

Outcome of delayed surgery in developmental hip dysplasia in a tertiary care setting

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Abstract:

Background: The delay in the detection of developmental dysplasia of the hip (DDH) can lead to incomplete hip stabilization and poor outcomes. This might also infer that the delay in DDH surgery can also be associated with unfavorable consequences. The purpose of this study was to compare the outcome of delayed versus early surgery on DDH patients with respect to clinical and radiological factors. **Methods:** This is a retrospective cohort study in which the charts of patients who underwent DDH surgery and whose age was less than 5 years at the date of referral to the orthopedic clinic, between 2008 and 2011 were reviewed. **Results:** This study included 62 patients, 34 of which presented with unilateral joint involvement and 28 affected bilaterally. Half of the patients underwent early surgeries (<6 months) and the other half had delayed surgeries (≥ 6 months).

Post-operatively the range of motion was significantly limited in the late surgery group ($P=0.001$). Limping gait was also significantly associated with late surgery ($P=0.005$).

Radiological abnormalities of all the X-Ray findings didn't reveal any statistically significant difference between early and delayed surgery except for the reduction in acetabular angle in the right hip post-op ($P=0.04$). **Conclusion:** Delayed DDH surgery can lead to a worse clinical outcome, physical disability and possible radiological effects on the patients. Poor outcome was significantly associated with the timing of the surgery. It is therefore recommended to perform DDH surgeries as early as possible to decrease the morbidity and prevent adverse clinical and radiological outcomes.

Key words: developmental dysplasia of the hip; surgery; pediatrics

Introduction:

Developmental dysplasia of the hip (DDH) is a dislocation of the hip, which is usually found at birth, but can also be detected later in life⁽¹⁾. The hip joint which is a synovial ball-and-socket joint articulates two bony parts, the femoral head and the acetabulum of the pelvic bone, which is a crucial component of hip stability⁽²⁾. In this condition, the acetabulum is too shallow, and the femoral head may slip out affecting one or both joints⁽¹⁾. The incidence of DDH varies and is reported to be 1 to 5 per 1000 children⁽³⁻⁵⁾. Risk factors of DDH include low amniotic fluid levels, being the first child, female gender, breech position of the baby during delivery and family history⁽⁵⁻⁷⁾. As for diagnosis, it is mainly based on clinical examination and ultrasound^(8, 9).

Ultrasonography is used in DDH to monitor the condition especially in high-risk children following treatment⁽⁵⁾. One of these radiologic parameters is the Shenton's line used in the diagnosis of acetabular dysplasia which is smooth in the normal hip and steps off in DDH⁽¹⁰⁾. A high acetabular index might also indicate hip dysplasia^(10, 11). Adding to the radiological parameters, the femoral head

should be in the lower medial quadrant formed by the Hilgenreiner's and Perkin's lines⁽¹¹⁾.

Treatment of DDH differs according to the patient's age of presentation. The standard treatment for infants less than 6 months of age is the Pavlik harness which is used to hold the hip joint as the child grows and mainly aims to reduce the hip^(12,13); an abduction brace has also been indicated for use in infants less than 6 months of age⁽⁴⁾. If the patient presents between 6 and 18 months of age or in case the harness was not beneficial, a closed surgical reduction is indicated, and a cast is needed afterward⁽¹⁵⁾. However, in refractory cases and in children older than 18 months an open reduction is required⁽¹⁶⁻¹⁸⁾. As for children older than 3 years, several types of pelvic osteotomies are performed according to the patient's age⁽¹⁹⁾.

DDH can be easily corrected once detected and treated, otherwise the condition might not become evident until the child starts walking after which the correction of the dislocation is more complicated and yields poorer outcomes⁽²⁰⁾. In this case, this treatable condition can progress into an anatomically abnormal hip which is a major source of disability in

children^(2, 20). This in addition to the higher costs of treatment associated with late diagnosis⁽²¹⁾. Hip pain, permanent waddling gait, limitation of hip abduction, avascular necrosis and poor functional outcomes are also among the complications of untreated DDH^(20, 22). Also, a major long-term outcome of DDH is the increase in the risk of developing hip osteoarthritis before the age of 60⁽²³⁻²⁵⁾. The delay of treatment or surgery as in the case of underdiagnoses or being on a long surgery waiting list might also pose similar risks and complications.

The purpose of this study was to compare the outcomes of delayed versus early surgery in DDH patients on several factors including number of procedures, gait, range of motion "ROM" and radiological X-Ray findings including Shenton's Line, H&P lines, ossification nucleus, and the acetabular angle.

