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Original Article

Role of Salter Osteotomy In Improving Acetabular Index of Ddh Patients Measured By Radiography Pre-Op and Post-Op

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ABSTRACT

Objective: To look for improvement in acetabular index of developmental dysplasia of the hip (DDH) patients measured by radiography before and after salter osteotomy.
Study Design: Cross-sectional study.
Setting and Duration of Study: Orthopedics Department Combined Military Hospital, Rawalpindi Pakistan, from July 2022 to June 2023.
Methodology: All the children between the age of 18 months and 4 years who were diagnosed as developmental dysplasia of the hip by consultant orthopedic surgeon were recruited for this study. They underwent all baseline investigations including relevant radiographs of pelvis. All the patients underwent Salter osteotomy in our hospital by orthopedic team lead by a senior consultant. Acetabular index was measured on radiographs of pelvis before surgery and then 8 weeks after the surgery in all the study patients. Change in acetabular index before and after the surgery (if any) was recorded for all the children who were included in the study.
Results: A total of 67 children between the 18 of 18 months and 4 years presenting with developmental dysplasia of the hip were included in final analysis. Mean age of children recruited in our study was 31.23±8.01months. Mean acetabular index on pelvic radiographs of children before Salter osteotomy was 32.25±3.770 while after surgery it was 19.16±5.250 (p-value<0.001).
Conclusion: Salter osteotomy emerged as an effective procedure for children having developmental dysplasia of the hip. Acetabular index calculated on pelvic radiographs was significantly found decreased after eight weeks of surgery in children included in the study.

Keywords: Acetabular index; Developmental dysplasia of the hip; Salter Osteotomy

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INTRODUCTION

Developmental disorders of skeletal system have been diagnosed more frequently in last few decades because of better post-natal facilities and neonates screened by treating teams.[1] Still few conditions remain undiagnosed for a long time till the child is grown up and then become difficult to manage or are managed with more morbidity and burden on patient, family and health care system.[2] Statistics reveal that developmental dysplasia of the hip is a fairly common developmental condition elated to pelvic skeleton and more commonly found in female children.[3]

Pediatric orthopedics surgery is still on a toddler stage as a specialty in our part of the world. It's usually adult orthopedic surgeons or general pediatric surgeons which manage pediatric skeletal conditions in our part of the world.[4] Multiple procedures are opted for children suffering from developmental dysplasia of the hip.[5] Salter osteotomy is performed in most of the cases of Developmental dysplasia of the hip and have its own merits and demerits but generally have shown good results with limited morbidity.[6]

Multiple studies have been conducted with different designs to look for results of Salter osteotomy for management of DDH in children. Koroglu *et al.*, in 2021 conducted a retrospective study to look for results of various surgical techniques including Salter osteotomy for management of DDH. They compared the results in children of less than 4 years of age and more than 4 years of age and concluded that clinical and radiographic results were better in children who were managed before the age of 4 years for DDH.[7] A study done in Iran looked for results of slightly modified Salter Osteotomy in which pressure was released from femoral head. It was concluded that this

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procedure was safe and had good results for management of DDH.[8] Akifusa *et al.,* in 2022 also studied results of modified Salter Osteotomy for management of children presenting with DDH. They revealed that short term radiological results were even better than routine Salter osteotomy in their study population.[9]

Congenital developmental skeletal conditions are seldom missed in developing country like ours due to lack of health care infrastructure in rural areas where huge chunk of our population reside. Despite this limitation, a recent local study showed that children who gets operated for developmental dysplasia of the hip show very good improvement and recover well from this otherwise disabling condition.[10] Salter osteotomy is usually performed at most tertiary care orthopedic centers for children presenting with developmental dysplasia of the hip but still limited local data is available regarding efficacy of this procedure in local population. We therefore designed this study with the rationale to look for improvement in acetabular index of developmental dysplasia of the hip (DDH) patients measured by radiography before and after salter osteotomy.

METHODOLOGY

This cross-sectional study was conducted at the Orthopedics Department Combined Military Hospital Rawalpindi. July 2022 to June 2023. Sample size was calculated by WHO Sample Size Calculator by using population prevalence proportion of improvement in acetabular index after Salter osteotomy in patients of DDH as 95.5% and keeping margin of error as 5%.11 Non probability Consecutive sampling technique was used to gather the sample.

Inclusion Criteria: All the children between the age of 18 months and 4 years diagnosed as DDH and managed via procedure of Salter Osteotomy were included in the study

Exclusion Criteria: Patients who were less than 18 months or more than 4 years were not recruited. Those children whose parents refused to let them undergo surgical management were also not recruited for this study. Children having any metabolic abnormalities which could interfere with healing and recovery process after the surgery were excluded as well. Patients who could not come for follow up or could not undergo radiography after the salters osteotomy was not included in the study.

Ethical approval was obtained from the hospital ethical committee via letter no. 405 on 20 june 2022. Parents of children were provided all the information about this study and their children were recruited after their informed consent. Children who fulfilled all the points of criteria laid for this study were included. Developmental dysplasia of the hip was diagnosed by consultant orthopedic surgeon on the basis of clinical and radiological findings.[12] All baseline blood investigations and pelvic radiograph were carried out on all the study participants. Acetabular index was calculated by on member of research team via set protocol on pelvic radiograph.[13] All the children underwent paranesthesia evaluation as per hospital protocols by anesthesia team of our own hospital. At the day of surgery, they underwent pre-anesthesia medication before the induction of anesthesia. Salter osteotomy was performed by consultant orthopedic surgeon with his fully trained team. Pelvic bone underwent osteotomy just above the acetabulum, and the distal segment was shifted outwards, forwards, and downwards for appropriate construction of the acetabular roof which corrected the dysplasia.[14] Patient was kept in recovery under anesthesia team care for three hours and then shifted to high dependency unit for 6 hours and if recovery was uneventful. Shifting to ward was done. Treating orthopedic team followed up the patient on regular intervals. Pelvic radiography was performed at eighth week of surgery and measurements of acetabular index were repeated in all the study participants.

