Intermediate-term Outcomes in Adolescent Recurrent Ankle Instability Managed With a Modified Broström-Gould Procedure Augmented With Distal Fibular Periosteum Incorporation

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Background: Once a child has developed chronic ankle instability with recurrent events despite conservative treatment, then ligamentous repair is warranted. We utilize a modification of the modified Broström-Gould technique that further incorporates the distal fibular periosteum into the construct. The purpose of this study was to describe the intermediate-term outcomes of our modified Broström-Gould technique for chronic lateral ankle instability in childhood athletes.

Methods: A retrospective review of children who underwent the surgical technique over a 10-year time period (2010 to 2019) was performed, excluding those with <2 years of follow-up. Demographic, surgical, and clinical data were recorded, as well as outcome scores: (1) the Marx activity scale, (2) University of California, Los Angeles activity score, and (3) foot and ankle outcomes score. Recurrent instability events, repeat surgeries, satisfaction with the surgical experience, and return to sport (if applicable) were also recorded.

Results: Forty-six children (43 females) with 1 bilateral ankle met the criteria with a mean age at surgery of 14.8 years, and a mean follow-up duration of 4.9 years. The mean Marx activity score was 9.0 ± 5.1, the mean University of California, Los Angeles score was 8.3 ± 1.8, and the mean total foot and ankle outcomes score was 84.0 ± 15.6. Twenty-six ankles (55.3%) reported having at least 1 recurrent episode of instability and 6 of the ankles (12.8%) underwent revision surgery between 3.5 months and 6.5 years of the index procedure. Thirty-nine (84.8%) patients responded that they would undergo our surgery again.

Conclusion: A modified Broström-Gould procedure can be performed in children with the incorporation of the adjacent periosteum, but recurrence of instability is distinctly possible with longer follow-up with a risk for revision surgery despite good subjective outcomes.

Level of Evidence: Level IV; retrospective case series.

Key Words: pediatric, ankle instability, Broström procedure

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Acute ankle sprains are common sports injuries that occur at an estimated rate of 2.15 per 1000 person-years, with the peak incidence occurring between the ages of 15 and 19 years.[1] Among ankle sprains, the lateral ankle sprain, which primarily damages the anterior talofibular ligament (ATFL,) as a result of an inversion mechanism is understood to be the most common type.[1–4] The main complication of these ankle sprains is the development of chronic lateral ankle instability (CLAI), which occurs in about 20% of patients.[5] Frequent episodes of recurrent instability despite conservative treatments (physical therapy and bracing) warrant the consideration of operative ligamentous repair. The goal of surgical intervention is to restore ankle stability and prevent the development of lesions such as osteochondral lesions at the talar dome and tibiotalar osteoarthritis.[6–9]

The preferred method of operative treatment for these lateral ankle sprains is the anatomic repair using a modified Broström technique, which has previously shown good long-term outcomes in the adult population.[10–12] Our institution utilizes a modification of this technique in children that further incorporates the distal fibular periosteum into the repair construct as a stout anchor to the sometimes-tenuous tissue being repaired in this pediatric and adolescent population (Fig. 1). Inspiration for this technique dates back to the 1990s when Rudert et al[13] demonstrated that using a periosteal flap supplemented ankle reconstruction without sacrificing other ligaments or tendons in the foot. Previous studies on using a periosteal flap for ligament reconstructions have shown greater

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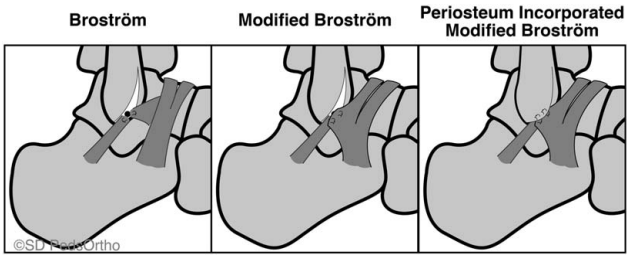

FIGURE 1. Line drawing illustrating the difference between the lateral ankle ligament repair techniques, the technique used in this study represented in the far right image.

success in patients with high functional demand, like pediatric patients participating in sports.[14,15]

Although previous studies have addressed short-term success rates of the traditional modified Broström-Gould technique with limited postoperative immobilization,[16] this study aims to address the intermediate-term outcomes in adolescent athletes who underwent our modification of the modified Broström-Gould technique for CLAI utilizing ~6 weeks of postoperative casting. Our hypothesis is that our modification of incorporating distal fibular periosteum into the modified Broström-Gould technique is not only an effective surgical treatment for the pediatric and adolescent patient but that it will have improved intermediate outcomes of the surgery compared with the previous study on this younger aged cohort.

