POSTEROLATERAL BONE GRAFTING FOR NONUNION OF THE TIBIA

J. P. SIMON, J. STUYCK, M. HOOGMARTENS, G. FABRY

Sixty-two tibial diaphyseal nonunions in 60 patients were treated with a posterolateral bone graft over an 18-year period (1969-1987). The majority were complicated by severe soft tissue damage or segmental bone loss. Thirty-four had a deep infection. Primary healing was achieved in 92%. Three types of bone grafts have been used : from 1969 to 1978 either a whole iliac bone graft (10 tibiae) or a nonvascularized fibular graft (11 tibiae) was used. Since 1978 small iliac cancellous bone chips (41 remaining tibiae) were applied to the posterior surfaces of tibia and interosseous membrane. In three tibiae with major bone defects, cancellous allografts were added to the autogenous bone. The use of cortico-cancellous bone chips resulted in a shorter healing time, compared to a nonvascularized fibular graft or a massive corticocancellous bone block.

Keywords : nonunion ; tibia ; posterolateral bone graft.
Mots-clés : tibia ; pseudarthrose ; greffe osseuse postéro-externe.

INTRODUCTION

Nonunion of the tibia still remains a challenging and difficult problem, especially when there is infection, bone loss and/or extensive soft tissue damage or scarring. We report the results of treatment of 62 nonunions of the tibia, treated with posterolateral bone grafts between 1969 and 1987 at the Pellenberg Orthopedic Hospital. Follow-up extended from 3 to 14 years and represents to our knowledge the largest series yet in the literature.

PATIENTS AND METHODS

Sixty patients with 62 tibial diaphyseal nonunions treated with a posterolateral bone graft were reviewed. All patients, except one who was lost to follow-up, were personally examined by one of the authors. Fifty-three were males and 7 females. The average age at the time of the grafting procedure was 31 years with a range from 16 to 66 years. Thirty-six fractures were open (Gustillo type 2 and 3) and 26 closed. In the majority of cases the initial fracture resulted from a high-velocity accident. The causes of injury were motorcycle accidents in 26, automobile accidents in 10, pedestrian-automobile accidents in 12, 4 soccer injuries, 1 gunshot injury, 1 shell explosion, 1 industrial machinery accident, 1 fracture after removal of a screw and 5 falls. One patient developed a bilateral nonunion after sustaining an open segmental diaphyseal fracture of both tibiae. A woman was successfully treated for a nonunion after a tibial fracture due to a fall. One year later, another fracture in the same leg at a more proximal level after removal of a screw resulted again in non-union, and again a grafting procedure was necessary.

Initial treatment was surgical in 49 patients : plates and screws in 26, intramedullary nails in 4 and external fixators in 19. Thirteen fractures were initially treated in a cast.

After the first procedure 10 patients underwent one or more operations, with a maximum of 5. Bone defects were present in 18 tibiae, ranging from 1 to 7 cm. In 4 of these cases a Papineau procedure had previously failed to bridge the gap. Electrical bone stimulation had

Orthopaedic Department, University Hospital, B-3212 Pellenberg, Belgium.
Correspondence and reprints : J. P. Simon.

been attempted in 5 without success. At the time of posterolateral bone grafting, 34 patients had an established deep infection, and 15 tibiae showed a draining sinus. In 3 patients an amputation had been proposed elsewhere. The average delay between the accident and the posterolateral grafting was 21 months.

OPERATIVE PROCEDURE

The original description of the technique is attributed to Harmon (6). The success of the procedure depends on the use of large quantities of bone graft, which must be extended well below and above the nonunion.

Intraoperative radiographic evaluation of graft quantity and placement is mandatory. A 35° internal oblique view of the leg should be obtained (1). If sufficient bone is not available from the iliac crest to bridge large defects, allograft bone chips are mixed with the autologous graft.

RESULTS

Healing was determined as clinical union when the patient was able to fully bear weight without pain and external support, and when no pain or signs of instability were present with applied stress. In addition roentgenographic assessment included an AP, a lateral and a 35° internal oblique view of the leg. Sixty-two nonunions were grafted using the posterolateral approach. Fifty-seven fractures healed after the first operation, resulting in an overall success rate of 92%. Two more nonunions healed after a second similar operation. In 3 cases the procedure definitevely failed. Nine tibiae were successfully grafted at least 2 years following the

Fig. 1a, b. — P. C. Nonunion following internal fixation for an open fracture of the distal tibia and fibula.

