

TIBIOCALCANEAL MARCHETTI-VICENZI NAILING IN REVISION ARTHRODESIS FOR POSTTRAUMATIC PSEUDARTHROSIS OF THE ANKLE

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The authors conducted a retrospective study of 7 patients treated with tibiototalcalcaneal Marchetti-Vicenzi nailing (one anterograde and six retrograde nails). All these patients had developed pseudarthrosis after previous arthrodesis for posttraumatic ankle fractures. The results were evaluated clinically and radiographically at a median time of four years.

Fusion occurred in three patients, in one of them only after removal of the proximal locking screw. Of the remaining four patients, one achieved consolidation after replacement of the Marchetti-Vicenzi nail by another intramedullary nail, two were lost to follow-up after replacement by external or internal fixation, and the last patient developed pseudarthrosis again. At least nine additional interventions were necessary in six patients, including one amputation for intractable pain and severe soft-tissue damage due to the trauma.

None of the patients had excellent or good results. The majority was unsatisfied with this type of intramedullary nailing. Therefore our study was terminated prematurely.

Revision ankle fusion for nonunion or malunion after external or internal fixation has a high complication rate. Further study is mandatory to prevent or resolve remaining problems.

INTRODUCTION

Nonunion is a rare but serious complication after arthrodesis for nonunion following ankle or tibial pilon fractures (4). Risk factors are morbid obesity, infections, diabetes mellitus, avascular necrosis, smoking and noncompliance.

Ankle arthrodesis is an alternative to joint replacement for posttraumatic pseudarthrosis of the ankle.

Although ankle fusion has been used for more than 100 years already, one universal procedure still does not exist. There are over 40 techniques and modifications, among them external fixation (e.g. Ilizarov), plate fixation, cancellous screws (1) and staples. All of these surgical techniques have a high complication rate (residual pain, delayed union or nonunion, sepsis, tibial fracture, soft-tissue damage, infections, etc).

Internal fixation for ankle fusions has become an increasingly popular technique (3, 7, 11, 12). Therefore we have chosen to evaluate Marchetti-Vicenzi locked intramedullary nailing as an alternative procedure in revision arthrodesis (5) of the ankle after nonunion of an ankle arthrodesis for posttraumatic pseudarthrosis with involvement of the subtalar joint.

PATIENTS AND METHODS

We retrospectively reviewed seven patients treated with intramedullary locked Marchetti-Vicenzi nailing (one anterograde and six retrograde nails) for failed fusion of an arthrodesis after previous surgery for posttraumatic malleolar or pilon fracture. Two patients had suffered an open fracture.

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Table I. — Arthrodesis techniques
- previous fusions

Case	External fixation	Plate fixation	Intramedullary nailing	Screws	Staples	Grafting
1	-	-	++	-	-	+
2	-	-	+	-	-	-
3	+	+	-	-	-	+
4	?	?	?	?	?	?
5	++	+	+	-	-	-
6	+	-	-	-	-	-
7	++	-	+	-	-	-

- revisions

Case	External fixation	Plate fixation	Intramedullary nailing	Screws	Staples	Grafting
1*	-	-	+	-	-	+
2	-	-	+	-	-	+
3*	-	?	-	-	-	?
4	+	-	-	-	-	-
5**	-	-	-	-	-	-
6	-	-	-	-	-	-
7***	-	-	-	-	-	-

* lost to follow-up after new revision

** consolidation only after removal of the proximal locking screw

*** amputation after 1 year, Girdlestone after 1.5 years

The follow-up, based on the charts and X-rays of the patients, had a median duration of four years. Two patients were lost to follow-up after repeat revisions.

The population consisted of four men and three women, with a median age of 49 years (range 17-74 years). The right side was involved in three patients, the left side in four patients. The median weight of the men was 80 kg; the median height 171 cm. For the women this was 64 kg and 167 cm, respectively.

Primary fusion was attempted by external fixation in four cases, by plate fixation in two cases, and by intramedullary nailing in four cases; screws and staples were not used (table I). This represents at least 23 procedures in seven patients prior to Marchetti-Vicenzi nailing.

Technique

According to Glissan (8) the four requirements for a successful fusion are complete removal of all cartilage, fibrous tissue, and any other material that may prevent contact of bone to bone; accurate and close fitting of the fusion surfaces; optimal position of the ankle joint; and

maintenance of bone apposition until the fusion is complete.

In our patient group these principles were adhered to as much as possible. Any remaining cartilage between the tibia and talus was removed by curettage through a mini-incision.

