Journal of Academic Research
Vol 30, Issu Special issue, 2026 "28-43"

Results of spica cast in treatment of developmental dysplasia of the hip in children between 6-18 Months

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Article information

Key words
Developmental dysplasia of the hip (DDH).
Closed reduction.
Hip spica cast.
Acetabular index.
Tönnis classification;
McKay criteria.
Severin classification;
Avascular necrosis;
Pediatric orthopedics.

Received: 07-07-2025
Accepted: 28-07-2025
Available: 01-01-2026

Abstract

Background: Developmental dysplasia of the hip (DDH) includes a range of abnormalities from acetabular dysplasia to hip dislocation. Early diagnosis and treatment are essential to achieve good hip function and prevent early degenerative changes. When bracing fails, closed reduction and hip spica casting are commonly used in infants. Delayed treatment may lead to structural changes such as inverted labrum, hypertrophied ligamentum teres, pulvinar tissue, and capsular tightening.
Aim: To evaluate the outcomes of static long-leg hip spica casting in children aged 6–18 months diagnosed with DDH at Misurata Medical Center.
Methods: Patients were treated with adductor tenotomy, closed reduction, and static long-leg hip spica cast. Hips were classified using the Tönnis system, and baseline acetabular index (AI) was grouped as 30°–35°, 36°–40°, and > 40°. Clinical outcomes were assessed with the modified McKay criteria, and radiological results with Severin's classification.
Results: Thirty-eight hips (29 patients) were evaluated. According to Severin classification, 70% showed good radiological results (grades I–II), while 30% were poor. Based on the modified McKay criteria, 89% achieved good clinical outcomes (types I–II). Avascular necrosis was observed in 3 hips (7.8%). The mean age at reduction was 6 months, and mean follow-up was 5 months. The average immobilization period in spica cast was 90 days.
Conclusion: Closed reduction and static hip spica casting is a safe and effective method for treating DDH in children aged 6–18 months. Outcomes are influenced mainly by the pre-reduction hip position, initial acetabular index, and occurrence of avascular necrosis.

I) INTRODUCTION:

The treatment method used for 6- to 18-month-old paediatric patients with (DDH) has become controversial. For example, increasingly more surgeons advocate an early operation,1 but reports on the long-term effects of the conservative treatment for patients older than 12 months are very rare.2 As a non-invasive treatment method, conservative treatment results in less trauma, so it is easier for patients and their families to accept, but the applicable age has been a controversial issue.3To date, a number of different types of conservative treatment have been used, such as frog fixation and human position fixation.4 The traditional method was often utilized to fix hips in an abduction and buckling

position.4 Furthermore, some surgeons have developed modified methods based on the traditional treatment.3 The aim of this present study was to determine the outcome of the adductor tenotomy, closed reduction, and static long leg casting method in infants with DDH diagnosed between the ages of 6 months and 18 months.

Some children may have a normal femoro-acetabular relationship at birth and only later go on to develop a dysplastic hip.{37} on other hand some paediatric hip undergoes a variety of changes abnormal in newborns may become normal without any intervention at all {41}.

In a dislocated hip there is no articular contact between the femoral head and the acetabulum. A dislocated hip may be irreducible or reducible.

In a subluxated hip, the femoral head is partially displaced from its normal position, but some degree of contact with the acetabulum remains. The hip is called dislocatable, when application of posteriorly directed force on the hip positioned in adduction, leads to complete displacementof the femoral head from the margins of the acetabulum

Similarly, the hip is called subluxable, if just gliding of the femoral head is noticed. Acetabular dysplasia describes the abnormality in the development of the acetabulum, including an alteration in size, shape and organization {35-36}. Dislocations are divided into two subtypes:

1*Dislocation that occurs in an otherwise healthy infant is called typical dislocation and it may occur pre- or post-natally.

2*Dislocation that is associated with neuromuscular disorders is called teratologic and it occurs prenatally {34-36-37}.

The normal development of the child's hip relies on congruent stability of the femoral head within the acetabulum.

The hip joint will not develop properly if it stays unstable and anatomically abnormal by walking age {36-38}.

The exact incidence of DDH is difficult to determine because of different levels of skills of clinicians. The incidence ranges from as low as 1 per 1,000 to as high as 34 per 1,000. Higher incidences are reported when ultrasonography is also used in addition to clinical examination.{39} risk factors include first born status, female sex, positive family history, breech presentation and oligohydramnios {40} first degree relative with DDH birth weight more than 4000 g, associated factor as foot deformities like metatarsus adductus and talipes may also increase risk of DDH.

However, it is important to note that more than 60% of neonates have no identifiable risk factors for DDH,

There is increased incidence of DDH in identical twins as compared to fraternal twins' careful clinical examination should be carried out on all newborn children especially those with risk factors for DDH. Routine screening should include both the Ortolani test and the Barlow maneuver, and each hip should be examined separately.

For physical examination, the child should be completely relaxed, on a smooth, warm, comfortable surface in a quiet environment.

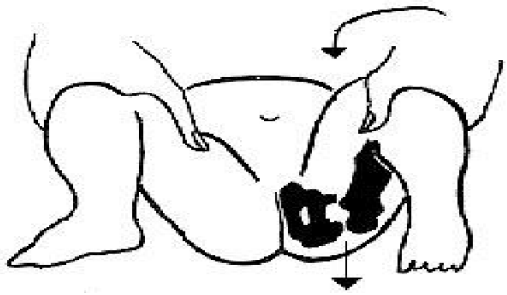
The management strategy for DDH depends on the child's age and the severity of the disease.

