The Egyptian Journal of Hospital Medicine (October 2022) Vol. 89 (2), Page 7202- 7206

An Insight about Skeletal Dysostosis: Review Article

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ABSTRACT
Background: In cases of dysostosis, faulty bone development results from embryonic morphogenic abnormalities that take place during the first six weeks of fetal life.
Objective: This review aimed to study of overview about skeletal dysostosis.
Methods: We searched PubMed, Google Scholar, and Science Direct for information on skeletal dysostosis. However, only the most current or comprehensive study from January 1986 to May 2020 was considered. The authors also assessed references from pertinent literature. Documents in languages other than English have been disregarded since there aren't enough resources for translation. Unpublished manuscripts, oral presentations, conference abstracts, and dissertations were examples of papers that weren't considered to be serious scientific research**. Conclusion:** Modern genetic testing is revolutionizing how uncommon genetic diseases are diagnosed, but appropriate clinical and radiological examination is still necessary. Identifying and preventing potentially serious consequences is important in the management of children with skeletal dysplasia.
Keywords: Skeletal dysostosis, Infants, Modern genetic testing.

INTRODUCTION

Skeletal dysplasia and dysostosis are two major groups of congenital skeletal diseases. A diverse collection of disorders known as skeletal dysplasias cause broad disruptions in bone and cartilage formation that start during early fetal development and progress throughout adulthood. While diseases known as dysostosis are those that develop as a result of embryonic morphogenic abnormalities during the first six weeks of fetal life and lead to improper bone development [(1)].

Skeletal Dysplasia:

A diverse set of more than 250 diseases known as skeletal dysplasias are defined by improper bone and cartilage formation, which causes disproportionately small height or dwarfism [(2)].

Classification of skeletal dysplasias:

37 categories of skeletal dysplasias have been identified based on the similarities among their radiological, clinical, and/or genetic features. We will concentrate on four categories of skeletal dysplasias that represent a spectrum of fatal and nonlethal dysplasias and include some of the most prevalent skeletal dysplasias in the neonatal period [(3)].

Skeletal dysostosis:

Conditions known as dysostosis include those that develop in the first six weeks of fetal life as a result of embryonic morphogenic abnormalities that lead to poor bone development [(4)].

Radial hypoplasia and club hand (Figure 1):

One in 100,000 live infants have hypoplasia of the radius, an extensively discussed but infrequently observed condition. In 50% of cases, it is bidirectional. The deformity can range from a little radius shortening to its total absence [(4)].

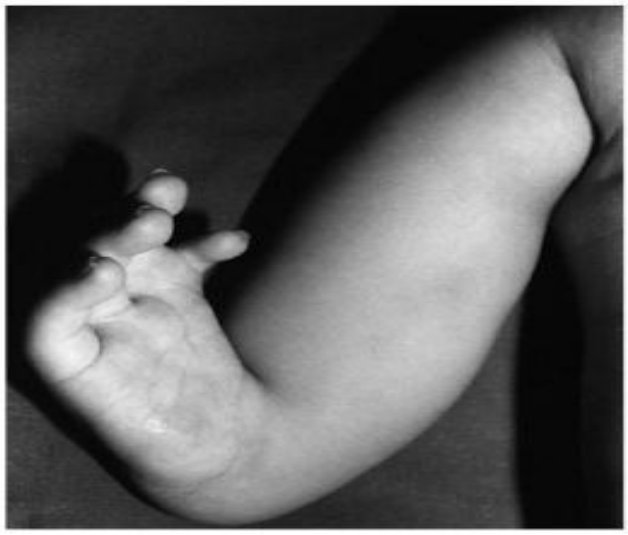

Figure (1): Clinical image shows a 1-year-old kid with a hypoplastic index finger and a right radial club hand [(2)].

