

Case Study

Non-surgical Intervention of Knee Flexion Contracture in Children with Spina Bifida: Case Report

SALEH AL-ORAIBI, PhD, MSCP, MHPC¹⁾

¹⁾ Rehabilitation Department, Applied Medical Sciences College, King Saud University for Health Sciences: P.O. Box 2490, Riyadh 11426, Saudi Arabia

Abstract. [Purpose] The purpose of this case report is to describe for the first time, the use of serial casting in the management of knee joint flexion contracture for a young child with spina bifida. [Case Description] The child was 6 years old, and had L3–L4 spina bifida level lesion with quadriceps muscle strength grade 3+. The child had previously received weekly physiotherapy including stretching for knee flexion contracture on both lower limbs, but without improvement. [Results] The knee flexion contracture, which was not corrected with passive stretching, improved with casting from -40° knee extension to -5° knee extension as measured by a standard goniometer over a period of 4 weeks. Careful measures were taken to ensure skin integrity. At follow up after one-year, the child could ambulate independently with the help of walking aids. [Conclusion] The outcome indicates that using serial casting and follow-up with the use of bracing may be useful for enhancing the walking ability of a young child with spina bifida with knee flexion contractures. Further investigations of serial casting as well as investigation of serial casting with other interventions are warranted.

Key words: Serial casting, Children with spina bifida, Physical therapy

(This article was submitted Aug. 8, 2011, and was accepted Oct. 7, 2011)

INTRODUCTION

Children with spina bifida develop a wide variety of congenital and acquired orthopedic deformities including knee flexion contractures. Knee flexion contractures in children with spina bifida affect children's functional activities and interfere with the ability of children to transfer and walk¹⁾.

A limited number of studies have looked at the management of knee flexion contractures in children with spina bifida. Surgical intervention is the most effective choice for correcting joint contracture in children with spina bifida^{2, 3)}. However, with surgical intervention there is a great potential risk of complications arising from anesthesia and the varying skills of surgeons⁴⁾.

One physical therapy alternative technique of joint contractures is serial casting. Serial casting is the process of successfully applying and removing corrective plaster of Paris casts to increase extensibility in the soft tissues surrounding the casted joint⁵⁾. Serial casting for improving range of motion in the knee joint has been used in conditions such as cerebral vascular accident (CVA), traumatic

brain injury (TBI) and pediatric cerebral palsy^{6–8)}. These previous studies show that serial casting can increase joint range of motion, muscle extensibility, and improve functional mobility. However, to date, no work has specifically looked at the use of serial casting in the management of children with spina bifida, and there is a lack of documented evidence on the long term benefits of serial casting apart from the evaluation at the time of the final cast removal. Hence, the purpose of this case report was to describe for the first time, the use of serial casting in the management of knee joint flexion contracture in a young child with spina bifida, with follow-up to document the long term benefit of serial casting after one year.

SUBJECT AND METHODS

The child was 6 years old with normal cognitive abilities, and had L3–L4 spina bifida level lesion with quadriceps muscle strength grade 3+. The child was born through a normal vaginal delivery and had normal developmental milestones. At 4 years old a clinical examination revealed there was an associated history of neurological weakness, gait abnormalities and urinary and bowel incontinence. Neurological examination revealed reduced sensation to pain and touch in the distribution of L3–L4 nerves. The child was referred for physical therapy intervention for the first time at 4 years old with lower limb joint contractures including knee flexion contractures. Physical therapy training included: manual stretching exercise and prolonged stretch

Corresponding author. Saleh Al-Oraibi (E-mail: soraibi@hotmail.com; oraibis@ksau-hs.edu.sa)

©2014 The Society of Physical Therapy Science. Published by IPEC Inc. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License <<http://creativecommons.org/licenses/by-nc-nd/3.0/>>.

through strapping on a tilt table or application of sandbag weights over the distal femur. Physical therapy training was conducted in one hourly session per week by a trained physical therapist but no improvement was seen. Pre-intervention testing was completed one day prior to intervention which consisted of standard goniometer measurement and was used to measure the child's knee joint ranges of motion (ROM) before and after casting over 4 weeks. The universal goniometer (ie. full circle manual goniometer) is widely used in clinical practice. The standard goniometer has a good intratester and intertester reliability⁹).

