Tibial fracture is the most common long bone fracture. Because of the superficial location of the tibia, surgery is usually required for the treatment of fractures to achieve union. The goal of this study was to evaluate the effect of decortication on the faster union of fractures treated with compression plates. In this clinical trial, conducted from 2009 to 2013, 42 patients were randomly assigned to the decortication (20 patients) and control (22 patients) groups. Follow-up was performed every 2 weeks until union was achieved, and then patients were examined after 6 and 9 months for analysis of final union. Mean time to weight bearing with 2 crutches, weight bearing with 1 crutch, weight bearing with a cane, and complete weight bearing without pain in the control group (receiving only the compression plate) was 5.59, 7.50, 9.32, and 11.05 weeks, respectively. Mean time to weight bearing with 2 crutches, weight bearing with 1 crutch, weight bearing with a cane, and complete weight bearing without pain in the decortication group was 4.90, 6.35, 7.75, and 9.25 weeks, respectively. All 4 values were significantly higher in the decortication group compared with the control group (P<.05). Erythema and signs of inflammation were significantly associated with decortication and were more common in the decortication group. No infection, broken plate, or nonunion occurred in either group. Because decortication had a significant effect on achieving union in nonunion fractures, it could be used to induce faster clinical union in acute tibial fractures. [Orthopedics. 2015; 38(3):e213-e216.]
The tibial shaft is a common site of long bone fracture because of its superficial location. In recent decades, there have been significant improvements in the treatment of these fractures that led to a higher percentage of unions, earlier union time, and the reduction of operative, postoperative, and fracture-related complications, including thrombosis, joint stiffness, osteoporosis, and pain.1

Many researchers are investigating the processes that influence bone repair and union. Most of these processes are in accordance with the current treatment of nonunion or delayed union. A common treatment of nonunion is decortication.2 Bone decortication is often performed as part of the guided bone regeneration procedure. The biologic rationale for bone decortication is to allow progenitor cells easy access to a guided bone regeneration-treated site to facilitate prompt angiogenesis.3

Decortication is a well-recognized procedure, used for refreshing and stimulating fracture ends in cases of nonunion, some dental procedures, or spinal fusions, including correction of deformity in scoliosis or kyphosis,4,6 and making multiple pedunculated osteoperiosteal flaps similar to fish scales near the bone ends. This procedure stimulates the bone cortex and medulla, increases local blood flow, and induces inflammation, and finally accelerates the process of bone healing and contributes to final fusion.

Previous studies have not reported the use of decortication in acute fractures. With regard to the effects of decortication on accelerating biologic inflammation and repair, and considering the authors’ experience, the goal of this study was to evaluate the effects of decortication, bone stimulation, and artificial induction of natural repair processes on union time, postoperative pain, time to weight bearing, and recovery time.

**MATERIALS AND METHODS**

The current study was a phase I clinical trial. Because no similar studies (human models) that considered certain inclusion and exclusion criteria for reducing the effects of confounding factors were found, the study by Oda et al7 was used to calculate the sample size.

The easy sampling method was used to select study subjects from patients referred to Emam Reza and Kamyab hospitals for open reduction and fixation with compression plates (Synthes, Solothurn, Switzerland). Compression plating is a standard treatment method for transverse and oblique fractures of the tibia, and in 96% of cases clinical and radiographic union occurs within 17 weeks.5

Patients were randomly assigned to the control and decortication groups, based on whether they were hospitalized on an odd or even date. Patients in the decortication group were informed about the study objectives, and they provided informed consent. In patients with closed fractures of the tibial diaphysis, which required a limited contact dynamic compression plate after open reduction, decortication was performed with the fish-scaling method. The procedure was performed with a 2/8-inch–wide osteotome, and decortication was started on at least a 5-cm distance of fracture line on 2 sides of the fracture line. The type of compression plate was similar for all patients.

Inclusion criteria were as follows: (1) closed fracture of the tibial diaphysis; (2) choice of limited contact dynamic compression plating for patients requiring open reduction; (3) patient age 20 to 50 years; and (4) type A fracture based on the Orthopaedic Trauma Association classification, with a transverse or oblique fracture line.

Exclusion criteria were as follows: (1) open fracture; (2) simultaneous fracture in the same limb or the other lower limb, interfering with weight bearing; (3) previous fracture at the current fracture site; (4) a 21-day lapse between fracture and reduction time, requiring bone grafting; (5) history of head trauma; (6) intensive care unit admission and loss of consciousness, leading to large bone callus formation; (7) history of malnutrition; (8) corticosteroid use; (9) systemic disease (eg, renal failure, hyperparathyroidism, malignancy); (10) tobacco use or addiction to opioids, which influence fracture union; (11) diagnosis of osteoporosis; and (12) ability to undergo open reduction and fixation without damage to the periosteum because decortication must be removed and causes damage. Surgical intervention is indicated for all displaced tibial fractures.

The patients remained in the hospital after surgery until satisfactory healing of the surgical wound was achieved. Before discharge, patients were fully informed and trained in wound care and were told to avoid weight bearing until at least 4 weeks. A researcher who was blinded to the study objectives provided clinical and radiographic follow-up.

Follow-up examinations were performed every 2 weeks for a 12-week period. After this period, patients were visited at 6 and 9 months. Follow-up included examination of the wound, possible side effects of surgery (eg, infection, nonunion), and appropriate time for weight bearing with 2 crutches, 1 crutch, and a cane, and complete weight bearing without pain. Union was evaluated based on improvement of the fracture line and other signs and symptoms, including pain.

Data were analyzed with SPSS version 15 software (SPSS, Inc, Chicago, Illinois). According to the Kolmogorov-Smirnov test, in the control group, the data distribution was normal except for erythema; in the decortication group, the distribution of all variables was normal. The confidence interval was considered 95%. P<.05 was considered statistically significant.

