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CASE REPORT

RETURNING A SPECIAL OPERATIONS CANDIDATE TO DUTY FOLLOWING AN AIRBORNE OPERATION INJURY: A CASE REPORT

Jessica Herring Gutschick, PT, DPT, CSCS[1]
Randall Scott Lazicki, PT, DPT, LAT, ATC, OCS, SCS, CSCS, TSAC-F[2]

ABSTRACT

Background: Musculoskeletal injuries are recognized as the leading health problem and primary source of injury, disability, and financial burden across the military.[1-5] Special Operations Forces are at an increased risk of musculoskeletal injury due to increased physical demands, precipitous deployments, and continual training and deployment cycles.[6,4] Multiple injury screening tools exist, yet decisions to return to duty are frequently deferred to individual institutional protocol or provider clinical decision making, with no accepted gold standard.[2,3,4,5]

Purpose: The purpose of this case report is to describe the application of a system to return a Special Operations Forces candidate to duty following an ankle injury sustained during a military static line airborne operation while in the Special Forces Qualification Course.

Case Description: The subject was a 34-year-old male with surgical fixation of a left distal fibular fracture with syndesmotic tear after landing from a static line airborne jump during the Special Forces Qualification Course. This case report provides a system to determine return to duty following an ankle fracture and provides a guide to returning a subject to participation, duty, and tactical performance training.

Outcomes: Outcome measures recorded were vast, as the use of multiple measures are more indicative of overall function than any single measure. Impairment based measures included Global Rating of Change Scale (GROC), Numeric Pain Rating Scale (NPRS), lateral step down and Closed Chain Dorsiflexion (CCDF). Functional outcome measures included: the Functional Movement Screen™ (FMS™), Lower Quarter Y-Balance (LQYB), three hop tests for distance, and physical performance metrics.

Discussion: The most substantial challenge to this process was the lack of standardized and validated military return to duty testing and guidelines in the literature. Ideally, pre-injury assessment would provide a baseline; however, compared to peers, the subject was well within acceptable ranges for all physical performance metrics at final Return to Duty testing. The subject was returned to duty 10 months after initial injury being physically comparable to his cohorts and being able to complete all military requirements.

Keywords: Military, movement system, return to duty, tactical athlete

Levels of Evidence: 5

[1] CORA Physical Therapy, Haines City, FL, USA
[2] Tactical Human Optimization, Rapid Rehabilitation and Reconditioning Program, US Army Special Operations Command, Fort Bragg, NC, USA

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CORRESPONDING AUTHOR
Jessica Gutschick
1770 Malvern Hill Cr, Apt 201
Celebration, FL 34747
Phone: 352-434-5859
E-mail: gutschickj@gmail.com

BACKGROUND AND PURPOSE

Without question, musculoskeletal injuries are recognized as the leading health problem and primary source of injury, disability, and significant financial burden across the military.[1-5] Musculoskeletal injuries cost over $548 million annually and are the single most common reason for discharge from service, costing additional hundreds of millions of dollars in continued medical expenses.[2] In addition, musculoskeletal injuries are responsible for nearly half of the restrictive work-days annually [2,4]

Special Operation Forces are at an increased risk of musculoskeletal injury due to increased physical demands, precipitous deployments, and continual training and deployment cycles.[4,6] Physical requirements within Special Operations Forces are considerably more taxing and remarkable than those of General Purpose Forces – the core and main group of the armed forces – potentially leading to increased incidence of injury. When comparing all military personnel, Special Forces have the highest incidence of injury rate at 12.1 per 100 soldier months.[7] Although these injuries occur at an alarming frequency, previous research has found 76.9% of musculoskeletal injures are preventable.[6] The lower extremity is the most common anatomical location injured, accounting for 50% of all musculoskeletal injuries and 60% of all preventable injuries.[6] The most common causes of lower extremity injury in Special Operation Forces include running (23.1%) and lifting (19.2%) usually occur during physical training.[6] Among Airborne soldiers, ankle injuries account for 30 – 60% of all military parachute injuries, with 7 – 23% classified as fractures.[3,8]

