



# Clinical Prosthetics & Orthotics



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## Biomechanical Considerations in the Orthotic Management of the Knee

by Victor H. Frankel, M.D., Ph.D.\*

The challenges facing the contemporary orthotist are akin to the interminable task of Sisyphus, the Greek mythic figure who was condemned to pushing a huge rock up an endless hill. Unlike Sisyphus, however, the orthotist has made and continues to make significant strides in the rational design and fabrication of prostheses and orthotic devices. Over the past decade major contributions to solving the anatomical and functional problems associated with joint replacement prostheses and orthoses have directly resulted from the growing interaction between orthopaedic surgery and biomechanics. The result of this increased interaction has been improved diagnosis and treatment of musculoskeletal disorders with prostheses and orthotic devices. The knee is certainly one of the joints that has greatly benefited from these biomechanical developments.

Biomechanics enables the scientist to accurately describe and quantify surface joint motion of the knee and to analyze the complex forces imposed on the knee. Biomechanics also brings the motion of and the forces acting on the knee into sharp focus by analyzing the mechanical properties of the static and dynamic structures surrounding the knee: muscles, bones, ligaments, cartilage, and tendons. The biomechanical analysis of motion and force in the knee joint can be widely and successfully applied in orthotic management of the knee.

The human knee is the largest and perhaps the most complex joint in the body. It is a two-joint structure composed of the tibiofemoral joint and the patellofemoral joint. Both joints sustain high forces and, located between the body's two longest lever arms, are particularly susceptible to injury. The knee transmits loads, participates in motion, aids in conservation of momentum, and provides a force couple for activities involving the leg.

Although motion in the knee occurs simultaneously in three planes, the motion in one plane is so great that it accounts for most knee motion. Similarly, muscle forces

on the knee are produced by several muscles, but a single muscle group (according to the activity) produces a force so large that it accounts for most of the muscle force acting on the knee. Thus, biomechanical analysis can be basically limited to motion in one plane and to the force produced by a single muscle group, and yet can still give an understanding of knee motion and an estimation of the magnitude of the main forces acting on the knee.

To analyze motion in any joint, one must use kinematics, the branch of mechanics that deals with motion of a body without reference to force or mass. To analyze the forces imposed on a joint one must use both kinematic and kinetic data. Kinetics is the branch of mechanics which analyzes the motion of a body under the influence of given forces.

### Kinematics

Kinematic data define the range of motion and describe the surface joint motion in three planes: frontal (coronal or longitudinal), sagittal, and transverse (horizontal).

The range of motion can be measured in any joint and in any plane. Gross measurements can be made by goniometry, but more specific measurements must be made with more precise methods such as electrogoniometry, roentgenography, or photographic techniques using skeletal pins.<sup>3,6,7</sup>

The range of knee joint motion needed for performing various physical activities can be determined from kinematic analysis. A full range of knee motion is needed for performing the more vigorous activities of daily life in a normal manner. Moreover, any restriction of knee motion will be compensated for by increased motion in other joints.

The values obtained in several studies indicate that full extension and at least 117 degrees of flexion are necessary

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for carrying out the activities of daily life in a normal manner (Table 1).<sup>2,5,8</sup>

## Surface Joint Motion

Surface joint motion, the motion between the articulating surfaces of a joint, can also be described for any joint in the sagittal and frontal planes, but not the transverse plane. The method used is called the instant center technique. This technique allows a description of the relative uniplanar motion of two adjacent segments of a body and the direction of displacement of the contact points between these segments. The instant center for motion of a planar joint can be obtained by the method of Reuleaux (1876).<sup>9</sup>

Clinically, a pathway of the instant center for a joint can be plotted by taking successive roentgenograms of the joint in different positions (usually ten degrees apart) throughout the range of motion in one plane, and applying the Reuleaux method for locating the instant center for each interval of motion. After the instant center pathway has been determined, the surface joint motion can be described. In a normal knee, the instant center pathway for the tibiofemoral joint is semicircular.

Especially pertinent to orthotic management is data concerning knees with internal derangements. If the knee is extended and flexed about a displaced instant center, the tibiofemoral joint surfaces do not slide tangentially throughout the range of motion, but become either distracted or compressed. Such a knee is analogous to trying to close a door with a bent hinge. If the knee is continually forced to move about a displaced instant center, it will gradually adjust to this situation by either stretching the ligaments and supporting structures of the joint or by exerting abnormally high pressure on the articular surfaces.

Such internal derangements of the tibiofemoral joint may interfere with the so-called screw-home mechanism, which is a combined motion of knee extension and external rotation of the tibia. The tibiofemoral joint is not a simple hinge joint, but has a spiral, or helicoid, motion. The spiral motion of the tibia about the femur during flexion and extension results from the anatomical config-

## Table I

### Range of Tibiofemoral Joint Motion in the Sagittal Plane During Common Activities

| Activity          | Range of Motion from<br>Knee Extension to<br>Knee Flexion (degrees) |
|-------------------|---|
| Walking           | 0-67*   |
| Climbing Stairs   | 0-83**  |
| Descending stairs | 0-90  |
| Sitting down      | 0-93  |
| Tying a shoe      | 0-106   |
| Lifting an object | 0-117   |

\*Data from Kettelkamp et. al., 1970. Mean for 22 subjects. A slight difference was found between right and left knees (mean for right knee 68.1 degrees; mean for left knee 66.7 degrees).

\*\*From Laubenthal, et. al., 1972. Mean for 30 subjects.

uration of the medial femoral condyle; in a normal knee this condyle is approximately 1.7cm longer than the lateral femoral condyle. As the tibia slides on the femur from the fully flexed to the fully extended position, it descends and then ascends the curves of the medial femoral condyle and simultaneously rotates externally. This motion is reversed as the tibia moves back into the fully flexed position. The screw-home mechanism gives more stability to the knee in any position than would be possible if the tibiofemoral joint were a simple hinge joint.

