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Research Article

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Is There a Difference in Femur Length Between Neglected Developmental Dysplasia of The Hip (DDH) And Contralateral Normal Hip-Femur Length?: A Radiographic Study

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Abstract

Background and Aim: *There are several anatomical problems with the hip joint that are associated with developmental dysplasia (DDH), such as the femoral head being out of place in relation to the acetabulum. First-born status, female sex, a positive family history, breech presentation, and oligohydramnios are all risk factors for preterm labor and birth. DDH severity has been graded using a variety of classification systems, including the Crowe classification, the Hartofilakidis classification, and the Eftekhar and Kerboul classification. The purpose of this study was to determine whether there is a difference in femur length between patients with neglected developmental dysplasia of the hip (DDH) and the normal femur.*

Materials And Methods: *This is a case series study of 14 patients with Unilateral DDH who did not have surgery. Between January 2017 and December 2020, data were retrieved and obtained from our hospital's picture archiving and communication system (P.A.C.S). A Pelvis x-ray and a Full-Length Femur x-ray were taken for those patients. As a radiological landmark, a full-length film from the tip of the greater trochanter to the intercondylar space was used in this study. The following were the inclusion criteria: 1. The patient must be an adult who is at least 18 years old. 2. The deformity should only occur on one side (Unilateral DDH). 3. They had never had surgery before. 4. Crowe types III and IV*

Results: *The mean age of the patients was 34 (SD 12.4) years, with females outnumbering males (71.4 % vs 28.6 %). Additionally, the mean length of the affected femur was 41.6 (SD 3.88) and the mean length of the normal femur was 42.2. (SD 4.08). When we compared the baseline characteristics of patients by age group (35 years vs 35 years), we discovered that the BMI of the older age group (35 years) was statistically significantly higher than the younger age group (35 years) (P-value =0.028)*

Conclusion: *As a result of our study, we found an approximately 1 to 2 cm difference in femur length between patients with unilateral DDH and normal hip, which was correlated with age and body mass index (BMI). Preoperative considerations for unilateral DDH include taking a long film of both femurs to determine their relative length differences. This will assist in determining the amount of subtrochanteric femoral osteotomy to perform.*

Keywords: Developmental Dysplasia of The Hip (DDH), Femur Length, Crowe Classification, Body Mass Index (BMI)

Introduction

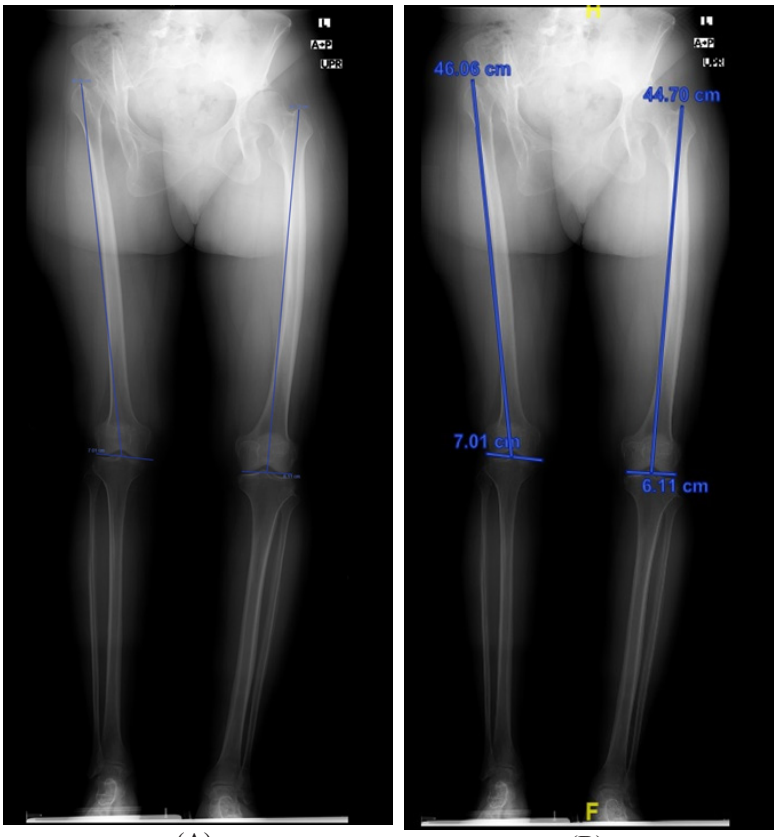
Developmental dysplasia of the hip (DDH) is a group of anatomical abnormalities of the hip joint in which the femoral head has an abnormal relationship with the acetabulum [1]. The incidence ranges from 1 in 1,000 to 34 in 1,000. When ultrasonography is utilized in conjunction with a clinical evaluation, a higher incidence is reported [2, 3] . First-born status, female sex, a positive family history, breech presentation, and oligohydramnios are all risk factors. supplementary to clinical examination. DDH can be divided into three types in adults .Type I : dysplasia in which the femoral head remains in real acetabulum; Type II: low dislocation where the femoral head articulates with a false acetabulum covering partially real acetabulum; and Type III : high dislocation in which the femoral head migrated superior posteriorly afterwards is not in real acetabulum contact [4-7]. There are different classification systems, including the Crowe classification, the Hartofilakidis classification, and the Eftekhar and Kerboul classification, have been used to grade the severity of DDH [8]. The Crowe classification is the most frequently used in literature. To classify the value of femoral head displacement, the Crowe classification considers the distance between the femoral head center and the inferior margin of the acetabulum [9] . Radiological criteria for DDH vary in literature, but parameters are generally accepted as central-edge (CE) angles < 20 ° and acetabular angles > 47 ° [10, 11] . However, unexpected long femurs have been observed in adults with DDH who were not treated surgically as children. We noticed that a patient who had unilateral DDH crow IV despite the fact that we had done osteotomy and shortening of approximately 6cm had a crow IV. Following the operation, we noticed that the femur in neglected DDH is significantly longer than normal. The purpose of this study was to determine whether there is a difference in femur length between patients with neglected developmental dysplasia of the hip (DDH) and the normal femur.

