OPEN ACCESS Freely available online

International Journal of Physical Medicine & Rehabilitation

Expert Review

Understanding Arthrogryposis

Craig H. Lichtblau[1,2*], Jaroslaw Michal Deszczynski[3], David Feldman[4], Gabrielle Meli[5], Christopher Warburton[5]

[1]Medical Director, Osseointegration Program, Physical Medicine and Rehabilitation Consultant to the Paley Orthopedic and Spine Institute at St. Mary's Medical Center, West Palm Beach, FL, USA; [2]Consultant to Children's Medical Services for the State of Florida, USA; [3]Department of Orthopaedics and Rehabilitation, Medical Dentistry Faculty, Medical University of Warsaw, Poland; [4]Associate Director of the Paley Orthopedic and Spine Institute, Florida, USA; [5]University of Miami Miller School of Medicine, Miami, FL, USA

ABSTRACT

Arthrogryposis, or Arthrogryposis Multiplex Congenita (AMC) is characterized by congenital joint contractures that are associated with lack of fetal movement. This review details the condition and provides an update on how arthrogryposis is managed throughout the lifetime. Common clinical manifestations, the forms of arthrogryposis interventions and coordinated care are covered.

Keywords: Arthrogryposis, Physical medicine, Rehabilitation

INTRODUCTION

Arthrogryposis, also referred to as Arthrogryposis Multiplex Congenita (AMC), is a condition often diagnosed intrauterine by noting fetal akinesia, lack of fetal movement. The etiology may be varied and may or may not have a genetic component. In the non-genetic forms, there may be a vascular insufficiency in the embryo or fetus leading to failure of formation or development of muscles, connective tissue, or even bone [1,2]. The condition is characterized by two or more congenital joint contractures, which restricts joint movement and often leads to deformity.

Arthrogryposis occurs in an estimated 1 in 3,000 live births, though the specific prevalence varies by type [3]. Arthrogryposis is non-progressive and usually improves with appropriate care and management [4]. Clinical practice guidelines for arthrogryposis have not been formally established. Barriers to streamlined guidance include an inconsistency in the phenotypic expression of the condition, variability of the causative gene, natural history, and outcomes associated with arthrogryposis [3,5,6]. Here, we review the details of the condition and provide the latest information on how the condition is managed throughout the lifetime.

Arthrogryposis is a clinical finding that presents with a variety of manifestations

Arthrogryposis is a characteristic of more than 300 different disorders and is thus a clinical finding rather than a specific diagnosis [3,7]. As isolated congenital contractures may not indicate arthrogryposis, multiple contractures at birth are required for a clinical finding of arthrogryposis [3]. The joints most likely to be affected are major joints such as the hands, wrists, elbows, shoulders, hips, feet, and knees [8].

Genetic causes may be identified *via* genetic testing such as whole exome sequencing, which may help in predicting prognosis [9]. Distal Arthrogryposis is arthrogryposis that mainly involves the hands and feet and is almost always a genetic abnormality. More than twelve types of distal arthrogryposes have been described based on the clinical findings and genetic abnormality.

Arthrogryposis of the AMC type is now thought of as an aborted identical twin. There are many examples of identical twins in which one of the children has AMC and the other is uninvolved. This may relate to the affected twin having a vascular insufficiency during development.

Correspondence to: Craig H. Lichtblau, Medical Director, Osseointegration Program, Physical Medicine and Rehabilitation Consultant to the Paley Orthopedic and Spine Institute at St. Mary's Medical Center, West Palm Beach, FL, USA, Consultant to Children's Medical Services for the State of Florida, E-mail: c.lichtblau@chlmd.com

Received: 18-Feb-2025, Manuscript No. JPMR-25-37005; **Editor assigned:** 20-Feb-2025, PreQC No. JPMR-25-37005 (PQ); **Reviewed:** 03-Mar-2025, QC No. JPMR-25-37005; **Revised:** 10-Mar-2025, Manuscript No. JPMR-25-37005 (R); **Published:** 17-Mar-2025, DOI: 10.35248/2329-9096.24.13.754

Citation: Lichtblau CH, Deszczynski J, Feldman D, Meli G, Warburton C (2025). Understanding Arthrogryposis. Int J Phys Med Rehabil. 13:754.