The child's parents signed an informed consent statement that had been approved by the Al-Hussein Center Ethical Committee and Al-Hashmite University Research Committee Board. The child's legs were immobilized in a long cast from the thigh to the ankle (Fig. 1).

The serial casting technique applied in this study was modified to be appropriate for a child with spina bifida. Children with spina bifida are usually prone to decubitus ulcers and other types of skin breakdown, especially on bony prominent areas¹⁰. Careful measures were taken to avoid bed sores or other complications which may occur with casting. One of these measures included reduction of cast interval changes; the duration was reduced to two to three days. Other measures included padding well and casting carefully¹¹. The cast was made of plaster of Paris (P.O.P) or gypsum. Chemically it is known as calcium sulphate dehydrate. P.O.P is cheap, strong and radio translucent but the limb cannot be inspected. In order to avoid skin breakdown and friction between the cast and the child's skin the leg was padded well with cotton wool. Two therapists were involved. One held the limb and the other immersed the 6 inches P.O.P roll in luke warm water until all air bubbles within the bandage had disappeared. Then the P.O.P roll was removed from the water and squeezed gently to expel excess water. The wet roll was then applied around the limb with gentle firmness, while the assistant maintained the knee in maximum possible extension. While the plaster was wet the physiotherapist smoothed it and molded it to conform to the contours of the limb. This process was repeated on a further 8 occasions at intervals of 2–3 days. Special care was taken to maintain gained ROM while checking the skin for breakdown or sores. Measurements were taken by orthotist for knee ankle foot orthosis (KAFO) with a hip attachment. During this period back slap was used to maintain the ROM gained. All processes were performed by pediatric physiotherapists and each casting process took around 30 minutes for each limb. Arrangements were made with orthotist and the child was fitted with KAFO and hip support days after cast removal. Following the KAFO fitting, the child received intensive physiotherapy including gait training. Gait training began in parallel bars for three weeks with the locked knee KAFO attached to the hip and was followed by walking outside the parallel bars using a brace and reverse walker for about 2 months. Then gait training progressed to using forearm crutches with the brace. At this stage therapists emphasized an upright posture and knee extension. Knee flexion contracture was measured in degrees before applying the serial casts and immediately after cast removal.



Fig. 1. Bilateral long cast

RESULTS

The knee flexion contracture, which was not corrected with passive stretching, improved with casting from -40° knee extension to -5° . At one year follow-up, the child continue to ambulate independently for short distances (home and school) with an unlocked KAFO and forearm crutches.

DISCUSSION

This case report shows that using serial casting and follow-up with bracing may be a useful intervention for a young spina bifida child with knee flexion contracture. One possible explanation for the knee flexion contracture presented in this child, was that in addition to muscle imbalance there was delayed physical therapy intervention as treatment started after 4 years of age. The result in the current case study was consistent with those studies which have examined the effectiveness of serial casting in the management of joint contracture^{3, 10, 11}. In these studies, the improvements translated into reduced spasticity and improved ROM, but whether the improvement of ROM resulted in function improvement was not clear. In this case report, immediately after cast removal and at one year follow-up, the gain in ROM directly translated into improvement in mobility function. Few studies have looked at the sustainability of ROM gain after cast removal. However, in this case report gain in joint range was maintained at one year after cast removal. A possible explanation for the ROM gain and improvement in mobility function after one year may be the arrangements which were made in advance with orthotist, and the intensive gait training and direct supervision provided by physical therapists.

Fear of skin breakdown in serial casting to correct joint contracture in children with sensory loss may be behind the limited use of serial casting trials in this patient group. In this case report careful measure such as padding well and changing the cast in a short period of time may have contributed substantially to the improvement in joint ROM without skin breakdown or any other complications. To date, this case report is the first to report using serial casting for children with sensory loss without complications. Another advantage of using the serial casting approach is that avoided surgical intervention. Despite the fact that, surgical intervention is the most effective choice for correction

of joint deformities, there is great potential risk of complications, arising from anesthesia and the varying skills of surgeons¹²⁾. In addition, surgical intervention requires a long waiting time for an appointment at public hospitals and if done in a private hospital it is very expensive. Other recognized complications of surgical intervention of knee flexion contractures in children with spina bifida include over lengthening, infection and scarring¹⁾.

