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MYOPLASTY FOR COVERING EXPOSED BONE OR JOINT ON THE LOWER LEG

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During recent years several reports have appeared on series treated successfully by myoplastic operations for covering skin defects on the lower limbs (Ger 1968, 1970 a, b, Boné Andersen & Helmig 1970, Barfod & Pers 1970, Ger & Efron 1972). After the Department of Orthopaedic Surgery was established in the Gentofte Hospital in October 1970, this operative method was included among the possibilities available for covering denuded bone on the lower leg. In eight cases we found this treatment indicated.

METHOD

The principle of the procedure is to cover the exposed bone with a vital muscle belly, and thereafter skin cover is obtained by a split-skin graft, primary or "primary delayed". The choice of muscle belly depends upon the site and size of the skin defect as well as the localization of associated soft-tissue injuries.

Applicable muscle bellies are the medial belly of the gastrocnemius, soleus, flexor digitorum longus, and the peronei. By means of these muscles it is possible to cover defects from the knee joint almost down to the malleoli. The medial malleolus may be covered with the abductor hallucis (Ger 1968) and the lateral malleolus with the extensor digitorum brevis (Reumert 1973). Ger (1971) has described the technique except that concerning the last-mentioned muscle.

CASE REPORTS

Case 1. A 57-year-old man was admitted with a left-sided complicated fracture of the left lower leg which was treated primarily by wound excision, plate osteosynthesis, and skin suture. Three months later the plate had to be removed because of wound infection. Muscle flow examined with Xenon¹³³ showed values at the lower

end of the normal range. At operation 6 months after the accident a 2×2 cm skin defect was covered with the belly of the *flexor digitorum longus*. The muscle was then covered with a split-skin graft. About one-third of the graft healed primarily, and the remainder became covered by epithelialization from the edges. Eleven months after the myoplasty the fracture had finally healed. Two years after myoplasty there were no complaints due to the lack of the flexor digitorum longus, the patient being able to flex the distal joints of the toes, presumably by means of the quadratus plantae. The fracture site showed a solid skin cover.

Case 2. A 37-year-old woman was admitted with a tumour just distal to the right medial tibial condyle. It had been growing slowly for 2 years. Neither a biopsy nor the tumour removed *en bloc* showed any signs of malignancy. Two months later she had a recurrence. Lymphography did not reveal any signs of metastases. Arteriography indicated malignancy, but a repeated biopsy still showed no signs of malignancy. *En bloc* dissection left a skin defect measuring 20×20 cm, and at its bottom 8 cm of the anteromedial part of the tibia was denuded. In addition, the medial collateral ligament had to be removed, but without opening the knee joint. The exposed bone could just be covered by the belly of the *medial gastrocnemius*. The entire skin defect was covered primarily by a split-skin graft. The final histological diagnosis was myxosarcoma. Valgus instability was demonstrable, but the knee was stable in walking. Nine months later metastases appeared on the medial aspect of the right thigh and in the right pelvis, and in another 10 months death ensued.

Case 3. A 22-year-old woman was admitted in 1966 with a complicated fracture high on the left lower leg. It was primarily treated by wound excision, reduction, and immobilization in plaster. After several operations for non-union and procedures done because of complicating infection, a Nicoll operation for non-union was performed 5 years later. This operation was complicated by skin necroses over the bone graft. Three weeks later it was attempted to cover the denuded bone with the medial belly of the *gastrocnemius* which was passed beneath an intact bridge of skin. Purulent discharge soon appeared, and the bone was again denuded. Five months after the operation for non-union a cross-leg flap was applied. It was primarily successful, but again a fistula arose, and at the same time there was a 2.5–3 cm bone defect in the already shortened tibia. As the final union of the fracture was doubtful and would in any case be prolonged, it was decided to perform a below-knee amputation. This was done without complications. Incidentally, the remains of the transposed muscle belly contributed to affording a solid soft-tissue cover of the stump.