Common manifestations of arthrogryposis occur when joints become deformed and include talipes equinovarus (clubfoot), vertical talus, severe flexion contractures of the knees and knees fixed in full extension and unable to bend. Patients also may have or develop spine-related complications including tethered spinal cord, scoliosis, kyphosis or lordosis. In rare cases, patients may suffer sensory challenges, including impaired proprioception, which affects coordination and balance [11].

Severe cases of arthrogryposis may involve respiratory challenges when there are deformities of the thorax that lead to restrictive lung disease [11]. When this occurs, often as a result of thin ribs, babies may need assistance with breathing and feeding upon birth [2,12]. Prognosis in these cases is often poor [12]. Respiratory failure more often occurs in neurogenic forms of arthrogryposis [13].

Anxiety and low self-esteem are also common manifestations in patients with arthrogryposis, but on average, levels of anxiety and depression mirror those of the general population [11,14]. For both children and adults, psychosocial outcomes have been shown to be comparable to those of the general population [15].

Intervention for arthrogryposis should start early and often lasts throughout the lifespan

Early intervention is critical in arthrogryposis, to facilitate adaptation and optimize outcomes. Cesarean section is recommended for this population so not to fracture the long bones upon delivery. The child will often look most affected right after birth. Immediately after birth, physical therapy and orthotics should be utilized to teach the family and caregivers how to handle the child. There is most often no reason to start casting the child in the hospital as the parents should bond with their newborn. Joint mobility is often improved with a combination of physical therapy and splinting, which can also prevent contractures from worsening [16].

Other than the initial tendon releases for the feet, physical and occupational therapy is the primary treatment in the first 18 months of the child's life. In cases with severe deformity and where daily functioning is adversely affected, orthopedic surgery may be necessary to release and reconstruct joints, usually between 18-36 months of age.

For instance, casting and bracing through the Ponseti method is relatively effective for correcting clubfoot deformities [10]. One 2024 study found that the Ponseti method led to improvements in about 1 in 4 arthrogrypotic patients without the need for major surgery [17]. To promote functioning and improve performance of daily activities, assistive devices and custom adaptations are also often employed [18].

Coordinated comprehensive care is necessary to enhance quality of life by improving mobility, autonomy and social integration [8]. Effective multidisciplinary approaches include orthopedists, physical therapists, geneticists, and other specialists such as physiatrists. These teams of experts often help to manage those with arthrogryposis throughout their lives to maintain joint range and muscle strength across all developmental stages [19]. Psychological support is also often incorporated into multidisciplinary care for children to improve self-esteem and facilitate healthy social relationships [20].

Characteristics of arthrogryposis and appropriate intervention depend on the specific disorder

Arthrogryposis has been classified into various types that more precisely define the disorder and inform tailored treatment that best aligns with underlying causes and prognostic factors.

Amyoplasia: Amyoplasia is sporadic and characterized by symmetrical contractures and underdevelopment of muscles that become replaced by fatty or fibrous tissue. This form occurs more frequently than other forms of the condition, making up 40% of arthrogryposis cases [3,21,22]. In this condition, contractures are often severe, and muscle mass and strength are significantly reduced, particularly in the limbs.

Patients with amyoplasia tend to have shoulders that are adducted and internally rotated as well as extended elbows, flexed and wrists deviated ulnarly, stiff fingers, and thumbs facing the palms [3]. Other common observations in these patients are dislocated hips, fixed flexed or extended knees, severe equinovarus contractures in the feet, and a midfacial hemangioma. Both symmetric and asymmetric involvement of the limbs have been reported in these patients [5]. Bowel atresia and gastroschisis have been observed in these patients as well. Fortunately, intelligence does not appear to be affected in these patients [23–25].

