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The Hip Disarticulation Prosthesis as Developed by the O.I.M. Noord Nederland

by Peter Tuil

What characterizes the hip disarticulation prosthesis of the O.I.M. Noord Nederland is the use of a four-bar Otto Bock knee joint as a hip joint. O.I.M. Noord Nederland has used this variation with much success over the last five years. At first, it was questionable whether the joint would be strong enough, but this has proven not to be an issue. There have been some problems with the 3R21, but only when it is used as a knee joint. These complications have been due to extreme flexion, lamination sections that were too thick and caused the joint to tear apart during flexion, or too much external rotation.

There are two advantages in the use of the four-bar hip joint. First, the patient walks with a lower energy expenditure because the prosthesis shortens the swing phase. In contrast to patients who have worn older style hip disarticulation prostheses (for years patients used to be fitted with a tilting-table prosthesis or later with a wooden "Canadian hip" prosthesis), the patients with the new style prosthesis walk more and have indicated that they use less energy. Second, there is hardly any strain on the cosmetic cover, so much less damage is done.

An additional advantage of the four-bar joint is that the construction can be less critical. Besides, the whole prosthesis can be readily adjusted.

Description of the Fabrication Method

To make the plaster impression, two wooden blocks are mounted on a table or casting stand. (Editorial note: Presumably this stand is adjustable in height.)

These wooden blocks have sloped planes so that a wedge-formed gap is created between them (Figure 1). In the back, the sloped side forms a 60° angle. In the front, the sloped side is divided into two different angles (Figure 2). Both blocks can rotate around their vertical

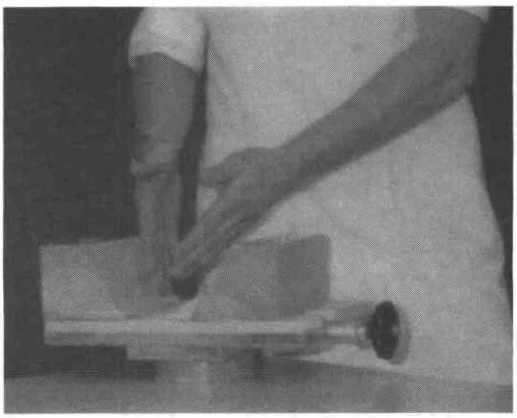


Figure 1. Apparatus used for casting.

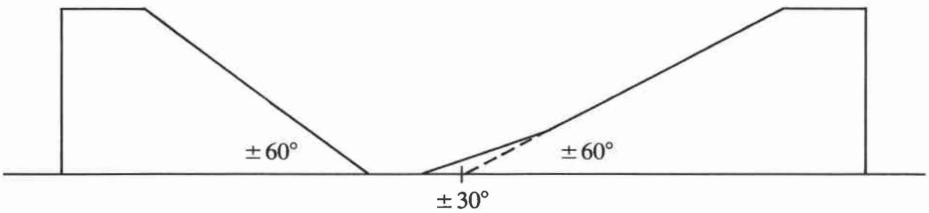


Figure 2. Side view of the wooden blocks.

Figure 3. The adaptor.

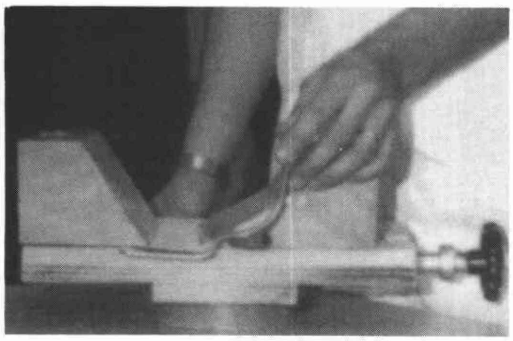


Figure 4. Shows how the adaptor, which will later be laminated into the socket, relates to the wedged form of the wooden blocks.

axles with regard to the table to which they are attached. They can also be shifted with regard to each other in the sagittal plane by means of a spindle (worm gear mechanism). The blocks are primarily meant to provide a good fitting of the residual limb and pressure relief in the places where that is necessary.