Among General Purpose Forces, only 50% of soldiers suffering a musculoskeletal injury returned to duty within 90 days.[3] Sixty eight percent of Special Operations Forces who had rehabilitation for recent orthopedic injuries were unable to deploy with their units despite compliance with prescribed rehabilitation activities over a 6-month time frame.[9] Since previous injury and fitness levels are leading risk factors for sustaining a subsequent injury within the military, return to duty decision making needs to be comprehensive prior to discharging a soldier to unrestricted activity.[9,10,11] Multiple screening tools exist, yet decisions to return to duty are frequently deferred to individual institutional protocol or clinical decision making, with no accepted gold standard. Clinicians working in the military need an efficient, objective, cost effective, and reliable system for determination of return to duty status.[4]

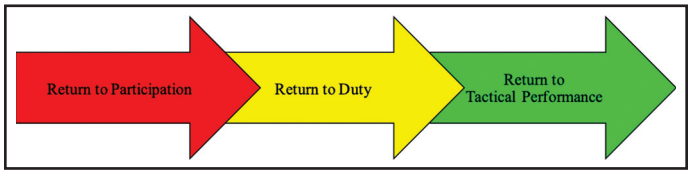

Figure 1. *Adapted from Arden et al.*[13]

Arden et al. defined a return to sport continuum that has been adapted and applied to the military population in order to provide a system to return Special Operations Forces to duty while also assessing injury risk and determining operational readiness (Figure 1).[13] The three elements applied to the military context are return to participation, return to duty, and return to tactical performance. This system emphasizes a graded, criterion-based progression in the rehabilitation process. Return to participation is defined when the military tactical athlete is physically active, but not yet ready medically, physically or psychologically to return to duty. Return to duty is defined as when the military tactical athlete has returned to duty but is not yet performing at their desired tactical performance level. In this stage, the emphasis is placed on injury risk reduction strategies while improving performance. Return to tactical performance is the last element where specific attention is placed on returning to operational readiness within the military context. The decision to return Special Operations Forces to duty following a musculoskeletal injury is multifaceted with both self-report and performance-based criteria being utilized in clinical practice to modify decisions.

The purpose of this case report is to describe the application of a system to return a Special Operations Forces candidate to duty following an ankle injury sustained during a military static line airborne operation while in the Special Forces Qualification Course.

CASE DESCRIPTION

The subject was a 34-year-old Caucasian male who presented for evaluation after surgical fixation of a left distal fibular fracture with syndesmotic tear after

landing from a static line airborne jump during the Special Forces Qualification Course. A static line refers to a cord tethered between the aircraft and the soldier's parachute, when upon exiting the aircraft, will automatically deploy the parachute for a safe landing.[14] The Special Forces Qualification Course consists of five phases over approximately 61 weeks. Each phase cultivates expertise in small unit and Special Forces tactics, survival skills, language and cultural training, unconventional warfare, survival, escape, resistance, evasion, and advanced combat survival tactics.[15]

During the airborne operation, the subject collided with another soldier before landing. Due to the mid-air collision, the subject's landing position was compromised, which contributed to his resultant fracture upon landing. Despite fracture, the subject completed the remainder of the four-week austere training event. The subject underwent surgery one month prior to evaluation for internal fixation and syndesmotic wire, without a syndesmotic screw (Figure 2). At initial evaluation, the subject was in the process of completing a six-week prescribed non-weight bearing status. The subject had no significant past medical history or red flags. The subject's perceived level of function out of 100 was assessed and reported to be 20%. Although not found in the literature, this was used to assess daily perceived function. Informed consent was obtained including that the data concerning the case would be submitted for publication and institutional review board approval was obtained from Womack Army Medical Center, Fort Bragg, North Carolina.

