Surgical versus Nonsurgical Treatment of Subaxial Cervical Pedicle Fractures

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Key words
- Cervical spine
- Nonsurgical treatment
- Pedicle fractures
- Surgical fixation
- Trauma

Abbreviations and Acronyms
ASIA: American Spinal Injury Association
CT: Computed tomography

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BACKGROUND: **Pedicle fractures in the cervical spine are common. They may occur in isolation or in combination with other concomitant fractures. Multiple classification systems have been introduced to provide a clinical framework when approaching these types of fractures; however, these systems do not provide guidelines for optimal treatment. Data regarding decision making are limited. Conservative treatment with orthoses may result in subluxation and instability requiring further treatment. Surgery may not be required in all instances because many of these injuries may heal without surgical intervention.**

METHODS: **All cases of cervical fractures treated at a single institution over a 5-year period were retrospectively reviewed. Cases with pedicle fractures were further evaluated, and 40 cases managed either with or without surgery were identified. Data on presenting history, neurologic examination, imaging findings, comorbidity, method of treatment, complication rate, and length of hospital stay were collected. Fractures were classified based on computed tomography scans. Data on associated injuries were also collected. Fusion rate and fracture displacement were assessed by plain radiographs and computed tomography scans at follow-up. Follow-up time points included 2, 6, and 12 weeks and 6 months after injury. Primary outcome was fracture healing regardless of modality in the absence of progressive deformity (i.e., listhesis, kyphosis) and need for further surgery.**

RESULTS: **Conservative therapy was administered to 26 patients, and 14 patients underwent surgery. There were no statistically significant differences between the 2 groups in terms of total levels injured ($P = 0.9$) or injury severity score ($P = 0.5$). Patients who presented with intact neurologic status were more likely to be treated conservatively (88% vs. 29%; $P = 0.0004$), whereas patients presenting with spinal cord injuries were more likely to undergo surgical fixation (35% vs. 0%; $P = 0.0004$). Length of hospital stay trended toward being significantly greater in patients who underwent surgery (10.6 days vs. 5.5 days; $P = 0.07$). According to our classification system, the most common fracture type was single line horizontal fracture occurring in 68% (27 of 40 cases). Vertical split pedicle fracture occurred in 28% (11 of 40 cases), and double line horizontal fracture occurred in 5% (2 of 40 cases). Posttreatment progressive listhesis was significantly higher in patients who were treated conservatively (31% vs. 0%; $P = 0.03$), especially when associated with comminuted lateral mass or subluxation or both.**

CONCLUSIONS: **This study describes and classifies unique cervical pedicle fractures and associated injuries. Our findings suggest that surgical treatment results in definitive stability for these injuries compared with conservative therapy, particularly for pedicle fractures associated with comminuted lateral mass or initially displaced fractures. However, nondisplaced vertical split pedicle fractures and isolated single line horizontal fractures may be treated nonsurgically without occurrence of further instability. A larger prospective study is required to confirm these findings.**

INTRODUCTION

Approximately 2%–5% of trauma admissions in the United States each year are for cervical spine injury (3, 7), and about 65% of those are for injuries to the subaxial cervical spine (13). It is critical to diagnose and treat these fractures because about 57% of fractures in the cervical spine are unstable, and about 70% are considered clinically significant (7, 13, 15). When fracture is not adequately treated, instability and progressive deformity result, leading to neurologic deterioration, decreasing function, and increasing pain (15). Pedicle fractures may occur in isolation or in combination with other concomitant fractures. Multiple cervical injury classification systems have been developed to provide a clinical framework when approaching these types of fractures

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(1, 6, 9, 20); however, guidelines for optimal treatment are still unclear. Data comparing surgical versus conservative treatments for these types of fractures are limited. Conservative treatment with orthoses may be inadequate because subluxation and instability can result requiring further treatment such as surgery. In contrast, the risks and costs of surgery may not be necessary in all instances because many of these injuries may heal without surgical intervention.

In current clinical practice, it is unclear which types of injuries associated with pedicle fractures require surgery and which may be adequately treated nonoperatively. The present study compared operative versus nonoperative treatment of cervical pedicle fractures. We hypothesized that nonoperative treatment of cervical pedicle fractures results in a worse outcome, such as progression of the fracture (i.e., listhesis) and requirement of further intervention, compared with surgery. Factors were analyzed to help predict successful nonoperative versus surgical management and to guide optimal management.