The Helfet test, a simple clinical test, is used to determine if external rotation of the tibia occurs during knee extension, thus showing whether the screw-home mechanism is intact.<sup>3</sup>

In a deranged knee it may happen that no external rotation of the tibia occurs during extension. Because of the altered surface motion, the tibiofemoral joint will be abnormally compressed if the knee is forced into extension, and the joint surfaces may be damaged.

## Kinetics

Kinetic data, based on static and dynamic analysis, are used to analyze the forces acting on a joint. The medical scientist can use kinetic analysis to determine the size of the forces imposed on the knee by muscles, body weight, connective tissues, or external loads in either static or dynamic situations. In particular regard to orthotic management, however, situations and movements which produce excessively high forces can be identified.

In static analysis, the three main coplanar forces acting on a body in equilibrium are identified as: (1) the ground reaction force (equal to body weight), (2) the tensile force exerted by the quadriceps muscle through the patellar tendon, and (3) the joint reaction force acting on the tibial plateau. Since most of our activities are dynamic, however, an analysis of the forces acting on the knee during motion—dynamic analysis—must be applied to given situations. In addition to the three coplanar forces of static analysis, the medical scientist must also take into account the acceleration of the body part (the amount of torque needed to accelerate a body, for which anthropometric

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data-tables are used).<sup>1</sup> An orthotist might use dynamic analysis, for example, to calculate the joint reaction, muscle, or ligament forces on the tibiofemoral joint at a particular instant in time during walking, or at a particular instant in time (with a stroboscopic film) while kicking a football.

Other biomechanical considerations in the orthotic management of the knee involve the two important functions of the patella: (1) it aids knee extension by lengthening the lever arm on the quadriceps, and (2) it allows a better distribution of stresses on the femur by increasing the area of contact between the patellar tendon and the femur. In a patellectomized knee, for example, the quadriceps muscle, now with a shorter lever arm, must produce even more force than normal to achieve the required torque about the knee during the last 45 degrees of extension. Full, active extension of a patellectomized knee may require as much as 30 percent more quadriceps force than normally required.<sup>4</sup>

During most dynamic activities, the greater the knee flexion, the higher all the muscle forces acting on the patellofemoral joint. Forces increase proportionately with knee flexion, for example, from walking to stair climbing to knee bends. Patients with patellofemoral joint derangements experience increased pain when performing activities requiring knee flexion, and orthotic management could be greatly aided by knowledge of such predictive biomechanical factors as knee flexion, and the muscle and joint reaction forces for specific situations.

Biomechanical analysis can yield invaluable, practical data for the orthotic management of the knee. A continuing, close interaction among orthopaedic surgeons, bioengineers, and orthotists will insure the applied efficacy of such data.

## The Role of Orthoses in the Care of Knee Ligament Injuries

by Kenneth E. DeHaven, M.D.\*

The role of braces in the management of knee ligament injuries, particularly in high risk athletics, continues to receive a great deal of attention. There are a multitude of braces currently being manufactured and marketed with various claims relating to the effectiveness, comfort, durability, and cost.

Two key questions remain for most clinicians: (1) Should knee braces be used at all?, and (2) If so, what type of brace should be used and under what circumstances? At present there is a paucity of scientific data available to answer either of these questions with certainty, but there are encouraging signs that this essential information will be forthcoming from current and future research. Until an adequate scientific basis has been established it is necessary to develop a philosophy about bracing in athletics that is consistent with the data that is available and our clinical observations.

### *Should braces be used at all?*

There is frequently an ego problem for both the athlete (who views a brace as a sign of weakness) and the physician (concern that a brace reflects less than optimal results) who delight in the statement "Doc, I don't need that

## References

<sup>1</sup>Drillis, R., Contini, R., and Blustein, M.: "Body segment parameters: A survey of measurement techniques," *Artificial Limbs*, 8:44, 1964.

<sup>2</sup>Frankel, V.H., and Nordin, M.: *Basic Biomechanics of the Skeletal System*. Philadelphia, Lea & Febiger, 1980.

<sup>3</sup>Helfet, A.J.: "Anatomy and mechanics of movement of the knee joint," *Disorders of the Knee*, edited by A. Helfet, Philadelphia, J.B. Lippincott, 1974.

<sup>4</sup>Kaufer, H.: "Mechanical function of the patella," *Journal of Bone & Joint Surgery*, 53A:1551, 1971.

<sup>5</sup>Kettelkamp, D.B., Johnson, R.J., Smidt, G.L., Chao, E.Y.S., and Walker, M.: "An electrogoniometric study of knee motion in normal gait," *Journal of Bone & Joint Surgery*, 52A:775, 1970.

<sup>6</sup>Laubenthal, K.N., Smidt, G.L., and Kettelkamp, D.B.: "A quantitative analysis of knee motion during activities of daily living," *Physical Therapy*, 52:34, 1972.

<sup>7</sup>Murray, M.P., Drought, A.B., and Kory, R.C.: "Walking patterns of normal men," *Journal of Bone & Joint Surgery*, 46A:335, 1964.

<sup>8</sup>Perry, J., Norwood, L., and House, K.: "Knee posture and biceps and semimembranosus muscle action in running and cutting (an EMG study)," *Transactions of the 23rd Annual Meeting, Orthopaedic Research Society*, 2:258, 1977.

<sup>9</sup>Reuleaux, F.: *The Kinematics of Machinery: Outline of a Theory of Machines*. London, Macmillan, 1976.

