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THE IOWA KNEE ORTHOSIS

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The Iowa Knee Orthosis (Fig. 1) is a custom made device that provides maximum collateral ligament support while allowing a relatively normal amount of flexion about the lax knee joint. It uses either metal or plastic polycentric joints to provide the necessary support medially and laterally and polypropylene cuffs molded to the contours of the leg and thigh. A medial supracondylar indentation, similar to the medial wedge so well known to students of below-knee prosthetics, makes the orthosis self-suspending. The orthosis weighs between 1½ and 2½ kilograms, depending on the type of joint used. It is indicated for medial-lateral knee instability and for prevention of anterior-medial "giving way."

A review of the literature reveals at least twelve devices that have been designed to improve knee stability (Fig. 2). Undoubtedly, many more have never been described. An analysis of these orthoses delineates certain common purported goals:

1. Control of support or recurvatum
2. Control or support of medial-lateral instability
3. Rotational control
4. Prevention of knee instability in the weight-bearing, and often painful, stance phase of gait (Fig. 2)

To accomplish these objectives, many designs of materials have been utilized, leaving the observer to wonder what the more per-

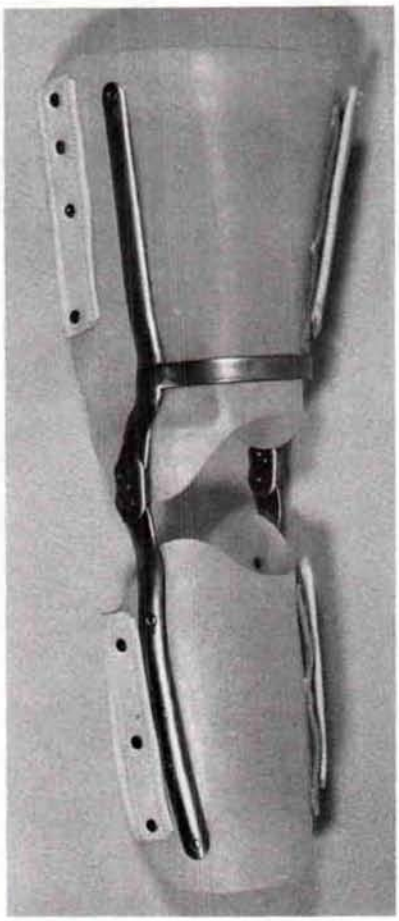

Fig. 1. Anterior view of Iowa knee orthosis. Metal polycentric knee joints are used in the version shown here.

KNEE ORTHOTICS (KO)

Name	Indication(s)	Credit	Date
Extension KO	Extend Knee, Prevent Flexion	H.H. Sinclair	1879
Molded Plastic Hinged KO	Mild Recurvatum	Sinclair	1967
Romer-Willen Knee Guiding Brace	M-L Instability	W. Nyga	1968
Molded Plastic KO (PTS)	Mild Recurvatum	Nitschke, Marschall	1968 1972
Swedish Knee Cage	Mild Recurvatum	Lehneis	1968
Michigan Brace	Recurvatum & M-L Instability	Smith Cook	1969
Supracondylar Orthosis (SK)	Recurvatum & M-L Instability	Lehneis	1972
Lenox Hill KO	M-L Instability	Castiglia	1972
Hinged KO	M-L Instability	Palumbo, Dixon	1975
External Cruciate Ligament Orthosis	M-L Instability AP Instability	Martin	1975
CARS-UBC KO Varus-Valgus	M-L Instability	Cousins, Foort	1975
Iowa KO	M-L Instability	Miller, Albright	1977

Fig. 2. Table showing most of the knee orthoses designed through the years to improve knee stability.

fect orthosis should contain. A list of the minimum requirements would include:

1. Light weight
2. Cosmetic appearance
3. Self-suspending
4. Anatomically accurate, to allow near normal knee motion
5. Durable
6. Capable of withstanding the deforming forces consistent with the disease process
7. Ease of doning and doffing