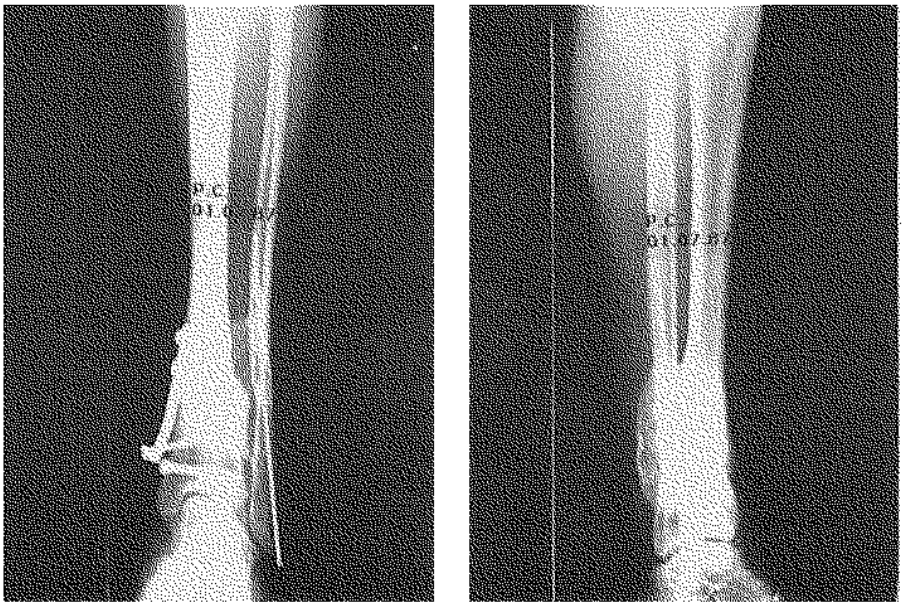

Fig. 1c, d. P. C. Solid union 6 months following p.l.g.

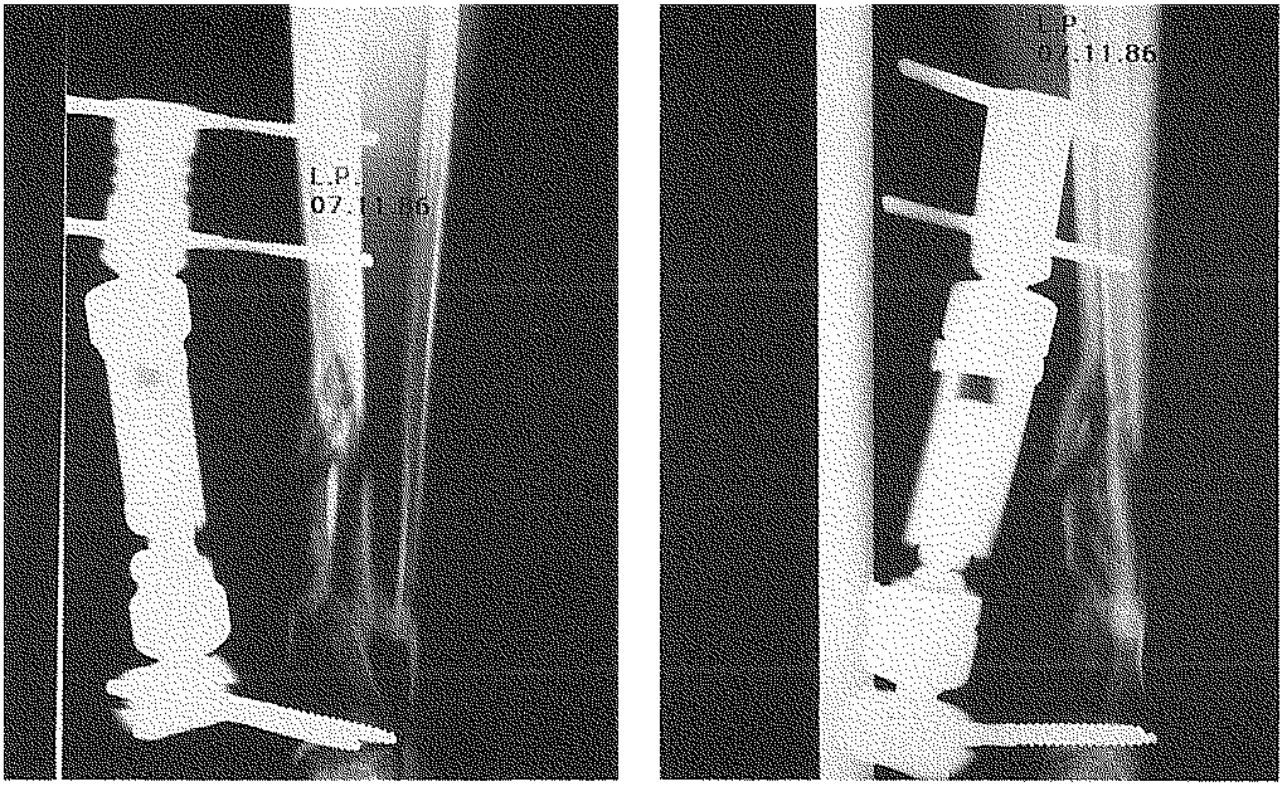

Fig. 2a, b. — L. P. Nonunion following an open segmental fracture of the distal tibia.

