

Normal values of quadriceps femoris angle in school age childrens between 4-10 years old.

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Asawakittiporn B, Aksaranugraha S. Normal values of quadriceps femoris angle in school age childrens between 4-10 years old. *Chula Med J* 1995 Jan; 39(1): 37-44

The quadriceps (Q) angle represents the vector for the combined pull of the quadriceps femoris muscle and the patellar tendon. A high Q angle is one of several factors which causes patella tracking dysfunction, e.g. chondromalacia patella and patello-femoral arthritis. In Thai children, the normal values of the Q angle have not previously been documented in the literature and this was our objective.

Normal values of Q angle in boys: 3 groups

4-6 years old, mean \pm SD of Q angle 15.4 \pm 2.6 degrees

6-7 years old, mean \pm SD of Q angle 13.2 \pm 2.4 degrees

7-10 years old, mean \pm SD of Q angle 12.0 \pm 3.1 degrees

Normal values of Q angle in girls: 4 groups

4-6 years old, mean \pm SD of Q angle 17.6 \pm 3.2 degrees

6-7 years old, mean \pm SD of Q angle 14.0 \pm 2.5 degrees

7-8 years old, mean \pm SD of Q angle 12.8 \pm 2.0 degrees

8-10 years old, mean \pm SD of Q angle 12.1 \pm 3.0 degrees

The Q angle gets progressively smaller from 4 to 10 years of age in both sexes, but the statistically significant difference is between 5 to 6 to 7 years of age in boys and 5 to 6 to 7 to 8 years of age in girls.

Key word : *Q angle, School age childrens.*

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Received for publication. December 8, 1994.

เบ็ญจวรรณ อัสวักตติพร, เสก อักษรานุเคราะห์. การศึกษาค่าปกติและการเปลี่ยนแปลงของค่าปกติของมุมคิว ของนักเรียนในกรุงเทพมหานคร ระหว่างอายุ 4-10 ปี. จุฬาลงกรณ์เวชสาร 2538 มกราคม; 39(1): 37-44

จากการค้นคว้ารายงานจากต่างประเทศ พบว่ามีรายงานการหาค่าปกติของ Q Angle หรือมุม Q เฉพาะในผู้ใหญ่เท่านั้น แต่ในประเทศไทยยังไม่มีรายงานค่าปกติของมุม Q เลย การศึกษาครั้งนี้จึงมุ่งหาค่าปกติและการเปลี่ยนแปลงของค่าปกติของมุมนี้ในเด็กนักเรียนไทยที่เรียนอยู่ในกรุงเทพมหานคร โดยได้ศึกษาเด็กจำนวนทั้งสิ้น 480 คน ทั้งเด็กชายและเด็กหญิง อายุระหว่าง 4-10 ปี แบ่งเป็น 6 ช่วงอายุ ช่วงละ 1 ปี อายุ 4-6 ปี จำนวน 160 คน จากโรงเรียนอุดมศึกษา แผนกอนุบาล และ อายุ 6-10 ปี จำนวน 320 คน จากโรงเรียนสาธิตจุฬาฯ แผนกประถม ซึ่งปรากฏผลการศึกษาดังนี้

ในกลุ่มเด็กชาย สามารถสรุปค่าปกติของ มุม Q ออกเป็น 3 ช่วง ดังนี้

ช่วงอายุ 4-6 ปี ค่าเฉลี่ย มุม Q 15.43 ± 2.58 องศา

ช่วงอายุ 6-7 ปี ค่าเฉลี่ย มุม Q 13.18 ± 2.37 องศา

ช่วงอายุ 7-10 ปี ค่าเฉลี่ย มุม Q 12.02 ± 3.11 องศา

ในกลุ่มเด็กหญิง สามารถสรุปค่าปกติของ มุม Q ออกเป็น 4 ช่วง ดังนี้

ช่วงอายุ 4-6 ปี ค่าเฉลี่ย มุม Q 17.64 ± 3.15 องศา

ช่วงอายุ 6-7 ปี ค่าเฉลี่ย มุม Q 14.02 ± 2.46 องศา

ช่วงอายุ 7-8 ปี ค่าเฉลี่ย มุม Q 12.75 ± 1.58 องศา

ช่วงอายุ 8-10 ปี ค่าเฉลี่ย มุม Q 12.13 ± 3.04 องศา

ในกลุ่มเด็กชาย มุม Q จะลดลงชัดเจนปีต่อปี จนอายุ 7 ปี แล้วจึงจะลดลงช้า ๆ จนถึง 9 ปี จึงค่อนข้างคงที่ ส่วนเด็กหญิงจะลดลงชัดเจนปีต่อปี จนอายุ 8 ปี หลังจากนั้นจะค่อนข้างคงที่

The Q angle is described as the acute angle formed by lines drawn from the anterior superior iliac spine (ASIS) to the center of the patella, and from the center of the patella to the tibial tuberosity. It represents the vector for the combined pull of the quadriceps femoris muscle and the patellar tendon.⁽¹⁻³⁾ Theoretically, higher Q angles increase the lateral pull of the quadriceps femoris muscle on the patella and potentiate such disorders as chondromalacia patellae or recurrent lateral subluxation of the patella.^(2,3,5-9)

For Thai children, the normal values of the Q angle and relationship between the Q angle and age had not been previously been documented in the medical literature.

