data-tables are used).[1] 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.[4]

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.

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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 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