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Chopart Joint Fracture-Dislocation: Initial Open Reduction Provides Better Outcome Than Closed Reduction

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ABSTRACT

Injury cause, treatment, and long-term results [American Orthopaedic Foot and Ankle Society (AOFAS) Midfoot Score, Hannover Scoring System, Hannover Outcome Questionnaire] of patients with Chopart joint dislocations or fracture-dislocations were evaluated. Between 1972 and 1997, 100 patients with 110 Chopart joint dislocations were treated in the authors' institution. Pure Chopart joint dislocations were observed in 28 (25%) feet, fracture-dislocations in 60 (55%) feet, and combined Chopart-Lisfranc joint fracture-dislocations in 22 (20%) feet. The primary treatment was operative in 91 (83%) feet and nonoperative in 19 (17%) feet. Sixty-five (65%) patients had follow-up after an average of 9 years (range, 2–25 years). The mean scores of the entire follow-up group were: AOFAS score, 75 points; Hannover Scoring System, 69 points (maximium possible score = 100 points); Hannover Outcome Questionnaire, 68 points (maximium possible score = 100 points). There were no differences between the scores for pure dislocations or fracture-dislocations of the Chopart joint, but significantly lower scores were noted with combined Chopart-Lisfranc joint fracture-dislocations. In all three injury pattern groups, an initial anatomic reduction was essential for good results. The high functional restrictions in Chopart dislocations can most likely be minimized with initial open reduction, especially in fracture-dislocations. A closed reduction yielded good results only with pure dislocations, when anatomic conditions could be restored, or if there were contraindications to surgery.

Key Words: Chopart Joint Dislocation; Chopart Joint Fracture-Dislocation; Closed Reduction; Long-Term Outcome; Open Reduction

INTRODUCTION

Among the uncommon midfoot injuries, Chopart joint dislocations or fracture-dislocations are the most severe injuries.[21] They predominantly occur in motor vehicle collisions.[3,18] Despite major improvements in automobile safety, the incidence and severity of these injuries have remained the same.[16,17] Chopart joint dislocations and especially fracture-dislocations are still problematic in both diagnosis and treatment and result in a high degree of long-term morbidity.[1,2,6,10,11,18,21,25]

The anatomy of the Chopart joints is critical for understanding the mechanism of injury and the rationale for appropriate treatment.[19–21] Anatomic reduction may be difficult in Chopart fracture-dislocations and an open procedure may be required.[4,21] In the delayed setting, the surgical correction of the length and shape of the longitudinal arch is important and technically challenging, especially in combined Chopart-Lisfranc fracture-dislocations.[5,14,21] For describing reduction and fixation techniques, the column theory is useful. The medial column includes the navicular, medial cuneiform, and first metatarsal; the middle column includes the second and third metatarsals and cuneiforms; and the lateral column consists of the calcaneus, cuboid, and fourth and fifth metatarsals.[25]

The treatment should also be dictated by the soft tissue conditions. The arterial anatomy is critical because the anterior tibialis artery has an intermetatarsal branch which has an anastomosis with the plantar circulation.[19] A rupture of this anastomosis can cause major hemorrhage and compartment syndrome. The anastomosis may be damaged during

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Table 1: Classification of soft tissue injuries in closed and open fractures according to soft tissue damage, fracture severity, and contamination

Classification	Skin	Soft Tissue Damage	Fracture Severity	Contamination
C0	Closed	Absent or negligible	Mild	None
CI	Closed	Superficial abrasion or contusion	Mild to moderate	None
CII	Closed	Deep abrasion, localized contusion	Mild to severe	None
CIII	Closed	Extensive contusion	Mild to severe	None
OI	Open	Superficial abrasion or contusion	Mild to moderate	None
OII	Open	Deep abrasion, localized contusion	Mild to severe	Minor
OIII	Open	Extensive contusion	Mild to severe	Moderate
OIV	Open	Extensive contusion	Mild to severe	Severe

Data taken from Tscherne and Oestern.[24]

reduction maneuvers when high forces are applied.[19] We performed a clinical retrospective study involving patients treated in a Level I Trauma Center to create a basis for treatment optimization and minimization of the long-term morbidity.

MATERIAL AND METHODS

The patients treated in the Trauma Department of the Hannover Medical School with Chopart joint dislocations or fracture-dislocations over a 25-year period (between January 1, 1972 and December 31, 1997) were evaluated retrospectively.