METHODS

After Institutional Review Board approval, charts were retrospectively reviewed for all children surgically managed for CLAI using our modification of the modified Broström-Gould technique by multiple surgeons at a single institution from September 2010 through February 2019. Although 101 children (13, or 12.9%, males) underwent surgery for ankle stability during the study period, exclusion criteria were applied: <2 years follow-up including patient-reported outcomes (48 patients), congenital deformities of the ankle (2 patients), only having a revision surgery within the study period (1 patient), and a postoperative casting duration of <4 weeks (4 patients).

Surgery was performed only on patients who complained of discrete recurrent instability episodes of the ankle and who failed at least an attempt at physical therapy. Some patients also had a secondary complaint of pain, most frequently described as being along the anterolateral aspect of the tibiotalar joint, and not at the lateral ligamentous structures. For those experiencing this additional symptom of anteriorly based pain, the index surgical event started with diagnostic arthroscopy to achieve 2 goals: (1) evidence of excessive talar tilt with varus stressing consistent with incompetent lateral ligamentous structures and (2) determination of concomitant pathology that may be causing the secondary pain complaint, such as: loose bodies, soft-tissue impingement, or cartilage pathology. After arthroscopy (if utilized) and postmanagement of any noted intra-articular pathology, a semicurvilinear incision was made over the anterior fibula from just proximal to the ligamentous complex (approximately the level of the physis or physeal scar) to just distal of the insertion of the ATFL on the talus.

The technique requires identification of the anterior retinaculum and protection of this structure for later incorporation into the construct (the modified Gould portion of the procedure). The ATFL and calcaneofibular ligament were then independently identified and truncated from their origin on the fibula. A 3.5 mm Corkscrew anchor (Arthrex Inc., Naples, FL) was placed between those 2 origins (under fluoroscopic guidance if an open physis was present) after exposing cancellous bone with decortication, or removal of loose bodies/os fibulares. One suture (2 needles) was used to capture the ATFL and the other set was used for the calcaneofibular ligament (being sure not to capture the underlying peroneal tendon) using horizontal mattress constructs. These were secured into position with the hindfoot held in neutral (the Broström). Those same sutures were then used to capture the protected extensor retinaculum using horizontal mattress constructs (the modified Gould). Finally, the same sutures were then turned back to the posterior distal fibular periosteum to close the gap between the retinaculum and the periosteum over the repair construct laying deep to this closure (our modification).

After confirming improved stability of the ankle with drawer testing, the skin was closed and local anesthesia was utilized in the standard manner. A below-knee fiberglass cast was then applied with the foot maintained in a neutral position. It was univalved, and no weight bearing was allowed until the first postoperative week when the cast was over-wrapped. After 5 weeks of in-cast weight bearing, the cast was removed at 6 weeks and physical therapy was initiated. The rehabilitation protocol required an early range of motion followed by strength training and proprioception training before discharge. At a minimum of 6 weeks of physical therapy (up to 3 mo) the patients were evaluated for return to sport.

Clinical and demographic data retrospectively collected from patients' electronic medical records included: sex, BMI, age at injury, preoperative treatment, laterality, primary diagnosis, concomitant injury, primary sport, specific indications for surgery, associated procedures, number of sprains before surgery, time in a cast, time to full activity from surgery, physical therapy notes, magnetic resonance imaging findings, x-ray findings, revision surgeries (if any), and time of index surgery until time of last clinical visit.

Outcome scores were recorded from the most recent encounter: the Marx activity scale; the University of California, Los Angeles (UCLA) activity score; and the Foot and Ankle Outcomes Score (FAOS). In addition, patients were queried about their current pain score (0 to 10), any recurrent episodes of instability (yes/no), repeat surgery at an outside institution (yes/no), current brace wear (yes/no), and whether they would have the surgery again (yes/no/unsure).

