Isolated Subtalar Dislocation

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educational objectives

As a result of reading this article, physicians should be able to:

1. Understand the etiology, epidemiology, and importance of treatment of isolated subtalar dislocation.
2. Understand the most common management practices when treating isolated subtalar dislocation and identify variations in management that may affect prognosis.
3. Consolidate reported patient outcomes as they pertain to variations in management strategies to explore which practices may provide the best prognosis after treatment of isolated subtalar dislocation.
4. Highlight the importance of further study to determine the best course of management for isolated subtalar dislocation regarding variables in treatment.

ABSTRACT

This study reviews the literature on isolated subtalar dislocation published within the past 5 years. Variation in management existed mostly in the categories of treatment choice, immobilizer type, and period of immobilization, with closed reduction, closed reduction and percutaneous pinning, below-knee casting, less than 4 weeks of immobilization, and 6 weeks of immobilization reporting good results. The good results described after the addition of percutaneous K-wire fixation to the initial treatment method of isolated subtalar dislocation, immobilization via below-knee casting, and shorter periods of immobilization suggest that these practices may be useful for the treatment of this rare injury.

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714
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Isolated subtalar dislocation is an uncommon injury, representing between 1% and 2% of dislocations in adults.\textsuperscript{1} Subtalar dislocation is a simultaneous dislocation of the talocalcaneal and talonavicular joint with no associated fractures of the talus.\textsuperscript{2} Approximately 55% of medial and 72% of lateral dislocations are associated with fractures, making isolated subtalar dislocation a rare injury.\textsuperscript{3} Four traditional classifications of subtalar dislocation are described in the literature. Medial dislocations, which result from a variety of contexts and are considered an inversion/rotation injury, are the most common type, accounting for up to 80% of presentations.\textsuperscript{4} Lateral dislocations, which are traditionally thought to be caused by high-energy trauma and eversion injuries, are the second most common type, accounting for 17% of presentations.\textsuperscript{4} Posterior dislocations account for 2.5% of dislocations, and anterior dislocations are rarely described.\textsuperscript{4}

The diagnosis and management of subtalar dislocations begins with a clinical assessment followed by radiographic evaluation to confirm the diagnosis and search for associated foot or ankle fractures; this is followed by immediate closed reduction with the patient under anesthesia, postreduction computed tomography to provide secondary assessment for associated injuries, and cast immobilization for 4 weeks.\textsuperscript{5} When subtalar dislocation is irreducible by closed means, open reduction is necessary.\textsuperscript{5} Currently, although the diagnosis and initial management of subtalar dislocations are consistent in the literature, significant variation in follow-up management may affect patients’ outcomes. The purposes of this study were to summarize the literature published in the past 5 years, identify variations in management, and provide an initial exploration into their effects on both subjective and objective outcomes at follow-up.

**Materials and Methods**

An electronic search of the literature was conducted using the PubMed database and the Google Scholar search engine. Using the filters function of the PubMed database to restrict the results of the search to articles published between 2007 and 2012, the following keywords were entered: *subtalar dislocation* (60 results), *subtalar dislocation* (1 result), *peritalar dislocation* (5 results), *subastragal dislocation* (0 results), and *subastragal dislocation* (0 results). In the Google Scholar search engine, the custom range filter was used to restrict results to abstracts published between 2007 and 2012, and the following keyword was used: *subtalar dislocation* (157 results).

The results were reviewed, and all cases of isolated subtalar dislocation were included. Cases with associated fractures or dislocations other than subtalar dislocations and cases of congenital dislocations or dislocations in small children were excluded. Twenty-one articles met the inclusion criteria and were evaluated.\textsuperscript{4,6-25} Using Microsoft Excel (Microsoft Inc, Redmond, Washington), a database was created with rows representing articles and columns containing the following categories of data: sex, age, side, type of dislocation, number of open injuries, mechanism of injury, comorbid injury, method of diagnosis, method of reduction, method of immobilization, duration of immobilization, time to follow-up, and outcome.

Statistical analyses of the data and cross-referencing between recorded variables and outcomes, which were summarized from all authors, were conducted at the conclusion of the review. Quantified variables were cross-referenced with outcome to assess the relationship between each variable and the reported outcomes at follow-up. Only authors who reported both outcomes and target variables were included in each cross-analysis. Because the number of reported outcomes often was not representative of the number of patients treated in each case, the quantity of each outcome refers to the number of times each outcome was reported in the literature, whereas the quantity of each variable represents the number of patients treated as such.