Study Design and Methodology:

This study was conducted at Prince Sultan Military Medical City (P.S.M.M.C), a tertiary care facility in Riyadh, Saudi Arabia. Our institution's Institutional Review Board approved this study. Between January 2017 and December 2020, data were retrieved and obtained from our hospital's picture archiving and communication system (P.A.C.S). For those patients, a Pelvis x-ray and a Full-Length Femur x-ray were performed. The following criteria were used to determine inclusion in our study:

- The patient must be an adult and at least 18 years old and above.
- The deformity should be in one side (unilateral DDH).
- They had no prior surgery.
- Crowe type III & IV

The full-length film from the tip of the greater trochanter to the intercondylar space was used in this study as a radiological landmark (Figure 1 [A, B])



(A) (B)

Figure 1 [A,B] : A full-length film x-ray revealed a radiological landmark for our study population from the tip of the greater trochanter to the intercondylar space, as well as a radiological significance in the femur length on the affected side (Right) of about 1.36 cm compared to the normal side (Left).

Statistical Analysis

The data analyses were performed using the statistical package for social sciences, version 26 (SPSS, Armonk, NY: IBM Corp.). Categorical variables were presented using numbers and percentages while continuous variables were presented using mean and standard deviation. Paired t-test was performed to determine the differences in mean between normal and affected femur length. Furthermore, the normal and affected femur length were compared to the different characteristics of the patients by using independent sample t-test and Fischer Exact test. Correlation procedures were also conducted to determine the linear relationship between the normal and affected femur length in regards to the BMI and age. P-value <0.05 was considered statistically significant.

Results

We analyzed 14 patients who diagnosed with DDH. As seen in (Table 1), the mean age of the patients was 34 (SD 12.4) years with females dominated the males (71.4% vs 28.6%). The prevalence of patients with family history of DDH was 28.6%. Furthermore, class 3 Crowe classification constitutes 64.3% while class 4 constitutes 35.7%. The mean values of weight (kg), height (cm) BMI (kg/m^2) were 65.5 ,155.5 and 28, respectively. In addition, the mean value of affected femur length was 41.6 (SD 3.88) and the mean value of normal femur length was 42.2 (SD 4.08). Paired t-test was performed at table 2 to determine the differences in length between normal and affected femur. Based on the results, it was found that the length of the affected femur was statistically significantly higher than normal femur length. (Mean diff.: -0.596; 95% CI: -1.140 – -0.051; p=0.034) (Table 2). The comparison of femur length in relation to gender, family history and Crowe classification was presented in (Table 3). Our investigation revealed that there was no significant difference being observed among gender, family history of DDH and Crowe classification in both normal and affected femur length (all p>0.05). When conducting correlation procedures between age in years and BMI in regards to normal and affected femur length, it was observed that the correlation between age in years and BMI in relation to normal and affected femur did not reach statistical significance (p>0.05) (Table 4). When comparing the baseline characteristics of the patients in regards to the age group (age <35 years vs ≥35 years), we have known that that BMI of older age group (≥35 years) was statistically significantly higher than younger age group (<35 years) (p=0.028). Other baseline characteristics of the patients did not significantly influence when compared to age group (p>0.05) (Table 5).

