

ULTRASONOGRAPHY OF THE HIP JOINT IN CHILDREN: ANTERIOR CAPSULE DISTANCE – WHAT IS NORMAL?

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Abstract

Ultrasonography of the hip joint in infants and older children is an important basic imaging method. The measurement of the anterior capsule distance gives us immediate information on the presence or absence of hip joint effusion. The aim of this study was to answer the following questions: what is normal anterior capsule distance (ACD) in children from 1 to 15 years old? Is ACD the same in boys and girls?

There is a difference between ACD in boys and girls. There is no difference between the left and the right side. There is no linear function between age and ACD. It does not increase with the age continuously, but decreases in boys at 6 years of age, in girls at 6 and 7 years of age. The value of ACD increases in both groups and does not exceed 8.5 mm after this age.

Key words

Anterior capsule distance, Healthy children, Age 1–15 years

INTRODUCTION

Ultrasonography of the hip joint has become a basic and useful examination method in children with clinical signs of hip effusion or an irritable hip joint. Ultrasonography of the hip joint is an inexpensive, easily available, non-invasive, and very sensitive imaging method. The aim of this study was to find the answer to the following questions: what is normal ACD in different child ages (1–15 years). Is ACD the same in boys and girls (population) or not?

MATERIALS AND METHODS

A 7 MHz or 5 MHz linear transducer (Acuson 128) was used for the measurement; this method according to Terjesen (1) is well described and known. The way of measurement was done in neutral position of the lower leg with mild abduction. Anterior capsule distance (ACD) was measured in both hips. ACD is the distance between the ventral surface of the femoral neck and the outer outline of the

