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ORTHOLETTER

WORLD HEALTH ORGANISATION

A NEWSLETTER ON ORTHOPAEDIC TECHNOLOGY IN LOW INCOME COUNTRIES

Number 11 Dec, 2002

Mobile prosthetic unit in Thailand

Therdchai Jivacate, MD, Thailand

Thailand, situated in South East Asia, is bordered by Myanmar (Burma) in the west and north, Laos towards the northeast, Cambodia in the east and Malaysia in the south. It has a total land area of 514,000 square kilometers and a total population of 63 million. Thailand is an agricultural country with sixty percent of its population involved in agriculture.

A farmer in Thailand

Several factors contribute to the problem of unnecessary amputation for Thai people. These include the lack of effective basic public health, lack of traffic disciplines among commuters and past fighting within the country and surrounding areas created by differences in ideology. Most of the amputees come from families of poor farmers who live in the rural and mountainous regions, whose annual income per family is about $200USD, and who do not even have enough money to travel to the government hospitals.

The late Royal Highness Princess Mother Sri Nagarindhra, who visited people in the rural areas annually, saw numerous amputees who could not earn a proper living because they did not have prostheses. Instead, they had to walk with auxiliary crutches or home-made artificial legs. Consequently, Her Royal Highness inaugurated the Prosthetic Foundation on the 17th of August 1992, with the aim to provide free prostheses to amputees of all races, nationalities, and religions. The prostheses to be provided must be made only from locally available materials.

Setting up the mobile clinic

The Foundation, under the patronage of the Princess Mother, initiated mobile prosthetic unit services because the establishment of local workshops required a great investment and to serve patients was considered to be the government's responsibility. The potential beneficiaries also lived in far scattered and remote rural areas. A mobile unit service can reach the amputees and can rapidly provide prostheses for them. With only ten staff personnel, the Foundation seeks help from volunteer orthopaedic technicians, from among the total of 200 technicians in the country. Most of these technicians work as public servants under the Ministry of Public Health, and are usually allowed a maximum of seven days leave with pay to help during each Foundation trip. The length of time for each mobile service is therefore limited to one week. Careful planning is required to make the trip efficient and effective in covering as many amputees as possible and in providing quality prostheses for them.

Casting patients at the mobile clinic

Following are the requirements for each mobile prosthetic unit service:

1. To train the technicians so that production will be consistent, standardised and of sufficient quality. Production methods have to be improved and quality increased up to a set standard.
2. To invent and adapt mobile equipment to enable speedy production of prostheses in a limited period of time under difficult conditions.
3. To enable smooth fabrication and production of prostheses.
4. To prepare and transport all needed equipment and parts for the prostheses to the work site by truck.

Implementation plan

Day 1: Preparation of the work site: (a) erecting tents to cover the amputees queuing up for assessment by physicians and for plaster casting by technicians; and (b) preparing space for machines, tools and equipment.

Day 2: Amputees are assessed and prosthetic devices prescribed for by physicians; technicians prepare plaster casts, plaster models of stumps, and polypropylene or high-density polyethylene plastic sockets.

Day 3: Technicians assemble each plastic socket with a shank and foot.

Day 4: Trial fitting and gait analysis made for each amputee.

Day 5: Finishing of prostheses.

Clinicians modifying plaster molds at a mobile clinic

Day 6: Distribution Ceremony.

Each mobile prosthetic unit can serve some 150-300 amputees. All types of prostheses, from hip disarticulation prostheses to Symes prostheses, can be provided. Ischial containment sockets are fabricated for above knee prostheses. There is a ventilation system that reduces heat within the socket, hence amputees feel comfortable and fungal infection is reduced. An artificial leg for agricultural work is also provided for each amputee who needs to do manual labor in the fields.

Between its beginning in August 1992 up to December 2001, the Foundation has provided 10,456 amputees with new artificial legs and has repaired 1,395 prostheses.

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Mobile clinic vehicles prepared for a morning departure

Wheelchair technology developments in Africa

Christine Cornick, Tanzania

The world's first wheelchair technologists graduated in August, 2001 from a one-year training course in Moshi, Tanzania. The Wheelchair Technologists Training Course, set up by the UK charity Motivation and the Tanzania Training Centre for Orthopaedic Technologists (TATCOT), is thought to be the first of its kind in the world.

