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This Issue

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Clinical Prosthetics & Orthotics

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Spina Bifida . . .

From the Editor

This issue of *C.P.O.* differs in tone from past issues. The Cuchnas' are a family, one member of which has spina bifida. Obviously they do not write with that measure of objectivity and detachment that is commonly considered appropriate for a journal of *C.P.O.'s* mission. It would, however, be illogical and contrary to reason to expect them to.

As a family and as individuals, they demonstrate that intangible element that we so frequently find ourselves exhorting from our patient: commitment. All of us at one time or another have found ourselves saying to a patient "You are the one that has to wear this prosthesis/orthosis. Only you can make it work for you." Obviously, the Cuchnas have decided to make it work for them.

It was decided to publish the Cuchnas' contributions in this issue, devoted to Spina Bifida, as a reminder that we must constantly remember that the patients we see are not just an extremity or trunk in need of a prosthesis or orthosis. Rather, they are individuals who function in larger contexts and have needs and concerns that cannot simply be addressed with a device. Upon behalf of myself and the members of the Editorial Board of *C.P.O.*, I wish to thank the Cuchnas for taking the time and effort of writing when asked to by John Billock, CPO.

Lead Articles

The Parents Experience

by James R. Cuchna*
Anna Mae Cuchna

A new birth . . . another miracle . . . a baby is born . . . but why is our baby not made perfect like our friends and relatives? Life began, but it was not surrounded by complete joy. We were confronted with the inevitable—"Your child was born with spina bifida. She will, probably, live no longer than a week." We were asked, "Do you want to put her in an institution or leave her in the hospital?" Try to imagine the feeling that would rush through your mind at the onset of this occasion. It is unbelievable.

Our immediate and only reaction was to take this child and love her just as if she were born "perfect." We accepted our daughter and were determined to treat her as if nothing was wrong. We had faith that God would help us through the problems we might encounter. This happened on March 21, 1966.

Today, Cindy is 18 years old and is entering her first year of college. We also have a 17 year old daughter and a 9 year old daughter. We feel we have been richly blessed.

Even though our first child was the one born with a physical problem, spina bifida, we really don't feel she has ever been "the problem." Society in general . . . everyone else's opinion, the medical profession, the people in government passing legislature, etc. are "the problems." Everyone thinks they know what "life is going to be like" for these children, what a "burden" they will be on the family. These statements infuriate us.

Having had other children helped us substantiate our thoughts and feelings that a child born with a physical problem is "no different" than a child born "normal." We have had to deal with medical problems, hospital stays, doctors visits, etc. with all our children—maybe not as many problems as with Cindy, but, all have been traumatic for us. We have also had parents

*Mr. and Mrs. Cuchna reside in Ohio and are the parents of Cynthia Cuchna.

inflicted with cancer and have cared for them. To us, life is what a person makes of it. It is the positive attitude that surrounds any child or person that is so important. One can only try to make the best of things and live each day to the fullest.

We are concerned for the babies that have doctors who perceive spina bifida as a dreadful defect/disability and make the decision of whether to treat or not. Cindy was not treated at birth but survived. Thoughts arise as to what more she could do had she been treated. Would her degree of paralysis and the kidney damage be less severe? We'll never know. Some doctors hesitate on treating babies born with spina bifida, but wouldn't give a second thought to treating victims of automobile, industrial or other accidents even though the outlook may be very bleak. An example of this is the president's aide, James Brady. What makes the difference?

Another concern lies in the high cost of the medical supplies and equipment she will need the rest of her life. It doesn't seem fair that urostomy bags bought 11 years ago cost $13.95 and today are $42.50, that a set of full braces is $5,000 or more, that a wheelchair is over $1,000, that vans with lifts are $20,000, or that urine analysis that were $2.00 are now $10.00. Most of the people with physical problems have limitations in job opportunities. Very few will be able to hold high paying jobs. Where will the money come from to pay for their needs?

Some places now want the money first and then they will bill your insurance. Where will she get the start to save money when she needs something? What happens when our 80 percent group insurance coverage lapses because she is an adult and then she cannot get insurance of her own because of her medical/physical involvement?

Cindy feels good about herself and has accepted her handicap. She realizes that she has limitations but that these should not preclude her from being able to achieve the goals she sets. The fact she is paralyzed from the waist down and requires orthopedic bracing brought Cindy to the realization that she would have to work very hard for what she wants very early in life. She knows that nothing is going to be handed to her on a silver platter and does not think that she deserves special treatment because she is "physically challenged." All she wants is an equal opportunity to contribute to society and earn her way.

Cindy has been a constant source of strength, love, and courage for us. As we watch her grow and see her achieve, our admiration for the child/young lady/soon-to-be woman grows. We truly believe that we have been more dependent on Cindy than she has been, or ever will be, upon us.

We have been very fortunate in having benefitted from the professional services of very dedicated, talented, competent, and caring people in the areas of medicine, education, and orthotics. Yes, there have been differences of opinions between themselves as well as with us. There were goals that took longer than anticipated to be reached. But, can't we all say this happened to us also in our "normal" lives.

It is one of our dreams and goals to see more medical professionals get involved with the National Spina Bifida Associaion of America and its local chapters. We don't need people to be afraid of spina bifida. We need help to spread a positive image, to achieve the establishment of a hospital for research and for the needs of all people with spina bifida. People need to know that children who are physically challenged don't need sympathy and things done for them. What they need is the opportunity to live, learn, grow in love and be loved—just as we all do.

A Personal Experience

by Cynthia L. Cuchna*

Most people would say, "It would be terrible to be born with a birth defect." Well, I know firsthand that it really isn't so terrible. I have been blessed with family and friends who have not let me feel that my disability should get in the way of reaching my goals.

My parents have never let me use my handi-

*Cynthia Cuchna was born with spina bifida on March 21, 1966. Now she is 18 years old and is entering her first year of college.

cap as a way of getting out of responsibilities. I have the same responsibilities around the house as my sisters and if I don't take care of them I am equally disciplined just as my sisters would be if they didn't do their share of the work. I feel my oldest sister, Sherri, has helped me the most in believing that I am just as capable as anyone else in doing things for myself. If I would ask her to get me a book or a glass of water or something, Sherri would probably say something like, "Get it yourself, you aren't helpless!" I wouldn't want it any other way between us.

People have asked me if I feel my sisters are allowed to go more places and do more things than me. I don't feel that I've missed out on any of the experiences my sisters have had. I go to football games, movies, go shopping, and go to the local disco just like my sisters.

The only problem I have is that most of my friends live too far away from me to just "drop by" whenever they feel like it. My friends are my classmates from the high school I had to attend, which is outside my local school district and is the only school in the county capable of handling my special problems. We can't even call one another very often because it is long distance.

Hospitals have been a vey important part of my life, since I was in and out of them quite frequently when I was young. I never really minded going into the hospital because the doctors and nurses were always nice and I knew they would take good care of me. Along with hospitals comes bills. Our family has never been eligible for financial aid because my parents always made "too much money." I know that at times it has been tough for my parents to make ends meet because I am such an "expensive kid." Sometimes I feel guilty about having my parents pay such big bills just because of me.

I have been in braces ever since I was four years old. I know that they have helped me considerably, but I often have negative feelings about my braces. There was a time when I was unable to wear my braces due to pressure sores. I like being out of them because my clothes weren't torn by the locks on my braces and I liked getting dressed faster. I thought I looked prettier without all of that plastic and metal sticking out of my clothes. I am finally starting to realize that I look better in them because they make me straighter. I don't look like I'm a "pretzel" when I'm in them. I have greater mobility in them, which enables me to do things and go places that I couldn't in my wheelchair. Even though the negative feelings may resurface in the future, I plan on wearing my braces a lot more than I have for the past two years.

When I go out to a movie or go shopping, sometimes people stare at me. This has never really bothered me. It just shows me that they are interested in my disability and are curious to see how my braces, crutches and/or wheelchair works. I especially like it when little children come up to me and ask, "What happened to you?" I am glad that children aren't afraid to ask questions. I wish that adults would open up and ask, because I would be more than willing to tell them about anything they would want to know.

My plans for the future are to graduate from college with a degree in psychology. I think that I would like to be a school psychologist because I love children. I know that the road ahead will have some rough spots, but I know that I can make it with the love and support of my family behind me.

A Need for Information

by Kent Smith

April 6, 1971. My wife and I were eagerly anticipating the birth of our second child. I accompanied her to the hospital in suburban Chicago. It had been a normal pregnancy, much like the pregnancy two years earlier when our daughter was born. Shortly after midnight the joyous moment arrived. The doctor came to the father's waiting room; he was not smiling. Our son was born with a birth defect known as spina bifida. As we look back on that moment, we've realized how much the birth of our son Stephen has affected our lives.

As a news writer/producer for a major television station in Chicago, I had access to a great deal of information. I had been trained to ask the right question, investigate the story thoroughly, and report both sides equally.

My wife had received her education in library science and enjoyed the research involved in establishing a library and developing good reference systems. Nowhere in our professional experience had either of us come across information on the birth defect spina bifida, nor were we to realize how difficult it would be to get the information that should be so readily available to new parents of a spina bifida child.

Parents find themselves very vulnerable after having given birth to a child with spina bifida. The hospital and medical staff appeared intimidating. We knew little about birth defects in general and nothing about our own child's specific needs. We looked to the "experts" whom we hoped would help.

Our first attempt to get information was through the local chapter of the March of Dimes. Their personnel were courteous, sympathetic to our needs, but could not answer specific questions on how other families were coping with a child with spina bifida. We tried to gain understanding on a variety of terms. How did it affect our Stephen? Were we unique with this problem? What was the outlook for our son's future? Those questions went unanswered, although we did receive some pages copied directly from a well-known book on birth defects.

Good friends stood by us trying to provide a sympathetic ear. They couldn't answer questions, but wanted to do the best for our family, even encouraging us to look at places where our child could be placed and be raised in a loving atmosphere; then we could go on with our own lives. This only frustrated us, for we wanted to help our son, who—by some quirk of fate—had problems that we knew were serious but we didn't understand. He was part of our family and we wanted to provide him with the best medical care available.

As parents, we had to depend on others for guidance. The most obvious person to turn to is the family physician. Clearly, new parents of a disabled child need information on the disability and its treatment, as well as the names of agencies and support groups available to assist the family unit. Other parents who have faced the same situation can share their knowledge and give comfort and assistance.

My wife and I were steered to a support group of parents and adults with spina bifida. This group met every month at the hospital. Our physician had been working with this parent group. Although he could not share the parental experience of raising a handicapped child, he respected the support that was freely given by parents "sharing their experiences." From our point of view, it was the best medicine that he could provide. It gave us hope that our son might make advances similar to other children.

Information is the key to knowledgeable parents raising their children with spina bifida. My wife and I became active in this parent support group to learn more about the birth defect. From those adults with spina bifida we learned some problems they had faced and how we could help our son.

Our involvement with a national organization

wasn't something we planned, it evolved. In 1979, I was asked to establish a central office to provide information to new parents and be a resource to chapters consisting of parents, adults, and professionals in many cities. Under a letter of agreement with my employer, the American Broadcasting Company, I took a year's leave of absence to establish the office. I've never gone back to ABC.

