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Return-to-play probabilities following new versus recurrent ankle sprains in high school athletes

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ABSTRACT

Objectives: Although ankle sprains have the highest recurrence rate of any musculoskeletal injury, objective estimates of when an athlete is likely to return-to-play (RTP) are unknown. The purpose was to compare time to return-to-play probability timelines for new and recurrent ankle sprains in interscholastic athletes.
Design: Observational.
Methods: Ankle sprain data were collected at seven high schools during the 2007–2008 and 2008–2009 academic years. Ankle sprains were categorized by time lost from participation (same day return, next-day return, 3-day return, 7-day return, 10-day return, >22-day return, no return [censored data]). Time-to-event analyses were used to determine the influence of ankle injury history on return-to-play after an ankle sprain.
Results: 204 ankle sprains occurred during 479,668 athlete-exposures, 163 were *new* (4 censored) and 35 *recurrent* (1 censored). There was no significant difference ($p = 0.89$) between the time-to-event curves for new and recurrent ankle sprains. The median (inter-quartile rage) time to return-to-play for new sprains (inter-quartile range) = 3 days (same day to 7 day return); recurrent sprains = next day return (next day to 7 day return). Noteworthy probabilities [95% CIs] include: same day return (new = 25.2[18.7, 31.9], recurrent = 17.1[6.6, 30.3]); next-day return (new = 43.6[35.3, 52.7], recurrent = 51.4[32.5, 67.5]); and 7-day return (new = 85.9[73.8, 94.4], recurrent = 94.3[47.8, 99.5]).
Conclusions: Previous injury history did not affect time until return-to-play probabilities for ankle sprains. Time until return-to-play analyses that describe the likelihood of return-to-play are useful to clinicians by providing prognostic guidelines and can be used for educating athletes, coaches, and parents about the likely timeframe of being withheld from play.

1. Introduction

Ankle sprains are the most prevalent sports related injury sustained in high school athletics, representing a significant health problem.[1,2] Among recurrent injuries, the ankle is also the most common site[3] and many individuals will go on to develop residual problems, such as pain and recurrent bouts of instability. The recurrent nature of these injuries increase the likelihood of decreased physical activity,[4] post-traumatic ankle osteoarthritis,[5] and resultant increased healthcare costs. It has been estimated that at least 1 out of 3 individuals who suffer an ankle sprain will go on to have recurrent issues.[6] This indicates that current care and decisions for return to activity may be inadequate for ankle sprains. Furthermore, it is currently unknown whether there is a difference in return to activity timelines for first-time and recurrent ankle sprains.

While ankle sprains are the most common injuries associated with sports, there are few prognostic indicators and a lack of objective evidence supporting an estimate of when an athlete will return to participation. Typical tissue healing timeframes for ligaments range into 6–12 weeks[7] for scar tissue to mature to full tensile strength, yet reported timeframes for return-to-play (RTP) indicate that more than 50% of all ankle sprains that occur in high school sports return in less than 1 week.[1] These time frames suggest that athletes are routinely returned to participation prior to complete tissue healing. Moreover, tissue damage may not be a strong prognostic indicator (at least not in isolation) in these cases; objective and evidence-based predictors of when an athlete is likely to RTP following an ankle sprain are needed. While the pattern of how

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injury history affects time to RTP is unpredictable[8] it is unknown if subsequent ankle sprain influences RTP time frames. There is evidence to suggest that recurrent injuries tend to be more severe than the initial and in fact, there may be a cumulative effect on the health of the structure affected.[9] In order to reduce the risk of recurrent injury, minimizing the effects of the initial injury should be paramount among the goals of rehabilitation.[9] When considering the high recurrence rates of these injuries, it may be that individuals who suffer ankle sprains may return to activity earlier than physiologically possible without greatly increasing the risk of recurrent injury.[10]

A method of generating evidence-based, objective estimates of when an athlete is likely to return-to-play is through the use of time-to-event probability analyses. Time-to-event probabilities can be used to estimate how likely an athlete is to RTP following a given injury, and are commonly used to determine survival probabilities for those with life-threatening conditions[11] or risk factors.[12] As with the prognosis of other medical conditions, time-to-event analyses do not take the place of RTP decisions made by the sports medicine clinician for each individual patient, as symptoms and treatment vary for each case. Instead, they provide a framework to augment current RTP decision-making by incorporating objective evidence from epidemiological trends associated with the injury,[13] thereby improving overall prognosis. With prognosis, the rehabilitation process must begin with accurate and precise information to educate the injured athlete about their injury.[14] With improved prognosis and better understanding by the athlete regarding the injury, adherence to the rehabilitation process improves.[15]

Statistical estimates of the probability of RTP following sports-related ankle sprains have not been previously published. To date, there have been no analyses of the timeframe estimates of RTP for new or recurrent ankle sprains. Recurrent ankle sprains are particularly difficult to analyze in this manner since most injury surveillance systems have de-identified records which does not allow for linking multiple injuries to a particular athlete, an important feature for these types of analyses. The probability of RTP for given timeframes is of direct clinical and prognostic importance by providing an evidence-based, objective tool for educating coaches, athletes, and parents on the likely course of RTP following an ankle sprain. Therefore, the primary purpose of this study was to generate statistical estimates of RTP probabilities following sport-related ankle sprain and to compare new and recurrent ankle sprains among high school athletes. Based on previous research on the increasingly severe nature of recurrent injuries[10] we hypothesized that recurrent ankle sprains would have longer RTP estimates that new ankle sprains.

