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ABSTRACT

Objective To analyse the association between Ankle-GO score during the return to sport process and the probability of becoming a coper 1 year after lateral ankle sprain (LAS). Copers were defined as patients returning to their preinjury sport without loss of function and reporting no episodes of reinjury or giving-way.

Methods Two months after a LAS, patients performed the Ankle-GO assessment which includes a cluster of four functional tests and two self-reported questionnaires for a maximum score of 25 points. One year after injury, participants were classified as copers or non-copers. Eight potential predictive variables associated with coper status were compared between the groups. Receiver operating characteristic curves (area under the curve (AUC)) and multivariable logistic regression models with OR and 95% CIs were used to determine the association of potential factors, including the Ankle-GO score, with copers.

Results 64 patients (56% females; age 33.7±13.2 years) completed the Ankle-GO-GO at 2 months postinjury. At 1 year postinjury, 10 patients (15%) were lost to follow-up, and only 17 of 54 patients (31%) became copers. Two-month Ankle-GO score was higher among copers (9.9±4.9 points vs 6.9±3.7, p=0.015) and was associated with future coper status at 1 year (AUC=0.70). Patients with an Ankle-GO score above 11 points and male patients were more likely to become copers (OR=12.1; 95% CI 2.5 to 59, p=0.002 and OR=5.2; 95% CI 1.2 to 22.4, p=0.026, respectively).

Conclusion The Ankle-GO may help identify patients more likely to become copers within a year of injury. Those with low Ankle-GO scores and female patients should receive additional rehabilitation to increase the odds of becoming a coper.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ A high proportion of patients suffering from lateral ankle sprain (LAS) will develop chronic ankle instability.
⇒ Copers are patients who have returned to their preinjury sport without loss of function and who report no episodes of reinjury or giving-way.
⇒ There is no clinical indicator to predict the likelihood of a patient becoming a coper.
⇒ The Ankle-GO assessment has been developed to help clinicians make valid return to sport (RTS) decisions.

WHAT THIS STUDY ADDS

⇒ The total Ankle-GO score is associated with coper status 1 year after LAS.
⇒ No single item of the Ankle-GO was associated with the probability to become a coper.
⇒ Female patients are less likely to become copers 1 year after injury.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The Ankle-GO battery of functional performance and self-reported function can be used to guide RTS decisions.
⇒ Patients with an Ankle-GO score below 11 points are at higher risk of reinjury or give-way and loss of function with their preinjury sport and should be cautioned on returning to sport.
⇒ Female patients were at higher risk and may require more robust rehabilitation during the RTS process.

INTRODUCTION

Lateral ankle sprain (LAS) is the most common injury in sport[1 2] with a high rate of recurrence that frequently leads to chronic ankle instability (CAI).[3 4] Most LAS patients suffer from long-term symptoms such as reinjury, episodes of 'giving way', loss of self-reported function[5–8] as well as an increased risk of osteoarthritis.[9 10]

The goal of rehabilitation following a LAS is to achieve a successful clinical outcome, where patients can return to their desired level of function. Outcomes therefore vary from full recovery (coper) to poor prognosis (CAI).[11] A coper is defined as an individual who has sustained no recurrent ankle sprains or episodes of giving-way, and report no or very minimal deficits in self-reported function for at least 12 months following a LAS.[5]

Numerous studies have identified key differences between copers, CAI patients and healthy individuals[12–14] but the exact mechanism and cascade by which some patients become copers remain unknown.[11] While numerous studies aimed to identify predictive factors of CAI following LAS,[15] there is a dearth of research evaluating the mechanisms that predispose an individual to a good (ie, coper) or poor (ie, CAI) post-LAS outcome.[16 17] For example, the prospective cohort study from Doherty *et al*[16] revealed that an inability to jump and land within 2 weeks, as well as poor dynamic postural control and lower self-reported function 6 months after a first-time LAS were predictive of CAI. However,

no factors have been associated with the ability of patients to become copers. Since the ultimate aim of LAS rehabilitation is to help the patient to become a coper, it is important to identify parameters that will enable clinicians to distinguish between patients who will achieve this from those who will not.[18]

As previously suggested,[19] the best way to increase the likelihood of becoming a coper could be to accurately assess residual impairments through the return to sport (RTS) continuum. This period allows a goal-oriented retraining to address identified deficits. Indeed, one hypothesised reason for the high rate of LAS recurrence and the development of CAI is a rapid RTS.[20 21] This is partially explained by a lack of consensus on objective RTS criteria following LAS.[19 22] As a result, clinician and patient decisions are generally time-based (eg, RTS at 1 week) and rely primarily on pain relief despite the residual sensorimotor and patient-reported deficits still present.[20 23]

Recently, a new valid and reliable assessment battery (Ankle-GO) was developed to guide decision-making throughout the RTS continuum following LAS[24] and was comprised entirely of clinician- and patient-oriented assessments. The Ankle-GO showed good predictive ability to identify patients who will return to the same preinjury level of sport and those more likely to sustain a reinjury within 2 years of the initial LAS.[24 25] However, its ability to identify patients who will become copers remains to be established.

