Treatment of Lower-extremity Long-bone Fractures in Active, Nonambulatory, Wheelchair-bound Patients

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abstract

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A retrospective review of surgically treated lower-extremity long-bone fractures in wheelchair-bound patients was conducted. Between October 2000 and July 2009, eleven lower-extremity fractures in 9 wheelchair-bound patients underwent surgical fixation. The Short Musculoskeletal Function Assessment, Short Form, and Spinal Cord Injury Quality of Life questionnaires were used to assess functional outcome.

Mechanism of injury for all patients was a low-energy fall that occurred while transferring. Four patients who sustained a distal femur fracture, 1 patient who sustained a distal femur fracture and a subsequent proximal tibia fracture, and 1 patient who sustained a proximal third tibia shaft fracture underwent open reduction and internal fixation with plates and screws. Three patients with 4 midshaft tibia fractures underwent intramedullary nailing.

At last follow-up, all 9 patients had returned to their baseline preoperative function. Quality of life was significantly higher (P<.01) than the Spinal Cord Injury Quality of Life questionnaire's reference score. Self-reported visual analog scale pain scores improved significantly from time of fracture to last follow-up (P=.02). All fractures achieved complete union, and no complications were reported. This study's findings demonstrate that operative treatment in active, wheelchair-bound patients can provide an improved quality of life postinjury and a rapid return to activities.

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The surgical indications and functional outcomes of long-bone fractures in ambulatory patients have been well established. However, the same fractures in wheelchair-bound patients have been poorly studied. Operative and nonoperative treatments have been advocated in the past, although the literature provides no clear consensus on management. The inability to bear weight and chronic wheelchair dependence result in decreased bone mineral density in these patients and places them at high risk for pathologic fractures. Further complicating the management of these patients are their unique comorbidities, including a negative nitrogen balance, malnutrition, skin insensitivity, and autonomic dysreflexia. Thus, the evaluation of long-bone fractures in wheelchair-bound patients entails a comprehensive assessment of not only the acute fracture, but also the patient’s baseline impairment preinjury, comorbidities, and available support system.

Traditional nonoperative management of fractures in these patients has included pillow splints, bracing, skeletal traction, and casting. These nonoperative treatment modalities require frequent skin checks to avoid the increased risk of decubitus ulcers, significant limitation of activities of daily living, and a limited ability for transferring. Nonoperative treatment has resulted in complication rates ranging from 19% to 42% and often involves numerous doctor office visits and constant nursing care. Complications that commonly arise with nonoperative treatment include decubitus ulcers, residual hip and knee stiffness, loss of reduction, nonunion, and malunion.

Some studies recommend aggressive treatment of lower-extremity fractures in certain subgroups of paraplegics, particularly in wheelchair athletes, patients for whom loss of joint motion will impair function and performance, and patients who suffer autonomic dysreflexia associated with the fracture. Young, active, wheelchair-bound patients are often functional, employed, and integrated members of society, and as such have high expectations following traumatic injury. To date, no study has addressed the quality of life and functional outcomes of lower-extremity fractures in young, active paraplegics. The purpose of this study was to report on 1 surgeon’s experience with wheelchair-bound patients who underwent operative stabilization of lower-extremity long-bone fractures, with particular attention paid to patient-reported functional outcomes and complications.

**Materials and Methods**

This study was a retrospective review of a single surgeon’s database conducted at affiliated centers of a large, urban academic hospital. Between October 2000 and July 2009, one surgeon (K.A.E.) treated 11 lower-extremity long-bone fractures in 9 wheelchair-bound patients with surgical fixation. No patient was treated with postoperative immobilization. Written and institutional review board approved consent were obtained from all patients who met inclusion criteria and agreed to the use of their personal data for research purposes. Inclusion criteria included age older than 18 years, a long-bone fracture and SCI-23 scores; and a standard series of radiographs was used as a specific measure of health-related quality of life and consists of 3 factors of daily living, and a limited ability for transferring. Nonoperative treatment has resulted in complication rates ranging from 19% to 42% and often involves numerous doctor office visits and constant nursing care. Complications that commonly arise with nonoperative treatment include decubitus ulcers, residual hip and knee stiffness, loss of reduction, nonunion, and malunion.

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tors: (1) problems (assessed via questions regarding perceptions of physical dependency, complications, and social stigma); (2) function (covers limitation in mobility, body care and movement, and social interaction); (3) depression (reflects distress and depressive symptoms); and (4) global rating (overall quality of life measured by a single standardized question and compared with reference values from the general population sample studied by Kreuter et al.12).

Statistical Analysis

Patient data were analyzed to determine the association between variables and outcomes using the Student’s t test for continuous variables and the Z-test for reference score comparison. Significance was set at P<.05.