**Results**

A total of 95 patients were included in the 21 studies; 75% (n = 71) were men and 25% (n = 24) were women, with a mean patient age of 34.3 years (range, 17-80 years). The total number of patients from the 21 articles reviewed was 107. However, in various categories, the data for that specific category were often unavailable. Thus, the total number of patients in each category changed slightly. For example, in the category of patient’s sex, 1 study had 12 patients and did not include data on patient gender; therefore, sex data were only recorded for 95 patients.

Among 105 patients, the direction of dislocation was medial (72.4%, n = 76), lateral (21.9%, n = 23), posterior (3.8%, n = 4), anterior (1.9%, n = 2), and anterolateral (0.95%, n = 1).\textsuperscript{6} After accounting for their exclusion, as indicated by de Palma et al,\textsuperscript{7} open injuries accounted for 15.6% (n = 12/77) of injuries. Injuries were right sided in 65.7% (n = 23/35) of patients. Mechanism of injury was noted for 96 patients: motor vehicle accident (38.5%, n = 37), fall from a height (30.2%, n = 29), sports injury (21.9%, n = 21), and low-energy trauma (9.4%, n = 9).

Among 107 patients, treatment consisted of closed reduction while under anesthesia (74.8%, n = 80),\textsuperscript{4,6,7-18} closed reduction and percutaneous pinning with K-wires (2.8%, n = 3),\textsuperscript{19} closed reduction with external fixation (2.8%, n = 3),\textsuperscript{4,13} open reduction only (3.7%, n = 4),\textsuperscript{11,19} open reduction and K-wire fixation (6.5%, n = 7),\textsuperscript{8,20-22} open reduction with external fixation (8.4%, n = 9),\textsuperscript{4} and initial arthrodesis use (0.93%, n = 1).\textsuperscript{4,8}

Information regarding immobilization method was available for 105 patients. Methods included below-knee casting (55.2%, n = 58),\textsuperscript{4,6,8,9,14,17,19,23,24} long-leg casting (31.4%, n = 33),\textsuperscript{20} external fixation (11.4%, n = 12),\textsuperscript{4,13} and
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<thead>
<tr>
<th>Author</th>
<th>No. of Patients</th>
<th>Injury</th>
<th>Mechanism</th>
<th>Treatment</th>
<th>Immobilizer</th>
<th>Duration, wk</th>
<th>FU, mo</th>
<th>Outcome</th>
<th>Mean AOFAS Score</th>
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<td>9</td>
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<td>Sports injury</td>
<td>Closed reduction under anesthesia</td>
<td>Below-knee cast</td>
<td>6</td>
<td>–</td>
<td>–</td>
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</tr>
<tr>
<td>Bali et al</td>
<td>10</td>
<td>Posterior subtalar dislocation</td>
<td>Motor vehicle accident</td>
<td>Closed reduction under anesthesia</td>
<td>Below-knee cast</td>
<td>3</td>
<td>24</td>
<td>Normal function, normal findings</td>
<td>–</td>
</tr>
<tr>
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<td>1</td>
<td>Medial subtalar dislocation</td>
<td>Sports injury</td>
<td>Closed reduction under anesthesia</td>
<td>Below-knee cast</td>
<td>4-6</td>
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<td>1</td>
<td>Medial subtalar dislocation</td>
<td>Low-energy trauma</td>
<td>Open reduction and internal fixation</td>
<td>Below-knee splint</td>
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<td>Normal function</td>
<td>–</td>
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<td>Sports injury</td>
<td>Closed reduction under anesthesia</td>
<td>Below-knee cast</td>
<td>3</td>
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<td>Medial subtalar dislocation</td>
<td>Motor vehicle accident</td>
<td>Closed reduction under anesthesia</td>
<td>Below-knee cast</td>
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<td>–</td>
<td>9 normal function; 3 decreased ROM; 9 mild degenerative changes</td>
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</tr>
<tr>
<td>Hotouras et al</td>
<td>1</td>
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<td>Sports injury</td>
<td>Open reduction and internal fixation</td>
<td>Below-knee cast</td>
<td>6</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
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<td>Jungbluth et al</td>
<td>23</td>
<td>Medial subtalar dislocation, 6 lateral subtalar dislocations, 1 posterior subtalar dislocation, 7 open injury mechanisms</td>
<td>Motor vehicle accident, 11 falls from a height, 6 sports injuries, 2 low-energy traumas</td>
<td>13 closed reductions under anesthesia, 1 closed reduction and external fixations, 9 open reduction and external fixations</td>
<td>Below-knee cast, 10 external fixators</td>
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<td>58.3</td>
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<td>Lansianos et al</td>
<td>11</td>
<td>Medial subtalar dislocation, 6 lateral subtalar dislocations, 1 posterior subtalar dislocation, 4 open injury mechanisms</td>
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</tr>
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<td>12</td>
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### Table (Cont.) Data From Individual Articles

