

Acromioclavicular Joint Separation in UEFA Soccer Players

A Matched-Cohort Analysis of Return to Play and Player Performance From 1999 to 2018

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Background: Acromioclavicular joint (ACJ) separation injuries are uncommon in professional soccer players, threatening future performance and team contributions. Data regarding return to play (RTP) in professional soccer players after ACJ separation are limited.

Purpose: To determine the rate, time to RTP, and player performance after ACJ separation in soccer players from the top 5 professional European leagues when compared with a retrospective, matched cohort of uninjured players.

Study Design: Cohort study; Level of evidence, 3.

Methods: Professional soccer players suffering ACJ separation injuries between 1999 and 2018 were identified and were matched to uninjured players (2 controls to 1 injured player) by position, height, age, season year, and length of time played. Information on date of injury, timing to RTP, and player performance metrics (minutes played, games played, goals scored, assists made, and points per game) were collected from transfermarkt.co.uk, uefa.com, fifa.com, official team websites, public injury reports, and press releases. Change in performance metrics for the 4 seasons after the season of injury were based on metrics 1 season before injury. Univariate comparisons were performed using independent 2-group *t* tests and Wilcoxon rank-sum tests when normality of distributions was violated.

Results: A total 59 soccer players with ACJ separation injuries were identified. Mean age at injury was 24.6 ± 5.3 years. Of these, 81% of the players returned to play, with 69% returning within postinjury season 1. Mean time to RTP was 49.8 ± 24.3 days (5.9 ± 4.1 games). Two players suffered recurrent ACJ separation injuries in their professional soccer careers. There were no significant differences between athletes who sustained ACJ injuries versus control athletes in the number of games played, minutes per game per season, goals scored, assists, or points in the 4 seasons after injury. Defenders played fewer minutes and recorded fewer assists during postinjury season 1 when compared with control athletes.

Conclusion: Of the 59 elite soccer players who sustained ACJ separation injuries during the study period, 81% returned to elite competition. Performance metrics were similar to preinjury levels and matched, uninjured control players.

Keywords: soccer; player performance; return to play; acromioclavicular joint separation; Union of European Football Associations (UEFA)

Acromioclavicular joint (ACJ) separation injuries are common and primarily affect contact sport athletes, frequently occurring as a result of a fall on or a direct blow to the superior aspect of the shoulder with the arm adducted.^{6,27,28} ACJ separations commonly occur in younger male athletes, with a male to female ratio of 8.5:1 and an estimated urban population incidence of 1.8 per 10,000 inhabitants per year.¹

ACJ separation injuries, namely Rockwood type III and IV injuries, present a treatment challenge in younger patients as optimal management remains controversial.¹⁹

Based on the demands placed on soccer players during competition, namely tackling, lunging and jumping, soccer players are at high risk for ACJ separation injuries.²⁸ Soccer players' choice of position has also been shown to affect injury risk, with the incidence of shoulder and elbow injuries being 4.6-times greater in goalkeepers when compared with field players.⁷ Given the high injury risk for goalkeepers, sports organizations such as Federation

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Internationale de Football Association (FIFA) have developed shoulder injury prevention programs to minimize the risk of injuries.³ While prior investigations have reported high return to play (RTP) rates in athletes sustaining ACJ separation injuries, studies^{9,25} have been limited as a result of small sample size and failure to separate data based on sport. Pereira-Graterol et al²³ reported on 11 professional soccer players sustaining ACJ separations, all of whom were able to RTP at a mean of 6 months.²⁵ However, performance after RTP was not evaluated.²⁵ As such, with over 270 million current soccer players worldwide, a better understanding of RTP rates and timing in soccer players after ACJ separation injuries is essential, while also evaluating differences in performance before and after injury.

The purpose of this investigation was to examine the incidence of ACJ separation injuries in elite soccer players from the 5 major European soccer leagues, while assessing RTP rates, time to RTP, and performance metrics after injury when compared with preinjury performance as well as with matched, uninjured control athletes. We hypothesized that there would be high RTP rates after ACJ separation injuries, with postinjury performance metrics comparable with preinjury levels and uninjured, matched controls.