The primary aim of this study was to analyse the association between the Ankle-GO score during the RTS process and the probability of becoming a coper 1 year after LAS. We hypothesised that because its construction is based on multiple items that target specific impairments associated with LAS and CAI, patients who exhibit high Ankle-GO scores are more likely to become copers 12 months after the initial LAS. In addition, since LAS recovery is complex and multidimensional,[5 26–28] a secondary aim was to identify potential demographic predictors of becoming copers.

METHOD

Study design

A 1-year prospective monocentric cohort study conducted in the Clinique du Sport-Paris, from January 2021 to June 2022, on patients who suffered LAS was used to address the research question.

Population

Patients were all recruited during an initial visit to the clinic by the same experienced orthopaedic surgeon (AH). Patients were eligible if they sustained a LAS within a month prior to their visit, engaged in sports activities at least once a week, and expressed a desire to return to their preinjury activity. Exclusion criteria were based on recommendations of the International Ankle Consortium (IAC)[29] including: (1) a history of lower limb surgery (eg, bones, joint structures and nerves), (2) a history of lower extremity fracture, (3) a history of neurological disorders and (4) acute lower extremity musculoskeletal injury in the past 3 months. In addition, patients were excluded in case of a suspected syndesmosis injury[30] and presence of a fracture. A LAS was defined according to the recommendations of the IAC as 'an acute traumatic injury to the lateral ligament complex of the ankle joint resulting from an excessive and sudden inversion mechanism of the rear foot combined with an adduction or plantar flexion of the foot, precluding participation in sports'.[24] The severity of the injury was clinically assessed from pain, swelling and ligament laxity using the Talar Tilt and the Anterior Drawer Tests.[31] Enrolled patients received a generic rehabilitation prescription of 10 sessions, according to the French national healthcare system and based on recent clinical practice recommendations[6] but were free to choose the practitioner. As such, the specific rehabilitation protocol patients underwent varied.

A priori power analysis for the primary aim determined that a minimum sample size of 61 patients was necessary to achieve a statistical power of 0.80 and a 'two-sided' alpha level of 5% based on an expected area under the curve (AUC) of 0.70.[17 24 32] The sample sizes were calculated to include 19 participants in the coper group and 43 participants in the non-copers group, assuming a baseline proportion of 0.30 for the coper group.[7]

A power analysis was not conducted for the secondary purpose of this study as it was preliminary in nature.

Patient and public involvement

Patients were not engaged in the development, conduct or oversight of the study.

Equity, diversity and inclusion

This study was open to people from diverse ethnicities, sexual orientations, social status and religions. The team of authors was composed of men, but included people from different disciplines (surgeons, physiotherapists, researchers), with junior and senior investigators.

Follow-up

Two months after injury, all patients completed the Ankle-GO score under the supervision of an experienced physical therapist (GR). All patients had completed their prescribed rehabilitation sessions prior to the assessment. This objective score is both valid and reliable[24] and comprised six items selected on their relevance for monitoring LAS patients[19 22] and the multidisciplinary consensus from the IAC.[21] The total score is 25 points spread over four functional tests as well as two self-reported questionnaires. Functional tests include the Single Leg Stance (SLS) on a firm surface,[33] the modified Star Excursion Balance Test (SEBT) in the anterior (ANT), posteromedial (PM) and posterolateral (PL) directions and the composite (COMP) score,[34] the Side Hop Test (SHT)[35] and the Figure-of-8 Test (F8T).[36] Questionnaires included the two subscales of the Foot and Ankle Ability Measure[37] and the Ankle Ligament Reconstruction-Return to Sport after Injury (ALR-RSI).[38] These questionnaires assessed patient function and the patient's perception and psychological readiness, respectively. Details of the Ankle-GO score construction and calculation system are available in online supplemental appendix 1.

Twelve months after the injury, patients were contacted by telephone. If there was no response, they were called back 24 hours and a week later, with a reminder by post and email if necessary. A blind assessor (fellow surgeon, KF) asked whether the patient sustained a recurrent sprain(s), episode(s) of 'giving way' or 'feelings of instability' in the injured ankle. Recurrence was defined according to the recommendations of the IAC as *a new ipsilateral LAS in the same location and of the same type*.[39] Conversely, 'giving way' corresponds to 'the regular occurrence of uncontrolled and unpredictable episodes of excessive inversion of the rear foot (usually experienced during initial contact during walking or running), which do not result in an acute LAS'.[29] Patients also completed the Cumberland Ankle Instability Tool (CAIT)[40] and reported if they returned to their preinjury activity/sport without functional limitations. The telephone interview lasted approximately 10 min and the assessor

ensured that the patients understood and answered the questions correctly.

According to their responses at the telephone interview, patients were then dichotomised according to their recovery status 12 months after LAS into (1) copers, operationally defined as LAS patients that experienced no episodes of giving way or recurrent LAS, had a CAIT score ≥24 and returned to their preinjury sports[11 14 16] or (2) non-copers. Patients who did not respond were excluded.

Data analysis

The analysis and presentation of data were consistent with the CHecklist for statistical Assessment of Medical Papers.[41]

For the primary aim of this study, the predictive validity of the Ankle-GO score to identify copers was evaluated using a receiver operating characteristic (ROC) curve. The AUC was determined with a precision score considered to be null (AUC=0.5), low (0.5<AUC<0.7), fair to good (0.7≤AUC<0.9), high (0.9≤AUC<1) or perfect (AUC=1).[42] The optimal cut-off score was calculated using the Youden index (J=sensitivity+specificity−1). Ankle-GO scores were then dichotomised as either above (positive) or below (negative) the cut-off point to simplify the interpretation of risk and the related ORs.[43] Then, LR+ (positive likelihood ratio) and LR− (negative likelihood ratio) as well as their 95% CIs were calculated using a 2×2 contingency table. Pretest (ie, coper prevalence) and post-test probability (ie, influence of Ankle-GO score on becoming a coper) were then calculated.