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brace—I can run and cut without it." Definitive treatment, whether rehabilitation or surgery followed by rehabilitation, must provide the functional stability, and it is rare in my experience that an unstable knee is made stable simply by applying a brace. However, no matter how good it might feel to the athlete, a knee that has previously sustained major ligament injury is not normal, and in fact has suffered ligament disruption at a time when it was normal. The role of bracing, therefore, is not to provide stability but to help prevent reinjury by keeping the knee from going into extreme positions when subjected to sudden stress. When presented in this light, the concept of protective bracing after major ligament injury to the knee is more reasonable and more acceptable to both the athlete and the physician.

### *What type of brace should be used and under what circumstances?*

While not definitively established, it appears that the beneficial effects of knee orthoses are related not only to their mechanical strength but also to providing increased proprioceptive input from the knee area (which can ex-

plain how some patients feel more stable in braces that provide little or no mechanical support). Optimal support is provided by braces that protect against varus/valgus and hyperextension stresses and are utilized routinely in our Center following ligament repair or reconstruction of collateral and/or cruciate ligaments. The brace is initially worn for ambulation in the early postoperative period (two or four months) and later for agility, contact, or other types of "high risk" sports. Less sophisticated braces that provide just varus/valgus support usually are sufficient for athletes returning to similar sports in the same season following Grade II collateral ligament sprains. The practicality, efficacy, and cost effectiveness of prophylactic bracing to prevent injury in contact sports such as football

is also a topic of great interest but remains unresolved at present.

It is important to emphasize that this represents personal philosophy and recommendations based upon the information available at this time. It is recognized that while these concepts appear to be reasonable they are largely unproven, and there continues to be great need for more biomechanical and clinical research to firmly establish a scientific basis for knee bracing in athletics.

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## The Technical Aspects of the Orthopaedic Treatment of the Knee after Sports Injuries

by Andre Bähler\*

The last decades have shown a marked increase in the number of people, both young and old, participating in sporting activities. As a result of systematic education and schooling, it has become generally recognized that a certain amount of physical exercise is necessary for a healthy body.

The mass media—radio, television, the press—as well as schools and private insurance companies, have systematically reported the advantages to be gained by participating in physical activities.

Sports are no longer the prerogative of the young; there is no age limit for those engaged in sports in one form or another. Senior citizen keep-fit groups, jogging, and the like, have proven to many older people that age is not a justified reason to neglect physical fitness, and they have become aware that exercise is a means of showing the body the respect it deserves.

However, this almost revolutionary attitude towards sports is not limited to amateurs, but has also brought changes into the world of top athletes. Today, the degree of involvement is greater than ever before, but so accordingly are the associated risks. Many forms of sports seem to have lost sight of the original ideal of sportsmanship. Enjoyment and leisure have been replaced by a deadly seriousness in attitude that only total dedication will bring the desired results. Not only in the competition itself, but in the long months and sometimes years of training prior to it, the body is stretched to its utmost. Success at any price is the motto of the day, and such an attitude consciously calculates and accepts casualties and losses as part of the "game."

It has been proven that this type of approach to sports results in an increase in injuries, strain, and general wear, particularly in the joints of the lower limbs. Clearly, modern sports put the knee-joint under great pressure. Be it cycling, football, skiing or ice-hockey, the movement of the knee is of central importance, as changing techniques increase the pressure put on it.

The large number of knee injuries are a cause of great concern to modern sports medicine. The top athletes in particular, are anxious to start training again as soon as possible after injury. Although the knee is capable of taking great strain, mobility is often restricted, either by external injuries, or because of wear within the joint itself.

Immobilization of the joint after injury or surgery can damage the cartilage, hindering the assimilation of nutrients. The ligaments begin to lose their tensility, there is a loss of coordination between muscle groups, and muscles atrophy.

Finally, immobilization of a limb also affects the whole organism, particularly circulation, respiration, and the digestive system, and last but not least, the psychological effect of immobilization should not be underestimated.

Controlled movement of the knee-joint after ligament surgery has great advantages during rehabilitation: movement between 20-60 degrees does not strain the collateral or cruciate ligaments to any degree.

The muscles are also activated within pre-controlled limits. In tests, Hettinger found that 20-30 percent of the maximum pressure was sufficient to retain normal muscle strength. However, in order to increase muscle strength, the pressure must be at least 40-50 percent, and this is not possible after surgery. Therefore, rehabilitation requires electro-stimulation. A pre-condition of functional treatment is the exact restoration of all the anatomical elements, (e.g. cruciate and collateral ligaments).

### Rehabilitation Phases

#### *Pre-operative Treatment*

When reconstructive surgery is required in the case of an old injury to the knee, the time before the operation should be used to improve and retain muscle strength, for

coordination exercises, and to instruct and explain the postoperative treatment

## Post-operative Treatment

**Day 1:** For the rest period, the leg should be held in a preoperative prepared plaster-splint with a flexion angle of 20-30 degrees.

**Day 5:** A knee-orthosis with a 20-50 degree range of movement is fitted and a gentle swinging movement is allowed. The orthosis is also worn in the pool but the injured leg should not actually be used for swimming. Rehabilitation at this stage should also include controlled extension and flexion exercises between 20-60 degrees and isometric quadriceps training.

**Fifth to sixth week:** Flexion and extension exercises from 0-90 degrees should be practiced. For walking, the orthosis must be locked in extension with the swiss-lock.

**After eight weeks:** The lock can be removed and the patient may be allowed to walk with free movement of the joint. The orthosis is usually worn for approximately one year.

## The Principles of Fixation and Correction with the Orthosis

Both the upper and lower leg must be securely held all round. If necessary, support at the thigh is given on the same principle as a prosthetic support. If the upper and lower leg are kept straight, then it is best to use a physiological (polycentric, Ed.) knee-joint.