Table 1: Baseline Characteristics of the patients (n=14)

Study variables	Mean ± SD
Age in years	34.0 ± 12.4
Weight in kg	65.5 ± 15.4
Height in cm	155.5 ± 9.09
BMI in kg/m2	28.1 ± 7.89
Affected femur length	41.6 ± 3.88
Normal femur length	42.2 ± 4.08
	N (%)
Gender	
• Male	04 (28.6%)
• Female	10 (71.4%)
Family history of DDH	
• Yes	04 (28.6%)
• No	10 (71.4%)
Crowe classification	
• Class 3	09 (64.3%)
• Class 4	05 (35.7%)

Table 2: Paired t-test between the affected femur and normal femur length (n=14)

Femur	Mean ± SD	Mean Diff.	95% CI	P-value
Normal Femur length	41.6 ± 3.88	-0.596	-1.140 – -0.051	0.034 **
Affected Femur length	42.2 ± 4.08			
CI – Confidence Interval. ** Significant at p<0.05 level.				

Table 3: Comparison of femur length in relation to the baseline characteristics (n=14)

Factor	Normal Mean ± SD	T-test; P-value §	Affected Mean ± SD	T-test; P-value §
Gender				
• Male	41.9 ± 7.22	-0.161;	41.5 ± 6.93	-0.080;
• Female	42.4 ± 2.56	0.875	41.7 ± 2.39	0.937
Family history of DDH				
• Yes	40.3 ± 4.94	-1.154;	39.9 ± 4.84	-1.026;
• No	43.0 ± 3.67	0.271	42.3 ± 3.49	0.325
Crowe classification				
• Class 3	41.1 ± 4.43	-1.429;	40.6 ± 4.24	-1.446;
• Class 4	44.2 ± 2.63	0.178	43.6 ± 2.39	0.174
§P-value has been calculated using independent sample t-test.				

Table 4: Correlation (Pearson-r) between femur length in regards to Age and BMI (n=14)

Factor	Normal Femur length		Affected Femur length	
	R-value	P-value	R-value	P-value
Age in years	0.399	0.158	0.517	0.058
BMI kg/m^2	0.326	0.256	0.355	0.213

Table 5: Association between the Age group and the Baseline Characteristics of the patients (n=14)

Factor	Age <35 years	Age ≥35 years	P-value
	Mean ± SD	Mean ± SD	
BMI in kg/m^2 [a]	24.3 ± 5.77	33.3 ± 7.75	0.028 **
Affected femur length [a]	40.2 ± 4.29	43.6 ± 2.35	0.106
Normal femur length [a]	41.0 ± 4.82	43.8 ± 2.28	0.215
	N (%)		
Gender [b]			
• Male	03 (37.5%)	01 (16.7%)	0.580
• Female	05 (62.5%)	05 (83.3%)	
Family history of DDH [b]			
• Yes	01 (12.5%)	03 (50.0%)	0.245
• No	07 (87.5%)	03 (50.0%)	
Crowe classification [b]			
• Class 3	05 (62.5%)	04 (66.7%)	1.000
• Class 4	03 (37.5%)	02 (33.3%)	
a P-value has been calculated using independent sample t-test. b P-value has been calculated using Fischer Exact test. ** Significant at p<0.05 level.			

Discussion

When a unilateral dysplastic hip is present, the affected femur is frequently longer than expected. Metcalfe et al. in their study found to have 66% of patients who had unilateral DDH, the femur length was longer than the normal femur with a peak frequency in the 5-10 mm compared to bilateral group [12]. Rai et al. in their study of the discrepancy in the length of the Tibia in unilateral congenital dislocation of the hip [13]. They included 10 patients who had unilateral DDH. They used a reference point from the medial joint line of the knee and the tip of the medial malleolus. The average tibial shortening on the affected side was 1 cm, and it was unrelated to the dislocation severity.

In our study, we found a clinically significant difference in femur length between affected and normal hips. Crowe type III accounts for the vast majority of them (64.3 %). Furthermore, there was a clinical correlation of BMI in patients over the age of 35.

We focused on femur length in this study because we typically perform surgery on Crowe type III and IV patients. They all require a subtrochanteric femoral osteotomy, so the difference will give us how much shortening is required to reduce the femur into the native acetabulum. However, in these cases, soft tissue release is required, and the results will influence the decision on pre-operative planning.

There were two potential flaws in this study that could have skewed the results. For starters, the chosen sample size was insufficient when compared to the study's intended audience. Second, only one instrument was used to gather the data for the study. The instruments' validity and reliability haven't been thoroughly investigated. Because of the scoring system, there is a high risk of bias affecting the results' accuracy and reliability.

Conclusion

There is insufficient evidence to support our hypothesis. However, we need to conduct additional studies on bone length. Our study demonstrated a difference in femur length between unilateral DDH and normal femurs of approximately 1 to 2 cm, which was correlated with the patient's age and BMI. We recommend that as part of preoperative planning for unilateral DDH, a long film of both femurs be taken to determine the length difference between them. This will assist in determining the amount of subtrochanteric femoral osteotomy to perform.

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