A sensitivity analysis on our primary analysis was conducted to address missing data and mitigate selection biases. This involved performing multiple imputation (M=10), under the assumption that missing values were missing at random, and inverse probability weighting (IPW) techniques.

For the secondary aim of this study, a total of 15 potential predictors associated with coper status 1-year post-injury were studied. These included age, sex, type and level of sport, ALR-RSI score (%), both subscales of the FAAM (%), SLS (errors), ANT, PL and PM direction of the SEBT as well as the COMP score (%), SHT and F8T (s) as well as the total Ankle-GO score (points). Data were checked for normality and homogeneity of variance using with Shapiro-Wilk and Levene's tests. Relationships between potential predictors variables and coper status was assessed using different statistical tests based on the nature of the data: χ^2 or Fisher's exact tests for categorical variables, independent t-tests for normally distributed data and Mann-Whitney U tests for skewed measures. Only variables with a significance level of p<0.20 between the two groups were entered into the model.[43] In addition, all potential predictive variables were tested using bivariate Pearson r correlations. If any combinations with p<0.20 returned a correlation r>0.8, only one of the variables was included in further analyses. Variance inflation factors were used to assess multicollinearity and outliers were searched using standard residual values and Cook's distance. Linearity for quantitative predictors was assessed using Box-Tidwell procedure.

After verifying that statistical assumptions of regression were met (ie, independence of observations, extreme outliers, multicollinearity and linear relationship between the independent variables and the logit of the dependent variable) a multivariable logistic regression (stepwise) was conducted in order to determine whether the remaining potential predictive variables were associated with coper status (dependant variable) 1 year after injury.[43]

ORs and 95% CIs were reported for the variables associated with the probability of becoming coper. There were no missing data at baseline. The statistical analysis was performed by two blind assessors using JASP (Amsterdam 0.12.2.0), R statistical software (V.4.2, Vienna, Austria) and SPSS V.12.0 (IBM Corp). The alpha level adopted for the significance of the regression models was 0.5.

RESULTS

64 LAS patients (36 females and 28 males, 33.7±13.2 years) were initially enrolled. At 1 year postinjury, 10 patients (15%) were lost to follow-up due to a lack of response to reminders (figure 1 and table 1). Of the 54 remaining LAS patients, 17 (31.5%) were classified as copers. The study cohort is summarised in figure 1.

Primary aim

The predictive ability of the Ankle-GO score was acceptable, with an AUC of 0.70 (95% CI 0.53 to 0.86; p=0.023). A cut-off of 11 points, yielded a sensitivity of 53% and specificity of 89% in identifying copers. The Ankle-GO score was re-coded as being either above or below this cut-off point (table 2). The LR+ was 4.9 (95% CI 1.75 to 14) and the LR− was 0.53 (95% CI 0.31 to 0.88). The probability of becoming a coper, increased from 28.7% to 69% if the Ankle-GO score was higher than 11 points. Conversely, a score of less than 11 points decreased the probability of becoming a coper to 6.8%.

In our sensitivity analysis using multiple imputation and IPW, we found a pooled AUC of 0.70 (95% CI 0.64 to 0.78). Using Youden's method, the same cut-off of 11 points was found, corresponding to a pooled sensitivity of 52% (95% CI 0.50 to 0.54) and pooled specificity of 90% (95% CI 0.89 to 0.91) for identifying copers.

Secondary aim

11 variables met the initial screening criterion of p<0.20 (table 3). However, high correlations (r>0.8) were noted between SEBT COMP score and the ANT, PL and PM directions. Thus, only the COMP score was entered into the model.[43]

The full model contained eight variables: sex, ALR-RSI score, $FAAM_{adl}$ and $FAAM_{sport}$, SEBT COMP, SHT, F8T and Ankle-GO score was statistically significant ($\Delta\chi^2_{(51)}=16.58$, p=0.035; Nagelkerke $R^2=0.37$ and Cox and Snell $R^2=0.26$), indicating that the model was able to identify participants who will become copers at the end of the follow-up period. The assumption of multicollinearity was met (variance inflation factors=1.129). An inspection of standardised residual values (>3) and Cook's distance revealed no outliers. Goodness of fit was confirmed with the Hosmer-Lemeshow test (p=0.415). The model correctly classified 78% of cases (95% CI 65.5% to 87.5%). Only two independent variables made a statistically significant contribution to the model. The Ankle-GO score above 11 points (OR=12.1; 95% CI 2.5 to 59) and sex (OR=5.2; 95% CI 1.2 to 22.4). That is, patients scoring above 11 points 2 months after injury had a twelve times higher chance of becoming copers (figure 2B). Similarly, male patients were nearly five times more likely to become copers relative to females.

