International Journal of Health Sciences and Research
Volume 15; Issue: 1; January 2025
Website: www.ijhsr.org
Case Study *ISSN: 2249-9571*

Mobile Sitting and Standing Corpus for Myelomeningocele - A Case Study

Chidatmika Mohanty[1], Madhusmita Lakra[2], Rashmita Dash[3]

Department of Prosthetics & Orthotics
Swami Vivekananda National Institute for Rehabilitation Training and Research, Olatpur, Post- Bairoi, Cuttack, Odisha, India

Corresponding Author: Rashmita Dash

DOI: https://doi.org/10.52403/ijhsr.20250133

ABSTRACT

Introduction: Myelomeningocele is a neural tube defect and a major birth defect. It is an embryological abnormality that results in a myriad of complex neuromuscular problems. Children with spina bifida can be classified according to the level of neurological involvement or functional impairment. The incidence of myelomeningocele is slightly higher in females than males, at a ratio of 1.3:1. Musculoskeletal deformity and sensory deficits are common and, depending on the level of involvement, can adversely affect the child's abilities and functioning in the community. Because of the complexity of this major birth defect, orthotic management is critical for the child's function and is a challenging endeavour for the orthotist. Specific issues that warrant particular attention include hip disorders (e.g., dislocation, subluxation, and contractures), knee flexion/extension contractures, and foot/ankle deformities (e.g., equino-varus, clubfoot). In these cases, the orthotic goal(s) should be preventing deformity and maintaining proper joint alignment in order to achieve appropriate muscle balance during development. Achievement of these goals can facilitate the initiation of proper weight bearing and future ambulation.
Method: The patient had poor strength in muscles of lower limbs which didn't allow independent standing. He was also not able to switch positions between sitting to standing and vice versa. The strength and ROM of the muscles of the lower limb were thoroughly assessed by the help of Manual Muscle Testing (MMT). As the patient is undergoing continuous therapeutically exercises focusing particularly on independent standing and sitting balance with strengthening on the core muscles, we decided to go for fabrication of a mobile sitting and standing corpus.
Result & Conclusion: The mobile sitting and standing corpus allow mobility for severely non-ambulatory individuals in both sitting and standing position. It is an approach to provide mobility and independence for children born with myelomeningocele. The design provides full body support with independent sitting and standing with increased mobility which is much needed when the child leaves the home environment for a long period of time. It is made with easily available materials. The designed device is an alternative to the wheelchair, where it is easy to carry and requires no such adjustability. The device takes less space for positioning and the patient can be easily seated within the device.

Keywords: *Myelomeningocele, Mobility device, Ambulation*

INTRODUCTION

Spina bifida, also known as split spine, is a congenital anomaly that is caused by incomplete development of the neural tube resulting in presence of a gap in the spine of the child involved. It is commonly used as a nonspecific term referring to any degree of neural tube closure. It happens during the first 28 days of conception and is considered a permanently disabling birth defect. The incomplete closure of the posterior spinal elements causes these types of spinal dysraphisms. The process of neuralisations occurs in two phases- primary and secondary. Primary neuralisations refer to the closure of the neural tube forming the brain and spinal cord. Secondary neuralisations involve the formation of the caudal structures of the neural tube forming the sacral and coccygeal portion. Spina bifida affects female babies more than males (1). As per statistics, the overall pooled birth prevalence (random effect) of neural tube defects in India is 4.5 per 1000 total births. The overall prevalence of neural tube defects from India is high as compared to other regions of the world. Only 5% of myelomeningocele occur in families with a positive family history, while 95% occurs spontaneously in children of women with no family history. The type of motor impairment experienced by infants with spina bifida will depend on the level of the lesion, as the nerves supplying the parts of the body located below the level of the exposed area do not function properly, leading to a range of motor and sensory problems, and disturbance of bodily functions, such as bowel and bladder dysfunction. The actual cause of spina bifida is unknown. But certain factors important for the foetal development come into play when causes are discussed. These include low folic acid (vitamin B9) intake during pregnancy, family history of spina bifida and usage of certain drugs like valproic acid during pregnancy. Various other rarely discussed causes involve chromosomal abnormalities, single gene disorders and teratogenic exposures. The extent of complications caused by spina bifida depends on various factors like the size and location of the opening in the spine, whether the affected area is covered by spine & the spinal nerves which come out of the affected area.