The leadership of Spina Bifida Association of America (SBAA) comes from the active participation of adults with spina bifida and parents working together. When SBAA was formed as a volunteer group in 1972, the greatest need was to provide printed information written in lay language. Today, the Association has 11 booklets directed to educators, new parents, adults with spina bifida, and to children. As a journalist, I was able to work with the writers in developing a distribution system that now has over 50,000 pieces of literature circulated each year.

One concern we have is the misinformation that others continue to tell new parents regarding the current treatment or the lack of potential of people born with the birth defect today. In 1979, the SBAA established a policy that encourages early evaluation and medical/surgical treatment of every infant with spina bifida, and recommends that the evaluation be performed by professionals experienced in that care and treatment.

Improved medical treatment within the last 25 years minimizes the disabling effects of spina bifida. Recent statistics from major treatment centers in New York, Pittsburgh, Chicago, Seattle, and elsewhere indicate that approximately 90 percent of those infants born today with spina bifida can lead a competitive life with some adjustments for physical disabilities.

The majority of infants who receive aggressive treatment early do not suffer mental retardation. Lack of bowel and bladder control can be dealt with and should not take the "opportunity for life" away from the child. Some amount of paralysis often occurs, but the degree of involvement varies widely and cannot be determined at birth.

The SBAA also sponsors an Adoption Referral program which offers a viable alternative to parents who feel unprepared to raise a child with a disability. The program has placed 70 babies in loving homes and has a waiting list of parents willing to take infants with spina bifida.

During these last five years I have met hundreds of parents with similar stories, all with a commitment to provide information to a new parent who, like each of us, needed someone or some group to answer questions. The adults with spina bifida hold challenging jobs, and in general make worthwhile contributions to society. They have devised innovative ways in which to overcome their disabilities. Each represents a realistic goal which our child born with this birth defect can hope to achieve.

If you would like further information on Spina Bifida and our Association, please call 1-800-621-3141.

What is Spina Bifida?

by Jeannie Gruse

I have chosen to do this report on spina bifida because of little Stephen Smith, a happy, loving, well-adjusted boy, who was born thirteen years ago with this condition. Stephen's parents are friends and neighbors, and I well remember the day that Kent came over to tell us about the birth of their first son.

When he described their handsome baby boy, and then explained that he had a birth defect called spina bifida, I had no idea what he was saying; I had never heard of this condition. Pam and Kent knew very little at that time, either, but in nine years of surgery, emergencies, difficult care, exercising, training, and learning, this has certainly changed for them. Kent is currently the Executive Director of The Spina Bifida Association of America, dedicated to "making the public, professional and all governmental agencies more aware of this worldwide health problem and assisting parents in helping their children." The program is also directed toward improving comprehensive medical care for children and adults with spina bifida, and expanding research programs which will search for the cause of this birth defect.

Spina bifida is a serious condition, and until thirty years ago, few babies born with it survived beyond infancy. The treatment techniques

developed within the last two decades make it possible for the majority of these children to grow to adulthood and live happy, productive lives in spite of their disability.

Spina bifida is not a new birth defect; it was referred to 2,000 years ago, and was described by a Dutch physician, Nicholas Tulp, friend of Rembrandt, in 1652. The technical terms, spina bifida aperta or spina bifida manifesta relate to a structural defect caused by failure of the neural plate to develop into a tubular structure. In the area where this occurs, the defect is technically referred to as myelomeningocele (G. myelos = marrow; meninx = membraine; kele = hernia). In development, plates of bone fail to close over the defective area of the spinal cord and there is a short spine on each side of open spinal cord rather than a single one in the midline, therefore the term spina bifida. If the bony plate does not close over the spinal cord during infancy, this defect is referred to as spina bifida occulta (hidden). This type generally causes no problems.

The newborn baby will have an obvious lump or cyst-like lesion on the back. It may be covered with skin, or more often wholly or partially covered with translucent bluish or white membranes. There may be a flat plate of imperfectly formed spinal cord on the surface of the cyst which may be leaking cerebro-spinal fluid.

While there are many claims or suggestions of causes of spina bifida, it is generally considered to be caused by an unknown environmental agent interacting with genetic factors, according to Dr. Swinyard, Stanford Unversity authority on spina bifida. Multiple complex problems presented by newborns with spina bifida have discouraged some physicians from applying the available intensive medical care and technologies to preserve lives of the more severely defective newborns. A number of physicians have advocated strongly that such treatment be withheld from newborns, presenting certain criteria with the expectation that these babies would soon die. This presents serious moral and legal problems, obviously, relating to rights of the children and the rights of parents to make such decisions, and since the predictability of death is quite uncertain, those who survive may have unnecessarily serious and lasting damage.

There are many problems associated with spina bifida besides the obvious surgery necessary, often immediately, to correct the condition. There is loss of awareness of touch, pain, pressure, and heat or cold in those areas of skin normally innervated by nerves involved in the spinal cord defect. There is muscle weakness in the lower limbs and lower trunk, the latter often resulting in weakness in muscles of the bladder and bowel, preventing normal control.

Nearly 70 percent of infants with spina bifida develop an associated defect known as hydrocephalus, causing a rapid enlargement of the head from the abnormal accumulation of fluid inside the brain. Although it does not occur in all of the infants, this problem is potentially a life threatening one which requires prompt attention of a neurosurgeon, and even then may often result in varying degrees of brain damage.

The degree of severity of these conditions associated with spina bifida varies widely. Some children will be able to walk without assistance, others may need braces or a wheelchair. Because spina bifida is such a complex condition, these cases are usually referred to a pediatric neurosurgeon who is part of an organized team. He will decide on the surgical closure of the myelomeningocele, carefully watch for signs of hydrocephalus, and be responsible for the management of this condition if it occurs.

Development of hydrocephalus would involve a serious neurosurgical emergency, as severe brain damage or death could result from the pressure of the fluid within the brain. A shunting procedure is used to reduce this condition, which consists of inserting one end of a flexible tube into a brain ventricle and passing the tube through a small opening in the skull. It is then passed underneath the skin from the head, either to the heart or to the abdomen, and includes a one-way valve which prevents the backward flow of spinal fluid. Even this procedure, a vital one to prevent pressure on the brain, is not totally free of dangers, as shunts can be obstructed or collapse, and revision is often necessary. However, it is the best procedure, and the only effective treatment currently available to allow the brain to develop more normally.

Besides the neurosurgeon, spina bifida children will be seen by a number of different specialists. A urologist may be necessary to control urinary infections, and to keep the lack of bladder control from becoming a problem. The pediatrician will watch the child's general health and work on management of the problems relating to lack of bowel control.

The orthopedic surgeon will have as his primary concern the growth and development of the bones and muscles. Children with spina bifida often have hip dislocation, club feet, scoliosis, kyphosis or lordosis. He will suggest

surgery, braces or crutches when needed. An orthotist will fill the surgeon's prescriptions and work with the child as he grows. In conjunction with the orthotist, a physical therapist will also help carry out the plans made by the orthopedic surgeon and will suggest others designed to strengthen weak muscles.

Finally, an occupational therapist may also aid in carrying out the physician's suggestions. She will work primarily with motor coordination and preceptual-motor impairment, and will assist in helping the child adapt to his physical environment in activities. Even with all of these trained experts' help, it is obviously the parents who are chiefly involved in the daily training and care of spina bifida children.

I feel fortunate to have been involved, along with my daughter, friends, relatives, and church member volunteers in a program of "patterning" with little Stephen a few years ago. The theory of the program was that an infant's ordinary body movements stimulate brain development through sensory-motor input. Gradually the child's movements become coordinated in cross-patterned crawling, creeping, and walking. By stimulating the body in various ways it was hoped we could "wake up" and condition the pathways to the brain and activate the millions of unused cells within the brain. The method involved artificially recreating patterns of movement in hopes of reaching the brain and having the brain take over these same movements on its own. With three people helping three or four times a day, we helped Stephen and his mother go through his prescribed exercise schedule according to the training his mother had previously received.

While some individuals with spina bifida have average or above average intelligence, those who also have hydrocephalus may, as a result, have some degree of mental retardation. The best school placement and curriculum planning will depend also upon physical limitations. The main consideration is that the child be placed in a flexible situation for effective learning.

Since many spina bifida children do have learning problems, teaching must be individualized, based on strengths and weaknesses. This may be possible in a regular classroom, mainstreamed partially, or in a self-contained situation, depending on the severity of the physical condition and the extent of the learning disability.

When Stephen was nine years old, he was completing first grade work, and beginning second, at the Fullerton School, in Addison. He was in a structured, protective environment with reinforcement of one full-time teacher and an aide to six or seven students; this was a self-contained room called Orthopedic-Learning Disabilities, with mainstreaming for music and art.

Having spina bifida means different things to different people. The actual physical condition varies greatly from person to person. How a person manages in life depends not only on the severity of the actual physical condition, but also upon the support he gets from others, the adaptations in the environment, and most of all, how the person feels about himself. With the tender, loving care and dedication of parents such as Pam and Kent Smith, spina bifida children like Stephen have a chance to grow up, able to cope with their own limitations, and to manage very well in life, feeling good about themselves.

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Editorial

Orthotic Philosophies of Treatment

by Wallace Motloch, C.O.*

In situations when a medical condition places a physical limitation on a growing child, the orthotic treatment and devices are aimed at minimizing that limitation. Through the combined knowledge and skills of the orthotist, medical team, and family, as well as the child, the orthotic program maximizes that child's assets.

To illustrate how the various aids and braces work within the orthotic program, one can compare the developmental milestones of a child with normal body to that of a child with spina bifida (Figure 1). As the developmental need for sitting, crawling, and ambulating is encountered, an orthotic device is introduced to the spina bifida child who cannot accomplish these tasks well. Depending on the availability of funds and clinical resources, the orthotic care may start at infancy with the fabrication of devices for safe handling of the newborn, modifying equipment for play, bathing, and safe transportation. The orthotic involvement continues for the rest of that person's life as various braces for ambulation, support of the spine, contracture management, and general development of a lifestyle are designed and manufactured.

As the children progress from one developmental milestone to another and their needs change, so must orthotic devices. Often these needs overlap, calling for a "wardrobe" of devices (Figure 2). To illustrate this point let's imagine a person developmentally ready to crawl. To accomplish such exploration safely one will best be served by a wheeled device called a Caster Cart. While the Caster Cart is not a brace per se, it provides a vital part of the program by helping in a way that no brace or wheelchair can. It allows the child to move around safely, positions him close to the floor, allows for retrieving playthings from the floor, and it aids in "hand-free" sitting.

Even though the Caster Cart has so many advantages, many parents are hesitant at this juncture, primarily because they imagine braces or some other bionic devices as restoring greater normalcy to their children. The orthotist must be very aware of the great pressure that drives the parents. They are desperate to do something! They are anxious to get the child into the best braces. They want to see the child up and ambulating. They want to see what it will be like—and that is the most normal behavior of any person. The orthotist must be compassionate at this point. He must know the dynamics of this situation. This is the most crucial moment in the parent-orthotist relationship; it will set the stage for many future meetings and achievements.

