ABSTRACT Developmental dysplasia of the hip (DDH) is a musculoskeletal issue in newborns. DDH changes hip biomechanics, over-burdening the articular cartilage and prompting early osteoarthritis. Therefore, DDH is the primary cause of total hip arthroplasty in the young population. The major objective of treating developmental DDH is to get a concentric joint surface as expected and keep up this early treatment to the normal development of the proximal femur and hip bone socket. Splint and brace are applied in various cases and considered the gold standard for DDH with a reducible hip because while they are worn, abduction and flexing of the hips are still possible. Literature mentions that there are many pros and cons in the use of Pavlik Harness in infants aged less than six months. Most said it was effective, some said they still needed further surgery, and some chose to wait/observe until the age of six months. The Pavlik technique has been found to have success rates as high as 98% for hip subluxation and dislocation. However, there is still discussion regarding the range of treatment, weaning management, and duration of radiographic follow-up as it identifies with requirements for reinterpretation Pavlik Harness (dynamic splint) can be given to DDH children before the age of 6 months, but it needs periodic evaluation to prevent overtreatment or unwanted complications.

KEYWORDS Developmental dysplasia of the hip, Pavlik Harness, Treatment

Introduction

Developmental dysplasia of the hip (DDH) is newborns’ most well-known musculoskeletal issue.[1] The name DDH covers a broad spectrum of hip changes such as neonatal unsteadiness, acetabular dysplasia, hip subluxation, and genuine separation of the hip.[2] DDH also changes hip biomechanics, over-burdening the articular cartilage and prompting early osteoarthritis. DDH is the primary cause of total hip arthroplasty in the young age population (approximately 21% to 29%).[2]

The growth of the acetabular cavity is determined by the presence of a concentrically reduced femoral head. Subluxation or dislocation of the hip in children will cause an insufficient advancement of the hip bone socket during the rest of children’s growth.[2] Screening can be done to find out whether the baby has the potential to develop DDH. Routine physical examination starts from the baby is born until the child can walk. A specific examination should be performed to evaluate the newborn’s hip with the Barlow and Ortolani manoeuvres.[3]

The affectability of Barlow and Ortolani assessment manoeuvres alone in recognizing DDH is, best case scenario, 54%; in this way, additional imaging modalities for identification can be helpful.[3] Barlow and Ortolani’s assessment is of restricted utility for the more aged children or adolescents because of the improvement of contractures. These patients are examined for leg length discrepancy, thigh-crease unevenness, and restricted hip abduction.[3] An inconsistency is demonstrated by inconsis-
The strolling adolescent may likewise give a Trendelenburg gait (trunk slant toward the influenced hip when weight is applied) if there is a one-sided disengagement or a waddling gait (trunk slant toward the weight-bearing side, exchanging all through the step cycle) if there is a dislocation.[3]

Careful ultrasound screening should be performed in any adolescent with strange actual assessment or high-risk factors (breech labour and positive family history). Widespread ultrasound screening has not exhibited its utility in reducing the occurrence of late dysplasia.[2]

Ultrasonography is the suggested imaging methodology in newborn children <4 months old because the baby’s hip is overwhelmingly cartilaginous, blocking clear radiographic representation. Ultrasonography may reveal the representation of the femoral head area compared with the hip bone socket and explicit anatomic boundaries, such as the depth of the hip bone socket and the tendency of the acetabular roof.[3]

The major objective of treating developmental DDH is to get a concentric joint surface as expected and keep up this early treatment to accomplish normal development of the proximal femur and hip bone socket. This essential treatment standard is applied to all children age.[4]

The treatment of DDH has gone through huge advancements in many decades. The treatment depends on the patient’s age and the severity of the condition. Splint and brace are applied in various cases and considered the gold standard for DDH in children under six months old with a reducible hip because while they are worn, abduction and flexing of the hips are still possible. With this support, the baby can move his legs within the range allowed by the support, keeping the hips in flexion and abduction while at the same time limiting extension and adduction. The most popular dynamic splint for DDH patients is the Pavlik Harness. Von Rosen, Frejka pillow, Tubingen splint, Coxaflex, Aberdeen splint, and Teufel brace are also types of dynamic splint for DDH patients.[5]

Arnold Pavlik developed his brace 'harness with stirrup' during the 1940s. He considers the dynamic development of the hip joint as a major improvement factor in the treatment of DDH and named his technique 'functional medicine'. Pavlik's principle is to achieve unrestricted and harmless repositioning and centring of the femoral head to achieve the best anatomical and practical results in children over one year. He speculated that the support, keeping the hips and knees inflexion and the hips in abduction, allowed dynamic hip development, first loosening adduction contractures and then spontaneous descent during the abduction. Mubarak and Bialik have presented the idea of the 'Pavlik technique' as the strategy, not support that drives higher rates of treatment attainment in DDH.[4]

The Pavlik technique has been found to have success rates as high as 98% for hip subluxation and dislocation. However, there is still discussion regarding the range of treatment, weaning management, and duration of radiographic follow-up as it identifies with requirements for reinterpretation. Reports of severe dysplasia after effective hip reduction using the Pavlik strategy have been noted, from 2.4% to 17%. Although several risk factors have been proposed to improve severe dysplasia, a careful assessment of the current writing has not been done previously.[6]