It is a course that is desperately needed. There is a huge demand for appropriate wheelchairs in Africa, yet only approximately one per cent of those who require a wheelchair receive one. Furthermore, the small number of wheelchairs that are available have often been donated from more developed countries. These wheelchairs cannot cope with the rough roads and rural environment and quickly break.

The aim of the course is to give students from across Africa the skills they need to run successful wheelchair workshops. By introducing appropriately designed wheelchairs, the course hopes to boost the long-term mobility and quality of life of wheelchair users, most of whom are very poor. The course is comprehensive, covering wheelchair design theory as well as practical skills. Subjects range from Materials and Workshop Technology to Management, Technical Drawing and Therapy.

Luckson Mghase, WTTC trainer, teaching theory of brakes

The designs of wheelchairs introduced in the course have also been developed and tested in Tanzania as part of the project, building on Motivation's ten years' experience in wheelchair design in Asia, Central America and Eastern Europe, and involving a collaboration with Whirlwind Wheelchair International. The wheelchairs are strong, robust and as they are made only from locally available materials, can be easily maintained and repaired.

The students learn how to make a range of wheelchairs including a folding chair, suitable for use in an urban environment, and a rigid chair with three wheels designed for use in rural areas. A child's chair and a tricycle attachment are also included as part of the course.

Fatuma Acan, a first year student, learns how to spoke

The course focuses on understanding the design and function of each component, from the castor module to the upholstery, so the students are not confined to reproducing the designs taught, but can adapt and redesign components to suit the materials and production methods available in their region.

So far, it looks as though the project is on track for success. The first intake of students, themselves disabled people from Tanzania, Uganda and Zimbabwe, graduated as the world's first wheelchair technologists in August, 2001. At his graduation Fredrick Kayungilo from Mwanza, Tanzania, exclaimed, "I enjoyed the course very much. It is like I was coming to a market with an empty basket, and I am going back with my basket full of knowledge and skills."

Frederick and his four fellow graduates have now been back in their own workshops for just over a year, and have all begun their own wheelchair production as pioneers in their new profession. Meanwhile the second intake of students successfully graduated in July 2002 and a third intake of six students - from Zambia, Nigeria, Zimbabwe, and Tanzania began their studies in October, 2002. A new training centre has been built at TATCOT to provide a permanent home for the course, which was officially opened by the President of Tanzania in November 2002.

Members of different organizations who already have experience in wheelchair production are being encouraged to apply, in order that they will be able to introduce more appropriate technologies into their existing workshops. As new graduate Fatuma Acan explained, "When I came here I had already been producing wheelchairs in Uganda. As a wheelchair user myself I knew something about them, but I really had no idea what was involved in making sure someone gets a wheelchair that is right for them. On this course I have learnt to produce high quality wheelchairs and how to fit someone with a wheelchair. I have learnt so much."

The joint Motivation/TATCOT project has been 50% financed by the European Commission. USAID has provided sponsorship for many of the first two intakes of students and are very supportive of the project. The Ministry of Health in Uganda has also recognised the value of the training and have now sponsored two students in the course. It is hoped that other Ministries in Africa will also send students in the future.

Meanwhile, the project is also establishing financing systems to ensure the poorest members of society are not denied access to a wheelchair. This action is a result of pre-project research, which showed that boosting technical knowledge alone will not improve the situation. 'Wheelchair Funds' will include provisions for means, testing applicants and operating credit schemes.

The project in Africa is being carried out alongside a more large-scale Motivation programme aimed at developing the 'WorldMade' flat-pack wheelchair. This wheelchair is designed for production at a centralised location in Asia, with the assembly and distribution taking place throughout different regions. In the long term, the WorldMade wheelchair may be included in the TATCOT course to give students the option of including this design in their own workshop's range of mobility products.

TATCOT is a highly respected centre of excellence in Africa. Founded in 1981, it is one of the first supra-regional training centres in orthopaedic technology. The centre offers a range of courses in orthopaedic technology including a three-year diploma course, a four-year degree course, and a range of short courses. The courses are recognised by both the World Health Organisation and the International Society for Prosthetics and Orthotics (ISPO).