Having seen several hundred Spina Bifida children and their parents go through this stage, personally I believe that not one but three devices are in order: a Caster Cart, Standing Brace (It should be pointed out here that the name "Standing Brace" is a misnomer as the device facilitates much more than standing), and Parallel Walker. The reason that this combination works the best is that crawling is very quickly followed by standing and ambulation. Oftentimes these are not demarcated clearly, and as the functions are accomplished, the devices continue to be used in an overlapping fashion—so why not have all three at once and let the child dictate the progress. While the actual design of braces can vary at this stage, as long as the child is upright safely and can stand "hand-free," the purpose is achieved.

As the child gets older (two to three years), another crucial bracing decision has to be made.

*Wallace Motloch, CO is the Director of the Center for Orthotic Design, Inc.

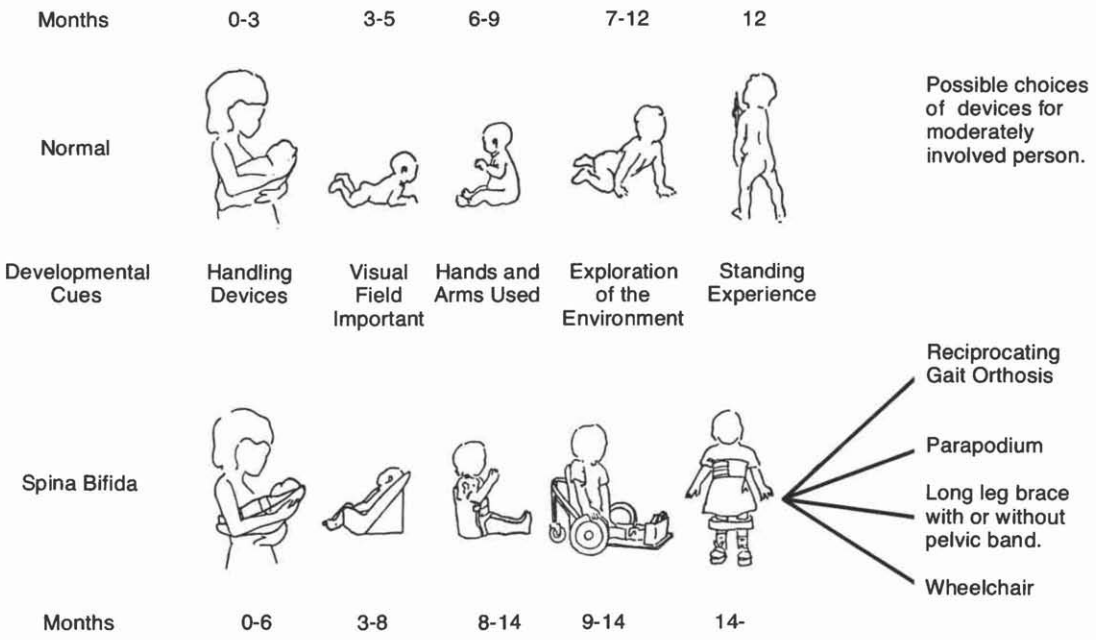

Figure 1. Comparison of the developmental milestones of a normal child to a spina bifida child.

It has to be decided if the child is capable of ambulating with a reciprocal gait (one leg in front of the other) or whether he/she must ambulate by swing-to, swing-thru, or pivoting. It has been my experience that whenever possible the Reciprocal Gait Brace (Dual cable type) should be considered, as it has particular importance for the Spina Bifida person. The Reciprocating Gait Brace (RGB) is a dynamic orthosis unlike any conventional device made. It provides:

Standing Balance and Support: Wearers can have their hands free for activities of function while standing.

Automatic Hip Joint Locking: This provides for ease of locking the brace with hands on crutches or walkers.

Efficient Ambulation: Compared to conventional orthosis, RBG was tested (distance walked with same increase in heart rate) to be two to three times more efficient. This saves energy for people with muscle weakness, and for people likely to gain weight, it encourages more physical activity.

Dynamic Hip Reciprocating: The special hip mechanism couples the hip joint motion so that flexing of one side causes forced extension of the opposite side (a mechanical hip extensor). This function facilitates walking, but in people prone to hip flexion contractures it also stretches the hip contractures with every step.

Around the age of ten another crucial decision comes up: the use of the wheelchair. There are many reasons for this. A few are: lack of physical strength for ambulation, cosmetic appearance and peer pressure, ease of assistance from others and general convenience of getting around. Many people with Spina Bifida find that ambulation in braces becomes quite energy consuming and that in the school setting in particular, it makes the carrying of books inconvenient. Many slowly, but surely, drift to greater use of the wheelchair. They find that their shorter stature in braces doesn't serve them as well as the sitting posture in a wheelchair. Also, it is harder for them to get help from others now that they are bigger and heavier. When need for assistance arises, say to go up ten steps, it is

Figure 2. Wardrobe of devices for a child who is ready to stand and ambulate (brace and walker). At the same time, the child retains a Caster Cart for exploration and Body Jacket for support of collapsing spine.

harder to help a brace wearer than a wheelchair rider. In any case, because many people choose a wheelchair in addition to, or instead of, braces, the orthotist stays involved in design and fabrication of special pressure sore prevention aids like contoured seat cushions and Suspension Body Jackets.

Unfortunately, for many spinal cord injured teenagers and adults we do not have braces that can compete effectively with the wheelchair's efficiency and convenience. As things are, while there are a fair number of devices to choose from for the under-ten-years-old group, the choice is very limited for the older group. Much more ingenuity and research is needed to develop designs that will prove useful to the latter group.

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Technical Article

Orthotic Maintenance Program for the Myodysplastic Child

by Terry J. Supan, C.P.O.*

The faculty of the Southern Illinois University School of Medicine has been actively involved in a comprehensive, multidisciplinary approach to the management of the myelodysplastic child. Since the establishment of the orthotic clinic in July of 1982, a systematic approach to the orthotic-physical therapy needs has proven successful in providing a higher degree of function and fewer complications for these patients. The purpose of this article is to inform the reader of the appropriate orthotic involvement and the high degree of orthotic maintenance which is necessary for this type of patient. By describing the experiences of Southern Illinois University School of Medicine, it is hoped that the reader will gain a more realistic understanding of the orthotist's role in this situation.

The types of orthoses run the full gambit from a simple UCB foot orthosis to a complex reciprocal gait orthosis. A consistency with these patients is that as children they develop at a normal rate. A second point with these children is the fact that without orthotic management, effective ambulation would not be possible. Higher levels of lesion necessitate a greater amount of orthotic management. When you combine an intimate fitting plastic orthosis with growth, you can understand the necessity for continuous maintenance and adjustments of their orthotic devices. A regular system of return visits is necessary.

The relationship of the myodysplastic child to the orthotist is similar to that of a patient to their general practitioner. They are seen on a routine basis, unlike the medical specialists who only see a patient a limited number of times. This should be kept in mind if an orthotist is considering the possibilities of becoming involved in myodysplastic patient management. An orthotist involved with a clinical practice of scoliosis can associate the nature of their spinal practice with the ambulatory myelominengocele practice that we have developed at SIU School of Medicine. The repetition of clinic visits is very similar to that involved with scoliosis. However, there is an increase of time involvement with the child to make growth adjustments and maintain proper fitting plastic orthoses necessitated by the insensate skin in these children. If a CTLSO is improperly adjusted, it may affect the outcome of the scoliosis treatment, but it will not effect the activities of daily living of the individual. An improperly fitting RGO severely decreases function.

Orthopaedic involvement with the myodysplastic child starts within the child's first few days of life. There is a high incidence of associated scoliosis, kyphosis, hip dysplasia and clubfoot deformities. Therefore, the infant must be continuously monitored. If any of these conditions exist, early orthotic intervention may be used effectively. Maintenance devices such as the Pavlik harnesses, thermoplastic TLSOs, and serial casting for clubfeet have all been used effectively.

When the child reaches nine months of age, plans for ambulation are considered. If a resistant clubfoot exists, it is dealt with by surgical intervention at this time. A one stage Turco[1] procedure is accomplished with post surgical maintenance in an ankle-foot orthosis.[2] During this time period, if a dysplastic hip is also prevalent, bilateral molded knee orthoses connected with a spreader bar to maintain the hip in abduction and internal rotation are used. Since the ninth month is the milestone period for

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standing in the normal child, use of a parapodium[3] is considered. Because of the growth spurts which normally occur during this same time period, consistent monitoring of applied devices is necessary. The ankle-foot orthoses must not impinge on either the calcaneous, navicular or metatarsal heads. Proper knee and hip locations in both the knee orthoses and the parapodium must be checked. Children in these devices should return to the clinic or the orthotist every three months.

Since the development of the reciprocal gait orthoses,[4,5] children with a thoracic level myelominengocele are now candidates for ambulation. This is only possible with aggressive orthopaedic and physical therapy management. Full range of motion of the paralyzed extremities and prevention of flexion contractures of the hip, knee, and ankle is necessary if effective use of the reciprocal gait orthosis is expected. If a dislocated hip exists unilaterally, which would impede the function of the orthosis, surgical intervention would be necessary prior to use of the RGO.

Our experience has shown that twenty-four months of cognitive development is the ideal time frame for training of the reciprocal gait orthosis and fitting thereof. Prior to this milestone, communication with the child and the necessity of multiple adjustments to the orthosis limits the effectiveness of the RGO. Once it is determined that a child is a candidate for reciprocal gait ambulation, an extensive physical therapy program is initiated to improve upper extremity strength and increase standing balance.

When the child is initially fitted with an orthosis, it is left in the adjustable state as recommended by the development team at Louisiana State University. Extensive post-fitting physical therapy is necessary. During the first week of physical therapy the orthotist repeatedly checks the device so that optimum orthotic ambulation can be achieved. Subtle adjustments of the cable housing length and hip joint locations can mean a difference between an ambulator and a nonambulator.

After one month's use of the reciprocal gait orthosis, the correct location of the hip joints and cable should become evident. At that time the hip joints and knee joints can be attached on a more permanent basis. Because of the necessity of numerous adjustments on a growing child, screws instead of rivets are used. High strength Loctite® is used to prevent loosening of the screws.

The child returns to the orthotic clinic one month after permanent attachment of the side bars to the RGO. Subsequent to that visit the child is seen every two months for the first five months. Thereafter return visits are decreased to four times a year.

The physical therapy routine also diminishes as independence in use of assistance devices is decreased. Initially the child is seen on a daily basis for two weeks. Thereafter, a weekly therapy program is established. As the child progresses from parallel bars, to walker, to forearm crutches, it is no longer necessary to maintain a continuing outpatient physical therapy treatment. Parents and teachers have successfully been taught to monitor the fit of the devices and the ambulatory status of the patient. Periodic physical therapy evaluation for gait deviation prevention is all that is necessary.

Growth adjustments and routine maintenance of both the reciprocal gait orthosis and parapodium are accomplished at approximately four month intervals. The use of the pop rivets on the parapodium, make it a relatively easy task to increase the distance between the floor and knee and hip centers. Increases up to one inch between each joint center can be accomplished before the tubular structures of the parapodium must be replaced. Since children are removed from the parapodium at age two, it is only necessary to maintain one size in stock. Because of the presence of static hip and knee joints in the parapodium, the exact alignment of anatomical/mechanical joint centers is not critical for standing. However, if the joint assemblies are extremely malaligned, they will cause impingement during seating.

