

Seating for the Severely Disabled Child

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Abstract : Children suffering from severe spastic cerebral palsy or other neuromuscular condition are frequently bedridden and have little or no potential for ambulation. These children are often neglected and develop marked lower limb contractures, pelvic obliquity and or scoliosis. Unfortunately, seating remains a neglected poorly understood and under utilized therapeutic modality in these handicapped children. The general goals of seating are to provide truncal support and control, improve body orientation and stability, improve function of the upper limbs and distal body parts, prevent pressure sores and improve the function of the cardiopulmonary and gastrointestinal systems. A multidisciplinary team comprising of an orthopaedic surgeon, physiotherapist, occupational therapist, bioengineer and technicians is central to the success of a 'Seating Clinic'.

310 non-ambulant children suffering from spastic quadriplegic CP or other neuromuscular condition have been treated at our Seating Clinic.

The primary considerations in prescribing a seat were the type of sitting support surface, back support, foot support and upper extremity support. The various chair types prescribed are discussed in the paper.

The key to seating a non ambulant child is the optimal balancing of a stable spine over a stable pelvis. The surgical assessment and correction involved in appropriate seating are discussed. Regular follow up in such a combined seating clinic, concurrent with patient and caregiver education, is essential for the successful seating of a non ambulant child.

Introduction

Children suffering from severe spastic cerebral palsy or other neuromuscular condition are frequently bedridden and have little or no potential for ambulation. These children are often neglected and develop marked lower limb

contractures, pelvic obliquity and/or scoliosis. Seating a bedridden child has a tremendous impact on the physiological and psychological status of the child. Unfortunately, seating remains a neglected poorly-understood and under-utilized therapeutic modality in these handicapped children. The benefits of an

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upright sitting posture are many. Proper seating can decrease the abnormal tone and reflex activity in the severely spastic child and prevent the development of contractures and deformity. The child is better able to develop head and trunk control, and the upper limbs can be freed for development of useful manipulative skills. The child benefits psychologically by being able to sit comfortably and interact with society, his peers and the environment. Finally it permits easier nursing and transportation of the child by the care-giver.

The general goals of seating are to provide truncal support and control, improve body orientation and stability, improve the function of the upper limbs and distal body parts, prevent pressure sores and improve the function of the cardiopulmonary and gastrointestinal systems. This can only be achieved by maintaining good pelvic position and optimizing spinal alignment. Postural deviations should be recognized and corrected if possible, to achieve optimal sitting posture. A multidisciplinary team comprising of an orthopaedic surgeon, physiotherapist, occupational therapist, bioengineer and technicians is central to the success of a 'Seating Clinic'.

Patients & Methods

310 non-ambulant children suffering from spastic quadriplegic cerebral palsy or other neuromuscular condition have been treated at our Seating Clinic. There were 194 males and 116 females. Two thirds (n=200) of the children suffered from severe spastic cerebral palsy, while the remaining had muscular dystrophy, spinal muscular atrophy or other neuromuscular condition as listed in Table 1. The children were initially assessed by the multidisciplinary

Table 1. Seating for the Severely Disabled Child

Diagnosis	Number
Spastic quadriplegic CP	200
Spastic diplegic CP	5
Spastic hemiplegic CP	3
Athetoid CP	3
Muscular dystrophy	20
Spinal muscular atrophy	5
Epilepsy	6
MMC with hydrocephalus	7
Other	61
Total	310

team to determine their suitability for seating. The sitting ability of the children was classified according to Hoffer as ; independent (hands-free), hands dependent, and propped¹⁾. Any abnormal postural deviation was noted and recorded as being either flexible or fixed (structural). The presence of any contracture in the lower limb, especially contracture which would interfere with proper seating ; presence of any pelvic obliquity ; and any abnormal spinal alignment were recorded at the initial assessment. Postural deviations that were considered to be an impediment to proper seating ; such as hamstrings contracture causing posterior pelvic tilt and sacral sitting ; hip adduction contracture and windswept hip deformity causing pelvic obliquity and abnormal sitting pressure ; scoliosis and kyphosis causing truncal malalignment, etc. were noted and considered for surgical correction where feasible. Deformities of two types were mainly noted, as previously described by Rang ;

