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 quadricep 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.

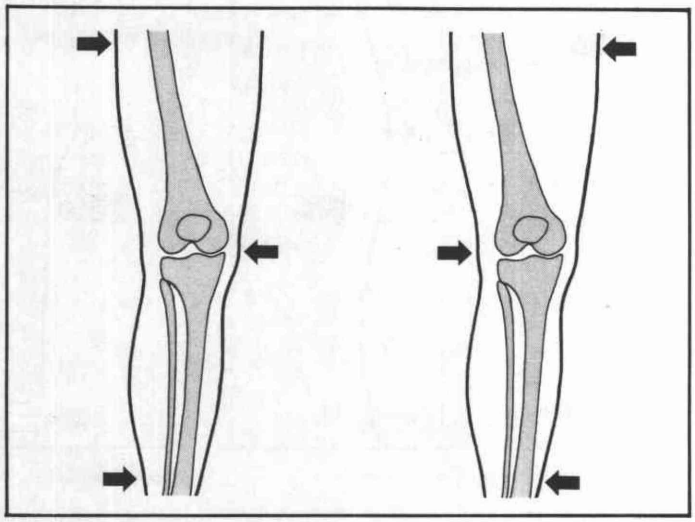

Figure 1: Triple-point correction to relieve the medial or lateral ligaments.

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

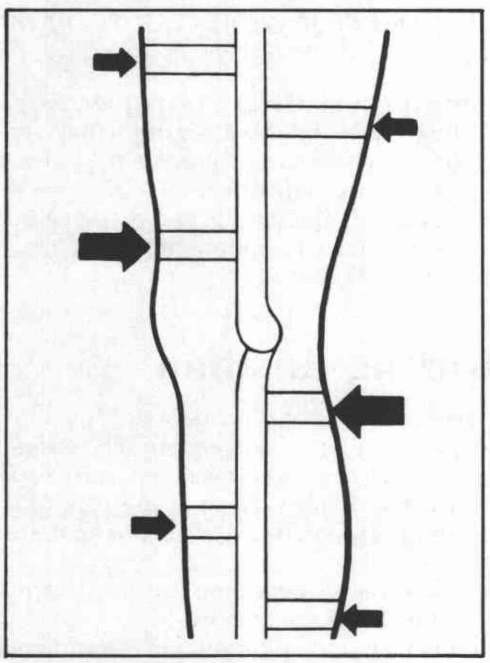

Figure 2: Controlling the posterior drawer.

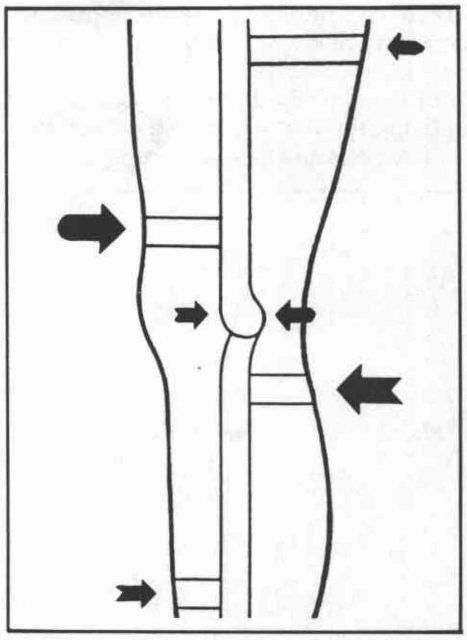

Figure 3: An alternative approach.

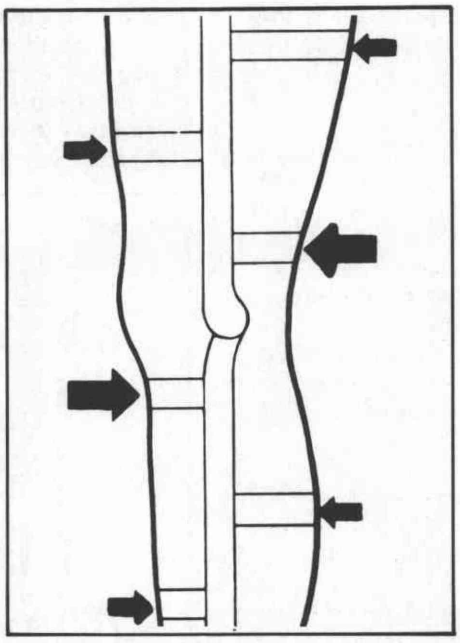

Figure 4: Fixation of the upper and lower leg.

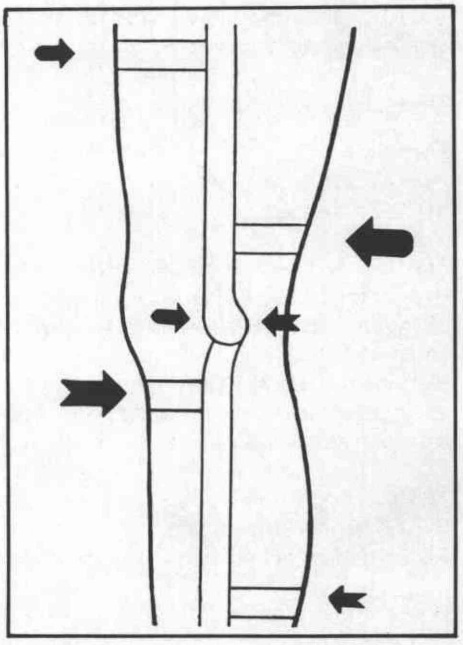

Figure 5: Increase the distance between the knee and the external counter-pressure.

