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## Evaluation of Surgical Treatment of Developmental Dysplasia of Hip for Avascular Necrosis of Femoral Head in Children

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**Abstract:** Developmental Dysplasia of the Hip (DDH) is a common congenital malformation. Avascular necrosis of femoral head is the major complication of both close and open reduction of the dislocated joint. Aim of this study was to determine the incidence and influencing factors in different types of a vascular necrosis of femoral head, following surgical treatment of developmental dysplasia of hip in 1-7 years patients. In this study, 120 patients aged from 1 to 7 years old with DDH who had been undergone open surgery, entered to the study. All of these patients followed up for at least 1 year. Surgery procedures divided to 4 groups: open reduction, open reduction+salter osteotomy, open reduction+femur shortening and open reduction+salter osteotomy+femur shortening. The presence of Avascular Necrosis (AVN) had been appraised. 27.5% of surgeries performed on male and 72.5 on female patients. 35.0% of DDH cases were unilateral and remaining was bilateral. 36 patients (30%) shows radiologic findings of AVN, although all of them placed at group I of Bucholz-Ogden classification. 40% of group A patients, 25% of group B, 14.3% of group C and 36.4% of group D patients developed this findings. Open reduction of DDH in older children is effective in the management of DDH and if all of the contrivance considered in the surgery, the rate of AVN would be low and mild (at least in short term follow ups).

**Key words:** Developmental dysplasia of the hip, avascular necrosis, open reduction, osteotomy, femur shortening

### INTRODUCTION

Developmental Dysplasia of Hip joint (DDH) includes a range of hip disorders differently manifest at different ages (Libri and Marchesini, 2010). In this disease, there is no natural relation between femoral head with acetabulum and natural position of hip joint and it can be seen as a complete or incomplete dislocation with or without dysplasia (Kitano *et al.*, 2010). In children, this syndrome is defined as instability of hip joint so that it can be completely or incompletely removed from commissural (Joo *et al.*, 2009). It is also possible that the joint be seen as displaced in resting position (Sibinski *et al.*, 2009). Lasting this disorder to puberty results in ineffectively cover of femur head by acetabulum. This is called dysplasia of hip joint (Funk *et al.*, 2008). DDH is more prevalent in females than males (Pach *et al.*, 2008). On the other hand, race differences are significantly effective in prevalence of this disorder. Comparing with African-Americans and yellows, DDH incidence is more prevalent in white newborns (Kotnis *et al.*, 2008). It is likely results from baby-caring methods in different races

(Tukenmez and Tezeren, 2007). Although, no single factor has been known for DDH incidence, some factors have been introduced to be involved in etiology of this disorder (Dezateux and Rosendahl, 2007). The most important of these factors are flabby ligaments (often congenital), bridge location while pregnant, status after delivery and initial dysplasia of acetabulum (Sibinski and Synder, 2006). This status, like other birth-time diseases such as phenylketonuria and hypothyroid should be recognized and treated before developing of complications (Sibinski *et al.*, 2006). Early treatment of the disease plays an important role in preventing subsequent disabilities (Kesa *et al.*, 2005). Avascular necrosis of femur head is one of the main factors of long-term disability following DDH treatment (Wirth, 2005). It can be almost always prevented as a complication relevant to treatment method. Several protocols have been offered in order to prevent this complication (LeBel and Gallien, 2005) To this end, the present study was conducted to clarify, if considering all methods in preventing AVN of femur head, whether prevalence of this complication subsequent to DDH treatment reduce.

**MATERIALS AND METHODS**

In this cross sectional study, 120 children (1-7 years old) who have undergone surgery for DDH correction in Shohada hospital, Tabriz University of Medical Sciences from March 2008 to March 2011 entered the study. They were followed up for about at least one year. In order to collect and document data, a checklist was designed according to the required variables. It was completed through referring to the patients file and later examinations as per the follow-up cares. Bucholz-Ogden classification was used for classifying AVN incidence. Patients were in four different surgical groups:

- Group A:** Open reduction, capsulorrhaphy, adductor tenotomy and psoas
- Group B:** Open reduction, capsulorrhaphy, adductor tenotomy and psoas+salter osteotomy
- Group C:** Open reduction, capsulorrhaphy, adductor tenotomy and psoas+initial shortening of femur
- Group D:** Open reduction, capsulorrhaphy, adductor tenotomy and psoas+salter osteotomy+initial shortening of femur