METHODS

A retrospective cohort study of male soccer players sustaining ACJ separation injuries was performed. Players from the 5 major European soccer leagues (English Premier League, Bundesliga, Serie A, La Liga, Ligue 1) from 1999 to 2018 were included. Injured and control players were identified using publicly available sources including transfermarkt.co.uk, uefa.com, fifa.com, official team websites, public injury reports, and press releases via methods established in previous investigations.^{5,8,14,16,18,20-23,26} Injuries and player performance data were manually cross-referenced by 2 authors (E.M.F. and O.Z.L.-G.) via official league injury reports.

Inclusion criteria included players drafted or signed to a team in 1 of the 5 major soccer leagues who had participated in at least 1 game in the season preceding ACJ separation to establish preinjury performance metrics. Characteristic data for each player including age, height, position, and number of seasons played were recorded. Injury and RTP data were collected, including date of injury, days/games missed, date of RTP, and the incidence of subsequent injuries. Performance metrics, consisting of

games played, minutes played per season, goals scored, assists, clean sheets, and conceded goals were recorded.

A matched-cohort analysis was performed to compare the performance metrics of injured players with uninjured, matched controls. A representative group of soccer players who had not sustained an ACJ separation injury were identified and matched to injured players in a 2:1 fashion (ie, 2 controls to 1 injured player) using previously published matching methodology.^{4,5,10,14,22,23} Players were matched by position, height, age (± 2 years), season year (± 1 year), and ± 1 length of time played in each specific league (± 1 year).^{11,12} Players with any other upper extremity injury were excluded from the control group.

Change in performance metrics 1, 2, 3, and 4 years after the year of injury were compared with metrics 1 season before the index year. Comparison of metrics with the previous year minimized the confounding effect of time missed on season performance in the injured cohort. Performance changes at the various postinjury time points were compared between the injured and matched control players by position to account for the roles of player positions. Players in the ACJ separation cohort who were unable to RTP in 1 of the 5 leagues were not included in the performance analysis. Injury history data are summarized as mean and standard deviation, and continuous data are summarized as median and interquartile range. Univariate 2-group comparisons were performed using independent 2-group *t* tests and Wilcoxon rank-sum tests when normality distributions were violated. Chi-square tests were used to compare categorical data. All analyses were performed using R Studio software Version 3.6.2 (R Foundation for Statistical Computing). Statistical significance was set at $P < .05$.

RESULTS

Characteristics and RTP

A total of 59 soccer players sustaining ACJ separation injuries between 1999 and 2018 were identified. The characteristics of injured and matched, uninjured players are presented in Table 1. Defenders recorded the greatest number of ACJ separation injuries. No baseline differences were appreciated in any parameter when comparing each group's respective index season. In athletes sustaining ACJ separation injuries, mean time to RTP was 49.8 ± 24.3 days, with 81% ($n = 48$ of 59) of the players returning to play and 3% ($n = 2$ of 59) sustaining recurrent ACJ separation injuries (Table 2).

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Ethical approval was not sought for the present study.

TABLE 1
Case-Control Match of Player Characteristics^a

	Control (n = 118)	AC Injury (n = 59)	P
Player position, n			≥.999
Attacker	30	15	
Midfielder	30	15	
Defender	46	23	
Goalkeeper	12	6	
Season of play (calendar year)	2013 ± 4.2	2012 ± 3.9	≥.999
Total years played in league	7.1 ± 5.8	7.2 ± 6.0	.999
Height (m)	1.8 ± 0.1	1.8 ± 0.1	.898
Age during season (y)	24.7 ± 4.5	24.6 ± 5.3	≥.999

^aAC, acromioclavicular.

Player Performance Metrics

Over 4 seasons, there were no statistically significant differences overall between athletes who sustained ACJ injuries and control athletes in number of games played, minutes per game per season, goals scored, assists, or points (Appendix Table A1). Athletes with injuries were found to play significantly fewer minutes per game compared with matched controls in postinjury seasons 3 and 4 ($P < .05$ for both).

When athletes were separated based on position, attackers sustaining ACJ separation injuries were found to play significantly more minutes in postinjury season 3 ($P < .05$) (Appendix Table A2). No significant difference in metrics was appreciated when compared with injured versus uninjured midfielders (Appendix Table A3). In defenders, injured athletes participated in significantly fewer games ($P < .05$) and recorded fewer assists ($P < .05$) in season 1 after ACJ separation when compared with uninjured controls (Appendix Table A4). Injured goalkeepers recorded a significantly greater number of clean sheets in postinjury season 1 when compared with matched, uninjured controls ($P < .05$) (Appendix Table A5).