All statistical analysis for this study was performed by using the Statistics Package for Social Sciences version 24.0 (SPSS-24.0). Mean and standard deviation for age and pre and post-operative acetabular index were calculated for all the children recruited in study. Frequency and percentages were calculated for qualitative variables included in this analysis. Comparison was made for mean values of acetabular index before and after the surgery by paired t-test and p-value less than or equal to 0.05 was considered significant.

RESULTS

A total of 67 children between the 18 of 18 months and 4 years presenting with developmental dysplasia of the hip were included in final analysis. Mean age of children recruited in our study was 31.23±8.01months. Table-I summarized the general characteristics of children suffering from DDH included in the study. There was clear female

predominance in study participants as only 15(22.3%) children were male while 52(77.7%) were female. Out of total 67 study participants, 35(52.2%) were from rural background while 32(47.8%) were from urban background. With regards to side involved, 36(53.7%) had left side involved, 22(32.8%) had right side involved while in 09(13.4%) children both sides were involved.

Table-II showed the results of statistical analysis. Mean acetabular index on pelvic radiographs of children before Salter osteotomy was 32.25±3.770 while after surgery it was 19.16±5.250. It was revealed that there was statistically significant decrease in acetabular index after the surgical procedure (*p*-value<0.001) which can be interpreted as significant clinical advantage in these patients after the surgical procedure.

Table-I: Characteristics of children recruited in the study (n=67)

Study Parameters	n(%)
Age (months)	
Mean + SD	31.23±8.01 months
Area of residence	
Rural	35(52.2%)
Urban	32(47.8%)
Gender	
Male	15(22.3%)
Female	52(77.7%)
Side	
Left	36(53.7%)
Right	22(32.8%)
Bilateral	09(13.4%)

Table-II: Mean Acetabular Index On Radiographs Before And After The Surgery (n=67)

	Mean ± Standard deviation of acetabular index before surgery	Mean ± Standard deviation of acetabular index after surgery	*p*-value
Acetabular index (degrees)	32.25±3.770	19.16±5.250	<0.001

DISCUSSION

Children having skeletal abnormalities, congenital or acquired if require surgery usually face multiple issues in a developing country like ours. Social taboos, lack of availability of basic health resources, late referrals and lack of trained pediatric orthopedic surgeons are some of the factors which hinder in timely management of developmental skeletal abnormalities in children including developmental dysplasia of the hip. Functional recovery in pediatric age group is sometimes very difficult to assess, therefore radiological improvements are considered more important in this age group. We conducted this study on children suffering from DDH and managed with Salter osteotomy with an aim to look for improvement in acetabular index of measured by radiography before and after salter osteotomy performed at our tertiary care military hospital.

Baghdadi *et al.,* published a study to look for results of Salter osteotomy in children suffering from DDH. They compared results in children of more than three years old and less than three years old. It was concluded in their study that results were satisfactory in children of both age groups. Complications like infection or re-dislocation negatively impacted radiological outcome.15 We studied children under the age of 4 years and found out that at the end of 8 weeks after the surgery radiological outcome was overall satisfactory.

Similar study was published in 2023 in which acetabular index and other radiological parameters were compared in children of DDH before and after modified Salter osteotomy. It was revealed that this procedure had excellent results in terms of radiological outcome but as it was case series so level of evidence fell at grade IV.16 Ours was a cross-sectional study and we performed conventional Salter Osteotomy and found out that it was an effective procedure and acetabular index was significantly reduced at 8 weeks' postoperative radiographs.

Aldhoon *et al.,* published a study from Jordan in which they tried to look for radiographic improvements in children of DDH after Salter osteotomy. They concluded that almost near normal radiological indices were achieved after Salter osteotomy in their study participants.17 Salter osteotomy emerged as an effective procedure for children having developmental dysplasia of the hip in our study as well. Acetabular index calculated on pelvic radiographs was significantly found decreased after eight weeks of surgery in children included in the study.

Jiang *et al.,* published a study from China and evaluated their study participants via three dimensional CT scan after the procedure of Salter osteotomy for management of DDH. They came up with the findings that indices in all dimensions were improved after the procedure.[18] We evaluated our patients via pelvic radiographs after 8 weeks of

surgery and found significant improvement in acetabular index.

LIMITATION OF STUDY

Follow up till 8 weeks was only included in the study which becomes an important limitation in generalizing the results as these patients are usually followed up for few years. Children under the age of 4 years were only included in the study which may not be true representation of all the children managed with DDH in our part of the world as good number of patients are managed even after the age of 4 years.

CONCLUSION

Salter osteotomy emerged as an effective procedure for children having developmental dysplasia of the hip. Acetabular index calculated on pelvic radiographs was significantly found decreased after eight weeks of surgery in children included in the study.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

HFUR & MSA: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

MQAS & ML: Data acquisition, data analysis, approval of the final version to be published.

MNI: Critical review, concept, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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