RESULTS

Average patient age was 54 years (range, 33-72 years). Five patients were women and 4 were men. Average follow-up was 28 months (range, 6-108 months). Average length of nonambulatory status at time of fracture was 20 years (range, 5-48 years). All patients were wheelchair bound at the time of injury; 7 patients were paralyzed by a spinal cord injury and 2 were wheelchair bound due to multiple sclerosis.

The mechanism of injury was similar for all patients. Eleven (100%) fractures occurred in 9 patients during a low-energy fall while transferring (McMaster type II). Seven fractures were initially treated nonoperatively by outside physicians (average time to surgery, 38 days), and 4 fractures were operated on acutely (average time to surgery, 11 days). Two of these patients were treated following their initial fracture for a subsequent contralateral lower-extremity fracture (average time from index surgery, 4 months). Average length of hospitalization for all 11 fractures was 3.3 days (range, 1-6 days), with a median length of stay of 2 days. The majority (67%) of patients had some form of inpatient, postoperative physical therapy for transfer training.

Four patients who sustained a distal femur fracture (OTA 33) (Figures A, B), 1 patient who sustained a distal femur fracture followed by a subsequent contralateral proximal tibia fracture (OTA 41), and 1 patient who sustained a proximal-third tibia shaft fracture (OTA 42) underwent open reduction and internal fixation (ORIF) with locked plates and screws (Figures C, D). Three patients with 4 mid-shaft tibia fractures (OTA 42) underwent intramedullary nailing. No concomitant soft tissue procedures were performed in any patient, and all injuries were closed.

All 9 patients had returned to at least their baseline preinjury function as measured by the SMFA dysfunction and bother scores (Table). No significant differences existed in improvement of follow-up SMFA dysfunction scores for patients who were treated acutely with surgical management vs those who were originally treated with nonoperative management (P=.36). Comparison of pre- vs postoperative SMFA dysfunction scores for acutely managed patients (P=.78) and initial nonoperative patients (P=.80) demonstrated no significance (Table). Five patients returned to their preinjury employment, 3 returned to retirement, and 1 remained unemployed.

Average self-reported VAS pain scores improved significantly from 3.09 preoperatively to .22 at latest follow-up (P=.02) as measured by the visual analog scale. As measured by the SCI-23 global rating score, overall quality of life at latest follow-up was 83.3 points (range, 67-100), which is significantly higher (P<.01) than the questionnaire’s reference score of 69.8 points as measured in a general population sample studied by Kreuter et al.12.

Qualitatively, all patients reported satisfaction with the results of their treatment, and 100% reported that they would undergo the same procedure if they had to make the decision again. All fractures

Figure: Preoperative anteroposterior (A) and lateral (B) radiographs of the knee of a 44-year-old man with a 17-year history of wheelchair dependence. The patient presented 6 weeks after injury with gross motion at the fracture site and reported pain related to muscle spasms and inability to transfer. Postoperative anteroposterior (C) and lateral (D) radiographs of the knee after treatment with plate and screw fixation of the distal femur. The patient had immediate improvement of function and return to independence.
Another study that authors advocating against. 22
3.09
42.13
6
6
Other
Historically, nonoperative
6
.02
.80
.80
6
6
3.00
retrospectively evalu
The majority (97%)
4.67
6
NA
6
6
3,6,13-15
6
6
39.15
.78
.80
Although patients in the study
a
44.12
40.58
36.21
6
6
3,6,13-15
6
6
3.00
wound infections occurred in this series.

**Discussion**

The reported rates of fractures in para-
plegic and tetraplegic patients range from
1% to 20%. 3,6,13-15 The majority (97%) of
these fractures are lower-extremity
fractures, with tibia fractures occurring
more frequently than femoral or ankle
fractures. 16 Historically, nonoperative
management of long-bone fractures in the
lower extremities of wheelchair-bound
patients has been advocated as the optimal
treatment. 1,3,17 Authors advocating against
operative treatment reason that an in-
creased risk of osteomyelitis, urinary tract
infection, contracture, and infection exists
with ORIF in this population. 3,17 Other
authors have argued that ORIF should be
an option for paraplegic patients on an in-
dividualized basis, primarily to allow for
early rehabilitation. 1,4,18,19 Currently, no
clear consensus exists on how to approach
these injuries, and knowledge regarding
surgical outcomes is limited.

