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Commercial Options for Positioning the Client with Muscular Dystrophy

by Michael Silverman, C.O.

Before the advent of modern medicine, progressive weakening of the musculature was thought to be due to disorders of the nervous system. Early researchers thought the problem was with the nerves somehow being unable to activate the muscles, which in turn caused the muscles to atrophy. It wasn't until the late nineteenth century that researchers began to understand that these problems were due to the muscles only, without involvement of the nerves.

In 1861 Guillaume-Benjamin-Amant Duchenne, a Bolognese sea captain's son, published the first description of the severe childhood form of muscular dystrophy now known by his name. Specifically Duchenne noted that the disease ran in certain families, and he clearly defined pseudohypertrophy (false overdevelopment) of the calf muscles as one of the disease's symptoms. It was thirty years later that Wilhelm Erb described the underlying clinical features of the various forms of progressive muscular dystrophy and outlined four subvarieties. "Some of the observed features included symmetrical muscle wasting, progression, abnormal gait, a development of charcteristic body deformities. Erb was the first to see that these symptoms were disorders of muscle tissue, not of nerves, and he hazarded to guess that they were due to a complex nutritional disturbance."[1]

Over the last few decades, many categories of muscular dystrophies have been designated. Some, such as Myasthenia Gravis are controllable with simple medication, and do not require special devices other than lightweight orthoses. Others such as Duchenne muscular dystrophy, are progressive and require increasing amounts of specialized equipment to make the disability as manageable as possible. In this paper, the development of specialized seating for clients with muscular dystrophy, as well as new systems on the market today, which can help to make these clients remain as functional as possible for as long as possible, will be reviewed. Below are listed some of the major types of muscular dystrophy whose treatment will often require specialized seating.

Duchenne
(*Pseudohypertrophic*)

Rapid, ultimately involving all the voluntary muscles. Death usually occurs within 10–15 years of clinical onset.

Werding-Hoffmann
(*Infantile Spinal muscular atrophy*)

The earlier the onset, the more rapid the course. Respiratory failure and/or infection usually cause death.

Kugelberg-Welander
(*Juvenile spinal muscular atrophy*)

Variable, but usually very slow. Most patients live to old age.

Amyotrophis Lateral Sclerosis

Rapid, leading to death usually within three to five years.[2]

There are no easy rules for seating the client with muscular dystrophy. The pattern and severity of weakness varies from client to client, and is usually changing so that each client has to be looked at for his individual needs. With the early onset of Werdnig-Hoffmann, specialized seating can be used to help with the prevention of deformities. These children tend to be very floppy. The positioning system will make them easier to handle and put them in a position where they can use their arms and hands to explore the world around them.

The pre-adolescent onset of Duchenne muscular dystrophy will often times lead to extreme curvatures of the spine unless the client is properly managed in a positioning system or orthosis. The advantage of using a positioning system in place of an orthosis is usually that of comfort. The positioning system should provide greater comfort to its user than the use of a wheelchair with a sling seat and back. The orthosis can be a source of discomfort to the user, and for this reason is likely to be left in the closet. "This tendency for the brace to be uncomfortable is understandable because of deformity is a collapsing type of scoliosis and the patient lacks the muscle power to pull away from a painful pressure area."[3] With degenerative forms of muscular disease, **the most important thing a positioning system can do for the client is to aid in increasing his function, allowing him to continue with normal activities of daily life for as long as possible.**

The client with Amyotrophis Lateral Sclerosis (ALS) presents a whole new set of problems for the clinician. Because of the age of onset and rapid progression of the disease, the clinician does not usually have to worry about the prevention of deformity. But these same problems make it nearly impossible to design a positioning system that will provide these clients with comfort and function for any reasonable length of time. Clients with ALS tend to prefer less contoured systems, and require adjustable reclining mechanisms for comfort.

Once the decision has been made that a positioning device may be beneficial, certain questions must be considered and information about the clients' family and home environment must be obtained. Then methods of transportation must be looked into. What is the prognosis of the clients condition? Is the client out with the family occasionally or most of the time? Are the outside conditions rural or urban? What are the client's favorite activities? What are the families needs? Does the family have, or will they be getting a van which would allow the client to be transported in his or her positioning system? How close is the roofline to the clients head while seated in their standard wheelchair? Is powered mobility needed now, or in the future?

An overall clinical evaluation should be made and the results of these tests should be available before any positioning decisions are made. A complete physical and functional evaluation of the client is necessary to determine the extent of the weakness and whether there are any contractures present. Orthopedic considerations add another dimension and may require the input of a surgeon to determine if releases are possible to aid in good long-term positioning. (A consideration with Duchenne muscular dystrophy is the question of a possible spinal fusion.) Any deformities which are present must be noted, as their severity will help further narrow the options for positioning the client. Slight flexion contractures of the hips or knees should not pose a problem for a successful positioning system. However, extension contractures of the hips or ankles could be more of a problem. Remember that a positioning system can serve a preventative role in reducing the formation of contractures and deformities, but the positioning system cannot be used to correct these situations. If correction is needed, it is best done on the operating table before the seating system is provided.

