Video-Assisted Orthopaedic Education Improves Resident Ankle Fracture Reduction: A Prospective Study

Robert Edward Bilodeau, Arielle Jordan Hall, Matthew Como, Frank Cautela, David Joseph, Rajiv Reddy, David Forsh, Aruna Seneviratne, Guang-Ting Cong

INTRODUCTION: Proper fracture reduction and splinting technique is critical for soft tissue protection and fracture stability in the acute management of ankle fractures. However, residency education for acute ankle fracture reduction and splinting techniques remains poorly standardized and streamlined. A video-assisted education program can provide necessary standardization, simplify incorporation into existing residency curricula, and ease dissemination. The purpose of this study was to prospectively evaluate the efficacy of a video-assisted education program describing ankle fracture reduction and splinting technique on reduction and splinting quality.

METHODS: A new class of seven first-year orthopaedic surgery residents (intervention group) were enrolled in a new video-assisted ankle fracture management education program, incorporating a 6-minute ankle fracture management video, an initial 2-hour hands-on splinting and casting workshop, and emailed reminders linking to the technique video prior to each resident's orthopaedic trauma rotation at a single level-1 trauma center. The 6-minute ankle fracture management video was independently animated, filmed, and narrated to demonstrate the Lauge-Hansen ankle fracture theory and ankle fracture reduction, radiography, and splinting techniques. Pre- and post-reduction radiographs of consecutive acute ankle fractures managed by the first-year residents were compared to two years of historical ankle fractures managed by first-year residents who did not receive the video-assisted education program (control group). Ankle radiographs were evaluated for pre- and post-reduction tibiofibular overlap, tibiofibular clear space, medial clear space, splint padding thickness, and splinted ankle dorsiflexion angle **[Figure 1]**. Quality reduction was defined as a tibiofibular overlap >5.9mm, a tibiofibular clear space <5.9mm, and a medial clear space <5mm. If one or more measurement fell outside the defined ranges, the ankle was classified as overall malreduced. Primary outcome for this study was fracture reduction quality in the supination-external rotation (SER) type IV and type IV-equivalent fracture subtype, and secondary outcome was splinting quality.

RESULTS:

A total of 280 cases were included for evaluation of splint quality **[Figure 2]**. 111 ankle fractures were treated by the intervention group (mean age 46; [range 14-92]; 44% female) and compared to 169 ankle fractures treated by the control group (mean age 44; [range 14-90]; 41% female) **[Table 1]**. Similar injury severity was observed between the control and intervention groups. Splint quality was not found to be significantly improved in the intervention group, as measured by splint padding thickness **[Table 1]**. A subgroup of 124 patients with displaced SER IV and SER IV-equivalent fractures for analysis of fracture reduction quality **[Table 2]**. There was significant improvement in fracture reduction quality in the intervention group as compared to the control group (RR: 1.52, [95% CI: 1.03-2.25], p=0.04) **[Figure 3]**. Additionally, there was significantly greater post-reduction medial clear space in the control group compared to the intervention group (mean 4.4 ±1.4 mm versus mean 3.8 ± 1.0 mm, p=0.005) **[Table 2]**.

DISCUSSION AND CONCLUSION: A supplemental ankle fracture management technique video was associated with improvements in overall resident reduction quality. Training programs should consider the incorporation of video technique guides into their educational curricula.

Figure 1: A) Anteroposterior radiograph with marked tibiofibular overlap B) Anteroposterior radiograph with marked tibiofibular clear space C) Mortise view radiograph with marked medial clear space; D) Mortise view radiograph with marked thickness of medial splint padding E) Mortise view radiograph with marked thickness of lateral malleoli splint padding F) Lateral radiograph with marked thickness of posterior malleoli splint padding.

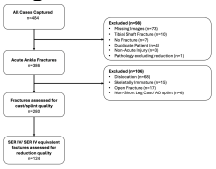

Figure 2: Final cohort with applied selection criteria.

