

# Successful Truncated Osteomyelitis Treatment for Chronic Osteomyelitis Secondary to Pressure Ulcers in Spinal Cord Injury Patients

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**Abstract:** Time-tested treatments for chronic osteomyelitis involve prolonged courses of costly antibiotic treatment. Although such treatment remains unquestioned in acute osteomyelitis, it is an excessive regimen for chronic osteomyelitis. With appropriate surgical debridement and careful operative care, antibiotic treatment can be truncated in diagnoses of chronic osteomyelitis. This study represents the clinical practice of the pressure ulcer management program at Rancho Los Amigos National Rehabilitation Center in dealing with this difficult problem.

One hundred fifty-seven patients with similar pressure ulcer wounds were studied retrospectively. Three groups of patients with pathologic diagnoses of acute osteomyelitis, chronic osteomyelitis, and negative osteomyelitis were compared for (1) postoperative stay, (2) wound infection, (3) wound breakdown requiring reoperation, and (4) same-site ulcer recurrence. In all cases, shallow bone shavings were sent for diagnosis via histologic study, and deep shavings were also sent to ensure adequate bone debridement and microbiologic study. All ulcers were subsequently closed with muscle and/or myocutaneous flaps. The negative and chronic osteomyelitis groups were treated with 5 to 7 days of IV antibiotics, whereas the acute group underwent a full 6-week course according to bone bacteriological culture and sensitivity.

There was no statistical difference between the chronic osteomyelitis group and the control (negative) osteomyelitis group with respect to postoperative stay (70 days for chronic group, 72.4 for control), wound breakdown rate (10.7% for chronic, 10.2% for control), or ulcer recurrence (1.8% for chronic, 4.1 for control). The acute osteomyelitis group incurred longer hospital stays, greater incidence of wound breakdown, and statistically significantly greater ulcer recurrence (78.6 days, 13.2% and 17.0%, respectively).

In cases of pressure ulcer management with bony involvement, bone pathologic diagnosis of chronic osteomyelitis allows for a shorter antibiotic course with better results when the offending tissue has been adequately debrided and closed with viable tissue

flap coverage, than simple long-term (4–6 weeks) antibiotic treatment. Because of the extreme contaminated nature of these wounds, if such therapy works in these patients, it may be applicable to chronic osteomyelitis in more varied contaminated surgical cases involving bone.

**Key Words:** osteomyelitis, pressure ulcer, spinal injury

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The established methods of diagnosis and treatment of osteomyelitis are similar in the medical and surgical patients. Multiple diagnostic radiology studies have been used (x-ray,<sup>1</sup> CT,<sup>2</sup> MRI,<sup>3,4</sup> bone scan,<sup>5</sup> and indium scan<sup>6</sup>)<sup>7,8</sup> to diagnose and characterize osteomyelitis with varied efficacy and support among the varied specialties concerned with infection of the bone (medicine, infectious disease, trauma, orthopedic, and plastic surgery). Perhaps the single most unifying theme of these tests is their cost. Similarly, cost and time is a defining aspect of the treatment of osteomyelitis. The classic 4 to 6 week IV antibiotic course<sup>9,10</sup> is a near reflex to any diagnosis of osteomyelitis, whether chronic or acute.<sup>11</sup>

Diagnosis of osteomyelitis is rarely refined into subtype. Possible surgical methods for diagnosis and treatment are also infrequently considered, despite the frequent involvement of primary surgical injury.<sup>12</sup>

Our initial goal is to highlight the presence of a subset of osteomyelitis, chronic osteomyelitis. Chronic osteomyelitis is frequently grouped in with acute infectious osteomyelitis because of current medical and radiologic diagnostic tools. We intend to prove that such thorough diagnostic methods and prolonged antibiotic courses are often unwarranted in this diagnosis.<sup>13</sup> Our study seeks to both curtail dependence on radiologic tests and drastically shorten the postoperative treatment for cases of established chronic osteomyelitis in the surgical patient.

We have separated the treatment plans for the histologic and microbiologic diagnosis of acute osteomyelitis, which has evidence of bacterial growth; from chronic osteomyelitis, which denotes only the body's inflammatory reaction to the offending ulcer pathology (Figs. 1–3). Additionally, we compared both to a group without osteomyelitis.