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<th>Author</th>
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<th>Injury</th>
<th>Mechanism</th>
<th>Treatment</th>
<th>Immobilizer</th>
<th>Duration, wk</th>
<th>FU, mo</th>
<th>Score</th>
<th>Outcome</th>
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<td>Closed reduction under anesthesia</td>
<td>Below-knee cast</td>
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<td>Low-energy trauma</td>
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<td>24</td>
<td>Normal function, decreased ROM</td>
<td></td>
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*Abbreviations: AOFAS, American Orthopaedic Foot and Ankle Society; FU, follow-up; ROM, range of motion.*

Immobilization periods specified in 104 of the 107 patients ranged from 2 to 6 weeks. Immobilization periods were less than 4 weeks in 9.6% (n = 10) of patients, four weeks in 4.8% (n = 5), five weeks in 32.7% (n = 34), and 6 weeks in 40.4% (n = 42). Immobilization was not specified and listed as between 4 and 6 weeks in 12.5% (n = 13).

The authors were able to obtain final follow-up data for 101 patients. The months to final follow-up ranges from 12 months in 7.9% (n = 8) of patients to 102 months in 29.7% (n = 30), with a mean final follow-up of 66.9 months.

Collectively among sources, subjective outcomes of normal function were recorded 33 times, stiffness 1 time, minimal pain 17 times, significant pain 6 times, unsteadiness 9 times, and decreased function 9 times. Objective outcomes were reported for 89 patients. Objective outcomes of normal findings were recorded 11 times, decreased range of motion (ROM) 33 times, and joint space narrowing 1 time. Recorded degenerative changes were mild in 30 (33.7%) patients, moderate in 8 (9%), and severe in 3 (3.4%), with 3 reports of arthrodesis (Table).

Referencing outcomes by treatment modality yielded 35 reports of normal function, of which 27 were treated by closed reduction, 3 by closed reduction and percutaneous pinning with K-wires, 2 by closed reduction and external fixation, and 3 by open reduction and internal fixation with K-wires. Stiffness resulted from treatment via closed reduction for 1 patient. Of the 21 reports of minimal pain, 19 were treated by closed reduction and 2 by closed reduction and external fixation. All 6 reports of significant pain occurred in patients who underwent closed reduction. Of 15 reports of instability, 10 occurred after closed reduction, 2 after closed reduction and external fixation, and 3 after open reduction.

Normal objective findings were recorded for 8 patients treated with closed reduction and 3 with closed reduction and percutaneous pinning. Decreased ROM was reported by 28 patients after closed reductions and 3 patients after closed reduction with external fixators. Joint space narrowing was recorded once after open reduction and internal fixation with K-wires. Reports of degenerative changes were mild after 17 closed reductions (3 of which were externally fixated) and 10 open reductions (9 of which were externally fixated), moderate in 6 closed and 2 open reductions, and severe after 3 closed reductions. Arthrodesis was recorded in association with 3 closed reductions (Figure 1).

Referencing immobilization modality by outcome, 25 reports of normal function, 1 of joint stiffness, and 3 of minimal pain were associated with below-knee casting. Long-leg casting was associated with 7 reports of normal function, 14 of minimal pain, 6 of significant pain, 9 of instability, and 9 of disability. Normal function was reported twice with external fixation (Figure 2). Below-knee casting was associated with 4 reports of normal findings, 9 of
decreased ROM, 1 of joint space narrowing, and 15 of mild degenerative changes. Long-leg casting was associated with 7 reports of normal findings, 23 of decreased ROM, 15 of mild degenerative changes, 8 of moderate degenerative changes, 3 of severe degenerative changes, and 3 of arthrodesis. External fixation was associated with 5 reports of decreased ROM and 11 of mild degenerative changes.