Subjects and methods:

This is a retrospective cohort study which was conducted in the orthopedic surgery department of King Abdul-Aziz medical city (KAMC), a tertiary care hospital in Riyadh, Saudi Arabia. It was approved by the ethics committee of King Abdullah International Medical Research Center (KAIMRC). It included pediatric patients younger than 5 years at the date of referral to the orthopedic clinic who underwent DDH surgery from January 2008 to December 2011. Patients belonged to two groups; the first group included all patients who waited for 6 months or more to undergo the surgery or if the patient shifted from one type of surgery to another as they grew older. The second group included an equal number of patients who had their surgery done within less than 6 months of waiting. The DDH surgeries included in this study were as follows depending on the patient's age: closed reduction and spica application for 6-18 months old, open hip reduction for 18 months-3 years and different types of pelvic osteotomies for older children.

Data pertaining to clinical and radiological factors were extracted from patient medical records. The following clinical variables were assessed: number of procedures performed, gait (normal, limping), and range of motion (ROM) (normal, limited). In addition, radiological variables of both joints pre-and

post-operatively were assessed including Shenton's Line, the ossification nucleus, Hilgenreiner's and Perkin's lines(H&P) and the acetabular angle through X-ray examination. Acetabular angle improvement was measured as the difference in acetabular angle pre- and post-operatively and as the percent reduction in acetabular angle.

Statistical analysis

For data entry and analysis, the Statistical Package for Social Sciences (SPSS), version 22 was used. Categorical variables were presented as frequencies(percentages) and continuous data were presented as mean \pm standard deviation (SD). To study the association between timing of the surgery and the other clinical and radiological outcomes, Chi squared test or independent sample t-test were performed. The level of significance was set at P -value less than 0.05.

Results:

This study included 62 patients, 34 presenting with unilateral joint involvement and 28 bilateral with a total of 90 hips. Half of the subjects had early surgeries and the rest had late surgeries (Table 1). Most of the patients (83.9%) were females. Mean age at presentation was 18 months and the mean age at operation was almost 26 months (Table 1).

The number of procedures was not significantly different among study subjects who had an early surgery and those who had late surgeries ($P= 0.45$) (Table 2). Limping gait post-operatively was significantly higher among late surgery group (35.5%) in comparison with those who had an early operation (6.5%) (OR=7.9, $P=0.005$) (Table 2). Post-operative ROM was also significantly associated with the timing of surgery; full ROM was higher in the early surgery group (96.8%) versus the late surgery group (64.5%) (OR=10.3) ($P=0.001$) (Table 2).

Shenton's line of the right hip was normal in almost all the patients in the early and late group with 100 and 93.5% respectively ($P=0.33$) (Table 2). Shenton's line of the left hip post-operatively was normal in all patients in both groups. Ossification nucleus of the right hip post-operatively was normal in all patients in the early surgery group, compared to 87.1% patients having normal ossification

nucleus in those with late surgery ($P=0.23$) (Table 2). In the left hip 97% of patients were having normal ossification nucleus in early surgery, compared to 87.1% in late surgery ($P= 0.26$) (Table 2).

H&P lines of the right hip post-operatively were normal in all early surgery patients compared to 97% patients in late surgery ($P= 1$). H&P lines of the left hip post-operatively were normal in all patients in both groups (Table 2).

Acetabular angle difference in the left hip post-operatively was 13.7 ± 7.3 in the early surgery group, and 17.5 ± 10.5 in the late surgery ($P =0.11$) (Table 2). Those in the early surgery group had an acetabular angle difference in the right hip post-operatively of 10.7 ± 9.4 and 15.4 ± 10.1 in late surgery ($P=0.07$). Reduction of Acetabular angle for the left hip post-operatively was 37% in those in the early surgery group versus 44% in the late surgery ($P= 0.22$). For the right hip, acetabular angle reduction post-operatively in the early and late surgery groups was 29% and 40% respectively ($P=0.04$).

Table 1 General Characteristics of Patients who underwent DDH surgery (n=62)

Variable	n (%)
<i>Gender</i>	
Male	10(16.1)
Female	52(83.9)
<i>Age of presentation (in months)</i>	18.45±10.7
<i>Age at operation (in months)</i>	25.8±13.6
<i>Timing of surgery</i>	
Early (<6 months)	31(50)
Late (≥6 months)	31(50)

Discussion:

The treatment or correction of DDH is a vital step in avoiding any future complications and poor outcomes. In addition to the importance of early detection of DDH ⁽²⁰⁾ in favoring the desirable outcomes of the intervention, the same applies to the timing the surgery was performed to correct the condition.

This study was the first to address the outcome of delayed surgery of DDH in a wide range of ages ranging from 6 months to 5 years in Saudi Arabia and the region. It compared several outcomes of delayed and early DDH surgery, thus shedding the light on the importance of early intervention in treating

DDH. Most cases were females, which was concordant with other studies ^(5, 7).

When comparing early and delayed surgery, some less favorable clinical findings were significantly associated with the delayed surgery. Abnormal limping gait was significantly more evident among the delayed surgery group which can be explained by the fact that pathological hip deformities led to abnormal gait deviations ⁽²⁶⁾.