Syndactyly:

The most prevalent limb abnormality, syndactyly (Syn = together; Dactylos = digits), is mostly characterised by digit webbing. Although it has also been described as autosomal recessive X-linked, or a solitary entit y, it can be webbing with or without bone fusion and is often inherited through the autosomal dominant pathway. Additionally, it has a wide range of clinical and phenotypic variation and is often manifest as unilateral, bilateral, symmetrical, or asymmetrical forms. Most often, syndactyly develops either alone or as a component of a complex syndrome (+150 syndromes). According to its genetic and molecular causes, non-syndromic syndactyly has been categorized in this article. Nine distinct kinds of non-syndromic syndactyly have been identified. The key genes responsible for hereditary syndactyly that have been discovered so far are mostly connected to the zone of

Received: 13/07/2022
Accepted: 16/09/2022

polarising activity and the sonic hedgehog pathway (Figure 2) [5].

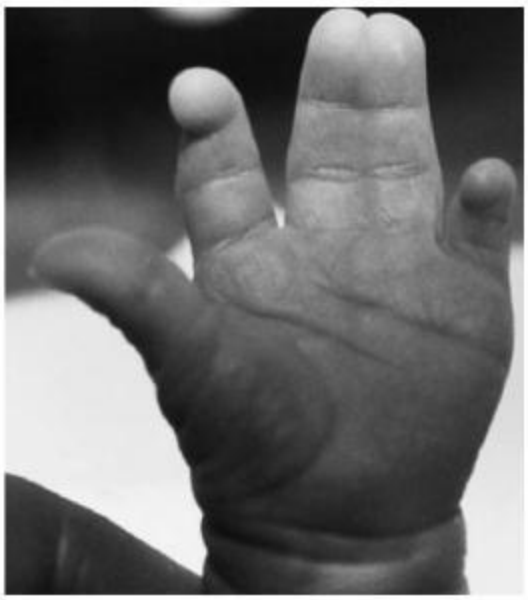

Figure (2): A 3-month-old boy's full syndactyly between the third and fourth fingers is seen in a clinical shot of the child. The small and index fingers' distal phalanges are hypoplastic [5].

Polydactyly:

Polydactyly, also known as hyperdactyly or hexadactyly, is the most common genetic limb deformity and is characterised by the presence of extra fingers or toes. It may exist as a syndrome component (syndromic polydactyly) or as a separate occurrence (non-syndromic polydactyly). The three primary types of non-syndromic polydactyly are preaxial polydactyly (radial), central polydactyly (axial), and postaxial polydactyly (ulnar). Flaws in the patterning of the developing limb's anterior and posterior regions cause this disorder, which is mostly inherited as an autosomal dominant trait with variable penetrance (Figure 3) [5].

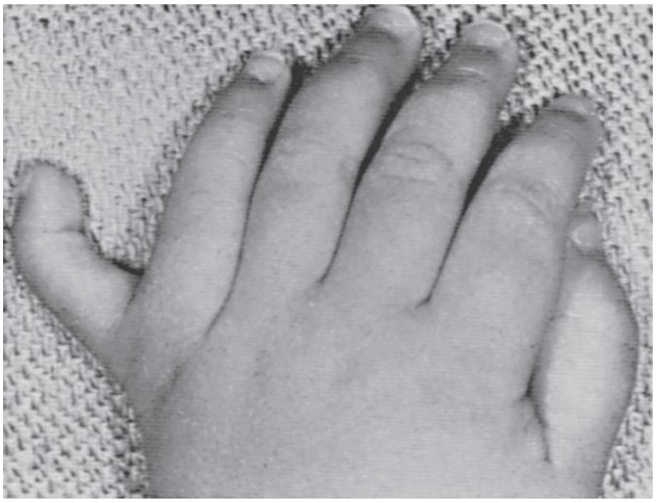

Figure (3): Congenital polydactyly, the most frequent kind of digit duplication, is shown in a clinical image with intact bones, tendons, and nerves. The advised course of action is early ablation followed by amputation [5].

Macrodactyly:

An uncommon congenital overgrowth condition affecting the digits of the upper or lower limb is called macrodactyly. The syndrome accounts for 0.9% of all congenital malformations of the upper limb, while the frequency of macrodactyly in the foot is 1/18 000. Although the cause is mainly unclear, it is speculated to be a nerve-stimulated disorder with aberrant neural regulation of a peripheral nerve's sensory distribution [6].