DISCUSSION

The main findings from this investigation were that from 1999 to 2018, 59 professional soccer players sustained ACJ separation injuries, with 81% of the players returning to play after injury, including 69% returning within 1 season of injury. When examining athlete performance in the season before injury compared with the subsequent 4 seasons after injury, no significant decline in the number of games played, minutes played per season, goals scored, assists, or points was appreciated in athletes with ACJ injuries when compared with matched, uninjured control players. This suggests that professional European soccer athletes are able to maintain performance metrics despite ACJ injury.

Of the players sustaining ACJ separation injuries, 81% were found to return to their prior level of play, comparable with rates reported in other contact sports.²⁴ The mean time to RTP was 49.8 days, slightly lower than the 64 days missed as

TABLE 2
Time Loss, Reinjury Incidence, and Return to Sport Rate/Timing (n = 59 players)^a

Variable	Value
Days missed, mean ± SD	49.8 ± 24.3
Games missed, mean ± SD	5.9 ± 4.1
Number of AC reinjuries, n (%)	2 (3)
Return to play, n (% of total) ^b	
At any time point	48 (81)
1 season after injury	41 (69)
2 seasons after injury	47 (80)
3 seasons after injury	48 (81)
4 seasons after injury	48 (81)

^aData are reported as mean ± SD or n (%). AC, acromioclavicular.

^bRepresents percentage of total based on athletes with a history of AC joint injury.

reported by Pallis et al²² examining young athletes in any sport with high-grade ACJ separation.²⁴ The quicker RTP time is likely attributable to increased motivation and medical attention provided to returning professional athletes back to play. As such, while professional soccer players can expect to miss time after injury, the majority of players effectively RTP.

When examining athlete performance in the season before injury compared with the subsequent 4 seasons after injury, no significant decline in performance was appreciated when compared with matched, uninjured control players. ACJ injuries occurring in elite athletes participating in contact sports have been infrequently reported to require operative management, demonstrating the relatively high rate of low-grade injuries amenable to conservative management. When evaluating the incidence of ACJ injuries in National Football League (NFL) athletes from 2000 to 2011 using the NFL Injury Surveillance System (ISS), Lynch et al¹⁵ identified 727 ACJ injuries, with the majority (48.8%) of injuries being low-grade partial sprains and contusions and only 1.3% requiring operative management. Meanwhile, Dragoo et al² examined the National Collegiate Athletic Association ISS, reporting a total of 748 ACJ injuries in collegiate football athletes from 2004 to 2009, of which 96.4% of injuries were partial (type 1 and 2) sprains, with surgery performed in only 2.41% on injuries. Despite time lost from sport during rehabilitation, ACJ injuries appeared largely unlikely to affect performance metrics in elite soccer athletes after RTP, out to 4 seasons after injury.

When performance metrics were evaluated based on player position, attackers produced nearly identical goal and assist totals in the 3 seasons after injury, slightly outscoring their matched uninjured controls. Similarly, midfielders contributed performances consistent with preinjury level of play. The only statistically significant drop in performance was seen in the number of games played by defenders in their first season after ACJ separation, which likely contributed to their statistically significant reduction in assist totals. This finding may point to a position-dependent difficulty in ACJ separation recovery, as defenders often use their shoulders to initiate contact with opponents, potentially forcing defenders recovering

from ACJ separation injuries to compete less aggressively or less effectively. Defenders were also found to suffer the highest number of ACJ separation relative to attackers and midfielders. While the performance metrics on defenders returned to preinjury levels by the second season postinjury, further investigation examining the exact causes of this decrease in performance 1 season postinjury is warranted to optimize player safety and performance.

Goalkeepers were found to sustain ACJ separations at similar rates to field players. This finding does not support the findings documenting greater rates of shoulder injuries rates in goalkeepers when compared with other positions.⁷ The comparable incidence may reflect successful injury prevention via the FIFA 11+ Program, which includes exercises and warm-up techniques aimed at minimizing shoulder injuries in goalkeepers.³ Despite allowing more goals over the course of season 1 after injury, injured goalkeepers were found to have significantly more clean sheets. The exact reason behind this finding is beyond the scope of this study and warrants further investigation.

