

## A study on the range of movements of knee joint in South Indian Females

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### Abstract

**Introduction:** The assessment of joint flexibility is clinically carried out by measurement of highest ROM presented at the joint. Researchers and clinicians are normally measuring of ROM of knee joint to evaluate diseases and injuries of the knee joint. There are only few studies reported in female population by assessing ROM of the knee joint.

**Materials and Method:** The current research was carried out in female population. A total of 480 female subjects were included in present study. American Academy of Orthopedic Surgeons (AAOS) is recommending the techniques of measurements in their handbook. Universal Goniometer was used to measure the ROM.

**Result and Discussion:** The current study reports on ROM of knee joint analyzed using Universal Goniometer. The maximum mean AROM (150 degrees) was noted in 6-10 years age group and the minimum mean AROM (123.6 degrees) in 71-80 years age group. The maximum mean PROM (157.5 degrees) was noted in 6-10 years age group and the minimum mean PROM (133.9 degrees) in 71-80 years age group. The ROM was more in younger subjects and decreased gradually with advancing age. In the prone position, the average AROM is 122.9 degrees, and PROM is 133 degrees.

**Conclusion:** The study concludes that the patient's healthy limb can be used for contrast with the affected side in the presence of unilateral limb lesion. These data can provide a more understanding of the ageing process. The results of the present study would be to the practitioners, physiatrist and researchers as quick references to measure the ROM of the knee joint.

**Keywords:** Joint Range of Motion, Knee Joint, Goniometer.

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### Introduction

The assessment of joint flexibility is clinically carried out by measurement of highest ROM presented at the joint. Researchers and clinicians are normally measuring of ROM of knee joint to evaluate diseases and injuries of the knee joint.<sup>(1)</sup> It may show an important impact on the improvement of scientific basis of therapeutic interventions and improves efficacy of treatment. There are only few studies reported in female population by assessing ROM of the knee joint.<sup>(2)</sup>

The existing data shows a deficiency about normal ROM of knee joint in different aged female group from South Indian community. The current study is carried out to understand the community-based normative standards of ROM of the knee joint in different aged female group using Universal Goniometer. Both PROM and AROM of knee joint were calculated in prone and supine position.

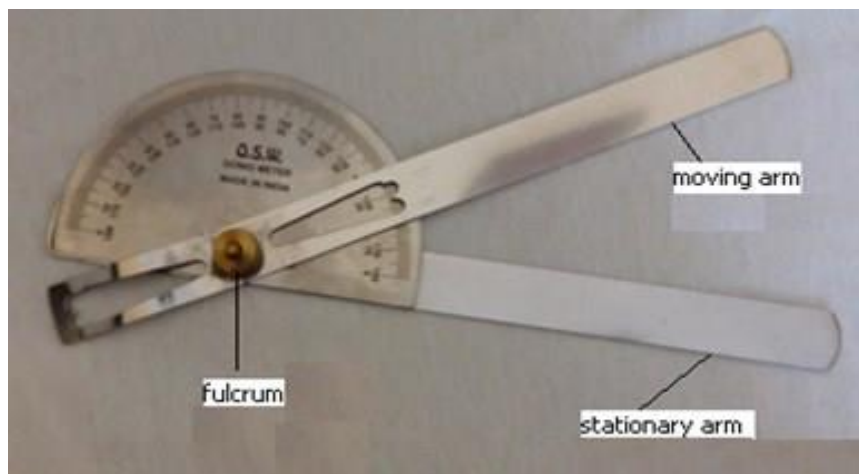
It is cheap and reliable to use goniometer for measuring ROM, but many factors can influence the findings. For example, age may act as a factor to influence the value by decreasing the joint ROM with the aging. Reduction of joint ROM is frequently agreed as usual part of ageing, happened due to deterioration of joint tissues which become noticeable with age. Other

factors like body weight, height, sex and physical activity may influence joint ROM. There is no existing data available on age-specific ROM of South Indian female population in a different poster. Current study is to confirm a normative ROM value for age-specific south Indian female population. It is essential and helpful for health care practitioners especially for physicians and orthopedic surgeons to find out diseases and injuries of the knee.