The Marx activity scale quantifies a baseline level of activity on a scale of 0 to 4 in 4 categories that are intended

to measure activity level rather than health status. A score of 16 on the Marx scale indicates high activity whereas a score of 0 indicated low activity.[17] Although originally created as a knee outcome measure, it has been applied to the ankle in previous reports.[16] The UCLA activity score is a 10-point scale (1 to 10) that quantifies the patients' usual activity level. A "1" indicates the lowest level of activity (dependent on others) and a "10" indicates the highest level of activity (regularly participates in impact sports).[18] The FAOS is a 42-question survey with 5 subscales [pain, other symptoms, activities of daily living (ADL), sport and recreation function, and quality of life]. The total score is calculated out of 100, with 100 reporting the best ankle outcomes.[19] We set an optimal outcome for the FAOS at a score of 75% or higher in at least 3 subscales, based on the reported minimal important change of the ADL subscore. Of all the subscores, this one has the highest minimal important change at 12 points; and we, therefore, doubled that score amount to determine which patients would be in a good-to-excellent value range.[20]

Statistical testing for this study was performed using SPSS v.26, and alpha was set to $P < 0.05$ to declare significance (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.). Data were assessed for normality visually and numerically using Shapiro-Wilk tests. Continuous variables were then compared between arthroscopy and no arthroscopy cohorts using analysis of variance. Data that were determined to significantly deviate from normal distribution were assessed with nonparametric analysis through the Mann-Whitney U test. Categorical variables were compared between groups with a χ^2 test.

RESULTS

A total of 46 children, including 43 females and 1 with bilateral ankle instability, with a mean age of 14.8 years (range, 9.1 to 18.7 y) met the criteria within the study period. There was a mean follow-up duration of 4.9 years (range, 2.1 to 10.3 y) and the mean time in a cast was 6.1 ± 0.6 weeks. A summary of patient demographics can be found in Table 1. The range of presurgical instability events was difficult to ascertain with some patients reporting "many" or "constant" when queried; however, for those with reported events, the mean was 2.25 events (2 to 20 events). The 22 patients not otherwise engaged in a specific primary sport/activity before surgery resumed activities, but continued to not participate in a specific organized sport.

Twenty-seven ankles (57.4%) underwent concomitant ankle arthroscopy before the open Broström procedure. During arthroscopy, only 1 patient (2.1%) was found to have an associated chondral injury during surgery not detected on preoperative imaging. All 27 ankles underwent concomitant debridement of anterolateral soft tissue that could be a source of impingement pain.[21] Three of these patients underwent drilling of their osteochondral lesion of the talus, 2 underwent loose body excision, 1 underwent a chondroplasty, and 1 underwent debridement of the distal fascicle of the anteroinferior talofibular (Bassett) ligament.[22] At the conclusion of management (and after diagnostic arthroscopy), it was noted that 12 ankles (25.5%) had concomitant pathology in addition to chronic ankle instability (not including soft-tissue impingement): 5 with os fibulare, 4 with osteochondral lesions of the talus, and 1 with peroneal tendon subluxation.

TABLE 1. Patient Demographics*

Characteristic	Value; n (%)
Age at surgery (y)†	14.8 ± 2.3
Sex	
Male	3 (6.5)
Female	43 (93.5)
Sports	
Soccer	12 (26.0)
Cheerleading	4 (8.7)
Dance	4 (8.7)
Gymnastics	4 (8.7)
Would they have surgery again?	
Yes	39 (84.8)
No	7 (15.2)

Patient demographics reported for all patients (n = 46).
*Data are reported as mean ± SD unless otherwise specified.
†Two ages included for bilateral ankle patient (n = 47).

All 46 patients (47 ankles) completed the final follow-up patients' outcome scores (Table 2). The mean Marx activity score, mean UCLA score, and mean total FAOS score was representative of good, but not necessarily excellent outcomes. Sixty-eight percent (32 of 47) of the ankles achieved optimal outcome scores. There were no significant differences in the mean Marx, UCLA, and FAOS scores when comparing patients who had concomitant arthroscopy and those who did not ($P = 0.214$, $P = 0.253$, $P = 0.846$, respectively). No postoperative neuromas or infections were identified, but 26 ankles (55.3%) reported having at least 1 recurrent episode of instability or a sprain postoperatively. Six of the ankles (12.8%) underwent revision surgery for ankle instability between 3.5 months and 6.5 years of the index procedure. For 8 ankles (17.4%), the patients reported current pain ranging from 3 to 7 on a 10-point scale at the time of the last follow-up.