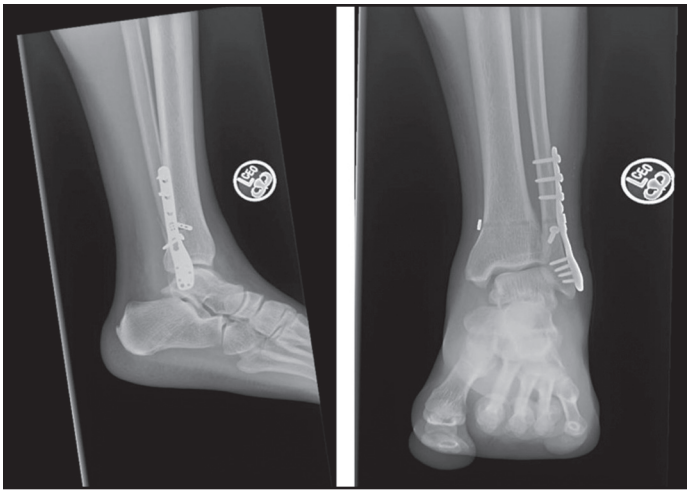

Figure 2. *Post-Operative Radiographs.*

CLINICAL IMPRESSION 1

This subject's diagnosis was a left distal fibular fracture and syndesmotic tear. Due to the unstable nature of the fracture and mortise disruption, open reduction and internal fixation (ORIF) was required. Typically, ORIF is performed secondary to an initial and temporary closed reduction stabilization to allow soft tissue swelling to decrease.[16] Due to this subject's occupational requirements and continued trauma post fracture an ORIF was the initial repair. ORIFs typically have a side effect of decreased functional outcome due to hardware placement[16]. However, due to lack of syndesmotic screw, physical activity prior to injury, high availability of physical therapy services, and motivation to return to duty, he had a good prognosis for full recovery. Examination details are described below. This subject is an ideal candidate for the purpose of this case report as the subject fits the demographics of being an active duty military soldier who sustained an injury while training. The subject was otherwise healthy; therefore, eliminating comorbidities/secondary injuries from affecting his progress. Lastly, due to his job description, will need to have achieved optimal pre-injury function before full return to duty.

EXAMINATION

The subject ambulated into the clinic using bilateral crutches non-weight bearing on the left lower extremity wearing an immobilization boot. A lower quarter screen consisting of dermatomes, myotomes, and reflexes were all within normal limits. Range of motion and strength of the hips and knees were equal and within normal limits. The left ankle demonstrated markedly restricted range of motion with 15 degrees plantarflexion and 3 degrees open chain dorsiflexion. Ankle joint mobility, balance/proprioception, strength, ligamentous integrity and functional testing were all deferred at this time due to healing constraints and precautions.

Test and Measures

Tests and measures assessed on this subject for general screening purposes included Kendall manual muscle testing (MMT) and range of motion measurement via goniometry. Although manual muscle testing has questionable reliability and validity, since gross lower extremity strength was not a major

impairment and testing was performed by one examiner, it was considered suitable in this situation.[17] Similarly, screening the range of motion of the lower extremities was performed for monitoring maintenance and performed predominantly by one examiner increasing reliability in this instance.[18] The only non-goniometric ROM measurement performed was closed chain dorsiflexion (CCDF). Detailed testing procedures are described in the subsequent section.

Outcome Measures

Outcome Measures recorded included: Global Rating of Change (GROC),[19] Numeric Pain Rating Scale (NPRS),[20] Lateral Step Down,[21] Lower Quarter Y-Balance (LQYB),[2] Functional Movement Screen (FMS™),[22] Closed Chain Dorsiflexion (CCDF),[23] Human Performance Program Metrics (5-10-5, broad jump, 3RM deadlift, 300-yard shuttle repeat), and three hop tests for distance[24] (single hop, triple hop, and crossover). The subject subjectively reported GROC and NPRS at every treatment session. The Lateral Step Down, LQYB, FMS™, and CCDF were measured approximately three months from initial evaluation and again at four months from initial evaluation. Four months after initial evaluation, hop tests were administered; followed by Human Performance Program metrics at final RTD testing. (Table 1)

The subject was not functionally safe to perform single leg jumping and agility tests at the four-month evaluation; therefore, the lateral step down was utilized to provide similar lower extremity functional information in a safe manor. It served as a bridge from impairment-based measures to functional measures and provided valuable information regarding dynamic strength and lower extremity alignment with moderate reliability (ICC = 0.67) and high (80%) Kappa agreement.[21] Instructions for administration and scoring can be found in the references.[21]

The LQYB was chosen due to its established reliable and valid ability to assess asymmetry and poor performance, as well as predicting non-contact injuries in athletes.[2] Reliability intraclass correlation coefficient (ICC) for the LQYB test is 0.89.[25] The minimal detectable change (MDC) when studied in service members is 8.7, 10.3, and 11.5 for the anterior, inferomedial, and inferolateral directions respectively.[26]