The seating system should allow the client enhanced abilities when using the system. The extremities also need to be looked at in relation to function. Arms must be free if independent mobility is possible; strength must be tested to determine if ultralight bases would be of benefit. The wheelchair is as much a part of the seating system as a headrest or foot support. There are many types of wheelchairs on the market today and the initial evaluation is critical in determining what type wheelchair would best serve the client. For the purposes of this paper, we will concentrate on positioning solutions only.

When deciding on the best position in which to seat a client with muscular dystrophy, it is necessary to start with the pelvis and achieve a neutral position to provide a stable base of support. Standard sling seats provide an unstable surface for sitting, as the pelvis will not sit

Figure 1. A person with abnormal tone becomes more a asymmetrical when seated on a hammock type surface. (A. Bergen and C. Colangelo, "Positioning the Client with CNS Deficits," 1985, p. 7)

Figure 2. A firm sitting surface provides a base for symmetrical sitting. (A. Berger and C. Colangelo, "Positioning the Client with CNS Deficits," 1985, p. 7)

level and forces a lateral compensatory curve up the spine (Figure 1). The pelvis should be in midline and should not be allowed to slide laterally by blocks built into the positioning system. A 90 degree position of hip flexion is desired, and in some cases a back-to-seat angle of less than 90 degrees may be beneficial, especially when introducing increased lordosis into the spinal section. An anteriorly wedged seat will help to achieve a proper hip angle, while assisting to maintain the client in the seating system. The object is not to immobilize, but to stabilize the pelvis.

To complete the base of support for the upper body, the clinician must properly position the lower extremities. An abductor (wedge) will help to position the legs slightly apart giving a wider base of support (be careful not to bring the legs any wider apart than the diameter of the hips.) When using an abductor, keep it away from the groin and make sure it is of the flip-down or removable variety if a urinal is being used. Sometimes the clinician may wish to use an abductor as a reminder of the proper placement of the client in the positioning system, especially when there may be multiple care givers. The knees and ankles should be at 90 degrees unless contractures are present. In many cases the knees may have to be extended slightly in order to clear the front casters of the wheelchair. The feet should always be supported so as to complete the stable positioning of the pelvis. As you can see, a great improvement in seating can be made just by replacing the sling seat upholstery with simple plywood and foam componentry (Figure 2).

Now the clinician is ready to work his way up the spine. The trunk must be held in midline, as close to natural shape as possible to allow better head control. In older clients the natural shape of the spine includes forward curves at the neck and lumbar region of the spine. For the floppy client, as well as those with a scoliotic deformity, lateral trunk supports are usually required. Usually with scoliosis, the pads are placed under the apex of the curve on the convex side, and under the axilla on the other side. The third point of the pressure system is the pelvic held in with good lateral positioners (Figure 3).[4]

With clients who have flexible spines, many different approaches to positioning are used. For the small child with spinal muscular atrophy, allowing the spine to shape into a gentle C-curve may promote the best head position. Increasing the lordosis with these clients may help to push them out of the chair, and cause their heads to fall backward. In the case of adolescent clients with Duchenne muscular dystrophy, increasing their lumbar spinal extension may actually help with the prevention of lateral curvature, as well as promote good head positioning. To understand this idea, one must first understand the mechanism of the spinal collapse in the client with Duchenne muscular dystrophy.

The first sign of spinal instability as demonstrated by roentgenograms (x-rays) is the appearance of a long thoracolumbar curve of less than 10 degrees sent in patients who are ambulating with the aid of long leg braces. During the early wheelchair bound stage, the curves lose their flexibility and they involve fewer vertebral segments, primarily in the lumbar spine, without axial rotation in curves of less than 20 degrees of lateral curvature as measured by Cobb's method. Rotation in the upper segment of the curve, which generally extends

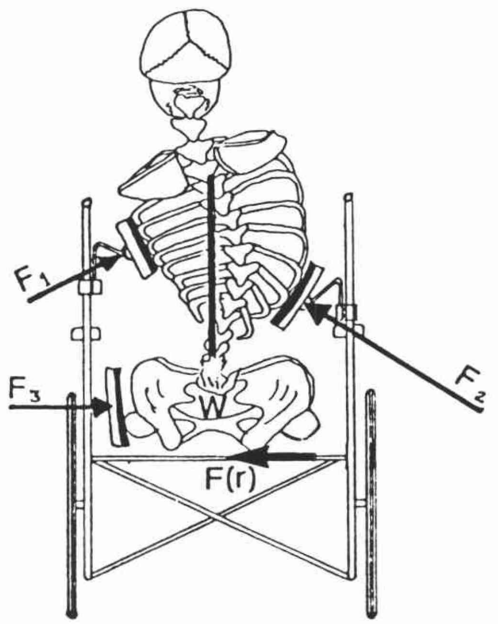

Figure 3. Transverse loading in seating the patient with scoliosis (rear view).

over the bodies of T10 to L3, is followed with maximal rotation at L2 of an estimated 5 degrees. Vertebral rotation then increases at a faster rate than the lateral displacement; and once rotation reaches 15 degrees and the lateral curve 30 degrees, both parameters increase rapidly.