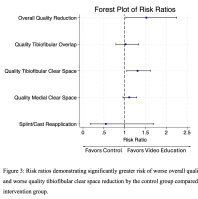

Figure 3: Risk ratios demonstrating significantly greater risk of worse overall quality reduction and worse quality tibiofibular clear space reduction by the control group compared to the intervention group.

Table 1: Baseline demographics of total patient cohort and splint padding quality comparison

Variables	Control Group	Intervention Group	p-value
Patients (N)	169	111	
Age (years) [Mean, Range]	44 [14-90]	46 [14-92]	
Females (N, %)	91 (41%)	49 (44%)	
Fracture Type			
Pronation-External Rotation IV	9	7	
Medial Malleolus	13	9	
Pronation-Abduction II	1	1	
Pronation-Abduction III	1	2	
Pronation-External Rotation III	3	2	
Pronation-External Rotation IV	7	7	
Posterior Malleolus	1	3	
Supination-Adduction I	1	1	
Supination-Adduction II	3	3	
Supination-External Rotation II	1	1	
Supination-External Rotation III	1	6	
Supination-External Rotation IV	12	9	
Displaced Supination-External Rotation IV	36	38	
Supination-External Rotation IV Equivalent	19	17	
Displaced Supination-External Rotation IV Equivalent	23	9	
Tibiofibular Overlap Pre-reduction (mm) [mean, SD]	6.4 [2.2]	6.5 [2.8]	0.54
Tibiofibular Clear Space Pre-reduction (mm) [mean, SD]	5.6 [4.8]	5.2 [1.7]	0.22
Medial Clear Space Pre-reduction (mm) [mean, SD]	4.6 [2.9]	5.4 [2.6]	**0.007**
Fibular Displacement Pre-reduction (mm) [mean, SD]	2.5 [2.7]	2.5 [2.6]	0.35
Thickness of Medial Malleoli Splint Padding (mm) [mean, SD]	6.1 [2.9]	6.4 [2.7]	0.75
Thickness of Lateral Malleoli Splint Padding (mm) [mean, SD]	7.1 [3.1]	6.4 [2.4]	**0.049**
Thickness of Posterior Malleoli Splint Padding (mm) [mean, SD]	5.7 [2.7]	5.5 [2.4]	0.85
Reapplication (n, %)	12 (7)	4 (4)	0.29

Intervention group received video-assisted education; Control group are pre-intervention historical controls

Table 2: Subset baseline demographics of SER IV and SER IV-equivalent cohort and fracture reduction quality comparisons

Variables	Pre-Video Education	Post-Video Education	p-value
Patients (N)	57	67	
Age (years) [Mean, Range]	44 [16—85]	47 [18—92]	
Females (N, %)	28 (49%)	26 (38%)	
Fracture Type			
Displaced Supination-External Rotation IV	36	38	
Displaced Supination-External Rotation IV Equivalent	21	9	
Tibiofibular Overlap Pre-reduction (mm) [mean, SD]	6.7 [3.9]	6.8 [3.0]	0.83
Tibiofibular Clear Space Pre-reduction (mm) [mean, SD]	4.3 [3.3]	5.2 [1.5]	**0.027**
Medial Clear Space Pre-reduction (mm) [mean, SD]	4.2 [2.8]	5.4 [2.6]	**0.007**
Fibular Displacement Pre-reduction (mm) [mean, SD]	3.7 [3.8]	3.8 [2.9]	0.64
Tibiofibular Overlap Post-Reduction (mm) [mean, SD]	7.0 [2.9]	7.4 [2.2]	0.86
Tibiofibular Clear Space Post-Reduction (mm) [mean, SD]	3.2 [1.7]	3.1 [1.7]	0.69
Medial Clear Space Post-Reduction (mm) [mean, SD]	4.4 [1.4]	3.8 [1.0]	**0.0045**
Fibular Displacement Post-reduction (mm) [mean, SD]	1.3 [1.7]	1.3 [1.7]	0.21