DISCUSSION

The results of the present study revealed that the 2-month Ankle-GO score was a significant predictive factor of becoming a coper. However, despite lower average scores by non-copers, no singular item was significantly different between groups, and none could independently predict coper status. This differs

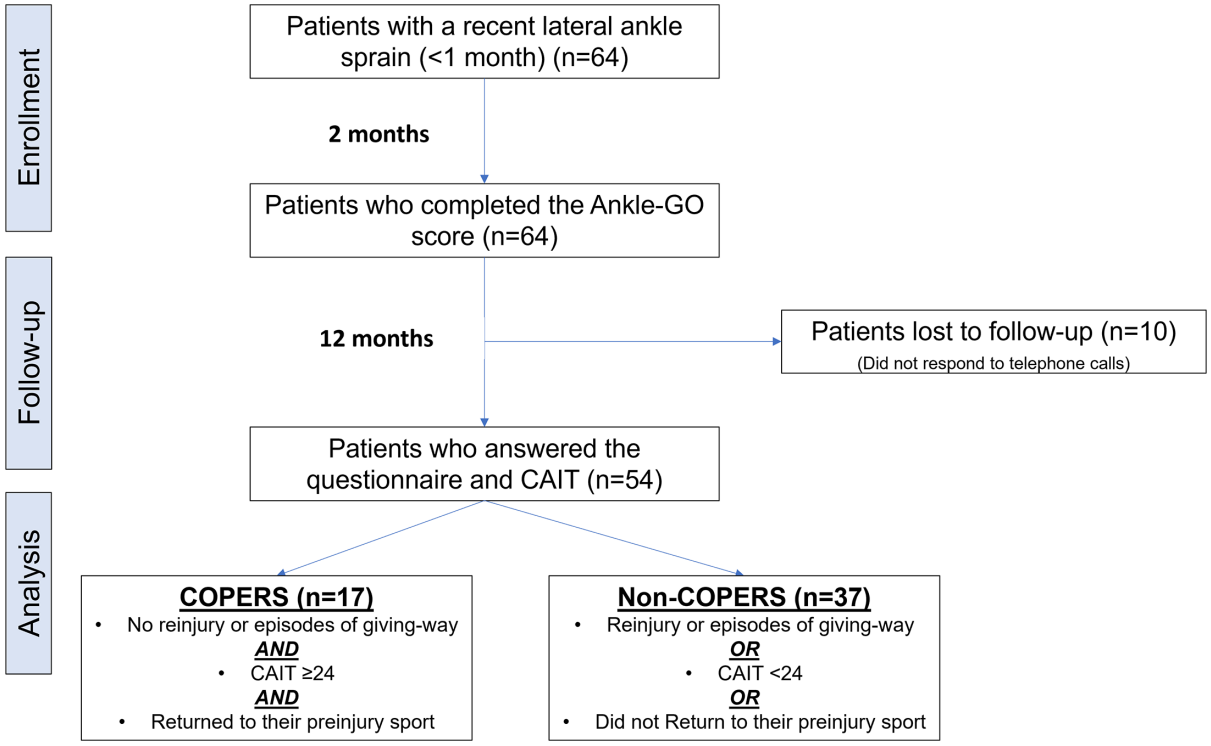

Figure 1 Flowchart of inclusion and analysis. CAIT, Cumberland Ankle Instability Tool.

Table 1 Participants baseline characteristics (means±SD or median and IQR for non-parametric tests) and comparisons between copers and non-copers 1 year after lateral ankle sprain

Participants at baseline (n=64)			
Sex	36 females (56%) and 28 males (44%)		
Age (years)	34.8±13.2		
Type of sport, n (%)			
Pivot contact	19 (30%)		
Pivot	22 (34%)		
In line	23 (36%)		
Level of sport, n (%)			
Professional	2 (3%)		
Intensive (>6 hours per week)	21 (33%)		
Regular (2–6 hours per week)	34 (53%)		
Casual (<2 hours per week)	7 (11%)		
Total protocol completion (n=54 patients)			
Lost to follow-up	10/64 patients (15%)		
	Copers, n=17 (31%)	Non-copers, n=37 (62%)	P value
Sex (males/females)	11/6	12/25	0.026
Age (years)*	27±19	34±15	0.285
Ankle-GO (points)	9.9±4.9	6.9±3.7	0.015
Type of sport, n (%)			
Pivot contact	6 (35%)	9 (24%)	0.677
Pivot	3 (18%)	9 (24%)	
In line	8 (47%)	19 (52%)	
Level of sport, n (%)			
Professional	1 (6%)	1 (3%)	0.869
Intensive (>6 hours per week)	6 (35%)	12 (32%)	
Regular (2–6 hours per week)	8 (47%)	21 (57%)	
Casual (<2 hours per week)	2 (12%)	3 (8%)	

*Non-parametric test (data are expressed in median and IQR with Mann-Whitney U tests).

from previous work illustrating SEBT performances and FAAM scores at 6 months postinjury were predictive of becoming coper 1 year after a first-time LAS.[16] Similarly, previous work demonstrated that an inability to complete jumping and landing tasks within 2 weeks of a first-time LAS was predictive of CAI.[16] These tasks are similar to the SHT and F8T used in the current study. The cumulative results underline the complex and multidimensional aspects of LAS recovery,[5] and strengthen the argument that clinicians should use an assessment battery that encompasses the whole spectrum of LAS impairments to guide RTS decision-making (figure 3). The cumulative results also underscore that the true coping mechanism(s) responsible for a full recovery and the timing of such mechanisms remain speculative as similar outcomes demonstrate different predictive abilities at different time points postinjury.[16] In the present cohort, less than one-third (31%) of patients were classified as copers at 1 year after injury. This is consistent with results showing only 26% of those that sustain a LAS become copers.[7] However, Doherty *et al* indicated about 60% of LAS patients become copers 1 year after a first-time LAS.[16] More recently, Terrier *et al*,[17] revealed that 52% patients from their cohort fully recovered. Differences may be attributed to the definitions of copers used by Doherty *et al* and Terrier *et al*.[16 17] Both author groups relied solely on a singular patient-reported outcome without considering recurrences, episodes of giving way or above all the ability to return to preinjury activity.

