Journal of Athletic Training 2018;53(8):776–781
doi: 10.4085/1062-6050-114-17

www.natajournals.org

Preinjury to Postinjury Disablement and Recovery After a Lateral Ankle Sprain: A Case Report

John J. Fraser, PhD, PT, OCS*†; Jay Hertel, PhD, ATC, FNATA*

*Department of Kinesiology, University of Virginia, Charlottesville; †Warfighter Performance Department, Naval Health Research Center, San Diego, CA

A healthy 19-year-old male college student (height = 177.8 cm, mass = 64.3 kg, body mass index = 20.3 kg/m^2, Foot Posture Index = −1) participating in a study sustained a grade 2 inversion lateral ankle sprain 3 days after completing patient-reported outcome measures. A treatment protocol including therapeutic exercises and midfoot mobilizations was provided. Patient-reported outcomes assessing physical health, mental health, and foot-ankle function were completed 3 days preinjury and 1, 3, and 12 weeks postinjury. Substantial postinjury changes in function, physical health, and kinesiophobia reflected functional limitations that improved with treatment and time. This level 3 exploration case report provides a rare opportunity to highlight preinjury-to-postinjury changes in patient-reported physical and psychological measures caused by a lateral ankle sprain.

Key Words: patient-reported outcomes, function, inversion sprain

Lateral ankle sprains (LASs) are the most common injury in sports[1] and frequently result in functional impairment, activity limitation, and participation restriction. Patient-reported outcome (PRO) measures are used clinically in conjunction with the patient history to quantify and qualify function, disability, and health after injury. Patient-reported outcomes measure body functions and structural impairments (eg, pain, perceived instability), activity limitations (eg, inability to run and cut), and participation restrictions (eg, inability to play sports with friends), while considering individual and environmental factors.[2] These measures provide useful clinical benchmarks when tracking patient recovery throughout the rehabilitation course.

Although PROs are commonly used in clinical research for group comparisons of healthy and injured individuals, opportunities to study within-patient changes in global health, physical function, mental health, and quality of life preinjury to postinjury are rare. The purpose of this level 3 exploration case report was to present preinjury-to-postinjury changes in function in activities of daily living (ADLs) and sport, physical activity, global physical and mental health, predicted quality of life, and kinesiophobia in a recreationally active young man after an LAS. This is the only case, to our knowledge, to measure physical and psychological changes from before to after musculoskeletal injury and during return to function.

CASE PRESENTATION

Patient

The patient was a 19-year-old male college student (height = 177.8 cm, mass = 64.3 kg, body mass index = 20.3 kg/m^2, Foot Posture Index = −1 [supinated]) who consented to participate in a research study approved by the university's institutional review board investigating foot function in individuals with or without LAS or chronic ankle instability (CAI; National Institutes of Health NCT02697461). He met the criteria for inclusion in the healthy group: aged 18–50 years, participated in 20 minutes of physical activity at least thrice weekly, and had no history of ankle or foot sprain, leg or foot fracture, lower extremity disability, neurologic or vestibular deficit, diabetes mellitus, lumbosacral radiculopathy, or connective tissue disorder. The patient completed commonly used PROs that included the Foot and Ankle Ability Measure (FAAM)-ADL[3] and Sport subscales,[4] Identification of Functional Ankle Instability (IdFAI),[5] Patient-Reported Outcomes Measurement Information System (PROMIS) Global Health Questionnaire,[6] and Godin Leisure-time Exercise Questionnaire.[7] Predicted EuroQol (EQ-5D) quality of life scores were calculated using previously described methods.[8] Collection of clinical measures of ankle-foot function was scheduled for the following week.

The patient sustained a left grade 2 inversion LAS after stepping on an opponent's foot during a basketball game 3 days before data collection as a healthy participant. He denied hearing or feeling a pop or crack at the time of injury but experienced immediate lateral ankle and foot pain and edema (Figures 1 and 2). He had limited mobility, self-medicated with over-the-counter ibuprofen as needed, and intermittently iced the joint to mitigate pain during the initial 36 hours after injury.