Ectrodactyly:

Ectrodactyly is a rare congenital overgrowth disorder affecting the digits of the upper or lower leg. While the prevalence of macrodactyly in the foot is 1/18 000, the condition accounts for 0.9 percent of all congenital abnormalities of the upper limb. Even though the etiology is mostly unknown, it is believed to be a condition that is nerve-stimulated and has abnormal neural control of a peripheral nerve's sensory dispersion [7].

Developmental Dysplasia of the Hip (DDH):

DDH refers to a variety of pathologic hip conditions where the acetabulum is deformed or the hips are unstable, subluxated, or dislocated. The greatest clinical result for developmental dysplasia of the hip depends on early diagnosis and treatment. DDH includes a range of physical and imaging symptoms, including frank dislocation as well as modest instability and developmental abnormalities [8].

Incidence:

A developmental dislocation of the hip occurs around once in 1000 live births. Due to the lack of a common definition, it is impossible to accurately estimate the incidence of the full spectrum of DDH. According to a research from the United Kingdom, breech-born females have a 2% prevalence of DDH [8, 9].

Physical Examination:

A DDH screening program's most crucial element is unquestionably the physical examination, with imaging by radiography and/or ultrasound serving as a support tool. The pathognomonic symptoms of a displaced hip are absent. The infant feeding from a bottle may make the physical examination easier and need patience on the side of the examiner. Even though asymmetry is often not visible in bilateral dislocations, evaluating for it is likely the most crucial step in the evaluation for DDH. If there is asymmetric abduction or a Galeazzi sign, a dislocation can be present. Thigh folds that are asymmetrical can be a symptom of DDH, but they regularly develop in neonates who are not affected. The newborn is laid supine on an examination table with the pelvis level and the hips and knees bent to 90 degrees in order to elicit the Galeazzi sign. The tester checks to see if the infant's knees are the same height when its hips are in neutral abduction. The hip may be posteriorly

displaced if it seems that one femur is shorter than the other (Figure 4) [8].

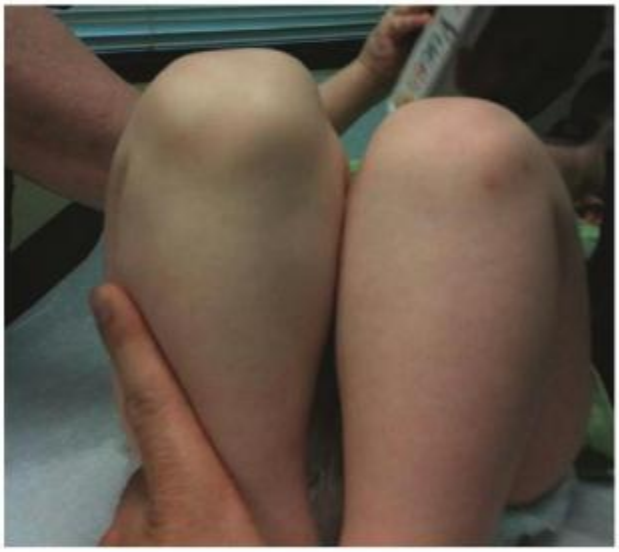

Figure (4): Galeazzi sign [8].

The evaluation was detailed in the 2000.

The American Academy of Pediatrics (AAP) clinical practice recommendation, included checking for asymmetric thigh or gluteal folds, restricted or asymmetric abduction, and limb length disparity. Care must be used throughout these manual tests. The dislocated hip often heals by the age of three months, which limits the usefulness and sensitivity of the Barlow and Ortolani tests. The damaged hip's restricted and asymmetric abduction is the most important observation at this point. The Barlow test is advised to be performed softly by adducting the hip and palpating for the head to emerge from the rear of the acetabulum without using any posterior-directed force, according to the AAP (Figure 5) [8].

