Is Video-Based Analysis a Valid Method for Determining Mechanisms of Ankle Injuries During Gameplay in the National Basketball Association?

Peter Zeblisky,*† BS, Andrew P. Collins,† BS, Joshua Cassinat,† BS, Joel Riemenschneider,‡ DPT, Pierce Ebaugh,‡ DO, Mohamed K. Shaath,† MD, and Benjamin C. Service,†§ MD

Investigation performed at Orlando Health Jewett Orthopedic Institute, Orlando, Florida, USA

Background: In the National Basketball Association (NBA), lower extremity injuries account for over 70% of games missed, with ankle injuries being the most common. High-quality video analysis has been successful for studying injury mechanism.

Purpose: To (1) determine the validity of video-based analysis as a method to evaluate ankle injury mechanisms in NBA players and (2) analyze the circumstances associated with injury, games missed due to injury, and associated costs in player salary due to time missed.

Study Design: Case series; Level of evidence, 4.

Methods: Ankle injuries were identified using an injury report database, and corresponding videos were searched using YouTube.com to access high-quality video evidence of these injuries during the 2015-2020 NBA regular season. We reviewed 822 injuries, of which 93 had corresponding videos (video subset), in our final analysis. Variables including number of games missed, necessity for surgical treatment, and injury recurrence were reported for the entire cohort. In the video subset, the mechanism of injury and other corresponding situational data were evaluated.

Results: The most common mechanism of injury occurred via ankle inversion (83.9%; n = 78; $P < .001$). These injuries were significantly associated with indirect contact with the player's ankle (79.6%; n = 74; $P < .001$). There were significant differences based on player position, within both the video subset ($P = .008$) and the entire cohort ($P < .001$), with guards being injured the most frequently. The average number of games missed due to injury was 7 games in the video subset and 5 games in the entire cohort ($P = .14$). There were significant differences between the groups in average player salary per game ($133,878 [video subset] versus $87,577 [entire cohort]; $P < .001$).

Conclusion: Despite its low yield of 11.3%, video analysis proved to be a useful tool to determine ankle injury mechanisms as well as the distribution of injuries based on player position. However, this methodology was subject to selection bias, as evidenced by a $50,000 increase in player salary among the video cohort. These findings should be considered when using video analysis in future studies.

Keywords:

Basketball is one of the most common sports played at the recreational, high school, and collegiate levels.[8] Approximately 450 million people engage in the sport worldwide.[7,22] Currently, 546 athletes are active in the National Basketball Association (NBA).[1] Within this population, there was a reported a 12.4% increase in game-related injuries across a 10-year span.[26] In the NBA, lower extremity injuries account for 62.4% of all injuries and 72.3% of games missed due to injury. In addition, the ankle is the most common joint injured, responsible for 14.7% of all injuries.[4] The NBA is a multibillion-dollar industry generating $7.92 billion per season with the average player making $8.32 million per year.[6] Therefore, injuries that cause missed game time can be very costly to these franchises. To develop an injury prevention program, the mechanism of injury must first be well understood. Traditional approaches to identify injury mechanisms include patient histories, detailed written reports, and cadaveric analysis.[16] However, the value of these methods is limited due to their inherent subjective nature. Recently, several studies have employed video-based analysis to analyze injury mechanisms in various sports.[2,3,13,14,19,20,27] Despite

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its use in other sports, no studies have assessed the validity of video analysis as a tool. Moreover, there is a paucity of studies utilizing video-based analysis among NBA athletes.[21]

The purpose of this study was to determine whether using a video-based analysis is a valid methodology to evaluate ankle injury mechanisms in NBA players during the 2015-2020 seasons. Secondarily, we aim to analyze the circumstances associated with injury, number of days missed due to injury, and associated costs in player salary due to time missed for players involved in this subset of videos.