Objectives

1. Normal Q angle study in children between 4-10 years old
2. Changes of Q angle due to child growth from 4-10 years of age

Materials and methods

240 boys and 240 girls 4-10 years of age a divided into 6 age groups.

40 subjects for each age and sex group

Inclusion criteria

1. Free of disease or injury of the lower extremities
2. Normal development

Position of subject

- Laid in a supine position⁽²⁾
- The knees were fully extended with the patella directed into the sagittal plane⁽²⁾

- The quadriceps femoris muscles were completely relaxed⁽²⁾

- The ankles were stabilized in a neutral position⁽¹⁰⁾

Measurement

- From the anterior superior iliac spine to the mid-point of the patella
- From insertion of the patellar tendon at tibial tuberosity to the mid-point of the patella
- Measure the Q angle using a goniometer

Statistic analysis

Student t-Test ($P < 0.05$)

Discussion

The Q angles may be increased by:

1. Malalignment: femoral neck anteversion, external tibial torsion, lateral position of tibial tuberosity^(11,12)
2. Position of the foot: inward rotation, pronation⁽¹⁰⁾
3. Position of the body: the Q angle is wider when standing than when supine⁽¹³⁻¹⁶⁾

Malalignment is one factor causing abnormal Q angles which was excluded from our study. In our method to measure Q angles, the subjects were placed in a supine position. The knees were fully extended with the patella directed into the sagittal plane and the quadriceps femoris muscle were completely relaxed. During measurement the ankle was stabilized in a neutral position because the position of the foot may effect the degree of the Q angle.

Pentti S. found that the tibiofemoral angle became progressively smaller from 4 years of age to about 7 years, and after that it remained stable.⁽⁴⁾ In our study, we found that the older the age (in the 4-10 year range), the smaller the Q angle in both sexes but there were statistically

significant differences only between the age groups 5 to 6 to 7 years among boys, and 5 to 6 to 7 to 8 years in girls. This was the same as the Pentti S. report (figure 2). In conclusion, there was correlation between the tibiofemoral angle and Q angle development.

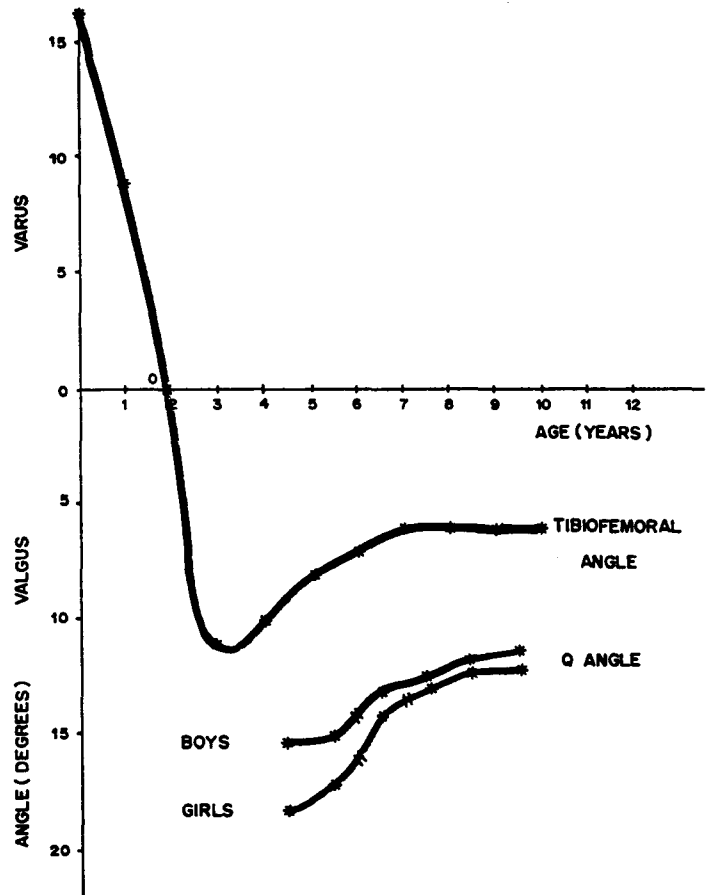
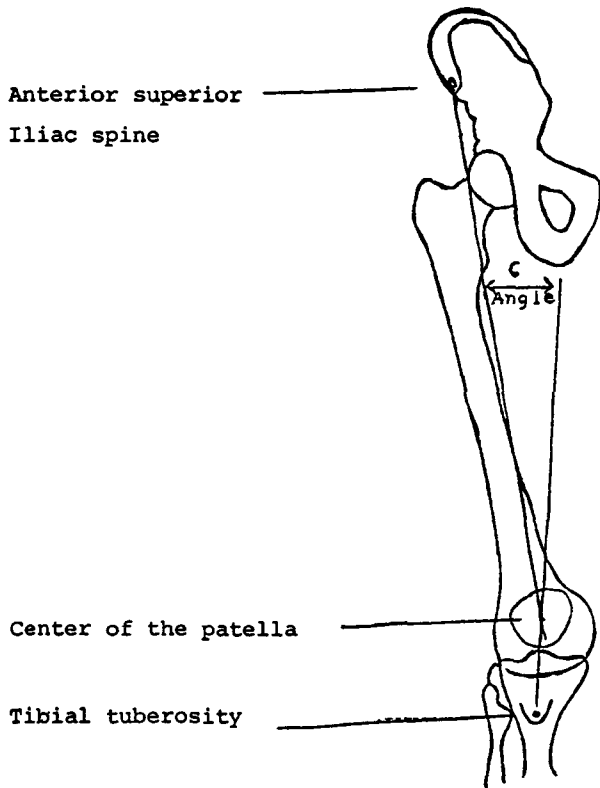