Motivation and TATCOT are very happy with the development of the Wheelchair Technologists Training Course so far. The principal of TATCOT and President Elect of ISPO, Harold Shangali, remarked: "It was just the right time for the development of the programme as it complements the school's intention of reinforcing disciplines involved in rehabilitation of people with different disabilities. It is also a unique opportunity as we hope the course will serve as a sample programme around the world in the future."

The rural wheelchair taught on the WTTC

For further information on the Wheelchair Technologists Training Course and other TATCOT courses, contact:

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Bayiyam Bilabina: First woman Orthopaedic Technician in West Africa

The following article was originally published in French in the Bulletin of the African Federation of Orthopaedic Technicians. It has been translated and edited by Linda Taggart.

Miss Bayiyam Bilabina, twenty-three years of age and of Togolese nationality, has entered the very "masculine" circle of orthopaedic technicians after her graduation from the School Orthopaedic Technology in Lomé in August, 2000.

Born September 26, 1977 in Kara, North Togo, Bayiyam Bilabina is the eldest in a family of ten children. Her father was a teacher and her mother a homemaker, though she was a dactylographic secretary by training.

Raised by her grandmother, nothing could dissuade this young girl from the profession of orthopaedic technician, which was until then, reserved only for men in Africa.

After her failure to meet university entrance requirements, Bayiyam Bilabina, like many young people her age, threw herself into examinations that would ensure a professional career prospect. She chose The National School of Medical Auxiliaries, where she passed the entrance examination in 1997. Why the choice of the Orthopaedic Section? "I was guided by my uncle, who counseled me and convinced me that no woman had ventured into this field in Africa and Togo, and especially, that I was the only woman to be accepted into this specialty."

From separated parents, Bayiyam Bilabina had to face a double challenge: "Glorify her abandoned mother" and succeed in this training, which was reserved for men. Being the only girl in a class of twenty-three students meant that each year of training was a battle in a field of work as physical as it is intellectual.

However, thanks to her self-sacrifice and her will to succeed, she was able to successfully complete the three years of orthopaedic technician training at Lomé, and finish ninth in her graduating class. Bayiyam Bilabina still remembers the day the diplomas were distributed where she, being the only woman of her class, attracted many stares and was the object of curiosity. She believes that she found this success, which she credits to her determination to work hard, in a particularly favorable and humane environment.

After a period of time at the Regional Centre of Orthopaedic Devices in Kara, and thanks to the support of Handicap International Togo, Bayiyam Bilabina joined the team from the National Centre of Orthopaedic Devices in Lomé in February, 2001. There, her motto is "give the most of myself" for the sake of all of the disabled people who are in need of help.

To her credit, she has fit fifteen patients and made seventeen devices. The orthoses included four KAFO's to treat valgus and varus deformities, two AFO's and three spinal orthoses. She also fit four large walking devices, one Thomas harness, one trans-tibial prosthesis, and one trans-femoral prosthesis.

Next comes reaching "the top of orthopaedics" and continuing to free this profession from the idea that it is reserved solely for men. Bayiyam Bilabina thinks that only continuous training or improvement in other centres will enable the attainment of this goal.

This past academic year, two other young girls of Togolese and Senegalese nationality were registered in first year of the Orthopaedic Technician program.

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Questions and Answers

REMINDER!! Everyone is welcome to pose questions either from past articles or from the field in general. These questions need not be specific to any particular topics, but can cover a wide variety of subject matter. Those who have questions or inquiries are encouraged to submit them for posting. It is hoped that the readership will respond to the questions posted through a related article or a short response.

Contact information is on the back page of the newsletter.

Folding wheelchair to accommodate two children with multiple disabilities: A case study

Vijay K. Gulati, India

Introduction

A number of wheelchairs of different designs are available on the market to fulfill the requirements of the disabled. For example, specialized wheelchairs have been designed for certain sports. Although there are strollers and carriages available to accommodate more than one child, there are no wheelchairs on the market to accommodate parents with more than one child with a disability. Of course, there are very few parents with two children with multiple disabilities. However, less demand for the rehabilitation aid is not a justification for not having developed such a wheelchair.