The child's parents were extremely pleased when they noticed that knee joint ROM had improved without complications and at a later stage when they saw their child could stand and walk. These improvements of functional mobility are vital for children with spina bifida¹³⁾. Correll and Gabler¹³⁾ reported that musculoskeletal deformities are one of the main factors influencing ambulation in children with spina bifida. On the other hand, children who stand or walk early in life, even if they become non-walkers later, will be more independent in their homes, have a lower incidence of medical complications, fewer fractures and greater independence compared to non-walkers¹⁴⁾. The outcome of this study should be treated with caution because only one case study is presented. Further research is needed to determine the effectiveness of using serial casting with larger samples including children with various levels of spina bifida.

REFERENCES

- 1) Flett P, Stern LM, Waddy H, et al.: Botulinum toxin A versus fixed cast stretching for dynamic calf tightness in cerebral palsy. *J Pediatr Child Health*, 1999, 35: 71–77.
- 2) Cusick RD: Progressive casting and splinting for lower extremity deformities in children with neuromotor dysfunction. Tuscon: Therapy skill builders, 1990.
- 3) Lehmkuhl LD, Thoi LL, Baize C, et al.: Multimodality treatment of joint contractures in patients with severe brain injury: cost, effectiveness, and integration of therapies in the application of serial/inhibitive casts. *J Head Trauma Rehabil*, 1990, 5: 23–42. [[CrossRef](#)]
- 4) Fernandez-Palazzi F, Battistella LR: Non-operative treatment 160 of flexion contracture of the knee in haemophilia. *Haemophilia*, 1999, 5(Suppl 1): 20–24.
- 5) Moen T, Gryfakis N, Dias L, et al.: Crouched gait in myelomeningocele: a comparison between the degree of knee flexion contracture in the clinical examination and during gait. *J Pediatr Orthop*, 2005, 25: 657–660. [[Medline](#)] [[CrossRef](#)]
- 6) Shurtleff DB: Decubitus formation and skin breakdown. In Shurtleff, DB (Ed.), *Myelodysplasias and extrophies: significance, preventive and treatment*. Orlando: Grune & Stratton, 1986, pp 299–312.
- 7) Ridgway CL, Daugherty MB, Warden GD: Serial casting as a technique to correct burn scar contractures. *J Burn Care Rehabil*, 1991, 12: 67–72. [[Medline](#)] [[CrossRef](#)]
- 8) Gajdosik RL, Bohannon RW: Clinical measurement of range of motion: review of goniometry emphasis reliability and validity. *Phys Ther*, 1987, 67: 1867–1872. [[Medline](#)]
- 9) Conine TA, Sullivan T, Mackie T, et al.: Effect 172 of serial casting for the prevention of equinus in patients with acute head injury. *Arch Phys Med Rehabil*, 1990, 71: 310–312. [[Medline](#)]
- 10) Moseley AM: The effect of a regimen of casting and prolonged stretching on passive ankle dorsiflexion in traumatic head-injured adults. *Physiother Theory Pract*, 1993, 9: 215–221. [[CrossRef](#)]
- 11) Pohl M, Rückriem S, Mehrholz J, et al.: Effectiveness of serial casting in patients with severe cerebral spasticity: a comparison study. *Arch Phys Med Rehabil*, 2002, 83: 784–790. [[Medline](#)] [[CrossRef](#)]
- 12) Singer BJ, Jegasothy GM, Singer KP, et al.: Evaluation of serial casting to correct equinovarus deformity of the ankle after acquired brain injury in adults. *Arch Phys Med Rehabil*, 2003, 84: 483–491. [[Medline](#)] [[CrossRef](#)]
- 13) Correll J, Gabler C: The effect of soft tissue release of the hips on walking in myelomeningocele. *J Pediatr Orthop B*, 2000, 9: 148–153. [[Medline](#)] [[CrossRef](#)]
- 14) Swank M, Dias L: Walking ability in spina bifida patients: a model for predicting future ambulatory status based on sitting balance and motor level. *J Pediatr Orthop*, 1994, 14: 715–718. [[Medline](#)] [[CrossRef](#)]