DISCUSSION

Our periosteum-based modification of the Broström-Gould procedure resulted in two-thirds of children reporting optimal clinical outcome scores, but with 1 out of 8 requiring further surgical intervention at the intermediate duration of follow-up. These ostensibly different outcomes likely represent either that young athletes can tolerate an occasional ankle instability event (just not chronic recurrent instability), or that despite recurrent instability they believe that 1 surgery was enough for them and they provide outcome scores that mirror that belief. Or perhaps, the longer outcomes provided in this report represent the satisfaction in outcome related to the young athlete retiring from sports due to reaching adulthood and not the state of ankle health.

TABLE 2. Outcome Data*

Characteristic	Value; n (%)
Time to follow-up (y)	4.9 ± 2.0
Time in cast (wk)	6.1 ± 0.6
Time to full activity (mo)	4.7 ± 1.6
Concomitant injuries	12 (25.5)
Os fibulare	5
OCD lesion	4
CRPS	2
Peroneal tendon subluxation	1
Concomitant ankle arthroscopy	
Yes	27 (57.4)
No	20 (42.5)
MARX	9.0 ± 5.1
UCLA	8.3 ± 1.8
FAOS total	84.0 ± 15.6
Pain	84.6 ± 16.0
Symptoms	79.3 ± 18.0
ADL	92.9 ± 12.9
Sport	73.6 ± 25.7
Quality of life	66.2 ± 25.0
FAOS optimal scores	31 (66.0)
Recurrent instability reported	26 (55.3)
Revision surgery	6 (12.8)

*Data are reported as mean ± SD unless otherwise specified.
Patient outcomes reported for all ankles (n = 47).
ADL indicates activities of daily living; CRPS, complex regional pain syndrome; FAOS, foot and ankle outcomes score; OCD, osteochondritis dissecans; UCLA, University of California, Los Angeles.

When weighing surgical options for CLAI, the modified Broström-Gould technique has proven to be more successful in adult populations when compared with the alternative Chrisman-Snook procedure.[11] A recent publication has focused on pediatric outcomes of the modified Broström-Gould procedure and found good-to-excellent results in 71% of adolescent patients with short-term follow-up.[16] A direct comparison to this previous study is difficult as they used a modification of the American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot score (likely dropping the physical examination questions), whereas we utilized the FAOS score to assess our patients. Unfortunately, even though the AOFAS ankle-hindfoot score is commonly utilized, the results in validating the measure have been mixed[23]; whereas, the FAOS score has been validated, at least in adults with ankle instability.[19] So, although we can compare the Marx and UCLA scores, the 71% good-to-excellent results previously reported using the AOFAS score may misrepresent the true outcomes in those patients. At the same time, our 68% optimal outcomes on the FAOS score may reflect the previous findings with a different outcome score, despite the validation and duration of outcome differences.

To tease out the truth of the findings, we present the subsection scores provided by our cohort. They scored the highest in the ADL subsection and the lowest in the sports and quality of life domains of the FAOS. Given that the mean age of our cohort at the time of surgery was that of someone starting High School, and our mean follow-up would put them over 4 years later in early adult life, perhaps our findings are very consistent with individuals that retired from athletics. A decreased demand on the ankle would explain why ADLs were great, but that sports (and potentially the quality of life with the loss of sports) were not as good. In the context of 68% of the cohort achieving an optimal outcome by patient-derived questionnaire, while finding 55% of the same cohort had experienced a recurrent instability event after surgery, we believe the best explanation is that by retiring from the sport, these patients could lead normal functional lives with their ankle instability; but, with the reduced amount of athletics and potentially a perceived decrease in quality of life.

An interesting finding of the study was that our cohort consisted of 43/46 (93.5%) female patients. This finding aligns with several previous studies that analyzed pediatric ankle instability reporting 75% to 85% of female cohorts undergoing the modified Broström-Gould procedure.[16,24,25] In addition, studies analyzing ankle instability requiring surgical intervention in adults report a smaller, yet still noticeable, majority of female patients ranging from 50% to 65% of their cohorts.[26,27] However, the literature examining the existence, or nonexistence, of a sex predisposition for CLAI requiring surgery is lacking and should be further explored. One missing element from this study and historical publications is the inclusion of physical examination findings, such as the Beighton score.

