistent with the findings of previous studies that reported inability of most participants to attain full passive knee extension (Walker, 1984; Mollinger and Steffan, 1993). The reason for this difference could be that relatively younger individuals with OA were involved in the present study.

The finding that the OA group demonstrated significantly lower active knee extension and flexion and passive knee flexion supports the fact that limitations of range of motion are a feature of osteoarthritis. The results of this study also indicate that patients with knee OA tend to exhibit more limitation of knee flexion than limitation of extension. The proportional passive knee extension restriction to passive knee flexion restriction of the OA group supports the idea of capsular pattern. Although the

mean passive motion restrictions ( $1.2^{\circ} \pm 4.4^{\circ}$  of extension and  $24.0^{\circ} \pm 14.8$  of flexion restriction) are a lot less than the  $5^{\circ}$  for extension and  $90^{\circ}$  for flexion described by Cyriax (1978), the ratio of passive knee extension restriction to passive knee flexion restriction of the OA group (0.05) is within the range (0.03-0.5) recommended by Fritz et al. (1998) for defining capsular pattern. This proportional motion restriction differentiates the OA group from the control group, who demonstrated no restriction. The capsular pattern may therefore be used along with other clinical criteria for knee OA diagnosis, such as the criteria of the American College of Rheumatology where radiographic facilities are not readily available.

## CONCLUSION

Our findings suggest that the pattern of passive motion restriction in knee osteoarthritis seen in Nigerian patients is similar to the capsular pattern described for the Western population.

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