

imperative. In the presence of contracture, the application of an orthotic device can be wrought with danger. If too much tension is applied in order to gain motion when the patient is walking, protective spasms may counteract any stretching effect. It is also possible that excessive pressure can result in a fracture, especially if the patient has been inactive for some time and if osteoporosis is present. The chances of successfully reducing joint limitations are increased when physical therapy and orthotic devices are combined in a comprehensive treatment program.

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Orthotic Correction of Blount's Disease

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

Infantile tibia vara is the result of abnormal growth in the proximal tibial epiphyseal late of the tibial plate. Blount¹ first identified the condition as osteochondrosis deformans tibialis in 1937. Clinically, tibia vara presents itself as a severe bowing of the proximal tibia, without the associated bowing of the tibial shaft or the femur, which is evident in physiological bowleg. On radiological examination of the child with tibia vara, a beaking of the medial aspect of the tibia metaphysis is noted. In 1964, Langenskiold and Riska² developed a grading system for chronologically staging the development of the Blount's disease. Mitchell, et al.³ advocated the use of the epiphyseal metaphyseal angle (E-M angle) as a simple quantitative measurement for Blount's disease in 1980. This method is useful to determine the severity of the disease and monitor treatment.

Historically, the use of orthotic management in the correction of Blount's disease has not proven to be as successful as hoped. The lack of correction and increased laxity of the joint capsule of the knee have been the main reasons for not continuing with orthotic management. To this point, the treatment of choice for individuals

with Stage IV or an E-M angle of greater than 30° has mandated that the child undergo one of several types of tibial osteotomies. Because of the high incidence of complications⁴ and the recurrence of the condition, the authors felt that a new orthotic approach should be investigated. The result of that investigation has been the development of a knee-ankle-foot orthosis. This orthosis has successfully been used in seven cases of Blount's disease.

ORTHOTIC DESIGN

Previous orthoses used in the treatment of Blount's disease have been either a KAFO with a medial side bar only, or a KAFO with bilateral side bars. The medial side bar KAFO incorporated a varus corrective knee pad. The bilateral side bar orthosis is essentially a passive device to maintain the existing condition and to prevent it from getting worse. Neither system has proven to be completely successful in the treatment of Blount's disease.

The design criteria established for the development of the knee-ankle-foot orthosis con-



Figure 1. Bilateral KAFO's for Blounts with stainless steel medial side bar, thermoplastic femoral section, and elastic tibial strap. Femoral section protects the knee joint while the elastic applies maximum force to the apex of the tibial curve.

sists of the following:

- The design must correct the varus deformity of the tibia.
- The medial joint capsule should not be distributed by the orthosis.
- Forces should be applied directly to the tibia and not the full length of the limb.

Because the patient is a growing child, it must be adjustable for growth as well as easily cleaned by the parents. The knee-ankle-foot orthosis which the authors have developed has met all of these criteria.

Stress to the medial joint capsule was prevented by using an inversion of the supracondylar suspension technique used for below knee prostheses.⁵ By having a medial thigh section extend beyond the joint space to the area of the medial tibial condyle, we were able to reduce the possibilities of applying stress to the joint space itself (Figure 1).

A dynamic system was used to apply corrective forces to the tibia. The use of an elastic material to provide dynamic forces has been well documented.⁶ A six-inch wide elastic gusset material with velcro closures provided an adjustable and continuously applied force to the tibia (Figure 2). The maximum force applied to the limb with the elastic material is at the apex of the

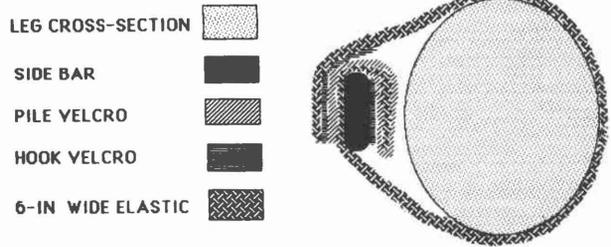


Figure 2. Cross section of leg and orthosis at mid-tibial level. The relationship of the sidebar, elastic, velcro, and limb are shown.

curve (Figure 1). This allows the maximum amount of correction with minimum amount of force. The velcro allows easy removal for laundering. All orthoses are provided with two sets of elastic straps.