Figure 1. Anatomic landmarks for establishing the quadriceps angle.

Figure 2. Correlation between the change of tibiofemoral angle and Q angle in this study.

Results

Table 1. Comparing Q angles between right and left knees in boys.

		Q angle : mean \pm SD (degrees)					
Side	Age groups (year)	4-5	5-6	6-7	7-8	8-9	9-10
No. Of child							
Right	40	15.45 \pm 1.89	15.55 \pm 3.00	13.10 \pm 2.37	12.50 \pm 2.73	11.8 \pm 3.93	11.45 \pm 2.69
Left	40	15.55 \pm 1.99	15.15 \pm 3.22	13.27 \pm 2.39	12.85 \pm 2.70	11.95 \pm 3.00	11.52 \pm 2.73
P-value		0.38	0.20	0.11	0.06	0.61	0.08

*Statistically significant difference at $p < 0.05$

no significant difference of Q angle between right and left knee.

Table 2. Comparing Q angle between right and left knees in girls.

		Q angle : mean \pm SD (degrees)					
Side	Age group (year)	4-5	5-6	6-7	7-8	8-9	9-10
No. of child							
Right	40	18.02 \pm 3.67	17.30 \pm 2.66	13.97 \pm 2.52	12.65 \pm 1.84	12.05 \pm 3.45	12.12 \pm 2.75
Left	40	18.17 \pm 3.72	17.07 \pm 2.36	14.04 \pm 2.42	12.85 \pm 2.03	12.30 \pm 3.32	12.07 \pm 2.73
P-value		0.26	0.29	0.37	0.12	0.11	0.32

*Statistically significant difference at $p < 0.05$

no significant difference of Q angle between right and left knees.

Table 3. Comparing Q angle between boys and girls.

		Q angle : mean \pm SD (degrees)					
Sex	Age group (year)	4-5	5-6	6-7	7-8	8-9	9-10
No. of knee							
Boy	80	15.50 \pm 1.93	15.35 \pm 3.10	13.18 \pm 2.37	12.07 \pm 2.71	11.91 \pm 3.76	11.48 \pm 2.71
Girls	80	18.10 \pm 3.67	17.19 \pm 2.51	14.02 \pm 2.46	12.75 \pm 1.98	12.17 \pm 3.37	12.17 \pm 2.73
P-value		0.000006*	0.00006*	0.03*	0.84	0.64	0.15

*Statistically significant difference at $P < 0.05$

Significant differences of Q angles between boys and girls only in age group of 4-5, 5-6, 6-7 years old.

Table 4. Comparing Q angle between each age group.

		P-value				
Sex	Age groups (year)	4-5 to 5-6	5-6 to 6-7	6-7 to 7-8	7-8 to 8-9	8-9 to 9-10
Boy	80	0.71	0.000002*	0.20	0.14	0.41
Girls	80	0.06	0.000006*	0.0004*	0.19	0.07

*Statistically significant difference at $p < 0.05$

Significant difference of Q angle only from 5-6 to 6-7 years in boys and from 5-6 to 6-7, 6-7 to 7-8 years in girls.