The cast was opened and pines were removed 6 weeks after surgery. The first control-graphy after surgery was done at this time and AVN incidence was examined. Then, the cast was repeated for another 6 weeks. Subsequent control-graphies were done during the patient's follow up. AVN incidence was verified through study of the obtained graphs and their comparison with those obtained before surgery. The results were registered so that before surgery dysplastic deficiencies are not considered as AVN incidence after surgery. One of radiologist colleagues evaluated the graphs. This radiologist was not aware of the study aims resulted in preventing from bias in this study. The collected data were analyzed through use of SPSS statistical software (version 16). Chi-square and ANOVA tests were used for verify existence of any meaningful relationship between variables. p value less than 0.05 was regarded as meaningful in this study.

**RESULTS**

According to the collected data and considering all patients, 33 surgeries (27.5%) were done on male patients and 87 (72.5%) on female ones. Among them, 42 cases (35%) were suffering unilateral DDH and 68 cases (65%) from bilateral DDH. Considering 120 surgeries, 54 cases (45%) operated at right side and 66 cases (55%) at left side (Table 1). In 24 cases (20%) of all surgeries, unusual bleeding was observed but it did not occurred at the

**Table 1: Demographic characteristics of the study population**

Characteristics	Group							
	A (n = 30)		B (n = 36)		C (n = 21)		D (n = 33)	
	No.	%	No.	%	No.	%	No.	%
<b>Sex</b>								
Male	12	40	9	25	6	28.5	6	18.1
Female	18	60	27	75	15	71.5	27	71.9
<b>Type of involvement</b>								
Unilateral	6	20	9	25	12	57.1	12	36.3
Bilateral	24	80	27	75	9	42.9	21	63.7
<b>Side of involvement</b>								
Right	12	40	12	33	9	42.9	21	63.7
Left	18	60	24	67	12	57.1	12	36.3

remaining 96 cases (80%). Only 12 patients (10%) out of 120 were treated through use of before surgery nonsurgical methods.

Among 30 patients of the group A, 12 and 18 surgeries were done on male and female patients, respectively. There were 6 cases suffering from unilateral DDH and 24 cases with bilateral DDH. Considering 30 surgeries done in this group, 12 cases were on right side and 18 on left side. Unusual bleeding was observed in 6 cases of this group. It was not occurred in the remaining 24 cases. Only 6 patients out of 30 were treated through use of before surgery nonsurgical methods (Table 1).

Among 36 patients of the group B, 9 surgeries were done on male patients and 27 on females. There were 9 cases suffering from unilateral DDH and 27 cases with bilateral DDH. Considering 36 surgeries done in this group, 12 cases were on right side and 24 on left. No unusual bleeding was observed in this group. Only 3 patients out of 36 were treated through use of before surgery nonsurgical methods (Table 1).

Among 21 patients of the group C, 6 and 15 surgeries were done on male and female patients, respectively. There were 12 cases suffering from unilateral DDH and 9 cases with bilateral DDH. Considering 21 surgeries done in this group, 9 cases were on right side and 12 on left. Unusual bleeding was observed in 12 cases of this group. It was not occurred in the remaining 9 cases. None of the patients of this group was treated through use of before surgery nonsurgical methods (Table 1).

Among 33 patients of the group D, 6 surgeries were done on male patients and 27 on females. There were 12 cases suffering from unilateral DDH and 21 cases with bilateral DDH. Considering 33 surgeries done in this group, 21 cases were on right side and 12 on left side. Unusual bleeding was observed in 6 cases of this group. It was not occurred in the remaining 27 cases. Only 3 patients out of 30 were treated through use of before surgery nonsurgical methods (Table 1).

Referring follow-up considerations it was observed that 36 patients (30%) out of the 120 ones undergone

Table 2: Distribution of AVN manifestation cases considering involved side and type of surgery

Type of surgery	Involved side				p-value
	Right		Left		
	No.	%	No.	%	
A	3	25.0	9	75.0	0.647
B	3	33.3	6	66.7	
C	3	100.0	0	0.0	
D	6	50.0	6	50.0	
Sum	15	41.7	21	58.3	

surgery afflicted by AVN but it was not observed at the remaining 84 cases (70%). Amount of AVN incidence in different surgical groups with p-value of 0.647 was not statistically meaningful (Table 2).