The current study found that independ-
dent wheelchair-bound patients who un-
derwent surgical stabilization of their lower
extremity long-bone fractures achieved
excellent postoperative results. Short
Musculoskeletal Function Assessment,
SCI-23, and VAS pain scores all improved
and returned to baseline function. These
patients also had a reasonably short hos-
pital length of stay, did not require sec-
ondary procedures, and were able to re-
turn to their preinjury job description on
achieving union. The SMFA dysfunction
and bothersome scores for these patients
not only returned to baseline, but also ex-
ceeded baseline scores. Although no liter-
ature describes such a phenomenon, once
healing occurs, patients reported improved
function and satisfaction on the SMFA
compare with the recent, acute injury sta-

tus.

The current findings are supported by
Chin et al, 20 who reported that retrograde
intramedullary nailing of femoral shaft or
supracondylar fractures in nonambulatory
patients allowed for fracture healing and
rapid return to their previous level of func-
tion, without complications of malunion,
nonunion, shortening, or infection. 20 Cass
and Sens 21 reported 25 myelopathic pa-
tients (29 fractures) who sustained a su-
pracondylar femur fracture (OTA 33).
Their findings demonstrated that the 17
patients treated with plates or intramedul-
lar rods had higher union rates and fewer
skin and wound complications compared
with the 12 patients treated nonopera-
tively. The authors recommended that sur-
geons consider operative treatment as an
option in the management of distal femur
fractures in nonambulatory, myelopathic
patients; however, the study did not ad-
dress quality of life or functional assess-
ments. 21

In a case report by Ruffing et al, 22 ex-
cellent clinical and radiologic results were
achieved in a 59-year-old wheelchair-
bound man who underwent minimally
invasive elastic intramedullary nailing for
a lower-extremity fracture. Another study
by Meiners et al 23 retrospectively evalu-
ated 55 lower-extremity fractures in 44
patients with chronic spinal cord injuries
who were managed surgically. The au-
thors found that for 53 of the 55 fractures,
the patients regained their normal level
of independence. 23 Another study that
examined 21 patients with an average 15-
year history of chronic spinal cord injury
demonstrated that operative fixation of
lower-extremity fractures with a ring fix-
ator resulted in fewer complications and
improved range of motion compared with
conservative management results in the
literature. 23 Although patients in the study
experienced superior results with the ex-
ternal fixator compared with nonoperative
management, the bulky fixator remained
on the patients for an average of 68 days,
and mean hospital stay was 76 days. 23

To the current authors’ knowledge, this
is the first study to examine quality of
life and functional outcomes of operative
treatment of chronic spinal cord–injured
or wheelchair-bound patients. Although
the quality-of-life measurement was limit-
ed in that it was compared with a younger
reference population sample that included
patients with other types of chronic in-

<p>| Table |
| --- | --- | --- | --- |</p>
<table>
<thead>
<tr>
<th><strong>Baseline and Follow-up VAS Pain and SMFA Scores</strong></th>
<th><strong>Mean Points±SD</strong></th>
<th><strong>Outcome</strong></th>
<th><strong>Baseline</strong></th>
<th><strong>Follow-up</strong></th>
<th><strong>P</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS pain a</td>
<td></td>
<td>All patients</td>
<td>3.09±3.30</td>
<td>.22±.67</td>
<td>.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acute treatment</td>
<td>3.00±2.76</td>
<td>.33±.82</td>
<td>.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initial nonoperative treatment</td>
<td>4.67±4.51</td>
<td>0±0</td>
<td>NA</td>
</tr>
<tr>
<td>SMFA dysfunction b</td>
<td></td>
<td>All patients</td>
<td>42.13±12.86</td>
<td>40.58±14.57</td>
<td>.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acute treatment</td>
<td>44.12±16.02</td>
<td>43.07±13.69</td>
<td>.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initial nonoperative treatment</td>
<td>39.15±6.99</td>
<td>36.21±9.37</td>
<td>.80</td>
</tr>
</tbody>
</table>

*Abbreviations: NA, not applicable; SMFA, Short Musculoskeletal Functional Assessment; VAS, visual analog scale.

a Based on a visual analog scale.

b Higher scores indicate poorer function.*
juries, the qualitative self-reports obtained from the patients highlighted the relatively high quality of life score calculated. Nonetheless, the small sample size, heterogeneous treatment modalities, and retrospective nature of the analysis present challenges to the conclusion.

In the authors’ opinion, the goal of operative treatment in young, active, independent, wheelchair-bound patients is to obtain early fracture stabilization, improve self-transferring and rehabilitation, and decrease hospitalization and nursing care. Operative stabilization of these fractures in this patient population precludes the need for prolonged casting or splinting, which allows for an earlier wheelchair return and thus an earlier return to independence and employment.

CONCLUSION
This study’s findings demonstrate that operative treatment in active, wheelchair-bound patients is safe and can provide an improved postinjury quality of life; rapid return to activities, rehabilitation, and preinjury function; and significantly less pain compared with baseline.

REFERENCES