It is very difficult for parents to manage one child with multiple disabilities, as the child is totally dependent for all of his/her activities of daily living. One person must always be available to take care of such a child. To take the older child with multiple disabilities out of the home, a wheelchair propelled by someone is very necessary.

Case study

Unfortunately, there are parents who have more than one child with multiple disabilities. The difficulties such parents face raising these children to adulthood is unimaginable. One such family visited me recently. Two children in the family had multiple disabilities - spastic diplegia with poor trunk control. The children understood each and everything happening around them, and wished to enjoy their childhood as normal children. Because of disability, they were being deprived of all the moments of joy blessed by nature and god. Of course the parents tried to provide optimal facilities and keep their children cheerful. At home, the children were kept together and played within a group. They sat together and had their meals with their parents. During office hours for the working parents, the children were cared for by the elderly people at home or by the minders. This family managed the children with great difficulty. Problems arose when the children wanted to go out of their home. One of the parents had been taking one child at a time on a conventional wheelchair available on the market. However, this particular pair of children are so affectionate that they wanted to enjoy being together even when they go out of their home. Two wheelchairs were needed to be propelled by both the parents.

The father of these two children was searching for a wheelchair. He was keen to take the children to different parts of the country on tour. Both his daughters (age 12 and 14 years) were regular students of the school run by The Spastics Society of Northern India, New Delhi. Being an Orthotics consultant to the Spastics Society, I embraced this problem as a challenge. Initially it was decided to convert one old chair to make it convenient for two children. The amendments made in a conventional folding wheelchair were as follows:

1) The width of the seat and back were increased to expand the wheelchair an additonal ten inches.
2) A divider was placed under the seat to make two equal sags of the seats.
3) An additional pair of foot-rests was attached on either side of the wheelchair. Both foot-rests were folding and adjustable to the length of legs of the individual children.
4) A collapsible attachment was added to the top of the back to keep the wheelchair stretched while in use.
5) Two waist straps were added to keep the children in the seat.
6) Two straps were placed on the foot-rests to hold the feet in position.
7) Propelling rings were removed from the rear wheels to reduce the width and weight, as the rings were not needed.

This wheelchair enabled the father to take his two children touring around India

After trials, some minor adjustments were made to make the wheelchair suitable to both the children. On this modified wheelchair, the parents took their children to far off places traveling by trains, buses and other means of transportation. The whole family enjoyed the tour to a number of beautiful places in India, and the children's father was delighted at the success of the wheelchair. This wheelchair was used for two years. Within these two years, the children grew and needed more space in the wheelchair to sit comfortably. The old wheelchair was also worn out. A new replacement wheelchair suitable for two older children, with folding capabilities as well as being lightweight, was needed.

Detailed description of the first amended wheelchair

A folding wheelchair with two large wheels at the rear, two castors at the front, as well as a pair of foot-rests was selected for altering. Seat size was standard, and the back (16" x 18") made of flexible material. The alterations made were:

Seat and back

The maximum width after unfolding was increased from 18" to 28" by increasing the length of crossing pipes. One separator at the level of sides of the seat was fixed to divide the wheelchair into two parts. Similarly the back was increased width wise to give full support to both the children. Instead of a separator on the back, a stretching bar was connected to keep the back stretched during the use of the wheelchairs. This stretching bar is collapsible to permit folding of the chairs.

Propelling rings

The propelling rings were removed from the rear wheel as the wheelchair was to be used by the disabled children and propelled by the attendant. This reduced the width of the wheelchair to some extent, which has increased by the wider seat and back.

Foot-rests

The foot-rests were replaced as these were very low and small in size. Newly designed foot-rests with the following characteristics were attached.

a) Opening on the lateral side so that it does not obstruct the folding of the wheelchair.
b) Both the foot-rests were adjustable according to the leg length of individual children.
c) If the child wanted to straighten the legs, foot-rests could be positioned straight at the level of seat to give comfort to the child. Straps, to keep the feet in position, were added.

A set of new castor wheels at the front was also replaced, as the previous ones wore out.