The four-bar joint is attached to the socket by means of a specially manufactured adaptor (Figures 3 and 4). The adaptor, which will later be incorporated into the socket, mimics the wedged shape of the wooden blocks (Figure 5).

Finally, the impression of the wooden table provides a good plane of reference for the plaster model (Figure 6).

This impression of the horizontal plane must remain horizontal during the construction process. During plaster modification, one should maintain unchanged the medial of the plaster model in the transverse plane, so that the impression of this edge will always indicate the line of progression of the plaster model.

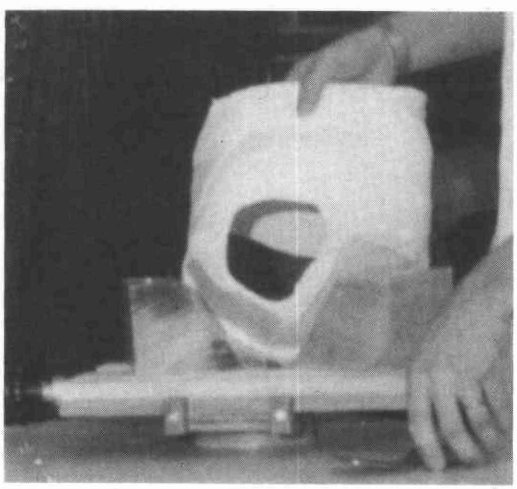


Figure 5. The apparatus forms a good plane of reference.

The socket is laminated in three layers. First though, a layer of Pe-Lite™ is put on the plaster model, followed by a layer of stockinette, and finally a layer of P.V.A. foil. The layer of stockinette is always applied under the first layer of foil. This will provide better suction, absorb some moisture, and the plaster model need not be as smooth.

The first layer is laminated from flexible resin with two layers of Perlon stockinette,

Figure 6. Position of the adaptor as related to the pelvic socket.