Case 4. A 21-year-old man was admitted with a complicated fracture of the left lower leg and disruption of all anterior and lateral leg muscles (Figure 1). The fracture was immobilized in a Hoffmann apparatus and covered with the proximal part of the torn muscles. A large skin defect was covered with a split-skin graft. Some of the transposed muscles underwent necrosis (Figure 2). Eight weeks after the accident the necrotic tissue was removed and a 6×7 cm defect over the fracture site was covered with the medial belly of the *gastrocnemius*. The muscle was primarily covered with a split-skin graft (Figure 3). One year after the accident the

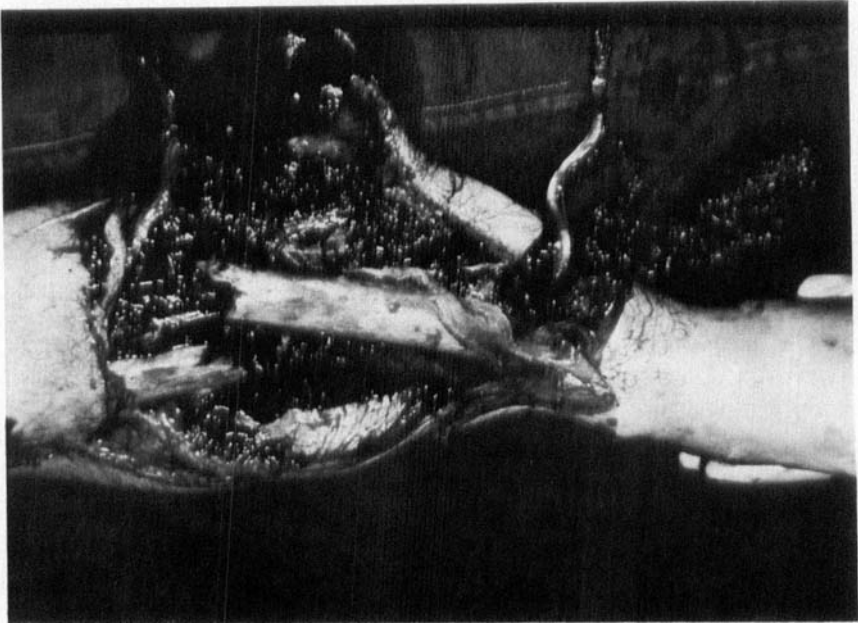


Figure 1. Left lower leg (Case 4), anterior view, on the day of the accident.

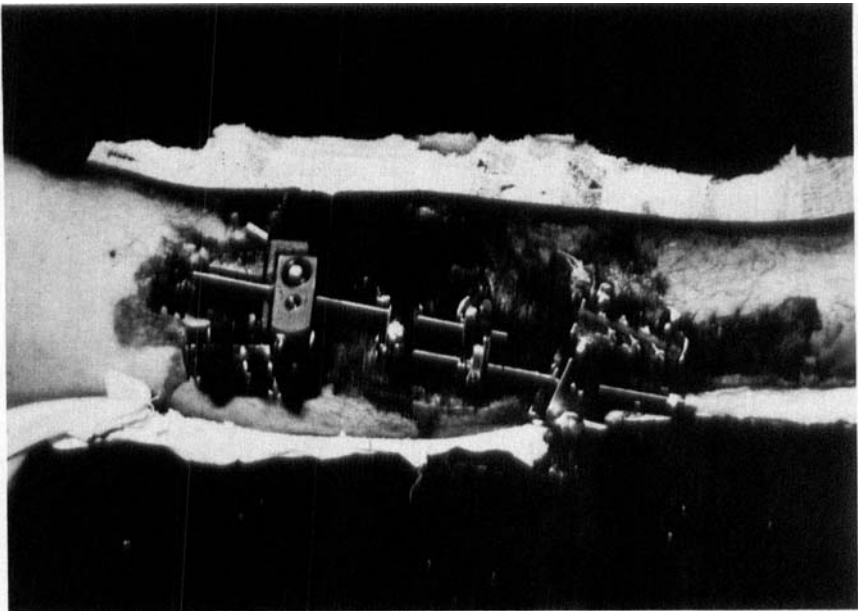


Figure 2. The same leg, anterior view, two weeks after primary treatment. There is a 6 × 7 cm cutaneous necrosis between and lateral to the 2 sets of Hoffmann pins.