The Iowa Knee Orthosis meets many of these requirements:

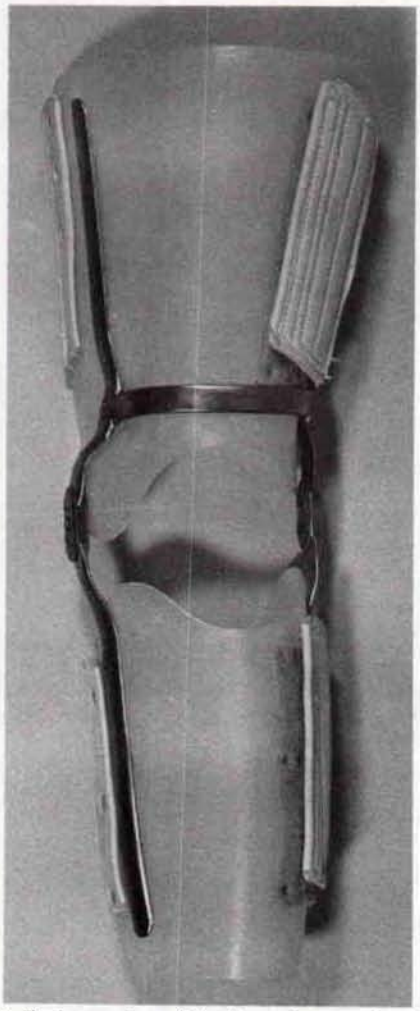

Fig. 3. Early version of the Iowa knee orthosis using stainless steel polycentric knee joints.

1. Its light weight derives from the form-fitted polypropylene molded from a plaster model of the patient's leg. Great care during the casting procedure insures an exacting interface. Two peices of welded 1/8-in. polypropylene form the cuffs.
2. Experience with the more conventional types of knee orthoses revealed that cosmesis ranks high on any patient's list of priorities. In the absence of any waist strap or support to the shoe, the Iowa Knee Orthosis fits well under pants or skirt and does not require special shoes or shoe modification. Only with the extremely obese patient where medial supracondylar suspension is technically difficult and inadequate is it necessary to incorporate a waist strap.
3. By virtue of the self-suspending design, the Iowa Knee Orthosis does not dislocate in flexion as do many other orthoses. The suspension demands that the patient become accustomed to moderate medial femoral pressure caused by the wedge-type suspension, similar to that caused by the medial wedges when used in PTB prostheses.
4. The design of the polycentric knee hinges allows nearly normal knee motion. Although the first generation orthoses were constructed with stainless steel polycentric joints (Fig. 3), the new orthosis incorporates a nylon polycentric joint that to date appears to function well (Fig. 4).
5. Durability has been remarkable. An offensive tackle of the Iowa football team played in all ten games of the 1976 season with one of our orthoses with stainless steel joints. (The conference officials do allow this type of equipment with only minor modification.)
6. In addition to being durable, the orthosis must endure the stress induced by various diseases. In our experience,

the orthosis is capable of withstanding forces both from within and without while allowing the patient freedom of knee motion in the desired planes. Additionally, patients are protected during sleep in the early postoperative period, when repairs may be vulnerable.

7. The patient is able to easily don and doff the Iowa Knee Orthosis, which is not always the case with other KO's. It relies on two 15 cm-wide posterior elastic straps which yield sufficiently to prevent hamstring tendon impairment, yet the cuffs remain in proper location. Closure is easily accomplished with one hand, making it ideal for any aged patient.

Of the first 123 cases fitted with the Iowa Knee Orthosis, the most common indication was postoperative protection for surgically repaired ligaments. The orthosis is fitted as soon as the edema has subsided and the patient is ready to begin the postoperative exercise program. Most patients complete isometric exercises with or without crutches while wearing the brace 24 hours each day to provide control of the knee without needless immobilization, which has been shown in dogs and monkeys to weaken knee ligaments. A regular rehabilitation program is then begun in an effort to return the patient to the performance test level (PTL) recorded by the University Department of Athletics before competition began.