The patient sought care at the university's student health clinic 2 days postinjury after experiencing joint pain, stiffness, muscle weakness, and difficulty bearing weight. He received axillary crutches from the clinic but left after becoming impatient before being seen by the primary care provider. The patient experienced substantial activity

Figure 1. Photograph of the ankle on the evening of the injury taken by the patient, superior view.

limitation after injury that increased difficulty during ADLs and precluded participation in fitness and recreational sport activities (Table 1). He returned to the laboratory 1 week postinjury and reconsented to participate in the LAS group. The patient completed new baseline PROs to reflect his change in status, was screened using the Ottawa ankle rules,[9] and was confirmed to have a grade 2 lateral sprain after a physical examination by an athletic trainer with 3 years of clinical practice experience. The study timeline of PRO collection and intervention provided is detailed in Figure 3. The study consisted of 3 laboratory visits over a 2-week course, with the visits spaced 1 week apart.

Intervention

The patient was randomly allocated a priori to receive a sham intervention consisting of a laying of hands during the first visit of the crossover randomized control trial. This intervention complemented a home exercise program (HEP) performed thrice daily consisting of gastrocnemius and soleus stretches; a 4-way foot stretch; a single-limb dynamic-balance exercise in eyes-open and eyes-closed conditions; single-limb heel raising; and resisted inversion, eversion, and dorsiflexion using elastic tubing. The HEP is described in Figure 4.

Figure 2. Photograph of the ankle on the evening of the injury taken by the patient, lateral view.

The patient returned to the laboratory 3 weeks postinjury to receive the experimental intervention. Because midfoot hypomobility was present on reexamination, he was provided grade 4 joint mobilizations consisting of forefoot-on-rearfoot inversion with dorsal cuboid pressure and a first tarsometatarsal plantar glide performed for 30 seconds each.[10] Cavitation did not occur during the first bout of either intervention, so a second 30-second bout of mobilizations was provided. Home exercises were reviewed and corrected as needed. Self-reported compliance was 70% of the total volume, and he could demonstrate all home exercises using appropriate technique at the follow-up and final visits.

Comparative Outcomes

Changes in PROs were assessed at 3 days preinjury and 1, 3, and 12 weeks postinjury. Changes were considered substantial if they exceeded the published minimal detectable change, which is the smallest measurement not attributed to error. Minimal detectable changes are useful when assessing change within individual patients across time points and are calculated using the standard error of measurement and intraclass correlation coefficient. A change in the IdFAI result was considered substantial if the score increased to >10 or decreased to ≤ 10.[11] The patient was asked to rate his treatment response immediately from preinjury to postinjury and from preinjury to 1 week after the intervention using a single assessment

Table 1. Preinjury Activity and Postinjury Disablement After Lateral Ankle Sprain

	1-wk Postinjury		
Preinjury Activity	Functional Impairment	Injury Limitation	Participation Restriction
Walking to class (approximately 5 mi/wk [8 km])	Pain Lateral foot Lateral ankle	Walking (limited for 3 days)	Took longer to get to classes but was able to attend
Basketball (1–2 games/wk)	Lateral compartment Swelling	Unable to run, cut, jump	Unable to play basketball with friends
Strength training (4–5 d/wk)	Lateral ankle Muscle weakness Fibularis longus/brevis, limited by pain Joint stiffness Talocrural articulation	Unable to perform rowing, lower extremity strengthening with weights	Unable to perform regular physical training program with partner