Mr. Jan Koreska and his group at the Hospital for Sick Children in Toronto, Ontario have done many studies of the spine which suggest that if lateral displacement of the lumbar spine is not prevented, axial rotation follows, and by this time conservative bracing is unlikely to succeed since structural failure has already occurred.[5] They also found that the posterior facets and ligaments of the lumbar spine appear to be responsible for the linear alignment of the lumbar spine. The influence of the posterior facets on the upper lumbar spine appears to be less significant, because their resistance to axial rotation is reduced.

"Some 80 percent of the children develop a collapsing type of scoliosis." The observation of 62 spines of boys by the Hospital for Sick Children yielded consistent results. "A few patients' spines gradually became very stiff and somewhat hyperextended over a period of years. When this happens, the patient will be a good sitter for a long time. The more usual pathway involves moving gradually from a straight spine, to a rapidly steady progression into a severe kyphoscoliotic.''[6]

The first seating system developed specifically for prophylactic use by clients with Duchenne muscular dystrophy was developed in the mid 1970's. This specially designed seat was effective in limiting the progression of spinal curves to less than one degree per month in 13 out of 16 patients. The thought was, if spinal deformity could be maintained until skeletal maturity was achieved, good spinal alignment could be maintained. Clients whose curves progressed to greater than 35 degrees would usually ultimately require surgery.

The Toronto Spinal Support System (Figure 4) is made of a fiberglass shell, lined with custom carved ethafoam, upholstered with a modified urethane foam and a tricot double knit covering. Headrests, arm rests and leg supports are attached to the fiberglass shell. The unit is meant to be inclined backward a minimum of 15 degrees. The pelvis is snugly fitted and the thoracolumbar junction extended, while the back has lateral guides to promote midline sitting. ''The snug fit gives the spinal column a stable base (the pelvis), and the extension of the thoracolumbar region reduces the mobility seen when the interarticular facet joints at this level are opened up in flexion. The 15 degree backward tilt reduces the load on the spine every time the patient leans back, while the foam lining makes it comfortable and acceptable to the patient.''[7]

Conclusions from the group in Toronto over the last few years show that although spinal deformity is not absolutely prevented, development is slowed, prolonging the period of trouble free sitting. This slowing down of the development of the spinal deformity takes place at a time when spinal growth is rapid, making the introduction of the system at a young age before puberty of utmost importance. A 10 year follow-up to the development of the Spinal Support System (SSS) sponsored by the Muscular Dystrophy Association of Canada was completed in late 1983. Following are some of the more significant findings.

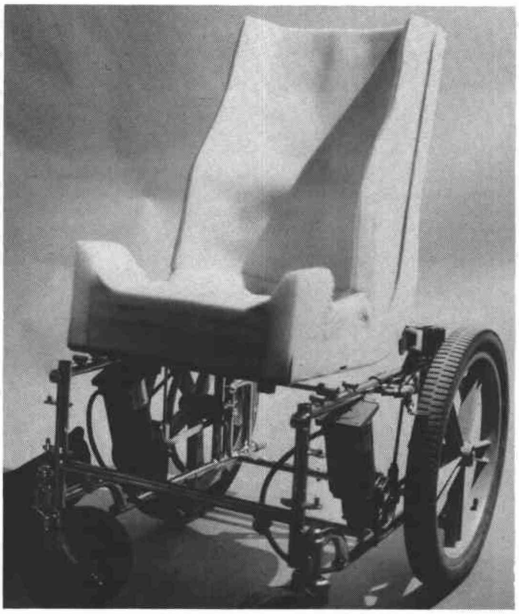

Figure 4. The Toronto Spinal Support System.

1. The Spinal Support System has made a significant contribution to the management of individuals with Duchenne muscular dystrophy across Canada. Improvement of user comfort is the attribute most consistently stated. The SSS development has been particularly well received by parents.
2. The SSS in its originally conceived design does not arrest the progression of spinal deformity. However, reduction in the rate of progression of deformity (1/3 to 1/2) was reported by the participating clinics.
3. From the clinical data available, it was not evident that any one single feature of the SSS is the key to the improvement of spinal management; but rather suggests that there is a combination of multiple interrelated factors involved.
4. There is no clear evidence supporting the hypothesis that extension of the lumbar spine is the key contributor to the lateral stabilization of the spine.
5. Lack of easy adjustment for growth or change of spinal alignment creates serious delays, or the postponement of the necessary revisions.
6. Although biomechanically advantageous, the 15 degree recline of the backrest necessitates that the child lean anteriorly

and away from the posterior supporting surfaces when participating in functional activities or seeking head stability. Only rarely were children observed or reported as using the back and head rest as intended by the designers.

7. The use of prefabricated modular components which results in relatively easy assembly is viewed as a very positive feature of the design concept.

