P-169

Femoral Anteversion Angle Measured by 3D-CT in Children with In-toeing gait : 3-year follow-up study

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Objectives

To investigate the long-term changes in femoral anteversion angle (FAA) in children with in-toeing gait and to identify factors affecting FAA changes.

Methods

- **Participants**
  - 64 children with symptomatic in-toeing gait with follow up interval of at least three year without active treatment between 2006 and 2022
- **Study design**
  - Retrospective study design
- **Data analysis**
  - FAAs at initial and follow up (using 3D-CT)
  - Mean changes in FAAs (calculated and compared)
  - Effects of sex, age, and initial FAA on FAA change
  - Changes in FAA severity of the initial and 8 years of age was assessed.
  - The severity of FAA was classified as mild (<25°), moderate (25 to 40°), or severe (>40°)
  - The cut-off values were selected based on the results of previous study.

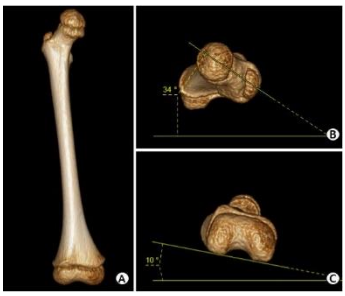

Figure 1. (A) Anteroposterior view of right femur obtained from three-dimensional computed tomography (B) Looking down view of the femur and the measurement of femoral neck angle (C) Upside-down view of the femur neck and the measurement of trans-condylar axis

Results

1. Age of the subjects at initial asessment and duration of follow-up period

FAA	Total (n=64)	Male (n=31)	Female (n=33)	p-value
Age (years)	5.09 ± 1.05	5.27 ± 1.14	4.97 ± 0.95	0.265
Follow-up period (months)	43.56 ± 7.68	43.3±6.25	43.85± 8.98	0.781

2. Changes in the FAA and differences according to gender

FAA	Total (n=128)	Male (n=62)	Female (n=66)	P-value
Initial FAA(°)	41.54±8.76	38.87±9.34	44.05±7.40	0.001*
Follow-up FAA(°)	33.07±9.58	30.31±8.71	35.67±9.70	0.001*
FAA change(°)	-8.47±7.78	-8.56±8.53	-8.38±7.07	0.900

n, numbers of limbs
*p<0.05

3. Correlation between age & initial FAA with FAA change

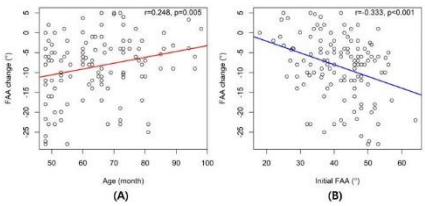

Figure 2. FAA change was greater in younger children (r=0.248, p=0.005) (A) and in those with higher initial FAA (-r=0.333, p<0.001) (B), according to correlations with age and initial FAA, respectively.

4. The severity of the initial FAA and FAA at 8 years old

	Initial FAA			FAA at age 8		
Severity	Male (n=62)	Female (n=66)	Total (n=128)	Male (n=60)	Female (n=66)	Total (n=126)
Mild (<25°)	3 (4.8)	1 (1.5)	4 (3.1)	11 (18.3)	11 (16.7)	22 (17.5)
Moderate (25-40°)	33 (53.2)	18 (27.3)	51 (39.8)	39 (65.0)	28 (42.4)	67 (53.2)
Severe (>40°)	26 (41.9)	47 (71.2)	73 (57.0)	10 (16.7)	27 (40.9)	37 (29.4)

Values are presented as numbers (percentages)
n, numbers of limbs

Conclusion

- The findings suggest that larger changes in FAA are more likely to occur in younger children and those with greater initial FAA.
- Most children still showed moderate to severe increases in FAA even at approximately 8 years of age, suggesting that early intervention may be necessary.
- Future prospective studies with larger sample sizes and longer follow-up periods are needed to confirm these findings.