Treatment for patients with amyoplasia aims to mobilize joints, enhance strength, and improve physical functioning and daily living, including adapting movement patterns that facilitate walking [3]. Approximately 80% of patients with amyoplasia continue to receive therapy for their condition into their teenage years [5].

Surgery serves to improve deformities and physical restriction in those with arthrogryposis [23–26]. According to one case series, surgeries on the feet were by far the most common (76%), with surgeries on knees (39%) and elbows (24%) also relatively common. Surgeries also occurred in the hips (18%), wrists (16%), hands (8%), and spine (5%) [6]. Surgery is not commonly needed for shoulder contractures with external rotational osteotomy of the humerus being common. Posterior capsulotomy, with ulna nerve transposition, may be performed at the elbow with tricep lengthening in cases where patients cannot reach their hand to their mouth [27–29].

Neurogenic and genetic forms: Some arthrogryposis occurs due to neurological impairments in either the central nervous system or peripheral nervous system, which are the catalysts for the fetal movement observed in the condition [31]. Some forms also have specific underlying genetic causes, which often involve mutations across multiple genes [32]. Treatment for neurogenic forms focus on physical therapy and correcting orthopedic challenges, whereas precision medicine is used for genetic forms.

Distal arthrogryposes: The less common form of arthrogryposis is distal arthrogryposis, which affects distal regions of limbs, hands, and feet [3,22]. The congenital contractures that occur in

distal arthrogryposis are not due to a neurological or muscle disorders [33]. There are more than ten subtypes of distal arthrogryposis that have been described, but consistent amongst all subtypes are the pattern of involvement of the hands and feet and sparing of proximal joints [33–35].

For a distal arthrogryposis classification, an individual must present with two major clinical criteria or one major clinical criterion in cases where a family member has arthrogryposis [3]. For the upper limb, these clinical criteria include camptodactyly or psueocamptodactyly, absent or hypoplastic flexion creases, ulnar deviation at the wrist, and overriding fingers. For the lower limb, talipes equinovarus, vertical talus, calcaneovalgus deformities, and metatarsus varus are major clinical criteria.

Specific characteristics of some subtypes are as follows

Distal Arthrogryposis type I (DA1): DA1 is characterized by clubfoot and camptodactyly, and absence or hypoplastic flexion creases are often observed. The pattern of joint involvement is consistent in DA1, though severity varies significantly [3,34-40].

Distal Arthrogryposis type II (DA2): DA2 often presents like DA1 but with nasolabial folds that are more prominent and smaller mouths. DA2 encompasses both Freeman-Sheldon syndrome and Sheldon-Hall syndrome, the latter of which is thought to be the most common form of distal arthrogryposis.

Distal Arthrogryposis types III, IV, and VI (DA3, DA4, and DA6): DA3, also known as Gordon syndrome, DA4, and DA6 are quite rare and characterized by short stature and a cleft palate.

Distal Arthrogryposis type V (DA5): DA5 often involves ocular abnormalities, including ptosis or strabismus. Patients with DA5 have also been reported to suffer from restrictive lung disease that results in pulmonary hypertension.

Distal Arthrogryposis type VII (DA7): DA7, or trismus-pseudocamptodactyly syndrome, is uncommon. Trismus, meaning the inability to fully open the mouth, is a key feature of DA7. Short stature and shortened hamstring muscles are also common, though clinical presentation varies in DA7.

In distal arthrogryposis, treatment focuses on fine motor function and correcting deformities and is less aggressive than interventions for amyoplasia [41]. Emphasis is placed on passive stretching and serial casting.

CONCLUSION

Arthrogryposis is a complex condition with a range of clinical manifestations and prognoses. Ongoing multidisciplinary intervention is critical for improving outcomes in patients with arthrogryposis and for customizing treatment approaches based on the type of arthrogryposis present and its severity. Early intervention tends to improve outcomes, and several different interventions conducted throughout the lifespan may help to enhance mobility and optimize quality of life.