Main Body

The major objective of treating developmental DDH is to get a concentric joint surface as expected and keep up this early treatment to accomplish normal development of the proximal femur and hip bone socket. This essential treatment standard is applied to all children age. A study from Cook et al. showed that of 30 infants aged 4-6 weeks, 11 (37%) (14 hips) who had persisten instability (from ultrasound or physical examination) were given a Pavlik Harness. Pavlik harness fitted for 23 hours/day and used around 3-11 weeks (7 weeks average). Whereas 19 (63%) (25 hips) had hip stability. Pavlik Harness was not applied. As a result, 11 infants (14 hips) were successfully stabilized with a Pavlik Harness, while in 19 infants, it turned out that seven infants (23%) (8 hips) required a Pavlik Harness at 12 weeks of age due to persistent dysplasia found on ultrasound (alpha angle less than 60°). Seven infants were treated for an average of 8 weeks, and as a result, all of these infants had an alpha angle of hip ultrasound greater than 60°.[7]

A study by Lee et al. looked at the hospital operating records of 27 patients (in May 2008 and June 30, 2016), the mean age was 25±19 months. Most of the patients were female, and the majority had unilateral (left-sided) DDH. The mean age at surgery was 40 ± 31 months. Only one patient who was detected as a newborn received a Pavlik Harness but failed and was performed an adductor release and closed reduction at three months of age, and then failed again, so an open reduction was performed. Newborn screening was the only variable that differed significantly between the groups (p < 0.01). This study concludes that the lack of institutionalized newborn clinical screening appears to be the root cause of delayed presentation of DDH, leading to open surgery needed for its management.[8]

According to Alves et al., Pavlik harnesses were the most well-known brace, utilized by 90% of POSNA (Pediatric Orthopedic Society of North America) and 71% of EPOS (European Pediatric Orthopedic Society). POSNA used hip abduction braces twice as likely as EPOS for the rest of acetabular dysplasia. Most surgeons would not perform a closed reduction at children under three months old or an open reduction at under six months old. Most traction is used before reduction by EPOS, as well as by POSNA. They both agree that the reduction should be postponed until the ossific nucleus is seen.[9]

In a study by Aarvold et al., 59 hips in 52 patients were recorded, and 48 of 59 hips were treated with Pavlik harness. The remainder were treated with elective support or primary open or closed reduction. Pavlik's treatment was a success in 27 of 48 hips. Pavlik’s treatment was stopped in 21 hips. Three of them is due to femoral nerve palsy, and the remainder due to inability to achieve reduction. There was no significant association between Pavlik’s outcome and children’s age (P = 0.22) and gender (P = 0.61). Left hips were more likely to have a good outcome in the Pavlik harness than right hips (P = 0.01). Five complications were recorded: three patients have femoral nerve paralysis, while two patients have avascular necrosis after Pavlik harness treatment and subsequent surgery.[10]

In a study by Neal et al., 65 DDH patients (75 hips/58 females) with a mean age of 33 + 17 months. There was no distinction in clinical or radiographic success rate between 23 hours versus 24 hours of Pavlic Harness (p > 0.99 both) or the frequently versus Infrequent follow up (p=0.49 both). In general clinical success rate was 97% (73/75 hips), and the radiographic success rate at two years was 97% (58/60 hips).[11]

According to Pollet et al., Pavlik harness treatment in 55 chil-
children aged three to four months old with stable DDH on ultrasound showed no difference compared with dynamic follow-up in 49 newborn children with indistinguishable hip dysplasia following 12 weeks of diagnosis. Moreover, treatment with the Pavlik harness did not improve the bony roof angle (α angle). It is important to understand that Pavlik harness treatment of stable yet sonographically seen DDH has no impact on the acetabular outcome. After twelve weeks, many patients (80%) will go through normal hip improvement. Therefore, we recommend observation rather than treatment for stable DDH.[12]

Pavone et al., in their study, describe the use of dynamic splints such as Pavlik Harness, Frejka, Tubingen, and static splints such as rhino style brace, ilfeld, and generic abduction brace applied within 4-5 months of life. They stated that dynamic bracing has low contraindications. Meanwhile, Static supports are also a viable alternative, but only for stable hips or remaining acetabular dysplasia.[5]

A systematic review from Shaw et al. studied results of DDH treated with the Pavlik technique. Seventeen examinations met the criteria, incorporating 6029 hips with 5.29 years follow-up. Radiographic proof of late dysplasia was seen in 280 hips, with 109 hips requiring further medical procedure (operation). A predetermined treatment plan had substantially reduced the rate of dysplasia examined radiographically (3.8% versus 17.6%, p=0.004).[6]

Conclusion

From the research above, which mentions the use of Pavlik Harness in infants aged less than six months, there are many pros and cons. Most said it was effective, some said they still needed further surgery, and some chose to wait/observe until the age of six months. However, it can be concluded that Pavlik Harness (dynamic splint) can be given to DDH children before the age of 6 months, but it needs periodic evaluation to prevent overtreatment or unwanted complications.

Declarations

Ethics approval and consent to participate
All consents have been taken.

Consent for publication
Informed consent has been taken.

Competing interests
The authors declare that they have no competing interests.

Author’s contribution
Panji Sananta: Conceptualization, Data curation, Methodology, Formal analysis, Interpretation, Supervision, Validation, Writing - original draft, Writing - review & editing. Virginia Ainurridlo Nugroho: Conceptualization, Formal analysis, Interpretation, Writing - original draft, Writing - review & editing. Lasa Dhakka Siahaan: Conceptualization, Formal analysis, Interpretation, Writing - original draft, Writing - review & editing. Thomas Erwin C. J. Huwae: Conceptualization, Data curation, Methodology, Formal analysis, Interpretation, Supervision, Validation, Writing - original draft, Writing - review & editing.

Funding
This work did not receive any grant from funding agencies in the public, commercial, or not-for-profit sectors.

References