Inclusion Criteria and Classification

Traumatic dislocations or fracture-dislocations of the Chopart joint were included. The injuries were categorized as pure Chopart joint dislocations, Chopart joint fracture-dislocations, or combined Chopart-Lisfranc joint fracture-dislocations. The soft tissue damage was classified as previously described (Table 1).[24] In addition to demographic data, the cause of the injuries, time from injury to treatment, and method of treatment were recorded.

Demographics and Injury Causes

One hundred patients with Chopart joint dislocation were included in the study group. Men (68 men) were affected twice as often as women (32 women). The mean age was 32 (range, 17–85) years. The patients were injured primarily in traffic accidents (Table 2).

Injury Pattern

Both sides were involved to an equal percentage (right, 46; left, 44; bilateral, 10). In total, 110 Chopart joint dislocations were analyzed. Pure Chopart joint dislocations were observed in 28 (25%) feet, fracture-dislocations in 60 (55%) feet, and combined Chopart-Lisfranc joint fracture-dislocations in 22 (20%) feet.

Table 2: Cause of injury in 110 Chopart joint dislocations or fracture-dislocations

Cause	Number (%) of Injuries
Motor vehicle accident	90 (82%)
Automobile	55 (50%)
Motorcycle	31 (28%)
Other	4 (4%)
Fall	10 (9%)
Contusion	5 (4.5%)
Other	5 (4.5%)
Total	110 (100%)

Table 3: Distribution of soft-tissue injury in 110 Chopart joint dislocations or fracture-dislocations

Type[a]	Number (%)	
	Closed	Open
O	4 (3.6%)	—
I	38 (35%)	3 (2.7%)
II	27 (25%)	5 (4.5%)
III	21 (19%)	6 (5.5%)
IV	—	6 (5.5%)
Total	90 (82%)	20 (18%)

[a]Classification defined in Table 1.[24] C0–CIII: closed fractures; OI–OIV: open fractures.

Ninety (82%) Chopart joint dislocations were closed injuries, and 20 (18%) were open injuries (Table 3). Associated injuries were noted in 88 (88%) patients. The associated injuries were predominantly fractures in the lower extremity in 74 (74%) patients (Table 4). Twenty-five (25%) patients were classified as having polytrauma.

Table 4: Incidence of 157 associated fractures of the lower extremity and/or polytrauma in 100 patients with Chopart joint dislocations or fracture-dislocations

Body Region	Number (%)
Femur	29 (29%)
Tibia	16 (16%)
Ankle	42 (42%)
Hindfoot	15 (15%)
Forefoot	55 (55%)
Polytrauma	25 (25%)

Note: Total percentage >100 due to multiple injuries.

Treatment

Closed Reduction, No Internal Fixation

The indications for nonoperative treatment were: sufficient closed anatomic reduction, sufficient stability after reduction in anatomic position, and contraindications for operative treatment. The nonoperative treatment included closed reduction if necessary, application of a rigid foot cast, and rehabilitation with partial weightbearing (15 kg) for 6 weeks. The design of the foot cast allows partial or total weightbearing and motion in the ankle joint. Heparin prophylaxis (Embolex™, Certoparin-Natrium 3,000 I.E. anti-Xa, Dihydroergotaminmesilat 0.5 mg, Novartis Pharma, Basel, Switzerland) against deep venous thrombosis was used when patients were treated with a short leg cast, but not when they were treated with a foot cast alone.

Closed Reduction With Internal Fixation

When the closed reduction was successful but the reduced joints were not considered to be stable, internal fixation utilizing 1.6- to 2.0-mm Kirschner wires (K-wires) or percutaneous 3.5-mm cortical screws was used. A short leg cast was applied in the operating room. The cast was changed to a foot cast after 2–3 days, and rehabilitation was performed in the cast with partial weightbearing (15 kg) for 6 weeks. Hardware removal was performed after 6 weeks.