Biomechanical studies have shown that crossed cancellous screws are stiffer than parallel screws (6). Intramedullary fixation is even stiffer than crossed lag screws in bending and torsion in all directions tested (2). Therefore it may help increase the fusion rate through increased stability of the internal fixation.

We treated all our patients with internal compression arthrodesis using intramedullary locked Marchetti-Vicenzi nailing. Six patients were treated transcalcaneally with a retrograde nail, one patient was treated tibiototalcalcaneally with an anterograde nail. Autografts were systematically used to obtain fusion of the posterior subtalar joint. Postoperatively the leg was immobilised in a short-leg cast for 1-4 weeks and full weight bearing was allowed after 1 to 6 weeks.

All patients completed a functional assessment questionnaire (quality of life index) (table II). Values

Table II. — The Quality of Life Index

Activity :
2 Working or studying full-time or nearly so in usual occupation ; or managing own household ; or participating in unpaid or voluntary activities, whether retired or not.
1 Working or studying in usual occupation or managing own household or participating in unpaid or voluntary activities ; but requiring major assistance or a significant reduction in hours worked or a sheltered situation, or on sick leave.
0 Not working or studying in any capacity and not managing own household.
Daily living :
2 Self-reliant in eating, washing, toileting and dressing. Using public transport or driving own car.
1 Requiring assistance for daily activities and transport, but performing light tasks.
0 Not managing personal care or light tasks and/or not leaving home or institution at all.
Health :
2 Feels well or 'great' most of the time.
1 Lacks energy and not feeling 'up to par' more than occasionally.
0 Feels very ill or 'lousy', weak and washed out most of the time, or unconscious.
Support :
2 Good relationship with others and receiving strong support from at least one family member and/or friend.
1 Support limited by family or friends and/or by patient's condition.
0 Infrequent support, or only when absolutely necessary or unconscious.
Outlook :
2 Calm and positive, accepting and in control.
1 Troubled, or periods of obvious anxiety or depression.
0 Seriously confused or frightened or consistently anxious or depressed or unconscious.

assigned to the Qualy (quality adjusted life years) were deduced from the disability/distress tables (table III).

RESULTS

The clinical, functional and radiographic results were evaluated at a median follow-up of four years after surgery.

Rate of union

Fusion occurred in three of the seven patients after several months and in one of the patients only after removal of the proximal locking screws. At least nine additional operations were necessary in six patients, including one amputation for intractable pain. Four new revision ankle fusions necessitated seven surgical procedures. One fusion was successful, two other patients were lost to follow-up and one again developed pseudarthrosis.

Functional criteria / satisfaction

– ADL-scores (activities of daily living) were obtained according to the Quality of life index (table II). The highest possible score is 10 points.

The values assigned to the Qualy (quality adjusted life years) were deduced from the disability/distress table and had a maximum score of 1.00 (table III). An excellent quality of life index scored 9-10 points, a good one 7-8 points, a fair one 5-6 points, an unsatisfactory one 3-4 points and a poor one 1-2 points. Most patients had a good score.

Qualy values equal to 1.00 were excellent, 0.995 signified a good result ; from 0.973 to 0.990 the result was fair, from 0.680 to 0.972 unsatisfactory, and from less than -1.486 to 0.677 poor. More than 50% had unsatisfactory Qualy values.

- Pain
One patient suffered intractable pain of the reflex sympathetic dystrophy type due to severe tissue damage, and had to have his leg amputated one year after the accident.
- Shoe modification
Two patients required an inside orthosis (fig 1).
- Walking
One patient had been paraparetic for more than 50 years and used crutches inside the house and

Table III. — Terminology used for the Qaly (quality adjusted life years)

Disability	
I	No disability
II	Slight social disability
III	Severe social disability and/or slight impairment of performance at work. Able to do all housework except very heavy tasks.
IV	Choice of work or performance at work very severely limited. Housewives and old people able to do light housework only but able to go out shopping.
V	Unable to undertake any paid employment. Unable to continue any education. Old people confined to home except for escorted outings and short walks and unable to do shopping. Housewives able only to perform a few simple tasks.
VI	Confined to chair or wheelchair or able to move around in the home only with support from an assistant.
VII	Confined to bed.
VIII	Unconscious.
Distress	
A	No distress.
B	Mild.
C	Moderate.
D	Severe.

