Infected pseudarthrosis of the leg treated by papineau modified method


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ABSTRACT
The authors have treated 29 cases of infected pseudarthrosis of tibia: 12 complications of open fractures of legs with loss bone stabilized firstly by external fixator; 09 closed fractures treated traditionally by jbira seen in pseudarthrosis infected, 05 cases of septic nonunion arising after plate osteosynthesis and 03 cases following centromedullary nailing. In all cases, two stage reconstruction: Initial surgery consisted of soft tissue and bone debridement, external fixation completed by Dressing percutaneous a day by antiseptic and intravenously antibiotic. After any remaining infection, at last 6 to 8 weeks, the reconstruction of the soft tissue with a free microsurgical muscle flap and skin graft. The second stage surgery consisted to replace external fixator by intramedullary nailing and the osseous reconstruction was cancellous or corticocancellous grafting. The final result was obtained after an average of 24 months and was excellent in 15 cases, good in 12 and 02 failures were observed. On the infectious; remaining infection were observed in 02 and required amputation of leg. The modified method of Papineau seems superior to any other method used for treatment of infected pseudarthrosis of tibia.

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Introduction
The infected pseudarthrosis of the diaphyseal tibia fracture continues to be one of the greatest challenges in orthopedic surgery, its frequency is 5.2% (1), in Europe it is not frequent and varies between 0-2% and when the working conditions are difficult it can reach up to 20% in poor countries (2,3). It defined nowadays no only to the notion of non-union in six months but to the prognosis of fracture and the degree of soft tissue damage (4). The coexistence of non-union, infection and the degree of the loss of skin tissue is the triptych of illness for the patient and the orthopedist surgeon. The method of Papineau was modified to make the bone reconstruction in our own experience; it consisted by debridement of bone and coetaneous tissue infected, followed by an external fixation and dressing percutaneous a day by antiseptic and intravenously antibiotic. The debrided areas will be covered by muscle flap or free vascular transfer. After any remaining infection, at last 6 to 8 weeks the second step of bone reconstruction after recovered skin wound to replace external fixator by intramedullary nailing. The reconstruction graft was usually cancellous or corticocancellous bone alone or associated with a vascularized graft (fibula) reconstruction are the two main stages of treatment. The aim of this study was to describe the technique of Papineau modified and to evaluate the outcome in treatment of infected pseudarthrosis of leg.

Materials And Method
We reported a retrospective study of 29 cases of infected pseudarthrosis of the leg collected between January 2008 and May 2013 in Orthopedic and traumatology department of Ibn sina hospital. 21 men and 8 women aged 20 to 65(mean, 40.3) who presented 12 complications of open fractures of legs with loss bone stabilized firstly by external fixator(fig.1a,1b), 09 closed fractures treated traditionally by jbira seen in pseudo-arthritis infected(fig.2a,2b), 05 cases of stabilization by plate osteosynthesis and 03 cases of nonunion following centromedullary osteosynthesis nailing(fig.3). The mean follow-up period was 24 months and the mean bone defect was 4.5 cm (range: 3.5 to 6cm)

Surgical Technique
The modified method of Papineau has two stage approach: two stage reconstruction: Initial surgery consisted to removal plate or nail maintained infection and of soft tissue debridement, the dead bone is curetted, Placement of external fixation of Hoffman completed by Dressing percutaneous a day by antiseptic and intravenously antibiotic (fig.4). Two consecutive negative wound cultures and normal values of blood cell count, C - reactive protein CRP, and estimated sedimentation rate were obtained. After the eradication of the infection. The debrided areas will be covered by muscle flap or free vascular transfer. The second stage surgery consisted to replace external fixator by intramedullary nailing and the osseous reconstruction was cancellous or corticocancellous grafting ,when the bone loss is less than 5 cm, or associated with a vascularized graft (fibula) when it is exceed 5 cm. The consolidation was on average at 24 months

Results:
29 patients, aged 20 to 65(mean, 40.3) were followed and the results were analyzed on the consolidation of nonunion, the healing of the infection, limb function and the professional reintegration.

The consolidation and infection On average at 24 months
27 patients had been drained and consolidated. 2 patients were amputated following defects consolidation and recurrent infections (fig.3). At 4 months the bone graft showed radiological consolidation (fig.4) and the result was excellent in 15 cases, good in 12 and poor in 2 cases
Functional results:
The deformity and length inequality were corrected successfully on the majority of the patients. (27/29) had a normal walking, but we noted an average shortening of 2 cm observed in patients with bone loss superior 4 cm. Varus and hyperextension in three cases was well tolerated by patients. Only 6 patients had dorsiflexion to 20° and plantar flexion to 30°. Knee and ankle mobility was not limited in all cases. The functional result was excellent in 16 cases, good in 8 cases, fair in 3 cases and poor in 2 cases. We noted long-term hospitalizations: 9 months on average and multiple interventions on average three interventions per patient. So most of the patients had returned to their daily activities.