Mean age of the patients was 4.42±2.13; the youngest one was 1 and the oldest 7 years old. Mean age in 36 cases resulted in AVN equal to 2.33 with minimum 1 and maximum 4 years old but at the other 84 cases not suffering from AVN, mean age was 4.52±2.18 with minimum 1 and maximum 5 years old. Difference between two groups with the P value of 0.730 was not statistically meaningful. Follow-up duration was averagely 16.60 months in all patients with minimum of 6 and maximum of 36 months. Average of operation time in all patients was 3.93±2.24 h. with at least 3 and maximum 5.5 h.

### DISCUSSION

DDH is a congenital dislocation or subluxation of the hip joint found in children. It occurs in 1 out of 1000 births (Burian *et al.*, 2010). The hip joint is a ball and socket joint, constant of femoral head (the ball) and the acetabulum (the socket). This joint may be fully dislocate or be little shallow in birth, it has many risk factors but the real reason is unknown till now (Walton *et al.*, 2010). Tukenmez and Tezeren (2007) studied results of Salter in 79 operations in a research conducted in Turkey during 1994- 2002, This study which its results was published in 2007 divided the patients into two groups: younger than 3 years old (46 surgeries) and older than 3 years old (33 surgeries). DDH was observed in left side of 34% of cases, right side of 37% cases and both sides in 30% of cases. Follow-up duration was 58 months for patients of the group one and 62 months for the second group. According to this study, 11% of younger than 3 years patients and 15% of older than 3 years ones afflicted by AVN. From among 10 hip joints suffered from AVN, 5, 3, 1 and 1 was in groups I, II, III and IV of Severin classification, respectively. Roth *et al.* (1974) study, 147 hip joints undergone femur lumpectomy+osteotomy and the results were averagely evaluated for 22 years. In this study, AVN prevalence

reported as 5% in these patients (Roth *et al.*, 1974). In another study 34 hip joints undergone femur lumpectomy+osteotomy and resulted outcomes were averagely evaluated for 17 years. In this study, AVN prevalence reported as 12% in these patients (Wilkinson and Weissman, 1988). In Gulman *et al.* (1994) study; open reduction operation with anterolateral+anonymous osteotomy approach was done on 52 hip joints and the results were evaluated for about 13 years. In this study, AVN prevalence reported as 63% in these patients. In Barrett *et al.* (1986) study, open reduction operation with anterolateral+anonymous osteotomy approach was done on 15 hip joints and the results were evaluated for about 11 years. In this study, AVN prevalence reported as 13% in these patients. In (Morcuende *et al.*, 1997) study, open reduction operation with medial approach was done on 93 hip joints and the results were evaluated for about 10 years. In this study, AVN prevalence reported as 43% in these patients. In Koizumi *et al.* (1996) study, open reduction operation with medial approach was done on 35 hip joints and the results were evaluated for about 19 years. In this study, AVN prevalence reported as 43% in these patients. In most of these studies, it has been stated that follow-up duration after surgery should be at least 10 years or until growth plates become stable because AVN of type II in Bucholz classification often occurs after 10 years old (in some studies, follow up measures continues for 36 years). These studies revealed that short follow-up period can falsely demonstrate lower levels of AVN prevalence (Wu *et al.*, 2010). As mentioned in the results section, amount of AVN prevalence was calculated as 30% in our study. Comparing with other studies, this seems a little higher but it should be noted that this study put all AVN cases in Type I of Bucholz classification. This is while AVN had usually higher degrees in other studies. On the other hand, the conducted studies demonstrate that more mistakes are observed considering diagnosis and radiologic evaluation of DDH even in developed countries (Perry and Bruce, 2010).

### CONCLUSION

Comparing most of other studies, AVN incidence in open reduction of femur was higher in this study. All AVN cases were put in type I of Bucholz classification our study. No meaningful difference was observed between different surgical groups considering amount of AVN incidence. There was no meaningful difference in age of patients afflicted by AVN at the time of surgery with those did not suffer this complication.

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