Another important result of this study is that male patients are almost five times more likely to become copers. Sex has

Table 2 2×2 contingency table of coper status and Ankle-GO score

Ankle-GO >11 points	Copers	Non-copers	Total
YES	9 (69%)	4 (31%)	13
NO	8 (19%)	33 (81%)	41
Total	17	37	54

Table 3 Distribution of the raw values (mean±SD or median±IQR for non-parametric tests) of the 2-month Ankle-GO score according to the recovery status (copers vs non-copers) 1 year after lateral ankle sprain

	Copers (n=17)	Non-copers (n=37)	P value
$FAAM_{adl}$ (%)*	92.9±8.3	84.5±14.3	0.058
$FAAM_{sport}$ (%)*	71.9±34.4	59.4±34.4	0.097
ALR-RSI (%)*	55.8±46.7	46.7±29.2	0.083
SLS (errors)*	2±4	4±3	0.232
SEBT COMP (%)	82.3±6.2	78.4±7.8	0.079
SEBT ANT (%)	63±5.2	59.2±7.2	0.054
SEBT PM (%)	95.2±7.1	90.7±9.1	0.079
SEBT PL (%)	90.3±9.9	85.3±11	0.118
SHT (s)	17.5±11.2	23.7±11.2	0.065
F8T (s)*	14.5±5	19±16	0.057

*Non-parametric test (data are expressed in median and IQR with Mann-Whitney U tests).
ALR-RSI, Ankle Ligament Reconstruction Return to Sport after Injury; ANT, Anterior; COMP, Composite score; $FAAM_{adl\text{-}sport}$, Foot and Ankle Ability Measures-Activities of daily living & sport subscales; F8T, Figure of Eight Test; PL, posterolateral; PM, posteromedial; SEBT, Star Excursion Balance Test; SHT, Side Hop Test; SLS, Single Leg Stance.

already been pointed out as a risk factor for LAS reinjury,[27] but to our knowledge this is the first time that sex has been identified as a key indicator of coper status. It could be speculated that sensorimotor differences between sexes exist and could limit the ability of female patients to become copers.[44] Recent data suggests that females were more likely to perceive ankle instability compared with males.[45] An approach towards a gendered care for ACL injuries has been proposed[46] and may also need to be advocated for foot and ankle rehabilitation to mitigate chronic issues in females.[47]

Strength and limitations

The Ankle-GO score is the first objective criteria that predicts copers status following a LAS. A key discussion point is the definition of coper. As previously highlighted by Wikstrom and Brown,[11] numerous descriptions exist, but one common characterisation is that patients resume all preinjury activity within a year after injury. Therefore, several criteria were selected to define copers in this study. First, a follow-up period of 12 months was chosen during which no recurrent sprain or episodes of giving way could have occurred. In addition, a CAIT score ≥24 was required and, finally, patients had to have returned to their preinjury activity to be considered as copers.[11 14 16] However, other studies quantifying the rate of full recovery[16 17] did not determine if their patients returned to their preinjury activity. As suggested by Hertel and Corbett, a coper should not change the type or volume of physical activities that he or she participated in preinjury.[5] Adapters are rarely described following LAS but very common in the context of ACL injuries.[48] Adapters change their physical activity to avoid symptoms or recurrent sprains and therefore should not be considered fully recovered. In the context of the RTS continuum,[19 49] adapters do not returned to their defined sport, whereas copers do return for the long term (ie, 12 months postinjury). In the current study, six patients (15%) within the non-coper group would be classified as adapters. Future research should further explore post-LAS adapters and why they chose to modify their activities as these reasons may represent opportunities for either physical or psychological intervention.

No objective measure is a clear indicator of LAS recovery and perception-based outcomes have shown the greatest ability to discriminate between copers and those with CAI.[18] Further studies are needed to assess the complex nature of coper status adequately and more objectively. Recurrence during the follow-up was assessed through a single phone survey at 1 year without any imaging and was only reported on the affected limb.[11 18 29] Thus, the number, severity and exact timing of reinjury as well as the occurrence of contralateral LAS were not examined. Hiller *et al* demonstrated that a previous ankle sprain was a predictor of future contralateral ankle sprain[50] and CAI is often considered as a bilateral issue. Further studies are needed to evaluate the association between Ankle-GO score and recurrences on the contralateral limb.