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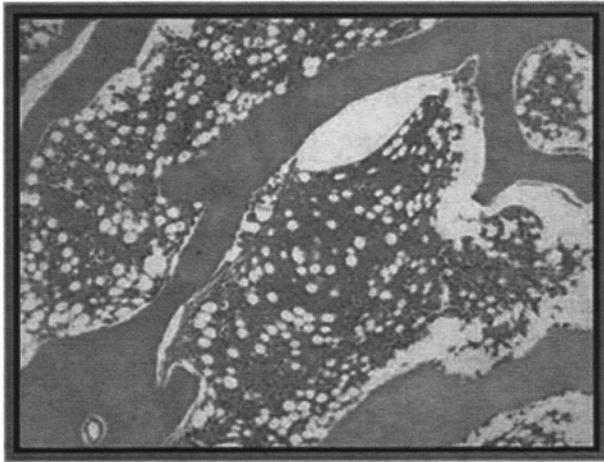
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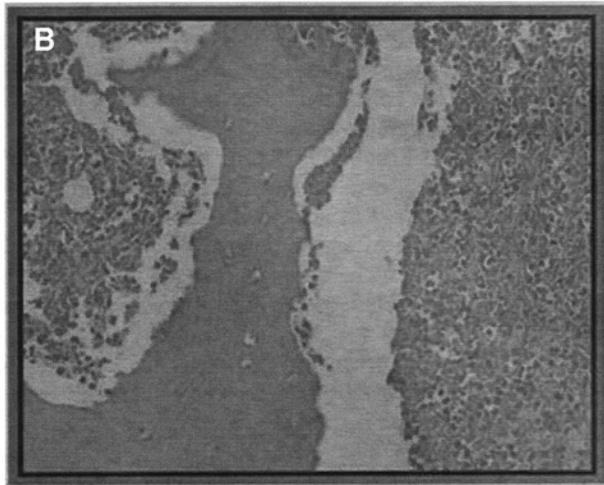
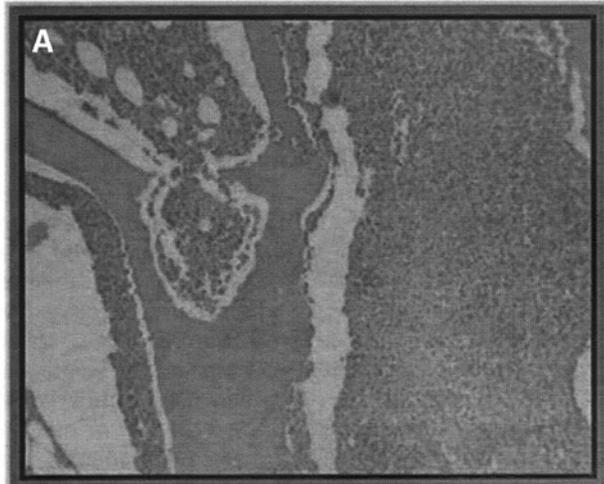
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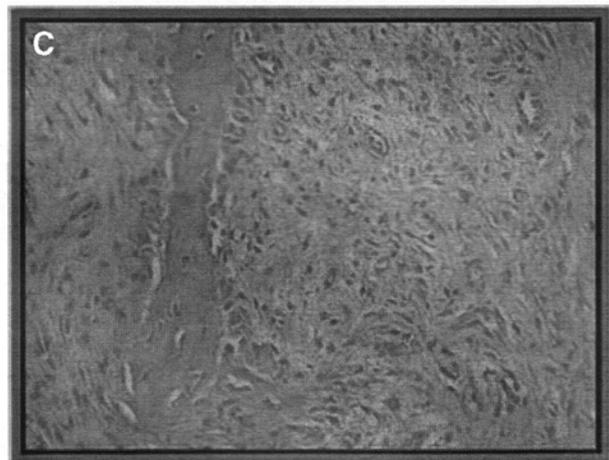
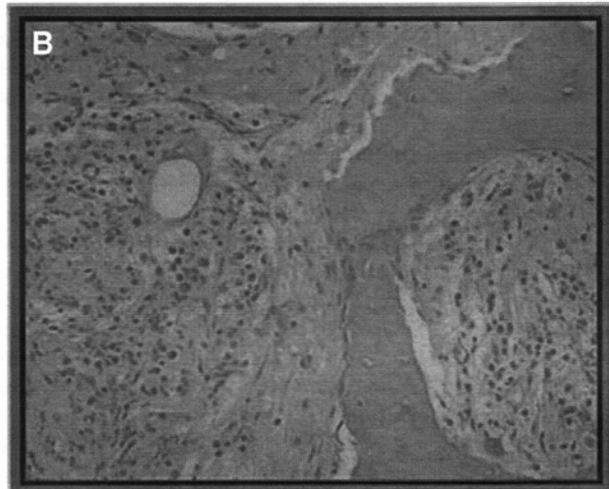
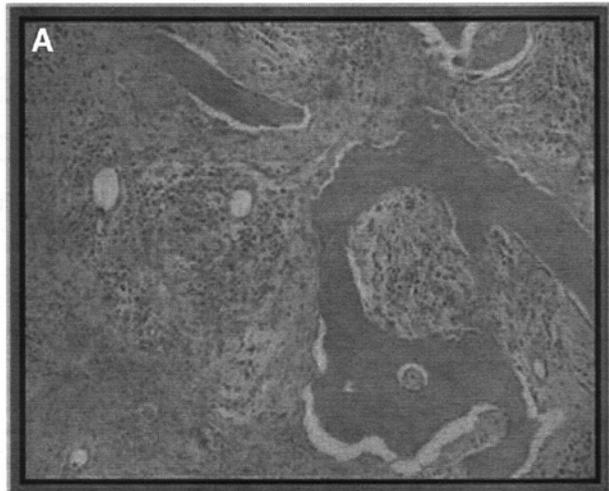
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**FIGURE 1.** Normal bone with hematopoietic marrow. Smooth outline of the bony trabeculae shown.