The orthosis needed to be strong and adjustable because these children are growing and extremely active. The side bars are made of stainless steel which overlap for growth adjustment only between the knee and ankle (Figure 1). The knee-ankle-foot orthosis was not made adjustable proximal to this area in order to maintain the tibial extension of the thigh piece in its proper relationship to the tibial condyle. The patient's foot is maintained in a high top shoe which is attached to the medial side bar by means of a free ankle stirrup.

PRESCRIPTION CRITERIA

The E-M angle is used to determine whether the patient meets the criteria for orthotic management of the Blount's disease. The E-M angle is measured on an anterior/posterior x-ray of the knee. To construct this angle, a line is first drawn through two points on the base of the proximal tibial epiphysis, selecting the first point at the base of the normal lateral side of the epiphysis and the second medial point as far away from the lateral side as possible, but at the base of the normal non-depressed epiphysis. Next, determine the midpoint at the base of the epiphyseal center, then draw a second or metaphyseal line from the medial tip of the metaphyseal peak to the midpoint of the epiphyseal center (Figure 3). If this E-M angle is equal to or greater than 20°, then orthotic intervention is recommended. Mitchell et al. determined that the mean E-M angle for normal children was 3°-11°. Orthotic management is maintained for a minimum of nine months and at such time as the E-M angle is less



Figure 3 (left). Method of measuring the E-M angle.

Figure 4 (right). Clinical appearance of B.D. at age 3 with bilateral Blounts Disease.

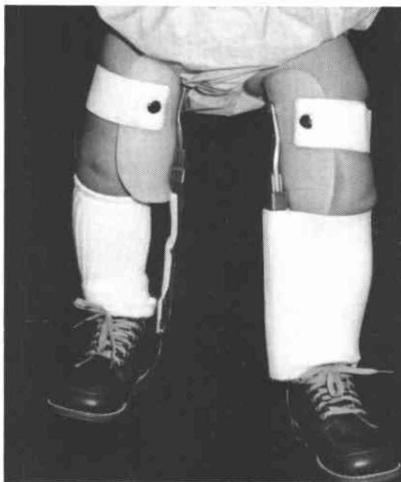


Figure 5 (left). Standing A/P radiograms show E-M angles of 20° bilaterally.

Figure 6A (right) and 6B (below). B.D. fitted with bilateral KAFO's. X-rays show no change at time of fitting.

than 15°. If the child is over eight years of age, orthotic correction will not be achieved. Based on our experience, orthotic management in stages I through III tibia vara can be effectively corrected with orthotic management. Aggressive treatment is necessary to achieve these results. Stages IV and V Blount's Disease and children over eight years of age need surgical treatment.

CASE STUDY

A white male, age 3, was presented at the orthotic clinic by his parents because of bowing of his right lower extremity (Figure 4). Clinical examination showed bilateral tibia vara. Bilateral standing AP radiograms were obtained. The E-M angle determined on these radiograms was 20° bilaterally (Figure 5). The child was fitted with the bilateral KAFO's (Figure 6A) and a new set of standing AP radiograms was obtained which showed no difference in the E-M angle at that time (Figure 6B).



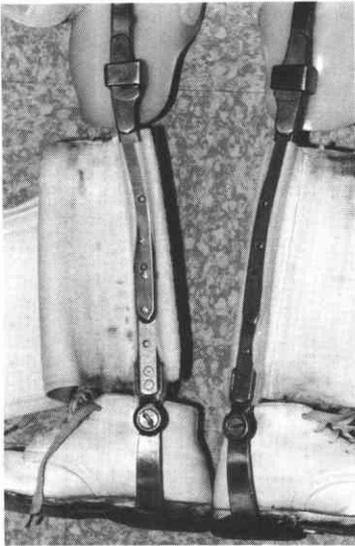


Figure 7. Sidebars were lengthened twice during the treatment period. One shoe transfer was also completed.

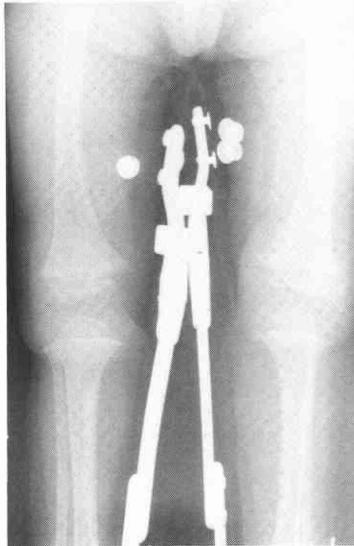


Figure 8. Radiogram taken after 9 months of treatment show an E/M angle of less than 15° as well as less bowing of the tibial shaft.