Values assigned to the Qaly

Disability	Distress			
	A	B	C	D
I	1.000	0.995	0.990	0.967
II	0.990	0.986	0.973	0.932
III	0.980	0.972	0.956	0.912
IV	0.964	0.856	0.942	0.870
V	0.964	0.935	0.900	0.700
VI	0.875	0.845	0.680	0.000
VII	0.677	0.564	0.000	-1.486
VIII	-1.028	—	—	—

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a wheelchair outside. Another patient's leg was amputated after one year, and he was fitted with a prosthesis. A few months later he needed a total hip arthroplasty after iatrogenic avascular necrosis of the hip. However, this prosthesis became infected and a Girdlestone disarticulation was performed.

– Employment

One patient was still a student at the time of surgery. Two patients were retired. One patient was an independent worker and started to gradually resume work immediately after surgery. One patient had been declared an invalid 50 years ago and the other two patients after the arthrodesis,

Fig. 1. — Two patients were able to walk only with this custom-made orthosis, which could be covered by a large shoe.

Table IV. — Outcome

	Complaints	Functional performance	Xrays	Number of patients
Excellent	No	No disability	Consolidation	0
Good	No	Slight disability	Consolidation	0
Fair	Discomfort	Disability	Consolidation	1
Unsatisfactory	Complications	Severe disability	Nonunion	5
Poor	Intractable pain	Severe disability	Consolidation	1

one because of his leg amputation, the other because of the accident and multiple failures of the previous interventions.

– Motion and alignment

One patient developed a pseudarthrosis in varus. At least two patients had shortening of the leg of several centimetres.

– Previous infection

Four patients had a history of infection before they underwent Marchetti-Vicenzi nailing. In one of them the infection had been totally eradicated preoperatively, and the fracture consolidated. In the other three patients fistulisation persisted, and consolidation was achieved in only one of them.

One patient developed a deep infection postoperatively without a history of previous infection. Even though the infection was treated successfully, the patient developed a pseudarthrosis.

– Complications

Some patients complained of ulceration of the heel due to pressure from the nail, massive synovitis, failure of the osteosynthesis, malalignment, shortening of the leg, pseudarthrosis or intractable pain of the reflex sympathetic dystrophy type. One patient had a deep infection, but was treated successfully.

Fifty percent of the patients who developed nonunion had several risk factors (table V). Two patients suffered from diabetes, three smoked and two had a history of chronic infection. None of the patients were morbidly obese, or had avascular necrosis, nor were they noncompliant with postoperative weight bearing.

– Outcome

All results were grouped and categorised. We created five groups according to the complaints, functional performance and X-rays (table IV).

An excellent outcome meant no complaints, no disability and consolidation. Good results implied no complaints, slight disability and consolidation. None of the patients fell into these two groups. One patient had a fair result. She showed some discomfort and disability despite fusion. The majority of the patients had unsatisfactory results. They all had complications, severe disability, and nonunion except for one patient in whom consolidation was achieved after removal of the proximal locking screw. One last patient had poor results. He suffered from intractable pain with severe disability after amputation of his leg one year after the trauma and a Girdlestone disarticulation 1.5 years after the trauma because of infection of his hip prosthesis.

DISCUSSION

Biomechanical studies have shown that the crossed cancellous screw technique is more rigid than the parallel cancellous screws, especially in resisting torsional stresses (6). Intramedullary fixation is even stiffer than crossed lag screws and may therefore help to increase the fusion rate through increased stability of the internal fixation (2).

However, the union rate in our study is unsatisfactory in comparison with other studies (10). More than 50% achieved no consolidation with the

Table V. — Risk factors for pseudarthrosis

Case	Diabetes	Morbid Obesity	Smoking	Infection	AVN	Non-compliance	Pseudarthrosis
1	–	–	–	–	–	–	Yes
2	+	–	+	–	–	–	Yes
3	–	–	+	+ *	–	+/-	Yes
4	–	–	–	–	–	–	Yes
5	+	–	+	+	–	–	No **
6	–	–	–	+	–	–	No
7	–	–	+	+ ***	–	–	No

* open fracture

** healed after removal of the proximal locking screw

*** MRSA, Gustilo IIIc open fracture.

Marchetti-Vicenzi nail. With a new revision arthrodesis only one of the four pseudarthroses healed with Marchetti-Vicenzi nailing. Two other failures were lost to follow-up after revision and in one other patient consolidation was not achieved as yet.

Fifty percent of our patients who developed nonunions had several risk factors that are known to increase nonfusion rates after primary ankle arthrodesis, such as infection, smoking and diabetes.

None of the four patients with a history of infection due to their previous operations developed a new infection, but consolidation failed to occur in three of them. One patient without previous infections suffered from a deep infection and consolidation was not achieved even though the infection was treated successfully.