Description of replacement wheelchair

Frame and foot-rests

A wheelchair to accommodate two children with multiple disabilities was designed. A mild steel tube was used to make the frame of the wheelchair. At the centre of the crossing pipes a seat separator is fixed with vertical supports on either side. Hand grips to push the wheelchair, brought closer by bending the tubes at about two inches above the proximal end of the back, were added. These helped to push the chair with less force and give comfort to the propeller of the wheelchair. The height of the hand grips was kept at a difference of 1.5 inches so that both the grips would not collide into each other and restrict the folding. Provisions for stretching the legs was not given in the foot-rests because it was not used when provided in the old wheelchair. A simple folding foot-rest with adjustment of height was provided.

Wheels

All four wheels have been accommodated under the seat of the wheelchair to restrict the width of it. The diameter of the rear wheel used was kept comparatively less than 12 inches so that it could be adjusted under the seat. Solid tire wheels with bicycle hubs and spokes, which were readily available on the market,

Wheelchair designed for two children with multiple disabilities

were fitted. The selection of solid tires was based on the conditions of roads in our country. Two castors, again with solid durable tires were selected. The location of the wheels provides a stable base to the wheel chair.

Seat and back

A flexible seat and back of fine Rexene reinforced with canvas (to give comfort and strength) were added. The seat and back were mounted on the frame with screws and washers. A collapsible bar was fitted at the top of the back to retain the unfolded position of wheelchair while in use.

Straps and harnessing

Belt straps with velcro fasteners were provided to retain the position of the children in the seat. Similar straps were provided on the foot-rest to hold the feet and legs in position.

Conclusion

A new model of the wheelchair that kept the needs of the children and the parents in mind was successfully developed. The parents were blessed with another baby who is healthy, which in turn has added to their happiness.

The father of the children requested a temporary provision for the third child in the wheelchair, so that the parents need not carry a separate pushchair for the infant along with the wheelchair. The addition is attachable and detachable within a few seconds by the parents and can be used until the third child grows up. It does not add more weight to the wheelchair. The wheelchair remains foldable and can easily be carried. This way, all three children can enjoy being together.

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Private workshops: A complement to public facilities

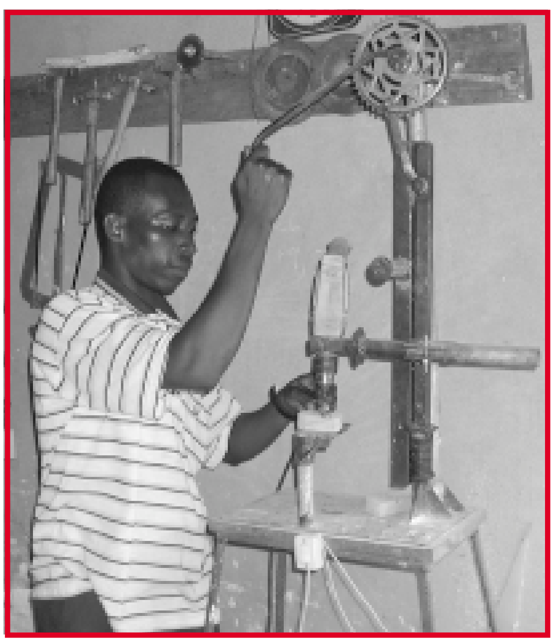
Sepp Heim, Germany

Togo is a narrow country in West Africa and has about 4.4 million inhabitants. The state care of physically handicapped persons with orthopaedic aids is done through the Centre National d'Appareillage Orthopédique, CNAO, in Lomé and its branches in Dapaon, Kara and Atakpamé. There are also two church institutions, which deal by and large with simple care.