Because of the relative newness of the program, the first child fitted with the RGO has not had to have a replacement of any major component of the orthosis. However, since we are approaching the twenty-month time period, it appears that future replacement of the plastic sections of the KAFOs will be necessary. A review of the adjustments made for growth indicates that the first length corrections were between the knee centers and the ankles. Subsequent growth adjustments were made between the hips and the knees to improve seating comfort. Seating discomfort seems to be the first indi-

cator of improper positioning of the hip joints.

Maintenance of the devices have included replacement of Velcro® straps because of wear, replacement of the anterior cable due to breakage at the point of connection between the cable and connector to the hip joint, and the replacement of two thrust bearings in one hip joint. One child also has had the metal pelvic band increased in diameter secondary to pelvic growth. Although the metal pelvic band makes the orthosis heavier and cannot be as form-fitted as the thermoplastic pelvic section, it does have allowance for pelvic widening. In cases of pelvic obliquity, lumbar scoliosis, or lumbar kyphosis, a thermoplastic pelvic section is mandatory. There have been no increases in the maintenance of the thermoplastic versus the metal pelvic band. Because of longitudinal growth between the calcaneous and the malleoli, several of the children needed adjustments in the malleoli area of the ankle-foot section of the orthosis. This is accomplished by localized heating and expansion of the carbon inserts and the polypropylene material. Care should be taken not to overheat the materials.

Initial assessment of the ambulatory program for thoracic level myelominengocele children at SIU has been favorable. All parties concerned—the clinic team, the parents, the funding agencies and the children themselves—seem to have accepted the program quite readily. Objective data cannot be determined on such a short range program. Only until such time as multiple years of experience has been gained in several centers will the determination of the cost/benefit ratio prove the worthiness of this program. Subjectively, however, the children seem to be much better off than they would be otherwise.

In our own program, four children with spina bifida are in the pre-parapodium stage (younger than nine months). Seven children are in the preambulatory, parapodium stage of growth development. Two children are awaiting fitting of their orthoses pending authorization from state funding agencies. Eight children have been fitted with the reciprocal gait orthoses with wearing time ranging from twenty months to one month duration. Each of these children are followed on a three-month basis by the clinic team with subsequent visits to the orthotist for adjustments. No major deformities or pressure sores have developed on the children who are in the program during this time period. Urinary tract infections and stress fractures have been reduced in the patients fitted with the reciprocal gait orthoses, although every child in the program has had at least one long bone stress fracture prior to being fitted with the reciprocal gait orthoses.

In summary, we have shown at SIU School of Medicine that a comprehensive team approach to myelomeningocele should include a program of ambulation for the thoracic level myodysplastic child. With a routine return visit program and follow-up adjustments on the orthotic devices, no major complications have arisen in the system. The use of pop rivets on the parapodiums, and screws for attachment of side bars on the reciprocal gait orthoses, have contributed to the ready availability of adjustments to the devices. Although there are increases in time constraints involved in dealing with this severe level of disability, the program has subjectively proven to all concerned that this present technique for spina bifida management has proven successful.

ACKNOWLEDGMENTS

The author wishes to thank Roy Douglas, C.P., and Carlton Fillauer, C.P.O., for their development of the RGO, and to acknowledge Barbara Sullivan, R.P.T., and John M. Mazur, M.D., for their assistance in the development of our program at Southern Illinois University School of Medicine. The assistance of Melenie Bolser in preparing the manuscript for this article is also acknowledged.

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Technical Article

Dynamics and the L3 Through L5 Myelomeningocele Child

by John Glancy, CO*

Since 1970, the orthotic management of myelomeningocele children treated at Indiana University has focused primarily on musculoskeletal deformities that develop after birth. Much of our effort has been directed to children with L3 through L5 lesions, because of their potential to be community walkers.[1] The decision to direct our attention to the problems that these lesion levels present also relates to the fact that they constitute the majority group among the myelomeningocele population. The range of orthotic dysfunctions, in kind or degree, that children with these lesion levels are prone to today, are identical to the orthotic dysfunctions that like youngsters had to endure in 1970.

Myelomeningocele remains "the most complex, treatable congenital anomaly consistent with life."[2] What has changed, in the interim, is our understanding of the pathodynamics acting upon the musculoskeletal systems of children with L3 through L5 lesions. The introduction of thermoplastic materials, along with vacuum forming techniques, now allow orthotists greater freedom of design. Consequently, there is a gradual change occurring in orthotic management, from the traditional approach based upon statics, to a growing appreciation of dynamics as a means of preserving function by preventing the formation of secondary dysfunctions caused by gravity, growth, and time. How may one describe the benefits these changes portend for the L3 through L5 myelomeningocele child, present and future? It now appears that while present-day children with L3 through L5 lesions may have the same vulnerability to secondary dysfunctions as the children of 1970 . . . they may not have to endure them, in kind or degree.

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Those concerned with the care of these children face the same dilemma today as was experienced in 1970—how to provide long-term protection from secondary dysfunctions without introducing unacceptable inhibitions to daily activities. Fortunately, some of the specific challenges within the makeup of this dilemma have been satisfactorily met:

- **The polypropylene Solid-Ankle Orthosis**[3] offers long-term protection to the foot/ankle complex. The Carlson, Berglund technique[5] adds to the efficiency of this orthosis.
- **Lightweight KAFO's** that utilize a unilateral upright with offset free knee joint, modified quadrilateral thigh cuff and dynamic knee extension assist[4] offer long-term protection to myelomeningocele knees.
- **A polypropylene thoracopelvic unit**[4] offers a promising foundation for achieving acceptable, long-term control of the trunk with L3 through L5 lesion levels, without having to extend the exoskeletal system below the anatomic hip joints (Figure 4).

Since the 1976 report on the dynamic orthotic system was published,[4] we have refined the modular aspects of the system for two primary reasons: (1) To ensure that each component meets the requirements for which it is designed, i.e., providing no more, nor no less control than needed, and (2) To encourage the night use of the daytime system by the utilization of quick releases, in order to remove any components unrelated to the areas requiring night-time dynamic control (Figure 1). These modular refinements were also prompted by our recognition of a correlation between early application and night-time dynamic control, to success in the

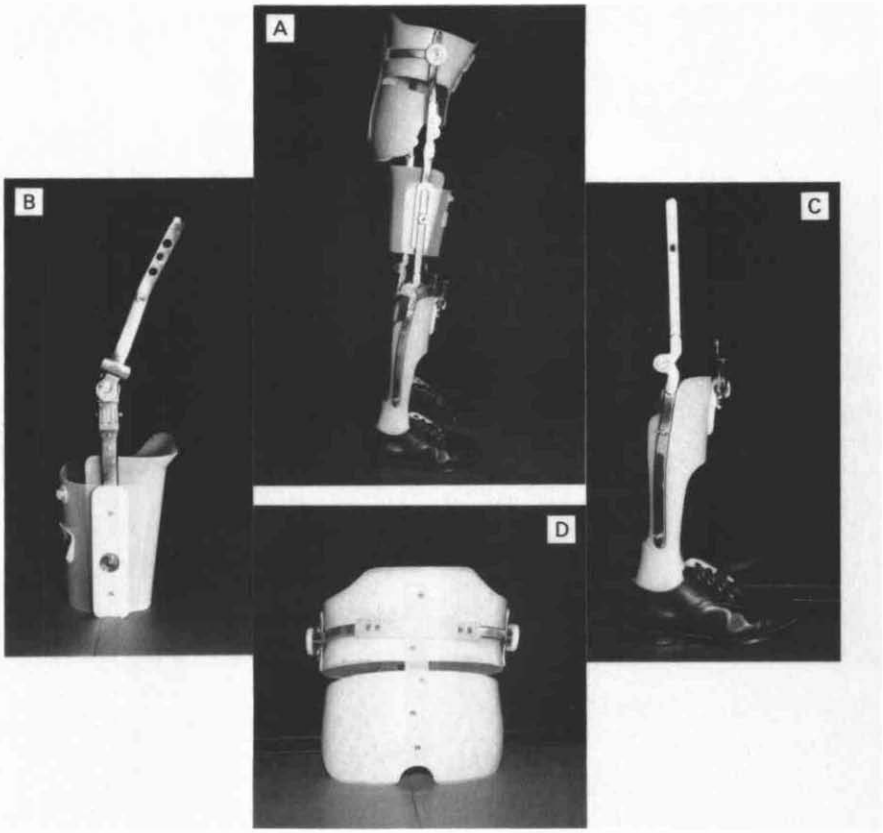

Figure 1. Features of modular system: (A) Assembled system for fitting: elastic components to knee and pelvic extension assist are not attached. (B) Modified quadrilateral thigh cuff; showing Nylon receptacle and locking nut for quick release of AK module. (C) Solid-ankle AFO with lateral off-set knee joint and pivotable attachment portion of knee extension assist assembly. Shockcord is not shown. (D) Thoracopelvic unit; receptacles for the quick release of the KAFO's and reinforcing horizontal bar are visible. Note: The combination polycentric and lateral motion joint shown in A. The lock joint shown in B is used for post-op cases.

prevention of secondary dysfunctions. Due to the complexities of the pathodynamics involved, particularly in the hip complex and lumbopelvic regions, an efficient night-time unit must be equally as functional as the day-time unit, hence the economic necessity that a single system provide both day and night protection against secondary dysfunctions.

The importance of night-time use became even more evident with an awareness of the startling amount of regression that often occurs during short periods of time when the system is not worn. Rapid regression occurs with discouraging frequency about the hips and lumbopelvic regions especially. Such 'down time' often is more frequent within the three-to-six month periods between orthotic checkup visits than we understood to be the case. For example, in addition to the usual childhood diseases, colds, etc, these children are subject to episodes of kidney and/or bladder infection and periodic revisions to their shunts. The success or failure of the dynamic orthotic system appears to be proportional to the frequency and duration of these occurrences. Without an appreciation for the circumstances just described, orthotists will experience constant frustration as they seek explanations for the gradual regression their patients present, because they will unintentionally attribute the cause to often non-existent weaknesses in the design of a given orthotic system.

The answer lies not only with better control of the hip and lumbopelvic regions, but also with constancy of control. We must be as persistent with our applications of biodynamics as nature is with the pathodynamics acting upon

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Response to Questionnaire on Knee Orthoses

Number of respondents: 6

1. Number fitting knee orthoses in practice: 6

2. Percentage of patient population

   0–20%—4
   20–40%—1
   40–60%—1
   60–100%—0

3. Knee orthoses most commonly used:

   Lenox Hill Orthosis—mentioned six times, four times mentioned as most commonly used

   Iowa Knee Orthosis—mentioned twice, both times as second most commonly used

   Polyaction, Scott or Becker—mentioned twice, both times as third most commonly used

   A total of six other designs were mentioned once each. Two of them were custom made designs.