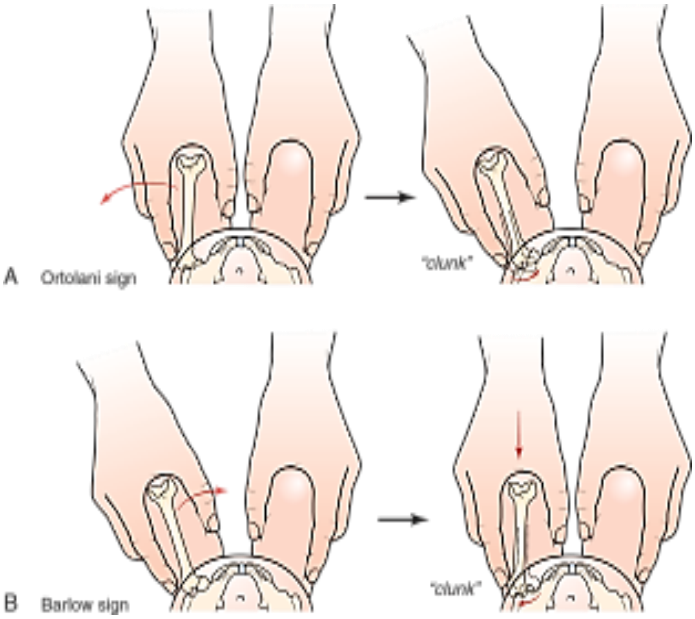

Figure (5): Assessing hip stability. (A) Hips that are Ortolani-positive allow for the relocation of a dislocated hip. (B) Despite being smaller, hips with Barlow positivity can dislocate [8].

Radiography:

The gold standard for the high-risk newborn without physical symptoms or any kid with positive clinical indications after the age of four months is still an AP radiograph of the pelvis. It is recommended to utilise any imaging modality between the ages of 4 and 6 months. Radiography is more accessible, less costly, and has a lower probability of false-positive findings than ultrasonography, but it exposes patients to extremely low radiation doses [8].

Ultrasonography:

Physical examination continues to be the principal screening method for DDH because most cases occur in children without risk factors. It is crucial that examiners with expertise and training perform and interpret infantile hip ultrasonography in accordance with the American Institute of Ultrasound in Medicine and the American College of Radiology recommendations. Based on the greatest resources available, regional guidelines for imaging screening and referral might result in more dependable and cost-effective treatment. Regional differences in the caliber of ultrasonographic imaging may lead to under- or overuse of treatment [8].

Treatment:

Treatment suggestions are given in light of the results of the clinical hip examination and the existence or absence of imaging anomalies. It is possible to monitor infants without a brace who have stable clinical hip tests but anomalies shown on ultrasonography [10].

For the treatment of clinically unstable hips, several studies suggest the use of an abduction brace either right away or subsequently. In babies with dislocatable hips treated with immediate or delayed abduction bracing, Gardiner and Dunn discovered that neither the clinical outcome nor the findings of hip ultrasonography had altered at the 6- or 12-month follow-up. In the event that hip instability remained or the aberrant hip ultrasonographic findings did not improve, the neonates in the delayed group (2 weeks) of treatment underwent abduction bracing [8].

The youngster can actively move the hips through a range of motion with the use of a dynamic orthosis called the Pavlik harness, which encourages the depth and stability of the acetabulum. Following a DDH diagnosis, the harness is employed as soon as is practical. The length of the therapy depends on the patient's age at presentation. Serial physical examinations, as well as static and dynamic ultrasound, are utilized to evaluate development [11]. If there is no progress after four weeks of wearing a splint, therapy is stopped for a clearly dislocated hip. At 4 to 5 months of age, a closed reduction is then tried under general anaesthesia, often with an arthrographic assessment and subsequent Spica casting (Figure 6) [11].

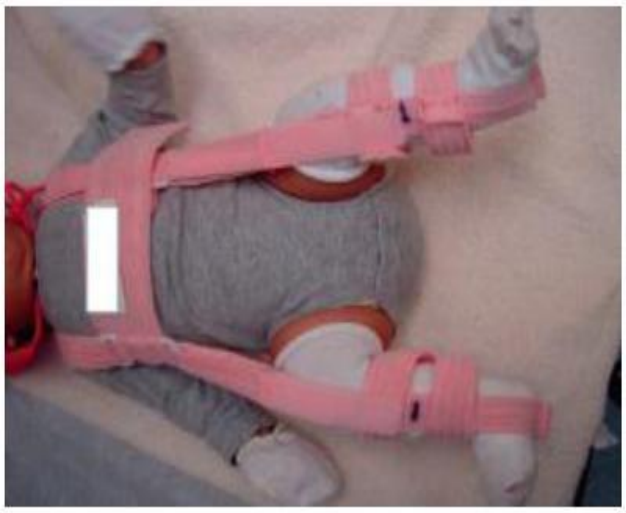

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Figure (6): The Pavlik harness [11].