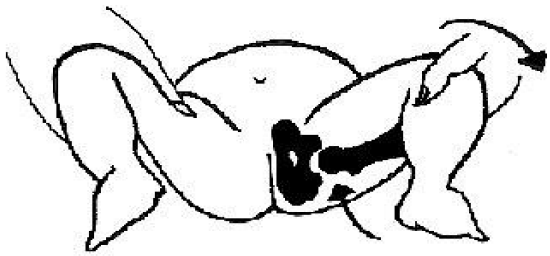
II) Aim of the study

To evaluate the effect of static long leg spica casting in pediatric patients with developmental dysplasia of hip (DDH) diagnosed at 6–18 months. Early diagnosis and treatment is the golden rule for DDH To determine the role of splinting and the optimal treatment strategy for the non-operative management of DDH in children. Radiography and conservative management are the corner stone's in DDH evaluation and treatment in children 6m – 18 m age group.

III) Literature Review:

Developmental dysplasia of the hip (DDH) refers to hip instability, sublaxition or dislocation of the femoral head or teratogenic dislocation or acetabular dysplasia in developing hip joint





A teratologic dislocation of the hip (TDH) an association with other severe malformations, such as spina bifida, arthrogryposis multiplex congenita, lumbosacral agenesis, chromosomal abnormalities, diastrophic dwarfism, Larsen syndrome and other rare syndromes {42}.

A) Epidemiology

DDH is the most common orthopedic condition in newborns. Hip instability occurs in approximately 1 per 100 births, while frank dislocation occurs in approximately 1 per 1000 births. The condition is significantly more common in females, with a reported female-to-male ratio of nearly 6:1. The left hip is more frequently affected, likely due to the typical intrauterine position in which the left hip is adducted against the maternal spine. Approximately 60% of cases involve only the left hip, 20% the right hip, and 20% are bilateral {36–37}.

Multiple maternal and fetal risk factors have been implicated, including oligohydramnios, primiparity, twin gestation, large birth weight, and intrauterine crowding. Postnatal factors such as traditional tight swaddling further increase the risk of hip instability. Female infants demonstrate increased ligamentous laxity due to maternal relaxin hormone exposure.

DDH is commonly associated with other musculoskeletal abnormalities, including congenital muscular torticollis, metatarsus adductus, congenital knee dislocation, and clubfoot.

B) Pathophysiology

The pathogenesis of DDH is multifactorial and includes maternal hormonal influences, genetic predisposition to ligamentous laxity, and fatal mispositioning. Persistent instability interferes with normal femoroacetabular contact, causing progressive anatomical deformity. A dislocated hip may be reducible or irreducible, depending on the degree of soft-tissue contracture and the chronicity of dislocation.

C) Classification and Clinical Presentation

A DDH is traditionally classified into three clinical categories: Dislocated hip, which may be Ortolani-positive when reducible or Ortolani-negative when irreducible; Dislocatable hip, identified by a positive Barlow test; and Subluxatable hip, indicated by gliding of the femoral head during examination.

1. Figure show dislocated hip 2 Figure show reduceble hip

1) Clinical Examination in Early Infancy (< 3 months)

The two principal tests for newborn screening are the Barlow test, which attempts to dislocate an unstable hip by adduction and posterior pressure, and the Ortolani test, which reduces a dislocated hip by anterior lifting and abduction. The Galeazzi sign, characterized by apparent limb shortening with the hips flexed to 90°, is indicative of unilateral dislocation.

2) Clinical Examination After 3 Months

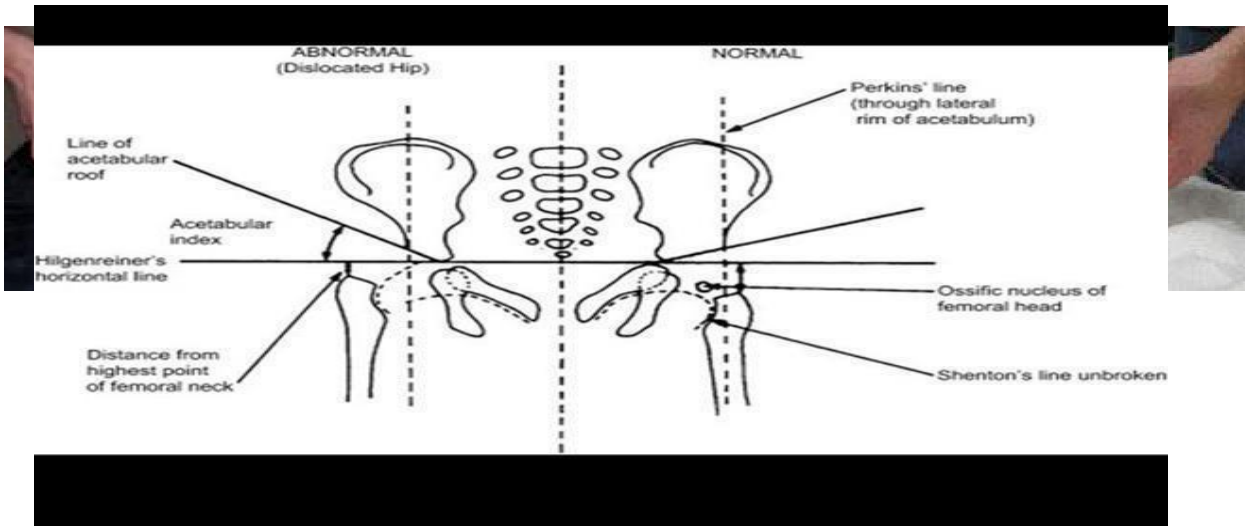
As children grow, classic examination findings evolve. Limited hip abduction, asymmetric thigh or gluteal folds, limb length discrepancy, and gait abnormalities may be observed. With chronic dislocation, the Ortolani test often becomes negative due to soft-tissue contracture.