The FMS™ was designed to assist in screening active individuals during the performance of seven full body functional movements to identify impairments. The FMS™ has been proven a reliable tool for use within (ICC = 0.869) and between (ICC = 0.843) clinicians.[22] It is suggested to have a positive relationship between scores and occupational measures of performance[11] and has excellent agreement among athletic populations.[27] The FMS™ has shown excellent reliability (0.91) for predicting future injury.[10] When tested in active duty service members, the minimal detectable change is 1.0.[12] The traditional cutoff score less than or equal to 14/21 is the guide for which increased risk of injury is established.[22] Detailed instructions for the Y-Balance and FMS™ can be found through numerous sources for mastery in administration. [2,22]

Closed chain dorsiflexion range of motion was one of the primary impairments affecting this subject. This test was highly predictive of injury among U.S. Army Rangers.[2] Range of motion is measured with the subject in half kneeling, with the affected lower extremity close to a wall. With the foot in full contact with

Table 1. *Timeline of Treatment and Outcome Assessments.*

Date	Day 0	Month 1	Months 2 - 3	Month 4	Month 5	Month 10
Event	Surgery	Initial Evaluation	Treatment	Functional Reassessment	Functional Reassessment	Return to Duty Testing
Tests/Measure and Outcome Assessments	N/A	GROC, NPRS	GROC, NPRS, ROM, MMT	GROC, NPRS, Lateral Step Down, LQYB, FMS™, CCDF	GROC, NPRS, Lateral Step Down, LQYB, FMS™, CCDF, 3 hop tests	Month 5 assessment measures, Human Performance Program Metrics
WB Status	6 weeks NWB		Full WB			

GROC= Global Rating of Change Scale; NPRS= Numeric Pain Rating Scale; MMT= Manual Muscle Test; LQYB= Lower Quarter Y-Balance; FMS™= Functional Movement Screen™; CCDF= Closed Chain Dorsiflexion

the floor, the subject shifts forward until the knee touches the wall. The maximum distance from the distal great toe to the wall is measured in centimeters. This method was chosen over other techniques due to its high reliability (ICC = 0.98 – 0.99) and low SEM (0.4 – 0.6cm). The MDC for this method is between 1.1 – 1.5cm.[23] The criteria of 10cm distance from the wall was the standard for this clinic when describing full closed chain dorsiflexion range of motion.

Human Performance Program metrics included the 5-10-5 pro-agility, the broad jump, a 3-rep max trap-bar deadlift, and 300m shuttle repeat. See Appendix 1 for further description of these metrics. Additionally, the 300m shuttle repeat is also included in the Military Power, Performance, and Prevention algorithm aimed at developing predictive models for return to duty.[2] The MP[3] algorithm was the first attempt to develop a prediction model for military musculoskeletal injuries prior to injury and inform return to duty decisions[2].

Due to lack of ankle region specificity among aforementioned tests, three hop tests used in other ankle examination studies[24,28] were also added to this subject's return to duty testing regime. These tests included the single hop, triple hop, and crossover hop and are all measured for distance. Each hop test has excellent reliability (ICC = 0.92 – 0.97) and SEM ranging from 4.61 – 17.74cm.[24]

Evaluation

Overall, the subject presented with no gross lower extremity deficits aside from the left ankle, which aligned with the traumatic mechanism of injury. Strength, joint mobility, balance/proprioception, and functional testing were assessed according to management guidelines.[29] At baseline performance, all were impaired compared to the contralateral side and were addressed during course of treatment. The subject demonstrated a need for skilled physical therapy to increase mobility for gait, motor control, balance, and power to return to full active duty.

CLINICAL IMPRESSION 2

The initial impression of diagnosis was correct as well as the subject's appropriateness for this case report. The timeline for this subject's plan of care was initially thought to be 3 – 4 visits/week for 10 – 12 weeks from initial evaluation (one-month post-operation) then a re-evaluation to determine further rehabilitation. In addition to following bone healing timelines, extra time was allotted for progression beyond a typical outpatient orthopedic plan of care due to the occupational requirements of this subject. One potentially negative contributing factor to the subject's prognosis was the unknown, yet likely, cortical damage imposed on the distal fibula due to persistent weight bearing while completing the austere training event prior to seeking medical treatment. Due to no additional limiting factors and availability of high physical therapy frequency, the subject continued to be appropriate for treatment and was expected to return to duty with full function. Based on outcome measures chosen, the subject's functional abilities were scheduled to be tested on a monthly basis until function improved enough to return the subject to participation, duty, and finally return to tactical performance.