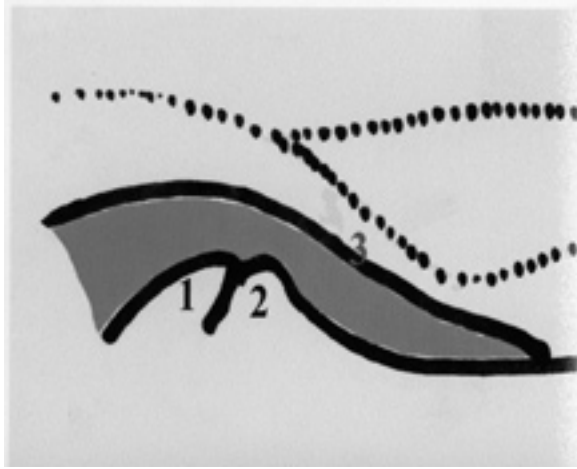


Fig. 1

ACD - scheme

1 - femoral head, 2 - femoral neck, 3 - joint capsule

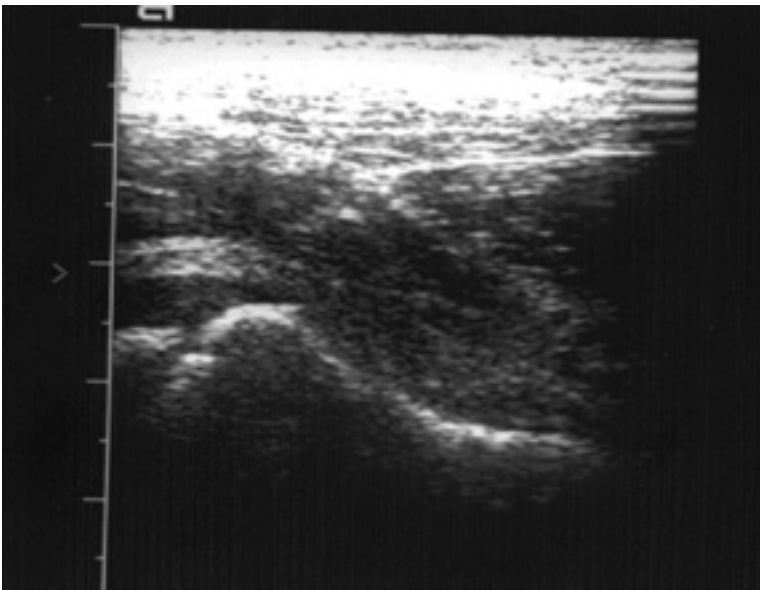


Fig. 2

ACD - normal finding, USG

joint capsule (*Figs 1 and 2*). There were 192 children examined at the age of 1–15 years: 100 boys and 92 girls during the years 1998–9. These children had no history of irritable hip joint or other hip joint disorders, and had a negative 2–3 weeks' history of any virosis or inflammatory diseases (orchitis, adenitis, etc.).

RESULTS

Two graphs were plotted: the first for boys (*Fig. 3*), the other for girls (*Fig. 4*) to show the distribution of the value of ACD with dependence on age. The curves of the graphs represent ACD values. Boys: increase of ACD can be seen from 1 to 4 years of life (maximum value is 7.1 mm, minimum is 1.6 mm). In 4- and 5-year-old boys the values of ACD stagnate, and further, at 6 years of life, they decrease to an average of 4.7 mm. In older boys the value of ACD increases again to an average of 6.6 mm, and declines again during 9th and 10th years of life (average 5.3 mm). From 11 years to 15 years of life the ACD does not change (average 6.7 mm). Girls: the value of ACD increases continually from 1 to 5 years of life (maximum value is 8.1 mm, minimum value is 1.8 mm). Within the 6th and 7th years of life the value of ACD decreases (at 6th year of life the average value is 5.5 mm, at 7th year of life the value is 4.7 mm). During the 8th year of life it increases to a value of 5.9 mm). During the 9th and 10th years of life the value decreases to 5.5 mm–5.6 mm. From 11th year of life to 12th year of life the value of ACD stagnates (average 6.2 mm). At the age of 13 years it decreases to an average value of 5.4 mm. At the age of 14 and 15 years it increases to an average value of 7.3 mm, 7.6 mm. Ninety-five per cent mathematical expectation of ACD is within the interval which is presented in these graphs (*Figs 3, 4*).

Statistical analysis was done.

In the group of boys the minimum value of ACD is 1.2 mm, while the maximum value is 8.5 mm. In girls the minimum in all age groups is 1.8 mm, the maximum is 8.3 mm.

The development of ACD is not the same in boys and girls and it is difficult to explain the cause.

The expected value in boys was 5.6 mm, in girls 5.5 mm. The error of the expected value was 0.27 in boys and 0.26 in girls. The standard deviation was 1.3 in boys and 1.01 in girls. For the comparison of the expected value in boys and girls Student's T-test was used. The variance in boys was 1.06, in girls 1.03. The correlation coefficient was 0.77 %.

DISCUSSION

A 7-MHz or 5-MHz linear transducer is used for the examination of the hip joint in infants and older children. The probe is applied from the front along the longitudinal axis of the femoral neck. This method was first described by *Terjesen (1)*. It is possible to use a sector transducer, too (*2, 3*). The leg is in the neutral position