The specific content of rehabilitation sessions was not controlled and could have impacted the outcomes. Since the guidelines from the IAC suggest tailoring rehabilitation to each patient's unique deficits, a thorough examination of rehabilitation protocols is recommended but beyond the scope of this study. The exact grade of LAS severity was not taken in account in the model despite being systematically assessed. There is limited and contradictory evidence that clinical tests can provide an accurate assessment of injury severity[31] and LAS severity does not necessarily predict

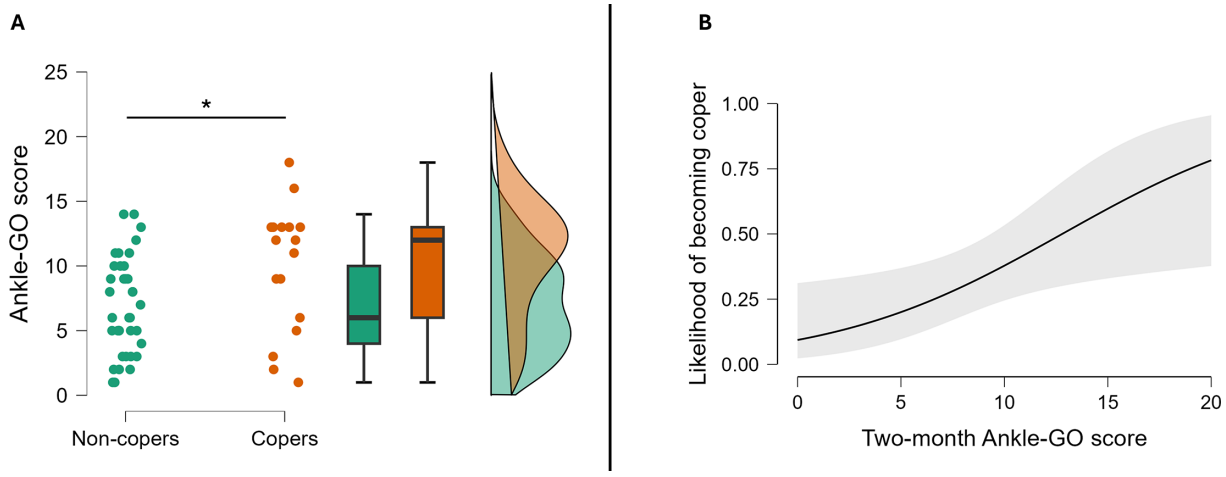

Figure 2 (A) Ankle-GO scores at 2 months among copers and non-copers 1 year after lateral ankle sprain injury. (B) Estimate plot of the probability to become coper according to 2-month Ankle-GO score. *p=0.015 The shaded area represents the 95% CIs.