However, if the securing bands of the orthosis are made of rubber or a similar material, then a simple single-axis knee-joint is sufficient.

Besides the above mentioned points, the orthosis for post-operative rehabilitation after ligament reconstruction must also exhibit the following characteristics:

1. The program of correction or fixation must be exactly determined in advance.
2. The upper and lower leg must be securely held in the orthosis.
3. The construction of the joint must allow for varying ranges of mobility:
  - a) 20-50 degrees
  - b) 0-90 degrees with the option of a locking device
  - c) 0-120 degrees with free movement.

## Procedure to Relieve the Medial or Lateral Ligaments

*Principle: Triple-point correction (Figure 1)*

The principle underlying the triple-point correction, forms the basis for efficient correction of genu varum or genu valgum. With young patients, it is possible to position the correcting pressure-pads exactly, but with older patients, because of the flaccid tissue, pressure must be applied over as large an area as possible, e.g., with splints which distribute the pressure equally. For technical as well as anatomical reasons, it is often not possible to apply

pressure at the centre of the joint itself, therefore pressure must be applied above and below the joint, but as near to it as possible.

If the splints do not fit securely, then the orthosis will twist inwards when bent and this results in a reduction of the correcting forces at extension.

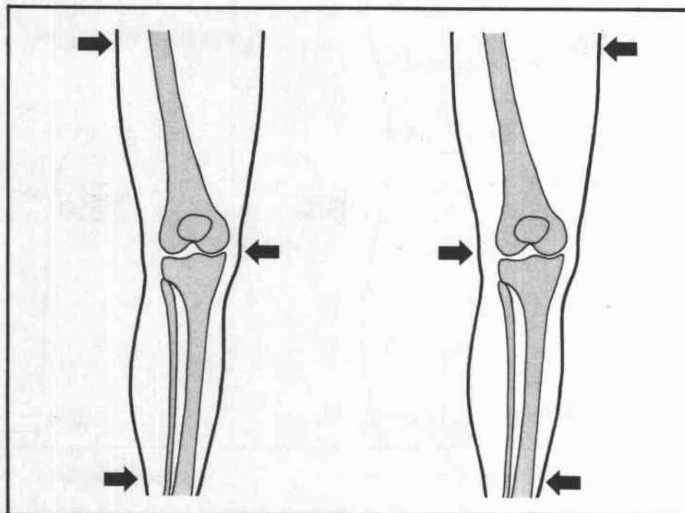


Figure 1: Triple-point correction to relieve the medial or lateral ligaments.

## Procedure for Controlling the Posterior Drawer

*Principle: Posterior pressure on the proximal lower leg and anterior pressure on the distal upper leg (Figure 2)*

There are two biomechanical procedures to choose from:

1. Fixation of the upper and lower leg with the orthosis on the basis of the triple-point method. With this method, the splints are fitted individually to the

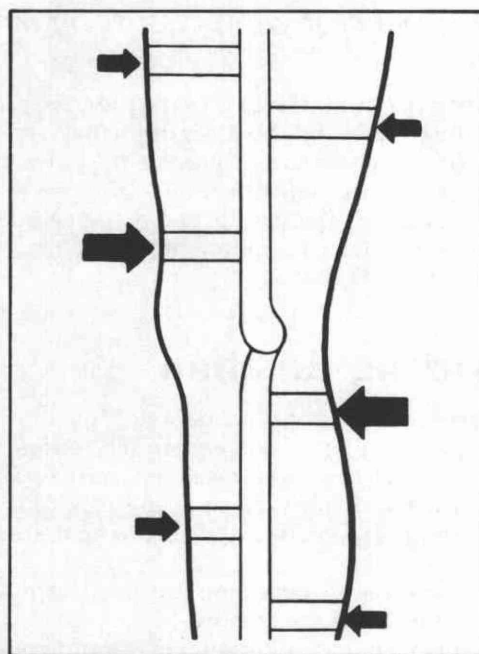


Figure 2: Controlling the posterior drawer.

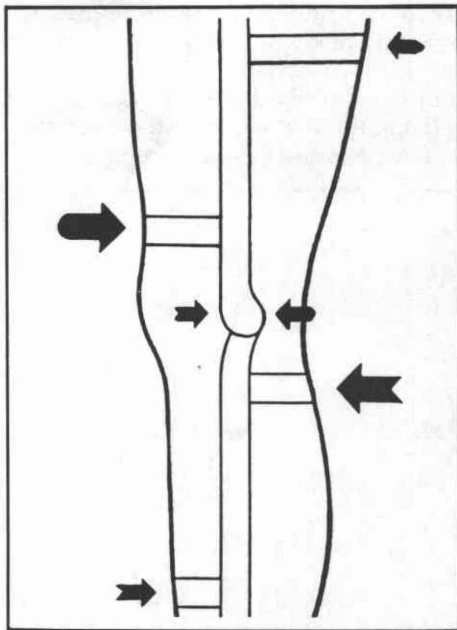


Figure 3: An alternative approach.

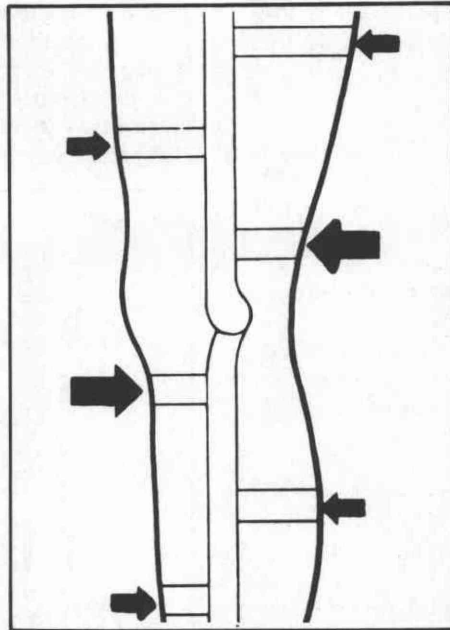


Figure 4: Fixation of the upper and lower leg.