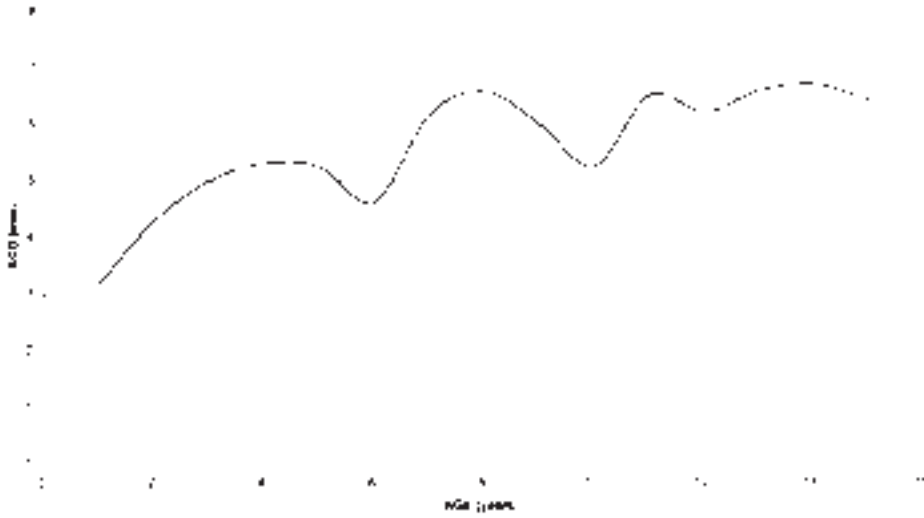


Fig. 3
ACD in boys: x axis = age (years), y axis= ACD (mm)

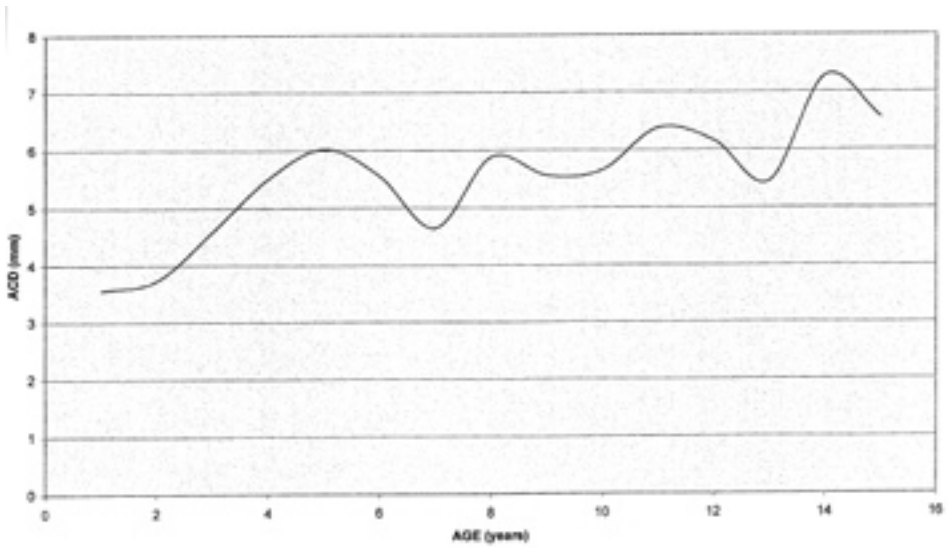


Fig. 4
ACD in girls: x axis = age (years), y axis = ACD (mm)

(4) and mild abduction. ACD is measured in both hips. Ultrasonography of the hip joint is a non-invasive, accessible, and simple examination method.

In the literature little information can be found concerning ACD in healthy children. A study similar to ours was done by *Rohrschneider* (5). The relations between ACD and the height of the child were measured. In children of more than 1000 mm of the height ACD does not exceed 7.5 mm. Several authors (6, 7) admit that a thin layer of anechogenic fluid does not necessarily give evidence of joint effusion. This may be the case. While examining the child's hip joint it is necessary to measure ACD in both hips for comparison. *Eckerwall* (8) describes findings on the hip joint in 30 children. A difference of 1 mm in ACD when comparing both sides is considered to be significant for pathology. Some authors (9) found the value of ACD 6 mm to be pathological. ACD over 5 mm in children older than 2 years is also considered to be pathological (5). *Erhendorfer* (9) found in 25 % of children with one-side transmission synovitis hip effusion on the opposite side. This finding was considered as asymptomatic synovitis as well.

According to our results a difference smaller than 2 mm or 2 mm between the ACDs of the left and right side does not give us evidence of hip effusion, and it may be considered as standard. A difference of 1 to 2 mm can be an individual error. If the joint effusion is present the difference is greater than 2 mm. The value of ACD does not increase linearly with age. In boys it decreases at 6 years of life, in girls at 6 and 7 years of life.