Referencing periods of immobilization by outcome, less than 4 weeks of immobilization was associated with 7 reports of normal function, 1 of stiffness, and 2 of minimal pain. Four weeks of immobilization was associated with 4 reports of normal function and 1 of minimal pain. Five weeks of immobilization was associated with 7 reports of normal function, 1 of stiffness, and 2 of minimal pain. Four weeks of immobilization was associated with 4 reports of normal function and 1 of minimal pain. Five weeks of immobilization was associated with 7 reports of normal function, 1 of stiffness, and 2 of minimal pain. Four weeks of immobilization was associated with 2 reports of decreased ROM. Four weeks of immobilization was associated with 3 reports of normal function. Five weeks of immobilization was associated with 8 reports of normal findings, 23 of decreased ROM, 15 of mild degenerative changes, 8 of moderate degenerative changes, 3 of severe degenerative changes, and 3 of arthrodesis. Six weeks of immobilization was associated with 7 decreased ROM, 1 narrowed joint space, and 15 mild degenerative changes.

Referencing time to follow-up by outcome, at 12-month follow-up, 7 reports of normal function were made. At 24-month follow-up, 4 reports of normal function, 1 of stiffness, and 1 of minimal pain were made. At 30-month follow-up, 1 report of normal function was made. At 36-month follow-up, 6 reports of normal function and 2 of minimal pain were made. At 39.8-month follow-up, 9 reports of normal function were made. At 60-month follow-up, 3 reports of instability were made. At 102-month follow-up, 7 reports of normal function, 14 of minimal pain, 6 of significant pain, 6 of subjective instability, and 9 of disability were made.

At 12-month follow-up, 4 reports of normal findings and 1 of decreased ROM were made. At 24-month follow-up, 2 reports of decreased ROM and 1 of narrowed joint space were made. At 30-month follow-up, 1 report of decreased ROM was made. At 39.8-month follow-up, 3 reports of decreased ROM and 6 of mild degenerative changes were made. At 58.3-month follow-up, 3 reports of decreased ROM and 9 of mild degenerative changes were made. At 60-month follow-up, 3 reports of decreased ROM, 1 of mild degenerative changes, and 2 of moderate degenerative changes were made. At 102-month follow-up, 7 reports of normal function, 20 of decreased ROM, 14 of mild degenerative changes, 6 of moderate degenerative changes, and 3 each of severe degenerative changes and arthrodesis were made.

**DISCUSSION**

After reviewing data on isolated subtalar dislocation within 5 years of the
initial injury, the epidemiologic data are unchanged regarding the male preponderance, average age, mechanism of injury, frequency of open injuries, and frequency by classification. Slightly fewer medial (72%) and slightly more lateral (22%) dislocations were observed than had been reported by Zimmer et al,3 who reported 80% medial and 17% lateral dislocations, but did not approach the difference reported by Jungbluth et al4 of 70% medial and 26% lateral dislocations. The mechanism of injury also reflected consistency with the consensus of the literature, attributing 68% of dislocations to high-energy mechanisms. Only 4 general mechanisms of injury were present in all of the studies combined: motor vehicle collision, falls from a height, sports injuries, and low-energy trauma such as stepping into a ditch or tripping over a step.15,19 Slightly less than 10% of dislocations were attributable to low-energy mechanisms, but many of these patients were from specific case reports of subtalar dislocations resulting from low-energy mechanisms, and this is probably an overrepresentation due to selection bias.15,19,21,23

Several indicators of prognosis have been defined in the literature, particularly treatment and duration of immobilization.7 Although lateral dislocations have been touted to have a less favorable prognosis, this idea has been refuted by Perugia et al1 and Jungbluth et al4 and in their studies of isolated subtalar dislocation. Neither study showed a difference in American Orthopaedic Foot and Ankle Society scores between medial and lateral dislocation, and the apparent difference seen in other studies has been attributed to the tendency for lateral dislocation to be associated with other osteochondral injuries about the foot and ankle.1,4 An association has not been made between the direction of dislocation and the tendency for an open injury to occur, which could also lead to a worse prognosis.26