Open Reduction, Internal Fixation, Optional Additional External Fixation

In the remaining cases without amputation, an open reduction was performed. An open reduction was also performed when closed reduction was insufficient, in all open injuries, and in all cases with compartment syndrome. A foot compartment fasciotomy was initially performed in 28 (25%) Chopart joint dislocations. In the 1970s and 1980s, the indication for foot compartment fasciotomy was determined clinically. In the 1990s, a specific pressure measurement was performed (Intracompartmental Permanent Pressure Monitoring System, Stryker™ Corporation, Santa Clara, CA, USA). The indication for fasciotomy was a difference of less than 30 mm Hg between diastolic blood pressure and compartment pressure.[22] If massive swelling without compartment syndrome was observed, the operative procedure was postponed until the swelling had decreased. In those cases, a closed reduction was initially performed and a short leg cast was applied. Those patients were then treated with bed rest and elevation of the foot; cooling with ice packs was performed up to the operation, and nonsteroidal anti-inflammatory drugs were prescribed.

One dorsomedial incision and one dorsolateral incision were used in the majority of the open procedures. For internal stabilization, 1.6- to 2.0-mm K-wires and/or 3.5-mm cortical screws were used. Regarding Lisfranc dislocations or fracture-dislocations, all rays were stabilized with K-wires, screws, or both in a distal-proximal (retrograde) direction perpendicular to the joint surfaces for optimal stability. In cases with associated hindfoot or ankle instability, and/or in patients who were ventilated, an external fixator between tibia and first and fifth metatarsals was applied to minimize the risk of decubitus ulcer in unconscious patients. A primary arthrodesis of the Chopart and/or Lisfranc joints was performed in cases with massive or irreconstructable articular damage. When primary skin closure was not possible, the skin defect was covered with artificial skin (Epigard™, Orthomed Medizintechnik, Vienna, Austria). Within 1 or 2 weeks, a secondary skin closure was normally possible and a skin graft was not necessary.

A short leg cast was applied in the operating room in all cases without external fixator. When the soft tissue conditions were satisfactory, the cast was changed to a cast shoe after 2–3 days. The treatment was carried on in the short leg cast in cases with critical soft tissue conditions (swelling, hematoma, or drainage). Ambulation with partial weightbearing (15–30 kg) was performed depending on the general condition of the patient. Hardware removal was performed at 6–10 weeks after surgery. When a primary arthrodesis or osteosynthesis of single bones was done, the screws were left for 1 year. Full weightbearing was allowed after 6–10 weeks.

Amputation

Primary amputation after 1990 was performed when the Mangled Extremity Severity Score (MESS) was higher than 7 points.[7] Before 1990, the decision was made by the treating surgeons based on their experience. Secondary amputation was considered in cases with deep infection and critical general condition of the patient.

Table 5: Treatment methods in 110 Chopart joint dislocations

Treatment	Number			Total
	Pure Chopart Joint Dislocation	Chopart Fracture-Dislocation	Chopart-Lisfranc Fracture-Dislocation	
Closed reduction, no internal fixation	19	0	0	19
Closed reduction with internal fixation	6	7	2	15
Open with internal fixation	3	50	11	64
(± external fixation)	(1)	(14)	(5)	(20)
Primary amputation	0	3	9	12
Total	28	60	22	110

Follow-up

The outcome was assessed during the year 2000 by clinical examination and radiographs for the majority of the patients. Only patients without amputation and whose treatment was completed at least 2 years before the time of follow-up were included in the outcome assessment. The evaluation of the overall results was carried out with three different scoring systems: Hannover Scoring System[23]; Hannover Outcome Questionnaire, rating patients' complaints and the functional status based on a severity-symptom scale and functional status[23]; American Orthopaedic Foot and Ankle Society (AOFAS) Midfoot Score.[8] The radiographs were evaluated independently by two orthopaedic surgeons, one of whom was not involved in the clinical care of the patients. Length of the medial and lateral column (grades: correct or incorrect length as previously described),[19] shape of the longitudinal arch (grades: excellent, good, fair, poor[13]), and extent of arthritic changes in the Chopart joint (grades: absent, doubtful, minimal, moderate)[8] were analyzed and graded. Each of the five cases with deviation in any assessment were discussed by both observers and reassessed. Seven patients who could not be called back for clinical examination and radiographs were included in the follow-up evaluation by Hannover Outcome Questionnaire completed by telephone interview. The two-tailed *t* test and chi-square test were utilized for the statistical analysis of score differences (significance level: $p < .05$).