1. Symmetrical slouch with sacral sitting due to hamstrings contracture
2. Wind swept deformity with adductor contracture, subluxated or dislocated hip and a contralateral hip abduction deformity with resultant pelvic obliquity and

Table 2. Seating for the Severely Disabled Child

Chair type	Number
Buggy	3
Insert	11
Buggy with insert	58
Wheelchair	12
Wheelchair with insert	108
Wooden chair with insert	43
Orthosis	31
Other	44

scoliosis.

Types of seats

The primary considerations in prescribing a seat were the type of sitting support surface, back support, foot support and upper extremity support. The chair type prescribed was either a buggy, a wheelchair, or a wooden chair; with or without appropriate inserts as necessary. (Table 2)

- The base of the seat provided was either a non-mobile wooden chair or a mobile buggy or wheelchair.
- The seat was of a non-compressible conforming material that increased surface contact while providing a firm base of support. A cushion that provides firm support under the fleshy, posterior thigh maintains good pressure and shear relief at the ischia and coccyx. This, when used in conjunction with a properly adjusted footrest height, can have a significant impact on ischial pressure.
- Depending on the needs of the child, the seat varied from a simple cushioned seat to seats which included lateral supports and head support, or an orthotic seat contoured to accommodate a severe non-correctible deformity.
- The independent sitter was seated by providing a mobile stable base with a backrest to

support optimal spinal alignment.

- The hands-dependent sitter was treated by providing back and lateral supports, so that the hands could be freed for development of manipulative skills. The trunk support was either in the form of a crossed chest strap or an H-strap.
- The propped sitter usually required back, lateral and head supports with an inclined seat to avoid the child from sliding off.

Surgical correction of deformities

15% (n=48) of the children had a C-shaped thoracolumbar scoliosis or hip flexion-adduction deformity with subluxation/dislocation of the affected hip that required surgical correction.

Affected hips were approached with four levels of intervention depending on the severity of involvement:

- An early contracture was managed by soft tissue stretching, physiotherapy and abduction splinting.
- A hip-at-risk to subluxation (having a combined abduction angle of $<60^\circ$) was considered for surgical release of the contracted adductors.
- A subluxated hip (having a Reimer's Extrusion Index of 30-50%) was treated by a femoral varus osteotomy with or without acetabuloplasty.
- A hip which had extruded $>50\%$, or a dislocated hip was treated by combined open reduction, and femoral varus osteotomy with acetabuloplasty.

Scoliosis was managed by posterior instrumentation and fusion using the Luque system and sublaminar wiring, with fixation to the pelvis using the Galveston technique in case of

pelvic obliquity.

Discussion

Seating a non-ambulant child has potential benefits on the respiratory and musculoskeletal systems in addition to the non-quantifiable psychological benefits to the child and parents. The key to seating a non-ambulant child is the optimal balancing of a stable spine over a stable pelvis. Thus providing proper seating to a severely spastic child is a challenging though rewarding field. Improper seating may encourage or even introduce postural deviations that can progress to a structural or fixed deformity. Wheelchair users often possess a limited repertoire of compensatory patterns to maintain comfort. Persistent utilization of these patterns result in fixed postural deviations. These postural deviations should be recognized and treated early, while still flexible.