**FIGURE 2.** A, Acute osteomyelitis. Necrotic bony spicules show fraying and erosion of their margins. B, Acute osteomyelitis. Inflammatory exudates adhere to the bony spicules (macro image).



**FIGURE 3.** A, Chronic osteomyelitis. Lymphocytes, histiocytes, and plasma cells along with fibroblastic proliferation are seen around the bony spicules. B, Chronic osteomyelitis. Lymphocytes, histiocytes, and plasma cells along with fibroblastic proliferation are seen around the bony spicules (macro image). C, Chronic osteomyelitis. New bone formation.

Chronic and acute osteomyelitis are radiologically identical. Furthermore, they are commonly joined under the diagnosis osteomyelitis and treated as the same entity. It is our contention that chronic osteomyelitis can be treated in a different manner than the well-rehearsed antibiotic course reserved for acute bacterial osteomyelitis. In this surgical diagnostic of grading of osteomyelitis and definition of its extent, bone biopsy and histopathologic evaluation are the gold standards.<sup>14</sup>

In the setting of pressure ulcers, osteomyelitis is a common complicating factor.<sup>15</sup> Although surgical repair has been accepted as the preferred method of healing pressure ulcers,<sup>16</sup> there is some debate as to the appropriate course of action to deal with osteomyelitis in this particular type of surgical patient. The very nature of these wounds, their frequent involvement with underlying osteomyelitis, and the prolonged postoperative recovery period make them an ideal group for the study of alternative methods of osteomyelitis diagnosis and treatment.

Hopefully such treatment, successful in the most difficult of pressure ulcer wound repairs, can be more broadly applied to surgical treatment of osteomyelitis in all circumstances amenable to surgical debridement and tissue flap coverage.

## METHODS

After obtaining hospital Institutional Review Board approval, a retrospective medical chart review was begun. Patients were selected either sequentially (by date) for acute osteomyelitis or in a sequential selection by a regular ratio (chronic osteomyelitis and control) to create similar-sized sample groups. The selection was for a period of 5 years from the year 1998 to 2002. Only medical record numbers were used for patient identification. Chart selection was done with no knowledge of patient's diagnosis.

In our treatment of chronic osteomyelitis we excise the inflamed bone, cover the shaved bone with a well vascularized muscle flap, then cover this deep muscle with a fasciocutaneous, or myocutaneous flap when possible. A 5 to 7 day course of IV antibiotics is used to cover polymicrobial soft tissue colonization instead of the previously asserted 4- to 6-week course. We hope to show similar results with our truncated postoperative course to results achieved with longer antibiotic regimens and to controlled cases lacking any bone infection at all.