RESULTS

Treatment

Closed reduction with no internal fixation was the primary treatment in only 19 (17%) Chopart joint dislocations. In the other 91 (83%) Chopart joint dislocations (83 patients; 8 bilateral), operative treatment included closed reduction with internal fixation in 15 (14%) Chopart joint dislocations, open reduction and internal fixation in 64 (58%) feet, and primary amputation in 12 (11%) feet (Table 5). Closed reduction had been attempted first, and was considered to be not sufficient in 20 (18%) feet before open reduction was performed. Internal fixation in 79 (71%) feet after open or closed reduction consisted of K-wires alone in 49 (45%) feet, K-wires and screws in 22 (20%) feet, and screws alone in eight (7%) feet.

An external fixator was applied as additional treatment in 20 (18%) feet; 16 external fixators were applied because the patient was ventilated due to critical general condition, and four due to associated hindfoot or ankle instability. Primary arthrodesis of the Chopart joint was performed in six feet (Chopart joint fracture-dislocation, three feet; Chopart-Lisfranc joint fracture-dislocation, three feet, and of the Lisfranc joint in eight feet (Chopart-Lisfranc joint fracture-dislocation, eight feet). Autologous bone graft was used in seven of the arthrodesis procedures. Primary below-knee amputation was performed in eight (7%) feet with open Chopart-Lisfranc joint fracture-dislocations in combination with polytrauma, and a primary amputation at the Chopart joint level was performed in four (4%) feet (three Chopart fracture-dislocations, and one Chopart-Lisfranc fracture-dislocation).

The mean time between injury and operative treatment was 3 ± 6 days (range, 0–25 days; median, 0 days). A secondary open reduction and internal fixation procedure with K-wires was necessary in two polytrauma patients with Chopart joint fracture-dislocations, who had a nonanatomic reduction with K-wire fixation because surgery was limited by the critical general condition of the patient; after stabilization

Table 6: Results of the radiographic ($n = 59$) assessment of Chopart joint dislocations or fracture-dislocations of follow-up examination

Injury Pattern[a]	Pure Chopart Joint Dislocation ($n = 14$)	Chopart Fracture-Dislocation ($n = 33$)	Chopart-Lisfranc Fracture-Dislocation ($n = 12$)
Medial column length[19] (correct/incorrect)	11/3	21/12	5/7
Lateral column length[19] (correct/incorrect)	12/2	23/10	4/8
Longitudinal arch shape[13] (excellent/good/fair/poor)	6/3/3/2	8/13/7/5	0/4/4/4
Arthritic changes[8] (absent/doubtful/minimal/moderate/severe)	4/1/5/3/1	6/3/11/8/5	1/0/3/4/4

[a]58 patients, 59 Chopart dislocations

of the general condition at 3 and 7 days after initial surgery, the patients had revision surgical reduction and screw fixation.

A secondary below-knee amputation was performed in three feet because of progressive infection, in one following an amputation at the Lisfranc level (see above) and in two feet of open Chopart-Lisfranc joint fracture-dislocations without primary amputation. Overall 15 (14%) amputations were performed in 14 patients. In total, deep infection was observed in four feet following open injuries. Forty surgical revisions were done in 35 (32%) feet after open reduction and internal fixation (secondary skin closure, 36 surgical revisions in 33 feet; debridement and irrigation for infection, four surgical revisions in two feet).

Postoperative early mobilization with partial weight-bearing was allowed in 75 (75%) patients (77 Chopart joint dislocations, i.e., two bilateral Chopart joint dislocations). Polytrauma patients made up the remaining 25 (25%) patients (33 Chopart joint dislocations, i.e., eight bilateral Chopart joint dislocations, 12 amputations) in the study group who had delayed ambulation, except one patient who sustained an amputation in absence of polytrauma. The K-wires and external fixators were removed 6 weeks after surgery. Nineteen feet (17%) with isolated unilateral pure Chopart joint dislocation were treated with closed reduction only.

Follow-up

Excluding the 14 patients who had amputation and eight patients who died, 65 of the 78 remaining patients (83%) had follow-up examination at an average of 9 years (range, 2–25 years). Fifty-eight (58%) patients with 59 Chopart joint dislocations (one bilateral) were examined clinically and radiographically.