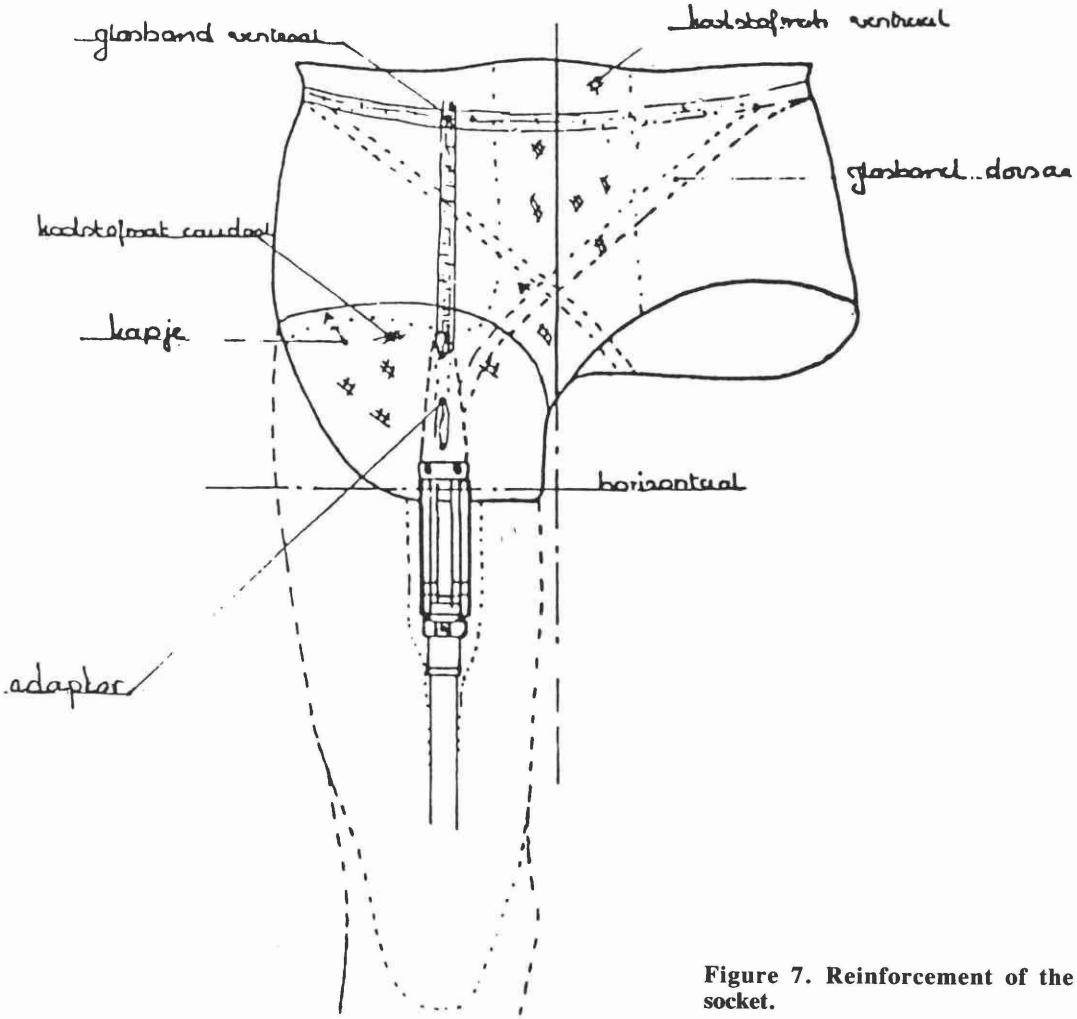


Figure 7. Reinforcement of the socket.

which is elastic in two directions. Subsequently the adaptor is located as shown in Figure 7.

The space between the adaptor and the plaster model is filled with ''leichtspatel'' (filler). The base of the plaster model must stand horizontally. The adaptor is placed approximately 4 to 5cm lateral of the groin. The maxim is to get the adaptor directly underneath the ischial tuberosity. However, this is influenced by the needs of the cosmetic cover.

The adaptor is then covered with two layers of stockinette and a reinforcing layer of carbon fiber matting to prevent the adaptor breaking loose from the forces generated at heel strike. A strip of carbon fiber is put in the front to prevent the pelvis socket from curling inward. A reinforcing band of glass fiber is placed diagonally as shown in Figure 8. Over this, two layers of stockinette are placed. First, rigid lamination resin is applied on those areas where the socket must be rigid. The rest is laminated with flexible resin. An adjustable ''jig'' is necessary in order to be able to turn the model around in the bench-vice quickly. The final layer is done with flexible resin and two layers of stockinette.

A layer of stockinette and P.V.A. foil are put on the socket. Then, the little cap needed to finish the cosmetic cover is laminated with three or four layers of stockinette and one layer of carbon fiber. The extra time needed to form this cap will later save a lot of time during the finishing of the cosmetic cover.

The prosthesis is completed with a four-bar knee joint (3R21), a single axis ankle joint foot, and a rotation adaptor.

The alignment of the prosthesis is first considered in the sitting position. One must take into account the symmetry in comparison to the healthy limb (Figures 9 and 10). The definitive alignment is settled upon during stance and walking exercises (Figure 10). The adjustment of the 3R21 knee joint is very important. Mistakes in alignment can cause malfunctions of the knee joint. Many adjustments are possible with regard to rotation in the hip joint itself. The lack of facility to adjust abduction has never been a problem.

The freedom of movement when seated is considerable (Figures 11 and 12).

The cosmetic cover is shaped in the hip area, as well as in the knee area, so that less tension will be induced in the cover during flexion and