The long-term risk of ankle instability and its association with other pathologies makes understanding this pathology and its best treatment important to understand. A comparative study matched adolescent participants who were a mean 8 years out from a sports-related ankle sprain injury to noninjured participants. They found that previously injured subjects reported less balance, ankle-related quality of life, and greater fear of pain than controls.[25] They made a call to focus management on early intervention rather than the need for surgical management, but this is not always possible. Another study investigating the utility of ankle arthroscopy performed at the same surgical setting as the modified Broström found that 65% of teenagers had anterior impingement, 53% had synovitis, 11% had chondral damage, and 4% had intra-articular loose bodies.[24] They proposed that the pathology in their adolescent patients was different from those in adults, who tend to demonstrate predominately osseous impingement at the time of ankle stabilization surgery. Our findings mirrored that previous work in that no osseous impingement was identified and yet previously undetected chondral injury was identified during arthroscopy. We believe that despite preoperative imaging findings, concurrent ankle arthroscopy may be helpful to identify and manage chondral and impingement issues in these children with chronic ankle instability and concomitant anterior ankle pain, with a low risk for the development of neuromas. However, in cases without concomitant anterior ankle pain, there is no evidence that diagnostic arthroscopy is necessary.

In addition to the retrospective nature of this study (which includes the potential for information bias), limitations include: that the study was conducted at a single institution with a relatively small cohort of patients, lack

of a control group, use of validated outcome measures that may have limited application in the pediatric population, the poor completion rate for preoperative PROs, and absence of objective measures for the intermediate-term timepoints. The latter point leaves us wondering whether these young athletes may have scored better at only 2 or 3 years of follow-up when they were still in High School athletics compared with after retirement, or whether their scores would have been even worse. Clinical measures, such as strength and range of motion could help identify if the long-term sequelae of this surgery hinge on variations of technique, or follow-through with physical therapy. Moreover, future studies could analyze a comparative, nonoperative cohort (with the addition of preoperative PROs for the operative cohort) to confirm both subjective and objective outcome differences in the long term and reduce the risk of confirmation bias.

The current study attempted to determine whether a subtle change in surgical technique (incorporating the adjacent fibular periosteum), coupled with a slightly longer immobilization period (more consistent with pediatric fracture management) could improve the overall outcomes in this highly active young population with recurrent ankle instability. Compared with historical controls that did not incorporate the periosteum, that used less than a month of immobilization, and had a shorter duration of follow-up, our study cohort seems to merely mirror the two-thirds excellent outcome of previous studies when assessing by patient-derived questionnaire. However, despite those scores 1 out of 8 adolescents required a second surgery. Moreover, at a mean of about 5 years outcome, just over half reported that they had experienced at least 1 recurrence of ankle instability, whereas at the same time 17 out of 20 reported that they would be willing to undergo the procedure again. The intermediate-term success of this modification to the modified Broström-Gould technique suggests that it works to an equal extent as other modified Broström-Gould techniques regarding outcomes and that 87% of adolescents will not need additional surgery, even though they may experience isolated recurrence of their ankle instability.