Various foot deformities that can occur in myelomeningocele involves varus, equino-varus, equinus, cavovarus, calcaneus, calcaneovalgus, calcaneovarus, abducto-valgus and external tibial torsional. Some miscellaneous deformities of the legs, feet and toes which include paralytic convex pes valgus (vertical talus), severe planus, claw toes, and hallux malleus et cetera. A flail undeformed knee, undeformed knee with quadriceps weakness and fixed flexion deformity are some of the commonly occurring deformities in the knee. Flail knees with minimal quadriceps control occur when there is little or no function in the 3rd and 4th lumbar segments. Sometimes there is progressive weakness of the quadriceps muscles which appears during the first six years of the life. Fixed flexion deformity of up to 20 degrees is usually present at birth and gets corrected spontaneously. Hip dislocation (both unilateral and bilateral), hip flexion deformity, external rotation and abduction are some of the major deformities occurring in children with myelomeningocele (2).

The degree to which orthotic management is implemented for myelomeningocele is largely based on patient's neurological status and remaining motor function. Orthotic treatment for myelomeningocele should begin early in the child's life with attention towards proper joint position, range of motion, and developmental milestones. Determination for mobility should focus on function and activities of daily living. In some instances, multiple mobility options provide the greatest opportunity for maximum function. It is important to maintain continuous follow-up throughout the child's life to ensure that orthotic management is still viable and appropriate. To understand the specific functional needs of the myelomeningocele

population, the intact motor levels of function and their specific orthotic interventions must be identified. Each level of motor function requires a different orthotic prescription. Many orthotic management and mobility devices are available for the myelomeningocele population depending on the level of involvement. Mobility devices can greatly reduce the effort required to transport a dependent child or adult from the home into the community. For others, mobility devices such as powered wheelchairs offer tremendous potential independence which is so important in educational and vocational pursuits (3).

MATERIALS & METHODS

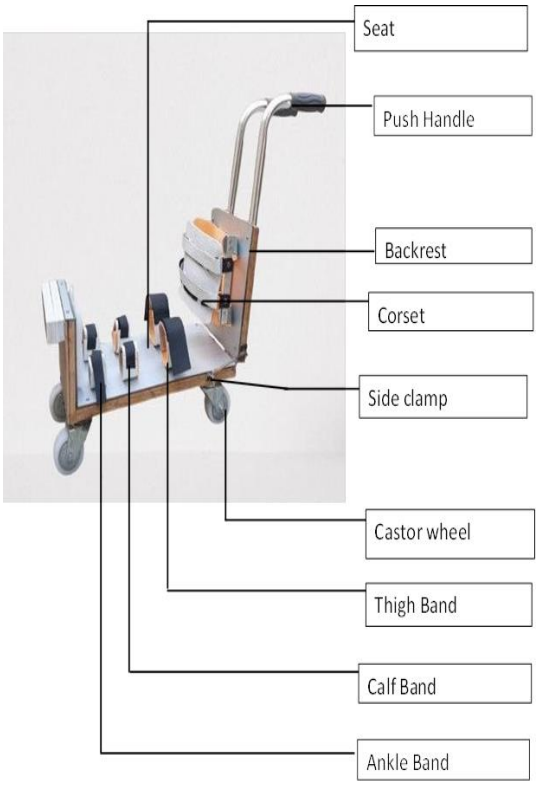
The patient [male, 5 years] suffered from myelomeningocele, reported to SVNIRTAR for general therapy and is using a wheelchair for mobility purpose. The patient had poor strength in muscles of lower limbs which didn't allow independent standing. He was also not able to switch positions between sitting to standing and vice versa. The strength and ROM of the muscles of the lower limb were thoroughly assessed by the help of Manual Muscle Testing (MMT). The MMT grading of muscles after proper assessment around the lower limb major joints [hip, knee and ankle joint] was coming 1/5 and 1+/5 respectively. The sensation was intact at the lower limb. There was mild knee flexion tightness around the left knee joint and rest joints are in fair condition. The speech, hearing and vision are intact. After proper assessment and medical history, the patient is advised for a mobility device designed especially for the patient need. As the patient is undergoing continuous therapeutically exercises focusing particularly on independent standing and sitting balance with strengthening on the core muscles, we decided to go for fabrication of a mobile sitting and standing corpus. The patient gave a written informed consent form to participate in the study, and appropriate approval was also obtained from the Institutional Ethical committee.