3.Figure show limitation of abdaction 4. Figure show leg length discrepancy

D) Imaging Evaluation

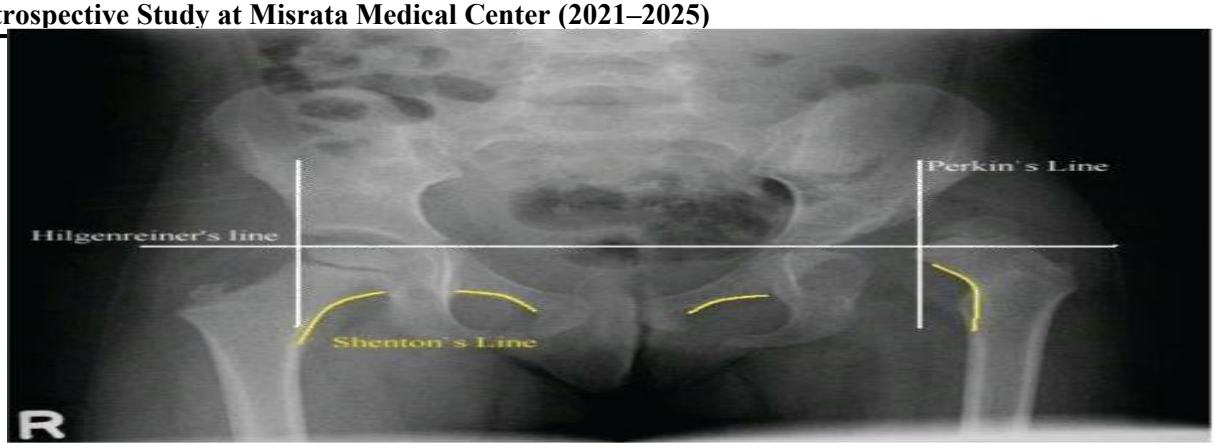
Radiographs become the primary imaging modality after 4–6 months, once femoral head ossification appears. Standard anteroposterior pelvic radiographs are used to assess hip alignment based on Hilgenreiner's line, Perkin's line, and Shenton's line. Delayed ossification or disruption of Shenton's arc is characteristic of DDH.

Acetabular dysplasia is quantified using the acetabular index, which should be less than 25° after six months of age. In older children, the center-edge angle of Wiberg provides additional assessment, although it is reliable mainly after age five.



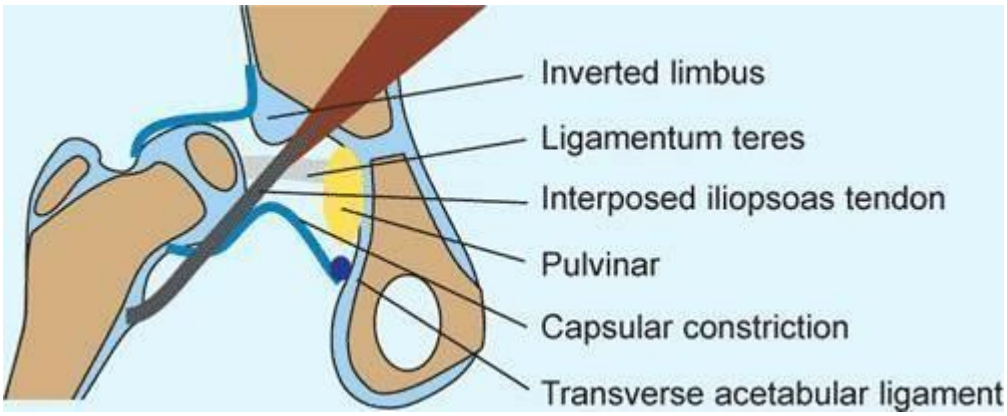
5. figure show Shenton line and difference between normal abnormal hip

6. figure show x ray finding Shenton line difference between normal abnormal



1) Arthrography

Arthrography is valuable during examination under anesthesia to confirm concentric reduction and identify obstacles to reduction, such as an inverted labrum, inverted limbus, hypertrophic ligamentum teres, pulvinar tissue, contracted transverse acetabular ligament, or hourglass deformity of the capsule caused by the iliopsoas tendon.



7. Figure show possible cause of mechanical block of redaction

E) Screening

Current recommendations emphasize universal newborn clinical screening using the Barlow and Ortolani maneuvers, performed by an experienced examiner within the first one to two weeks of life. Abnormal or equivocal findings require timely orthopedic evaluation. Parents should be educated on proper infant wrapping techniques to avoid hip extension and adduction. Mild abnormalities detected on ultrasound may be monitored, while clinically unstable hips require early intervention.