METHODS

To identify potential ankle injuries for the study, a publicly available NBA injury data set that included all reported injuries from the 2015-2020 regular and postseason games were filtered by "ankle injury." The SportsReference database reflects statistics reported by SportRadar, an official partner of the NBA.[15] The database is frequently updated with reliable official injury data from the NBA. Ankle injuries were defined as any fractures, ligamentous injury, tendinous injury, or other soft tissue injuries to the ankle region. All acute ankle injury complaints were verified by NBA injury reports in this study. Once injured players were identified, the cohort was divided into 2 groups: (1) the entire cohort, which included all ankle injuries in the 5-year period to serve as a representative sample; and (2) the subset of ankle injuries that had corresponding video footage. A systematic verification process was implemented, whereby (1) injury footage was obtained from YouTube.com with the search engine terms "athlete name," "year of injury," and "NBA ankle injury"; (2) injuries with high-quality video footage and a clear mechanism of injury were compiled by 2 independent reviewers (P.Z. and A.P.C.); and (3) videos were cross-referenced with official NBA injury reports to ensure their validity.

Data collected surrounding the injury followed the protocol as defined by the International Olympic Committee Consensus Statement,[12] which included the following: (1) scenario (planting/landing); in our study, we defined planting as any act where the player was grounded, mobile, and foot met the floor, and landing injuries were defined as those immediately following a jump; (2) laterality (left/right); (3) position of ankle (neutral, plantarflexion, dorsiflexion, inversion, eversion), as determined by naked eye video analysis; (4) indirect contact with the ankle (yes/no; defined as a force applied by another player that does not directly cause the injury to the ankle but is in the causal chain of events preceding the injury); (5) injury type (new vs recurrent); recurrent injuries were defined as injury to the same ankle within the 5-year review period; (6) player in control of basketball (yes/no); (7) team position (offense, defense, loose ball); (8) player position (guard, center, forward); (9) injury time during the game (stratified by quarter); (10) injury time during the season (before/after All-Star break); (11) shoe type (high-top vs low-top); (12) bracing (use of an external ankle stabilization device) at time of injury (yes/no); and (13) requirement of surgical treatment (yes/no). Additional data were collected regarding the number of games missed and player salary per game from the SportsReference database.[15] Mechanism of injury was assessed by the same 2 independent reviewers and discrepancies were addressed by discussion and agreement.

The exclusion criteria for the video subset included (1) ambiguous injury mechanism, (2) poor-quality video evidence, and (3) injury mechanism disagreement. Inclusion criteria included the following: (1) participants were playing under the NBA at the time of injury, (2) injuries occurred during active gameplay, (3) injuries took place between 2015 and 2020, (4) adequate video visualization was available on media clips, and (5) video clips were available through the public domain.

Of an initial 1098 injuries, 822 were included after screening for duplicates. Regarding the video subset, 104 of the 1098 original injuries contained videos of ankle injuries among 90 unique players. Of these, 11 videos were of poor-quality resolution; thus, the data remaining for statistical analysis included 93 videos (11.3% yield) of 90 unique players with high-quality coverage of the mechanism of injury unanimously agreed upon by the reviewers. Three players had >1 injury video analyzed. Figure 1 shows the selection process for the study groups.

Statistical Analysis

Descriptive statistics were calculated to determine means and standard deviations. A chi-square goodness-of-fit analysis were performed to characterize the injuries and determine associations between variables within both the entire cohort and the video subset. Independent t test analysis was performed to calculate the difference in means between the entire cohort and the video subset analysis for quantitative

*Address correspondence to Peter Zeblisky, BS, University of Central Florida College of Medicine, 6850 Lake Nona Boulevard, Orlando, FL 32827, USA (email: peter.zeblisky@knights.ucf.edu).

†University of Central Florida College of Medicine, Orlando, Florida, USA.

‡Orlando Health Jewett Orthopedic Institute, Orlando, Florida, USA.

§Florida State University College of Medicine, Tallahassee, Florida, USA.

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Ethical approval was not sought for the present study.