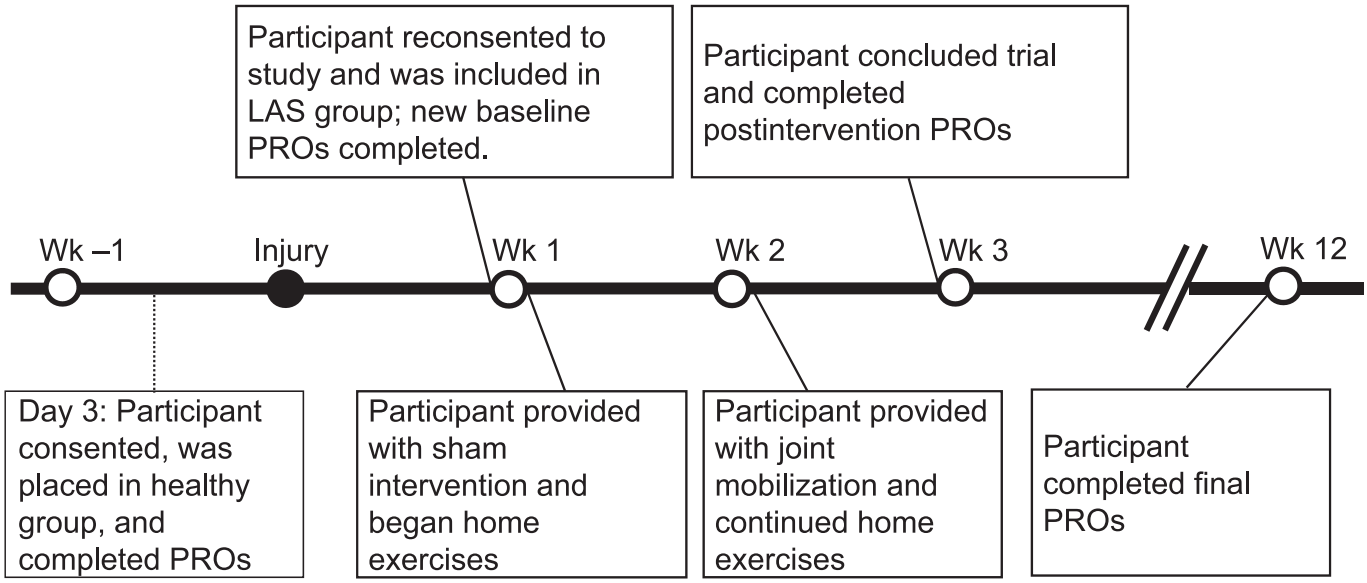


Figure 3. Study timeline. Abbreviations: LAS, lateral ankle sprain; PRO, patient-reported outcome measure.

numeric evaluation (SANE; −100% = *full exacerbation*, 0 = *no change*, 100% = *full resolution*) and the Global Rating of Change (GROC) scale.

The changes in PRO measures from preinjury to postinjury and during recovery are shown in Table 2. Substantial activity limitations in the FAAM-ADL and Sport,[3] PROMIS Physical Composite,[12] and IdFAI scores were observed after injury. Although his IdFAI score improved to a subclinical level[13] after the 2-week intervention (3 weeks postinjury), a subsequent decline in function was observed at 12 weeks postinjury, indicative of increased perceived or episodic instability. Functional scores on these measures followed a similar trend of improvement after intervention that persisted until 12 weeks postinjury. Physical activity as reflected in the Godin Leisure-time Exercise Questionnaire score did not change from 3 days preinjury to 1 week postinjury.

However, measures of perception of injury and mental health changed after injury. *Kinesiophobia*, or fear of movement, increased[14] substantially on the Tampa Scale for Kinesiophobia (TSK-11) after injury. The TSK-11 score gradually improved at subsequent time points but did not exceed the minimal detectable change calculated from the reported measurement properties.[14] The injury had no effect on the PROMIS Mental Health Composite score, yet a substantial improvement in mental health was observed from 3 days preinjury to 1 week posttreatment that persisted to 12 weeks postinjury. Predicted quality of life declined after injury, followed by incremental and progressive improvements through 12 weeks postinjury.