The overall experience with the Spinal Support System was pretty well summed up in a follow-up study completed by a review committee in 1983. "Most of the principles obtained from the SSS study in Toronto have included the importance of the incorporation of a lumbar lordotic pad to maintain the lumbar and thoracic spine in a lordotic position. The concept is, if the spine is going to become fused, or rigid spontaneously, it will adopt a stiff extended alignment rather than collapsing kyphoscoliosis. However, this is the exception rather than the rule. There is no orthotic or seating system in use today, including the Spinal Support System, that will prevent the majority of these children (approximately 90 percent) from developing a collapsing kyphoscoliosis. Even in the few cases (perhaps 10 percent), in which the result is a stiff extended spine, the contribution of the seating system towards that outcome is probably only minimal. Surgery is serious; it must be offered to the patients and parents with full knowledge of potential complications. The patient's pulmonary reserve must be sufficient to withstand the surgery, and hence the disease. The rationale for surgical intervention may be difficult to accept by the parents when the effects of non-surgical intervention are not yet readily evident. If successful, the surgical intervention will stabilize the spine, making the seating problems easier for the management team. However, even when surgical stabilization is undertaken, appropriate seating systems are required, since the patient still requires pelvic support, upper and lower limb alignment and support, head support and mobility. Generally, the Spinal Support System has addressed the problem of development of scoliosis in muscular dystrophy patients. It has decreased the rate of progression, as shown in several studies. However, this may be detrimental to the patients general health because of the progression of the decreased pulmonary reserves. That is, the management team may be lulled into a "wait and see mode," only to find out later that the reduced vital capacities have shifted the balance of risk towards non-surgical management, whereas early surgical intervention would have been the treatment of preference. The use of the modified Spinal Support System in conjunction with early surgical stabilization of the spine may be useful.[8]

The Spinal Support System was a pioneering development at a time when there were virtually no commercially available seating systems or components. Today, the interest in specialized seating is booming, and commitment by manufacturers has led to a variety of systems and components. In this next section, some of the newer systems on the market and how they are used as tools for positioning different types of clients will be reviewed. Also, current methods of seating and their ability to correct a corresponding level of orthopedic deformity will be considered.

In a case where there is no orthopedic deformity, or very little orthopedic deformity which does not present positioning problems, the standard wheelchair should still be modified with a rigid seat insert, or off the shelf wheelchair cushion over a rigid base. The normal folding wheelchair with a sling seat and back does not provide a stable base of support for the pelvis. It is alright when used temporarily, but if it is to be used for any length of time, a firm seat insert is mandatory. Sitting on a sling seat causes the hips to internally rotate, contributes to abduction and usually an oblique pelvis, which in turn causes a compensatory spinal curve. The client with muscular dystrophy will have differential muscle weakening in the spinal musculature, and will almost always assume this position in due time. Therefore, for anyone sitting in a wheelchair for more than just quick trips, the addition of a rigid seat is mandatory.

Most wheelchairs can be ordered from the factory with a rigid seat of either the drop-hook variety, or attached with a special folding mechanism. A firm seat can also be made as a separate piece meant to be placed on an existing wheelchair seat. Those wheelchairs with attached non-removable rigid seats tend to make the folded chair unruly and increase the weight. The separate variety is preferred, but because it is removable, it is often left behind. This problem is usually alievated with the drop-hook seat. After removing the seat upholstery, these cushions have special hooks which clip on to the seat rails with clamps. (The wheelchair then can not be used if the seat is left behind.)

The base of the seat cushion is usually plywood, at least 3/8". On top of the wood, different foams can be used, preferably a high density urethane which will not bottom out over time. In Chicago, we make three or four-inch cushions of two different types of T-foam or Sun-Mate foam which have special weight distribution properties. On the first layer, we use one to two inches of firm Sun-Mate for the base and two inches of medium-to-soft foam on top of that. The cushions are then upholstered with a thin flexible vinyl surface. The vinyl takes away some of the properties of the Sun-Mate foam, but protects the open cell structure against water damage.

Where problems with either boney prominences or an already oblique pelvis are envisioned, the Jay Cushion will provide a stable surface while accommodating these deformities. The Roho cushion provides excellent pressure relief, but may not provide enough stability and encourage leaning. The Roho is best used where pressure relief is the main concern and stability is not a problem, as with paraplegics. This is why an overall clinical evaluation is important as well as an understanding of available products. There are many other commercially available seating cushions on the market, and they must be in stock and tried on the client to determine if one will better fit the clients needs than another. A good place to see all of what is commercially available in this field is at the National Home Health Care Expo in Atlanta.[9] The show is always in late fall or early winter and is free.

For the moderately involved clients with muscular dystrophy, there are also many choices available. More likely they are the type of clients seen. These clients spend almost all of their time in a wheelchair when not in bed, and are in the early to moderate stages of deformity or contracture. Moderate levels of deformity or contractures are measureable, but not enough to create seating or functional problems.