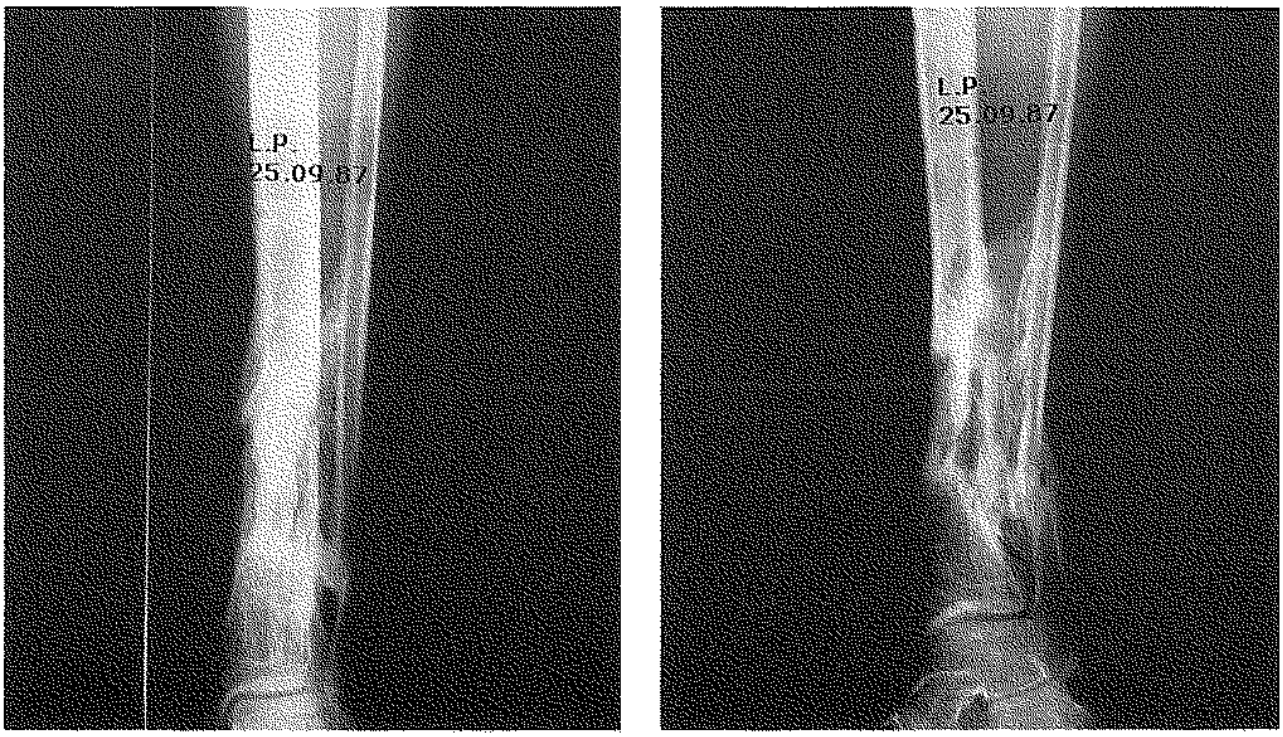

Fig. 2c, d. — L. P. Solid union 7 months following p.l.g.

initial injury : 2 after 2 years, 3 after 3 years, 2 after 4 years and 2 after 5 years. It is appropriate to consider separately the cases treated with a massive iliac bone block, a fibular graft and small cancellous bone chips.

Massive iliac bone block

Ten nonunions were grafted with a massive cortico-cancellous bone block. They resulted from 7 open and 3 closed fractures. Five tibiae were infected, and 3 of these showed a draining sinus at the time of the bone grafting. Postoperatively an external fixator was applied in all patients.

Nine fractures healed after an average time of 43 weeks, with extremes from 16 to 60 weeks. In one patient a repeat procedure was necessary. Six months later he was lost to follow-up. At this time the fracture had not healed, and therefore this case is considered as a failure.

Fibular bone grafts

Eleven fractures were grafted by transferring the fibula as a free graft to the posterior tibial surface, after an osteotomy dividing the fibula above and below the nonunion. The disadvantage of this procedure is that the interosseous membrane may be disrupted. This may allow spreading of a possible infection to the posterior compartment. The procedure is therefore no longer recommended. Four of these cases were initially open fractures. Five tibiae were infected, and one was draining at the time of grafting.

Postoperatively all patients were stabilized with an external fixator. Ten nonunions healed after an average time of 34 weeks with extremes ranging from 20 to 48 weeks. Small cancellous iliac bone grafts were successfully applied in a second procedure in the one failure.