REFERENCES

1. Hall JG. Arthrogryposis multiplex congenita: Etiology, genetics, classification, diagnostic approach, and general aspects. J Pediatr Orthop B. 1997;6(3):159-166.
2. Langston S, Chu A. Arthrogryposis multiplex congenita. Pediatr Ann. 2020;49(7):299-304.
3. Bamshad M, Van Heest AE, Pleasure D. Arthrogryposis: A review and update. J Bone Joint Surg Am. 2009;91:40-46.
4. Dahan-Oliel N, Cachecho S, Barnes D, Bedard T, Davison AM, Dieterich K, et al. International multidisciplinary collaboration toward an annotated definition of arthrogryposis multiplex congenita. Am J Med Genet C Semin Med Genet. 2019;181(3):288-299.
5. Vanpaemel L, Schoenmakers M, van Nesselrooij B, Pruijs H, Helders P. Multiple congenital contractures. J Pediatr Orthop B. 1997;6(3):172-178.
6. Sells JM, Jaffe KM, Hall JG. Amyoplasia, the most common type of arthrogryposis: The potential for good outcome. Pediatrics. 1996;97(2):225-231.
7. Hall JG, Reed SD, Greene G. The distal arthrogryposes: Delineation of new entities–review and nosologic discussion. Am J Med Genet. 1982;11(2):185-239.
8. Kowalczyk B, Felus J. Arthrogryposis: An update on clinical aspects, etiology, and treatment strategies. Arch Med Sci. 2016;12(1):10-24.
9. Rink BD. Arthrogryposis: A review and approach to prenatal diagnosis. Obstetrical & gynecological survey. 2011;66(6):369-377.
10. Ayadi K, Trigui M, Abid A, Cheniour A, Zribi M, Keskes H. Arthrogryposis: Clinical manifestations and management. Arch Pediatr. 2015;22(8):830-839.
11. Dai S, Dieterich K, Jaeger M, Wuyam B, Jouk PS, Perennou D. Disability in adults with arthrogryposis is severe, partly invisible, and varies by genotype. Neurology. 2018;90(18):1596-1604.
12. Bianchi DW, Van Marter LJ. An approach to ventilator-dependent neonates with arthrogryposis. Pediatrics. 1994;94(5):682-686.
13. Millichap JG. Spinal Muscular Atrophy and Arthrogryposis. Pediatric Neurology Briefs. 1997;11(10).
14. Wall LB, Vuillerman C, Miller PE, Bae DS, Goldfarb CA. Patient-reported outcomes in arthrogryposis. J Pediatr Orthop. 2020;40(7): 357-360.
15. Cachecho S, Boruff J, Wong T, Lacombe F, Dahan-Oliel N. Psychosocial wellbeing among children and adults with arthrogryposis: A scoping review. Health Qual Life Outcomes. 2021;19:1-8.
16. Thompson GH, Bilenker RM. Comprehensive management of arthrogryposis multiplex congenita. Clin Orthop Relat Res. 1985;194:6-14.
17. Berger N, Forkl H, Heimkes B, Frimberger V, Wagner F, Hildebrand F, et al. Midterm clinical and radiological outcomes of arthrogryposis-associated clubfoot treated with the Ponseti method: A retrospective observational study and comprehensive literature review. J Orthop Surg Res. 2024;19(1):595.
18. Munawaroh N, Putri RI. Case Report Arthrogryposis Multiplex Congenita (AMC): Functional Improvement of a Seven-Year-Old Girl after 3 Years of Physical Medical Rehabilitation Intervention. SPMRJ. 2023;5:(1):32-36.
19. Wagner LV, Cherry JS, Sawatzky BJ, Fąfara A, Elfassy C, Eriksson M, et al. Rehabilitation across the lifespan for individuals with arthrogryposis. Am J Med Genet C Semin Med Genet. 2019;181(3):385-392.
20. Ayadi K, Trigui M, Abid A, Cheniour A, Zribi M, Keskes H. Arthrogryposis: Clinical manifestations and management. Arch Pediatr. 2015;22(8):830-839.
21. Bernstein RM. Arthrogryposis and amyoplasia. J Am Acad Orthop Surg. 2002;10(6):417-424.
22. Kimber E. AMC: Amyoplasia and distal arthrogryposis. J Child Orthop. 2015;9(6):427-432.
23. Bennett JB, Hansen PE, Granberry WM, Cain TE. Surgical management of arthrogryposis in the upper extremity. J Pediatr Orthop. 1985;5(3):281-286.