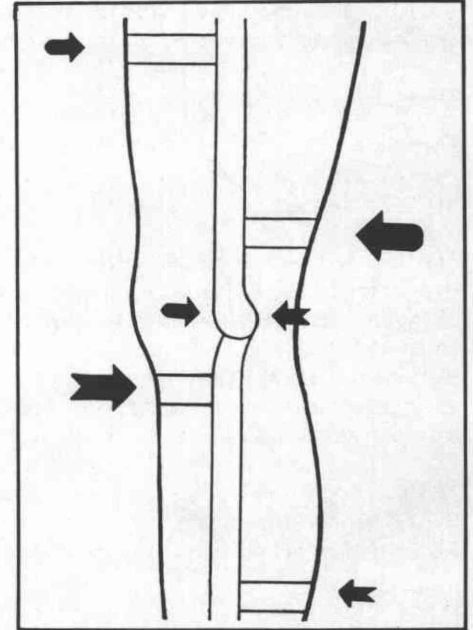


Figure 5: Increase the distance between the knee and the external counter-pressure.

upper and lower leg and the correcting pressures are placed so that a posterior drawer is held firmly.

2. Placing the correcting pressures in such a way that together with the knee-joint of the orthosis, they act as a lever. Here too, it is advantageous to distribute the pressure over as large a surface as possible (Figure 3).

## Procedure to Correct the Anterior Drawer

*Principle: Anterior pressure on the proximal lower leg and posterior pressure on the distal upper leg*

This involves, first, the fixation of the upper and lower leg with the orthosis on the basis of the triple-point principle (Figure 4), and second, placing the correcting pressure so that together with the knee-joint of the orthosis, they act as a lever. The greater the distance between the knee and the external counter-pressure, the better the corrective effect (Figure 5).

## Restricting Rotation

The restriction of rotation depends on how well the orthosis fits the upper and lower leg. The efficiency of the orthosis in restricting rotation is determined less by the type of orthosis, than by the size and type of the surface area of support. In practice, the following points must be checked:

1. Any fixation of the knee-joint must conform to the principles of biomechanics.
2. The orthosis and all bandages should cover the leg properly to ensure that the orthosis does not slip.

3. The orthosis must fit so as not to hinder or limit muscle activity.

As we found that the orthotic devices available at present did not completely satisfy our needs, we devised a system of our own which we would now like to explain with the help of some photographs.

## Type I: Sport Orthosis for Old Injuries to the Knee, or for Instability of the Joint

In order to keep the reduction in fitness to a minimum, the athlete aims to return to training as soon as possible. However, the knee is often not strong enough to cope with the high demands made upon it and needs some form of support, without however, limiting the range of movement.

This orthosis guides the joint and eliminates the forward and backward drawer as well as movements to the side (Figures 6, 7, 8). If necessary, it can also be fitted so as to restrict all extreme movements. The half-splints of the orthosis are made of the new Plexiglass XTO (natur) by the Röhm Company (Darmstadt 1). This material is much tougher than the well-known Plexidur. It is easy to form, and locks can be fitted to the joints without first having to be strengthened. In order to stop the splints from slipping, they are lined with a thin layer of foam-rubber. The best results are achieved when the orthosis is formed from a plaster model of the leg.

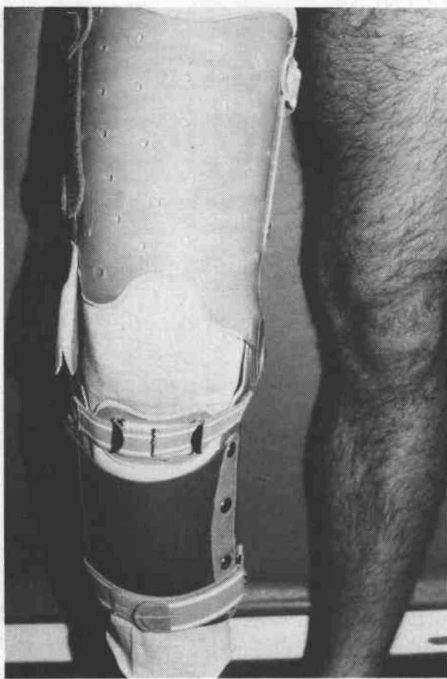


Figure 6: The sport orthosis eliminates forward and backward drawer.

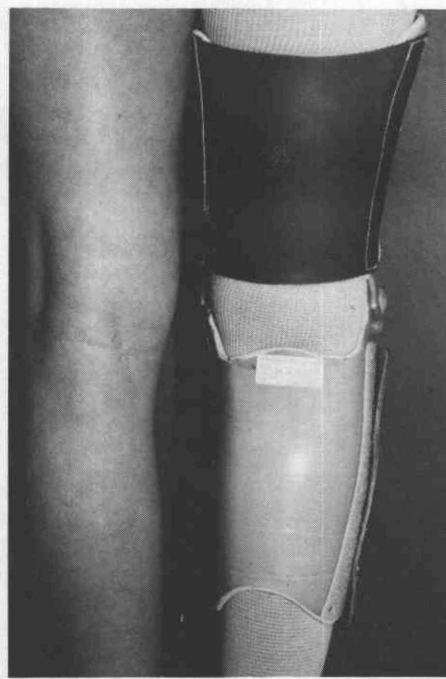


Figure 7: The orthosis can be fit to eliminate all extreme movements.