INTERVENTION

Treatment focused on pain reduction; regaining ROM, strength, and balance; and gradually loading the ankle. Isolated ankle plantarflexion and dorsiflexion exercises with resistance bands were initiated at initial evaluation and continued through the 2 weeks of non-weight bearing status to promote safe movement; in addition to use of a cooling and compressive garment to manage edema and pain. During this stage, the subject also received education on supportive nutrition from performance dieticians as well as performance training for the upper extremity combined with cardiovascular conditioning from Human Performance Program strength coaches and athletic trainers as part of an interdisciplinary approach for optimal performance and recovery.

Once full weight-bearing was allowed, traditional physical therapy exercises were progressed weekly and as tolerated by the subject until the surgical site and healing timelines allowed for manual therapy to be added in conjunction with traditional exercises. Manual therapy included many techniques such as: talocrural joint anterior to posterior (AP) in supine and tall kneeling with and without mobilization with movement, talocrural joint posterior to anterior (PA) in prone, distal and proximal fibular AP in

tall kneeling, and general talocrural joint distraction in supine. Techniques were performed throughout grades 1 through 4 as tolerance allowed for durations typically last 30 seconds per technique, repeated as necessary. Exercises included, but were not limited to, single leg balance, double and single leg squatting with variations, and subject-controlled ankle mobility activities. Throughout exercise progressions, the subject did not experience any lasting increase in pain, symptoms, or decrease in function.

Dorsiflexion range of motion was the limiting factor behind most progressions. Therefore, in-clinic management was heavily manual based, geared toward gaining range of motion and reinforced by supervised and independent workouts. Manual therapy included grade 3 and 4 generalized talocrural distraction, talocrural anterior to posterior mobilizations, distal fibular anterior to posterior mobilizations, and mobilization with movement. Hand placement was typical with the exception of distal fibular mobilizations, in which care was taken not to shear the surgical site on the lateral fibula. Since pain free range is requirement of mobilization with movement, this was the last manual technique to be added.

Once ankle range of motion reached 5 cm in CCDF, jumping and running progressions were initiated. This stage marked the initiation of return to participation as described by Arden et al (2016). The subject tolerated all progressions well with no increase in symptoms and continued to slowly improve ankle range of motion. Impact progression was crucial to this subject's rehabilitation due to the mechanism of injury, occupational physical requirements, and detrimental consequences of re-fracture. As a prerequisite to the run progression, the subject had to demonstrate walking one mile in less than 15 minutes with no increase in pain or symptoms for three sessions in one week. Upon completion, a timed run/walk progression was initiated. In order to advance through the phases, no pain, swelling, or altered gait pattern could be present (Appendix 2). The subject completed two phases of the run/walk progression then was transitioned to strength coaches to improve overall tactical performance including military specific activities.

While the run progression was performed independently outside of clinic, the jump progression was performed under direct supervision. Bilateral landing exercises began the loading process in conjunction with more dynamic and full body warm up activities. The subject advanced through landing activities and multidirectional jumping on bilateral lower extremities while maintaining form before progressing to single leg activities. Adjustments including theraband around bilateral knees and use of a mirror for tactile and visual cues were utilized temporarily to address dynamic valgus. Single leg impact progression followed a similar pattern, while simultaneously increasing the height of bilateral lower extremity landing. Emphasis was on "soft" landings with appropriate impact absorption and unsullied biomechanics during each phase. Jump count gradually increased, as well as the intensity and impact involvement of all dynamic warm up activities. (Table 2)

OUTCOME

Self-Report Measures

The Global Rating of Change (GROC) and Numeric Pain Rating Scale (NPRS) were recorded at each treatment session; however, since they did not play a major role in the return to duty decision, they were not considered key outcomes for this case report. All self-report measures improved from initial to final evaluation. (Table 3)

Impairment Based Measures

The lateral step down was administered at the initial reassessments due to the subject's inability to perform the physical performance metrics safely. It served to bridge a gap between assessment but is not a factor in return to duty testing due to the higher challenges posed by other key outcome measures. Initial impairments noted on the lateral step-down score included trunk lean, rotated pelvis, and overall unsteady motion; resulting in an initial score of +3. At the second reassessment, the lateral step-down score improved to a zero; an optimal score which indicated no impairments. No information exists regarding the minimally detectable change for the lateral step down due to its ordinal properties. (Table 4) Closed chain dorsiflexion improved from 5cm to 10cm throughout the course of treatment which is equal to the contralateral limb and exceeds the minimal detectable change.[23] (Table 4)

