

# Incidence and Variance of Knee Injuries in Elite College Football Players

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## ABSTRACT

Knee injuries are among the most common musculoskeletal injuries in US football players. The literature includes little information about the role of player position and risk for knee injury. We hypothesized that the incidence of knee injury in elite collegiate US football players is high and that type of injury varies by player position.

We evaluated 332 elite collegiate US football players at the 2005 National Football League Combine. All players underwent radiographic examinations, including plain x-rays and/or magnetic resonance imaging when necessary. All knee pathologic conditions and surgical procedures were recorded. Data were analyzed by player position to detect any trends.

Fifty-four percent (179) of the 332 players had a history of knee injury; knee injuries totaled 233 (1.3/player injured). Eighty-six players (25.9%) had a total of 114 surgeries. The most common injuries were medial collateral ligament injury ( $n = 79$ ), meniscal injury ( $n = 51$ ), and anterior cruciate ligament (ACL) injury ( $n = 40$ ). The most common surgeries were arthroscopic meniscectomy ( $n = 39$ ), ACL reconstruction ( $n = 35$ ), and arthroscopic meniscal repair ( $n = 13$ ). A history of knee injury was most common in defensive linemen (68% of players), tight ends (57%), and offensive linemen (57%). Knee surgery was more commonly performed on running backs (36%) and linebackers (34%). There were no significant associations between type or frequency of specific injuries with regard to player position.

Knee injuries are common injuries in elite collegiate football players, and one fourth of these players undergo surgical procedures. However, there were no statistically significant differences in type or frequency of injuries by player position.

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It is estimated that 11% to 81% of participants in US football sustain an injury at some time while playing the sport.<sup>1,2</sup> Numerous injury incidence studies have evaluated players from youth football to college and professional football.<sup>3-8</sup> Knee injuries, along with ankle and hand injuries, are consistently among the most common sites of musculoskeletal injury, making up 20% to 36% of the total number of injuries encountered.<sup>3-11</sup>

Although knee injuries are quite common, few studies have evaluated possible player-position-specific trends in these injuries. One recent study analyzed anterior

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cruciate ligament (ACL) injuries in National Football League (NFL) athletes by position<sup>12</sup>; another recent study analyzed injury patterns in Big Ten Conference football athletes by position.<sup>13</sup> However, most studies have instead focused on reporting only general categories of injuries and their numbers.

In the present study, we sought to determine the incidence of different knee injuries in elite collegiate US football players and the possible influence of player position on these injuries. We hypothesized that knee injuries in US football players are related to player position.

## METHODS

Permission for the study protocol was obtained from our institutional review board and from the NFL Health and Safety Committee. The study took place during the 2005 NFL Combine in Indianapolis, Indiana, where elite college football players with potential professional ability were evaluated by various NFL teams and their respective medical staffs over a 4-day period. The data for this study were collected during each athlete's medical evaluation.

Three hundred thirty-two elite college football players were invited to the NFL Combine. All players attended voluntarily and signed waivers for evaluation. NFL team orthopedic surgeons obtained thorough medical histories and performed thorough physical examinations, with specific detailing on previous injuries and treatments and current status. Medical histories were obtained from players' college training staff records, from professional team

**Table I. Incidence of Knee Injuries and Knee Surgeries by Football Position**

Position	No. of Players	Players With History of:			
		Knee Injury		Knee Surgery	
		n	%	n	%
Defensive lineman	50	34	68.0	13	26.0
Defensive back	60	31	51.7	11	18.3
Placekicker	11	3	27.3	2	18.2
Linebacker	35	19	54.3	12	34.3
Offensive lineman	61	35	57.4	18	29.5
Quarterback	24	7	29.2	2	8.3
Running back	36	20	55.6	13	36.1
Tight end	14	9	64.3	4	28.6
Wide receiver	41	21	51.2	11	26.8
All positions	332	179	53.9	86	25.9

scouts, and from players' own reports. Previous medical and surgical records and previous and current imaging studies were analyzed during the medical evaluation. Imaging studies were evaluated for bony, ligamentous, and meniscal pathologies.

Two of the authors evaluated each player to obtain a knee injury history, which was provided by the team or the player. The authors and the player discussed mechanism of injury and playing time lost, and the player's knee was physically examined.

For this study, all athletes with a history of knee injury or knee surgery were identified during the medical evaluation. The information collected included player position, type of knee injury, and all surgical procedures performed. Player positions were defensive back, defensive lineman, linebacker, offensive lineman, placekicker, quarterback, running back, tight end, and wide receiver. Radiographic features and physical findings (range of motion, strength, stability) were used to confirm and further define injury patterns when necessary. Data on estimated playing time lost and nonoperative treatment protocols were not collected.