The patient reported no change in symptoms (GROC = 0, *about the same*; SANE = 0%) from immediately preinjury to postsham treatment during the initial study visit (1 week postinjury). A preinjury to 1-week improvement was reported (GROC = 2, *a slight bit better*; SANE = 25% improvement) after performing a 7-day HEP. The patient crossed over to receive the joint mobilizations during his follow-up visit (2 weeks postinjury) and reported immediate preinjury-to-postinjury improvement afterward (GROC = 2, *a slight bit better*; SANE = 25%) that persisted at 1 week posttreatment (3 weeks postinjury; GROC = 2, *a slight bit better*; SANE = 99%).

At 3 weeks postinjury, the patient reported substantial improvement in his symptoms; resumed basketball-specific tasks that did not require cutting, jumping, or pivoting; and restarted lower extremity weight training without difficulty. Persistent discomfort, stiffness, and perceived instability precluded him from running and cutting, which restricted his ability to participate in basketball games with his friends. The patient had resumed all functional activity without difficulty or limitation by 12 weeks postinjury.

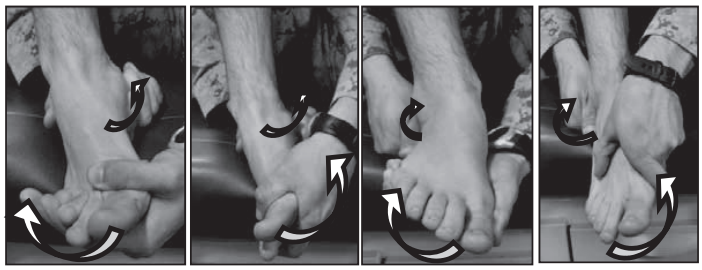
DISCUSSION

The primary findings of this exploration case report were that substantial changes in physical health, function, and kinesiophobia PROs reflected activity limitation after LAS. Activity and participation restrictions improved with treatment and time. This is the only case report, to our knowledge, to highlight preinjury-to-postinjury changes in patient-reported physical, psychological, and functional measures after LAS. These findings substantiate the clinical necessity of tracking multidimensional PROs when caring for patients after LAS. This case provides clinicians with an example of how physical and psychological function changed after injury and how PROs can be used to track treatment responses and functional outcomes throughout the rehabilitation course.

The patient reported difficulty walking; an inability to run, cut, or jump while playing basketball; and limitations when performing closed kinetic chain lower extremity strengthening due to ankle pain, stiffness, weakness, and feelings of instability after injury. Postinjury limitations and participation restrictions were reflected in changes in the IdFAI, FAAM-ADL and -Sports subscales, and PROMIS Physical Composite scores. These PROs measure physical function related to the ankle-foot complex or general health and accurately differentiate uninjured from injured individuals.[3,11,15] Our patient's IdFAI score improved to a subclinical level ($\leq$10) after treatment at 3 weeks postinjury but interestingly increased to 15 at 12

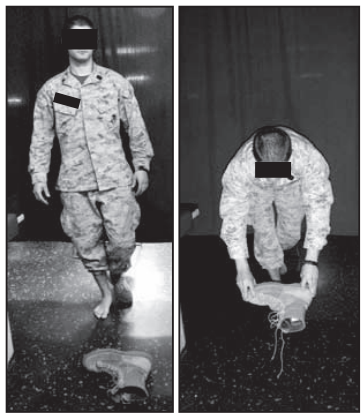
Four-Way Foot Stretch

With rear hand cupping the heel and the forward hand gripping the forefoot, the patient inverts the calcaneus while inverting the forefoot for 30 s, followed by forefoot eversion for 30 s. This is repeated with the rearfoot everted. The exercise is performed 3 times daily.



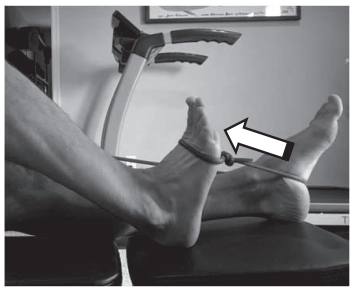
Calf Stretching

With the heel in contact with the ground, the patient stretches the gastrocnemius and soleus with the knee straight for 30 s. The stretch is repeated with the knee bent for 30 s. This is performed 3 times daily.