Table 2. *Example of Treatment Progression.*

Day	Month 2	Month 3	Month 4
Warm Up	Stationary bike x 10 min	Jacob's Ladder™ x 10 min	Jump rope 30 x 3 High knees and butt kicks 30ft x 2 Mountain Climbers 25 x 2 Alternating Lateral BOSU® Taps 20 x 3
In Clinic*	1a. BL Goblet Squat with heels elevated 3 x 8 1b. Sidelying Clam shells with theraband 3 x 12 2a. Inchworm 3 x 5 2b. Weighted calf raise 3 x 8 2c. DF self-mobilization on ½ foam roll 3 x 30	1a. BL body weight squat with no heel lift 2 x 15 1b. SL balance on dynamic surface 30 sec x 2 1c. DF self-mobilization on ½ foam roll 3 x 30 2a. SL mini squat with 3-direction reach 3 x 5 2b. Lateral Monster Walks 15ft x 2	1a. BL Landing 20 inches 15 x 2 1b. Calf Raise to Med Ball Slam 12 x 2 2a. BL Vertical Jump (75% height effort) 15 x 2 2b. SL Box Squat 8 x 2 2c. SL Vertical Jump w/ BL Landing and TRX® Strap Assist 15 x 2
Outside of Clinic	Bike ≥ 30 min 3 – 4 times/week HEP	Walk 1 mile ≤ 15 min 3 sessions/1 week HEP	Run Progression: [4 min walk/2 min jog] x 5 = 30 total minutes HEP

* Exercises were performed in a circuit design. The patient would cycle through exercise 1a, 1b, and 1c with minimal rest in between before completing the second round of exercises.

BL= bilateral; DF= dorsiflexion; SL= single leg

Table 3. *Subjective Reports from Initial Evaluation, Re-evaluation, and Final.*

	NPRS	GFL	GROC
Initial Evaluation	1	20%	N/A
First Reassessment	1	75%	+3
Second Reassessment	0	80%	+5
Final RTD Testing	0	100%	+7

NPRS= Numeric Pain Rating Scale; GFL= Gross Functional Level; GROC= Global Rating of Change; RTD= Return to Duty

Functional Outcome Measures

From initial to final outcome administration, the subject improved FMS™ scores from 13/21 to 16/21, surpassing the MDC and threshold for increased risk of injury.[22] (Table 4)

Initial anterior and inferolateral differences in the LQYB were both greater than the 4cm side-to-side cut off value, with 5 and 10cm differences respectively.[25] These measures both improved by the final evaluation, each measuring within normal limits for side-to-side differences. Due to the subject's phase of rehab and inability to meet physical criteria required for hop testing during initial reassessment, the final scores were compared to male college athletes due to their analogous demographics, rather than tracking this subject's progress.[28] Among initial trials involving the unaffected limb, subject was 21 – 108cm below the average distance, depending on the test. Additionally, limb symmetry indexes in the context of hop distance were assessed. The threshold used for this study was for the affected limb distance to be 90% of the unaffected limb distance. This ratio has been commonly reported in ACL rehabilitation among similar subject demographics.[30] The subject reached this threshold for all three hop tests by his final return to duty testing. (Table 5). In addition, among peers the subject fell within the standard deviation for all Human Performance Program metrics including the 5-10-5 pro-agility, the broad jump,

Table 4. *Functional Outcomes from Re-evaluation and Final Evaluation.*

Test	Measurement	First Reassessment	Second Reassessment	Final RTD Testing
Lower Quarter Y-Balance	Anterior Difference	5	2.5‡	0.5†‡
	Inferolateral Difference	10	3.0‡	0.5†‡
	Inferomedial Difference	0	4.5	0.5†‡
Closed Chain DF*	Range of Motion	6	8†‡	10†‡
Lateral Step Down*	Score	+3	0‡	NT
Functional Movement Screen	Score	13/21	15/21†‡	16/21†‡

None of these tests were administered during initial evaluation due to phase of rehab/healing times and thus are compared from middle/re-evaluation to final evaluation
* Performed on injured extremity
‡ Indicate a positive change in function
†Exceeds MDC

RTD= Return to Duty; DF= Dorsiflexion

Table 5. *Hop Tests.*

	Single Leg Hop	Triple- Single Leg Hop	3 Hop Crossover
Standard Values for LSI[30]	90%	90%	90%
Limb Symmetry Index at Second Reassessment	91%	89%	82%
Limb Symmetry Index at RTD Testing	98%	96%	94%

a 3-rep max trap-bar deadlift, and 300m shuttle repeat (Table 6).