24. WILLIAMS PF. Management of upper limb problems in arthrogryposis. Clin Orthop Relat Res. 1985;194:60-67.
25. Ezaki M. Treatment of the upper limb in the child with arthrogryposis. Hand Clin. 2000;16(4):703-711.
26. Hall JG, Reed SD, McGillivray BC, Herrmann J, Partington MW, Schinzel A, et al. Part II. Amyoplasia: twinning in amyoplasia—a specific type of arthrogryposis with an apparent excess of discordantly affected identical twins. Am J Med Genet. 1983;15(4):591-599.
27. Bennett JB, Hansen PE, Granberry WM, Cain TE. Surgical management of arthrogryposis in the upper extremity. J Pediatr Orthop. 1985;5(3):281-286.
28. Ezaki M. Treatment of the upper limb in the child with arthrogryposis. Hand Clin. 2000;16(4):703-711.
29. WILLIAMS PF. Management of upper limb problems in arthrogryposis. Clin Orthop Relat Res. 1985;194:60-67.
30. Hall JG, Reed SD, Driscoll EP, Opitz JM. Part I. Amyoplasia: A common, sporadic condition with congenital contractures. Am J Med Genet. 1983;15(4):571-590.
31. Hall JG. Arthrogryposis (multiple congenital contractures): Diagnostic approach to etiology, classification, genetics, and general principles. Eur J Med Genet. 2014;57(8):464-472.
32. Bayram Y, Karaca E, Akdemir ZC, Yilmaz EO, Tayfun GA, Aydin H, et al. Molecular etiology of arthrogryposis in multiple families of mostly Turkish origin. J Clin Invest. 2016;126(2):762-778.
33. Bamshad M, Jorde LB, Carey JC. A revised and extended classification of the distal arthrogryposes. Am J Med Genet. 1996;65(4):277-281.
34. Krakowiak PA, Bohnsack JF, Carey JC, Bamshad M. Clinical analysis of a variant of Freeman-Sheldon syndrome (DA2B). Am J Med Genet. 1998;76(1):93-98.
35. Stevenson DA, Carey JC, Palumbos J, Rutherford A, Dolcourt J, Bamshad MJ. Clinical characteristics and natural history of Freeman-Sheldon syndrome. Pediatrics. 2006;117(3):754-762.
36. Williams MS, Elliott CG, Bamshad MJ. Pulmonary disease is a component of distal arthrogryposis type 5. Am J Med Genet A. 2007;143(7):752-756.
37. Klemp P, Hall JG. Dominant distal arthrogryposis in a Maori family with marked variability of expression. Am J Med Genet. 1995;55(4):414-419.
38. Freeman EA, Sheldon JH. Cranio-carpo-tarsal dystrophy. Arch Dis Child. 1938;13(75):277.
39. Pallotta R, Ehresmann T, Fusilli P. Occurrence of Dandy-Walker anomaly in a familial case of distal arthogryposis type IIB. Am J Med Genet. 2000;95(5):477-481.
40. Pallotta R, Ehresmann T, Fusilli P. Ocular findings in distal arthrogryposis. Ophthalmic Genet. 2001;22(2):125-130.
41. Griffet J, Dieterich K, Bourg V, Bourgeois E. Amyoplasia and distal arthrogryposis. Orthop Traumatol Surg Res. 2021;107(1):102781.