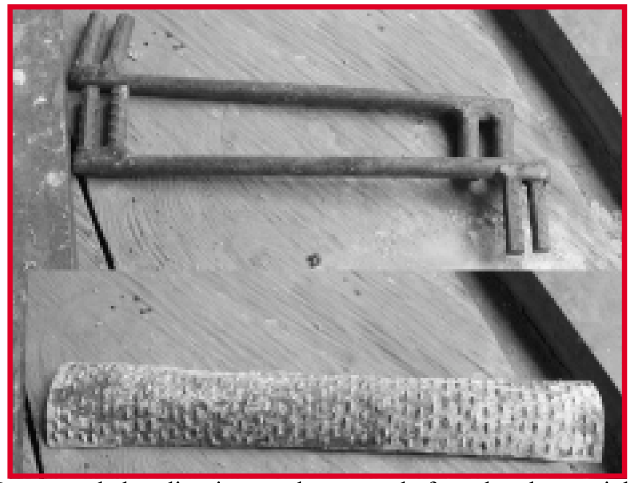
Togo runs an orthopaedic technical training centre in co-operation with the CNAO. This is integrated into the École Nationale des Auxiellières Medicaux, ENAM. The CNAO serves as a clinical training workshop for the school where the students have access to patient care. In this connection, it is interesting to know that Lomé is seen as a nation-wide training centre offering an education program for orthopaedic technicians to the French-speaking countries in West and Central Africa.

The population actually has access to quite a good network of care operations which can be reached easily. In spite of this, it must be noted that the cost to travel to the individual centres is a considerable social burden for those in need. The idea of a further decentralisation of the provision for care was presented and would be desirable.

A third possibility is care provided through private workshops. One such workshop with a limited care program is run by Mr. Nyavo Dotzi in Kpalimé, (a small town with about 20,000 inhabitants) 150 km from Lomé. Mr. Dotzi was trained at the CNAO. When he was unable to find employment with the state, he saw his professional future as a private supplier of care services away from the large towns in Togo. Since 1999, he has



A home-made drill press in Mr.Dotzi's clinic



Home-made bending iron and rasp made from local materials

run a small one-room workshop in the back yard of a house in Kpalimé.

Mr. Dotzi uses the garden and a terrace for fittings using hand-made parallel bars. His workshop fittings are very simple as he has made part of the tools himself, or bought them from the local market.

In 1999, he started with 4 patients. In 2001, he supplied about 30 patients, in addition to doing repairs and providing other services. The main requirements are polio orthoses, body orthoses, lower leg prostheses and foot orthoses. He also offers his technical services to the nearby regional hospital and a church clinic.

Mr. Dotzi has recently employed two additional staff (a physiotherapist and a technical helper) and makes quite a good income for this location.

A patient being assessed for a back brace

An example of positive development, this private workshop employs three previously unemployed people, who now earn an income and at the same time provide relief for the affected population.

There are no fares for transportation to the clinic for the local people. Before the clinic opened, individual patients had to travel to Lomé or other large town by bus or taxi, which is quite expensive and can take several days. Having a repair workshop in the local area saves travel costs and time.

During our visit, I had the opportunity to see several patients during the fittings or after supply. I can only say that this private facility demonstrates how technology can be adapted and adjusted to fit the needs of the local people and the economic resources, as well as environmental conditions. The devices fit were biomechanically correct, and fully functional.

This private workshop demonstrates how one's own initiative leads to success, and how good work can also be performed under local conditions. This example illustrates how private care operations can usefully complement the existing state system and contribute to the social security of those affected.

An oven for heating plastics

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Management of Polio

Phnom Penh, Cambodia July 2-11, 2002

John R. Fisk, M.D. Course Director

The 2002 ISPO instructional course on the Management of Polio was a resounding success. Drawing on the experience gained from previous courses held in Bangalore, India and Moshi, Tanzania, minor modifications were made to the organisation, course content, and faculty which proved beneficial overall. The curriculum is an outgrowth of the Consensus Conference on Polio held in Tunisia in 1997 and will be presented at future locations in the non-industrialised world.

Phnom Penh proved to be a good venue with its well established P&O school and many Physicians, Therapists and Orthotists eager to improve their skills. The country of Cambodia has two fundamental disability problems: land mine victims and polio paralysis. There are fifty Prothetic and Orthotic workers fitting an estimated 5,000 prostheses and 5,500 orthoses annually.

The first three days consisted of formal lectures followed by three days of hands-on patient evaluations and orthosis fabrication. The lectures were problematic due to poor English skills on the part of the participants. During the second half of the course, participants were divided into groups of ten people, which functioned as clinical teams. During these sessions small group teaching techniques helped to ensure that all were involved and that there were no problems with understanding. Patients were evaluated and fit. This approach proved very enjoyable and productive.