The most widely used method of manufacture for seating devices today is using plywood and foam technology. Here there is a seat and back section, with body supports, pelvic supports, and leg supports bolted on. Many clinicians combine the linear plywood technology with custom carving of blocks of foam (usually ethafoam) to give a custom contoured look. The advantage of the contoured system is that they provide a larger area of contact between the seating system and the client. The Toronto Spinal Support System mentioned earlier is just an advanced version of this method, utilizing component parts such as a preshaped fiberglass shell instead of plywood. It was also one of the first systems to have head rests, arm rests and leg supports specially designed as part of the seating system.

Today it really makes little sense to make an entire seating system from scratch with so many commercially available components on the market. Many companies will actually make the entire seating system based on measurements of the individual client. For componentry and/or complete systems of the non-molded variety, some of the leading systems include those manufactured by Scott Therapeutics, Freedom Designs, Miller's, CRD, Gunnell, and CP seat by Pin Dot Products. Of the contoured modular systems, there is the Winnipeg system, the Otto Bock MOSS System (Figure 5) and the Pin Dot Modular Seating System (Figure 6).

These systems are all designed for "moderately involved" clients who have minimal deformities only, with no rotational deformities. Rotational deformities become more and more evident as lateral deformities increase, and the linear systems (or those contoured with preformed cushions) becomes less and less effective.

The next group with rotational as well as lateral deformities are designated the high moderates or low severe. Two new systems developed recently by the University of Tennessee Rehabilitation Engineering Program work well for this category. The Foam-in-Place seating system (Figure 7) uses a plastic module with an elastic bladder which fits into the chair, and liquid polyurethane foam is measured, mixed and injected into the empty bladder while the client is properly positioned on a pre-ischial strap. The foam rises and within minutes sets up and forms a customized seat or back

Figure 5. The M.O.S.S. system from Otto Bock.

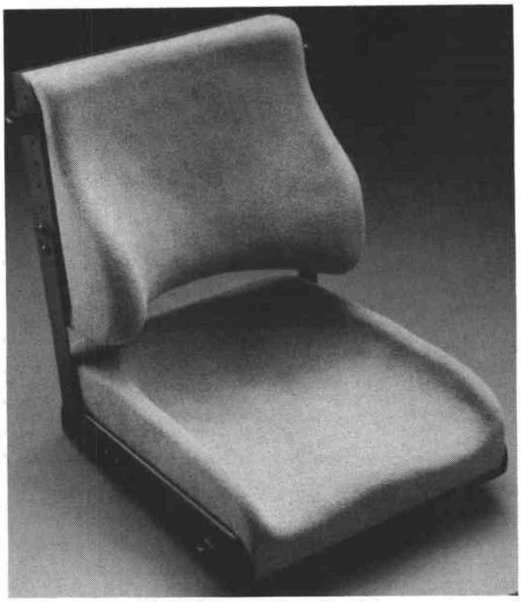

Figure 6. Pin Dot Modular seating system.

cushion. Because the foam takes on the exact contours of the individual, it is possible to accommodate difficult rotational deformities. The difficulties with this system are that the client is forced to sit on a 2 inch wide strap, and be perfectly positioned in a chair while the foam is mixed, injected and set up (about 5 minutes). Even though the foam can shape to the most severely involved, only the high moderates can support themselves or be supported in the proper position under these conditions. Foam-in-Place may be better used for seat cushions only, as they are easier to form and more consistent in their results.

It is important to remember that all of the systems described here should not be thought of as complete systems only, but also as various components. The best way to produce an individualized seating system is to use some of the various components of each system in the best way possible to give the desired result for the individual client. Adrienne Bergen, O.T.R., a pioneer in this field, has used the word "eclectic" to describe those devices made from a variety of components from various companies, and it allows her to best fill her clients needs in the most economical manner.

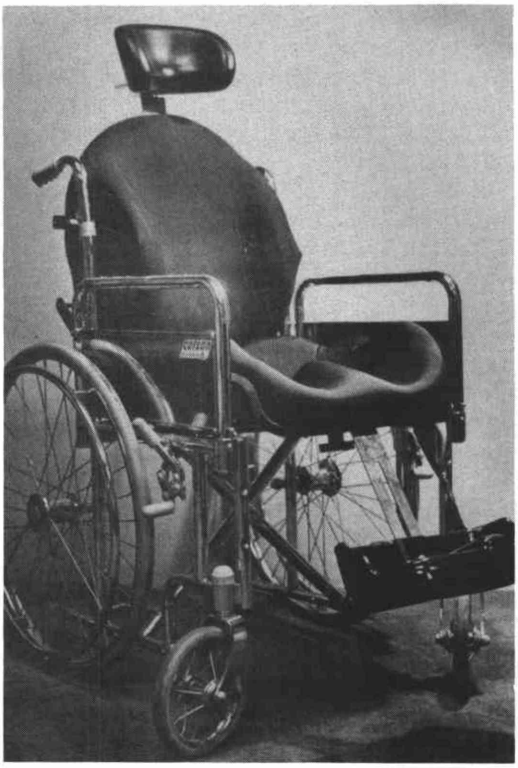

Figure 7. Foam-In-Place seating system.