Cortico-cancellous iliac bone chips

Forty-one tibial nonunions were grafted with small iliac bone chips. They were the result of 25 open and 16 closed fractures. The major bone defects belong to this group. Twenty-four patients had an established infection, and 11 presented with a draining sinus at the time of grafting.

Only the discharging and grossly mobile tibiae were stabilized with an external fixator. In the other patients an above-knee cast was applied for 6 weeks followed by a PTB cast and gradual weight bearing until the fracture had healed. The mean healing time was 25 weeks, ranging from 12 to 48 weeks. Three failures occurred.

FUNCTIONAL RESULTS

Excellent ratings (fracture healed, no symptoms related to the involved extremity, no drainage and less than 2.0-cm shortening) were present in 31 tibiae (50%). Good ratings (fracture healed, mild intermittent drainage, or more than 2.0-cm shortening) were evident in 27 tibiae (43%). One patient presented with a fair result due to a shortening of 6.0 cm (2%). In 2 patients, knee flexion was limited to 100° as a result of an ipsilateral femoral fracture at the time of the original injury. The level of synostosis seemed to play no role in the ankle mobility. When patients manifested limited ankle mobility, this was invariably present prior to the grafting procedure as a result of the initial trauma or surgery, with often extensive scarring, infection or compartment-related symptoms (17, 18). Preoperatively 34 (56%) of the nonunions presented with a deep infection. Fifteen were draining at the time of graft application. Ten sinuses ceased draining after healing of the nonunion. Following a sequestrectomy another infection became silent. Finally 4 legs continued to discharge small amounts of pus.

COMPLICATIONS

Definitive failure occurred in 3 cases, representing 5% in this series. Globally 5 nonunions did not heal after the primary procedure. After a repeat operation consolidation was obtained in 2 more tibiae. In one of these 2 cases the bone grafts had been applied proximal to the nonunion and did not bridge the gap. This patient had been placed in a lateral position on the operating table, which did not allow good visualization of the

posterior surface of the tibia. This emphasizes the advantage of the prone position, and the benefit of using an image intensifier or a 35° internal oblique view, as mentioned above to avoid misjudgement during the operation. In a second primary failure there was gross infection with a draining sinus. A postoperative Tc bone scan showed that the bone ends proximal and distal to the fracture site were avascular over a large area. The reason for definitive failure in 2 other cases has not been elucidated. Finally one patient was lost to follow-up. There were no operative deaths or amputations. In 2 cases the peroneal artery was lacerated during the procedure, but this problem could be resolved prior to closure. In 14 patients temporary postoperative drainage was attributed to wound hematomas. All resolved spontaneously without operative intervention. There were no neurological deficits related to the procedure.

CONCLUSION

The success rates reported in the literature on posterolateral bone grafting range from 80 to 90% (17, 18, 19). In this series, a high success rate (92%) with good to excellent functional results, was obtained.

Small iliac corticocancellous bone chips appeared to give the fastest healing rate. Experience gained in more recent years also indicated that immobilization in a cast is sufficient to stabilize these nonunions, and that early weightbearing in a PTB cast may enhance the speed of healing. An external fixator is only recommended in a very unstable or grossly infected pseudarthroses. The main advantage of this technique is that it is a one-stage procedure. It can be performed in the presence of infection and drainage in the anterior compartment. In addition it was confirmed in our series that anterior drainage from the infected tibia often ceases, once solid union of the fracture has been obtained (17, 18).

Extensive scarring and attenuated skin at the front of the lower leg are of little importance since the incision lies in healthy and well-vascularized skin.

It was shown moreover that posterolateral bone grafting stimulates bone healing even up to 5 years following the initial injury. Since posterolateral bone grafting for tibial nonunion is a simple, safe and highly effective operation we still believe that this procedure should be given primary consideration in the treatment of complicated and infected nonunion of the tibia.

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SAMENVATTING

J. P. SIMON, J. STUYCK, M. HOOGMARTENS en G. FABRY. Posterolaterale botenten bij tibia pseudartrosen.

Tussen 1969 en 1987 werden 62 pseudartrosen van de tibia behandeld met botenten aangebracht via dorsolaterale toegangsweg. Heling werd bekomen in 57 gevallen (92%). Deze techniek is aangewezen bij infectie, drainerende sinus, slechte toestand van de huid en voor het overbruggen van beendefecten.

RÉSUMÉ

J. P. SIMON, J. STUYCK, M. HOOGMARTENS et G. FABRY. Greffe osseuse postéro-externe pour pseudarthrose.

De 1969 à 1987, 62 pseudarthroses du tibia furent greffées par voie postéro-externe ; la consolidation a été obtenue dans 57 cas (92%).
Cette technique est indiquée en cas d'infection, de fistule, de mauvais état cutané et pour le pontage des pertes de substance osseuse.