Our standard operative treatment of the ulceration involved several steps. First, the ulcer was painted with methylene blue dye to ensure complete identification and excision of the ulcer walls and margins. The underlying bone was then shaved, providing superficial shaving samples for histopathologic evaluation. An additional deep shaving was sent to the microbiology department for bacterial identification and culture and sensitivity. Part of the deep shaved bone specimen was also sent for histopathologic examination to ensure complete removal of the involved infected or inflamed bone. The bone was then rasped to smoothness. Two flaps were used when possible, a muscle flap to form a deep layer to cover the bone surface, and a more superficial faciocutaneous

or myocutaneous flap to close the resulting defect.<sup>17</sup> Drains were placed along the flap harvest sites and within the ulcer defect. They were brought out to separate skin incisions. The wounds were closed in several layers with absorbable sutures deep and nonabsorbable, monofilament suture at skin level.<sup>18</sup>

The pathology and microbiology departments at Ranch Los Amigos Hospital made a diagnosis of acute, chronic, or negative osteomyelitis in each case. The diagnosis was performed on bone biopsies that were sent from the operating room at the time of ulcer debridement and flap repair. Separation of the patients into control, acute, or chronic osteomyelitis groups was done based on the histologic and microbiologic study of this bone tissue.

A preoperative wound culture was collected from each patient before admission.<sup>19</sup> This culture and sensitivity report was used to select perioperative antibiotics that were continued for a standard course of 5 to 7 days.<sup>20,21</sup> A diagnosis of negative osteomyelitis or chronic osteomyelitis did not change this course. However, a diagnosis of acute bacterial osteomyelitis resulted in a continuation of the antibiotics for a full 4- to 6-week course.

Postoperatively, the patient was placed on an air fluidized (Clinitron, Hill-Rom, Batesville, IN)<sup>22</sup> bed to reduce pressure on the fresh flap and incision lines. All patients underwent a standard postoperative course of at least 8 weeks of hospitalization. Surgical drains were removed when drainage reports fell to minimal, typically within 1 week. Skin sutures and staples were removed at 3 weeks. At 4 weeks, the patient was transferred from the Clinitron bed to a firmer step down air-loss mattress (FlexiCare, Hill-Rom) bed. At 6 weeks, the patient was started on a progressive sitting program that culminated at 8 weeks with the patient tolerating up to 6 hours, permitting there was no skin breakdown. The average patient hospital stay is 8 to 9 weeks (56–70 days) to achieve complete healing according to our protocol. At this time, the patient is discharged home with a scheduled outpatient clinic visit in 1 month.

Any signs of wound, incisional breakdown, or of new skin ulceration resulted in delay of each of these dates, until clinical evaluation of the wound progress dictated resumption of the scheduled course.<sup>21</sup>

Three groups of patients were defined: acute osteomyelitis, chronic osteomyelitis, and negative osteomyelitis (control). Details of patients' history, perioperative course, postoperative course, and postdischarge long-term follow-up were compiled and compared.  $\chi^2$  statistical analysis was performed by SPSS/PC+ (SPSS Inc, Chicago, IL).

## RESULTS

In the acute group, there were 55 original subjects. Three subjects were excluded out because of immediate postoperative death. Of the 52 remaining subjects, 48 were men and 4 were women. The mean age was 37.8 years. Injuries ranged from ASIA classification C4 to L2.<sup>23</sup> There were 2 spina bifida patients. The mean postoperative stay was 78.6 days. The bacteriological result of the deep shaved bone culture and sensitivity in the acute group showed 35 of 50 (70%) methicillin-resistant *Staphylococcus aureus* (MRSA),

47 of 50 (94%) *S. aureus*, 12 of 50 (4%) were pseudomonas, and 1 of 50 (2%) acinetobacter. Within the postoperative period, small incisional openings occurred in virtually every other patient (33 of 52 acute, 24 of 56 chronic, 23 of 50 control) and serious wound infection or flap loss requiring additional antibiotic course or return to the operating room occurred 7 times (7 of 53 or 13.2%). One patient required 2 return visits for revision of flap loss. With more distant follow-up of at least 3 years (follow-up 3–8 years), 9 patients broke down again at same or adjacent sites (17.0%).

In the chronic osteomyelitis group there were 56 subjects. None were excluded. Seven were women and 49 men. The mean age was 37.6 and the injury levels ranged from C4 to L1. One patient had multiple sclerosis. The mean postoperative stay was 70.0 days. Serious wound infection or flap loss occurred in 6 of 56 patients (10.7%), and long-term follow-up (3–8 years) revealed a recurrent breakdown of 1 patient (1.8%).