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.

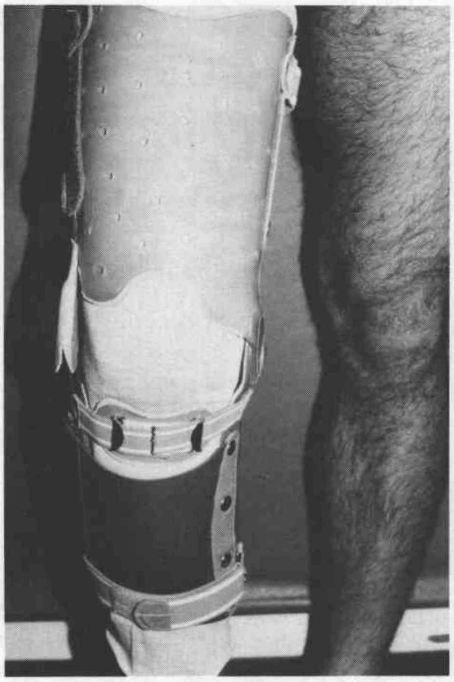

Figure 6: The sport orthosis eliminates forward and backward drawer.

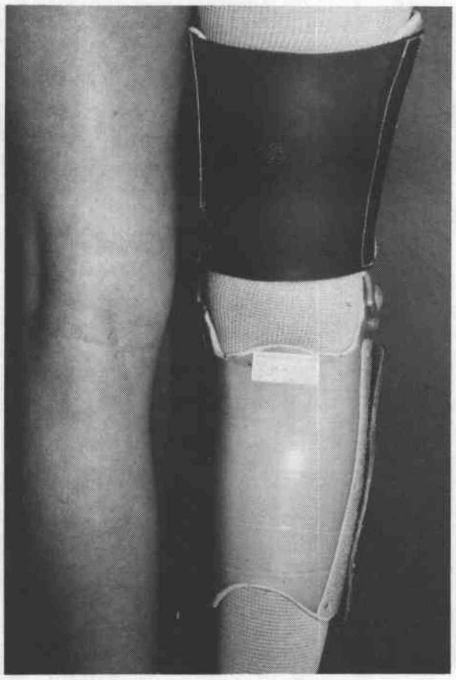

Figure 7: The orthosis can be fit to eliminate all extreme movements.

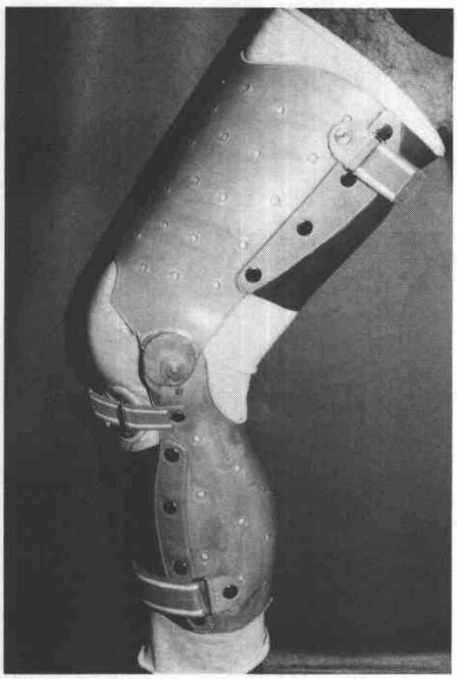

Figure 8: The half-splints are made of Plexiglass XTO.

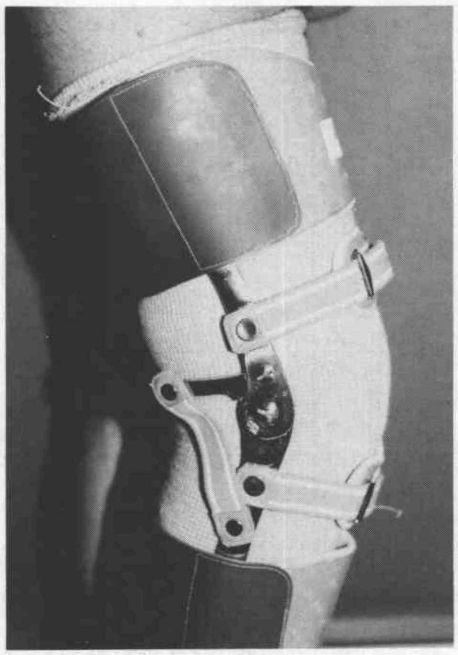

Figure 9: A lock and positioning screw are fixed to the outside of the splint.

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.

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