CONCLUSIONS

The upper limit of anterior capsule distance in healthy children (aged 1-15 years) is 8.5 mm, the lower limit is 1.2 mm. There is no left - right difference. There is no linear correlation: ACD - age. ACD is not the same in boys and girls.

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ULTRASONOGRAFICKÉ VYŠETŘENÍ KYČELNÍCH KLOUBŮ U DĚTÍ: PŘEDNÍ KAPSULÁRNÍ VZDÁLENOST - CO JE NORMÁLNÍ HODNOTA?

Souhrn

Ultrasonografické vyšetření kyčelních kloubů u dětí je důležitou základní vyšetřovací metodou. Měření přední kapsulární vzdálenosti nás informuje o přítomnosti výpotku v kyčelním kloubu. Cílem práce bylo najít odpověď na otázku: jaká je přední kapsulární vzdálenost (ACD) u zdravých dětí věku 1-15 roků? Je ACD stejná u chlapců a dívek?

Výsledky. ACD není stejná u chlapců a dívek. Není stranový rozdíl v její hodnotě. Mezi růstem věku a ACD neplatí lineární závislost. U chlapců hodnota ACD klesá ve věku 6 roků, u dívek ve věku 6-7 roků. U chlapců ani dívek hodnota ACD nepřekročí 8,5 mm. Horní limit ACD u zdravých dětí je ve věku 1-15 roků 8,5 mm, dolní 1,2 mm, nebyl nalezen stranový rozdíl hodnoty ACD pravá strana, levá strana, ani lineární korelace věk - ACD, hodnota ACD není stejná u chlapců a u dívek, žádný

objem výpotku v kyčelním kloubu nelze hodnotit jako fyziologický nález, pomocí USG lze detekovat tekutinu od objemu 0,5 ml).

REFERENCES

1. *Terjesen T, Runden T, Johnsen HM.* Ultrasound in the diagnosis of congenital dysplasia and dislocation of the hip joints in children older than two years. *Clin Orthop* 1991; 262: 159-69.
2. *Mc Goldrick F, Bourke T, Blake N, et al.* Accuracy of sonography in transient synovitis. *J Pediatr Orthop* 1990; 10: 501-3.
3. *Schuller P, Griss P.* Sonographische Diagnose der Coxitis fugax [Sonographic diagnosis of coxitis fugax]. In: Frank W, Eyb R. *Die Sonographie in der Orthopädie.* Wien: Springer, 1988: 179-83.
4. *Dörr U, Zieger M, Hauke H.* Ultrasonography of the painful hip. Prospective studies in 204 patients. *Pediatr Radiol* 1989; 1: 36-40.
5. *Rohrschneider WK, Fuchs G, Tröger J.* Ultrasonographic evaluation of the anterior recess in the normal hip: a prospective study on 166 asymptomatic children. *Pediatr Radiol* 1996; 9: 629-34.
6. *Kallio P, Paterson DC, Foster KB, Le Quesne GW.* Classification in slipped capital femoral epiphysis - sonographic assessment of stability and remodelling. *Acta Orthop Scand* 1992; 63 (Suppl 248): 2-3.
7. *Kallio P, Ryöppy S, Jäppinen S, Siponmaa AK, Jääskeläinen J, Kunnamo I.* Ultrasonography in hip disease in children. *Acta Orthop Scand* 1985; 56: 367-71.
8. *Eckerwall G, Hochberg P, Wingstrand H, Egund A.* Sonography and intercapsular pressure in Perthes' disease. *Acta Orthop Scand* 1994; 65: 575-80.
9. *Ehrendorfer S, Le Quesne G, Penta, et al.* Bilateral synovitis in symptomatic unilateral transient synovitis of the hip. *Acta Orthop Scand* 1996; 67: 149-52.