Design concept- The corpus (frame) is made out of wood. It has two modules – a body support module and a multipurpose wheeled base module. The multipurpose wheeled base module has three basic parts - backrest, seat and footrest. The backrest is attached to the seat with the help of two hinges which enable the seat and backrest to change angles while switching from sitting to standing and vice versa. Four wheels have been attached to the Corpus which enables mobility while sitting as well as standing. The pair of wheels in front allows linear mobility, whereas the ones attached on the rear end enable changing direction during ambulation while sitting. The footrest is fixed to the Corpus which provides a platform for the patient's feet. The push handles make it easier for the attendant to propel it forward. The thoracic band and the pelvic band have been attached to the backrest while the thigh, calf and ankle bands have been attached to the seat with the help of self-tapping screws. These bands have an inner soft lining made up of evathene which prevents the patient from any discomfort caused due to sharp metal edges or extreme temperature conditions. The patient's body is secured to the bands with the help of straps made up of Velcro hook and loop. An abdominal corset has been provided to secure the patient's torso to the backrest.

While sitting, the backrest maintains an obtuse angulation with respect to the seat in order to provide sitting comfort to the patient. This angulation is maintained by the help of two clamps attached on either side of the Corpus. The patient needs to engage the hook to the clamp while sitting. The Corpus can change direction during ambulation while sitting. While standing, the backrest forms an angle of 180 degrees with respect to the seat while standing. The seat and the backrest act as a single supporting unit to enable the patient to stand upright. In order to prevent the seat from falling, the tower bolts present on the back

of the junction between the seat and the backrest can be lodged. This locks the seat in an erect position throughout standing hours. The wooden slab present under the anterior aspect of the footrest enables stable standing. The attendant would require to lift the wooden slab from the ground by slightly pulling the seat and backrest combination towards himself/herself while keeping the junction between the backrest and footrest still to enable ambulation.

From sitting to standing, the attendant would need to disengage the hook from the clamp on both sides of the frame. He/she should then straighten the backrest in order to align it with the seat followed by lodging the tower bolts to lock the frame in the respective position. The attendant should make sure to lift the frame up while aligning the backrest and seat together. It should be kept in mind that there is enough support on the patient's back so that he/she does not fall backwards after disengaging the hooks from the clamps. From standing to sitting, the attendant would need to dislodge the tower bolts in the first step. He/she should then gently fold the backrest forward to bring it back to its original position followed by engaging the hook and clamp together. There should be sufficient support on the posterior aspect in order to prevent the patient from falling backwards while engaging the clamp and hook.



RESULT

The mobility devices and orthoses needed for ambulation vary widely for patients with myelomeningocele (MMC), depending largely on each patient's functional abilities. The motor and sensory deficiencies related to MMC are most important to consider when assessing for orthoses and mobility equipment. The design comprises two modules: a body-support module and a multi-purpose wheeled base module that interfaces with the body support advantages gained with wheeled mobility such as that provided by a wheelchair. The mobile sitting and standing corpus allows mobility for severely non-ambulatory individuals in both sitting and standing position. It is an approach to provide mobility and

independence for children born with myelomeningocele. The design provides full body support with independent sitting and standing with increased mobility which is much needed when the child leaves the home environment for a long period of time. The components attached within the device helps to maintain the body alignment in upright position. The lumbar support helps to maintain the trunk in upstanding position and thus helps to strengthen the core muscles and back muscles, thus avoiding from falling down. Similarly, the components attached to the sitting region helps to maintain and hold the lower extremity in sagittal plane alignments and help to reduce the knee flexion tightness and ankle deformity if present. Furthermore, the design within the device helps to promote and maintain proper joint alignment for muscle balance during ambulation or development in general.