Calcaneovalgus:

The dorsum of the foot is or can be exactly opposite to the anterior side of the leg in people with calcaneovalgus (Figure 7). A postural deformity that is considered to be induced by intrauterine placement. The anterior ankle and lateral soft tissues' rigidity frequently limits the plantar flexion of the foot. Calcaneovalgus is thought to affect between 0.4 and 1 out of every 1000 live births. A comprehensive hip examination is advised since developmental dysplasia of the hip tends to affect more women than males and may be connected to breech births [13, 14].

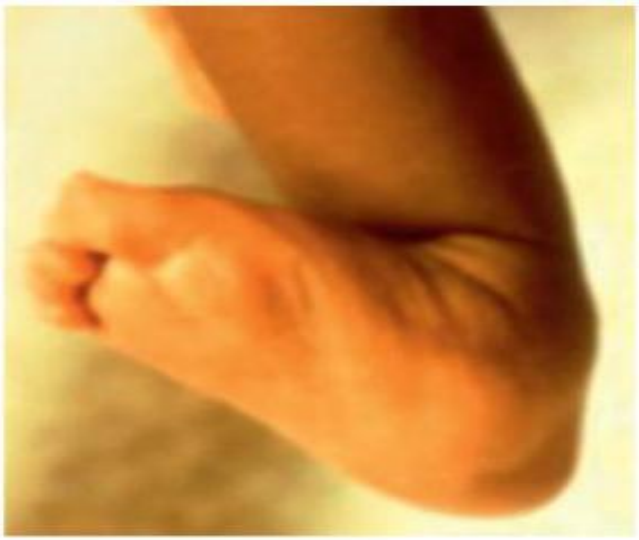

Figure (7): Calcaneovalgus foot [10].

Congenital vertical talus:

The hind foot is trapped in equinus (plantar flexion) in congenital vertical talus because the midfoot is dorsally displaced via the talonavicular joint, giving the foot's sole a characteristic "rocker bottom" appearance (Figure 8). To lengthen the dorsal soft tissues and reduce the midfoot, serial casting is employed throughout infancy. If necessary, limited surgical release, talonavicular joint pinning, and Achilles tenotomy are subsequently carried out [15].

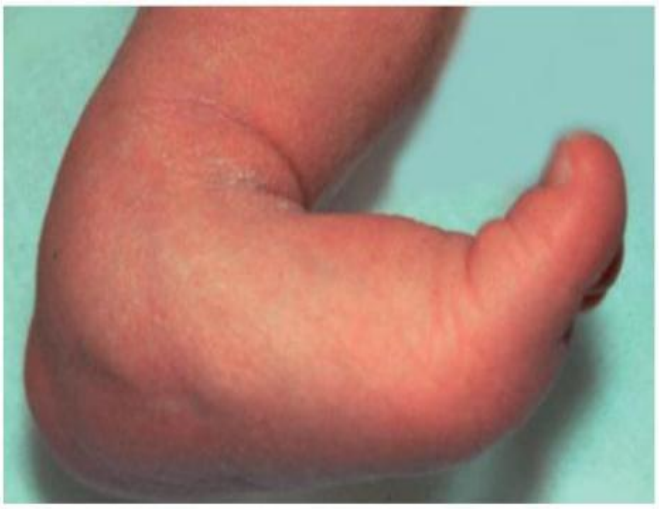

Figure (8): Congenital vertical talus [10].

Metatarsus adductus:

The illness is thought to be caused by crowding inside the uterus. A distinctive feature of the foot is its "bean-shaped" sole, concave medial border with curved lateral border, higher-than-normal-appearing arch, and neutral heel (Figure 9).

There are two types of metatarsus adducts: those that receive passive correction and those that don't. It is advisable to leave untreated feet that can receive passive treatment alone since they will naturally become better [16].