While most professional soccer players recovered to preinjury level of performance, professional soccer players' longevity after ACJ separation may suffer. Namely, injured players were found to contribute significantly fewer minutes per game during postinjury seasons 3 and 4 compared with their matched, uninjured controls. This finding may point to decreased durability due to a history of ACJ separation; however, player performance metrics of goals and assists are not directly associated with fewer minutes played. Further studies examining long-term follow-up of players sustaining ACJ separation injuries are necessary to determine the impact of ACJ separation injuries on career length.

Limitations

This study is not without limitations. Public data sources were utilized in generating the ACJ separation player cohort. This lends the possibility of a selection bias toward players with publicly reported injuries while not fully capturing information on injuries that remain undisclosed to the public. This limitation is minimized in the context of investigating ACJ separation due to the prolonged rehabilitation necessary after injury and thus the low likelihood of a player's reason for absence remaining undisclosed to the public. Additionally, it was not possible to determine individual players' differences in treatment and rehabilitation without access to official medical record documentation. Moreover, the presence of concurrent injuries to the glenohumeral joint, rotator cuff, or surrounding soft tissue structures was infrequently reported, prohibiting any meaningful analysis being performed based on the presence of associated injuries. The fate of athletes who did not return to the same level of competition, along with the associated reason(s) for being unable to RTP, was also rarely reported. The impact of additional athlete-related and team-based variables on time lost, return to sport timing and performance metrics in athletes sustaining ACJ injuries was not recorded and cannot be inferred based on the current data. ACJ separation may be treated conservatively or surgically; however, this study does not

differentiate outcomes between these treatments, as the degree of ACJ separation injury was not frequently reported. Based on the inclusion criteria and the inherent limitations of using public data sources, a relatively small cohort of athletes was identified, potentially confounding the results reported in this investigation, emphasizing the need for further study in professional European soccer athletes to identify correlations more accurately between athlete performance and ACJ injury. Moreover, the findings from this investigation cannot be generalized to include nonelite soccer athletes. Additionally, creating matched cohorts for elite athletes poses the challenge of maximizing similarities in player characteristics within the restriction of a relatively small and fixed number of players. Prior investigations rely on either manual selection of players or matching of calculated propensity scores to generate matched cohorts. Manual matching imparts an elevated risk of selection bias, whereas the use of an aggregated propensity score imparts the limitation of generating higher levels of imbalance, skewing and potentially masking effects of statistical models calculated.^{11-13,17} To minimize these potential risks of bias associated with matching, we used a matching method that optimizes the matching solution for a given data set and thus minimizing the imbalances within each group that are otherwise unaccounted for with manual and propensity score matching.

CONCLUSION

In elite soccer players participating in the 5 professional European soccer leagues, 59 athletes were found to sustain an ACJ separation injury from 1999 to 2018. Of these players, 81% returned to elite competition and were found to maintain performance metrics similar to preinjury levels and matched, uninjured control players.

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APPENDIX

TABLE A1
Player Metrics Compared With 1 Year Before Index Year^a

Player Metrics	Control	AC Injury	P
Games played per season			
Index year	-1.0 ± 10.6	-1.34 ± 10.9	.991
1 year post	-0.1 ± 13.7	-0.4 ± 12.7	.930
2 years post	-1.4 ± 15.2	-0.2 ± 13.6	.551
3 years post	-0.4 ± 14.9	-2.5 ± 14.3	.696
4 years post	-1.7 ± 14.8	-1.6 ± 12.5	.970
Minutes played per season			
Index year	-52.3 ± 919.0	-78.7 ± 956.7	.875
1 year post	-53.8 ± 1195.4	17.4 ± 1115.7	.882
2 years post	-24.4 ± 1270.7	59.2 ± 1145.6	.673
3 years post	82.0 ± 1187.6	-294.9 ± 1314.5	.300
4 years post	-33.6 ± 1175.7	-233.7 ± 1092.8	.911
Minutes played per game			
Index year	-5.9 ± 26.8	-2.1 ± 24.1	.751
1 year post	-5.5 ± 24.8	1.6 ± 24.4	.331
2 years post	1.9 ± 25.9	-1.2 ± 17.5	.275
3 years post	7.8 ± 34.6	-9.3 ± 36.5	<.05
4 years post	5.1 ± 26.4	-18.2 ± 35.9	<.05

(continued)

Table A1 (continued)