The control group contained 49 patients, with 1 patient excluded because of early postoperative death. Seven were women, 42 were men with injuries ranging from C4 to L3. One patient had spina bifida, and 1 was a polio survivor with loss of function at approximately the T6 level. The mean age was 37.1. The mean postoperative stay was 72.4 days. Serious wound infection or flap loss occurred in 5 of 49 (10.2%), and recurrent breakdown with long-term follow-up occurred twice (4.1%) (Table 1).

Our evidence shows that there is no statistical difference in postoperative stay or wound infection rate when comparing chronic osteomyelitis treated with 5 days of IV antibiotics to a control group without bone involvement. Additionally, the chronic group, when treated with a truncated course of antibiotics, performed better in terms of these qualities (postoperative stay, wound infection) when compared with the acute osteomyelitis group and did statistically significantly better when comparing long term flap viability.  $\chi^2$  analysis showed significance of 0.2636 for postoperative stay, 0.2046 for postoperative wound infection rate, 0.7899 for flap revision rate, and 0.0003 for ulcer recurrence rate (statistically significant).

## DISCUSSION

The dramatic shortening of our treatment protocol for certain subsets of osteomyelitis is due to 4 primary efforts that cannot be done with simple radiologic studies and medical treatment.

The first is how we diagnose the involved bone in the first place, by direct biopsy. Such comprehensive evaluation of the bone itself simply cannot be matched by distant radiologic evaluation, no matter how expensive. The medical (vs. surgical) rationale of diagnosis and treatment of osteomyelitis involves multiple sensitive radiologic tests; yet the specificity of these tests does not have the power of definitive surgical biopsy for pathologic and microbiologic studies.<sup>24</sup> Although core needle biopsy is a viable substitute,<sup>25</sup> its use is limited to diagnostic use alone and requires treatment as a separate event.

The second is our subdivision of the osteomyelitis diagnosis. We treat chronic osteomyelitis with our abbreviated protocol, but treatment of acute osteomyelitis remains the established 6-week course. Again, such distinctions are only possible with surgical differentiated diagnosis.

Third, our aggressive bone debridement is always completed by sending the last layer of bone and the deep layer of bone for histopathologic study to ensure adequate removal of infection. Such assurance of the completeness of excision can only be accomplished under direct surgical vision.

Finally, the primary difference in our treatment protocol is the surgical removal of infection and coverage with healthy viable muscular flaps. Thus, this truncated antibiotic treatment option is only successful pari-pasu with surgical action. The explanation of the reoccurrence of ulceration with long-term follow-up in all the groups we studied can be based on many factors in this group of patients: poor compliance, smoking habits, drug abuse, psychosocial behavior, skeletal pathology of the spine and pelvic, and the quality and reserve of local skin and muscles. All play an important role in the reoccurrence of ulceration. Acute osteomyelitis is not an initial factor in wound recurrence in this patient population.<sup>26</sup>

## CONCLUSIONS

Direct surgical biopsy and debridement should be performed on any wound that has involved bone, specifically chronic wounds. This allows for more accurate diagnosis of osteomyelitis, delineation of the severity of bone involvement, and empowering the surgeon with the option of removing the infected bone. The use of several layers of bone sampling for pathology helps to ensure adequate debridement. Thorough surgical debridement, when accompanied with muscle flap coverage, shortens the necessary subsequent antibiotic treatment drastically, from 4 to 6 weeks, to 5 days.

TABLE 1. Acute Osteomyelitis Group

Group	Total No. Patients	No. Male Patients	No. Female Patients	Average Age	Level of Injury	Mean Postoperative Days	Bacterial Colonization of Bone
Acute osteomyelitis group	52	48	4	37.8	C4–L2	78.6	35/50 70% MRSA, 47/50 9% <i>Staphylococcus aureus</i> , 12/50 4% Pseudomonas, 1/50 2% acinetobacter
Chronic osteomyelitis group	56	49	7	37.6	C4–L1	70.0	No growth
Control group	49	42	7	37.1	C4–L3	72.4	No growth

It has been said that while medicine gently alters the course of a disease, surgery directly assaults it to affect a cure. This paraphrase aptly applies here, to the treatment of chronic osteomyelitis associated with chronic wounds.

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