Likewise, ROM was also significantly limited in the delayed surgery compared to the early surgery. This might imply that the later the surgery is done, the poorer the functional outcomes in terms of gait and ROM ^(2, 3, 26).

Regarding secondary surgical procedures following the hip correction, some studies reported that more than half of the patients required further surgeries ^(27, 28). In this study, there was no significant difference between the two groups regarding the number of procedures undertaken by patients which might be attributed to the difference in the surgical skills between the orthopedic surgeons who performed the procedures, the degree of dysplasia and the complications occurring intra and post-operatively.

Radiographic parameters were shown to be valid and reliable in measuring the long-term outcomes ⁽²⁹⁾. Although acetabular index has been shown to improve in all hips after evaluation ⁽³⁰⁾, the radiological findings (Shenton’s Line, Ossification Nucleus, H&P lines and acetabular angle) in this study showed no significant difference between the early and late surgery groups except for the acetabular angle improvement post-operatively in percentage for the left hip.

A study similar to ours explored the outcomes of neglected DDH surgery after walking age and concluded that technically it is a more difficult procedure that requires high expertise ⁽³⁰⁾. However, it didn’t compare the outcome between early and late surgery which makes comparison between our results and those found by the other authors seem to be unreliable ⁽³⁰⁾. Some limitations of this study were the small sample size which might have masked any actual association between the timing of the surgery and the outcomes. This in addition to being a single-centered study which might not apply to other institutions and a longer term follow up is needed for better outcome assessment.

Table 2 Frequency distributions and bivariate associations of the clinical and radiological findings in early and late surgery

Variable	Early surgery (N=31) <i>n (%)</i>	Late surgery (N=31) <i>n (%)</i>	Total <i>n (%)</i>	Odds ratio	P-value
<i>Number of procedures</i>					
1-3	28(90.3)	26(83.9)	54(87.1)	0.57	0.45
≥4	3(9.7)	5(16.1)	8(12.9)		
<i>Gait</i>					
Normal	29(93.5)	20(64.5)	49(79)	7.9	0.005*
Limping	2(6.5)	11(35.5)	13(21)		
<i>ROM¹</i>					
Full	30(96.8)	20(64.5)	50(80.6)	10.3	0.001*
Limited	1(3.2)	11(35.5)	12(19.4)		
<i>Shenton line of Right joint²</i>					
N ³ -N	10(32.3)	8(25.8)	18(29)	2.2	0.33
D ⁴ -N	21(67.7)	21(67.7)	42(67.7)		
D-D	0(0)	2(6.5)	2(3.2)		
<i>Shenton line of left joint²</i>					
N ³ -N					
D ⁴ -N	6(19.4)	7(22.6)	13(21)	0.09	0.75
	25(80.6)	24(77.4)	49(79)		
<i>Ossification nucleus of left joint²</i>					
N ³ -N					
D ⁵ -N	6(19.4)	8(25.8)	14(22.6)	2.7	0.26
D-D	24(77.4)	19(61.3)	43(69.4)		
	1(3.2)	4(12.9)	5(8.1)		
<i>Ossification nucleus of right joint²</i>					
N-N					
N-D ⁵	12(38.7)	10(32.3)	22(35.5)	4.3	0.23
D-N	0(0)	1(3.2)	1(1.6)		
D-D	19(61.3)	17(54.8)	36(58.1)		
	0(0)	3(9.7)	3(4.8)		
<i>H&P lines for right hip²</i>					
N ³ -N	12(38.7)	9(29)	21(33.9)	1.5	0.46
D ⁶ -N	19(61.3)	21(67.7)	40(64.5)		
D-D	0(0)	1(3.2)	1(1.6)		
<i>H&P lines for left hip²</i>					
N-N	6(19.4)	7(22.6)	13(21)	0.09	0.75
D ⁶ -N	25(80.6)	24(77.4)	49(79)		
<i>Acetabular angle difference for left hip</i>	13.7± 7.3	17.5± 10.5	-	-	0.11

Acetabular angle difference for right hip	10.7± 9.4	15.4± 10.1	-	-	0.07
Reduction in acetabular angle of left hip post-op in percentage	37	44	-	-	0.22
Reduction in acetabular angle in right hip post-op in percentage	29	40	-	-	0.04*

*Statistically significant (P<0.05)

¹ ROM: range of motion

² Pre-surgery category –Post surgery category

³ normal, ⁴ disrupted, ⁵ delayed, ⁶ dislocated

Conclusion / Recommendations:

Delayed DDH surgery seems to carry a poor clinical outcome and physical disability and a possible radiological effect on the patient. We suggest conducting similar multicentered studies that can investigate more cases to compare between the early and late hip surgeries in terms of outcome. We also recommend performing early surgeries in the case of DDH to reduce any poor surgical outcomes and improve the well-being and lifestyle of the DDH patients.

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