2. Methods

This study employed an observational design. Ankle sprain injury data (academic years 2007–08, 2008–09) were collected for this study from seven high schools of Central [blinded] by the athletic trainer (AT) employed at each high school (7 ATs in total) and entered into an injury surveillance system. Subjects were injured high school athletes who participated in at least 1 of the 2 academic years at any sporting level (varsity, junior varsity, or freshmen). Sports included in this study were football, soccer, cross country, golf, volleyball, cheerleading, basketball, swimming and diving, wrestling, track and field, baseball, softball, and tennis.

The ATs at each included school were informed regarding the definitions of injuries; however this was not strictly enforced. This allowed for more generalizability toward how professionally credentialed and experience clinicians would classify ankle sprains. Each AT reported athlete-exposures and ankle sprain injury data on a standardized injury report that contained the following information: sex, sport, referrals, previous ankle sprain history (new or recurrent injury), and severity based on *time to return-to-play* (T-RTP). These reports were collected monthly by 1 investigator (AR) and entered into an electronic spread sheet for analysis. In the event that there was missing or unclear information within an injury reports, this same investigator contacted the respective AT in order to clarify and complete the injury report.

An *ankle sprain* was defined as injury to the lateral ligamentous or capsular tissue of the ankle. Injuries to the medial ligament structures or the tibiofibular joint were not included. Further, these injuries had to occur during a scheduled school-sponsored practice or game, and required the athlete to report to the AT or physician[1,16] for evaluation. All ankle sprains that required the athlete to be removed from participation and diagnosed as an injury by the treating AT or physician were reported, regardless of time lost from participation.

A *new injury* was defined as an ankle sprain with a sudden, traumatic onset of symptoms with no prior history of that injury. In contrast, a *recurrent injury* was defined as one or more subsequent traumatic sprain that occurred to the same ankle during the same year or any previous year in high school or before.[1,8] Recurrent injuries were documented as recurrent if the athletic trainer had previously documented a same-side ankle sprain in that athlete or if the patient reported a previous ankle sprain in that same ankle, and were entered into the database as such.

Ankle sprain severity was defined in terms of days lost from participation and was reported in RTP time intervals that were similar to those used previously in other sports injury databases.[1,2] These RTP intervals were: *same day return*, *next day return*, *3-day return*, *7-day return*, *10-day return*, *21-day return*, *greater than 22-day return*, *season ended before athlete returned*, or *medical disqualification*. Although previous literature[1,2] has required the athlete to miss at least one day of participation to be counted as an injury, documenting same-day returns as injuries has been used in the literature[17] and reflects current clinical practice. *Athlete exposures* (AE) were defined as one athlete participating in one game or practice. These were also documented by the ATs.

Frequency counts of when an athlete went back to participation following an ankle sprain were generated for each injured athlete and served as the RTP interval. In the cases where the season ended before the athlete was cleared to return to play or the athlete was medically disqualified, the time out of participation was determined by subtracting the date of injury from the date the season ended. All cases where the season ended and the athlete did not return-to-play were referred to as *censored*. By using censored data, we accounted for the fact that all athletes did not get injured at the exact same time-point during their season. *New* and *recurrent* ankle sprains were classified separately. For those athletes who sustained one or more recurrent injuries, only the most recent recurrent injury was used for analysis.

Statistical analyses were performed in SPSS (version 17, SPSS, Chicago, Illinois) and (MATLAB, version R2008b, The MathWorks, Natick, MA). Alpha levels were set a priori at $p < .05$ for all statistical analyses.

Incidence rates (IR) were calculated for new and recurrent ankle sprains. These were presented as injuries per 10,000 AE. The calculation for IR was [(# ankle sprains per sport/#AEs per sport) $\times$ 10,000].

Kaplan–Meier (KM) estimators[18] using censored data were calculated to determine the estimated time-to-event probabilities. Estimated time-to-event probabilities are a predictive probability for how long until athlete with the same injury will return to participation. The event of interest was the athlete returning to participation; the primary outcome *time to RTP* was based on whether the event occurred or not during each time frame. Separate time to RTP probabilities with exact 95% confidence intervals