The mean AOFAS score for the entire follow-up group was 75 (range, 35–100) points. The mean Hannover Scoring System score was 69 (range, 29–100) points and the mean Hannover Outcome Questionnaire score was 68 (range, 30–100) points. The radiographs showed the greatest osteoarthritic changes in patients with Chopart-Lisfranc joint fracture-dislocation (Table 6).

Prognostic Factors

An analysis of outcome was done as a function of patient age at the time of the injury, gender, injury cause, injury pattern and classification, type/extent of soft tissue damage, time up to surgery, type of treatment, and method of reduction and internal fixation. No significant differences in the AOFAS scores were found for age at the time of the injury (<35 years and ≥ 35 years) or gender (Table 7). The mean AOFAS scores in motor vehicle accident (MVA) victims were lower than in non-MVA victims. Patients with complex or open injures or associated fractures or polytrauma had lower mean AOFAS scores than patients with simpler, closed, or isolated injuries (Table 7). The patients with pure Chopart joint dislocations or Chopart joint fracture-dislocations showed no significant score differences between groups. Patients with Chopart-Lisfranc joint fracture-dislocations had significantly lower scores than patients with pure Chopart joint dislocations or Chopart joint fracture-dislocations.

Statistical analysis of the Hannover Scoring System and Hannover Outcome Questionnaire showed no

Table 7: AOFAS Midfoot Score at follow-up examination in in 58 patients (59 Chopart joint dislocations)

Prognostic Parameter	Parameter Groups (number of feet)	Mean AOFAS Score	*p* Value
Age at time of injury	≤35 years (30)	77	NS
	>35 years (29)	73	
Gender	Male (39)	75	NS
	Female (20)	77	
Cause of injury	MVA (41)	69	.05
	non-MVA (18)	79	
Injury pattern	Pure Chopart joint dislocation (14)	79	.03
	Chopart fracture-dislocation (33)	78	D vs. CL, .02
	Chopart-Lisfranc fracture-dislocation (12)	61	FD vs. CL, .02
Type of soft tissue damage	Closed (50)	77	.01
	Open (9)	61	
Extent of soft tissue damage[24]	C0, CI, CII, OI (45)	78	.01
	CIII, OIII, OIV (14)	60	
Compartment syndrome	No (41)	65	.02
	Yes (18)	77	
Associated fractures	No (10)	81	.05
	Yes (49)	69	
Time to surgery (operative treatment in 51 feet of follow-up group)	0, 1 day (27)	79	.05
	>1 day (24)	65	
Type of treatment	Open/closed reduction with internal fixation (51)	73	NS
	Closed reduction, no internal fixation (8)	78	
Method of reduction (8 cases of closed reduction group sustained closed reduction and no internal fixation)	Open reduction before internal fixation (39)	79	NS
	Closed reduction before internal fixation or no internal fixation (20)	75	
Method of reduction during operative treatment (treatment in 51 feet of follow-up group)	Open reduction before internal fixation (39)	79	.03
	Closed reduction before internal fixation (12)	70	
Method of internal fixation (screws alone in 6 cases)	K-wires (40)	75	NS
	K-wires & screws (13)	75	

D, pure Chopart joint dislocation; FD, Chopart fracture-dislocation; CL, Chopart-Lisfranc fracture-dislocation; NS, not significant; all comparisons evaluated with a two-tailed *t* test except for injury pattern, tested with ANOVA.

statistical differences for age and gender (data not shown). Chopart-Lisfranc joint fracture-dislocations showed significantly lower mean scores than pure Chopart joint dislocations or Chopart joint fracture-dislocations in the Hannover Scoring System and Hannover Outcome Questionnaire (Table 8). In all three injury pattern groups (pure Chopart joint dislocations, Chopart joint fracture-dislocations, Chopart-Lisfranc joint fracture-dislocations), an initial anatomic reduction was essential for good scores. An open reduction resulted in higher scores than closed reduction (Table 8).