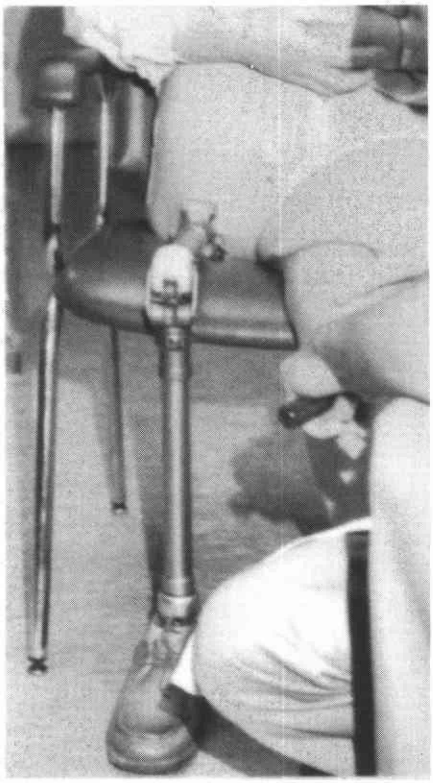


Figure 8. Alignment is first considered with the patient seated.

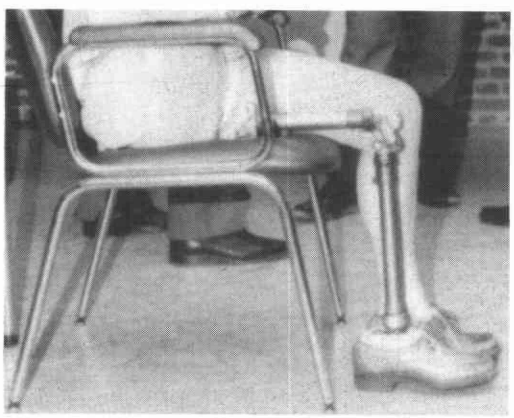


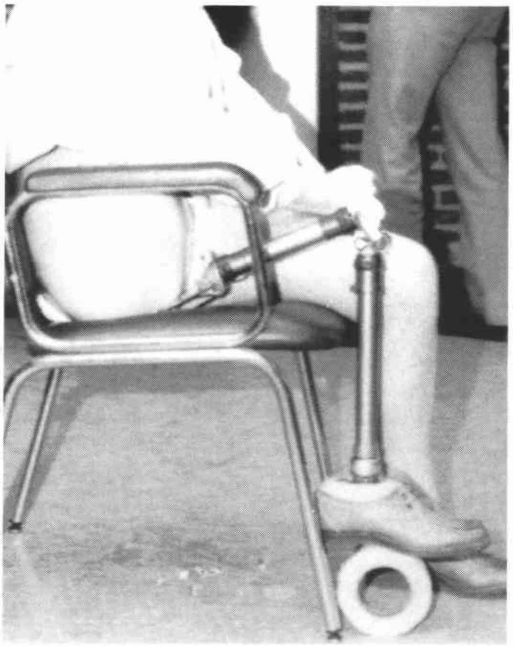
Figure 9. Side view of the patient sitting and wearing the prosthesis.

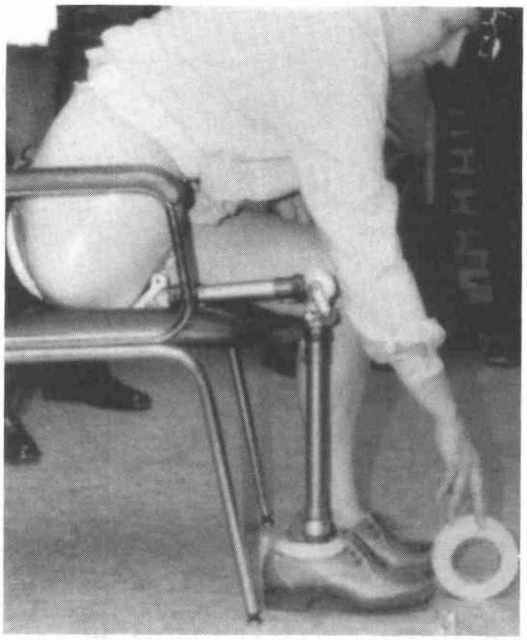
when seated. Finally, a long elastic strip is glued to the inner anterior wall of the cover. This is done to protect the foam-cover.

The construction process for a prosthesis for a hemipelvectomy is similar.

Figure 10. The realization of definitive alignment.

Figure 11 (right) and 12 (below). Freedom of movement when seated.





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