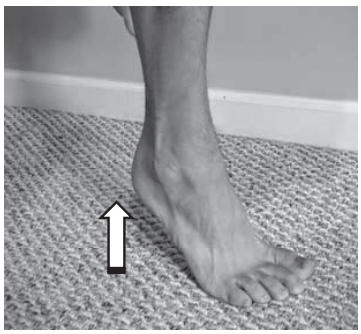
Single-Leg Forward Reaching

The patient places the shoe approximately 0.5 m in front at 12:00. While standing on the affected side, he picks the shoe up while maintaining balance on the single limb. With eyes closed, he returns the shoe to the starting position. The exercise is progressed to the 10:00 and 2:00 positions. The exercise consists of 10 repetitions 3 times daily.



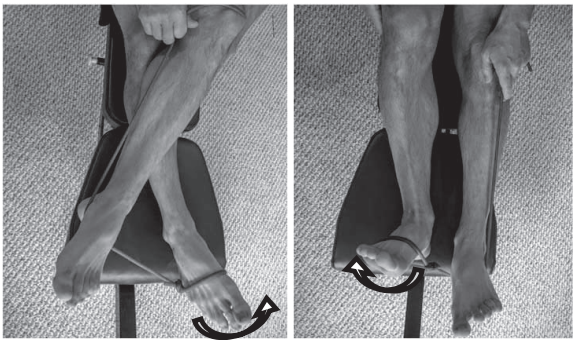
Resisted Dorsiflexion

With resistance tubing wrapped around the foot, the patient performs resisted dorsiflexion with a 2-s concentric phase and a 4-s eccentric phase. Thirty repetitions of the exercise are performed 3 times daily.



Single-Limb Heel Raises

In single-limb stance, the patient performs a heel raise with a 2-s concentric phase and a 4-s eccentric phase. Thirty repetitions of the exercise are performed 3 times daily.



Resisted Inversion and Eversion

With resistance tubing wrapped around the foot, the patient performs resisted dorsiflexion with a 2-s concentric phase and a 4-s eccentric phase. Thirty repetitions of the exercise are performed 3 times daily.

Figure 4. Home exercise program.

Table 2. Preinjury to Postinjury Self-Reported Measures

Measure	Preinjury	Postinjury			Minimal Detectable Change
	3 d	1 wk	3 wk	12 wk	
Godin Leisure-time Exercise Questionnaire	29	29	29	33	NA
Foot and Ankle Ability Measure					
Activities of Daily Living subscale, %	100	89	100	100	5.7[3]
Activities of Daily Living SANE, %	100	95	100	100	
Sports subscale, %	100	50	97	100	12.3[3]
Sport SANE, %	100	40	99	100	
Sport Functional Level	Normal	Nearly normal	Normal	Normal	NA
Identification of Functional Ankle Instability	0	24	10	15	NA
Tampa Scale of Kinesiophobia	11	18	14	13	7[a]
PROMIS Global Health composite *t* score					
Physical	61.9	57.7	61.9	67.6	4.2[12]
Mental	62.5	62.5	67.6	67.6	5[23]
Predicted EuroQol, %[b]	86	83	86	88	0.09[24]

Abbreviations: NA, not available; PROMIS, Patient-Reported Outcomes Measurement Information System; SANE, single assessment numeric evaluation.

[a] Calculated from the standard error of measurement reported by Woby et al.[12]

[b] Predicted score based on response to the PROMIS Global Health instrument.

weeks postinjury. This finding has clinical importance given the IdFAI's discriminative validity to detect whether an individual has CAI (score >10),[11] especially if the symptoms persist for longer than 12 months.[16] This patient was only followed to 12 weeks postinjury, so it is unclear whether he will develop CAI.