Statistical analysis was carried out as follows. The association between knee injuries (or procedures) and position was assessed with  $\chi^2$  tests. Only injuries and diagnoses with at least 10 observations were considered. If significant differences were found at 5%, individual cell contributions to the  $\chi^2$  test statistic were computed, and values exceeding 2.5 were noted as a possible source of the significance. All computations and tables were done in R for Windows version 2.1.0 patched (2005-04-18).

## RESULTS

At the 2005 NFL Combine, 332 elite college football players were evaluated: 176 offensive players, 145 defensive players, and 11 placekickers. Offensive linemen ( $n = 61$ ), defensive backs ( $n = 60$ ), defensive linemen ( $n = 50$ ), and wide receivers ( $n = 41$ ) had the largest number of athletes per position evaluated and constituted 64% of athletes at the NFL Combine (Table I).

A history of a knee injury sustained while playing football was reported by 179 players (54%). Knee injuries totaled 233. Of these players, 84 (47%) were defensive

players, 92 (51%) were offensive players, and 3 (2%) were placekickers (Table I).

The most common knee injuries (Table II) were medial collateral ligament (MCL) tears (73 players, 79 injuries), lateral or medial meniscal injuries (47 players, 51 injuries), ACL injuries (34 players, 40 injuries), and tendonitis (17 players, 17 injuries). Defensive linemen (68%), offensive linemen (57%), and tight ends (64%) were the players who sustained knee injuries most often; quarterbacks (29%) and placekickers (27%), least often. There was no significant association between type or frequency of specific injuries with regard to player position.

MCL injuries were by far the most common injury, with 20 (33%) of 61 offensive linemen and 14 (28%) of 50 defensive linemen affected. A history of a medial or lateral meniscal injury was documented in 47 (14%) of the 332 players. Thirty players sustained a total of 34 lateral meniscal tears. Linebackers (17%, 6/35) and running backs (8%, 3/36) were at highest risk. Seventeen players sustained a total of 17 medial meniscus tears. Running backs (8%, 3/36) and tight ends (14%, 2/14) were at highest risk for a medial meniscus injury. ACL injuries were also very common, affecting 34 players (10%). ACL injuries occurred most often in offensive players: tight ends (21%, 3/14), wide receivers (17%, 7/41), and running backs (11%, 4/36). None of these positional differences in injury incidence was found to be statistically significant ( $P < .05$ ).

Overall, 114 surgeries were performed on 102 players (57 offensive players, 43 defensive players, 2 special teams players). Running backs (36%), linebackers (34%), and offensive linemen (30%) had the highest percentage of players with a history of surgery, but these differences were not significant.

Of the surgical procedures performed, the most common was arthroscopic meniscectomy (34%, 39/114). Linebackers (23%, 8/35) and running backs (25%, 9/36) were the positions most often operated on for meniscal injuries. Overall, meniscectomies were performed on 34 players, including 8 running backs and 7 linebackers. Twelve players, including 5 wide receivers, underwent meniscal repairs. Statistical significance was found in the incidence of meniscal repair in wide receivers ( $P = .03$ ) No

**Table II. Summary of Injuries and Surgeries**

Injury	No. of Players With Injury	Total No. of Injuries	No. of Players With Surgery	Total No. Surgery of Surgeries	Rate
ACL tear/sprain	34	40	28	35	87.5
MCL tear/sprain	73	79	3	3	3.8
Medial meniscal tear	17	17	16	16	94.1
Lateral meniscal tear	30	34	29	36	97.1
PCL tear/sprain	4	4	1	1	25
Osteochondral defect	8	8	7	7	87.5
Tendonitis	17	17	0	0	0

Abbreviations: ACL, anterior cruciate ligament; MCL, medial collateral ligament; PCL, posterior cruciate ligament.

**Table III. Common Knee Surgeries<sup>a</sup> by Football Position**

	Position									Total
	DL	DB	PK	LB	OL	QB	RB	TE	WR	
No. of players	50	60	11	35	61	24	36	14	41	332
No. of players with surgery	15	13	2	16	22	2	13	6	14	103
% of total no. of players/ % of injuries requiring surgery	15.1/ 14.6	18.1/ 12.6	3.3/ 1.9	10.5/ 15.5	18.4/ 21.4	7.2/ 1.9	10.8/ 12.6	4.2/ 5.8	12.3/ 13.6	
No. of players with:										
ACL reconstruction	4	4	0	3	4	2	3	3	5	
Meniscal repair	0	2	0	1	1	0	1	2	5*	
Meniscectomy	6	5	1	7	6	0	8	0	1	

Abbreviations: DL, defensive lineman; DB, defensive back; PK, placekicker; LB, linebacker; OL, offensive lineman; QB, quarterback; RB, running back; TE, tight end; WR, wide receiver; ACL, anterior cruciate ligament

<sup>a</sup>Do not include revisions.

