Improving Outcomes in Patients with Ankle and Hindfoot Fusions Following Trauma

Andrew Sheean, MD[1]; David Tennent, MD[2]; Johnny Owens, BS, MPT[1];
Jason Wilken, PhD, MPT[1]; Joseph Hsu, MD[3]; Daniel Stinner, MD[1];
[1]San Antonio Military Medical Center, San Antonio, Texas, USA;
[2]US Army Institute of Surgical Research, San Antonio, Texas, USA;
[3]Carolinas Medical Center, Charlotte, North Carolina, USA

Background/Purpose: Fractures of the distal tibia, ankle, and foot sustained through high-energy mechanisms can be extremely debilitating, and ankle and/or subtalar fusion may be indicated if the limb is deemed salvageable. Functional outcomes among this population are generally poor. Recently, the integration of a novel, carbon-fiber orthosis with a specialized rehabilitation regimen has shown promise in improving physical performance measures among a cohort of patients with a variety of lower extremity injuries. However, the benefit of this combined program on patients with ankle and/or hindfoot fusion is unknown.

Methods: We conducted a prospective, longitudinal, observational cohort study. This is subgroup analysis of a larger study previously conducted at our institution of 23 active-duty service members treated for lower extremity trauma in the Return to Run clinical pathway (RTR CP) between January 30, 2012 and December 20, 2012. The 23 patients in this series had 9 ankle fusions, 11 subtalar fusions, 2 unilateral ankle and subtalar fusions, and 1 bilateral ankle fusion. For the purposes of comparison, patients were separated into two groups; Group 1 was comprised of 12 patients with isolated ankle fusions or ankle fusion combined with ipsilateral subtalar fusion, and Group 2 was comprised of 11 patients with subtalar fusion only. The RTR CP consists of two rehabilitation phases: an initial out-of-brace phase (4 weeks) followed by an in-brace phase (4 weeks). Patient-reported outcome measures included the Short Musculoskeletal Function Assessment (SMFA), the Veterans Rand 12-item health survey (VR-12), and the visual analog pain scale (VAS). Physical performance was assessed using four validated outcome measures: the four-square step test (FSST), self-selected walking velocity (SSWV), timed stair ascent, and the 20-meter shuttle run. Outcomes data were collected at program initiation (week 0), week 5, and week 8. A one-way analysis of variance (ANOVA) with repeated measures was used to examine the change in each of the physical performance measures and patient-reported outcomes during the course of the study. A two-way ANOVA with repeated measures and the Tukey-Kramer adjustment for multiple comparisons were used to determine if there were differences in the rate and magnitude of improvement in the scores in each of the physical performance measures. SAS 9.2 was used for all statistical analysis. Statistical significance was set at $P < 0.05$.

Results: Significant improvements in both groups were seen in each of the four physical performance measures between week 5 to week 8 and from week 0 to week 8. No significant improvement in these same measures was observed in either group between week 0 and week 5 (Tables 1 and 2). While there was no significant difference in VAS values between Groups 1 and 2 at week 0 (4.0 vs 5.1, $P = 0.60$), there was a significant decrease in pain as represented by the VAS among Group 2 from week 0 to week 8 (5.1 to 2.3, $P < 0.0001$). Regarding SMFA results, Group 1 did not demonstrate any significant change in these values throughout the RTR CP. Conversely, Group 2 demonstrated significant improvements in all domains, except for arm and hand function, between week 5 to 8 and week 0 to 8. With

See pages 47 - 108 for financial disclosure information.

respect to VR-12 results, Group 2 demonstrated significant improvements in physical component summary scores from weeks 5 to 8 and week 0-8. Additionally, Group 2 improved in the mental health component summary score from week 0 to 5, prior to the addition of the IDEO (Intrepid Dynamic Exoskeletal Orthosis). Group 2 also showed improvement in the mental health component summary score at the 8-week point (47.5 to 53.7, P = 0.04).

Conclusion: Patients treated with either isolated subtalar fusion, ankle fusion alone, or in combination with subtalar fusion who completed 8 weeks of the RTR CP showed significant improvements in physical performance and patient-derived outcome measures. These promising short-term results may be of particular importance to a specific group of patients previously thought to be destined for suboptimal clinical and functional outcomes.

Table 1. Group 1 Physical Performance Measures				P value		
	Week 0	Week 4	Week 8	Week 0 - 4	Week 4-8	Week 0-8
Four Square Step Test (s)	8.8	8	6.1	ns	< 0.0001	<0.0001
Self-Selected Walking Velocity (m/s)	1.2	1.3	1.5	ns	<0.0001	<0.0001
Timed Stair Ascent (s)	6.6	5.9	4.3	ns	0.009	<0.0001
Shuttle Run (s)	11.9	10.9	7.8	ns	<0.0001	<0.0001

Table 2. Group 2 Physical Performance Measures				P value		
	Week 0	Week 4	Week 8	Week 0 - 4	Week 4-8	Week 0-8
Four Square Step Test (s)	8.3	8.8	5.7	ns	<0.0001	<0.0001
Self-Selected Walking Velocity (m/s)	1.2	1.2	1.4	ns	0.0002	<0.0001
Timed Stair Ascent (s)	6.9	7.5	3.9	ns	<0.0001	<0.0001
Shuttle Run (s)	12.5	12.9	6.6	ns	<0.0001	<0.001