F) Treatment Principles

The overarching objective of DDH treatment is to achieve and maintain a stable, concentrically reduced hip at the earliest possible age to promote normal acetabular development and minimize complications {35–56}. Early treatment correlates strongly with improved radiographic outcomes. Ideally, intervention occurs within the first months of life; however, treatment remains effective if initiated before four years of age {57–58}.

1) Management in Children Aged 6 Months to 2 Years

Children in this age group are commonly treated with closed reduction and hip spica casting, although open reduction may be required in irreducible dislocations. Closed reduction aims to restore stable femoral head–acetabular contact while minimizing vascular insult to the femoral head. Several studies suggest improved outcomes when reduction is performed after the appearance of the ossific nucleus.

2) Closed Reduction and Spica Casting

Closed reduction is typically performed under general anesthesia using the Ortolani maneuver. Arthrography is used to confirm reduction, with an acceptable medial dye pool of < 5 mm and no soft-tissue interposition. Excessive medial pooling (> 7 mm) correlates with poorer outcomes and higher rates of avascular necrosis (AVN). Adductor tenotomy is indicated when excessive abduction is required to maintain reduction. The hip is immobilized in approximately 100° of flexion and 45° of abduction (the "human position") for about three months. Wide abduction should be avoided, as angles exceeding 50° increase the risk of AVN.

8. Figure spica table

3) Complications

The AVN remains the most significant complication following closed reduction, with reported incidence ranging from 6% to 47% in the literature. Risk factors include excessive abduction, increased medial dye pool, prolonged dislocation, and technical factors during reduction. AVN can lead to long-term sequelae including limb-length discrepancy, joint incongruity, coxa valga, and persistent subluxation.

Closed reduction has a reported success rate approaching 95%, but complications—including redislocation, residual dysplasia, and AVN—necessitate careful long-term follow-up.

IV) Materials And Methods

A) Study Design and Setting

This retrospective descriptive case series was conducted at the Department of Pediatric Orthopedics, Misrata Medical Center, Misrata, Libya. The study period spanned from January 1, 2018, to December 31, 2018. The study aimed to evaluate the outcomes of adductor tenotomy, closed reduction, and static long-leg casting for the treatment of developmental dysplasia of the hip (DDH) in pediatric patients aged 6 to 18 months. Completed follow-up data were available for a proportion of the treated patients.

B) Study Population

All patients included in this study met the following criteria: they presented with simple hip dislocation not associated with other congenital malformations, were aged 6 to 18 months at the time of treatment initiation and had not received prior treatment. Infants with hip dislocations secondary to inflammation, spasticity, spina bifida, arthroereisis, Down's syndrome, or associated with other malformations were excluded. Patients were categorized into three groups according to their acetabular index (AI) before treatment: 30°–35°, 36°–40°, and >40°. Additionally, radiographic assessment using the Tonnis classification divided patients into four types based on the degree of femoral head displacement relative to Hilgenreiner's and Perkin's lines. Functional outcomes were assessed using McKay's criteria, while radiographic outcomes were evaluated according to Severin's classification. The

presence of avascular necrosis (AVN) of the femoral head was assessed according to Salter's criteria.

C) Treatment Protocol

All patients underwent pre-reduction traction. For Tonnis types 1 and 2 dislocations, double lower-limb suspension skin traction was applied. For types 3 and 4, femoral condyle pinning with horizontal bone traction and lower-leg skin traction was implemented, using a weight of 0.5 kg per 6 months of age for one week. Post-traction X-rays were obtained for types 3 and 4 to ensure proper femoral head positioning.

Under general anesthesia, all patients underwent adductor tenotomy followed by closed reduction. The adductor tendon was partially released percutaneously through a pubic approach, and hemostasis was achieved using gauze compression and pressure dressing. With the pelvis stabilized, the hip and knee joints were flexed to 90°, and gentle traction was applied to guide the femoral head into the acetabulum. Reduction was confirmed using intraoperative X-ray. Dynamic long-leg casting was applied with hips at 90° abduction, external rotation, and 110° flexion, leaving the ankle and hip joints exposed.

Post-discharge, patients were allowed limited motion, including sitting, lying, standing, and flexion-extension exercises. After three months, casts were removed, and an adjustable abduction orthosis was fitted, allowing movement of the knees and ankles while maintaining hip positioning. The orthosis was removed after an additional three months, enabling patients to walk freely. Pelvic X-rays were taken at six-month intervals to monitor acetabular and femoral head development, and follow-up data were recorded.