\**P*<.05.

other differences were statistically significant. Meniscal injuries (medial or lateral) led to surgery 96% (45/47) of the time (Tables II, III).

ACL surgeries were also quite common (Tables II, III). Thirty-four players sustained 40 partial or complete ACL tears; of these 34 players, 28 underwent reconstruction. An additional 6 players had partial ligament tears or sprains (5 underwent nonoperative treatment, 1 underwent arthroscopic knee débridement). Five players (1 quarterback, 1 running back, 1 linebacker, 1 defensive back, 1 tight end) sustained bilateral ACL tears. One tight end who underwent bilateral ACL reconstructions reruptured and required a third ACL reconstruction. Tight ends (21%, 3/14) and wide receivers (12%, 5/41) were the players most likely to sustain complete ACL tears with subsequent reconstruction, but these differences were not significant. Regarding graft used for the 34 ACL reconstructions, 25 used bone–patellar tendon–bone (BPTB) autograft (74%), 5 used hamstring autograft (15%), 2 used allograft Achilles (6%), and 1 used allograft BPTB (3%); 1 graft type was unknown.

There were 4 posterior cruciate ligament (PCL) injuries. No player had PCL reconstruction. One player with a partial PCL injury underwent arthroscopic knee débridement (Table II).

Although MCL injuries were the most common, only 4% (3/73 players) of these injuries led to surgery (Table II). One linebacker and 1 offensive lineman underwent MCL repairs, and 1 additional offensive lineman underwent

MCL reconstruction. Lateral collateral ligament injuries were uncommon (1 player, treated nonoperatively). None of these differences in incidence of injuries or surgeries was significant.

Overall, 5 players required revision surgery. One linebacker sustained an osteochondral injury; initial treatment with open reduction and internal fixation failed, and débridement was then performed. As mentioned, 1 tight end with bilateral ACL injuries and subsequent bilateral reconstructions sustained a repeat ACL tear that required revision ACL reconstruction. Two players (1 linebacker, 1 wide receiver) sustained lateral meniscal tears; these injuries were initially treated with partial meniscectomies but remained symptomatic, and repeat partial meniscectomies were performed. Last, 1 defensive back sustained a lateral meniscal tear that required 2 separate meniscal repairs.

## DISCUSSION

We found knee injuries to be common in elite football players. Whereas annual incidence ranged from 13% to 22% in previous epidemiologic studies,<sup>4-7,9,10,14</sup> almost 54% of players who attended the 2005 NFL Combine had a history of knee injury. The knee joint is highly susceptible to injury in football players with increasing exposure, and is at higher risk as opponents become stronger and more skilled.

In a previous study,<sup>15</sup> we showed that a history of shoulder injury was a risk factor for repeated injury (1.3 shoul-

der injuries per player injured); in the present study, mean number of recurrent injuries was the same (1.3 per player injured). Results from these studies support the findings of Turbeville and colleagues<sup>16</sup>—that increasing experience and previous injury are risk factors for subsequent injury. Fifty-six percent of injuries in the present study were not treated surgically, but the percentage varied with injury type: ACL and meniscal injuries had a high rate of surgery, whereas MCL injuries had a very low rate of surgery. In addition, different player positions show different injury patterns. Overall, ACL injuries, MCL injuries, meniscus injuries, and tendonitis were the most common diagnoses.

ACL injuries occurred more often in offensive players, with tight ends, wide receivers, and running backs all highly affected. The higher injury risk in these so-called skill positions may be related to the increased cutting and change-of-direction activities required and to the increased risk for a twisting injury on being tackled. A similar mecha-

in linemen, running backs, and linebackers.<sup>12,14,16</sup> An increased risk for MCL injuries among linemen and players with increased playing experience has been documented in previous studies.<sup>15,16</sup>

Meniscal tears are associated with concurrent ligamentous injuries (ACL, MCL, PCL) and with running activities that involve cutting or pivoting movements. Thus, in the present study, football positions associated with high ligamentous injury rates (running backs, linebackers, defensive linemen) and football positions associated with cutting activities (defensive backs, wide receivers) all have meniscal injury rates above 10%. In this study, 49 of 51 meniscal tears were treated surgically, most with partial meniscectomies as opposed to meniscal repairs.