The faculty in all of the courses have represented all members of the clinical team and have been truly international in their makeup. It is also important to involve local faculty members to ensure that there is a balanced content relevant to the local needs. This generally proves to be difficult because of their lack of experience in presenting to such a forum and when not presenting in their native tongue. Nevertheless their involvement is invaluable. The audience literally cheered when one of their countrymen mounted the podium to give a presentation. They are always more popular than the international faculty.

The practical sessions have always been the highlight of the courses. They have introduced thermoplastics where none had previously been used. They introduced new techniques and in Phnom Penh allowed the orthotists and therapists to significantly upgrade their patient assessment skills.

Future sights for the Management of Polio course include Viet Nam and Togo. ISPO also sponsors an instructional course on the Orthotic Management of Cerebral Palsy.

These course directors can be reached via email.
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Plastic Architecture - Part III

Plastic reinforcements to enhance shape, material distribution, and function

Gordon K. Ruder, Canada

This article is the third of a series dedicated to using plastic architecture to dictate structural strength and orthotic function. The author is a certified orthotist and instructor at the George Brown College, Prosthetics & Orthotics Programs in Toronto, Canada.

Plastic Architecture – Parts I + II detailed how the shape and distribution of material relative to the bending axis can influence the structural strength and function of an orthosis. These two articles emphasised that correct cast rectification involves more than accounting for pressure tolerant and intolerant landmarks. The shape and trimlines of the orthosis optimize its effectiveness in generating corrective forces and / or preventing unwanted motion. This article will give an example of how these principles can be applied to the thermoplastic molding and finishing of an ankle-foot orthosis (AFO) to enhance effectiveness further. By selectively reinforcing specific regions of the orthotic device, instead of blocking abnormal motion, they can also function as springs to assist desired motion. If done correctly, plastic reinforcements result in an increased lifespan and less bulk.

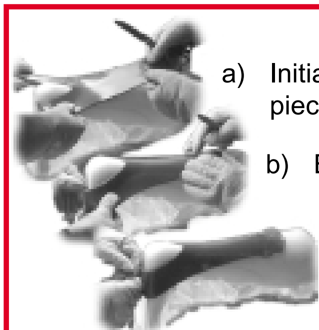

Fig. 1: Molding of a "Y-shaped" reinforcement on the posterior of the AFO

The important technical issues are as follows:

a) Initial placement of the reinforcing piece. An outline of where the reinforcement is to be placed is drawn onto the positive to facilitate accurate placement. The reinforcement is pre-cut before it is placed in the oven with the piece for the shell of the AFO. Immediately after the shell has been molded and before it begins to cool, the reinforcement is pressed on.

b) Ensuring a complete thermal bond, the reinforcement must contact along its centre line first. Then, it is pressed onto the shell, working out from the centre line. Care must be taken not to trap any air between the shell and the reinforcement. Delamination, or even complete fracture, usually occurs if air is trapped between the layers of plastic during the thermal molding process.

c) Finishing the molding of the reinforcement. Next the ends of the reinforcing piece are wrapped around the heel and the ends overlapped. Compress the plantar surface to minimize bulk and push out any trapped air.

Fig. 2: Standard flexible thermoplastic AFO in the neutral or resting alignment

The standard thermoplastic AFO has a good cross-sectional shape to resist plantarflexion during initial contact and swing phase. With dorsiflexion past the resting alignment, the bending force causes outward buckling of the medial and lateral walls of the heel and ankle area (Fig.3).

Where and when the buckle occurs, the cross-section shape changes dramatically and over a concentrated area. This focuses the stress of bending and makes the brace weaker in dorsiflexion.

Clinically it is often desirable to have free dorsiflexion with only drop foot or plantar flexion past neutral being resisted. The standard thermoplastic AFO however, is prone to fatigue and eventual fracture at the high stress area of bending.

Technical finishing of the reinforcement is critical, as there is a definite time required to learn this technique. Any air trapped between the shell and the reinforcement can lead to delamination and eventual mechanical failure. In finishing it is important to sand and bevel the reinforcement so that the transition is gradual; otherwise a weakness will arise at the border of less to more flexibility.