REFERENCES

1. Waterman BR, Owens BD, Davey S, et al. The epidemiology of ankle sprains in the United States. *J Bone Joint Surg Am*. 2010;92:2279–2284.
2. Doherty C, Delahunt E, Caulfield B, et al. The incidence and prevalence of ankle sprain injury: a systematic review and meta-analysis of prospective epidemiological studies. *Sports Med*. 2014;44:123–140.
3. Ferran NA, Maffulli N. Epidemiology of sprains of the lateral ankle ligament complex. *Foot Ankle Clin*. 2006;11:659–662.
4. Yeung MS, Chan KM, So CH, et al. An epidemiological survey on ankle sprain. *Br J Sports Med*. 1994;28:112–116.
5. Garrick JG. The frequency of injury, mechanism of injury, and epidemiology of ankle sprains. *Am J Sports Med*. 1977;5:241–242.
6. Gross P, Marti B. Risk of degenerative ankle joint disease in volleyball players: study of former elite athletes. *Int J Sports Med*. 1999;20:58–63.
7. Harrington KD. Degenerative arthritis of the ankle secondary to long-standing lateral ligament instability. *J Bone Joint Surg Am*. 1979;61:354–361.
8. Hirose K, Murakami G, Minowa T, et al. Lateral ligament injury of the ankle and associated articular cartilage degeneration in the talocrural joint: anatomic study using elderly cadavers. *J Orthop Sci*. 2004;9:37–43.
9. Takao M, Ochi M, Uchio Y, et al. Osteochondral lesions of the talar dome associated with trauma. *Arthroscopy*. 2003;19:1061–1067.
10. Bell SJ, Mologne TS, Sitler DF, et al. Twenty-six-year results after Broström procedure for chronic lateral ankle instability. *Am J Sports Med*. 2006;34:975–978.
11. Hennrikus WL, Mapes RC, Lyons PM, et al. Outcomes of the Chrisman-Snook and modified-Broström procedures for chronic lateral ankle instability. A prospective, randomized comparison. *Am J Sports Med*. 1996;24:400–404.
12. Krips R, Brandsson S, Swensson C, et al. Anatomical reconstruction and Evans tenodesis of the lateral ligaments of the ankle. Clinical and radiological findings after follow-up for 15 to 30 years. *J Bone Joint Surg Br*. 2002;84:232–236.
13. Rudert M, Wülker N, Wirth CJ. Reconstruction of the lateral ligaments of the ankle using a regional periosteal flap. *J Bone Joint Surg Br*. 1997;79:446–451.
14. Choi HJ, Kim DW, Park JS. Modified Broström procedure using distal fibular periosteal flap augmentation vs anatomic reconstruction using a free tendon allograft in patients who are not candidates for standard repair. *Foot Ankle Int*. 2017;38:1207–1214.
15. Mittlmeier T, Rammelt S. The periosteal flap augmentation technique in chronic lateral ankle instability. *Oper Orthop Traumatol*. 2019;31:180–190.
16. Kocher MS, Fabricant PD, Nasreddine AY, et al. Efficacy of the modified Broström procedure for adolescent patients with chronic lateral ankle instability. *J Pediatr Orthop*. 2017;37:537–542.
17. Marx RG, Stump TJ, Jones EC, et al. Development and evaluation of an activity rating scale for disorders of the knee. *Am J Sports Med*. 2001;29:213–218.
18. Naal FD, Impellizzeri FM, Leunig M. Which is the best activity rating scale for patients undergoing total joint arthroplasty? *Clin Orthop Relat Res*. 2009;467:958–965.
19. Roos EM, Brandsson S, Karlsson J. Validation of the foot and ankle outcome score for ankle ligament reconstruction. *Foot Ankle Int*. 2001;22:788–794.
20. Tapaninaho K, Uimonen MM, Saarinen AJ, et al. Minimal important change for Foot and Ankle Outcome Score (FAOS). *Foot Ankle Surg*. 2022;28:44–48.
21. Edmonds EW, Chambers R, Kaufman E, et al. Anterolateral ankle impingement in adolescents: outcomes of nonoperative and operative treatment. *J Pediatr Orthop*. 2010;30:186–191.
22. Bassett FH, Gates HS, Billys JB, et al. Talar impingement by the anteroinferior tibiofibular ligament. A cause of chronic pain in the ankle after inversion sprain. *J Bone Joint Surg Am*. 1990;72:55–59.
23. SooHoo NF, Shuler M, Fleming LL. American Orthopaedic Foot and Ankle Society. Evaluation of the validity of the AOFAS Clinical Rating Systems by correlation to the SF-36. *Foot Ankle Int*. 2003;24:50–55.
24. Evans BT, Tepolt FA, Niu E, et al. Intra-articular findings during the modified Brostrom procedure for lateral instability of the pediatric ankle. *J Pediatr Orthop B*. 2018;27:73–76.
25. Owoeye OBA, Whittaker JL, Toomey CM, et al. Health-related outcomes 3-15 years following ankle sprain injury in youth sport: what does the future hold? *Foot Ankle Int*. 2022;43:21–31.
26. Coetzee JC, Ellington JK, Ronan JA, et al. Functional results of open broström ankle ligament repair augmented with a suture tape. *Foot Ankle Int*. 2018;39:304–310.
27. Petrera M, Dwyer T, Theodoropoulos JS, et al. Short- to medium-term outcomes after a modified broström repair for lateral ankle instability with immediate postoperative weightbearing. *Am J Sports Med*. 2014;42:1542–1548.