Knee injury rates in previous studies involving high school football athletes<sup>4,10,14,19</sup> were found to be 13% to 22% in participating players—much lower than the rate of 54% found in the present study. The reason for this

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nism may explain the 12% incidence of ACL injuries in defensive backs. As expected, the majority of these injuries were treated with operative reconstruction. The specific technique of reconstruction was not identified in the present study.

In contrast, reviewing ACL injuries sustained in the NFL, Bradley and colleagues<sup>12</sup> found that linemen have some of the highest ACL injury rates. Defensive linemen (39%), defensive backs (38%), offensive running backs (32%), and offensive linemen (30%) were found to be at highest risk. The increased risk faced by NFL linemen (versus collegiate linemen) might be explained by the fact that NFL players may be more likely to have previous knee injuries and more playing experience than collegiate players.

MCL injuries were most common among both offensive and defensive linemen as well as linebackers and running backs. Linemen are subjected to multiple potential injury mechanisms, including blocking techniques such as “chop blocks” and “cut blocks,” whereby opposing players attempt to block them by undercutting their legs. An additional mechanism involves a player’s falling into or “rolling up” onto the lateral aspect of another player’s knee, creating an acute valgus force. Similar mechanisms could explain the increased MCL injury rate in linebackers and running backs, with the latter having the additional risk for injury while being tackled by one or more defensive players. These injuries are known to heal well with nonoperative treatment.<sup>17,18</sup> Accordingly, only 3 players in our series underwent primary repair or reconstruction of an MCL injury.

These numbers are consistent with those in previous studies in which increased ACL and MCL tears were found

difference may be underreported or missed injuries at the high school level—a result of lack of consistent medical presence at practices and games. However, previous studies have also documented increased risk with increased playing experience.<sup>15,16</sup> Such a risk factor may seem to go against conventional wisdom, as experienced players are more likely to be proficient at fundamental techniques than less experienced players and thus less likely to be injured. However, in an analysis of Big Ten Conference football injuries, Albright and colleagues<sup>13</sup> found higher injury rates among linemen and skill position players (similar to the rates found in the present study), with knee injuries again among the most common. Whether the higher injury rates for college football players (vs high school players) reflect faster and stronger players, increased exposure, predisposition secondary to previous injuries, or other aspects requires further study.

In contrast to a similar study on shoulder injuries in NFL Combine players,<sup>15</sup> the present study did not show any statistically significant associations between player position and specific injuries or injury rates. In addition, the previous study on shoulder injuries found high injury rates among quarterbacks and defensive backs, which is in contrast to our study, in which these 2 position groups had lower injury rates.

Our study had some limitations. The project was designed to identify associations between player position and knee injury type. Information on mechanism of injury, play type, playing conditions, playing time lost for each injury, and validity of diagnoses was not collected. In addition, data on injuries during special teams play were not analyzed indepen-

dently. This information could be valuable in understanding associations between injuries and player positions. Also, this study is a snapshot of accumulated knee injuries during a single NFL Combine. Some of the injuries may have occurred outside football-related activities. Our sample size was relatively small, which could have influenced the analysis. Also, elite college players with injuries severe enough to prevent them from progressing to the level of the NFL Combine were not included in this study.

Thus, it is difficult to say how well these injury patterns would correlate with those of high school or lower-level collegiate football players. However, we believe that this information is of value to physicians who cover football teams at any level of participation. In addition, incidence and variance of these football injuries may be of interest to players, parents, coaches, and school administrators.

Data were collected from players' teams, professional team personnel, and players' own reports—which kept recall bias to a minimum. However, there is an obvious tendency for players to minimize the effects of their injuries, as such information may reduce their value as professional football players. Obtaining thorough medical histories and performing complete physical examinations can help counter, but cannot eliminate, such selective reporting. Continued evaluation of knee injuries is warranted to determine if the trends found in this study are a consistent representation of knee injuries in this player population.

## CONCLUSIONS

This study illustrates the incidence of self-reported knee injuries in elite collegiate US football players. Knee injuries are common injuries in elite collegiate football players, with one fourth undergoing surgical procedures. Although player position has an impact on type of injuries sustained, and could be used to target injury prevention strategies for elite collegiate athletes, there were no statistically significant differences in type or incidence of injuries by player position.

## AUTHORS' DISCLOSURE STATEMENT

Dr. Bradley is a consultant for Arthrex (Naples, Fla). The other authors report no actual or potential conflict of interest in relation to this article.

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