Table 8: Hannover Scoring System[23] and Hannover Outcome Questionnaire scores of follow-up examination in different groups and statistical significance between groups in 58 patients (59 Chopart joint dislocations)

Prognostic Parameter	Parameter Groups (number of feet)	Mean Score	*p* Value
Hannover Scoring System			
Injury pattern	Pure Chopart joint dislocation (14)	81	
	Chopart fracture-dislocation (33)	77	.02 D vs. CL, .02
	Chopart-Lisfranc fracture-dislocation (12)	58	FD vs. CL, .03
Method of reduction during operative treatment (treatment in 51 feet of follow-up group)	Open reduction before internal fixation (39)	78	.03
	Closed reduction before internal fixation (12)	52	
Hannover Questionnaire			
Injury pattern	Pure Chopart joint dislocation (14)	78	
	Chopart fracture-dislocation (33)	73	.03 D vs. CL, .03
	Chopart-Lisfranc fracture-dislocation (12)	53	FD vs. CL, .03
Method of reduction during operative treatment (operative treatment in 51 feet of follow-up group)	Open reduction before internal fixation (39)	72	.02
	Closed reduction before internal fixation (12)	45	

D, pure Chopart joint dislocation; FD, Chopart fracture-dislocation; CL, Chopart-Lisfranc fracture-dislocation.

DISCUSSION

In our clinical study we found the same proportion of pure Chopart joint dislocations and fracture-dislocations (Chopart joint fracture-dislocations, Chopart-Lisfranc joint fracture-dislocations) as described in the literature.[9,14,20,21] The results of the different scoring systems in our study are comparable to other studies.[11,25] We could not find significant statistical differences in AOFAS score for different age and gender. Significantly lower mean AOFAS scores were observed in those patients with Chopart-Lisfranc fracture-dislocations (Table 7).

Further classifications of the Chopart dislocations or fracture-dislocations were not performed because we could not find a correlation between classification and outcome in earlier midfoot studies,[15,18] and there is no international consensus about the classification of Chopart dislocations and fracture-dislocations. In contrast, the type and extent of soft tissue damage, the incidence of associated fractures, and the incidence of compartment syndrome had a major influence on the outcome as described in the literature.[12] After surgical treatment within 24 hours after trauma, higher AOFAS Midfoot scores were observed than after surgical procedures at a later stage as found for other injuries of the foot region.[15] In the group that had surgery at a later time, swelling was frequently the indication for a delayed procedure. The soft tissue damage that causes that swelling may influence the outcome more than the delay in the operative procedure itself. Vice versa, patients with compartment syndrome were assigned to the group with operative

procedure within the first 24 hours, which achieved higher AOFAS scores. Consequently, the effect of the time between injury and operation may depend on other factors such as concurrent compartment syndrome. Nevertheless, an early operative procedure seems to be reasonable in the absence of contraindications.

No statistically significant differences were found in the follow-up scores considering different methods of treatment (operative vs. nonoperative, internal fixation with K-wires vs. K-wires and screws). That does not necessarily mean that the treatment has no influence on the outcome of this particular type of fracture, but this may have resulted from the low statistical power. However, the method of reduction during operation had a major impact on the follow-up score. Open reduction led to a better score than closed reduction with percutanous fixation (Table 7). Summing up, a complex fracture-dislocation that was treated operatively with open reduction and internal fixation did not show a significantly worse outcome than a simple Chopart joint fracture-dislocation or pure dislocation that was treated with closed reduction. However, in all fracture-dislocations (Chopart joint fracture-dislocations, Chopart-Lisfranc joint fracture-dislocations), an initial and maintained anatomic reduction with internal fixation or added external fixation was essential for good results. Although we could not show significant differences in the outcome regarding different methods of internal fixation, we favor screws for stabilization in open procedures. In our series, no loss of reduction was observed when screws were used. However, a loss of reduction occurred in two cases when initially utilized K-wires and screws were inserted as a second procedure. Furthermore, stable internal fixation may allow initial partial weight-bearing.

At present, based on our experience and data, we are more aggressive in the reduction of complex fracture-dislocation injuries. In our view, an open surgical procedure must be performed to achieve an anatomical reduction for all complex Chopart injuries (i.e., fracture-dislocations). For open reduction, we recommend one dorsal or two dorsomedial/dorsolateral incisions. Compartment pressure monitoring is performed and fasciotomy is done when indicated. A primary arthrodesis is considered in injuries with severe joint and/or cartilage destruction. The high rate of associated injuries of the lower extremity or of polytraumatized patients results in frequently missed or underestimated Chopart injuries. For the initial diagnosis, we currently recommend conventional radiographic evaluation in three views (dorsoplantar, lateral, and oblique [30° dorsolateral to plantarmedial]) and CT scanning.

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