Isolated Transverse Process Fractures: A Systematic Analysis

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Key words
- Review
- Spine trauma
- Transverse process fractures

Abbreviations and Acronyms
ITPF: Isolated transverse process fracture
MVA: Motor vehicle accident
TPF: Transverse process fracture

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OBJECTIVE: **To review the literature on isolated transverse process fractures (ITPFs) and provide evidence for the current practice of conservative management.**

METHODS: **The PubMed database was searched for published literature related to ITPFs. Baseline patient (age, sex, presentation, and mechanism of injury) and fracture (number of fractures, level, and single or multisegmental) characteristics were extracted. Management and outcomes were also recorded. Statistical comparisons were ascertained through n−1 Pearson χ^2 tests.**

RESULTS: **A total of 4 studies comprised of 398 patients with 819 ITPFs were evaluated. Mean age was 33.5 years (69% men and 31% women). No patients presented with neurologic deficits. The most common mechanism of injury was motor vehicle accident (MVA), followed by fall. MVAs were more commonly the cause of ITPFs in pediatric versus adult patients (88% vs. 65%, respectively; $P = 0.0001$). Falls were more commonly the cause of ITPFs in adults than in children (18% vs. 9%, respectively; $P = 0.05$). Management strategies involved unrestricted movement, bracing, and orthotics. Radiologic evidence of spinal instability or deformity was not reported in any of the cases. Mean follow-up was 20.5 months.**

CONCLUSIONS: **Our data suggests that nonsurgical management of ITPFs leads to complete resolution of the fracture without evidence of permanent neurologic deficit or spinal instability. However, interpretation of our results is limited by the paucity of meaningful literature reporting on long-term outcomes. Nevertheless, the results provide support for conservative management and highlight the existing need to identify markers or scenarios where the diagnosis of ITPF is actually likely to be erroneous.**

INTRODUCTION

Isolated transverse process fractures (ITPFs) of the spine were once thought to be rare.[1-3] However, recent studies suggest that misdiagnoses of ITPFs on plain radiographs occur in as many as 11% of patients undergoing evaluation after trauma to the spine.[4] Increased resolution and utilization of computed tomography have improved sensitivity in the detection of ITPFs (Figure 1).[3,5-9] The term isolated describes the absence of other fractures within the involved vertebra. Although these fractures do not extend into lamina, pedicle, or facets, they may involve multiple segments (Figure 2). ITPFs are considered stable fractures that generally do not require surgical intervention. It is common practice to recommend nonoperative treatment, with some institutions having mandated a no neurosurgical consult policy for patients with ITPFs. Conservative measures typically include pain management and orthotics, with unrestricted mobilization as tolerated. Additionally, a collar, brace or corset may be recommended for comfort.[3,5,10,11]

The National Emergency X-Radiography Utilization Study criteria and Canadian C-Spine Rule categorize cervical ITPFs as insignificant fractures that do not require stabilization or follow-up imaging.[12-14] A caveat is an ITPF extending into cervical transverse foramina, which has the potential to injure enclosed vertebral arteries. Current management of ITPFs is largely based on clinical acumen, rather than evidence.[11] To date, only 4 publications detail the management of ITPFs; only 2 report follow-up and outcomes data. The authors of this study performed a comprehensive review of the published literature on ITPFs to provide evidence for and validate the current practice of conservative management.

METHODS

Search Strategy

The PubMed database was searched for literature published between the years 1975 and 2016. Peer-reviewed articles related to ITPFs) were identified using a strategic combination of search terms: *isolated transverse process fracture(s)* OR *transverse process spine fractures*. All identified titles and abstracts were screened for relevance by the independent authors (T. T. Bui and C. Lagman).