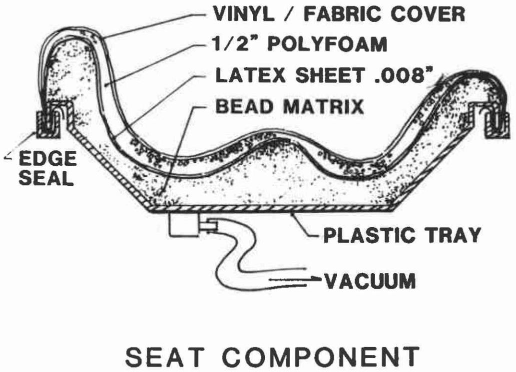

Figure 8. Side view of Bead Seat Technology.

The Bead Seat is another new development from Douglas Hobson's group at The University of Tennessee Rehabilitation Engineering Program, which uses essentially the same componentry of the Foam-in-Place seating system. The difference between the two systems is the filling or "stuffing" in the cushions. In the Foam-in-Place system there is a liquid foam which sets up and forms while the person is suspended over the empty shell. The Bead Seat's "stuffing" is a mixture of a fast setting epoxy and polystyrene pellets (Figure 8). The epoxy will set up two hours after the introduction of the catalyst, locking the lightweight pellets into the form desired. The form is made while the whole system is under vacuum using the dilation method.

Dilation is a molding technique used for more than three decades, and consists of an airtight bag filled with pellets and attached to a vacuum pump. When the vacuum is introduced into the system, the bag compresses against the pellets and holds whatever shape it has prior to the introduction of the vacuum. To change the shape, air is introduced into the bag, loosening the pellets' structure and allowing a change in shape.

The Bead Seat system depends on the vacuum to hold the shape until the epoxy sets up, creating a mechanical bond between the styrene pellets. Once the epoxy has set, the vacuum can be removed and the positioning system completed. The advantage of the Bead Seat over Foam-in-Place is that there is more time available to mold and remold the system, while simulating the finished system, to attain the desired shape. The extra time available for shaping with the Bead Seat allows it to be used with more severely involved clients than Foam-in-Place. This advantage of extra time is also a disadvantage when compared to the Foam-in-Place system, since it takes longer to produce the finished product. Also, when finished, the Bead Seat has a harder surface compared to the flexible surface of the Foam-in-Place cushion. This harder surface may be an advantage with positioning, but a disadvantage when pressure relief is the objective. Bead Seat, as well as Foam-in-Place, will accommodate rotational deformities, but may not be durable enough for the long-term needs of the larger clients because of the plastic framework. For lighter clients (under 100 pounds), the Bead Seat will easily accommodate the severely involved. Another limiting factor of both the Foam-in-Place and Bead Seat systems is that only a headrest system and a simple 90 degree legrest are available as options for customizing the systems, as they are designed to be used with the accessories in the existing wheelchair and this may not be enough for the most severely involved clients.

When dealing with the severely involved, the traditional orthotic approach is the vacuum-formed plastic or Gillette style seating system. Using this system, a mold is taken of the individual by placing the client, prone on a table with the hips flexed to 90 degrees, while a mold is taken using either the dilation method or with plaster bandages. This method of taking an impression is a problem. The mold (or measurements) should always be taken while the client is simulating the final seating position. The effect of gravity on the client cannot be felt when the client is molded in a prone position, and the client's shape may be completely different when upright. It is easy to straighten a client's spine when prone on a table; the problem is that the client may not be able to tolerate this corrected position for long periods of time when upright. This applies especially to the client with muscular dystrophy, who may not have the muscle strength to pull away from a sore area. When one is dealing with a client in the severely involved category, the idea is to correct as much flexible deformity as possible, while making the positioning system as comfortable as possible so the client will be able to use the system for long periods of time during the day.

Other difficulties with the traditional orthotic approach include the time needed to fabricate the finished system and the inability to adjust the system once it is finished. These problems are the same as those encountered when making a sophisticated seating system out of plywood and foam. With the traditional orthotic approach, the finished mold is filled, smoothed and corrected. Over the finished mold, a layer of foam is vacuum formed, then a layer of polypropylene is added. The plastic shell is then trimmed out, set in a box to form a base so it sits in the wheelchair at the desired angle, and upholstered. Time is valuable, and today most private facilities cannot profitably produce seating systems in this manner.

Today, because of the large amount of commercially available componentry, systems do not have to be made this way. Is anybody still hand forging knee joints? Today seating is where orthotics was in the late 50's or early 60's, at the advent of commercially available componentry.