Player Metrics	Control	AC Injury	P
Goals per season			
Index year	-0.3 ± 2.9	-0.6 ± 3.0	.832
1 year post	-0.6 ± 2.9	0.0 ± 3.1	.277
2 years post	-0.8 ± 3.6	-0.1 ± 2.0	.700
3 years post	-0.4 ± 2.5	-0.4 ± 4.0	.841
4 years post	-0.2 ± 3.3	-1.1 ± 4.9	.969
Assists per season			
Index year	-0.1 ± 2.7	0.0 ± 2.1	.499
1 year post	0.4 ± 2.6	0.5 ± 3.0	.515
2 years post	-0.4 ± 2.6	0.0 ± 3.6	.58
3 years post	0.4 ± 2.3	-0.9 ± 3.8	.093
4 years post	0.4 ± 3.1	0.4 ± 4.9	.801
Points per game			
Index year	0.0 ± 0.8	0.0 ± 0.7	.555
1 year post	0.0 ± 0.6	0.0 ± 0.8	.697
2 years post	-0.1 ± 0.6	-0.1 ± 0.7	.663
3 years post	0.1 ± 0.7	-0.2 ± 0.9	.314
4 years post	-0.1 ± 0.5	-0.1 ± 1.1	.764

^aData indicate changes in player performance metrics (mean difference ± SD) as compared with 1 year before index year (ie, time point of injury for players with AC separation and index year for matched controls). Bolded P values indicate statistically significant differences between groups (P < .05). AC, acromioclavicular; post, postinjury.

TABLE A2
Attacker Metrics Compared With 1 Year
Before Index Year^a

Player Metrics	Control	AC Injury	<i>P</i>
Games played per season			
Index year	-0.3 ± 8.9	-1.4 ± 10.6	.507
1 year post	-2.7 ± 13.3	1.4 ± 11.5	.479
2 years post	-12.1 ± 8.9	-0.1 ± 12.0	.061
3 years post	-9.8 ± 11.6	-3.6 ± 19.4	.556
4 years post	0.0 ± 4.2	-1.0 ± 13.2	.800
Minutes played per season			
Index year	-10.9 ± 827.6	-23.2 ± 959.2	.332
1 year post	-435.4 ± 1086.5	128.4 ± 1085.8	.222
2 years post	-968.8 ± 859.2	241.0 ± 1035.5	<.05
3 years post	-569.3 ± 1156.8	-251.8 ± 1669.5	.730
4 years post	45.0 ± 428.5	-422.7 ± 1103.4	.800
Minutes played per game			
Index year	-1.1 ± 26.2	2.9 ± 19.6	.640
1 year post	-7.7 ± 25.9	-4.2 ± 30.8	.730
2 years post	-9.1 ± 28.6	7.1 ± 17.7	.408
3 years post	2.6 ± 64.9	-9.6 ± 23.7	.730
4 years post	7.0 ± 10.5	-18.3 ± 10.7	.200
Goals per season			
Index year	-1.1 ± 3.9	-1.4 ± 5.5	≥.999
1 year post	-2.2 ± 4.7	-0.4 ± 5.4	.535
2 years post	-3.1 ± 4.1	-0.3 ± 3.6	.240
3 years post	-0.8 ± 3.6	-0.8 ± 7.3	.805
4 years post	-3.0 ± 5.7	-3.3 ± 9.5	≥.999
Assists per season			
Index year	-0.2 ± 3.4	1.2 ± 3.4	.242
1 year post	1.3 ± 4.0	0.8 ± 2.5	.505
2 years post	-1.4 ± 3.5	0.7 ± 5.2	.2
3 years post	0.0 ± 2.9	-1.6 ± 4.4	.709
4 years post	6.0 ± 7.1	-2.0 ± 6.1	.554
Points per game			
Index year	-0.2 ± 0.5	0.1 ± 0.6	.117
1 year post	-0.2 ± 0.5	0.1 ± 0.6	.353
2 years post	-0.2 ± 0.6	0.1 ± 0.4	.681
3 years post	-0.3 ± 0.7	0.2 ± 1.0	.413
4 years post	0.4 ± 0.7	0.3 ± 0.7	.8

^aData indicate changes in player performance metrics (mean difference ± SD) as compared with 1 year before index year (ie, time point of injury for players with AC separation and index year for matched controls). Bolded *P* value indicates statistically significant differences between groups (*P* < .05). AC, acromioclavicular; post, postinjury.