After a review of prognostic studies on subtalar dislocation, variation in management as suggested by Horning and DiPreta5 was identified in the initial treatment, method of immobilization, and duration of immobilization. Although initial clinical management, radiographic evaluation, and attempts at closed reduction were unanimous, many differences in initial treatment were attributable to individual injuries. For example, Simon et al8 found 4 of 12 cases to be irreducible and require open reduction with temporary K-wire fixation; Siddiqui et al,22 Tak et al,23 and Hotouras et al24 used this method for treatment of a neglected injury after irrigation and debridement and the finding of an unstable reduction. External fixation was used in cases requiring soft tissue management and in 1 case to stabilize a repositioned reduction.4,13

In a presentation of 4 cases, 3 of which were subtalar dislocations, Pavic19 used closed reduction with percutaneous talocalcaneal K-wire fixation in cases of pure subtalar dislocation, making an argument for use of this technique on the basis that it prevents recurrence of subluxation. At 1-year follow-up, these 3 cases had subjectively returned to normal function without pain.19 Of the 80 patients treated with closed reduction, 27 reported normal function and 11 reported normal findings at follow-up. This suggests that a benefit may exist to including percutaneous K-wire fixation as an addition to the now widely accepted initial treatment via closed reduction. It is difficult to assess the validity of this statement based on the limited number of patients treated with percutaneous pinning, the lack of long-term follow-up of the patients presented by Pavic,19 and the lack of standardized follow-up and evaluation among studies. A randomized, controlled trial could assess for a difference in outcome following these 2 treatment modalities while controlling for these confounding variables.

The most commonly used immobilization method was below-knee casting, which was used by 14 authors to treat 58 patients. Long-leg casting was the second most popular immobilization method, which was used by 2 authors to treat 33 patients. Understanding that outcomes were not ubiquitously reported, below-knee casting was associated with more normal function and comparable mild degenerative changes reported per case treated than long-leg casting. Long-leg casting was associated with more reports of adverse outcomes despite being the modality used in fewer patients. These associations are limited by the fact that long-leg casting
was used predominantly in 1 study of 30 patients, a source of significant sampling error, as well as confounding by other variables such as initial treatment and length of immobilization. Although this review supports below-knee casting as associated with better outcomes, controlled trials are necessary to definitively determine the most beneficial method of immobilization.

The most common period of immobilization was 6 weeks, which was used by 6 authors during the treatment of 42 patients. The second most common period of immobilization was 5 weeks, which was used by 3 authors to treat 34 patients. It is generally thought that decreasing the time of immobilization will decrease the incidence of joint stiffness after treatment, and shorter periods of immobilization (ie, 4 weeks or less) have been widely suggested and proven effective.1-3,5,18 Most reports of normal function occurred after 6 weeks of immobilization, despite literature in favor of shorter periods of immobilization; however, this was also the most commonly used practice. Among those authors immobilizing for less than 4 weeks, the number receiving treatment compared with the number of reported outcomes was 1:1, and 7 of 10 patients returned to preinjury status, making an argument in support of Lansianos et al11; however, the majority of those were patients involved in the Lansianos et al11 series. The remaining 2 cases were reported by Bali et al10 and Camarda et al,14 who both immobilized patients for 3 weeks and reported return to preinjury status. The ability to describe the relationship between immobilization and outcome is limited by incongruence in study design and outcome measurement, as well as a lack of sufficient patient data to provide power to the study. Duration of immobilization has been shown to be of prognostic importance and as such merits controlled trials to delineate the best course of action.5

**CONCLUSION**

Standards of timely attempts at closed reduction and immobilization with good outcomes after isolated subtalar dislocations are uniform among authors, but good results have been described after the addition of percutaneous K-wire fixation to the initial management of isolated subtalar dislocation. Good outcomes after immobilization via below-knee casting are suggestive that this practice may be of benefit in the management of isolated subtalar dislocations. Period of immobilization has been shown to be of prognostic importance, and a high proportion of good outcomes after a shorter course of immobilization of isolated subtalar dislocations supports the broadly cited notion that shorter periods of immobilization could be useful in the treatment of this rare injury.

**REFERENCES**