DISCUSSION

An interdisciplinary team must address the family's goals and expectations before instituting a mobility device and orthotics plan for a child. The motor deficit can range from minimal muscle weakness to complete paraplegia or even quadriplegia. Similarly, the sensory impact can range from subclinical sensory alterations to complete lack of sensation. Mobility devices can greatly reduce the effort required to transport a dependent child or adult from the home into the community (4, 5). The initial major focus of this task has been to investigate alternate approaches to providing mobility and increased independence for children and young adults born with myelomeningocele efforts to provide mobility for this population have focused on the full hip, knee, ankle, foot orthoses (HKAO), and ambulation with walkers or crutches. Generally, this approach has been expensive and does not yield an acceptable long-term result in that a high percentage of these individuals opt for a wheelchair, either late in the first decade, or early in the second decade in life (3, 6). The deigned device composed of components that help to maintain the HAT (head, arm and trunk) in aligned position. The device consists of lumbar support with corset attached to it. The lumbar support helps to maintain the trunk in upstanding posture and also helps the core muscles and back muscle of the spine in erect position. The lumbar support is attached to the back rest and the back rest is maintained in seat to back angle. The Seat-to-back angle helps to align the head and trunk over the pelvis, which can improve posture and avoid a forward position. This is beneficial for the patient with poor head and neck control and for the patient with poor core muscle control like in myelomeningocele. The sitting surface consists of components like calf band and thigh band for holding the lower limb in aligned position. The foot rest is attached with a pair of UCBL where the foot is rest or loaded while standing. The UCBL helps to stabilize the foot from any deviation or developing deformity and thus maintains the foot in neutral position. The device is attached with wheels for easy propulsion of the device with the help of handles attached to the back rest.

CONCLUSION

The mobile sitting and standing corpus for myelomeningocele is made with easily available materials. The designed device is an alternative to the wheelchair, where it is easy to carry and requires no such adjustability. The device takes less space for positioning and the patient can be easily seated within the device. It requires less maintenance and light in weight. It should be emphasized that because of the uni sample size nature of this study, the validity of this intervention should be reconfirmed by a large sample size and randomized clinical trial.

Declaration by Authors

Acknowledgement: None
Source of Funding: None
Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Godbole K, Deshmukh U, Yajnik C. Nutrigenetic determinants of neural tube defects in India. Indian Pediatr. 2009 Jun 1; 46(6):467-75.
2. Menelaus MB. The orthopaedic management of spina bifida cystica. (No Title). 1980.
3. Shaikh-Mohammed J, Dash SS, Sarda V, Sujatha S. Design journey of an affordable manual standing wheelchair. Disability and Rehabilitation: assistive technology. 2023 Jul 4;18(5):553-63.
4. Glimcher MD, Hall JE. Rehabilitation Engineering Center Harvard University/Massachusetts Institute of Technology 77 Massachusetts Avenue, Cambridge, Mass. 02139 William Berenberg, MD, Robert W. Mann, Sc. D., Melvin J. Bulletin of Prosthetics Research. 1980; 10(33-34):108.
5. Sansom JK, Ulrich BD. Energy Efficiency in Children with Myelomeningocele during Acute Use of Assistive Devices: A Pilot Study. Adapted Physical Activity Quarterly. 2018 Jan 1; 35(1):57-75.
6. Knutson LM, Clark DE. Orthotic devices for ambulation in children with cerebral palsy and myelomeningocele. Physical therapy. 1991 Dec 1; 71(12):947-60.

How to cite this article: Chidatmika Mohanty, Madhusmita Lakra, Rashmita Dash. Mobile sitting and standing corpus for myelomeningocele - a case study. *Int J Health Sci Res.* 2025; 15(1):251-256. DOI: *https://doi.org/10.52403/ijhsr.20250133*

******