DISCUSSION

The purpose of this case report is to describe the application of a system to return a Special Operations Forces candidate to duty following an ankle injury sustained during a military static line airborne operation while in the Special Forces Qualification Course. The largest challenge to this process was the lack of standardized and validated military return to duty testing and guidelines in the literature. An extensive collection of outcome measures was utilized in this RTD decision and included: CCDF, LQYB, FMS™, single leg, triple hop, three hop crossover for distance, and Human Performance Program metrics. Positive changes in functional performance from initial to final assessments were observed in all outcome measures. Improvements in CCDF, FMS™, and LQYB exceeded the minimal detectable change.[22,23] After the first reassessment, the subject was returned to participation as he trained with Human Performance Program strength coaches and athletic trainers on an upper body resistance training program combined with cardiovascular training.

Returning a soldier to unrestricted duty without adequate motion, strength, or motor control will merely perpetuate the situation, leaving them at a high risk for re-injury and reinitiate a massive sequela of negative physical, operational, and financial consequences. However, there is insufficient evidence of a standardized return to duty protocol or testing procedures to aid these clinical decisions among military populations. Pronouncements to return a

Table 6. *Human Performance Program Metrics.*[27]

Test	Class Averages	Standard Deviation	Patient Scores
FMS™	15.5	1.8	16
Deadlift	351 pounds	58 pounds	335 pounds
Broad Jump	93 inches	8.5 inches	92 inches
300 yd Sprint	64.6 sec	3.4 sec	65 sec
5-10-5 Agility	4.95 sec	0.30 sec	5.25 sec

FMS™= Functional Movement Screen™

soldier to full duty rely on the clinical decision making of the health care team.

With the contribution of expert opinion in the field of military physical therapy and evidence from other musculoskeletal studies, the FMS™, LQYB, CCDF, Human Performance Program metrics, and three hop tests were chosen to assist in the return to duty decision making process of an U.S. Army Special Forces student status post distal fibular fracture with ORIF. The FMS™, LQYB, and CCDF were administered at the first and second reassessments, four and five months from surgical date respectively. (Table 1) Final values were compared to mid-point evaluation values, as well as clinically accepted standards, to gauge progress and performance. The hop tests were administered at the final evaluation and compared to cutoff values established for male college athletes for reference.

The subject demonstrated functional improvements in the FMS™, Y-Balance, and CCDF. The FMS™ score enhancement brought the subject to the positive side of the threshold for risk of injury and exceeded his peers' averages.[22] Lower Quarter Y-Balance scores also improved, meeting the MDC criteria. By decreasing side-to-side differences, the subject demonstrated an increased symmetry between each lower extremity and therefore may have reduced his overall risk of re-injury.[25] The improvement in anterior reach direction may be partially explained by the improved closed chain dorsiflexion range of motion. Improvements in CCDF were also noted by the isolated measurement which adds to the overall reduction in injury risk for this subject. For the purpose of this case report, the lateral step down served as an objective way to quantify quality of motion into simplified categories. While not directly related to risk of injury, the lateral step down tests lower kinetic chain kinematics in a functional weight bearing position until increased load could be applied.[21] With this subject's improvement in quality of movement, as tested by the lateral step down, it is reasonable to extrapolate a carry over for reduction in injury.

When compared to male college athletes, the subject was deficient across all three hop tests during the initial administration, suggesting a lack of lower extremity power and balance due to residual lower limb asymmetries. However, upon final testing, limb symmetry for all hop testing surpassed the set 90% limb symmetry index threshold reaching 94 - 98% depending on the test.

All aforementioned outcome measures demonstrated improvement in lower extremity function and provided valuable information regarding the remaining deficits which assist in the discharge planning. To return to the intense and rigorous physical activity of a Special Forces student, the subject needed to perform at least as well as the average in his cohort. Ideally, pre-injury assessment would provide a baseline; however, compared to peers and as demonstrated by Table 6 above, the subject was well within acceptable ranges for all physical performance metrics at final RTD testing 10 months post injury. At this point, the subject was returned to duty and entered the return to tactical performance stage 10 months after initial injury - being physically comparable to his cohorts and being sound to complete all military requirements. One month later, the subject completed Robin Sage - the austere training phase where the initial injury was sustained - successfully and graduated the Special Operations Forces Qualification Course.