Fig.3: Standard flexible thermoplastic AFO buckling in dorsiflexion. The mechanical bending axis is very focused, concentrating the stresses over a small area

The type of thermoplastic used is important. Polypropylene will yield superior spring assist/resist, but is by nature more brittle than a copolymer.

The distal end of the posterior leaf is sanded so that its cross-sectional area (CSA) has a flat surface on the back and is more rectangular in shape (Fig 4a). This renders the AFO very resistant to in/eversion motion, but allows sagittal plantar-dorsiflexion. The plastic reinforcement makes this region thicker and more able to act as a spring. The more rectangular the CSA, means that buckling will not occur and the bending force is distributed over a greater area.

Through the heel region, the ends of the reinforcing piece are more anterior and wrap around the medial and lateral walls of the calcaneus (Fig 4b). The material distribution of the reinforcement blocks buckling from occurring in the area. This places the mechanical axis closer to the anatomical axis so there is less migration of the brace over the limb. Since the plastic doesn't bow out in the heel region, the AFO can control rear foot alignment better.

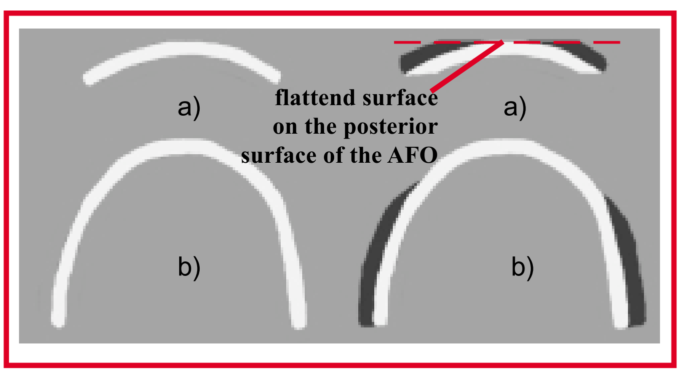

Fig.4: Cross-sectional views of the standard vs. reinforced. a) across the posterior leaf b) through the heel region

By continuing the rectangular CSA over the lower third of the posterior leaf, the plastic will bend more gradually and over a greater distance (fig. 5). This reduces stress-related fractures. Increasing the thickness of the posterior leaf means that it can act more like a spring, absorbing energy as the brace is dorsi- or plantar- flexed beyond neutral, and returning energy on the way back to the resting alignment. The heel region does not buckle so rear foot control is not compromised and the mechanical and anatomical ankle axes are more congruent.

Fig.5: The reinforced AFO's mechanical bending axis is spread out and thus less likely to buckle

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Please go to our website for a demonstration of the thermoplastic molding involved with this technique.
Other examples and related information will also be available at this site, which can be accessed by way of the ISPO website - http://www.ispo.ws

Message from the Editor

The May/June issue of ORTHOLETTER had a letter included with the mailing that was directed to an identified group of our subscribers. We hope those that received the letter will try to assist us in soliciting articles and material. This support is necessary from all of you to make this a viable publication and to sustain it for the long term. Many times those who wish to submit something to ORTHOLETTER feel the information they have is not of good quality or their command of the English language is not strong enough. We must encourage these individuals not to be deterred, as it is often this group who contributes the most valuable information to our readers. This issue is a very good example of this.

Also take note on page 5 where a "Questions and Answers" section is mentioned and described. This was included in the May/June 2002 issue but we only received one response to this request. We feel a continued dialogue in some way would enhance the value of ORTHOLETTER - so if you have any inquiries or comments on things you have seen in ORTHOLETTER, please let us know.

As a final note, please check out our website (listed below) as we are planning to place photos and movie files on the Internet to help explain or show things from an issue in a better way. For this issue, we are including some pictures and video to highlight the article on Plastic Architecture (pg 10-11). If you have access to the Internet we encourage you to have a look!

ORTHOLETTER is published twice a year by the International Society for Prosthetics and Orthotics, in collaboration with the World Health Organization.

For a free subscription or to make submissions to ORTHOLETTER, please contact the Editor at the address below:

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