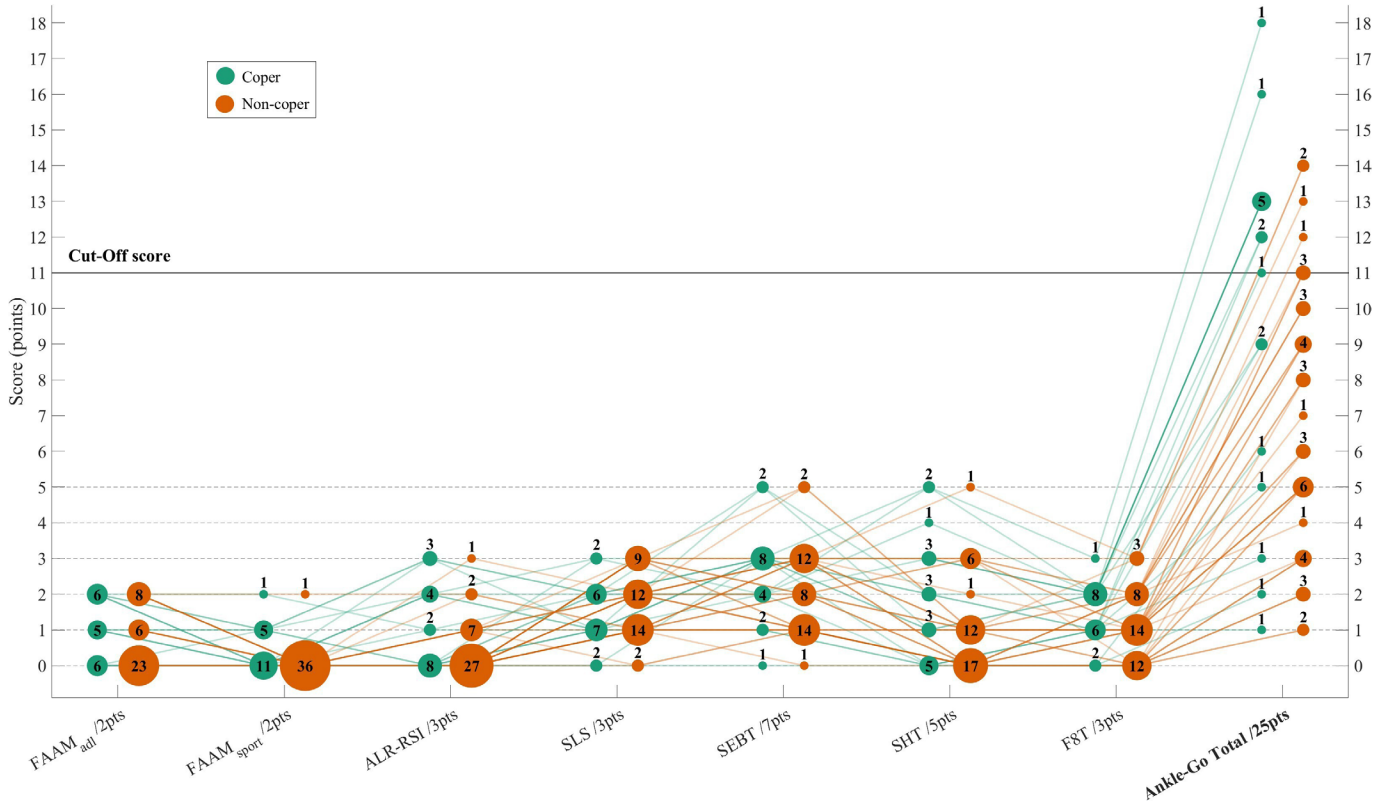

Figure 3 Graphical representation of the scores obtained by copers (green) and non-copers (orange) individuals for each Ankle-GO item and the total score. The size of the circles represents the number of patients who obtained this score. The opacity of the lines connecting the circles reflects the number of patients who have followed this trajectory (ie, the more transparent the line, the smaller the number of patients). ALR-RSI, Ankle Ligament Reconstruction Return to Sport after Injury; ANT, anterior; COMP, composite score; $FAAM_{adl\text{-}sport}$, Foot and Ankle Ability Measures Activities of daily living and sport subscales; F8T, Figure of Eight Test; PL, posterolateral; PM, posteromedial; SEBT, Star Excursion Balance Test; SHT, Side Hop Test; SLS, Single Leg Stance.

reinjury or development of CAI.[15 17 51] We have also included patients regardless of injury history (number of previous LAS) prior to this study to mimic the fact that clinicians do not select their patients. Future studies should evaluate the impact of the number of sprain episodes on coper status at 1 year after a LAS. Finally, the limited sample size of this study should temper the generalisability of the results. In the present study 10 patients were lost to follow-up which is comparable to that of the Doherty *et al* study (15%),[16] but higher than that of Pourkazemi *et al* (5%)[43] and lower than that of Terrier *et al* (43%).[17]

The wide CIs and large OR estimates reflect the variability of the prediction but confirm the existence of a significant positive association between the Ankle-GO score and the likelihood of becoming a coper after LAS. The results from the sensitivity analysis are consistent with the primary analysis, demonstrating robustness in the study findings. This approach enhances the reliability of our conclusions despite the challenges posed by missing data.

Further investigations are needed with large sample sizes to confirm the association between Ankle-GO score and full recovery following LAS. Given that most of the patients were not high-level athletes, it is difficult to generalise the results for this population. We believe that the Ankle-GO values identified in this study are usable for competitive and recreational athletes, and further studies are needed in elite athletes, particularly for analyses according to type of sport.

Clinical implications

The goal of rehabilitation for any musculoskeletal condition, is to obtain a full recovery. Specifically for LAS, the goal is helping patients become a coper.[5 11] Using the Ankle-GO score and the free online application (https://anklego.com/) during the RTS continuum can help clinicians and patients better understand the patient's likelihood of returning to the level of sport they desire,[24] the risk of a recurrent LAS[25] and risk of having a poor clinical outcome at 12 months postinjury. An Ankle-GO score <11 points should be interpreted as poor and that the patient needs additional rehabilitation. From a clinical perspective, results support the work of the IAC and Hertel's model, which showed that each LAS patients have specific deficits. Figure 3 shows the patients' performance on the seven Ankle-GO items. For both copers and non-copers, there is no common pattern, but rather individual trajectories depending on the tests. This confirms the need for individualised rehabilitation for each patient, based on the deficits identified during assessments. Rehabilitation, and in particular the late phase of RTS continuum, must be tailored rather than adopting a one size fits all approach. It should also be noted that all patients who did not become copers scored below 14 points (figure 2A), which could also be an important threshold before allowing RTS but additional research is needed. For methodological reasons and to limit the biases linked to different recovery times between patients, we chose to carry out the Ankle-GO score 2 months after the injury. However, in day-to-day practice, we believe that it is more appropriate to perform

the tests according to the patient's symptoms and the progress of rehabilitation. We recommend carrying it out when the practitioner and the patient are considering RTS. It is also worth noting that the Ankle-GO cannot be used to decide on a full return to performance in sports that place high demands on the ankle, since it does not include assessments in a state of cognitive stress, fatigue or specific field tests at this time. Allowing RTS after a LAS should be a shared decision and cannot rely solely on functional scores or self-reported questionnaires. The Ankle-GO score in isolation cannot ensure informed decision-making and clinicians need to adopt a more comprehensive assessment approach to LAS recovery.[19 49] Practitioners should also be more conservative with female LAS patient given that they were five times more likely to have a poor clinical outcome at 12 months postinjury.

CONCLUSION

Ankle-GO score seems to be a relevant tool to help clinician identifying patients who will become a coper 1 year after LAS. Patients who score >11 points is twelve times more likely to fully recover. In addition, males exhibit a five times higher chance of becoming copers. Results confirm the multidimensional nature of the LAS recovery as no isolated item within the Ankle-GO battery was able to predict coper status. Ankle-GO might be an interesting score to identify altered functional performance and decreased levels of self-reported function in LAS patients to guide decision-making throughout the RTS continuum. Further studies are needed to confirm the role of this score to predict full recovery following LAKs.