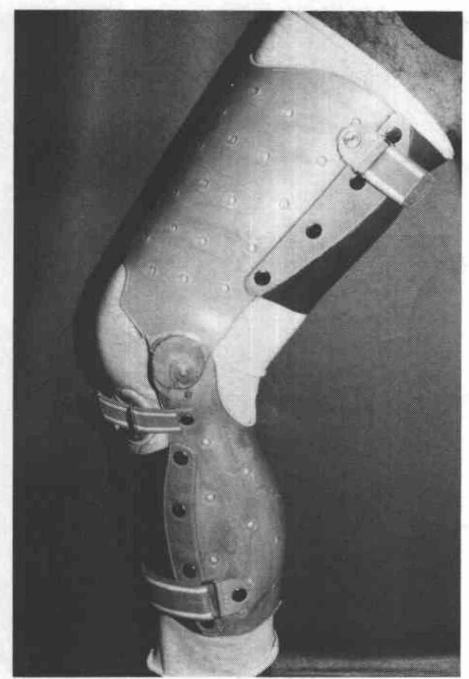


Figure 8: The half-splints are made of Plexiglass XTO.

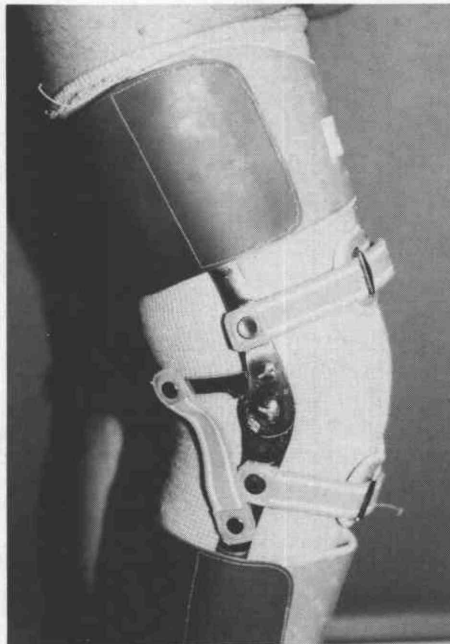


Figure 9: A lock and positioning screw are fixed to the outside of the splint.



Figure 10: The positioning screw allows movement between 20-60 degrees.

## Type II: Orthosis for Operative Ligament Reconstruction, or Other Similar Serious Knee Injuries

Basically the same orthosis is made as in Type I (Figures 3, 4, 5) but with the difference that a lock and positioning-screw are fixed to the outside of the splint (Figures 9, 10). As already mentioned, the positioning screw allows a movement between 20-60 degrees. After a while, this can be removed and the lock used to hold the leg in extension.

Depending on the injury, the half-splints are placed either at the front or at the back of the upper and lower leg. Securing straps and pressure-pads increase the corrective effect.

\*Andre Bähler is an Orthotist/Prosthetist from Zurich, Switzerland.

# Results from the Questionnaire on Hydraulic-Pneumatic Knee Units

Eleven responses were received by the first of February. The individual responses were as follows:

1. For what percentage of your AK amputees would you consider hydraulic-pneumatic control units relevant?

|         |   |       |
|---------|---|-------|
| 0-20%   | 7 | (64%) |
| 20-40%  | 2 | (18%) |
| 40-60%  | 1 | (9%)  |
| 60-80%  | 1 | (9%)  |
| 80-100% | 0 | —     |

2. Of those for whom you consider such units suitable, what percentage are using them?

|         |   |       |
|---------|---|-------|
| 0-20%   | 2 | (18%) |
| 20-40%  | 0 | —     |
| 40-60%  | 1 | (9%)  |
| 60-80%  | 3 | (27%) |
| 80-100% | 1 | (9%)  |

3. Are you and your patients satisfied with the units?

|     |   |       |
|-----|---|-------|
| Yes | 8 | (73%) |
| No  | 3 | (27%) |

4. Do you think further R&D is justified and necessary?

|          |   |       |
|----------|---|-------|
| Yes      | 9 | (82%) |
| No       | 1 | (9%)  |
| Yes & No |   | (9%)  |

5. Name the hydraulic-pneumatic control unit most frequently used in your practice.

|                         |    |
|-------------------------|----|
| S-N-S                   | 10 |
| Dapaco                  | 2  |
| Dynaplex                | 1  |
| Mortenson<br>(Kingsley) | 1  |

With the exception of one individual who stated that the Dapaco was the unit he used most frequently, all other respondents mentioned the S-N-S unit. Eight cited the S-N-S as their most frequently used unit and the others cited the other units mentioned (Dapaco, Dynaplex, Mortenson) as being used in conjunction with the S-N-S.

6. Additional Comments:

- These units were only used with young, active males and traumatic amputations. The bulk of my A/K patients are geriatrics and I have never used such a unit with them.
- Even in an active amputee practice, hydraulic needs don't arise often, close to 20 percent. Further R&D is hard to justify if sales are the only payback.
- Need more reliable units. Many times the length of time spent on repairs outweighs the benefits of the knee unit. Very suitable for all active amputees.

d. The hydraulic units are in my opinion not cost efficient considering durability and repair cost. I suggest that research be done on extending the life of the units. I have recently begun using the UCBL unit to reduce service costs.

e. More research could be justified and considered relevant if it involves micro-computers and a totally new mechanical design of the unit to interface with the micro-computer.

f. The weight and cost of the S-N-S are definite disadvantages. I believe this unit represents the state-of-the-art in knee control. However, if the weight can be trimmed, the cost may no longer be a deterrent factor in prescription analysis.

g. Regarding question #3, dissatisfaction relates to problems with maintenance rather than function. All prefer the function to the hydraulic knee unit.