4. R&D Work wish to see:
   a. Knee joint design
   b. Anterior & posterior bands
   c. Lighter materials
   d. Less expensive knee joints
   e. Uncertain
   f. A definitive study of KO's with X-Rays to better define proper application

5. Other comments:
   a. Posterior bands do not permit same degree of flexion as Anterior bands
   b. There is a need for CO's to explore the expansion into providing knee orthoses to prevent injuries

EDITORIAL COMMENTS

It would seem that knee orthoses just are not that important to orthotists either intellectually or economically. In light of the small number of respondents, the relatively small volume that knee orthoses represent in their practice, and of the predominence of one design (Lenox Hill), it is difficult to account for the positive explosion in the number of different Knee Orthoses that have come available in the past five years. It is also curious to consider the question of who is fitting all these different orthoses, to whom, and for what.

Questionnaire: Spina Bifida

1. Do you see patients with spina bifida in your practice?

   Yes _____
   No _____

2. What percentage of your orthotic practice do they represent?

   0–20 % _____
   20 %–40 % _____
   40 %–60 % _____
   60 %–80 % _____
   80 %–100 % _____

3. Are these patients seen in a multi-disciplinary clinic groups, or singly by private referral?

   Clinic _____
   Singly _____

4. Do you employ the concept of a "wardrobe" of devices as advanced by Mr. Motloch?

   Yes _____
   No _____

5. Have you acquired experience with the techniques of Mr. Glancy?

   Yes _____
   No _____

6. Do you have recent experience with the L.S.U. Reciprocating Gait Orthosis (minimum of three fit in the past year)?

   Yes _____
   No _____

7. If you have such recent experience with the Reciprocating Gait Orthosis, would you be willing to participate in a clinical evaluation of it by Mr. Supan?

   Yes _____
   No _____

   (If so please record your name and address below legibly and/or forward it to: Terry J. Supan, C.P.O., Prosthetic/Orthotic Services, P.O. Box 3926, Springfield, Illinois 62708.)

Additional Comments:

_____

_____

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Send all questionnaires to Charles Pritham, CPO, Durr-Fillauer Medical, Inc., Orthopedic Division, 2710 Amnicola Highway, Chattanooga, Tennessee 37406.

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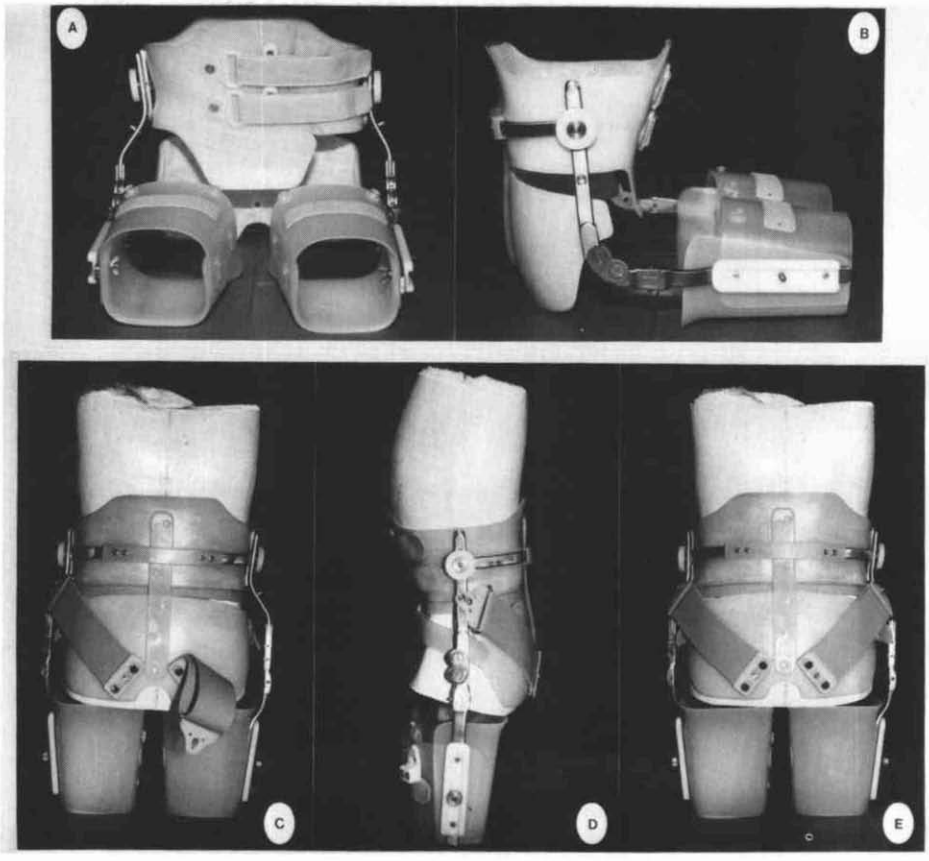

Figure 2. (A & B) Sitting stability and comfort is enhanced by the flat, posterior surfaces of the modified quadrilateral cuffs, abduction motion and polycentric feature of the hip joints. (C) Posterior view: Thoracopelvic unit on casts with the new pelvic extension assist showing right rubber strap detached from the upright. (Note how the model has dropped on the right side.) (D) Side view showing how rubber strap attaches to upright. AK and BK quick releases and Delrin fitting for shockcord of the knee extension assembly. (E) Posterior view with both rubber straps of the pelvic extension assist attached to the uprights. (Note the horizontally level suspension of the cast, demonstrating the force the rubber straps generate.)

these regions. There are three needs that must be considered, which hopefully can be met by a single dynamic thoracopelvic design. They are:

1. A reliable method of eliminating jack-knifing of the trunk during ambulation without the use of locks.
2. Control of the lumbopelvic and hip regions in a manner which does not require extensions to the lower extremities. The need to protect the growing child's lumbar spine when his gluteous maximum muscles are paralyzed, but his hips and/or knees do not require protection (L4 and L5 levels), has yet to be met.
3. The controls in 1 and 2 above, must operate wtih the same efficiency during night-time wear as they do during the day, in order to reverse the inevitable regression resulting from unavoidable periods when illness prohibits wearing the orthosis.

Granted, these design criteria demand a major breakthrough in the state-of-the-art. Nevertheless, using our current thoracopelvic unit as a point of departure, an acceptable solution seems within our grasp. Figures 2, 3, and 4 show our progress to date. A resolution to this problem would have broad orthotic applications—it should be vigorously pursued. Our work on this project is ongoing, and we invite our readers' active participation.

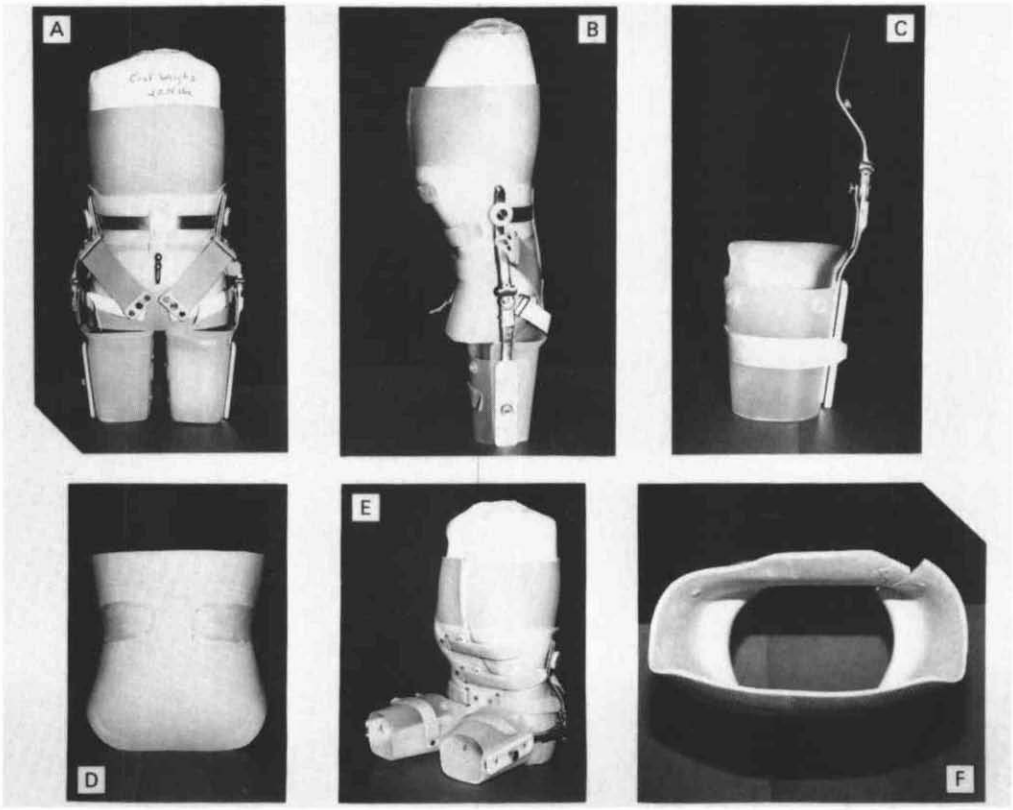

Figure 3. Most recent prototype: (A) Dacron straps with slide-bar buckles serve as a passive, adjustable 'pelvic band.' Puhient weighs 43 lbs. Each rubber strap is set to generate 14 force pounds equal to 62 inch pounds of extension moment which resists the first 20 degrees of forward flexion of the lumbar spine. Any voluntary forward flexion of the trunk beyond 20 degrees overrides the dynamic extension. (Note: Posterior polypropylene bar must be slotted at pelvic end (drawn in) to permit forward rotation of lumbar spine, as the dacron straps check unwanted forward rotation of the pelvis.) (B) Side view: Lock used for 2-3 months post-op. Dynamic extension is fully operative even with locks. Patient has 45 degree hip contractures, which explains posterior gap of thigh cuff in post-op alignment. (C) Anterior view: Note Nyloplex stud medial to hip joint which is the pivotal attachment point for slide-bar buckle. (D) Posterior view of Plastazote® lining showing the sealed 'pockets' at waistline level. Pockets are filled with #382 Elastomer. (E) Model shown in seated position. Although 28 force lbs. (both rubber straps) are acting to extend the lumbar spine when sitting, this force has no effect upon the lower extremities. (F) Bottom view: showing 'shelves' formed with the lining and filled with Elastomer via the pockets shown in photo D. Their effectiveness in transferring the weight of the thorax to the uprights is well demonstrated. This technique prevents pressure sores to insensitive skin.