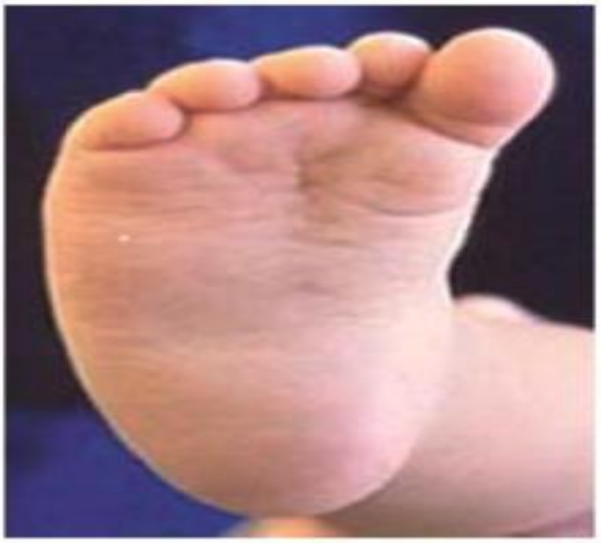

Figure (9): Metatarsus adductus [16].

At the age of 6 to 9 months, feet that cannot be passively corrected (the curved lateral border cannot be straightened) should be managed with manipulation and serial casting.

The repairs can then be kept up using reverse or straight-last shoes, as needed. Only children with inflexible deformities who are older than 3 years old and who have not responded to a casting program should be given the option of surgery [16].

Clubfoot (Figure 10): A severe paediatric foot abnormality that occurs 1 in every 1000 live births, which is congenital talipes equinovarus, often known as clubfoot. Ankle equinus, forefoot adductus, midfoot cavus, and hindfoot varus are the four complex foot deformities that make up this condition [(17)]. Early amniocentesis (11 to 13 weeks' gestation) is thought to increase the incidence of clubfoot because it reduces foetal mobility at a crucial time for foot development [(16)].

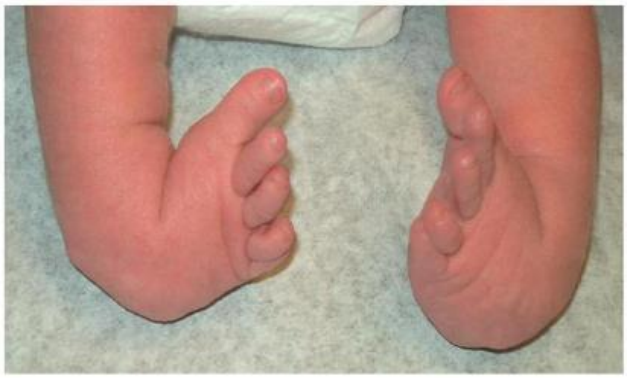

Figure (10): newborn clubfoot [(17)].

The "postural" mild clubfoot seems to be a packaging issue brought on by intrauterine placement. This deformity is passively correctable, exhibits little to no calf atrophy, lacks deep medial creasing, and cures on its own or responds fast to a stretching and casting routine. The arthrogrypotic or neuromuscular clubfoot, which exhibits significant stiffness, lack of skin creases, suggesting early in utero disease, and inability to respond to non-operative treatments, is at the other end of the range. The typical, idiopathic clubfoot deformity is located in the middle of these two extremes. The typical clubfoot has inflexible varus and equinus of the heel with a deep, single, posterior skin crease, curved lateral border with a high arch, and deep, single, medial skin crease [(18)].

Congenital knee dislocations: In clinical practice, congenital knee dislocation is an uncommon occurrence. An estimated 0.017 out of every 1000 live births is the incidence. This deformity typically coexists with other congenital musculoskeletal abnormalities such as clubfoot, spina bifida, arthrogryposis multiplex congenita, developmental hip dysplasia, and forefoot and hindfoot deformities. The primary underlying pathology is discovered to be a short quadriceps femoris muscle. Treatment for this uncommon congenital knee instability has been documented using both conservative and surgical approaches [(19)].

CONCLUSION

Modern genetic testing is revolutionizing how uncommon genetic diseases are diagnosed, but appropriate clinical and radiological examination is still necessary. Identifying and preventing potentially serious consequences is important in the management of children with skeletal dysplasias.

Financial support and sponsorship: Nil.

Conflict of interest: Nil.

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