### Materials and Method

The current research was carried out in female population with the age of 6-80 years. A total of 480 female subjects from Kasargod, Kerala and Mangalore, Karnataka were included in present study. Subjects with pain and deformities in knee joint, and population with congenital anomalies were considered in exclusion criteria of the study. American Academy of Orthopedic Surgeons (AAOS) is recommending the techniques of measurements in their handbook.

Universal Goniometer was used to measure the ROM. Goniometer is made up of stainless steel having a moving arm and stationary arm with a body part. The body has readings from 0- 180 degrees, which is look like a protractor (Fig. 1).



**Fig. 1: Universal goniometer**

**Positioning:** The fulcrum was located on the lateral epicondyle of femur. The proximal arm is associated along the line extending from lateral epicondyle to greater trochanter and the distal arm along the line extending from lateral epicondyle to lateral malleolus. The location of fulcrum is confirmed above the estimated position of the axis of motion. Fulcrum should be tuned accordingly to manage the movement changes during motion.



**Fig. 2: Alignment of goniometer in supine position**

Informed consent was obtained from the patients after detailing the procedure. By using a black marker lateral malleolus of fibula, lateral epicondyle and greater trochanter of femur were marked. Extending from lateral epicondyle to greater trochanter of femur was noted with a line and the other line was denoting the connection from lateral epicondyle of femur to lateral malleolus of fibula (Fig. 2). PROM and AROM were calculated by means of goniometer both in prone and supine position.



**Fig. 3: AROM in supine position**



**Fig. 4: PROM in supine position**

**Supine position:** Patient need to lie in supine pose, fulcrum of the goniometer kept over the femur at lateral epicondyle. The proximal arm associated across the line extended from the lateral epicondyle to greater trochanter and distal arm along the line extending from lateral epicondyle of the femur to lateral malleolus of the fibula (Fig. 1).

The patient was requested to flex their knee joint up to their maximum possible flexion obtained with related flexion of the hip joint; AROM was noted (Fig.

3). Little more flexion was probable with the help of the examiner, it will note as PROM (Fig. 4). Resistance feeling due to connections with the calf and muscle of thigh was considered as the end of PROM. The procedure will repeat for the other limb also.

**Prone position:** As like positions in supine poster, patient lied in prone position, distal arm of the goniometer were placed on fulcrum and proximal arm. Both PROM and AROM of knee joint were calculated on both left and right limbs.

After the complete extension, ROM was measured from zero degrees and the extra extension was documented as minus degrees. Total computations were carried out by single investigator. ROM on the left and right side were compared using student's t-test. The comparison of ROM on the left and right side shows statistically insignificant in all age groups, hence the ROM of left and right knee joints were pooled together.

## Results

**Supine position:** Table 1 demonstrates how does the mean value and standard deviation (SD) of AROM and PROM of the knee joint in supine point. The maximum AROM noticed in the age of 6-10 years (mean 150 degrees) and minimum in the age of 71-80 years (mean 123.6 degrees). The highest PROM was also in the age 6-10 years (mean 157.5 degrees) and least in the age group 71-80 years (mean 133.9 degrees). In the supine position, the average AROM was 133 degrees, and PROM was 140 degrees.

**Table 1: ROM of knee joint in supine position**

Age in Years	6-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
No. of Subjects	30	30	30	30	30	30	30	30
AROM	150.0	141.7	132.8	128.2	128.5	125.6	124.0	123.6
S.D.	2.4	1.7	2.0	2.9	2.7	3.0	2.9	3.0
PROM.	157.5	151.7	143.0	138.1	138.5	136.0	134.8	133.9
S.D.	2.5	1.8	2.5	3.1	2.7	2.9	2.8	3.0

**Table 2: ROM of knee joint in prone position**

Age in Years	6-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
No. of Subjects	30	30	30	30	30	30	30	30
AROM	141.8	134.1	124.8	119.6	118.3	115.9	114.8	113.5
S.D.	2.5	3.0	2.6	2	3.4	2.6	2.6	3.0
PROM.	151.5	144.1	134.7	130.2	128.2	126.7	125.3	123.8
S.D.	2.4	2.6	2.8	2.3	3.0	2.7	2.8	3.1

**Prone position:** Table 2 showed the mean value and SD of AROM and PROM of the knee joint in prone point. The highest AROM was noted in the age groups of 6-10 years (mean 141.8 degrees) and minimum in the age group 71-80 years (mean 113.5 degrees). The highest PROM was also in the age of 6-10 years (mean 151.5 degrees) and least in the age group 71-80 years (mean 123.8 degrees). In the prone point, the average AROM was 122.9 degrees, and PROM was 133.1 degrees.