D) Statistical Analysis

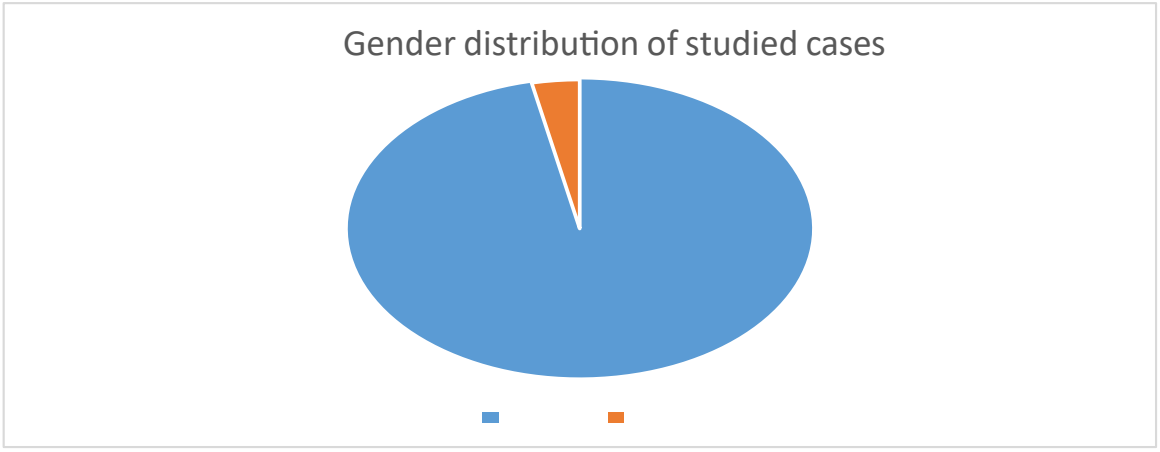
Data were analyzed using SPSS® version 15.0 (SPSS Inc., Chicago, IL, USA). Clinical outcomes at the final follow-up were evaluated using McKay's hip function criteria, while radiographic outcomes were classified according to Severin's system. Paired analyses were conducted based on the acetabular index and Tonnis type to assess the relationship between pre-treatment classification and outcomes.

V) Results:

A) Gender Distribution of Studied Cases

The study included 29 cases, of which 28 were girls (96.55%) and 1 was a boy (3.45%), yielding a girls-to-boys ratio of 28:1. There is a clear predominance of cases among girls.

Figure (9): Gender distribution of studied cases.



B) Distribution of Cases According to Joint Involvement

Out of the total 29 cases, 9 cases (31%) were bilateral DDH, and 20 cases (69%) were unilateral, giving a unilateral-to-bilateral ratio of 2.3:1.

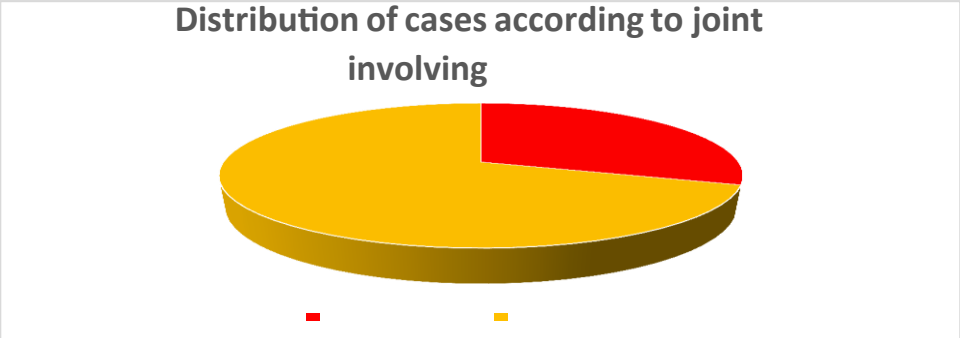


Figure (10) Distribution of cases according to joint involving

C) Distribution According to the Method Described by Tönnis

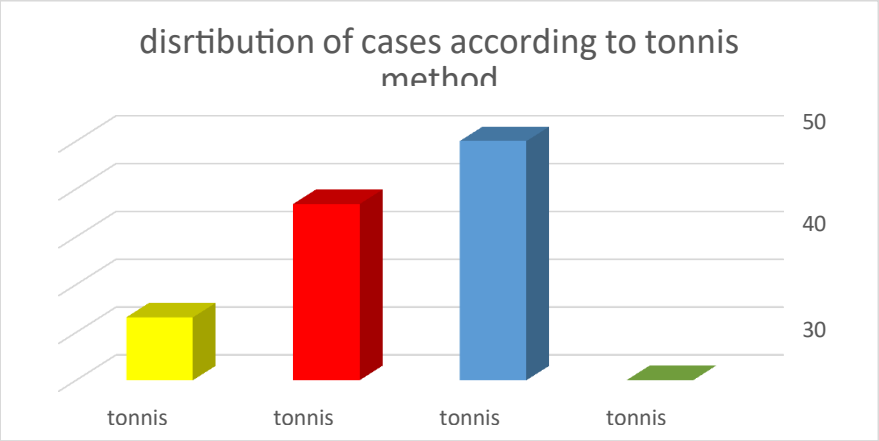
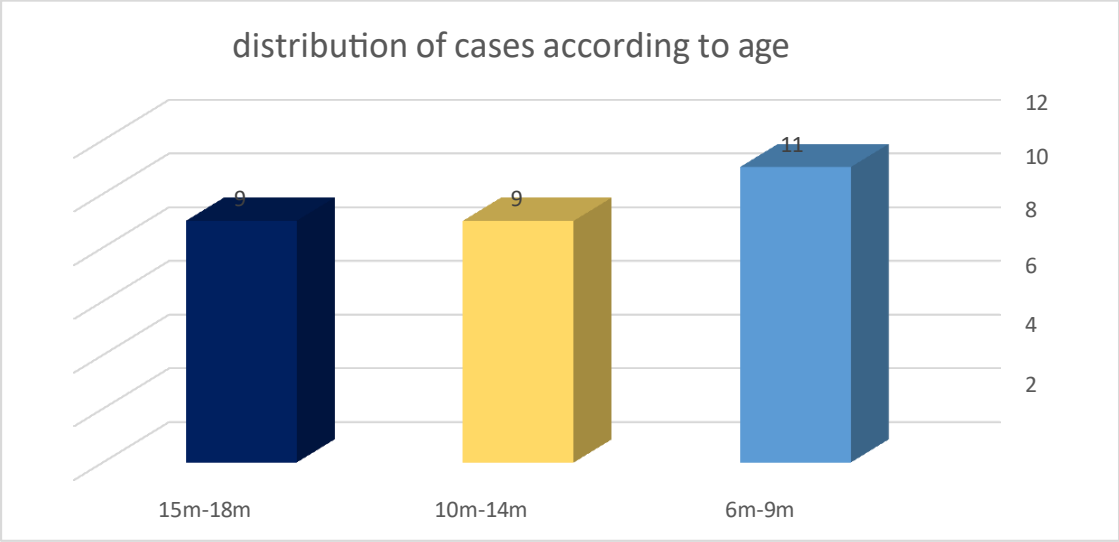