As has so often been pointed out in the past, it is very difficult and even irrelevant to attempt to draw any meaningful conclusions from so small a sample gathered in this fashion. It is, however, striking that 64 percent of the respondents used hydraulic units with less than 20 percent of their AK patients, and that only 27 percent said that 60-80 percent of the patients for whom hydraulics were suitable used them.

It is also interesting that while 73 percent said that they and their patients were satisfied with the units available, 82 percent were in favor of more R&D in the subject matter and problems of weight, expense, and maintenance were frequently cited in the additional comments.

**Attention!**  
**All meeting organizers,  
seminar planners and  
course coordinators—**

In order to have your event accredited by the ABC Continuing Education Committee, you must *apply* for credit. Please send descriptive material (program, course outline, etc.) with a request for accreditation, to ABC National Headquarters, 717 Pendleton Street, Alexandria, VA 22314.



# Questionnaire on Knee Orthoses

The Clinical Prosthetics and Orthotics—C.P.O. editorial board believes that two-way communication will aid the growth of the profession. The Academy provides a forum, within this publication, through which practitioners can let their voices be heard on significant issues. Please take the time to complete the questionnaire on knee orthoses and return to: Charles H. Pritham, CPO, Editor, Clinical Prosthetics and Orthotics, c/o Durr-Fillauer Medical, Inc., Orthopedic Division, 2710 Amnicola Highway, Chattanooga, TN 37406.

1. Do you fit knee orthoses in your orthotic practice?  
Yes \_\_\_\_\_ No \_\_\_\_\_
2. If you do, what percentage of your total orthotic patient population does this represent?  
0-20% \_\_\_\_\_ 60-80% \_\_\_\_\_  
20-40% \_\_\_\_\_ 80-100% \_\_\_\_\_  
40-60% \_\_\_\_\_
3. Name, in order of use, the three most commonly prescribed orthoses.  
1. \_\_\_\_\_  
2. \_\_\_\_\_  
3. \_\_\_\_\_
4. What research and development work would you most like to see in this area? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. Additional comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



Kurt Marschall, CP

## Kurt Marschall Addresses the Academy as President

Dear Fellow Practitioner:

Many presidents, upon assuming their duties in office for their members and constituents, introduce goals and aspirations that in many cases cannot be kept or are out of reach. I, as your new president, will not propose any earthshaking new programs but suggest that we consolidate and build upon the ones we already have.

In short, I propose that we return to basics, to the goals and principles that we set forth in our bylaws 14 years ago when this Academy was founded—that is, continued education via seminars and workshops of high caliber, that keep our practitioners sharp and offer them the latest in the state-of-the-art. But besides the technical know-how, we have to provide the practitioner also with better patient management and better business skills. Our existing schools should make it a point to include introductory courses in business, communication, and patient management in their curricula, because it is my firm belief that the prosthetist/orthotist of the future will be different than the one of today. His knowledge of the technical matter, his knowledge and understanding of the patient he treats, combined with a good basic business education, will make him a far superior and well-rounded individual than the existing prosthetist/orthotist. This is the only way to enhance our professional status, the only way to be recognized as equals by other health professionals, and, most importantly, this well-rounded and well educated prosthetist/orthotist will determine and control the

destiny of this field, as it should be. Therefore, this president and your new Board of Directors will make continued education one of its top priorities.

I plan to charge every chapter president to conduct at least one seminar and/or one workshop a year, easily accessible for the practitioners throughout the country, the attendance at which can be utilized by the practitioners to accumulate enough points for their continued education credits. Never do I want to see survey results like the one last year indicating that only 17 percent of our practitioners had bothered to apply for and receive continued education credits. This certainly is no way for a profession to achieve excellence. It can only come through a meaningful, mandatory continuing education program. The sooner we institute such a program, the better off we are as a profession. Let the practitioners opposing this approach fall by the wayside. They are not helping our cause. Others will take their place and join our ranks—practitioners who have stood at the sidelines precisely because our efforts so far have been half-hearted and who have therefore lost faith in our credibility as a viable organization.

For professionals like us, treating handicapped people year in and year out, continuing education should never be a voluntary or mandatory issue; it should be a moral issue and part of that constant dedication that a practitioner must possess to carry out his work. Dedication becomes the most important ingredient in the life of a prosthetist/orthotist. Next to the physician, I dare say the prosthetist/orthotist needs to be dedicated "beyond reason." I can think of two individuals, who are no longer with us, who possessed that inborn dedication: Bert Titus and Joe Ferguson. They were two shining examples from the past of what the practitioner should be like in the future.

Another point of our agenda that will receive top priority is the restructuring of our local chapters. By granting chapter status to everyone who came along, without giving direction, guidance, and stringent reporting and communication requirements, we have lost control of our own offspring. True, some have made the best of the opportunity given to them and do a good job for their members, but others have fallen flat on their faces through lack of enthusiasm and leadership for the cause. But they all have one thing in common: they all think they enjoy an autonomous status, without further responsibility to their national umbrella organization. This calls for a change.

Your chapter representatives have recently gone through an extensive, and, hopefully worthwhile introductory session with the Board to make our relationship reciprocal in every way. Where help from the national organization is needed, it will be forthcoming. Where speakers are needed to enhance a seminar or workshop, your Board of Directors will do its utmost to provide them. Some of the increased dues money will be spent precisely for that purpose.

I can assure you, nobody in particular can or should be blamed for the problems we find ourselves in with the chapters. Mistakes have been made through the years, and again will be made through others, but we should always be willing to rectify them as soon as we recognize them. But the last thing we need at this juncture of the Academy would be a polarization by members over this issue. We need unity desperately, not divisiveness or the courting of negative forces that could drop us into a morass so deep we might never climb out of it.

A word to our two sister organizations, AOPA and ABC.