METHODS

Institutional review board approval was obtained before the start of the study. A retrospective review was performed of all patients who presented to MetroHealth Medical Center, a level I trauma center, with a subaxial cervical pedicle fracture during the period 2005–2010. Patients were divided into patients who were treated surgically and patients who were treated conservatively. There were 6 surgeons involved in the study. The decision to proceed with surgery or use an orthosis was made based on the individual surgeon's preference and experience. Patients were not randomly assigned into treatment groups. Decisions were made largely on the presumed risk of further instability without surgery. Existing patient data that fit our criteria were retrieved from the electronic medical record system. All patients who presented to our level I trauma center with a cervical fracture involving a pedicle fracture were included in the study. All fractures were evaluated and diagnosed by high-resolution computed tomography (CT) scan read by a diagnostic attending radiologist.

Data including preoperative symptoms, neurologic examination, imaging findings, cause and extent of injury, operative information, hospital stay, and posttreatment outcome were collected. Fusion rate and fracture displacement were assessed by plain radiographs and CT scans at follow-up. Follow-up time points included 2, 6, and 12 weeks and 6 months after injury. Anteroposterior and lateral radiographs were obtained at each follow-up visit. Some patients underwent additional CT scanning based on x-ray findings. The primary outcome was fracture healing regardless of treatment modality in the absence of progressive deformity (i.e., listhesis, kyphosis) and no need for further surgery.

Subaxial pedicle fractures were divided into either unilateral or bilateral fractures. Fractures were grouped as single line horizontal, double line horizontal, or vertically split pedicle fractures (Figures 1 and 2). Fractures were also assessed to determine if they were comminuted or displaced or extended to the foramen transversarium. This assessment was

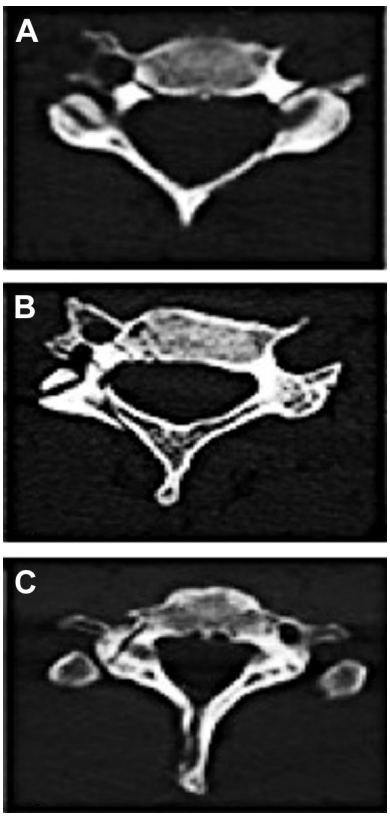

Figure 1. Cervical pedicle fracture types. (**A**) Single line horizontal pedicle fracture. (**B**) Double line horizontal pedicle fracture. (**C**) Vertical split nondisplaced pedicle fracture.

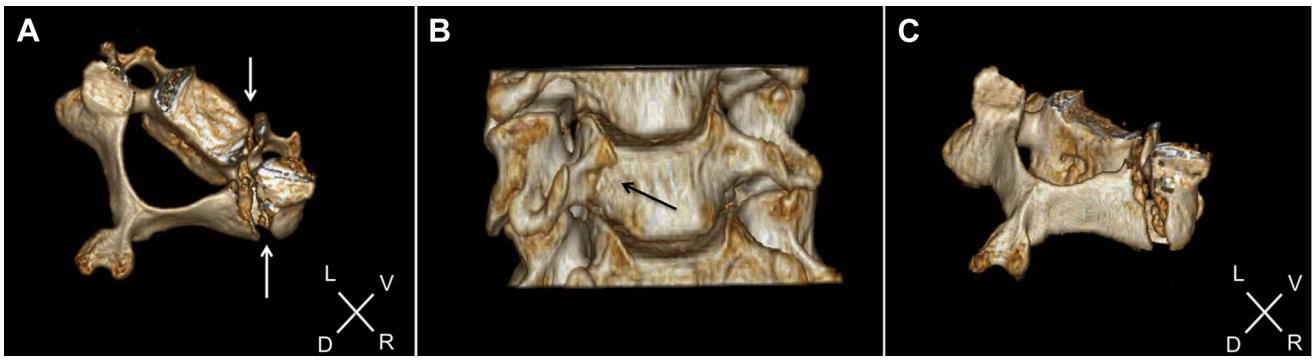

Figure 2. Three-dimensional reconstrauction computed tomography scan shows a right vertical split pedicle fracture. (**A**) Axial view. (**B**) Anterior view. (**C**) Posterolateral view. D, dorsal; L, left; R, right; V, ventral.