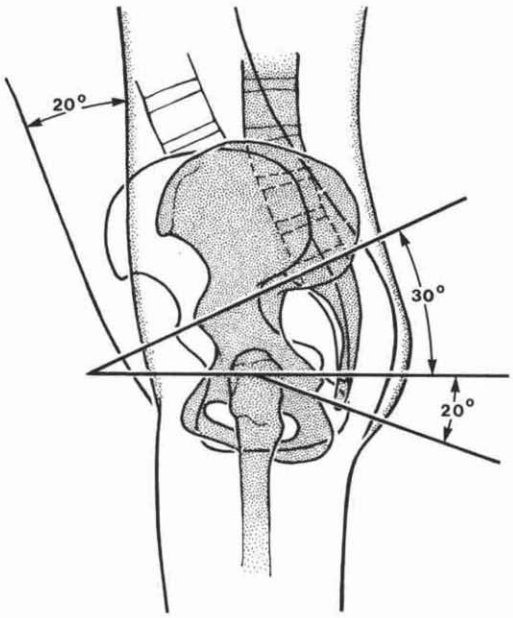

Figure 4. Schematic lateral view of normal lumbopelvic relationship to the horizontal. Shaded areas show the optimum sacral angle of 30 degrees, with respect to the center of the hip joint, during normal standing posture. The normal amount of postural lordosis resulting from the optimum sacral angle is also depicted. The unshaded outline shows the pelvis rotated 20 degrees about the hip joint in an anterior direction, taking the entire trunk with it, indicated by arrow in upper left. The downward oblique line, originating from hip center, indicates the maximum distal point (gluteal fold), relevant to the horizontal at hip level, which is feasible as an attachment point for passive pelvic control when fitting small children (see A & B, Figure 3). The arrow between the horizontal and oblique lines, to the right of the figure, demonstrates that beyond 20 degrees of forward rotation of the pelvis, the distal attachment point will rise *above* the horizontal. The contribution of the passive pelvic control, relative to forward rotation of the pelvis above the horizontal, is nil. However, the intimate fit of the thoracopelvic unit (especially the abdominal position) ensures that the optimum relationship between the lumbar spine and the rotating pelvis is passively maintained throughout the full range of pelvic A-P rotation. Consequently, any *involuntary* forward rotation of the trunk about the hips (within the first 20 degrees) can be controlled as a single body segment. The functional status of the abdominal and particularly the hamstring muscles, may be expected to be crucial contributors to the system's success. *Unless the pelvis and lumbar spine can be passively placed in a normal standing posture to begin with, neither can be controlled in an upright position without locks.*

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I wish to express my thanks to John G. Patsko, CO, whose fine photography adds so much to the text.

Technical Note

Rochester Parapodium

by Edwin Kinnen, Ph.D.
Martha Gram, P.T.
Kenneth V. Jackman, Ph.D.
Franklin V. Peale, M.D., P.C.
P.W. Haake, M.D.
Gerald A. Tindall, C.P.O.
James A. Brown, O.P.A.

The Biomechanics Team at the University of Rochester Medical Center has been developing and testing design modifications to the Toronto parapodium since 1975. Early in 1983, these design modifications had stabilized, and prototypes of the new design were offered to medical centers and orthopedic laboratories in the United States and Canada. The Rochester parapodium has now been fitted to over 80 young children of ages 17 months to 14 years. Most of these children have flaccid paralysis due to spina bifida or spinal injury from L5 to T12.

The Rochester parapodium differs from the Toronto design in the hip and knee hinge and locking mechanisms. The hip joints unlock together with a single lever release and lock automatically on extension. The hip joints unlock with a forward motion and have no lateral projections, which allows ease in releasing hip lock in a confined space such as a wheelchair. The knee joints also unlock independent of the hip joints with a second single lever release and lock automatically on extension with the aid of an extension assist bar.

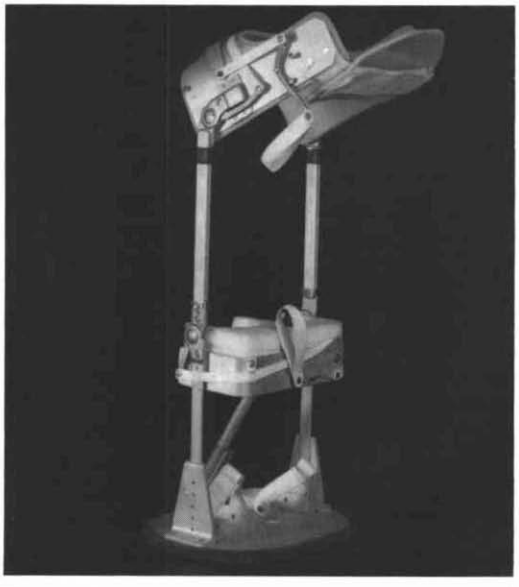

Figure 1. The hip joints unlock independent of the knee joints.

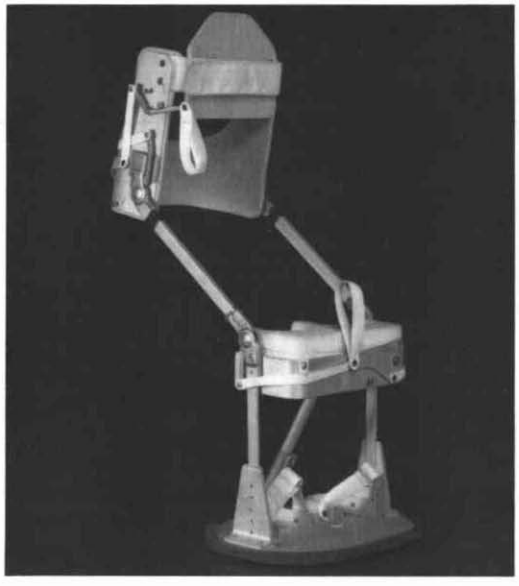

Figure 2. Both joints unlock with a pull of a lanyard.

Figure 3. A child can bend over to pick up objects with hips flexed and knees locked.

Without lateral projections, rolling is easier for the child who applies the orthosis sitting or in the supine position on floor, then rolls to prone position in order to elevate to a standing posture. This separated locking and unlocking action has simplified many everyday activities for the paraplegic child.

With increased control, the child can become independent in sitting and standing from a chair with arms. He can also bend over to pick up objects from the floor with hips flexed and knees locked. These are important functions for a preschooler exploring his or her surroundings and participating in peer group activities.

Previously, children wearing the parapodium had to get up from a prone position on the floor by pulling to standing with fully extended knee and hip joints. Now a child can use jackknife-like movements to stand. These movements appear to require much less energy and open the activity to children with higher levels of paralysis.

The lateral supports have also been redesigned for the Rochester parapodium, using bar stock instead of tubular sections. These flat lateral supports facilitate rolling, a very important movement for a child who is independent in dressing and changing positions. The new side bar design, a more rigid construction, also improves the child's momentum during swivel walking. With polypropylene added to the bottom of the base, many children can learn to swivel-walk at functional speeds, with hands free.

The activities now possible with the new design allow the paraplegic child to function at home and in school with relatively little need for adult supervision or assistance.

AUTHORS

Edwin Kinnen, Ph.D., Dept. of Electrical Engn, University of Rochester, Rochester, New York 14627. **Martha Gram, P.T.,** Dept. of Pediatrics, University of Rochester, Rochester, New York 14627. **Kenneth V. Jackman, Ph.D.,** Associate Professor of Pediatric Orthopedics, University of Rochester, Rochester, New York 14642. **Franklin V. Peale, M.D., P.C.,** 220 Alexander Street, Rochester, New York 14610. **P.W. Haake, M.D.,** 220 Alexander Street, Rochester, New York 14610. **Gerald A. Tindall, C.P.O.,** Rochester Orthopedic Laboratories, Inc., 1654 Monroe Avenue, Rochester, New York 14618. **James A. Brown, O.P.A.,** Rochester Orthopedic Laboratories, Inc., 1654 Monroe Avenue, Rochester, New York 14618.

Partial support for this work has been provided by the J.M. McDonald Foundation, Cortland, New York.

Technical Note

Orthotic Pelvis Control in Spina Bifida

by H.R. Lehneis, Ph.D., C.P.O.

Control of the pelvis has been typically problematic in high level spina bifida patients due to the imbalance of motor power around the hip joint. This can be readily appreciated when one considers the differential innervation particularly of the hip flexors versus the hip extensors (Table 1). Note that the hip flexors are at least partially innervated at the L2 and L3 level, whereas the hip extensors are innervated below the L3 level. Such imbalance at the L2 and L3 level of involvement is the cause of lordosis so often seen in these patients, which is often aggrevated by hip flexion contractures. Control of the pelvis and thus lordosis has been difficult with conventional designs.

In analyzing the force system required to prevent hip flexion and thus lordosis, it becomes clear that the rigid portion of the pelvic band needs to be reversed from the conventional location (Figure 1). It should be noted that this consists of a plastic molded Subortholen panel which extends superiorly to the level of the xyphoid process. The uprights of the hip joints are attached to this panel. An anteriorly directed force is provided by a leather hammock covering the buttocks (Figure 2). Straps attached on each of the four corners of the hammock run through D rings, attached equi-distant above and below the orthotic hip joint center. This system has worked quite effectively in controlling lordosis since first initiated approximately five years ago.

In cases where the patient presents a relatively severe hip flexion contracture, the hip joint uprights are attached to the panel by means of a single pivot placed approximately 5 cm. below the lateral trim line of the panel. By gradually tightening the straps of the buttock pad, some correction can often be achieved. The pivot allows the anterior panel to adapt to the changing angulation as correction is attempted.

Figure 1.

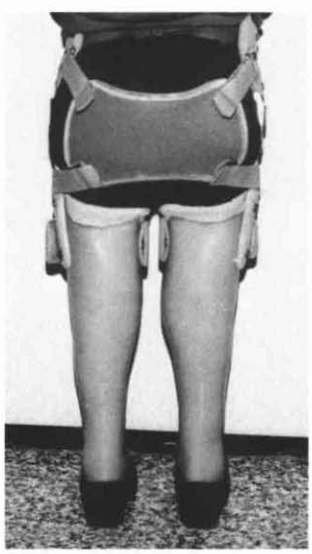

Figure 2.

Innervation of Muscles of Lower Limb

	Muscle	Spinal Cord Segment							
		L1	L2	L3	L4	L5	S1	S2	S3
Peripheral Nerves of Lumbosacral Plexus	Iliacus								
	Psoas Major								
	Psoas Minor								
	Gluteus Maximus								
	Gluteus Medius								
	Gluteus Minimus								
	Tensor Fascia Latae								
	Piriformis								
	Gemellus Superior								
	Gemellus Inferior								
	Quadratus Femoris								
	Obturator Internus								
O	Obturator Externus								
O	Adductor Longus								
O	Adductor Brevis								
O + S	Adductor Magnus								
O	Gracilis								
F	Quadriceps Femoris								
F	Sartorius								
S	Semitendinosus								
S	Semimembranosus								
S	Biceps Femoris								
T	Popliteus								
P	Tibialis Anterior								
P	Extensor Hallucis Longus								
P	Extensor Digitorum Longus								
P	Peroneus Tertius								
P	Peroneus Longus								
P	Peroneus Brevis								
T	Gastrocnemius								
T	Soleus								
T	Tibialis Posterior								
T	Flexor Hallucis Longus								
T	Flexor Digitorum Longus								
P	Extensor Digitorum Brevis								
P	Extensor Hallucis Brevis								
T	Abductor Hallucis								
T	Abductor Digiti Minimi								
T	Flexor Digitorum Brevis								
T	Quadratus Plantae								
T	Lumbricales								
T	Flexor Hallucis Brevis								
T	Adductor Hallucis								
T	Interossei								

Key to Peripheral Nerves:
F = Femoral N.
O = Obturator N.
S = Sciatic N.
T = Tibial N.
P = Peroneal N.