1. Probably, the most common posture seen among wheelchair users is the slouched or kyphotic posture. This posture is assumed to compensate for lack of intrinsic trunk control and lack of external postural aids. Bilateral hamstrings contracture worsens the problem. The posture consists of a posterior pelvic tilt, a flattened or kyphotic lumbar spine, thoracic kyphosis, and lower cervical flexion with upper cervical and head extension. Complications associated with this posture include increased mechanical stresses at the sacrum, coccyx and spinous processes with risk to developing pressure sores, loss of femoral support with associated lower limb deformities, increased muscular imbalance, compromised cardiopulmonary function; back, shoulder and neck pain; and impaired visual fields and associated deficits of upper limb function. Intervention at

the earliest opportunity is imperative for optimal restoration of function and prevention of secondary deformity. This can be achieved by supporting the pelvis in a level, derotated position with optimal alignment in the sagittal plane, providing pressure relief to prominent areas, restoring lumbar lordosis and surgical release of any contracted hamstrings to correct posterior pelvic tilt and sacral sitting.

2. The second abnormal posture is asymmetric seating due to pelvic obliquity resulting from scoliosis or hip dislocation. Children with quadriplegic CP have a very high risk (>80%) to hip flexion-adduction contractures with consequent hip subluxation/dislocation. The resultant pelvic obliquity causes increased mechanical stresses on the lower ischial tuberosity with possible impact on skin integrity. Adduction contractures also interfere with perineal hygiene and proper seating. Secondary spinal curvature further compounds the problem. Every child should thus be routinely examined for development of any adductor contracture, and remedial measures should be instituted immediately on detection. A combined hip abduction angle of <60° should raise suspicion of hip subluxation and warrants a screening anteroposterior pelvic X-ray. A break in the Shenton's line and progressive extrusion in the femoral head as calculated by the Reimer's Extrusion Index, should be treated by the appropriate surgery as described earlier. A unilateral hip dislocation should always be treated as it can result in severe pelvic obliquity, scoliosis and recurrent ischial ulceration on the lower side of the pelvis. Wenger and associates have reported good results from comprehensive surgery that includes adductor and iliopsoas release, open reduction, femoral

varus osteotomy and pelvic acetabuloplasty for a neuromuscular hip dislocation²⁾. Treatment of bilateral hip dislocations is less well defined. Treatment options have ranged from conservative nihilism, to proximal femoral valgus osteotomies, to comprehensive open reduction with combined femoral and pelvic osteotomy, or proximal femoral resection as described by Castle and Schneider.

In conclusion, the following broad guidelines are recommended in order to seat a non-ambulant child. These guidelines are general and may have to be modified as necessary, so as to customize the intervention that best meets the individual user's needs.

- Provide a level base of support to help prevent pelvic obliquity or kyphotic posture.
- Provide a pressure-relieving medium under the ischia, coccyx and sacrum that will accommodate dynamic postural activity.
- Build pressure and shear on the fleshy, posterior weight-bearing aspects of the thighs to assist hips in maintaining a good position, provide a functional base of support, reduce ischial pressures and maintain good lower limb alignment.
- Maintain knees as close to 90° as possible. Adjust footrest height for maximal posterior thigh support.
- Stabilize pelvis in optimal position by providing support to the posterior/superior aspect of the pelvis and sacrum to block posterior pelvic tilt and sacral sitting. If necessary, apply a pelvic positioning belt with the angle of pull passing inferior to the rotational axis

- of the pelvis, i. e. at the level of the hip joints.
- Provide lower thoracic support to correct/accommodate kyphosis.
- Adjust spinal alignment over the pelvis to obtain optimal head and neck alignment.
- Provide lateral supports and head support if necessary.
- At follow-up visits, document the degree of hip abduction, popliteal angles and spinal symmetry. If progressive hip subluxation or scoliosis is suspected, then take a hip/spine X-ray.

There exists no one ideal solution for all non-ambulant users. Any prescription for seating a non-ambulant child should thus be a multidisciplinary effort that can help evaluate individual needs, create specific objectives to meet those needs, intervene judiciously with therapy or surgery where necessary and finally prescribe the best-matched product. Regular follow-up in such a combined Seating Clinic, concurrent with patient and caregiver education, are essential for successful seating of a non-ambulant child.

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