We pledge our support and our willingness to work together on the serious problems that face our profession today. In return, we ask AOPA to recognize our basic right to exist under the bylaws laid down by some of the distinguished people out of their own ranks, to be the educational arm of the prosthetic/orthotic profession, responsible for meaningful continued education and the publication and dissemination of scientific/technical matter. Past experience has shown that some of our goals and aspirations coincide with AOPA's. We must recognize our differences and try to resolve them in a civil, amicable, mature manner. Let us not get caught up in a vicious and dangerous cycle in which suspicion on one side breeds suspicion on the other.

We ask ABC to provide us with definite and just guidelines as far as the awarding of credit hours for our continued education program is concerned. A yardstick has to be found to measure these efforts easily, so as to reward practitioners for their attendance at these scientific and technical meetings, rather than punish and discourage them.

Having said that, and knowing that both leaders of our two sister organizations, Gene Jones of AOPA and Ben Pulizzi of ABC, will cooperate wholeheartedly, I can pledge the Academy's willingness to work together. The Academy, under my one-year leadership, wants to build bridges, not walls. We are too small a group of professionals not to be interested in each other's survival.

We are presently experiencing an unstable crucial time in the state of our affairs, the outcome of which, according to our ability to handle it, will make a decisive difference for better or for worse. In short, we have reached a time of crisis and we have to make up our minds whether we want to give that extra little effort that makes the difference between achieving excellence, or being swept away in a rising tide of mediocrity. We cannot afford to let that happen.

Sincerely,

Kurt Marschall, CP  
President of the Academy

1985  
Academy  
Annual Meeting  
&  
Scientific Seminar

# Meetings and Events

Please notify the National Headquarters immediately concerning additional meeting dates. It is important to submit meeting notices as early as possible. In the case of Regional Meetings, it is mandatory to check with the National Headquarters prior to confirming date to avoid conflicts in scheduling.

## 1984

**May 3-5**, AOPA Regions I, II, and III Combined Annual Meeting, Concord Hotel, Kiamesha Lake, New York.

**May 12**, Southern California Chapter of the Academy Seminar, location to be announced.

**May 13-19**, The Ninth International Congress of Physical Medicine and Rehabilitation, Jerusalem Hilton Hotel, Jerusalem, Israel. Theme: "Rehabilitation Medicine: The Bridge Between Medical Science and Society." Contact: KENES—Organizers of Congresses and Special Events Ltd., P.O. Box 50006, Tel-Aviv 61500, Israel.

**May 24-26**, AOPA Region V Annual Meeting, Amway Grand Plaza Hotel, Grand Rapids, Michigan.

**June 1-3**, AOPA Region IX, COPA and the California Chapters of the Academy Combined Annual Meeting, Lake Arrowhead, California.

**June 4-8**, 15th World Congress of Rehabilitation International, Lisbon, Portugal. Theme: "Information, Awareness, and Understanding for Integration of Disabled Persons and Society," Contact: Rehabilitation International, 432 Park Avenue South, New York, New York 10016.

**June 6-8**, Electric Elbow Seminar, Newington Children's Center, Newington, Connecticut. Presented by Hosmer Dorrance Corporation. Contact: Catherine Wooten, 561 Division Street, Campbell, California 95008, 408-379-5151.

**June 9-10**, Florida Academy Chapter and Florida Association Combined Summer Meeting, Holiday Inn-Surfside, Clearwater, Florida.

**June 12-July 4**, 7th World Wheelchair Games, University of Illinois, Champaign, Illinois. Contact: Professor Timothy Nugent, Rehabilitation Education Center, 1207 South Oak Street, Champaign, Illinois 61820.

**June 16-28**, 1984 International Games for the Disabled, sponsored by the International Sports Organization for the Disabled, Nassau County, Long Island, New York. Contact: Michael Mushett, Director, 1984 International Games for the Disabled, c/o Special Populations Unit, Eisenhower Park, East Meadow, New York 11554.

**June 17-22**, "1984—The Bright Side," The Second International Conference on Rehabilitation Engineering, combined with the 7th Annual Conference on Rehabilitation Engineering, Congress Centre, Ottawa, Ontario, Canada. Sponsored by the National Research Council of Canada, the Rehabilitation Engineering Society of North America, and the Canadian Medical and Biological Engineering Society. Contact: Conference Services, National Research Council of Canada, Ottawa, Ontario, Canada K1A 0R6.

**June 21-24**, AOPA Region VI and the Academy Midwest Chapter Annual Combined Meeting, Holiday Inn, Merrillville, Indiana.

**June 28-30**, AOPA Regions VII, VIII, X, and XI Combined Meeting, North Shore Convention Center, Coeur d'Alene, Idaho.

**September 30-October 5**, 16th Congress of the International Society for Orthopaedic Surgery and Traumatology (SICOT), London, England. Contact: Conference Services, Ltd., 3 Bute Street, London, SW7 3EY, United Kingdom.

**October 16-21**, AOPA General Assembly and International Congress, Fontainebleau Hotel, Miami Beach, Florida. Contact: AOPA National Headquarters, 703-836-7116.

## 1985

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

**April 18-20**, AOPA Region IV Annual Meeting, Wilmington Hilton Hotel, Wilmington, North Carolina.

**May 2-4**, AOPA Region V Annual Meeting, Holiday Inn, Cleveland, Ohio.

**June 7-9**, AOPA Region IX, COPA, and the California Chapters of the Academy Combined Annual Meeting.

**October 15-20**, AOPA Annual National Assembly, Town and Country Hotel, San Diego, California. Contact: AOPA National Headquarters, 703-836-7116.

January 30-  
February 3



Cathedral Hill Hotel  
San Francisco

# Clinical Prosthetics and Orthotics . . . C.P.O.

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