The orthosis is worn routinely 24 hours per day until the patient reaches 80 percent of that performance test level (PTL), after which the orthosis is worn only during exercise, provided there is full knee ROM and a noncontact life style.

The other large group of patients who have benefitted from the orthosis are those with instability, secondary to chronic knee laxity. As the figures indicate, the Iowa Knee Orthosis has been used as an alternative to surgery, or without further surgery. Other uses include: 1) a preoperative trial to determine if further surgery is necessary; and 2) as an adjunct to total knee replacement.

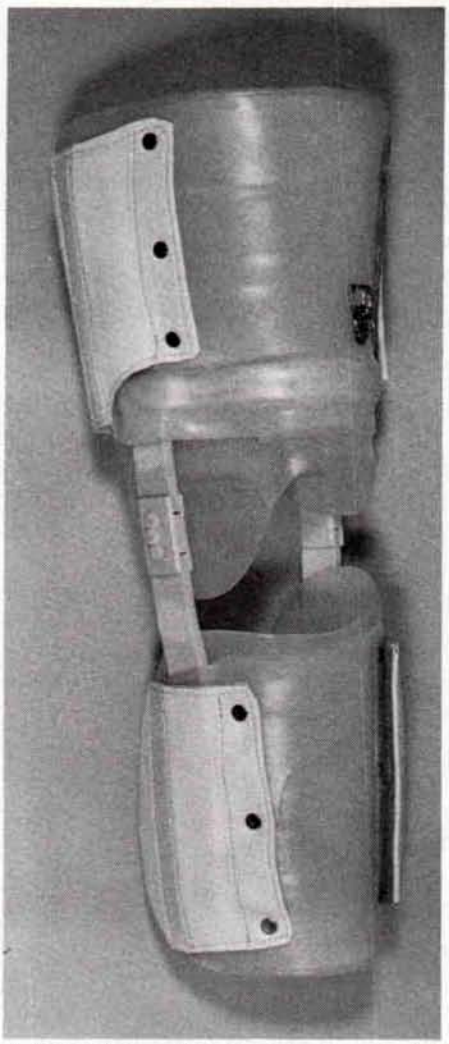

Fig. 4. Later design of the Iowa knee orthosis that uses a nylon polycentric knee joint.

In 20 patients after total knee replacement, the knee instability made walking difficult and painful. In these 20 cases, mostly with rheumatoid disease, the Iowa Knee Orthosis has been helpful in making walking easier. The patients have accepted a self-suspending, plastic KO, and have rejected ones attached to the shoe. In other cases of soft or loose ligaments, the orthosis acts as a useful support allowing those ligaments to heal,

with resultant increased knee stability.

The Iowa Knee Orthosis represents a combination of successful conventional ideas combined in an all-plastic orthosis. The most critical component in its production is the absolute attention to detail required in taking an accurate negative cast. The success of fabrication demands a perfect mold.

Prior knowledge of PTB-wedge casting techniques is extremely helpful. Proper pressure and positioning of the medial suspensory indentation determines the success or failure of the fit.

In conclusion, a description of 123 fittings of the Iowa Knee Orthosis has been presented. Material type, design, and use of the orthosis have been described as part of the total postoperative care of the patient with an unstable knee.

It appears by a review of the uses of the Iowa Knee orthosis:

1. A contour fit provides marginal knees with good M-L stability;
2. Rigid support may afford protection from injury during competition;
3. Polycentric joints allow excellent motion while maintaining a constant fit of the brace;
4. Protection of post-surgical knee is most common indication and added stability may prevent rotational "giving way" when primarily due to medial-anterior-medial/lateral laxity.

Footnotes

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