Table 1

It should also be noted that in our practice, patients up to the age of approximately six years old are provided with solid ankles and knees since their legs are still short enough to sit through hip flexion without obstructing much of the space in front of the chair. The purpose of this is to provide the patient with maximum stability and lightweight orthoses. As the patient gains upper limb strength and mobility, knee joints with drop locks are added, usually of the lateral single bar type. Double bars are only used when the patient is relatively heavy and when there is a torsional problem in the orthosis. The ankle-foot portion of the orthosis remains of the solid ankle type to provide the largest possible base of support over which the patient's center of gravity can be maintained with a greater degree of latitude than is possible if orthotic ankle joints were to be used.

ACKNOWLEDGMENT

The assistance of Barry Gosthnian, CPO in developing the system described is gratefully acknowledged.

Technical Note

Rigid A.F.O.—Another Choice

by Robert E. Doran, C.P.O.*

When an orthotic prescription calls for an ankle/foot orthosis to provide rigid ankle/foot stabilization, the two basic choices have been (1) a double bar metal orthosis or (2) a thick and/or reinforced thermoplastic orthosis. We are all familiar with the advantages and disadvantages each has to offer.

It was this author's goal to design a rigid A.F.O. that would combine the advantages of both. The features of such an orthosis should include light-weight construction; provide rigid ankle stabilization; provide adjustable plantar and dorsiflexion in order to dynamically align the orthosis; fit inside the shoe; be cosmetically acceptable; be easily donned; and maintain alignment while changing heel heights.

With the above in mind, the following orthosis was designed. The orthosis consists of "prepreg" (the resin is impregnated in the matrix in an uncatalyzed form prior to lay-up, generally at the factory. Once the desired lay-up is achieved, the structure is exposed to a catalyzing agent so that it hardens), carbon-fiber and fiberglass fabric. Epoxy and polyester resin have been used as bonding agents and the orthosis is formed over a plaster model of the patient's leg. Such pressure applying agents as vacuum bags and pressure wraps have been used. The carbon fiber and fiberglass fabric are properly oriented to resist the stresses imposed upon the orthosis and comprise a structure that provides a high strength to weight ratio.

The orthosis has a foot section which begins on the plantar aspect of the foot and extends proximally on the medial and lateral sides of the leg. The "uprights" are connected by adjustable velcro-closing calf straps. Plantar and dorsiflexion adjustments are independently achieved by adjusting the anterior and posterior velcro-closing calf straps (see Figures 1-3).

In some cases, donning is simplified by removing the posterior strap, thus allowing for a posterior entry of the foot and leg into the orthosis and shoe.

Over the past eighteen months, nine patients with diagnoses that include low level paraplegic, C.V.A., and neuromuscular disease have been fitted with the graphite composite A.F.O. as a successful alternative to "traditional" orthoses.

Orthotists now have another choice when designing a rigid ankle foot orthosis for their patients. The graphite composite A.F.O. combines some of the advantages of the standard metal and thermoplastic constructed A.F.O.

*Thousand Oaks Prosthetic Orthotics, 253 Lombard Street, Suite C, Thousand Oaks, California 91360.

Letters to the Editor

Dear Sir:

Since December of 1983 I have fitted six suction socket below-knee prostheses and have more in the works. My interest in this area was sparked by a presentation given by Ake Friestedt of Uppsala, Sweden at the 1983 AOPA National Convention. While the results seem to be quite promising, there remain to be many details to be worked out. For this reason therefore, I would greatly appreciate hearing from any of your readers who have been doing similar work and who would like to compare notes.

Sincerely yours,
Karl D. Fillauer, C.P.O.
Fillauer Orthopedics, Inc.
314 N. Shore Drive
Knoxville, Tennessee 37919
(615) 584-9309

Dear Sir:

I read with extreme interest the article "Evolution of the AK Socket" in the Summer 1984 edition of *Clinical Prosthetics & Orthotics*. There definitely is a pressing need to re-evaluate the traditional quadrilateral AK socket design.

One correction to the article is the mention of the Contoured Adducted Trochanteric Controlled Alignment Method (CAT-CAM), which the article states was developed by Sabolich. In fact, this alignment and socket shape was developed by Ivan Long, C.P., and from the beginning in 1974, has been called "Long's Line." Ivan Long's first article was published in *Orthotics and Prosthetics,* December 1975, titled "Allowing Normal Adduction of Femur in A/K Amputations."

In February 1981, Ivan Long presented a continuing education program at the Sabolich, Inc. prosthetic facility in Oklahoma City titled "Fabricating the Long's Line Above Knee Prosthesis." It was after this presentation in Oklahoma that Sabolich started using the name CAT-CAM socket.

Sincerely,
Carole Harper, Secretary
Polycadence, Inc.

Dear Editor:

I would like to respond to a copy of a letter I received from Carole Harper of Polycadence, Inc.

I feel it is important to express my admiration for Mr. Long's contribution made at our facility. He is one of the first people, as far as I know, who recognized the fallacies of the quadrilateral socket. For this he should receive great credit.

The statement made in the *Clinical Orthotics and Prosthetics,* however, is not out of line. We have indeed developed the CAT-CAM, (Contoured Adducted Trochanteric-Controlled Alignment Method) with the help of many prosthetists. I could name at least nine others that have been avidly working on this project with us. We at Sabolich have spent over $150,000 and thousands of clinical hours to get the CAT-CAM where it is today. This does not include the nine other researchers mentioned.

Necessary work has included casting fixtures, posterior wall angles, true adduction measurement, Ischial placement in a fossa, lateral wall troughing to capture the entire length of the femur, methods for determining the exact ML dimension rather than guessing, the virtual elimination of the Scarpas Triangle, and adductor longest channels. We also had to develop new ways to obtain true length, the abandonment of "Long line" in favor of using an adjustable line, and a lateral leaning pylon-syndrome, to mention a few.

I have not seen Mr. Long's socket for about five years and do not know if any changes have taken place. However, the CAT-CAM has been undergoing continued evolution. I saw my first AK weight bearing x-ray 11 years ago and started tinkering with adding pelite medially and laterally, trying to make quad sockets effective. I have been extremely interested in above knee socket design ever since.

Again, I would like to emphasize the tremendous contribution of Mr. Long for getting us on the right track much faster than would have otherwise been possible.

Sincerely,
John Sabolich, CPO
Sabolich Orthotic-
Prosthetic Center

Kurt Marschall, CP

A Question of Professional Competence

Dear Fellow Practitioner:

As you may recall, I sent an open letter to Dr. Donald Fedder, President of the Board for Orthotist Certification (BOC), published in the July issue of the *Almanac*. Dr. Fedder has now replied to me in a communication dated July 31, 1984. In his response he requests that his answer also be published to make our membership aware of BOC's position.

Since this matter, in my opinion, poses a serious threat not only to every ABC certified practitioner in the United States and Canada, but also to our credentialing body, The American Board for Certification (ABC), I have requested that both letters receive prominent exposure in *C.P.O.*, a publication created specifically for the certified practitioner in prosthetics and orthotics.

The Academy, in conjunction with ABC, is presently looking into ways of resolving this problem.

Sincerely,
Kurt Marschall, CP
President
American Academy of
Orthotists and Prosthetists

Editor's Note

It is the editorial policy of *C.P.O.* to publish articles of a scientific nature and not to publish material of a current events nature. However, President Kurt Marschall, CP has asked that his exchange with Dr. Fedder receive the broadest possible dissemination. President Marschall has asked that concerned Academicians write to him and Dr. Fedder conveying their opinion on the actions of the Board for Orthotist Certification (BOC). President Marschall would particularly like to receive copies of all letters addressed to Dr. Fedder.

Academy President Kurt Marschall Addresses Dr. Fedder

June 7, 1984

Dear Dr. Fedder:

The undersigned is President of AAOP, the American Academy of Orthotists and Prosthetists, a professional association whose members are practitioners certified by the American Board for Certification in Orthotics and Prosthetics, Inc. (ABC). A memorandum by your Board for Orthotist Certification (BOC) dated January 23, 1984, addressed to your "certifees" has been brought to our attention. Certain aspects and representations contained in the above-identified communication have given us cause for great concern.

Orthotic and prosthetic certification by ABC have been in existence since 1948. The programs of certification by that body which are a prerequisite for membership in our professional society are substantial, comprehensive, and extremely substantive.

There are two pertinent areas that form the basis for our concern. The first area is a significant parallel and similarity between the programs you now seem to be promoting, at least by description, and those which have been in existence for many years in ABC. In this regard, as you are undoubtedly aware, ABC certifies practitioners in the field of orthotics and prosthetics as well as accrediting facilities in those fields. ABC's programs enjoy substantial proprietary protection, both at common law and pursuant to the Copyright and Trademark laws of the United States.

The importance of this is that ABC and its certification programs are the foundation and prerequisite for membership in our professional society. While it is not the desire of this Association to in any way interfere in the independent conduct of your organization, it is also our concern that there may be confusion between the activities of your organization and that organization which forms the basis of membership in AAOP, as well as activities of our own members.

In this regard, the concept of "orthotist" as a certified individual is well defined in the By-Laws and Book of Rules of ABC as follows:

Orthotist:

a. The term for the practitioner who provides care to patients with disabling conditions of the limbs and spine by designing, fabricating, and fitting devices known as orthoses. At the request of and in consultation with physicians, the orthotist assists in formulation of prescriptions for orthoses, and examines and evaluates the patients' orthotic needs in relation to their disease entity and functional loss. In providing the orthosis, he is responsible for: formulating its design, including selection of materials; making all necessary casts, measurements, model modifications, and layouts; performing fittings, including static and dynamic alignments; evaluating the orthosis on the patient; instructing the patient in its use; and maintaining patient records; all in conformity with the prescription. The orthotist is expected to keep abreast of new developments concerning orthotic patient care. He is required to supervise the function of support personnel and laboratory activities related to the development of orthoses.

b. The title of Certified Orthotist (CO) is awarded to the practitioner who successfully completes the examination in this discipline.

Education and Experience:

Applicants for practitioner certification must be admitted to examination, provided they make proper application to the Board of Directors, pay the prevailing fees, and otherwise conform with one of the following criteria.

a. They must (1) possess a bachelors degree with major emphasis in orthotics and prosthetics from a program accredited by ABC, and (2) must also have acquired a minimum of one year acceptable experience (as defined in paragraph C.1.c.), subsequent to the degree, in the discipline for which they are applying.

b. They must (1) possess a bachelors degree, (2) have successfully completed an ABC accredited long-term (certificate) education program in orthotics or prosthetics, and (3) have acquired a minimum of one year of acceptable experience subsequent to successful completion of the certificate program, and must be in the discipline for which the certificate was awarded.

c. They must (1) possess a bachelors degree, (2) have successfully completed an ABC accredited long-term (certificate) educational program in orthotics and prosthetics, and (3) have acquired a minimum of one year of acceptable experience subsequent to successful completion of the certificate program, and must be in the discipline for which they are applying.

d. They must (1) possess an associate degree, (2) have successfully completed an ABC accredited long-term (certificate) educational program in orthotics or prosthetics, and (3) have acquired a minimum of four years of orthotic and/or prosthetic experience. At least one year of experience must have been subsequent to successful completion of the certificate program, and must be in the discipline for which the certificate was awarded.

e. They must (1) possess an associate degree, (2) have successfully completed an ABC accredited long-term (certificate) educational program in orthotics and prosthetics, and (3) have acquired a minimum of four years of orthotic and/or prosthetic experience. At least one year of experience must be subsequent to successful completion of the certificate program, and must be in the discipline for which they are applying.