Incremental and progressive improvements in functional measures of ADLs occurred, and these values returned to preinjury levels by the end of treatment. This finding is clinically important because the FAAM-ADL has been identified as a primary predictor of progression from LAS to CAI.[17] The FAAM-Sports subscale score improved to subclinical level by the end of treatment, but residual symptoms delayed restoration to the preinjury level until 12 weeks postinjury. Short-term improvements in functional PROs have previously been reported[18] 4 weeks after LAS in response to natural recovery. How much recovery in this case could be attributed to natural recovery versus treatment response is unknown. Delayed intervention in this patient may limit the generalizability of the findings to the sports medicine clinic setting, where interventions may be applied earlier in the treatment course. Future study of the effects of manual therapy and therapeutic exercise for addressing the multiple segments of the ankle-foot complex on functional outcomes is warranted.

Predicted quality of life and kinesiophobia substantially worsened after injury and improved incrementally after treatment. The patient maintained a high level of quality of life[19] and a subclinical level of kinesiophobia[20] after injury, despite the substantial decline in function noted on the PROs. This was also evident in the unchanged Godin Leisure-time Exercise Questionnaire score after injury. The patient adapted to his injury by focusing on activities he could do in lieu of his normal routine. These factors likely indicate the patient's ability to cope with his injury, his attitude toward injury, and his high levels of resiliency and self-efficacy. These psychological traits have been suggested to play important roles in injury recovery and return to sport.[21,22] When asked to qualify why there was no change in the activity questionnaire score, the patient explained that he capitalized on the opportunity to strengthen his upper extremities and uninjured limb. His positive attitude likely influenced compliance with treatment and the rate of recovery. This characteristic also likely explains the lack of change in the PROMIS Mental Health Composite score from preinjury to postinjury. Future research investigating the effects of clinician-led strategies promoting positive psychological attributes and mitigating detrimental factors after LAS is needed.

CLINICAL BOTTOM LINE

This patient presented a unique opportunity to evaluate preinjury-to-postinjury changes in PROs after LAS and in response to treatment and recovery. He demonstrated substantial changes in self-reported function during ADLs and sport, global physical health, and kinesiophobia that reflected functional limitations and participation restrictions after injury that likely improved due to treatment and time. Leisure-time physical activity, global mental health, and predicted quality of life were relatively unaffected by the LAS and probably stemmed from the patient's resiliency and self-efficacy. When caring for patients who sustain musculoskeletal injuries, clinicians should consider using PROs that assess elements of both physical and mental health. Because of the inherent limited generalizability of a single case study, future investigation is needed to prospectively evaluate patients' perceptions of function from preinjury to postinjury. We also acknowledge that the interventions used in this patient need to be empirically assessed. The report of a randomized controlled trial comparing a combined midfoot joint mobilization and HEP versus a sham mobilization and HEP is forthcoming.

DISCLOSURES

This case report met the Health Insurance Portability and Accountability Act requirements for disclosure of protected health information. Neither the Department of the Navy nor any other component of the Department of Defense has approved, endorsed, or authorized this manuscript.