Two newly developed systems work especially well for the severely involved clients; the Contour-U seating system (Figure 9) and the Matrix seating system. Contour-U utilizes the same dilation technology as the Bead Seat, but molds are taken on a specially designed molding frame with rubber seat and back bags filled with polyethylene pellets. Once a mold is taken of the individual in the proper position, plaster splints are worked into the mold to give a positive impression of the client. The molds are then turned into flexible upholstered cushions on a central fabrication basis, designed to eliminate the shop time needed for fabrication. The finished seat and back cushions snap into aluminum hardware, which also has the ability to be angularly positioned (both back-to-seat angle and recline orientation), and adjusted for length. This system accepts a wide variety of accessories designed to accommodate even the most severely involved client properly. The system is not labor intensive, but can be expensive, especially when used with the many accessories available.

As clinicians, knowledge of patient priorities should be uppermost. Don't use Contour-U when a Bead Seat will do. Don't use a Bead Seat where a Jay cushion will do the job. Think eclectically for the patient. Contour-U cushions with plywood and simple componentry can be used to create an inexpensive, custom molded seating system. For another client, a Bead Seat molded back and a Foam-in-Place seat may be the best solution.

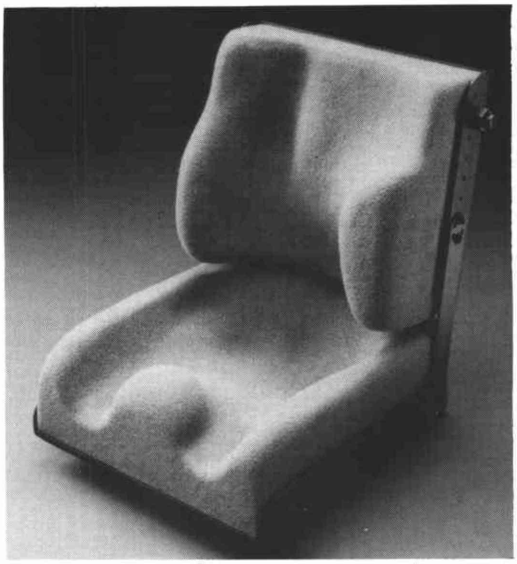

Figure 9. Contour-U seating system.

Another advancement in seating developed in Vancouver and now manufactured in England is the Matrix system (Figure 10). The Matrix takes an altogether different approach by providing a flat sheet of locking ball joints which can be contoured to almost any shape and locked into that position by individually tightening the ball joints.

Essentially, a sheet of material into which tucks can be taken and contours formed, Matrix can be fabricated to position somebody in any position desired. A nice feature of the Matrix is that it can be loosened and reshaped when necessary. Also, where growth is expected, the matrix can be extended by just adding a row or two of modules. The disadvantage of this system is in the time required to produce the finished product. Anywhere from 15 to 25 hours is necessary, which puts it into the same category as traditional orthotic seating systems. Fortunately, Matrix fabrication is also available on a central fabrication basis.

Some may consider the Matrix unattractive, but its high tech design also makes it airy, lightweight, and waterproof. The Matrix fits in well with the eclectic approach, as pieces of the material may be used for a custom head rest or

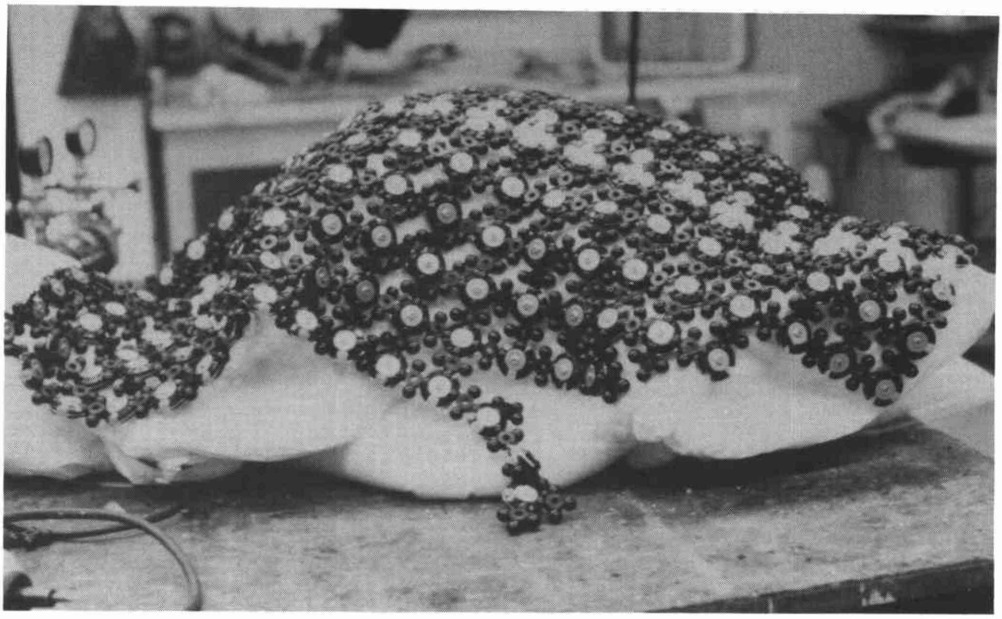

Figure 10. Matrix seating system.

arm trough when needed, making a whole system out of material unnecessary, unless preferred for the client.