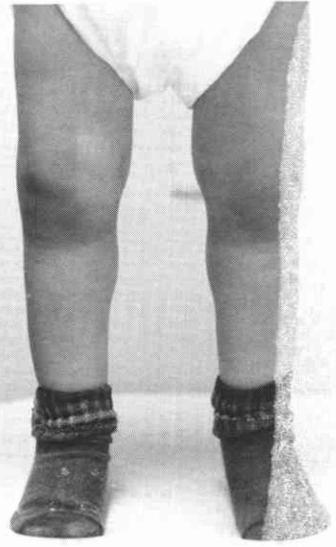


Figure 9. Orthotic treatment discontinued after 12 months. Clinical examination shows normal lower limbs.

For the next six months, B.D. wore his bilateral KAFO's 23 hours a day with the knee joints in the locked position during weight bearing. After one week's wearing time, the patient no longer objected to wearing the devices and adapted his lifestyle accordingly. No restrictions were placed on the child concerning his daily activities.

At his six-month checkup, new radiograms, both in and out of the KAFO's, were obtained. The E-M angle at that time was determined to be 15° bilaterally. Clinically, the child appears to have less bowing of his tibia as well. It was determined at that time that the side bars needed to be lengthened, which was done. It was decided that the parents could then allow the child to use the orthoses in the unlocked position during the daytime, but to return to the locked position at night. Because of growth of the child's feet, a shoe change was necessary.

At nine months, the patient was again presented to the clinic. Once again the orthoses were lengthened (Figure 7). New standing AP radiograms were also obtained, showing no significant alterations from the previous exam at six months (Figure 8). Day use of the KAFO was discontinued.

The patient returned for a twelve-month evaluation. No significant changes had occurred clinically in the patient's extremities (Figure 9), thus use of the orthoses was discontinued.

SUMMARY

This successful use of orthotic management in the early stages of Blount's disease has been proven at Southern Illinois University School of Medicine. An orthosis was designed to specifically meet the established criteria of correcting the tibial deformity, reducing the stress on the medial joint capsule, and allowing adjustability for growth. The device has been used in seven cases of tibia vara with excellent results in all cases. The E-M angle of the affected tibiae have been reduced to less than 15°. Aggressive treatment in the early stages of Blount's disease will reduce the necessity of tibial osteotomies with their significant level of complications.

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Passive Mobilization: An Orthotist's Overview

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INTRODUCTION

The application of passive motion in orthopedics has brought a new dimension to an old concept for the treatment of musculoskeletal problems. It is now recognized that the adverse effects of immobilization such as joint stiffness, poor articular cartilage nourishment, and collagen loss can be reversed by prolonged passive mobilization. R.B. Salter demonstrated significant results with his experimental work in the healing of osteochondral defects in rabbits subjected to continuous passive motion. R.D. Coutts followed with clinical experiences of improved range of motion after total knee replacements. The indications for passive motion have since broadened to include knee ligament reconstructions, injuries about joint, fractures, dislocations, joint sepsis, and many others.

The orthotist is often consulted for evaluation of passive motion devices, their set-up, adaptation, and implementation with fracture orthotics, external fixation, and traction. This article will provide an overview of passive mobilization as supplement to the practitioner's data base and present a variety of clinical situations encountered in the Dallas area at a large trauma and reconstruction center.

BACKGROUND

For centuries, the clinician has vacillated between the uses and benefits of rest versus motion in the management of various disorders and injuries involving body joints. Rest or motion have been the most prescribed forms of non-operative treatment, yet the controversy of indication, duration, and value of each is far from being resolved.

In the teaching of Hippocrates, the injured body was to be at 'rest and lie up.' His use of splints in musculoskeletal injuries assured rest. With the impregnation of bandages with plaster of Paris in 1852 by Flemish surgeon Antonius Mathijsen, immobilization took on a new form. The use of plaster casts in treating trauma and injury unquestionably assured the concept of immobilization by orthopedic surgeons for the next 130 years with little examination of the potential damage to articular tissue. Additional support of the rest concept was led by the British surgeon Hugh Owen Thomas. His doctrine of rest was to be complete, prolonged, uninterrupted, and enforced. This was accomplished through the use of splints of his own design, many of which are still in use today with minor modifications. Thomas' immobilization tech-