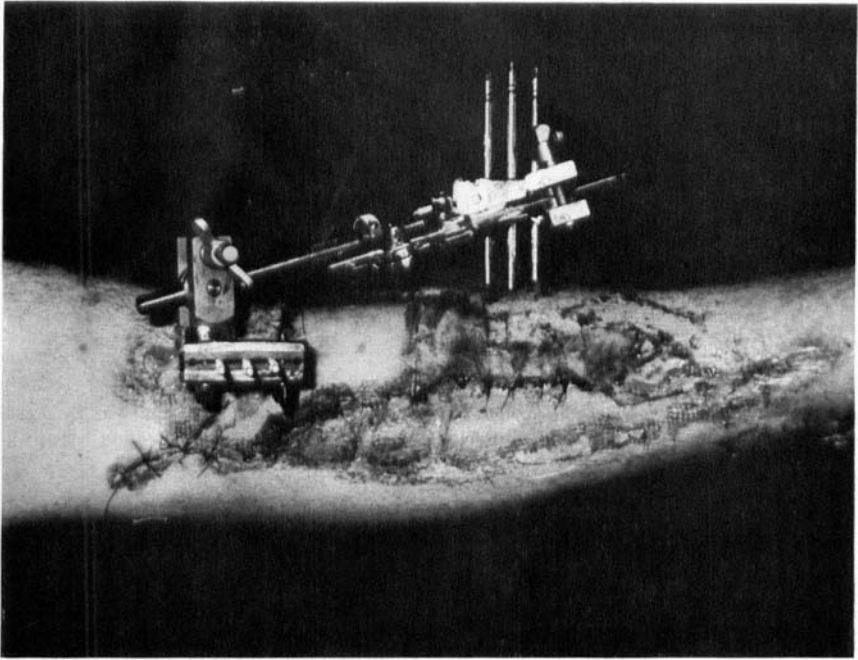


Figure 3. The same leg from the medial aspect 3 weeks after myoplasty using the medial belly of the gastrocnemius.

fracture had not yet united, so that a medullary nail was inserted, and this procedure did not necessitate exposure of the fracture site. Eighteen months after the accident the fracture had united, and full weight-bearing was possible without pain.

Case 5. A 52-year-old woman was transferred to the Department after having undergone osteosynthesis of a left-sided malleolar fracture 12 days previously. Because of massive infection the wound had to be opened, and the lateral malleolus as well as lateral collateral ligament were excised. This left a skin defect of 15×8 cm at the bottom of which the talocrural joint was exposed. There was varus instability and a tendency to dislocation in the joint. Eight days after the revision the talocrural joint could be closed by transposition of the *extensor digitorum brevis*. The skin defect was covered with a split-skin graft. When the plaster cast was removed one month later, the joint proved to be so stable that no further splinting was needed. One year after the operation the patient had no complaints, even though in her work she had to stand and walk all the time.

Case 6. A 39-year-old woman was admitted with a right-sided bimalleolar fracture which was fixed with Rush pins. Owing to non-union in both malleoli she was subjected, 2 years later, to arthrodesis which, however, did not prove stable. Reoperation 18 months later was complicated by a skin defect in the region

of the lateral malleolus. The denuded bone was covered by reversing the belly of the *extensor digitorum brevis* over the defect. Solid closure was obtained laterally, but in 6 weeks a perforation appeared on the medial side of the ankle. The arthrodesis was still unstable. Now, 4 months after the myoplasty, the patient has been admitted to another hospital from which it is reported that revision and rearthrodesis have been performed without compromising the skin on the lateral aspect of the ankle.

