ANKLE-FOOT PROSTHESIS INCORPORATING THE ARTICULATED BONY SKELETON OF A SURGICALLY AMPUTATED LIMB

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To simulate the functions of the living foot, mechanisms are provided in an ankle-foot prosthesis to allow bi-planar or tri- planar movements (1). However, material and methodology constraints in fabrication technology limit the extent to which structural and functional replication can be achieved. The Jaipur Foot (2) is an exception because it is hand-made and is capable of being modified readily during fabriction.

We report here an ankle foot prosthesis incorporating the intact articulated bony skeleton of a surgically amputated limb as an endoskeleton (Figure). We substituted the core rubber blocks of the Jaipur Foot with the entire foot endoskeleton, while retaining the reinforced rubber shell of the foot. Three such prostheses were prepared using formalin fixed bony skeletons from limbs amputated for vascular insufficiency. The feet were dissected free of soft tissue down to the capsules and ligaments, dried and painted with vulcanising cement, and covered with unvulcanised rubber compound, after which they were incorporated in the shell of Jaipur Foot (3, 4). The prostheses proved satisfactory on bench-testing (4) for load deflection and limited fatigue studies under simulated conditions. They could not be tested on the patients themselves. One patient had hemiplegia on the unamputated side, another was unwilling to bear weight on the stump because of stump pain and the third was lost to follow up. A volunteer amputee, however, has found them satisfactory.

Earlier, we had demonstrated the feasibility of such prostheses prepared using exhumed or cadaveric bones (3, 4). These prostheses were bench tested, subjected to prolonged, simulated fatigue and field tested on a volunteer amputee. Radiological studies revealed that movements occurred at the various joints on loading, and that the joints were restored to a neutral position on unloading the foot. The prostheses were well received by the amputee. However, exhumed bones showed multiple fractures after prolonged use while formalin fixed cadaveric bones remained intact after similar testing.

Such encouraging results were tempered by the fact that both cadaveric bones and exhumed bones are difficult to obtain. We therefore undertook the present study to prepare ankle foot prostheses of bones harvested from surgically amputated limbs. Surgically amputated feet appear to hold potential for use as an endoskeleton in ankle foot prostheses. We have no reason to believe that they will not be as durable or versatile as formalin-fixed cadaveric bones while remaining a viable alternative to available prostheses. We further believe that, among the currently available prostheses, the bony endoskeleton prosthesis most closely matches the normal foot functionally. Additionally, if a patient's amputated foot were to be used to fashion his own prosthesis and with his full knowledge, the ensuing psychological benefits could be immense.

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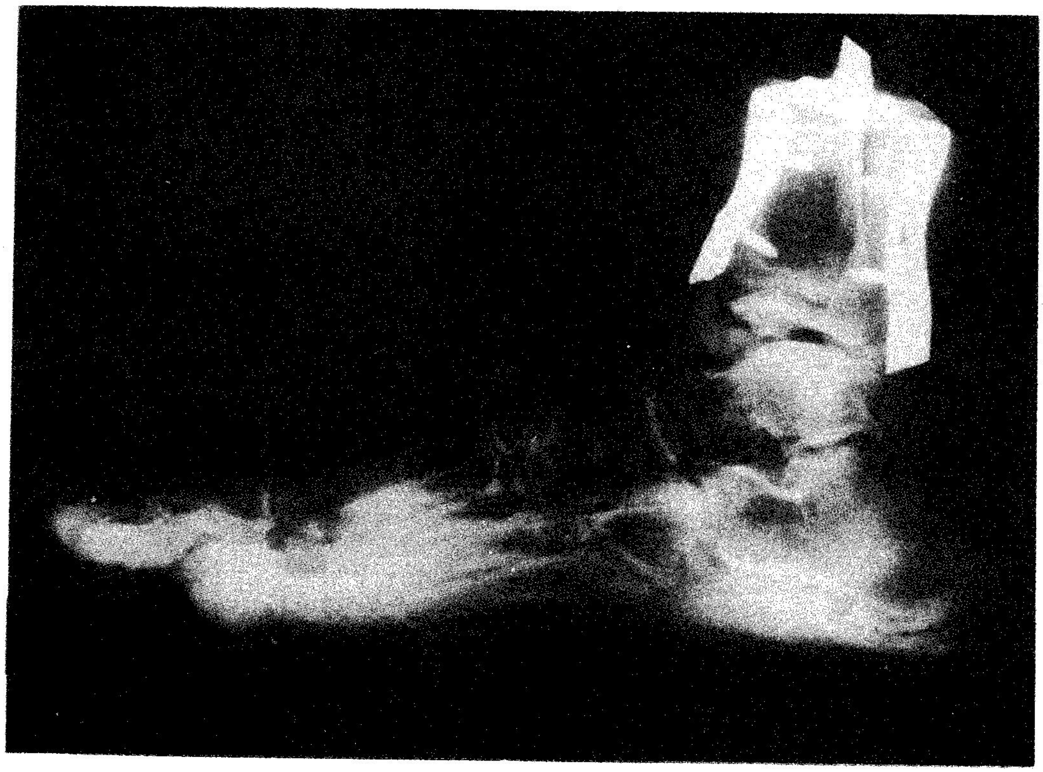
LEGEND FOR FIGURE

Lateral radiograph of an ankle-foot prosthesis prepared with incorporation of bony endoskeleton obtained from a formalin fixed surgically amputated limb. All the bony articulations are well preserved inside a fibre-cord reinforced rubber shell. The carriage bolt is attached to tibia and fibula by means of screws passing through a 'U' shaped metallic extension from the base of the bolt.



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