According to Cobb *et al* (4) the relative risk of nonunion for active smokers is increased 3.75 times. Four of our patients smoked and each of them also had other known risk factors. Two patients developed a pseudarthrosis and two achieved consolidation, one however only after removal of the proximal locking screws.

At the time of Marchetti-Vicenzi nailing only two patients underwent grafting at the site of the pseudarthrosis. However, all subtalar joints were grafted with locally harvested bone from the calcaneus. One patient did not consolidate and the other patient only consolidated after removal of the proximal locking screws.

Postoperatively the leg was immobilized in a short-leg cast for 1 to 4 weeks and full weight bearing was allowed after 1 to 6 weeks. In their study, Mahan *et al* (9) however, prescribed a long-leg cast for 4 to 6 weeks in order to hold the knee in 25 to 30° of flexion, followed by a short-leg cast or complete removal of the cast. Nonweightbearing is promoted for 12 weeks or until consolidation on X-rays. After removal of the cast 50 % weightbearing is allowed for two weeks, followed by full weightbearing with walking aids.

All techniques of ankle fusion involve multiple complications. In our series these consisted of malalignment (varus) pseudarthrosis, shortening of the leg of several centimetres, pressure ulcers, failure of the osteosynthesis or massive synovitis. Further studies are mandatory to prevent or resolve remaining problems.

One patient had an amputation of his leg one year later because of intractable pain and severe soft-tissue damage due to the trauma.

CONCLUSIONS

Intramedullary fixation in ankle fusion has become very popular. It offers more stiffness than crossed lag screws and may thus help increase the fusion rate through increased stability of the internal fixation.

However, in our experience, revision arthrodesis for failed arthrodesis after posttraumatic nonunion of ankle fractures using a locked intramedullary

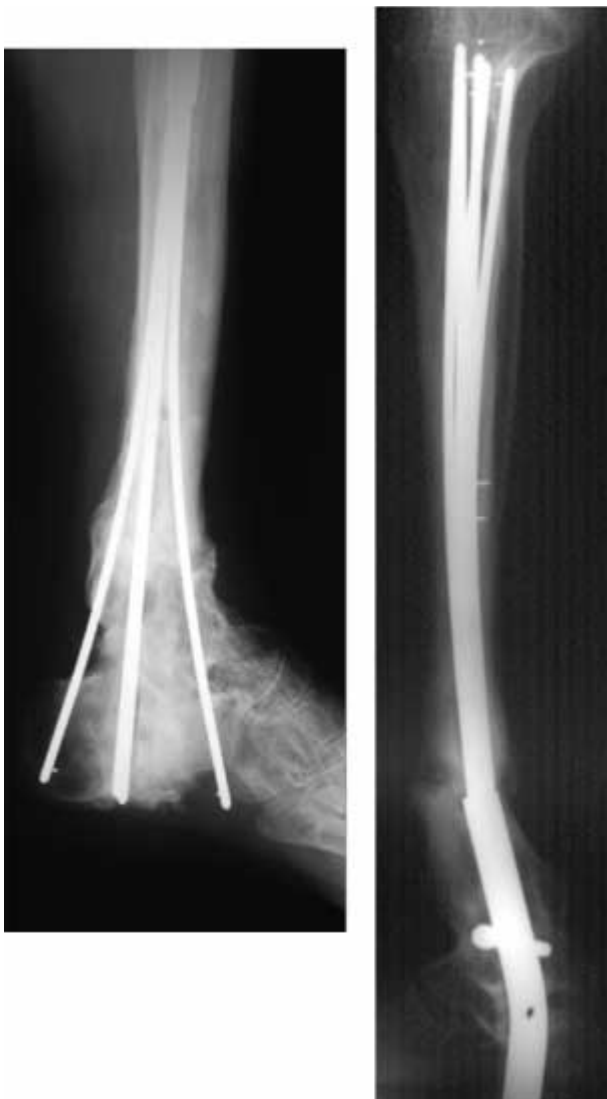


Fig. 2. — On the left side an example of antegrade nailing, on the right a retrograde nailing.

Marchetti-Vicenzi nail had an unacceptable number of complications and a high failure rate, and it cannot therefore be recommended for this indica-

tion. Further studies are mandatory to prevent or resolve remaining problems.

Amputation gives excellent functional results in unsalvageable cases and should be considered a viable option to improve the functional outcome in patients with solid, well-aligned fusions who are disabled by severe chronic pain.

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