## Discussions

Joint disorders are increasing in female population particularly after menopause due to osteoporosis. Hence the awareness of normal ROM and its assessment is very essential in general practice. Measurement of ROM is the easiest way to assess mobility and its knowledge is helpful to know amount of restriction, planning treatment and prognosis of treatment. There are many factors which affect ROM like age, sex, weight, testing position whether supine or prone, physical activity, type of instrument, experience of examiner, etc.<sup>(3)</sup> Very few studies exist on age related changes in the ROM of knee joint in females.

As per the observation of American Academy of Orthopaedic Surgeons, the average ROM of knee joint is 134 degrees. The AROM was 120 degrees with hip extended and 140 degrees with hip flexed.<sup>(4)</sup> In supine position, the PROM is between 130 and 140 degrees.<sup>(5)</sup> Literatures available do not give age or sex related data and limited details of position. In this study, the average AROM of females was 133 degrees and PROM was 140 degrees in supine position. In prone position, the average AROM was 122.9 degrees and PROM was 133 degrees. The study by Vinay et al<sup>(6)</sup> on male subjects was done on male subjects of different age groups in both supine and prone position. This study confirms the importance of position in measuring ROM.

According to the study by Vinay et al,<sup>(6)</sup> the average AROM in males was 131.7 degrees and PROM was 141.7 degrees in supine position. In the prone position, the average AROM was 122.8 degrees and PROM was 132.9 degrees. Comparing with the present study there was no statistically significant difference in the measurements between males and females.

According to Nagar et al.,<sup>(7)</sup> there was a significant difference in the range of active flexion and perhaps related to sex in different age groups. James and Parker<sup>(8)</sup> studied knee flexion in men and women age more than 70 years and observed women had a better range of knee flexion. In our study, the females had a greater range of knee flexion in supine and prone position in 11-30 years and 71-80 years age group. This is in accordance with a similar study done on male South Indians by Vinay K V.<sup>(6)</sup> From the 4th to 7th-decade males had slightly increased the range of flexion in both supine and prone position. In the males, PROM in supine position was 150.3 degrees at 11-20 years, 141.8 at 21-30 years, 139.2 at 31-40 years, 138.9 at 41-50 years, 136.5 at 51-60 years, 135.2 at 61-70 years and 133.8 at 71-80 years. In females, it was 151.7, 143, 138.1, 138.5, 136, 134.8 and 133.9 degrees, respectively.

Increased flexion in the males from 4th to a 7th decade was credited to the increased daily actions resulting in a more movable joint whereas the female candidates were mainly sedentary resulting in a lesser range of flexion. In the females, massive hamstrings

and calf muscles further resulted in the restriction of flexion in the 4th to 7th decade.

ROM of knee joint was found to decrease with increasing age as per Roach et al<sup>(9)</sup> and Nagar et al.<sup>(7)</sup> In the present study, there is a gradual decrease during every decade of life and a significant decrease (>10 degrees) between second and third decade. The decrease in ROM may be due to age related changes on the joints (increased rigidity of connective tissue). Significant decrease in joint mobility should always be considered as abnormal and treated accordingly.

Regarding the effect of side, the ROM on the right and left side were almost similar. Literatures also give similar views in studies of Boone et al,<sup>(10)</sup> Vinay et al<sup>(6)</sup> and Asbjorn et al.<sup>(11)</sup> So it is recommended that ROM of normal limb can be used for comparison with diseased limb. The age related values will be helpful in diseases affecting both limbs.

Regarding the reliability of goniometer, this study confirms that Universal Goniometer and its placement when standardized can achieve good reliability in clinical practice. Longitudinal aging studies can give more accurate effect of age on ROM. Again a more elaborate study is necessary taking into account physical activity, body mass index and height of the individual before stating that difference of ROM is age related.

## Conclusion

This study gives data of age wise ROM of knee joint in females. The ROM is higher in younger subjects and decreased gradually with increasing age. The difference in ROM of right and left side is insignificant. The present values can always be used as ready reference by orthopaedicians, clinicians and researchers in evaluating mobility of knee joint.

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