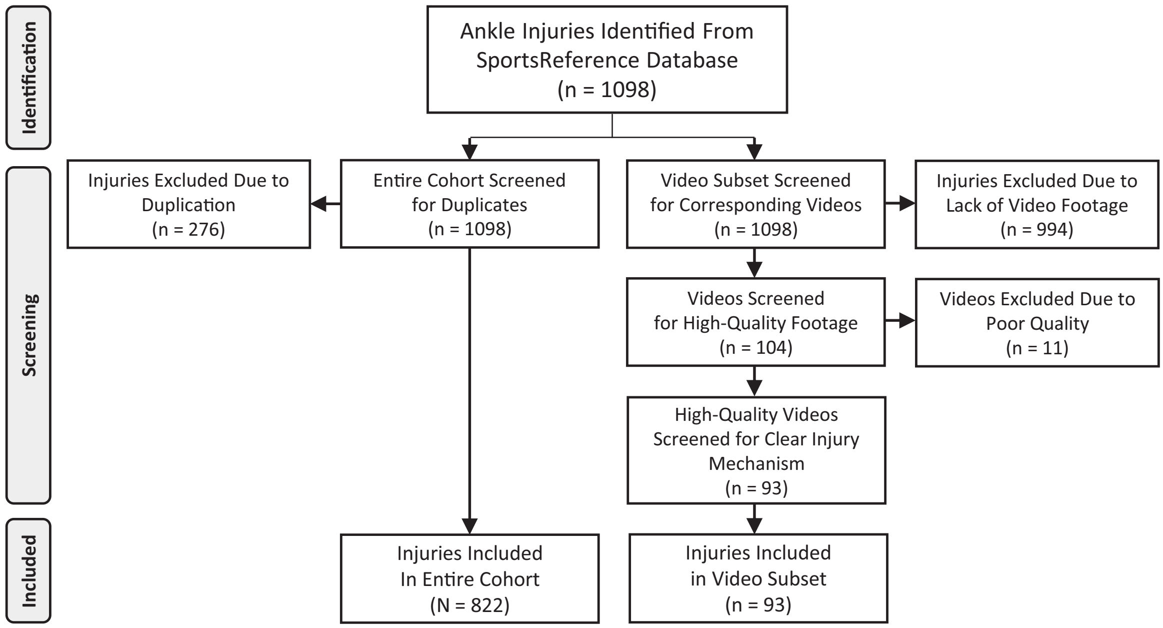

Figure 1. Injury selection process for the study groups.

variables. Critical values for statistical significance were assumed at an alpha level of $<.05$. All statistical analyses were performed using R Studio Version 4.01 (RStudio).

RESULTS

Injury characteristics measured in the entire cohort and within the video subset demonstrated marked differences (Table 1). Notably, our data revealed that assessment of injury laterality revealed significantly more injuries involving the left side within the video subset (61.3% vs 38.7% [right side]; $P = .029$), but no significant differences among the entire cohort ($P = .069$). Regarding position of the ankle when injury occurred found, significantly more injuries occurred via ankle inversion (83.9%; $P < .001$) than in the eversion, dorsiflexion, plantarflexion, or neutral positions. A significantly higher proportion of injuries involved indirect contact to the ankle by another player ($P < .001$). First-time ankle injuries in the NBA were significantly more common than ankle reinjury within the 5-year study period, in the entire cohort, and within the video subset ($P < .001$ for both) (Figure 2). Significantly more injuries occurred on offense than on defense ($P = .017$). There were significant differences in injury distribution based on player position on court, for the entire cohort ($P < .001$), and the video subset ($P = .008$), with guards sustaining the highest percentage of injury in both groups (Figure 3).

When comparing the video subset to the entire cohort, there were no significant differences in the average number of games missed due to injury (7.02 ± 13.2 vs 4.95 ± 7.7 games, respectively; $P = .14$). However, there were significant differences between the groups in player salary per game ($133,878 ± $123,488 vs $87,577 ± $92,093, respectively; $P < .001$) (Table 2).

DISCUSSION

To the best of our knowledge, this is the first study to determine the validity of video-based analysis as a methodology to determine mechanisms of ankle injury within the NBA population. Video analysis was able to capture 11.3% of all injuries included in this study. The video analysis group demonstrated that significantly more injuries involved inversion of the ankle and were associated with indirect ankle contact, consistent with large-scale epidemiologic studies of NBA ankle injuries.[4,10,28]

In addition, both the video subset and the entire cohort showed that guards were injured most frequently. Owing to the mobile nature of the position, guards frequently drive, cut, and jump at high velocity. These circumstances put increased strain on players' ankles and increase the likelihood of a player's ankles coming into contact with another player.[5,23] This may suggest that despite its low sample size, video analysis may provide an accurate analysis of ankle injury mechanisms and injury distribution based on player position. However, further research is required in this area to develop a comprehensive understanding defining why guards may be at increased risk of injury.