It is clear that qualification for membership or participation in your organization and its program do not fall within the details of the definition hereinbefore set forth. With this in mind, there is a second area of difficulty involving a substantial problem with representations in your communication that your program has been redesigned to fully conform to the standards of the National Commission for Health Certifying Agencies (NCHCA). This could easily be interpreted as meaning that your organization is approved (directly or indirectly) or has qualified for accreditation by NCHCA. However, inquiry of that body indicated that you have apparently not applied nor qualified in that regard. Therefore, for you to suggest that you conform to their requirements is a significant departure from an appropriate assertion of facts. Such action could lead to the significant misleading of physicians, governmental agencies, or third party payors.

By contrast, in December 1983, the American Board for Certification in Orthotics and Prosthetics, Inc. was granted full, unconditional accreditation as a certifying body of NCHCA. In order to attain that status, ABC was required to meet lengthy and comprehensive criteria covering areas of examination validity and reliability, safeguards to protect the public interest, and appropriateness of qualifications to enter the certified occupation in question.

Certainly, the American Academy of Orthotists and Prosthetists, representing the majority of certified orthotists and prosthetists throughout the United States, does not wish to contest your right to engage in business or pursue such programs as you deem appropriate. However, it would seem that neither can we ignore clear attempts to infringe upon the proprietary interest of this Association or its members through the dispensing of incomplete or inaccurate information regarding certification or certification programs.

At least part of the problem would seem to stem from the fact that your organization, according to our information, limits or restricts its involvement to software or prefabricated products often referred to as over-the-counter or shelf items. Of course, we do not object to this, and the previous title of "certified fitter" appeared to appropriately describe the area.

However, now you appear to be broadening your title, but engaging in the same services with little or no apparent change in criteria for the title. The result contains substantial potential for misleading the public and others as was discussed above. The use of terminology such as "advanced" and "entry level" unfortunately merely compounds the difficulties created.

We forthwith urgently and strongly request that you address the issues raised in the communication and respond to us at your earliest opportunity so that clear lines of definition as to programs offered and concepts of credentialing in orthotic certification can be drawn.

Very truly yours,
Kurt Marschall, CP
President
American Academy of
Orthotists and Prosthetists

Dr. Fedder Replies

July 31, 1984

Dear Mr. Marschall:

I am in receipt of your letter of June 7, 1984 in which you discussed a January 23, 1984 memorandum of the Board for Orthotist Certification (BOC) and raised two concerns.

First, let me state that BOC's Certified Orthotist Program neither interferes with nor infringes upon programs administered by the Academy of Orthotists and Prosthetists, ("Academy") or the American Board for Certification ("ABC") as they fall within the protection of copyright and trademark laws. Further, I am unaware of any confusion between the programs or activities of the Academy and the BOC.

With regard to your "concept of orthotist," I submit that this is a constantly changing one based upon your organization's perceptions only. Your own literature speaks to the lack of precision in terminology in the field of orthotics. The word "orthotist" as defined in Dorland's *Medical Dictionary* is the basis for our use of the term. In fact, two other certifying bodies, in addition to BOC and ABC, currently use the term in their titles:

The New York Board of Certified Orthotists—Certified Orthotist (CO)
The National Association of Retail Druggists Certified Master Orthotist (CMO)

The tasks performed and skills that you claim are inherent to the practice of orthotics are not universally accepted. In fact, I am told that many of your certifees are deficient in one or more of the areas you claim as prerequisite for certification.

Second, nothing in the BOC memorandum referred to above can be characterized to imply accreditation by the National Commission for Health Certifying Agencies (NCHCA), The memorandum clearly states that the BOC accreditation program is "designed to conform with criteria established by the NCHCA."

As you are aware, the BOC has been in operation only since January, 1984. However, it evolved out of the Health Care Industry Foundation (HCIF) program that had applied for NCHCA accreditation. The responses to that application have been used in structuring the BOC and its examination process.

The examination has been developed under the guidelines of the Equal Employment Opportunity Commission (EEOC) and has been validated using the American Psychological Association (APA) standards for test validation.

As you no doubt are aware, the federal antitrust laws were created to foster and encourage competition and, therefore, the BOC is pleased that the Academy "does not wish to contest [BOC's] right to engage in business or pursue such programs as [BOC] deem[s] appropriate." You may be assured that the aim of BOC is to ensure that the public is fully protected and it will, in that regard, certify only those orthotists who satisfy the BOC's strict requirements.

Incidentally, my credentials are incorrect. I am not a physician. Rather, I have a Bachelor of Science degree in pharmacy from the University of Maryland (1950), a Master of Public Health (1976), and a Doctor of Public Health (1982) from Johns Hopkins University. I am president of the BOC, not its executive director.

I hope that this clarifies the issues raised. It is noted that your original letter has been published in the July issue of the AOPA *Almanac*. I trust that you will treat this response accordingly so that your membership will be aware of our position.

Thanking you for your interest in our program, I am

Very truly yours,
Donald O. Fedder, Pharm.B.S., Dr.P.H.
President, Board for Orthotist Certification
University of Maryland at Baltimore
20 N. Pine Street
Baltimore, Maryland 21201

Thomas Martin Receives *C.P.O.* Award

The award for the best unsolicited article appearing in Volume 8, Number 3, *Clinical Orthotics and Prosthetics,* went to Thomas A. Martin, CPO, President of Baja Orthotic & Prosthetic Services. The article was entitled "Follow-up Experience with an Orthosis Combining the Supracondylar Knee Orthosis and the Spiral Orthosis."

The award is issued by the *C.P.O.* editorial board to encourage and recognize contributions. Anyone who wishes to contribute and be considered for the award should send their article to Charles H. Pritham, CPO, Editor, *Clinical Orthotics and Prosthetics,* c/o Durr-Fillauer Medical, Inc., 2710 Amnicola Highway, Chattanooga, Tennessee 37406.

Calendar

1984

November 3, Midwest Chapter of the Academy Fall Seminar, Northwestern University, Chicago, Illinois.

November 14–16, Electric Elbow Seminar, presented by Hosmer Dorrance Corporation, University of Texas Health Science Center, Dallas, Texas. Contact: Catherine Wooten, 408-379-5151.

December 2, Northwest Chapter of the Academy Meeting and Seminar, Red Lion Inn, Portland, Oregon. Contact: William E. Teter, CO, 208-342-4659.

December 5–7, Electric Elbow Seminar, Hosmér Dorrance Corporation, 561 Division Street, Campbell, California 95008. Contact: Catherine Wooten, 408-379-5151.

December 7–9, "Innovative Strategies in Rehabilitation: The Search for Function," a postgraduate course sponsored by the Department of Orthopaedics and Rehabilitation, University of Miami School of Medicine, and Jackson Memorial Rehabilitation Center, Sheraton Bal Harbour Hotel, Miami Beach, Florida. Contact: Dennis Cahill or JoAnn Moyer, Course Coordinators, Dept. of Ortho. and Rehab., Univ. of Miami School of Medicine, P.O. Box 016960 (D-27), Miami, Florida 33101; tel. 305-547-6996.

1985

January 24–29, American Academy of Orthopedic Surgeons Annual Meeting, Las Vegas, Nevada.

January 30–February 3, Academy Annual Meeting and Scientific Seminar, Cathedral Hill Hotel, San Francisco, California. Contact: Academy National Headquarters, 703-836-7118.

February 9, Midwest Chapter of the Academy Prosthetics Workshop, Northwestern University, Chicago, Illinois.

April 11–13, Association of Children's Prosthetic and Orthotic Clinics (ACPOC) Annual Meeting and Scientific Sessions, New Orleans. Contact: Dr. Robert Tooms, tel. 901-525-2531.

April 12–13, New York State Chapter of the Academy seminar, The Hotels at Syracuse Square, Syracuse, New York.

April 20, Midwest Chapter of the Academy Spring Seminar/Social Event.

June 24–28, RESNA 8th Annual Conference on Rehabilitation Technology, "Technology—A Bridge to Independence," Peabody Hotel, Memphis, Tennessee. Contact: RESNA, Suite 402, 4405 East-West Highway, Bethesda, MD 20814, 301-657-4142.

September 13–15, Fifth Annual *Advanced* Course in Lower Extremity Amputation and Prosthetics, Nassau County Medical Center, East Meadow, New York. Contact: Lawrence W. Friedmann, M.D., Chairman, Dept. of Physical Medicine and Rehabilitation, Nassau County Medical Center, 2201 Hempstead Turnpike, East Meadow, NY 11554; (516) 542-0123.

1986

January 27–February 2, Academy Annual Meeting and Scientific Seminar, MGM Grand, Las Vegas, Nevada. Contact: Academy National Headquarters: 703-836-7118.

February 20–25, American Academy of Orthopedic Surgeons Annual Meeting, New Orleans, Louisiana.

April 8–11, Pacific Rim Conference, Intercontinental Hotel, Maui, Hawaii.

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Clinical Prosthetics and Orthotics (017590) is published quarterly by the American Academy of Orthotists and Prosthetists for $12.00 domestic, $13.00 foreign subscription. Address of the known office of publication and headquarters of the publisher is the American Academy of Orthotists and Prosthetists, 717 Pendleton Street, Alexandria, Virginia 22314. The publisher and publication's owner is the American Academy of Orthotists and Prosthetists, at the address above.

Editor—Charles H. Pritham, CPO, c/o Durr-Fillauer Medical, Inc., Orthopaedic Division, 2710 Amnicola Highway, Chattanooga, Tennessee 37406. Managing Editor—Christopher R. Colligan, 717 Pendleton Street, Alexandria, Virginia 22314.

During the last twelve months (1982–1983), the average press run of *Clinical Prosthetics and Orthotics* has been 2,125. Total paid circulation has averaged 1,907. Free distribution has averaged 43 copies, for a total distribution average of 1,950. On the average, 75 copies are not distributed. For the issue nearest the 1983 filing (Volume 7, Number 3) total number of copies published is 2,000. Total paid circulation is 1,848, and total distribution is 1,923. Copies not distributed total 77.

I certify that the statements made by me above are correct and complete.

Christopher R. Colligan
Managing Editor

Statement of Ownership—1984 (required by USPS reg. 39 U.S.C. 3685)

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During the last twelve months, the average press run of *Clinical Prosthetics and Orthotics* has been 2,300. Total paid circulation has averaged 1,968. Free distribution has averaged 150. Total distribution is 2,118, with the average of non-distributed copies at 182. For the issue nearest the filing date (Volume 8, Number 3) total number of copies published is 2,500. Total paid circulation is 2,044, with 200 distributed free. There remain 260 copies for office use.

I certify that the statements made by me above are correct and complete.

Christopher R. Colligan
Managing Editor

American Academy
of Orthotists and Prosthetists
717 Pendleton Street
Alexandria, Virginia 22314