Figure 11: Distribution of cases according to the Tönnis method (38 hips).

D) Distribution of Cases According to Age

Figure 12: Age distribution of studied cases.



E) Distribution According to Acetabular Index Before Treatment

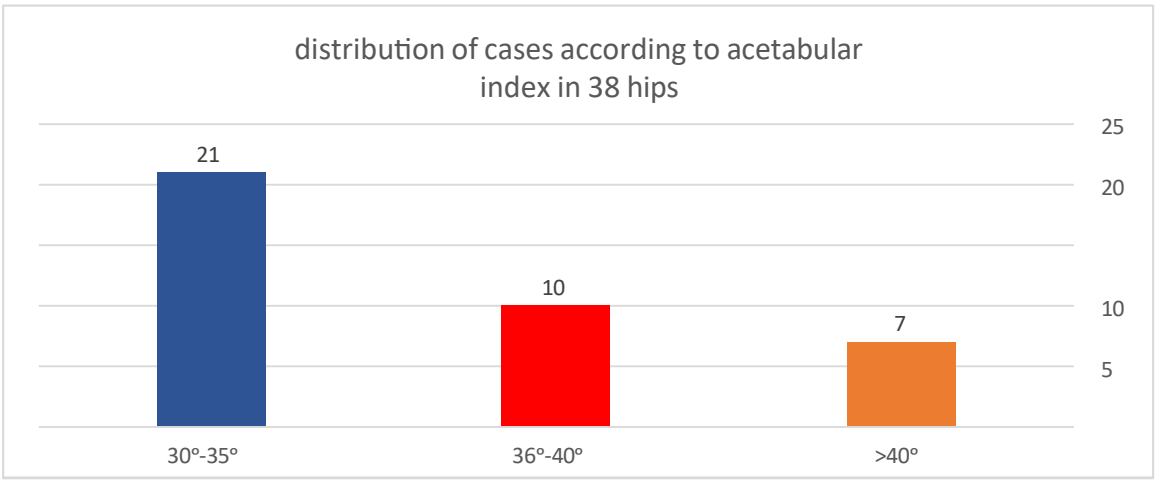


Figure 13: Distribution of cases according to acetabular index prior to treatment.

F) Radiological Outcomes According to Severin's Method

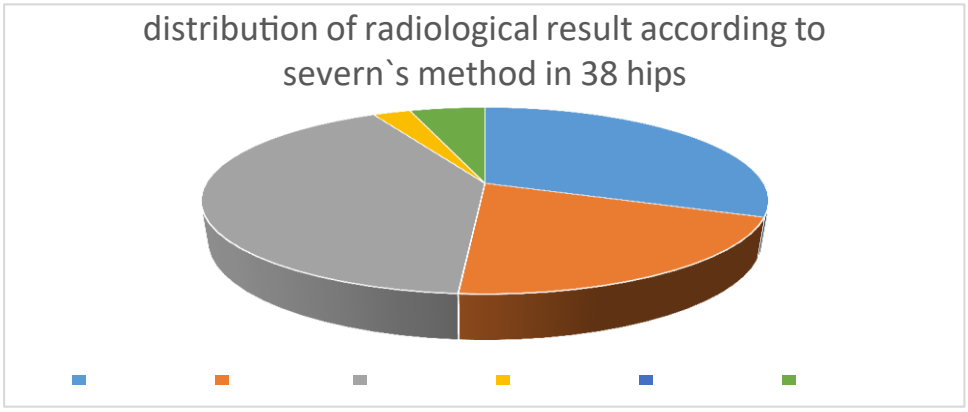


Figure 14: Radiological results of 38 hips according to Severin's classification.

