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STUDY OF NORMAL RANGE OF MOTION OF KNEE JOINT IN SOUTH INDIAN INFANTS

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ABSTRACT

The purpose of this cross sectional study was to establish normal values of range of motion (ROM) of knee joint and extension limitation of normal healthy infants at birth, third month and at sixth month. Since normative values for passive range of motion (PROM) and extension limitation of the knee joint in infants are not well-documented in literature, the present study was undertaken. The present paper reports on PROM and extension limitation of knee joint measured using universal goniometer. It is based on 60 knee joints. The results of the present study showed that there was no significant statistical difference of PROM and extension limitation between male and female infants and between right and left knee joints. Thus the average of the two was taken. The mean PROM was 159.3 degrees in newborns, 152 degrees in infants of 3 months and 144 degrees in infants of six months. The extension limitation was 19.2 degrees in newborns, 10.3 degrees in infants of 3 months, and 2.5 degrees in infants of six months. A gradual decrease of PROM of knee joint and extension limitation was observed with age. The findings of the present study will be helpful to the clinicians, therapists and researchers as ready references to PROM and extension limitations of knee joint in infants. Since there was no statistically significant difference between right and left knee joint, in the presence of a lesion of one knee joint, the movement on the healthy side of the joint can be used for routine comparison with the affected limb. In the presence of bilateral lesion, the present data can be used for comparison. The advantage of using these data is that, they provide the best available estimates of normal knee joint PROM and extension limitation for the South Indian healthy infants.

Key Words: *Joint motion, Knee Joint, Infant and Goniometer*

INTRODUCTION

Joint flexibility is often quantified by range of motion (ROM), which is clinically defined as the maximal range of joint angle (AAOS, 1965). It reflects the flexibility of the joint. The measurement of ROM is extremely useful for clinicians, therapists and researchers for preventive screening, assessment and treatment of newborns and infants with knee joint lesions. The correct interpretation of the measurement results can have a substantial impact on the development of the scientific basis of therapeutic interventions. There are very few studies in which passive range of motion (PROM) and extension limitation of knee joint in infants have been studied in South Indian population. Hence, there is a need for our own metrical data. Since the normal variations in PROM and extension limitation are not well documented in literature, the present study was undertaken. The main objective was to compile a database of mean and normal PROM and extension limitation measured in healthy full-term newborns, in infants of 3 months and in infants of 6 months. These data can be used clinically to aid in detecting pathological joint and muscle conditions, to assess and document changes in response to therapeutic regimens and to provide useful information about muscle tone and motor development of infants.

MATERIALS AND METHODS

The present cross sectional study was done on knee joints of 30 healthy full-term infants at birth, 30 infants of three months and 30 infants of six months of age. All babies with pre term delivery and infants with congenital anomalies and diseases of the knee joint were excluded from the study. The terminology

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and techniques of measurements were those suggested in the handbook of the AAOS (AAOS, 1965). Goniometry is the method most widely used to measure PROM (Boone and Azen, 1979). A universal goniometer was used to measure the PROM of the knee joint. It is a half circle goniometer having a body, stationary arm and a moving arm. The body of goniometer resembles a protractor with reading from 0 to 180 degrees and from 180 to 0 degrees (Figure 1). The stationary arm (Proximal arm) is aligned with the proximal segment of the joint and the moving arm (Distal arm) is aligned with the distal segment of the joint. The fulcrum of the goniometer is placed over the approximate location of the axis of motion. Since the axis of motion changes during movement, the fulcrum was adjusted accordingly.



Figure 1: Picture showing bony markings
1- Lateral epicondyle, 2- Greater trochanter 3- Lateral malleolus

Figure 2: Picture showing the measurement of extension limitation using goniometer

The Lateral epicondyle, Greater trochanter and Lateral malleolus were marked using a hypoallergenic skin cosmetic crayon. Two lines are drawn, one extending from the lateral epicondyle to the greater trochanter and the other extending from the lateral epicondyle to the lateral malleolus (Figure 1). For all measurements, infants under sedation were placed in supine position with their head maintained in the midline to diminish any effects of neonatal neck reflexes. The fulcrum of goniometer was placed on the lateral epicondyle of femur. The proximal arm is aligned along the line extending from the lateral epicondyle to greater trochanter; the distal arm aligned along the line extending from the lateral epicondyle to the lateral malleolus (Figure 1). Then the knee is passively extended and the angle is noted-extension limitation (Figure 2). Then the knee is passively flexed till an end feel is felt and PROM is noted. The same procedure is repeated on the other limb. All measurements were recorded to the nearest 5 degrees. The mean PROM, mean extension limitation and standard deviation were determined separately in infants at birth, in infants of 3 months and in infants of six months of age separately. Student's t-test was used to compare the PROM and extension limitation on the right and the left side and to compare between male and female infants. P value <0.01 was considered statistically significant.

