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FRACTURE-SUSPENDING EFFECT OF THE PATELLAR-TENDON-BEARING CAST

H. SVEND-HANSEN, V. BREMERSKOV & P. OSTRI

Department of Orthopaedic Surgery, Copenhagen County Hospital, Glostrup, Denmark

In order to evaluate the fracture-suspending effect of the patellar-tendon-bearing cast, experiments using a load cell under the heel were carried out on four subjects. Measurements were made using a conventional below-knee cast, the PTB cast, and an above-knee cast. There were no differences between the forces transmitted by the same subject wearing the three types of casts in turn and consequently the choice of cast must be based on other factors.

Key words: early weight-bearing; patellar-tendon bearing cast; tibial fractures

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The patellar-tendon-bearing cast (PTB cast) is a functional below-knee total contact cast first described by Sarmiento (1967). Experience with the patellar-tendon-bearing prosthesis in current use for the below-knee amputee led to the development of the cast and its use in the treatment of tibial fractures. In principle it is a below-knee cast extending to the upper pole of the patella and with a firm moulding over the medial flare of the tibia, the patellar tendon, and the popliteal space, and shaped in a triangular manner at the upper end of the tibia. Sarmiento (1967) stated that the PTB cast stabilized the proximal fragment of a tibial fracture, left the knee free to move, and allowed early ambulation as weight-bearing forces should be transmitted from the ground to the proximal end of the tibia, virtually bypassing the fracture site and suspending the fractured bones. To assess whether the latter assertion is correct, the present investigation was carried out. A PTB cast was compared with a conventional below-knee cast and an above-knee cast.

MATERIAL AND METHODS

Four subjects weighing 50, 65, 80, and 100 kg were used in the experiments. A miniature load cell (Kyowa LM 100 KA) was encased in a double brass casing with a pressure area of 14.5 cm^2 (Figure 1A). The leg was covered with a thin stockinette and the load cell was then placed on the sole of the foot a little laterally and in the axis of the tibia. The foot and ankle part of the cast were then applied, incorporating an adjustment screw resting on the upper aspect of the cast heel. This screw enabled us to elevate or lower the load cell casing so that it just touched the undersurface of the foot with the leg in a non-weight-bearing position. The cast was then extended to just below the tibial tubercle as in a conventional below-knee cast. Figure 1B shows the position of the load cell casing. After the cast had dried, the load cell was connected to a pen recorder (Servogor RE 511) and a pressure curve was obtained when the test subject walked without

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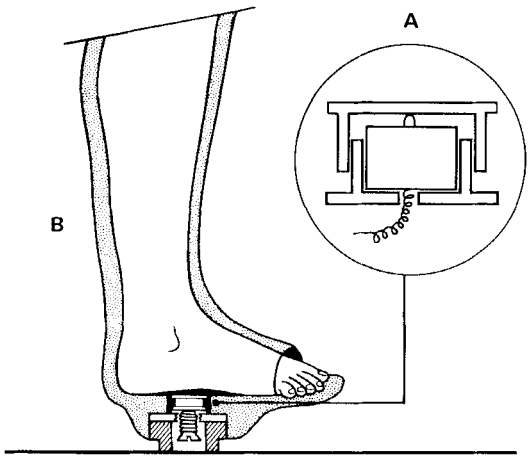

Figure 1. A. Transection of the load cell casing. B. The position of the load cell casing in the cast.

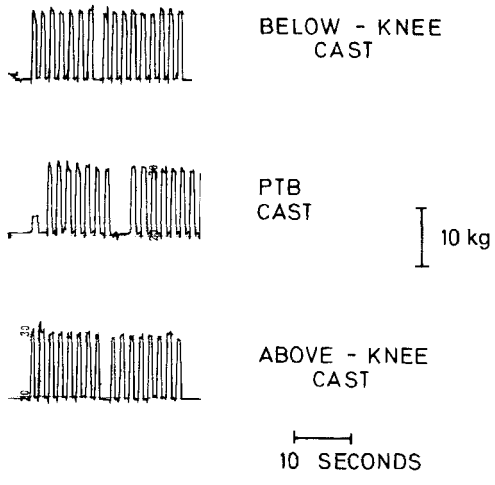

Figure 2. Pressure curves obtained from the subject weighing 65 kg.

support. The cast was then extended and moulded as a PTB cast and new measurements were taken. Finally the cast was cut down until well below the knee and subsequently extended until high on the femur. A third set of measurements was obtained.

RESULTS

In Table 1 the forces transmitted by the four subjects are recorded. The relative forces transmitted are almost the same with the three different types of casts, while the forces vary between test subjects, ranging between 10.6 and 20.0 per cent body weight transmitted. In Figure 2 typical curves obtained from the subject weighing 65 kg are shown. The forces transmitted from the tibia through the heel into the heel of the plaster cast are of the same magnitude in the three types of cast, and thus no difference was found as regards fracture-suspending effect.

DISCUSSION

The principle of early weight-bearing was first described by Gurd (1940). Later Dehne et al. (1961) and Brown & Urban (1969) advocated this form of treatment. Sarmiento (1967) described the PTB cast and its

Table 1. Forces transmitted by the four subjects using three types of casts.

		Below-knee cast		PTB cast		Above-knee cast	
Subject no.	Body weight (kg)	Force transmitted (kg)	Force transmitted (per cent)	Force transmitted (kg)	Force transmitted (per cent)	Force transmitted (kg)	Force transmitted (per cent)
1	50	5.7	11.2	5.7	11.2	5.3	10.6
2	65	13.0	20.0	13.0	20.0	12.3	18.9
3	80	11.0	13.8	11.0	13.0	10.5	13.1
4	100	16.5	16.5	16.2	16.2	15.8	15.8

application in 180 patients. Many surgeons have later adopted this principle in selected cases (Wiedmer et al. 1975, Hackstock 1974, Mølster et al. 1976). Dehne (1972) claimed that a small amount of movement at the fracture site stimulates healing of the fracture. Sarmiento (Sarmiento 1974, Sarmiento et al. 1974) introduced the "hydraulic container theory". He stated that the soft tissues of the lower leg within the rigid tight fitting walls of the cast constitute some sort of hydraulic system, which in combination with the interosseus membrane prevents shortening of the fracture. He claimed furthermore that the rhythmic compression of the visco-elastic structures of the calf enhanced blood circulation and osteogenesis. In the latter study he conceded that the fracture-suspending effect of the cast may be smaller than originally assumed.

In this paper we do not aspire to recommend any specific treatment in tibial fractures. We have merely shown that the axial forces transmitted through the bone to the ground are the same in below-knee, PTB, and above-knee casts. The choice of treatment must consequently be based on other factors as no difference exists in the fracture-suspending effect.

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Correspondence to: Henrik Svend-Hansen, Bibliotekvej 10, 2650 Hvidovre, Copenhagen, Denmark.