Case 7. A 59-year-old woman was admitted with an open trimalleolar fracture sustained 12 hours previously. Primary wound excision, suture, and reduction was performed. A fistula appeared in the wound, leaving a skin defect of 1×3 cm over the medial malleolus communicating with the joint.

Three and a half months after the accident the joint was closed by means of the *abductor hallucis* which was exposed by an incision into the medial aspect of the foot. To avoid constricting the vessels of the muscle, this incision was connected to the primary defect. The skin defect was primarily covered with a split-skin graft. The soft-tissue cover of the malleolus is now, two months later, sufficiently stable for performing arthrodesis which will presumably be needed.

Case 8. A 69-year-old woman was admitted with a right-sided bimalleolar fracture as well as an open, low spiral fracture of the left lower leg. After wound excision of the large, curved wound on the left lower leg the fracture was immobilized by 3 crossed screws. There remained a 15×10 cm skin defect in which the tibia was exposed in an area almost 10 cm in length. This defect was covered by the belly of the *soleus muscle*. Because of oozing bleeding from the fracture site, the wound was covered with towels moistened in saline, and 48 hours later the soleus muscle was covered with a split-skin graft which took 100 per cent. At the most recent follow-up, 3 months after the accident, the soft-tissue cover was perfect, but the fracture line was still distinct and there was no definite formation of callus.

DISCUSSION

Among the eight cases a cross-leg flap was unsuitable in Case 2 because of the size of the defect and in Cases 1, 5, 6, 7, and 8 because of the patients' age and relatively reduced vascularization. In Case 4 the defect was not too large to be covered with a cross-leg flap, but it was felt expedient to employ the medial belly of the gastrocnemius, since all the antagonists were already non-functioning. None of the other patients had complaints that could be ascribed to lack of muscle function.

In two cases (Nos. 2 and 5) the myoplasty proved a marked advantage above other methods, as it simultaneously afforded skin cover and active stabilization of the knee joint and ankle joint, respectively.

It has been pointed out that preserved innervation of the muscle is necessary for a successful result. This applies most particularly to

cases in which the transposed muscle is to take over the function of a ligament. In two instances (Cases 1 and 7) there was, by clinical criteria, no preserved function of the muscle, but the goal, to produce a skin cover over the bone, was nevertheless attained.

In Case 7, where the abductor hallucis was used, coverage of the open ankle joint required a very extensive exposure, right back to the origin from the calcaneus. Nevertheless, the muscle did not reach further than just to cover the defect over the ankle joint. Proximally the defect reached a little further and could be covered by suturing the skin edges, but if the defect had been just a little bit larger the belly of the flexor digitorum longus would have been required for cover.

In the two cases in which the myoplasty was unsuccessful the explanation was presumably as follows. In Case 3, the muscle belly was placed in a tunnel limited by bone and a skin bridge and thereby it was strangulated. Ger (1971) has warned against this complication. In the other case (Case 6) the infection was not sufficiently subdued, perhaps because the resection did not include sufficient bony tissue. We have not had any late complications. Ger (1970 b) suggested pressure by shoes as the cause of late muscle necrosis following transposition of the abductor hallucis.

The problem whether grafting should be primary, "primary delayed" (1-2 days) or deferred for 5-7 days as advocated by Ger (1971) cannot be decided on the basis of the present series. We feel that it should always be primary. In Case 8, however, haemostasis was not satisfactory, and the skin defect was not covered until 2 days later with split skin which nevertheless showed a 100 per cent take.

CONCLUSION AND SUMMARY

Like previous authors, we can conclude, on the basis of eight operated cases, that myoplasty for covering denuded bone on the lower leg as well as an open knee joint or ankle joint is an important alternative to transposition flaps and cross-leg flaps. Myoplasty is even superior to these methods in elderly patients, patients with open joint injuries, and patients with particularly extensive soft-tissue injuries.

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