This case report provides an example of return to duty decision making with the use of functional tests chosen from evidence available for similar athletic

populations and their interpretation to assess performance. Due to lower extremity asymmetries, certain tests initially selected for return to duty testing were not performed at every assessment to ensure the safety of the soldier being tested. This case may assist physical therapists who need to make similar decisions for military athletes.

The outcome measures discussed in this case report provided objective and salient information regarding this soldier's performance ability which assisted in the return to duty decision making. A limitation of this case report research is the inability to extrapolate results and decisions to all military personnel. Future research needs to be geared towards establishing baseline cutoff values for these and other outcome measures for various military occupational specialties to further guide decision making. This research would be best formatted using a large sample size using either a prospective or retrospective design with outcomes related to successful return to duty. Lack of testing among military populations using these outcome measures is a limitation of this case report. Additionally, there may be other measures that reflect occupation specific requirements.

CONCLUSION

Return to duty testing is lacking in research, thus leaving such decisions up the discretion of the medical team involved in the soldier's recovery. This case report provides a system to determine readiness to return to duty following an ankle fracture. Similar methods could be used for other lower extremity injuries, as few of the aforementioned tests are exclusively used for evaluation of the ankle. One valuable lesson learned throughout this process was to keep the subject's safety as a top priority. Although certain functional tests were initially selected to be tested, when the subject did not display a sufficient functional capacity, these tests were deferred until later when deemed safe. This further supports the need for sound clinical decision making for return to duty determinations. This case report also provides a guide to returning a subject to participation, duty, and tactical performance training with a core background in clinical decision making that is supported by evidence-based outcomes. This system should be considered for all military personnel returning to duty and other tactical athlete populations.

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APPENDIX 1

Table 1. *Physical Performance Metrics*

Activity	System Tested	Description
5-10-5 Pro-Agility	Agility	Start at in the middle of a 10m line. When told to do so, sprint to the right 5m, back to the left 10m, then back to the starting position 5m to the right as fast as possible. Repeat, starting from the left.
300m Shuttle Repeat	Anaerobic Endurance	Sprint 300m for time. Allow 1 min rest. Sprint 300m again for time.
3RM Trap-Bar Deadlift	Strength	Perform a deadlift using a trap-bar equivalent to a 3 rep-max.
Broad Jump	Lower Body Power	With both feet evenly planted behind the start line, jump as far forward as possible. The jumper must stick the landing without losing balance or taking steps forward to count attempt. Record farthest distance jumped on 3 attempts.

**Allow proper warm up prior to all activities.*

APPENDIX 2

Table 2. *Phase 1 and 2 of 4-Phase Running Program*

Phase 1: Impact Tolerance/Running for Appreciation (2-4 weeks)	
Perform a walking warm up/light dynamic warm up and proper recovery. Perform every other day with a maximum of 2 consecutive days pending soreness. Guidelines: <60% max HR or 6/10 RPE	
2 min jog/2 min walk x 5 reps	20 min total: 10 min running
3 min jog/2 min walk x 5 reps	25 min total: 15 min running
4 min jog/2 min walk x 5 reps	30 min total: 20 min running
5 min jog/2 min walk x 5 reps	35 min total: 25 min running
5 min jog/2 min walk x 6 reps	42 min total: 30 min running
Criteria to Progress: No pain, no swelling, normal mechanics.	
Phase 2: Endurance Building/Volume Tolerance (2-4 weeks)	
Perform a walking warm up/light dynamic warm up and proper recovery/ Perform every other day with a maximum of 2 consecutive days pending soreness. Gradually build pace with each step below and repeat 2 – 3 sessions prior to progressing. Guidelines: <75% max HR or 7/10 RPE [Finish 8/10 RPE as able]	
10 min jog/1-2 min walk x 3 reps	36 min total: 30 min running
2 miles consecutive x 1 rep	Pace dependent
2.5 miles consecutive x 1 rep	Pace dependent
3 miles consecutive x 1 rep	Pace dependent
Criteria to Progress: No pain, no swelling, normal mechanics. Able to run 30 minutes continuously at least 2x/week.	