

# Nonoperative Management of Minimally Displaced Lateral Compression Type 1 (LC1) Injuries with Comminuted Rami Fractures is Associated with Late Displacement

Nicholas Jerome Tucker<sup>1</sup>, Bryan Scott, Austin Heare, Stephen Stacey, Cyril Mauffrey, Joshua A Parry<sup>2</sup>

<sup>1</sup>Orthopedics, University of Colorado School of Medicine, Denver Health Medical Center, <sup>2</sup>Denver Health

**INTRODUCTION:** The management of minimally displaced (<1 cm) lateral compression type 1 (LC1) pelvic ring injuries is controversial. Potential benefits of operative management for injuries with dynamic displacement of ≥1 cm include improved pain control, mobilization, hospital length of stay, and ability to clear physical therapy (PT) with discharge home. In two recent studies (Hadeed et al. and Ellis et al.), rami comminution was found to be predictive of LC injury instability on examination under anesthesia (EUA) and lateral stress radiographs (LSR). The purpose of this study was to evaluate how rami comminution and subsequent operative vs. nonoperative management impacts the late displacement of these injuries.

**METHODS:** Retrospective review of a prospectively collected LC1 database was performed to identify all patients with minimally displaced LC1 injuries and follow-up radiographs over a four-year period (n=125). Groups were separated based on the presence of rami comminution and subsequent management, including rami comminution/operative (n=49), rami comminution/nonoperative (n=54), and no comminution/nonoperative (control group, n=22). The primary outcome was late fracture displacement, analyzed as both a continuous variable and as late displacement ≥5 mm.

**RESULTS:** Patients were similar in all demographic and injury characteristics with the exception of a greater proportion of complete sacral fractures in the comminution/operative group, consistent with this criterion as a historic operative indication. As a continuous variable, late fracture displacement was lower in the comminuted rami/operative group as compared to the comminuted rami/nonoperative group (PD: -3.0 mm, CI: -4.8 to -1.6 mm, p=0.0002) and statistically non-different from control. Late displacement ≥5 mm was significantly more prevalent in the comminuted rami/nonoperative group than in the comminuted rami/operative and no comminution/nonoperative groups (control)(PD: -33.9%, CI: -49.0% to -16.1%, p=0.0002 and PD: -30.0%, CI: -48.2% to -6.5%, p=0.02, respectively).

**DISCUSSION AND CONCLUSION:** Late fracture displacement, as both a continuous and categorical variable, was greatest in the group with rami comminution/nonoperative management. Rami comminution, which has been previously associated with dynamic displacement on EUA and LSR, is also associated with a higher incidence of late displacement when



**Figure Legend**  
**Figure 1:** Anteroposterior (AP) pelvis of a 22-year-old female status post auto-pedestrian accident with a minimally displaced (<1 cm) lateral compression type 1 (LC1) pelvic ring injury treated nonoperatively. Left ramus comminution and an incomplete Denis I sacral fracture were identified on computed tomography (CT).  
**Figure 2:** AP pelvis at 2 month follow-up demonstrating 14.5 mm of internal displacement (utilizing difference in vertebral distance).

| Variable                            | Comminuted Rami  |                     | No Comminuted Rami |                     | P-Value |
|-------------------------------------|------------------|---------------------|--------------------|---------------------|---------|
|                                     | Operative (n=49) | Nonoperative (n=54) | Operative (n=22)   | Nonoperative (n=22) |         |
| Age                                 | 30.2 (SD 10.1)   | 30.2 (SD 10.1)      | 30.2 (SD 10.1)     | 30.2 (SD 10.1)      | 0.98    |
| Gender                              | 49 (100%)        | 54 (100%)           | 22 (100%)          | 22 (100%)           | 0.98    |
| Body Mass Index                     | 26.2 (SD 6.1)    | 26.2 (SD 6.1)       | 26.2 (SD 6.1)      | 26.2 (SD 6.1)       | 0.98    |
| Time to Surgery                     | 2.1 (SD 1.2)     | 2.1 (SD 1.2)        | 2.1 (SD 1.2)       | 2.1 (SD 1.2)        | 0.98    |
| Discharge                           | 1.8 (SD 0.8)     | 1.8 (SD 0.8)        | 1.8 (SD 0.8)       | 1.8 (SD 0.8)        | 0.98    |
| Number Displaced                    | 2 (4.1%)         | 11 (20.4%)          | 1 (4.5%)           | 1 (4.5%)            | 0.0002  |
| Number Anest                        | 4 (8.2%)         | 17 (31.5%)          | 1 (4.5%)           | 1 (4.5%)            | 0.0002  |
| Number Oper                         | 45 (91.8%)       | 37 (68.5%)          | 21 (95.5%)         | 21 (95.5%)          | 0.0002  |
| Number Control                      | 0                | 0                   | 22 (100%)          | 22 (100%)           | 0.02    |
| Number Displacement                 | 0                | 14 (25.9%)          | 0                  | 0                   | 0.0002  |
| Number Displacement ≥ 5mm           | 0                | 14 (25.9%)          | 0                  | 0                   | 0.0002  |
| Number Displacement < 5mm           | 0                | 0                   | 22 (100%)          | 22 (100%)           | 0.02    |
| Number Sacral Fracture              | 1 (2.0%)         | 1 (1.9%)            | 1 (4.5%)           | 1 (4.5%)            | 0.98    |
| Number Sacral Fracture Complete     | 1 (2.0%)         | 1 (1.9%)            | 1 (4.5%)           | 1 (4.5%)            | 0.98    |
| Number Sacral Fracture Incomplete   | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis I      | 1 (2.0%)         | 1 (1.9%)            | 1 (4.5%)           | 1 (4.5%)            | 0.98    |
| Number Sacral Fracture Denis II     | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis III    | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis IV     | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis V      | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis VI     | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis VII    | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis VIII   | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis IX     | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis X      | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XI     | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XII    | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XIII   | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XIV    | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XV     | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XVI    | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XVII   | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XVIII  | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XIX    | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XX     | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XXI    | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XXII   | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XXIII  | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XXIV   | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XXV    | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XXVI   | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XXVII  | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XXVIII | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XXIX   | 0                | 0                   | 0                  | 0                   | 0.98    |
| Number Sacral Fracture Denis XXX    | 0                | 0                   | 0                  | 0                   | 0.98    |