Different stages in reconstruction of infected Pseudarthrosis in developed countries
I. Septic nonunion of leg:
1. With loss of bone in open fracture stage III according to Cauchoix and Duparc (a, b), fixed firstly by external fixator of Hoffmann.

![Image](image1.jpg)

2. Closed fractures treated traditionally by jbira seen in pseudarthrosis infected (a, b)

![Image](image2.jpg)

Discussion
The infected pseudarthrosis of the diaphyseal tibia fracture continues to be one of the greatest challenges in orthopedic surgery whatever the surgical technique described in the literature, the results of the treatment of septic nonunion are still a problem for long periods of hospitalization, recurrent infections, and multiple interventions on average 3 per person interventions. The infectious loss of bone is treated by amputation or reconstruction. With limb salvage always preferable, surgeons rely on already established techniques such as grafting and distraction osteogenesis to avoid amputation and ideally restore structure and function. The modified method of Papineau with two-stage approach in our own experience is an effective method of the bone reconstruction and limb salvage. It can reduce the duration of the eradication of the infection to 6 weeks, and the bone reconstruction by autograft does nothing require to the patient but Silber (5) reported acute and chronic complications of donor sites. The presence of fistula and the anteroposterior and lateral radiographs may be sufficient in the diagnosis of septic nonunion (6). The multiple and profound preoperative samples, culture and antibiogram are realized for the bacteriological diagnosis and microbial poly forms are seen in 1/3 cases (7). Staphylococcus aureus was frequent (8) or associated with Escherichia coli were in 09 cases treated traditionally by jbira, an association of Klebsiella and Pseudomonas aeruginosa in 3. Wichou in Casablanca (9) has found that the germs were isolated in 6/22 cases with predominance of pseudomonas aeruginosa in 5 cases and an association Klebsiella-aeruginosa in one case. Moyikoua (10) in a series of 10 was isolated germs in 7/10; the Staphylococcus aureus in 3/7 cases, followed by pseudomonas in 2/7 and an association of Klebsiella and cytobacter in 2/7. Patrick (11) reported some difficult for healing infection in osteosynthesis material.

3. Septic nonunion followed centromedullary nailing

![Image](image3.jpg)

II: Soft tissue debridement, the dead bone curetted, Placement of external fixation of Hoffman completed by Dressing percutaneous a day by antiseptic
III. Reconstruction of the soft tissue with a free microsurgical muscle flap and skin graft 4 weeks later

IV. External fixator changed by intramedullary nailing and grafting cancellous or corticocancellous.

All patients had received dressing percutaneous a day by antiseptic and intravenously antibiotic after antiobigram for 6 to 8 weeks. The persistent infection was in 2 cases leading to amputation. For nonunion with loss lower than 3 cm substance cortical cancellous autograft taken at the anterior iliac crest or posterior was used. The consolidation was in 27 cases with a mean of 2 years and the dorsal and plantar flexion of the ankle joint were respectively 20° and 30° in 23 cases. Moyikoua (10) obtained a limitation of dorsiflexion of the ankle in 8/10 patients. Vidal (12) reported failures in 13/47 case with GITP caused to a technical operator error and recommended a recovery by iterative GITP using anterior diaphyseal graft. When the bone loss is large, Bumbic (13) preferred in some recovery by iterative GITP using anterior diaphyseal graft supported by cancellous or corticocancellous.

Reconstruction-cancellous graft supported by the fibula (GSAP) (15), this method requires an environment of soft tissue alive and retro position of the bone graft.

- Reconstruction by fibula pro tibia (19): This is a simple, classic and effective technique is to translate the fibula.

Recently, Alain Charles Masquelet (20) proposed a two-stage technique: first debridement and filling of bone loss with an acrylic spacer, second bone reconstruction by filling with cancellous bone in the space left free.

For to prevent complications of septic nonunion in case of loss of posttraumatic bone type III of open fractures, Garbuio (21) preferred in emergency an intramedullary nailing followed by bone and skin graft at the same time, and the results were excellent in 3/5.

Conclusion:
The infected pseudarthrosis of the diaphyseal tibia fracture continues to be one of the greatest challenges in orthopedic surgery, whatever the surgical technique described in the literature; the modified method of Papineau is a therapeutic arsenal unaffected and cheap adapted on the countries with low wages.

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