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Construction of the Ankle-GO score

The Ankle-GO is a composite score based on the sum of 7 components for an objective evaluation of the main deficits associated with LAS or CAI. It was calculated from 4 functional tests: the Single Leg Stance (SLS) on a firm surface, the modified Star Excursion Balance Test (mSEBT), the Side Hop Test (SHT) and the Figure-of-8 Test (F8T). In addition, 2 patient self-reported questionnaires were used: the Foot and Ankle Ability Measure, involving two subscales evaluating activities in daily life ($FAAM_{adl}$) and sports ($FAAM_{sport}$), as well as the Ankle Ligament Reconstruction-Return to Sport after Injury (ALR-RSI).

The system to calculate points for each of the items is set out in the following table and presented below (Picot et al., 2024).

- Self-reported questionnaires
    - Ankle Ligament Reconstruction-Return to Sport after Injury (ALR-RSI), 3 points.

This questionnaire measures psychological readiness to return to sport among patients with injured ankle. It includes 12 questions, from 0: No confidence to 10: Fully confident. The global score is obtained by dividing the total score by 1.2 to obtain a percentage (%) (Sigonney et al., 2020).

    - Foot and Ankle Ability Measure (FAAM), a total of 4 points.

This evaluates patient-reported function and is composed of two subscales (2 points each): 21 for the evaluation of daily activities ($FAAM_{adl}$), and 8 items for sports ($FAAM_{sport}$) (Carcia et al., 2008). The patients respond to each item by completing a 5-point scale (0: Incapable of performing the exercise – 4: without difficulty) or by responding «Not-Applicable» when the

activity in question is limited by something other than the foot or ankle. The percentage of each subscale is then determined.

- Functional performance tests
    - Single Leg Stance (SLS) on a stable surface, 3 points.

The subject must stand barefoot on one leg, with the knee slightly flexed (10°), hands on the hips for 20 seconds with the eyes closed. This test evaluates static postural control based on the participant's number of errors. One error was recorded for any of the following: lifting hands off hips, moving the thigh into more than 30° of flexion or abduction, lifting the forefoot or heel, remaining out of the testing position for more than 5 seconds, or opening eyes. The practitioner counted and added up the number of errors on each leg (Riemann et al., 1999).

After two learning sessions, the test was performed once on each foot.

- Modified Star Excursion Balance Test (mSEBT), 7 points.

The patient stands barefoot on the tested foot in the center of a « Y » formed by three branches. The subject must reach as far as possible with the opposite leg in the three directions: anterior (ANT), posteromedial (PM) and posterolateral (PL), then return to the original position. The trial is refused if the subject takes his/her hands off the hips, if the weight-bearing leg moves or if the heel is raised, if s/he loses balance or falls, or s/he transfers his/her weight on the non-weight-bearing foot. To obtain comparable results the distances obtained are normalized in relation to the length of the participant's leg (from the anterior and superior iliac spine to the medial malleolus). After four learning trials in each direction for each leg, three trials were recorded and averaged.

The composite score (COMP) was then determined for each leg and corresponding to the average of the three directions (ANT, PM and PL).

One point was added if the measurement in the ANT direction was above 60% and another point if the measurement in the direction of PM was above 90% (Rosen et al., 2019).

- Side Hop Test (SHT), 5 points.

This test involves hopping laterally and medially as fast as possible 10 times between two lines 30cm apart (Docherty et al., 2005). The first hop is always towards the outside. If the patient touches the line, that back-and-forth hop is not counted.

- Figure-of-8 test (F8T), 3 points.

This test involves skipping in a figure 8 around two posts 5m apart as fast as possible (Caffrey et al., 2009). The patient has to perform two consecutive laps (for a total distance of 20m). Because Caffrey et al.(Caffrey et al., 2009) have clearly shown the importance of assessing feelings of giving way in patients with LAS or CAI, one additional point was added for each test if the patient did not experienced instability during the tasks.

Table. List of tests and questionnaires used for the construction of the Ankle-GO score and system to determine the points for each component.

	TESTS		RAW VALUES	POINTS	MAXIMUM SCORE
FUNCTIONAL PERFORMANCE TESTING	**Single leg stance test (SLS)**		> 3 errors	0	**3**
			1 - 3 errors	1	
			0 error	2	
			No apprehension	+1	
	Star excursion balance test (SEBT)		< 90%	0	**7**
			90 - 95%	2	
			> 95%	4	
			Anterior (ANT) > 60 %	+1	
			Posteromedial (PM) > 90 %	+1	
			No apprehension	+1	
	Side hop Test (SHT)		> 13 s	0	**5**
			10 - 13 s	2	
			< 10 s	4	
			No apprehension	+1	
	Figure-of-8 hop Test (F8T)		> 18 s	0	**3**
			13 - 18 s	1	
			< 13 s	2	
			No apprehension	+1	
PATIENT REPORTED OUTCOME MEASURE	**Foot and Ankle Ability Measure (FAAM)**	**Activities of Daily Living**	< 90 %	0	**2**
			90 – 95 %	1	
			> 95 %	2	
		Sport	< 80 %	0	**2**
			80 – 95 %	1	
			> 95 %	2	
	Ankle ligament reconstruction-return to sport after injury (ALR-RSI)		< 55 %	0	**3**
			55-63 %	1	
			63 – 76 %	2	
			> 76 %	3	
Ankle-GO	**25**				

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