RESULTS AND DISCUSSION

Estimation of the normal ROM of knee joint in infants for the South Indian population is extremely essential as clinicians become more involved in preventive screening, assessment and treatment of newborns and infants. The abnormal joint ROM is an important factor in movement dysfunction and physical disability. The restriction of the ROM of knee joint would be known only by measuring the deviation of it from its normal range. Objective measurements of ROM are required with increasing frequency as indices of improvement following a certain course of treatment. In addition, they are often an essential component of an impairment rating. The ROM varies among individuals and is influenced by many factors such as age, sex and whether the motion is performed actively or passively. Researchers have shown that PROM

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measurements in infants and children differ from that of adult values and specific sequential changes in ROM occur during the first 15 months of normal development (Hoffer, 1980). In addition, factors relating to the testing process, such as testing position, type of instrument used and experience of the examiner have been identified as affecting ROM. Although general observation indicates that the amplitudes of motion of the joints differ in children and adults, little information exists about the influence of aging on the ROM (Davies, 1961).

There were no significant differences of mean PROM and extension limitation between male and female infants in the present. These results were similar to studies done by Coon *et al.*, (1975). Thus the mean PROM and the extension limitation in both male and female measurements were pooled together. Table 1 shows the distribution of mean values and standard deviations of PROM and extension limitation of right and left knee joint in infants. Since PROM and extension limitation on the right and left side were not statistically significant the average of the two were taken for comparison with other studies. The mean PROM decreases from 159.3 degrees at birth to 152.3 in infants of 3 months and further decreases to 144.3 in infants of 6 months which is more when compared with other studies (Broughton NS *et al.*, 1993 and Schwarze and Denton, 1993).

Table 1: Passive Range of Motion of left and right knee joint

		In infants At Birth	In infants of 3 months	In infants of 6 months
PROM	Right	159.3+/-2.3	152+/-2.3	144+/-3.3
	Left	159.2+/-1.8	152.5+/-2.4	144.5+/-3.3
Extension Limitation	Right	19.2+/-2.5	10.3+/-1.8	2.5+/-1.6
	Left	18.8+/-1.9	10.4+/-1.8	2.4+/-1.5

The extension limitation is 19 degrees at birth, which decreased to 10.4 in infants of 3 months and further decreased to 2.5 in infants of 6 months of age. At 6 months, two infants did not have extension limitation. These results were similar to the results of Broughton *et al.*, (1993) and Waugh *et al.*, (1983). But more when compared to Schwartz and Denton (1993). The probable explanation for the degrees in extension limitation is that, in the uterus, the fetus is in a confined space and in the first few months of life it stretches out. Since age influences ROM, age appropriate norms should be used whenever possible.

Decreased PROM is often accepted as a normal part of aging. Increased rigidity of connective tissue, particularly in and around the muscles and tendons becomes apparent with increasing age. This could explain the cause for reduced PROM with an increase in age. Any substantial loss of joint mobility should be viewed as abnormal and not attributed to aging and should be treated early.

The mean PROM on the right and left side were not significant statistically in all age groups which is similar to other studies (Boone and Azen, 1979; Schwartz and Denton, 1993; Asbjorn and Andersson, 1982). This suggests that, in the presence of a lesion or disease in one knee joint, the movement on the healthy side of the joint can be used for routine comparison with the affected limb. In the presence of bilateral lesion, the present data can be used for comparison provided the same measuring procedure is employed. The advantage of using these data is that, they provide the best available estimates of normal knee joint PROM and extension limitation in healthy infants of the South Indian population.

Conclusion

This study evaluated the influence of sex and side of the limb on PROM and extension limitation of knee joint in infants. There was no significant statistical difference in PROM and extension limitation between male and female infants. The mean PROM and extension limitation on the right and left side of the knee joint was not statistically significant hence a patient's healthy limb PROM can be used for comparison with the affected side in the presence of disease or a lesion. A gradual decrease of PROM and extension

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limitation of the knee joint was observed from birth to 6 months of age. Because of the variability in PROM and extension limitation according to age and region, national estimates PROM of knee joint in infants should be determined. The findings of the present study will be helpful to the clinicians, therapists and researchers as ready references to mean PROM and the extension limitation of the knee joint. This study provides best available estimates of normal PROM and extension limitation of knee joint in healthy infants of the South Indian population.

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