These are brief descriptions of some of the newer systems on the market today. Information is available from the manufacturers to learn the benefits and weaknesses of all these systems (see suppliers list). The idea is to best provide the client with a product which, individually, does what is required for the most economical price. Having a variety of systems at our disposal, as well as the ability to custom fabricate components when necessary, will allow us to provide the best service to our clients and establish our facilities as specialists in this expanding field.

In Chicago, we have done just this by establishing the Chicago Seating Institute. At the facility, we specialize in proper positioning of clients, while providing various styles of seating systems, wheelchairs, and environmental controls. In the future, we hope to expand our field of expertise to include communication devices as well. Over the last few years, the development of the specialized seating side of our business has increased our volume from 12–15 clients a year in 1981 to 150–200 clients a year today. In no other area of our business could we have expected to see a ten fold increase in the number of clients seen, even with the same commitment made as we've done for specialized seating. The field of specialized seating is up and coming, not only for the orthotist, but the prosthetist and other allied health professionals as well.

Unfortunately, traditional education for specialized seating is not available. However, there are some programs and seminars offered, with increasing frequency in the past few years. Watch the upcoming issues of the American Orthotic and Prosthetic Association *Almanac,* or contact The Association for the Advancement of Rehabilitation Technology (RESNA) at Suite 700, 1101 Connecticut Avenue, Washington, D.C. 20036; (302)857-1199. Historically, as with orthotics and prosthetics, the best and only real way to learn, is to learn by doing. See your clients, and learn from making systems for them. This hands-on method is the best teacher for seating, because you can watch the clients expression to know if they are comfortable. The "cookbook" approach with easy rules just doesn't work here, since people do not demonstrate this reflex or that reflex, this deformity or that deformity, but a hodgepodge of various reflexes, deformities and contractures. Add to this, differing age groups, backgrounds, living conditions, and mental abilities, and the cookbook method becomes impossible. Have a variety of solutions at your disposal. Think of the client as an individual. This education will help you understand your clients discomforts and needs, and with the help of a therapist, decide on realistic attainable goals. With this in mind, there are many ways to achieve the desired results of functional (where possible) and comfortable (always possible) seating for clients.

REFERENCES

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[7] Gibson, D.A. and Koreska, J., "The Management of Spinal Deformity in Duchenne's Muscular Dystrophy," *Orthopedic Clinics of North America,* Vol. 9, No. 2, April, 1978, p. 440.

[8] Hobson, D., Desrosier, F., Beauchamp, R., and Martel, G., "The Spinal Support System and Other Approaches to Specialized Seating for Duchenne Muscular Dystrophy Patients—A Review Report," The Muscular Dystrophy Association of Canada, November, 1983.

[9] National Home Health Care Expo, Atlanta, Georgia. Call (305)773-2222 for details.

SUPPLIERS

BEAD SEAT
Pin Dot Products, 2215 West Belmont, Chicago, Illinois 60618. (Developed by The University of Tennessee Rehabilitation Engineering Program.)

CP SEAT
Pin Dot Products, 2215 West Belmont, Chicago, Illinois 60618. (Second generation of the MPI seating system developed by The University of Tennessee Rehabilitation Engineering Program.)

CONTOUR-U SEATING SYSTEM
Pin Dot Products, 2215 West Belmont, Chicago, Illinois 60618.

CRE
Creative Rehabilitation Equipment, 513 NE Schuyler, Portland Oregon, 97212.

FOAM-IN-PLACE SEATING SYSTEM
Carapace, Inc., P.O. Box 45040, Tulsa, Oklahoma 74147.

FREEDOM DESIGNS
Freedom Designs, Inc. 18165 Napa #8, Northridge, California 91324.

GILLETTE SEATING SYSTEM
Gillette Childrens Hospital, Orthotic Department, Minneapolis, Minnesota.

GUNNELL
Gunnell Manufacturing, 221 North Water Street, Vassar, Michigan 48768.

JAY CUSHION
Jay Medical Ltd., 805 Walnut, Boulder, Colorado 80302.

MATRIX SEATING SYSTEM
Pin Dot Products, 2215, West Belmont, Chicago, Illinois 60618. (Developed by Clinical Engineering Designs, Kingston upon Thames, England.)

MILLER'S
Miller's Rentals and Sales, 284 East Market Street, Akron, Ohio 44308.

MOSS (Modular Orthotic Seating System)
Otto Bock Industries, 4130 Highway 55, Minneapolis, Minnesota 35422.

PIN DOT MODULAR SEATING SYSTEM
Pin Dot Products, 2215 West Belmont, Chicago, Illinois 60618.

ROHO CUSHION
Roho, Inc. P.O. Box 658, Belleville, Illinois 62222.

SCOTTIE SEATING SYSTEM
Scott Therapeutic Designs, 430 Robertson Lane, San Jose, California 95112.

TORONTO SPINAL SUPPORT SYSTEM
The Hospital for Sick Children, 555 University Avenue, Toronto, Ontario.

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