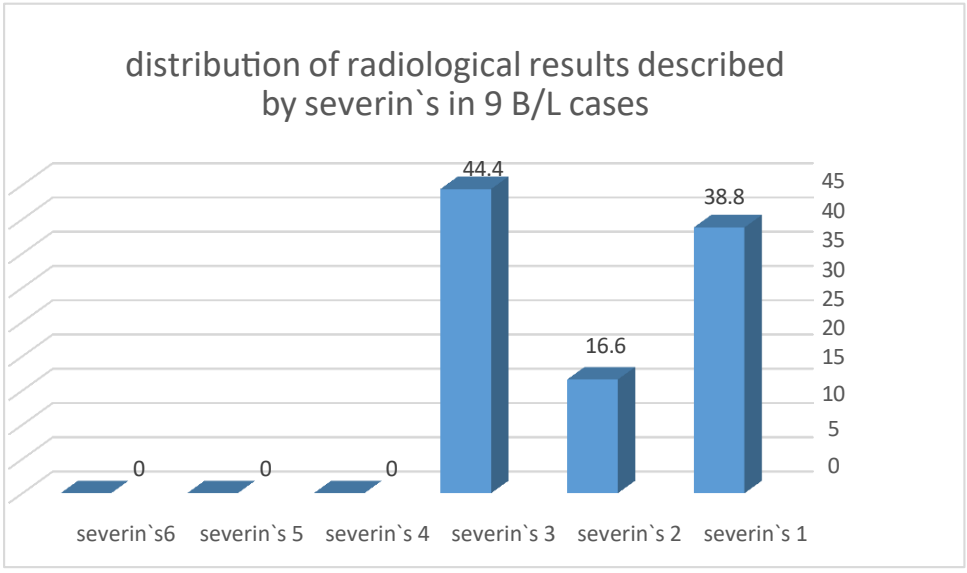


Figure 15: Radiological results of 9 bilateral hips according to Severin's classification.

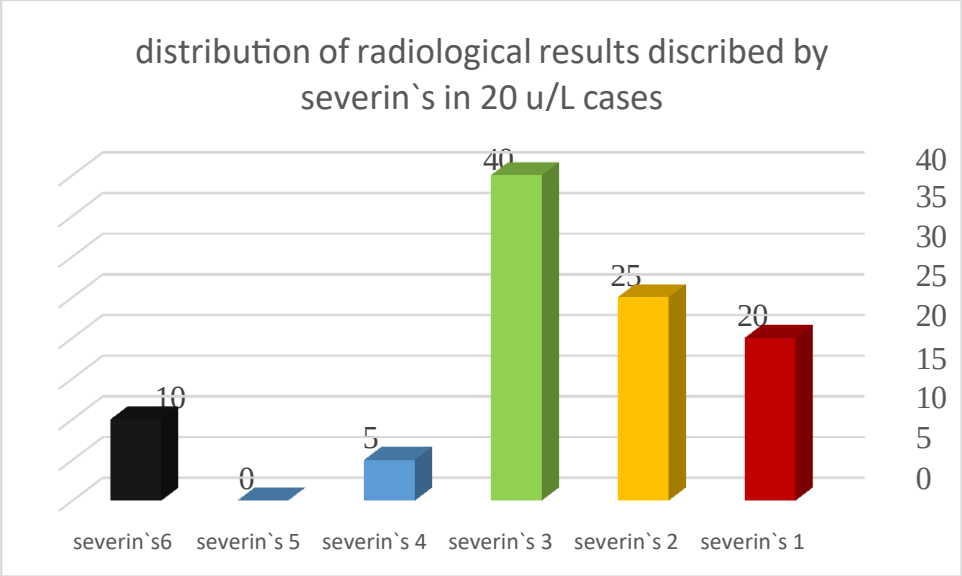


Figure 16: Radiological results of 20 unilateral hips according to Severin's classification.

G) Clinical Assessment According to McKay's Method

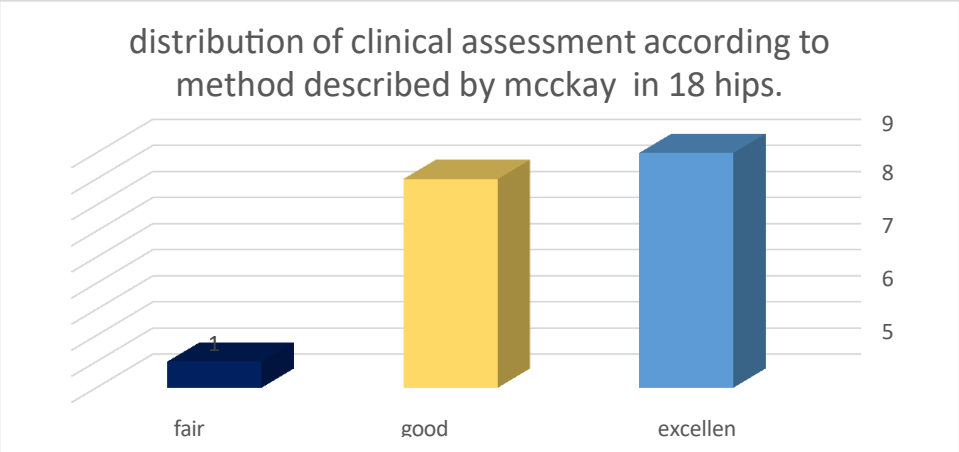


Figure 17: Clinical assessment of 9 bilateral hips according to McKay's method.

