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Significance of Q angle as a prognostic outcome measure for subjects with spastic diplegia

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Abstract:

Cerebral Palsy (CP) is a neurological disorder caused by a non-progressive brain injury or malformation that occurs while the child's brain is under development and mainly affects body movement and muscle coordination. Spastic diplegia is one of the most common and concerning types of cerebral palsy which is manifested as "tightness" or "stiffness" — mainly in the muscles of the lower extremities. Since Spastic Diplegia has its major impact on lower limbs, it is important to factor in the change in Quadriceps angle (Q angle) value with increasing spasticity. Quadriceps angle (Q angle) is the angle formed by two imaginary lines, one from ASIS to center of the patella and other from the tibial tuberosity to center of patella. Abnormal Q angle is one of major causes for abnormal gait. In spastic diplegic, lower limb muscles go for tightness leading to Q angle changes. Quadriceps angle (Q angle) is an angle formed by the crossing of two imaginary lines. The first line extends from the ASIS to the center of the patella (COP).

The second line is drawn from the tibial tuberosity (TT) to the COP. The angle formed between these two lines represents the Q angle. Any variation in q-angle, either less or more, can lead to gait abnormality as well as increased susceptibility to injuries. Even though Quadriceps angle provides useful information about the alignment of the knee joint and it has come to be accepted as an important factor in assessing knee joint function, the literature available about Quadriceps angle changes in children with CP is close to none. This study was conducted to assess if q-angle value can be used as a prognostic outcome measure in subjects with spastic diplegia. Though numerous qualitative measures are available to assess the prognosis of spastic diplegic child during rehabilitation, no quantitative prognostic measure has been used till date. If a relation is established between Quadriceps angle (Q angle) variation and rehabilitation of child with CP, Quadriceps angle (Q angle) can be used as a prognostic tool by physiotherapists worldwide to evaluate the effectiveness of provided treatment quantitatively. This study was performed as a continuation of our previously published research "Does Quadriceps angle (Q angle) change in Spastic Diplegia subjects?" in IJCP2016;2(2):85-89.

In the previous study, total of 30 spastic diplegic male subjects aged 7-12 years were assessed for their Quadriceps angle (Q angle) and the study had concluded that the spastic diplegic children with internal and external tibial torsion have decreased and increased q-angle respectively. In this study, 10 subjects were selected out of previously included 30 male subjects based on randomized sampling. The subjects selected were divided into two groups: Group A included 5 subjects with internal tibial torsion and Group B included 5 subjects with external tibial torsion. This study was Experimental, Pre-Post Test design. Subjects included in the study had spasticity of Grade 1 and 2 (according to Modified Ashworth Scale) and were at least able to stand with minimum support. Children who had undergone prior orthopedic surgery at lower extremities were excluded from the study. All subjects underwent active rehabilitation of lower limbs for 12 weeks. The rehabilitation protocol included four components: Strengthening, Stretching, Endurance and Balance. The exercises were given for 1 hour for 5 days a week. The mean age of subjects in group A was 7.8 and group B was 8.4. Similarly, the mean BMI of subjects in group A was 16.4 and that of group B was 15.8. The between-group difference of both age and BMI were non-significant.

The limb length discrepancy was also measured in all subjects in lying position and the difference was found to be non-significant. In group A, pre-intervention values of Quadriceps angle (Q angle) were 6.6 (left limb) and 6.8 (right limb) whereas post intervention values were 8.6 (left limb) and 9.0 (right limb). In group B, pre-intervention Q angle was 22.8 (left limb) and 22.6 (right limb), post intervention 20.6 (left limb) and 20.2 (right limb). In this study, the children showed improved Q angle following the 12 weeks of rehabilitation program. In group a (children with internal tibial torsion) had Q angle much lesser than the normal range pre intervention. After the rehabilitation, their Quadriceps angle (Q angle) tends to increase towards the normal range. Similarly, Group B (children with external tibial torsion) whose Q angle was on the higher range decreased towards the normal range post intervention. It is evident that lower extremity alignment characteristics change the position of the anatomical landmarks used to measure the Quadriceps angle (Q angle), thus impacting its magnitude. However, Q angle might not be used as an assessment tool for children below 7 years of age because of the continuous physiological changes occurring in the lower extremity alignment. Since the Q angle is very closely related to the strength and tone of quadriceps muscles, degree of tightness and weakness in quadriceps muscle have been found to interfere with the normal value of Q angle.

The reason behind improvement in the Quadriceps angle (Q angle) value post intervention might be due to stretching and strengthening of quadriceps muscle. Along with that, the decrease in tightness and alignment of lower extremity during rehabilitation might have contributed to the shift of Quadriceps angle (Q angle) values towards normal. After analyzing results from the current study and support from past literatures, this study concluded that q-angle is not only the good outcome variable for assessing musculoskeletal problem related to lower limb in spastic diplegic cases, but it also has the potential to be used as a reliable quantitative prognostic tool during diplegic spastic cerebral palsy children rehabilitation program. However, further research and large-scale studies are needed to have better analysis of the same.