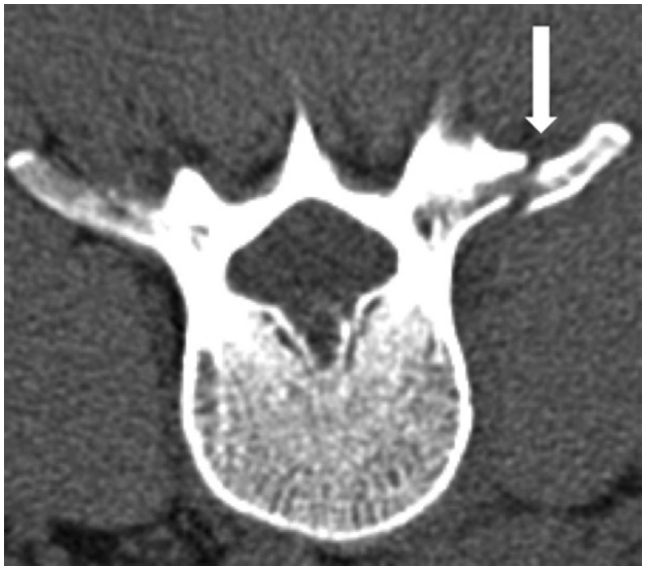

Figure 1. Axial computed tomography scan of right-sided L2 isolated transverse process fracture (*arrow*).

Study Selection

English full text articles reporting on original data regarding the management of ITPFs were included. Non-English articles, review articles, and studies deficient in outcomes data were excluded. Limits on age and sample size were not enforced. A total of 210 articles were screened. Nineteen articles passed the initial evaluation, and all available full texts were reviewed. Fifteen articles were deemed irrelevant (e.g., not specific to ITPFs) and were excluded from further review. The remaining articles were assessed for data extraction eligibility.

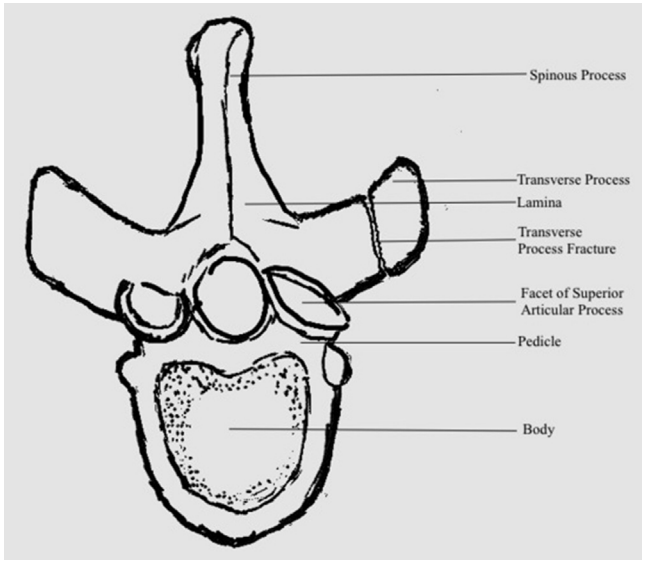

Figure 2. Illustration of a right-sided isolated transverse process fracture and corresponding bony landmarks in a lumbar vertebra.

Data Extraction and Synthesis

Data on sample size, mean age, sex, presentation, mechanism of injury, level, extent of involvement (i.e., single or multilevel), the number of fractures, management, and outcomes, were extracted (Table 1). Data, collated from individual articles, were analyzed using n−1 Pearson χ^2 tests to compare proportions.[15,16] Statistical significance was defined as a P value <0.05. Individual studies were not at risk of bias as assessed by the Risk of Bias in Systematic Reviews assessment tool.[17]

RESULTS

A total of 4 articles comprised of 398 (316 adults and 82 pediatrics) patients were included in the quantitative synthesis. The mean age of all patients identified was 33.5 years (adult patients mean age, 38.1 years and pediatric patients mean age, 15.5 years). There was, on average, an observed male predominance (approximate ratio, 2.2:1; range, 1.5:1−2.6:1), which held true for both adult and pediatric patients (2.4:1 and 1.7:1, respectively). However, these differences did not achieve statistical significance.

Neurologic deficits were neither noted at the time of injury, nor at the end of follow-up, for any patient. Associated system injuries (71%), generalized pain (43%), and spinal pain (28%) were common. The most common mechanism of injury was motor vehicle accident (MVA) at 70% (range, 43%−88%), followed by fall at 16% (range, 9%−29%). MVAs were more commonly the cause of ITPFs in pediatric versus adult patients (88% vs. 65%, respectively; $P = 0.0001$). Falls were more often the cause of ITPFs in adults than in children (18% vs. 9%, respectively; $P = 0.05$).

Single level ITPFs were less common than multilevel ITPFs (48% vs. 52%, respectively). Management consisted of unrestricted movement as tolerated (80%; range, 73%−100%), with braces or orthotics for comfort (18%; range, 0%−27%). No radiologic evidence of spinal instability or deformity were encountered