As significantly more injuries were new in both groups, it raises concern for subsequent injury, as prior research demonstrated that ankle injuries predispose players to a 5-fold increased likelihood of sustaining a future injury, with recurrence rates as high as 73%.[18,24,25] Although results from our video subset had a recurrence rate of only 11%, this increased to 39.4% when measured in the entire cohort in the 5-year period, demonstrating that studies based solely on video analysis may underreport injury recurrence. This may be a consequence of the inability of video analysis to capture a higher percentage of ankle injuries that may also occur in training or outside of filmed game time.

TABLE 1
Characteristics of the Included Injuries in the Entire Cohort (N = 822) and within the Video Subset (n = 93)[a]

Variable	n (%)	χ^2	*P*	Variable	n (%)	χ^2	*P*
Laterality: entire cohort		3.3	.069	Had control of basketball		0.9	.351
Left	437 (53.2)			No	42 (45.2)		
Right	385 (46.8)			Yes	51 (54.8)		
Laterality: video subset		4.7	**.029**	Time during game		1.1	.786
Left	57 (61.3)			1st quarter	20 (21.5)		
Right	36 (38.7)			2nd quarter	27 (29.0)		
Ankle position		42.7	**<.001**	3rd quarter	23 (24.7)		
Neutral	1 (1.1)			4th quarter	23 (24.7)		
Dorsiflexion	3 (3.2)			Time during season: entire cohort		86.1	**<.001**
Plantarflexion	3 (3.2)			Before All-Star break	544 (66.2)		
Inversion	78 (83.9)			After All-Star break	278 (33.8)		
Eversion	8 (8.6)			Time during season: video subset		0.9	.351
Contact injury		32.5	**<.001**	Before All-Star break	42 (45.2)		
No	19 (20.4)			After All-Star break	51 (54.8)		
Yes	74 (79.6)			Injury recurrence: entire cohort		36.8	**<.001**
Scenario		0.1	.756	No	498 (60.6)		
Planting	45 (48.4)			Yes	324 (39.4)		
Landing	48 (51.6)			Injury recurrence: video subset		54.2	**<.001**
Team position		35.7	**<.001**	No	82 (88.2)		
Loose ball	15 (16.1)			Yes	11 (11.8)		
Offensive	58 (62.4)			Surgery: entire cohort		81.4	**<.001**
Defensive	20 (21.5)			No	807 (98.2)		
Position: entire cohort		54.7	**<.001**	Yes	15 (1.8)		
Guard	326 (39.6)			Surgery: video subset		81.4	**<.001**
Forward	322 (39.2)			No	90 (96.8)		
Center	174 (21.2)			Yes	3 (3.2)		
Position: video subset		9.5	**.008**	Shoe type		16.4	**<.001**
Guard	45 (48.4)			Low-top	27 (29.0)		
Forward	23 (24.7)			High-top	66 (71.0)		
Center	25 (26.9)			Bracing used		77.7	**<.001**
				No	89 (95.7)		
				Yes	4 (4.3)		

[a]Boldface *P* values indicate statistically significant difference within variable ($P < .05$).

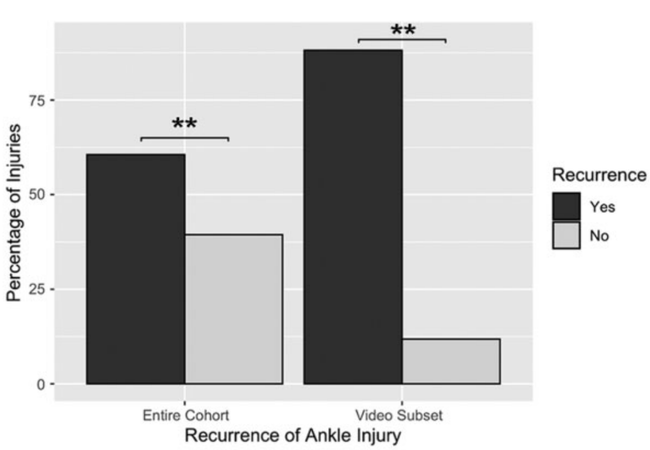

Figure 2. Bar graph comparing the recurrence of ankle injuries in the entire cohort and video subset groups. **Statistically significant difference between positions ($P < .01$).