**RESULTS**

In this study, by considering certain inclusion and exclusion criteria, the authors attempted to eliminate the effects of confounding factors, such as age, smoking, diabetes, alcohol consumption, severe soft tissue trauma, and history of head trauma.
Because radiographic evaluation of bone callus is difficult in the presence of compression plates, patients were mostly evaluated according to clinical signs of repair and union.

Patients’ ages ranged from 20 to 47 years. Thirty-two patients were male, and 10 were female. Twenty patients were assigned to the decortication group (16 men and 4 women), and the control group included 16 men and 6 women. Study variables included age, sex, decortication, infection, and erythema at the reduction site (Tables 1-2).

The persistence and improvement of erythema up to the end of the first week received scores of 1 and 0, respectively. Data analysis showed the positive effect of decortication on relative and complete weight bearing. Because the number of patients with erythema at the end of the first week was higher in the decortication group, the chi-square test was applied. Five patients in the control group (22.7%) and 11 (55%) patients in the decortication group had erythema at the end of the first week. The difference between the 2 groups was statistically significant ($P=.031$). No cases of infection, readmission, nonunion, or plate failure occurred.

**DISCUSSION**

The effect of bone decortication on fractures has not been fully elaborated in human models. In a literature review of the role of bone decortication in enhancing guided bone regeneration, Greenstein et al reported conflicting results and insufficient clinical trials to allow definitive determination of the merits of bone decortication before guided bone regeneration procedures.\(^5\)

Decortication has been used to treat tibial nonunion. However, its use has not been reported in patients with acute fractures. With regard to the effects of this treatment on accelerating biologic inflammation and repair processes, and considering the authors’ experiences, the authors evaluated the effect of decortication on healing of closed tibial diaphysis fractures. Because this method was not previously used in acute human fractures of long bones, the authors designed the study protocol meticulously. The study results showed an overall union rate of 100% in both groups, which is comparable to results with other methods, including intramedullary nailing.\(^8,9\)

Slappey et al\(^10\) studied the effect of decortication on accelerating the process of spinal fusion. They reported that decortication seems to promote fusion and also provides a rich vascular supply from the underlying cancellous bone as well as access to pluripotent stem cells within the marrow.\(^10\) Because of the differences between spinal vertebrae and long bones (as the focus of the authors’ study) in terms of healing and complications, comparison between results is troublesome.

Verdugo et al\(^11\) evaluated bone healing in large defects treated by cortical perforation without using other membranes except the periosteum. The results showed that periosteal preservation may provide a sufficient barrier membrane to protect particulate or block osseous grafts; moreover, bone decortication may enhance clinical and histologic outcomes.\(^11\)

Piriou et al\(^12\) analyzed decortication and medial plating for the treatment of tibial nonunion after intramedullary nailing. The results, with a union rate of 94% and mean union time of 108 days (indicating a nonsignificant difference between atrophic and hypertrophic nonunion), showed that decortication and medial plating

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic Data</th>
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<tbody>
<tr>
<td>Sex</td>
<td>Without Decortication</td>
</tr>
<tr>
<td>Male, No.</td>
<td>16 (73%)</td>
</tr>
<tr>
<td>Female, No.</td>
<td>6 (27%)</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
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<table>
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<tr>
<th>Table 2</th>
<th>Comparison of Improvement Between Groups</th>
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</thead>
<tbody>
<tr>
<td>Time/Decortication</td>
<td>Mean, wk</td>
</tr>
<tr>
<td>2 crutches</td>
<td>-</td>
</tr>
<tr>
<td>+</td>
<td>4.90</td>
</tr>
<tr>
<td>1 crutch</td>
<td>-</td>
</tr>
<tr>
<td>+</td>
<td>6.35</td>
</tr>
<tr>
<td>Cane</td>
<td>-</td>
</tr>
<tr>
<td>+</td>
<td>7.75</td>
</tr>
<tr>
<td>Weight bearing</td>
<td>-</td>
</tr>
<tr>
<td>+</td>
<td>9.25</td>
</tr>
</tbody>
</table>
provided a safe and effective treatment for tibial nonunion after failure of intramedullary nailing. This treatment also allowed better reduction and repeated nailing.12

Finally, induction and persistence of erythema were significantly higher in the decortication group. This could be related to the higher rate of manipulation; however, because decortication accelerates inflammation, which leads to faster union, it probably causes more erythema. Further research is needed to identify the factor responsible for prolonged erythema in the decortication group.

Although these studies were dissimilar in terms of fracture type and severity, they all generally showed better results with decortication, which is similar to the authors’ findings. Therefore, if decortication with more manipulation increases the risks of infection and osteomyelitis, then the advantages of accelerating the rate of union with decortication should be evaluated against the disadvantages of infection.

**Limitations**

The main limitation of the current study was the small sample size. Another limitation was the patients’ nonreferral for follow-up; therefore, it was necessary to call the patients and obtain the data by telephone. In the authors’ small study, complications such as infection did not occur; therefore, more studies with larger sample sizes are required to determine risks and benefits. The authors recommend further studies with larger sample sizes to evaluate possible complications of decortication, such as infection; daily instead of weekly evaluation of patients (which was performed in this study); and similar studies of the upper limbs. Investigation of other variables, such as delayed discharge, difficulty with rehabilitation, readmission, and infection, and observation and report of more clinical manifestations are also recommended.

**CONCLUSION**

In cases of acute closed diaphyseal fractures of the tibia, decortication and plating together seem to accelerate the union rate and shorten the time to weight bearing.

**REFERENCES**