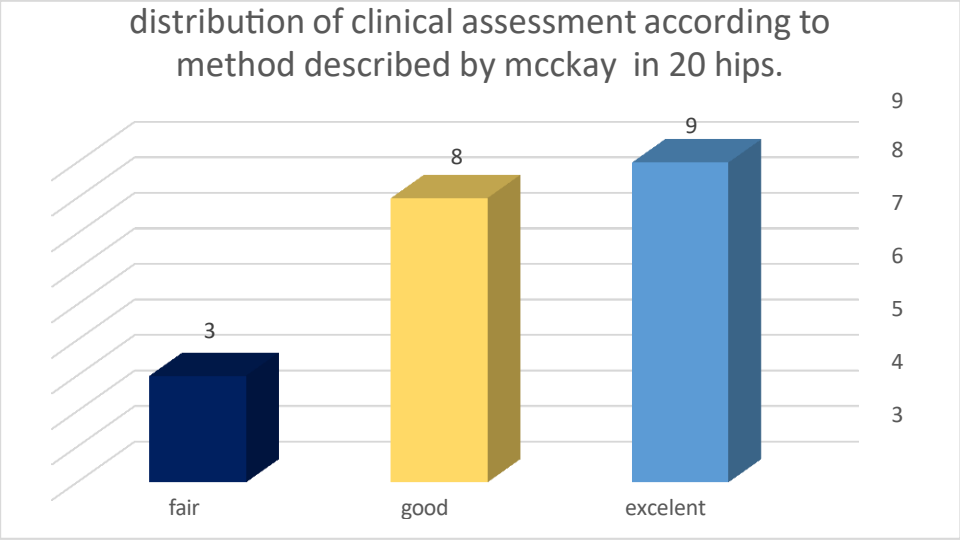


Figure 18: Clinical assessment of 20 unilateral hips according to McKay's method.

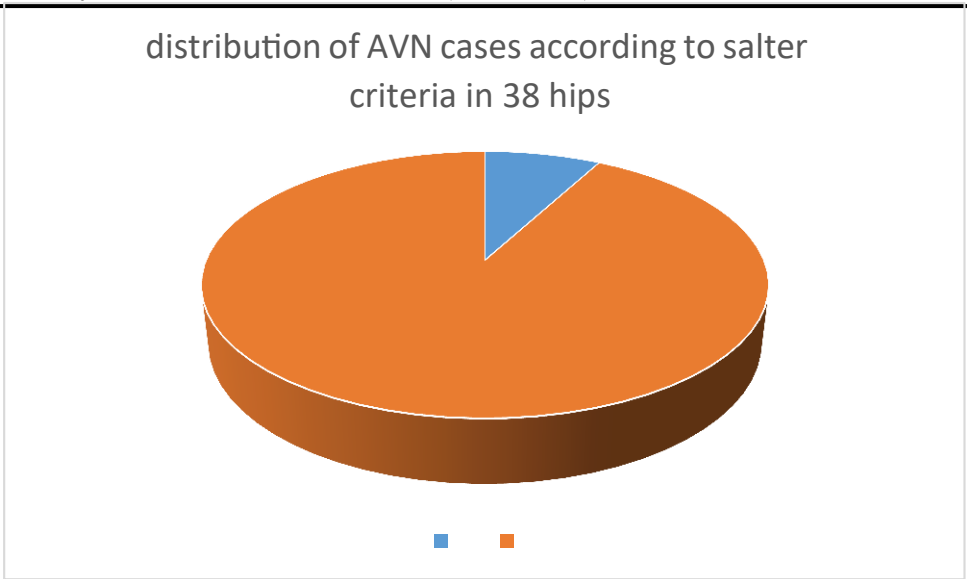


Figure 19: Distribution of AVN cases according to Salter criteria for all 38 hips.

VI) Discussion

Treatment of DDH is often challenging, and evaluation of the results in the published series is difficult because there is no universally accepted, standard system for the assessment of function and of radiographs of patients who have hip disease[9,12,13]. Severin Class I and II are generally accepted as excellent and good results[5]. Similar diversity in the systems of classification for function also makes comparison of results difficult. There is a discrepancy between excellent clinical results and radiographic results that are not excellent anatomically, especially in children[14'15]. Radiologic results better predict the long-term prognosis of the joints.

VII) Conclusions:

We retrospectively evaluated 38 hips of 29 patients with the diagnosis of developmental dysplasia of the hip treated with closed reduction and hip spica cast. There were 37 female and 1 male hips in the group. The mean age of the patients at the time of the reduction were six (range. 2-13) months and mean follow-up 5 (range: 3-6) months. All the patients were treated with closed reduction and were immobilized in hip spica cast.

The mean time of immobilization in the cast was 90 (range: 45-190) days. Avascular necrosis was observed in 7.89% of the hips. Clinical and radiological end results of the patients were evaluated with modified McKay criteria and Severin classification. Eighty-

nine percent of the patients had satisfactory results according to modified McKay criteria and 70% of the patients according to Severin classification. The most important parameters affecting the result were pre-reduction location of the hip, pre-operative acetabular index values and avascular necrosis. Based on the results of this study, treatment of developmental hip dysplasia with closed reduction and hip spica cast is a safe and effective method.

VIII) Recommendations:

DDH is one of the most common presentation in our country and it's a serious, treatable condition with improving outcomes if early and proper diagnosis is achieved, so we recommend our patients to seek medical advice in all babies with high risk factors , also we recommend pediatrition to transfer babies to specialist as needed, lastly we recommend a generalized screening at birth regardless of the presence or absence of risk factors and/or clinical signs, is the only way to achieve early diagnosis even when clinical signs and risk factors for DDH are lacking, because diagnosis and treatment of the disorder and try to reduce incidence of adolescent osteoarthritis.

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