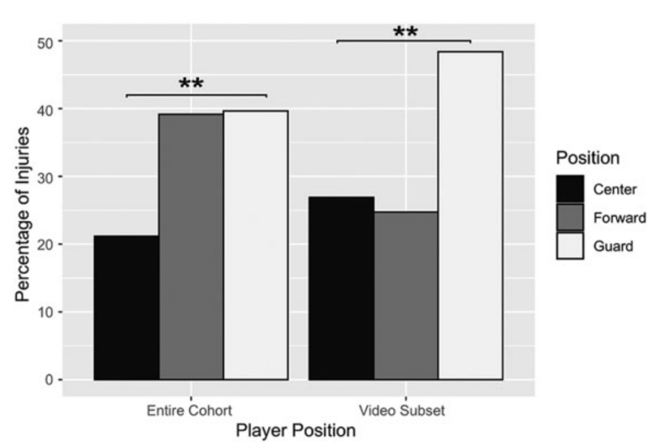

Figure 3. Bar graph comparing player position when injury occurred in the entire cohort and video subset groups. **Statistically significant difference between positions ($P < .01$).

Reinjury rates may be exacerbated by the fact that over half of basketball players do not seek professional treatment following ankle injury.[4,18] This lack of clinical awareness may result in players returning to play prematurely. Markovic et al[17] reported that recurrence of ankle injuries strongly correlates with premature return to sport.

TABLE 2
Comparison of Games Missed and Salary per Game between Study Groups[a]

Variable	Video Subset	Entire Cohort	P
Games missed	7.02 ± 13.2	4.95 ± 7.7	.14
Salary per game	$133,878 ± $123,488	$87,577 ± $92,093	**<.001**

[a]Boldface *P* value indicates statistically significant difference between groups ($P < .05$).

Previous work has indicated that ligament healing time can range from 6 weeks up to 3 months.[9] Results from this study revealed that players in the video subset missed an average of 7 games (14 days) and players in the entire cohort missed an average of 5 games (10 days), indicating that players may be returning to play prematurely.

There were significant differences between the video subset and entire cohort in the average salary per game. Injuries within the video subset averaged $46,300 more per game. This increase is likely due to selection bias on behalf of the individuals uploading the videos. More popular players likely have increased coverage due to the fiscal and social ramifications surrounding their injury within the video analysis subset. This selection bias may limit the generalizability of video analysis within the entire NBA population and corroborates a recent finding evaluating the utility of public databases.[11]

Limitations

This study has several limitations. Given that the study only analyzed injuries from the 2015-2020 seasons and dynamic nature of how athletes play the sport, our results may only be generalizable for recent NBA ankle injuries. Data were collected exclusively from NBA players and may not be generalizable to other areas of competitive and recreational play. In addition, utilizing publicly available videos, a subset of injuries was excluded due to poor video quality, which may have exacerbated selection bias both on the part of the study video reviewers and that of the individuals uploading the video.

As this was the first study to assess the validity of video analysis and it has been widely used in other sports,[2,3,13,14,19,20,27] future work assessing the efficacy of video analysis in other sports may prove useful. In doing so, we will gain a better understanding of the strengths and weaknesses of video analysis and how we can appropriately employ this methodology in professional athletics.

CONCLUSION

Despite its yield of 11.3%, video analysis proved to be a useful tool to determine ankle injury mechanisms as well as the distribution of injuries based on player position by correctly identifying contact ankle inversion injuries, primarily to guards. In addition, this method was representative of the average number of games players missed due to ankle injury when compared with the entire cohort. However, this methodology was subject to selection bias as evidenced by a $46,300 increase in player salary per game among the video cohort injuries. Consequently, video analysis overrepresented high-status players within the NBA. All these findings should be considered when using video analysis in future studies.

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