REFERENCES

1. Roos KG, Kerr ZY, Mauntel TC, Djoko A, Dompier TP, Wikstrom EA. The epidemiology of lateral ligament complex ankle sprains in National Collegiate Athletic Association Sports. *Am J Sports Med*. 2017;45(1):201–209.
2. World Health Organization. *International Classification of Functioning, Disability and Health: ICF*. Geneva, Switzerland: World Health Organization; 2001.
3. Martin RL, Irrgang JJ, Burdett RG, Conti SF, Van Swearingen JM. Evidence of validity for the Foot and Ankle Ability Measure (FAAM). *Foot Ankle Int*. 2005;26(11):968–983.
4. Carcia CR, Martin RL, Drouin JM. Validity of the Foot and Ankle Ability Measure in athletes with chronic ankle instability. *J Athl Train*. 2008;43(2):179–183.
5. Donahue M, Simon J, Docherty CL. Reliability and validity of a new questionnaire created to establish the presence of functional ankle instability: the IdFAI. *Athl Train Sports Health Care*. 2013;5(1):38–43.
6. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009;18(7):873–880.
7. Shephard R. Godin leisure-time exercise questionnaire. *Med Sci Sports Exerc*. 1997;29(6):S36–S38.
8. Revicki DA, Kawata AK, Harnam N, Chen WH, Hays RD, Cella D. Predicting EuroQol (EQ-5D) scores from the Patient-Reported Outcomes Measurement Information System (PROMIS) global items and domain item banks in a United States sample. *Qual Life Res*. 2009;18(6):783–791.
9. Stiell I. Ottawa ankle rules. *Can Fam Physician*. 1996;42:478–480.
10. Fraser JJ, Feger MA, Hertel J. Clinical commentary on midfoot and forefoot involvement in lateral ankle sprains and chronic ankle instability. Part 2: clinical considerations. *Int J Sports Phys Ther*. 2016;11(7):1191–1203.
11. Simon J, Donahue M, Docherty C. Development of the Identification of Functional Ankle Instability (IdFAI). *Foot Ankle Int*. 2012;33(9):755–763.
12. Ho B, Houck JR, Flemister AS, et al. Preoperative PROMIS scores predict postoperative success in foot and ankle patients. *Foot Ankle Int*. 2016;37(9):911–918.
13. Delahunt E, Coughlan GF, Caulfield B, Nightingale EJ, Lin CW, Hiller CE. Inclusion criteria when investigating insufficiencies in chronic ankle instability. *Med Sci Sports Exerc*. 2010;42(11):2106–2121.
14. Woby SR, Roach NK, Urmston M, Watson PJ. Psychometric properties of the TSK-11: a shortened version of the Tampa Scale for Kinesiophobia. *Pain*. 2005;117(1–2):137–144.
15. Madsen LP, Evans TA, Snyder KR, Docherty CL. Patient-Reported Outcomes Measurement Information System Physical Function Item Bank, version 1.0: physical function assessment for athletic patient populations. *J Athl Train*. 2016;51(9):727–732.
16. Gribble PA, Delahunt E, Bleakley C, et al. Selection criteria for patients with chronic ankle instability in controlled research: a position statement of the International Ankle Consortium. *J Orthop Sports Phys Ther*. 2013;43(8):585–591.
17. Doherty C, Bleakley C, Hertel J, Caulfield B, Ryan J, Delahunt E. Recovery from a first-time lateral ankle sprain and the predictors of chronic ankle instability: a prospective cohort analysis. *Am J Sports Med*. 2016;44(4):995–1003.
18. Aiken AB, Pelland L, Brison R, Pickett W, Brouwer B. Short-term natural recovery of ankle sprains following discharge from emergency departments. *J Orthop Sports Phys Ther*. 2008;38(9):566–571.
19. Fryback DG, Dunham NC, Palta M, et al. US norms for six generic health-related quality-of-life indexes from the national health measurement study. *Med Care*. 2007;45(12):1162–1170.
20. Neblett R, Hartzell MM, Mayer TG, Bradford EM, Gatchel RJ. Establishing clinically meaningful severity levels for the Tampa Scale for Kinesiophobia (TSK-13). *Eur J Pain*. 2016;20(5):701–710.
21. Connolly FR, Aitken LM, Tower M. An integrative review of self-efficacy and patient recovery post acute injury. *J Adv Nurs*. 2014;70(4):714–728.
22. McCann RS, Gribble PA. Resilience and self-efficacy: a theory-based model of chronic ankle instability. *Int J Athl Ther Train*. 2016;21(3):32–37.
23. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003;41(5):582–592.
24. Brown G. Value-based technology adoption in arthroplasty. *Bone Jt J*. 2016;98–B(suppl 7):54.

Address correspondence to John J. Fraser, PhD, PT, OCS, Warfighter Performance Department, Naval Health Research Center, 140 Sylvester Road, San Diego, CA 92106. Address e-mail to john.j.fraser8.mil@mail.mil.