In Table 4, the ages were regrouped according to statistic undifferent Q angle for both boys and girls.

Boys : 4 to 6, 6 to 7, 7 to 10

Girls : 4 to 6, 6 to 7, 7 to 8, 8 to 10

Table 5. Normal values of Q angle.

Age group (year)	Q angle : mean±SD (degree)	
	Boys	Girls
4 to 6	15.4±2.6	17.67±3.2
6 to 7	13.2±2.4	14.0±2.5
7 to 8	-	12.8±2.0
7 to 10	12.0±3.1	-
8 to 10	-	12.1±3.0

Conclusions

1. Normal values of Q angle in boys between 4-10 years old: 3 groups.

age (years old)	mean±SD of Q angle (degrees)
4-6	15.4±2.6
6-7	13.2±2.4
7-10	12.0±3.1

2. Normal values of Q angle in girls between 4-10 years old: 4 groups.

age (years old)	mean±SD of Q angle (degrees)
4-6	17.6±3.2
6-7	14.0±2.5
7-8	12.8±2.0
8-10	12.1±3.0

3. The Q angle becomes progressively smaller from 4 to 10 years of age in both sexes but the only statistically significant differences

were between 5 to 6 to 7 years of age in boys, and 5 to 6 to 7 to 8 years of age in girls.

Recommendation

Because this study was cross sectional, it may not represent the true values and the changes of the Q angle. It would be beneficial to do another longitudinal study.

Acknowledgements

Assistant Prof. Somchit Chewprecha, Headmaster Chulalongkorn Demonstration School

Dr. Dootchai Chaiwanichsiri, Physiatrist, Rehabilitation Medicine, Chulalongkorn Hospital

Ms. Kamolwan Chaiwanichsiri, Udomsauksa School

References

1. Hungerford DS, Barry M. Biomechanics of the patellofemoral joint. Clin Orthop 1979 Oct; 144:9-15

2. Insall J, Falvo KA, Wise DW. Chondromalacia patellae. A prospective study. *J Bone Joint Surg* 1976 Jan; 58A(1):1-8
3. Aglietti, Insall JN, Cerulli G. Patellar pain and incongruence 1: Measurement of incongruence. *Clin Orthop* 1983 Jun; 176: 217-24
4. Salenius P, Vankka E. The development of the tibiofemoral angle in children. *J Bone Joint Surg* 1975 Mar; 57A(2):259-61
5. Huberti HH, Hayes WC. Patellofemoral contact pressure. The influence of q-angle and tendofemoral contact. 1984 Jun; 66A (5):715-24
6. Hughston JC. Patellar Subluxation and Dislocation. Philadelphia: WB Saunders, 1984.
7. James SL. Chondromalacia patellae in the adolescent, In: Kennedy JC, ed. *The Injured Adolescent Knee*. Baltimore: Williams & Wilkins, 1979; 205-25
8. Kettelkamp DB. Current concepts review. Management of patellar malalignment. *J Bone Joint Surg* 1981 Oct; 63A(8): 1344-7
9. Sojbjerg JO, Lauritzen J, Hvid I, Boe S. Arthroscopic determination of patellofemoral malalignment. *Clin Orthop* 1987 Feb; 215:243-7
10. Olerud C, Berg P. The variation of the Q angle with different position of the foot. *Clin Orthop* 1984 Dec; 191:162-5
11. Tria AJ Jr, Palumbo RC, Alicea JA. Conservative care for patellofemoral pain. *Ortho Clin North Am* 1992 Oct; 23(4): 545-54
12. Freeman BL 3d. Recurrent dislocations. In: Crenshaw AH, ed. *Campbell's Operative Orthopaedics*. Vol. 3. 7th ed. St. Louise: C.V. Mosby 1987:2173-4
13. Woodland LH, Francis RS. Parameters and comparisons of the quadriceps angle of college aged men and women in the supine and standing positions. *Am J Sports Med* 1992 Mar-Apr; 20(2):208-11
14. Buchbinder Mr, Napora NJ, Biggs EW. The relationship of abnormal pronation to chondromalacia of the patella in distance runners. *J Am Podiatr Med Assoc* 1979 Feb; 69(2):159-62
15. D'Amico JC, Rubin M. The influence of foot orthoses on the quadriceps angle. *J Am Podiatr Med Assoc* 1986 Jun; 76(6):337-40
16. James SL, Bates BT Ostering LR. Injuries to runners. *Am J Sports Med* 1978 Mar-Apr; 6(2):40-50