TABLE A3
Midfielder Metrics Compared With 1 Year
Before Index Year^a

Player Metrics	Control	AC Injury	<i>P</i>
Games played per season			
Index year	1.0 ± 13.6	-1.8 ± 9.6	.553
1 year post	3.1 ± 11.9	4.0 ± 5.7	≥.999
2 years post	-2.2 ± 14.8	-4.7 ± 14.8	.844
3 years post	-1.0 ± 21.7	-3.7 ± 8.5	.629
4 years post	-0.2 ± 20.0	15.0 ± NA	≥.999
Minutes played per season			
Index year	235.1 ± 1078.8	-61.4 ± 754.8	.680
1 year post	332.3 ± 1099.7	507.1 ± 466.9	≥.999
2 years post	-58.5 ± 1271.8	-336.4 ± 1111.3	.536
3 years post	113.5 ± 1807.1	-990.7 ± 603.4	.400
4 years post	94.6 ± 1488.9	1063.0 ± NA	≥.999
Minutes played per game			
Index year	-1.3 ± 25.8	-2.9 ± 16.5	.610
1 year post	-2.3 ± 26.9	3.4 ± 18.6	.773
2 years post	11.1 ± 18.5	-7.2 ± 22.8	.109
3 years post	-0.8 ± 41.8	-34.0 ± 13.3	.400
4 years post	-12.2 ± 39.0	-7.6 ± NA	≥.999
Goals per season			
Index year	0.3 ± 4.0	-0.5 ± 0.7	.641
1 year post	-0.8 ± 3.3	0.6 ± 0.8	.377
2 years post	-1.3 ± 4.8	-0.4 ± 1.6	.960
3 years post	-2.3 ± 4.4	1.7 ± 3.1	.400
4 years post	0.0 ± 5.8	3.0 ± NA	.667
Assists per season			
Index year	-0.3 ± 3.6	-0.2 ± 1.5	.235
1 year post	-0.3 ± 2.4	1.7 ± 2.6	.151
2 years post	-0.9 ± 2.1	-1.0 ± 2.8	.729
3 years post	-0.3 ± 3.3	-2.7 ± 3.8	.629
4 years post	-0.2 ± 3.5	0.0 ± NA	≥.999
Points per game			
Index year	0.2 ± 1.0	0.1 ± 0.6	.941
1 year post	0.1 ± 0.5	0.3 ± 0.5	.34
2 years post	0.0 ± 0.5	0.0 ± 0.5	.887
3 years post	-0.1 ± 0.7	-0.1 ± 0.4	.857
4 years post	-0.3 ± 0.7	0.3 ± NA	.333

^aData indicate changes in player performance metrics (mean difference ± SD) as compared with 1 year before index year (ie, time point of injury for players with AC separation and index year for matched controls). AC, acromioclavicular; NA, not available; post, postinjury.

TABLE A4
Defender Metrics Compared With 1 Year Before Index Year^a

Player Metrics	Control	AC Injury	<i>P</i>
Games played per season			
Index year	-1.9 ± 10.8	-4.5 ± 8.2	.444
1 year post	0.8 ± 14.1	-8.1 ± 11.4	<.05
2 years post	4.0 ± 16.0	-3.8 ± 10.0	.276
3 years post	2.1 ± 14.3	-8.9 ± 10.1	.088
4 years post	-2.9 ± 15.7	-9.5 ± 15.3	.543
Minutes played per season			
Index year	-158.9 ± 944.3	-422.2 ± 739.5	.330
1 year post	30.6 ± 1199.9	-683.8 ± 924.2	.074
2 years post	439.6 ± 1264.1	-365.6 ± 875.1	.167
3 years post	236.5 ± 1094.1	-764.9 ± 1019.1	.103
4 years post	-105.7 ± 1294.6	-812.8 ± 1432.7	.599
Minutes played per game			
Index year	-6.4 ± 21.7	-6.4 ± 13.6	.685
1 year post	-3.2 ± 19.1	-2.8 ± 9.3	.988
2 years post	2.4 ± 27.8	-5.7 ± 13.7	.283
3 years post	6.1 ± 15.6	-6.8 ± 18.6	.175
4 years post	12.9 ± 22.3	-22.0 ± 45.9	.262
Goals per season			
Index year	-0.1 ± 1.2	-0.3 ± 1.9	.729
1 year post	0.0 ± 1.7	-0.1 ± 2.3	.999
2 years post	0.5 ± 1.9	0.4 ± 1.2	.891
3 years post	0.1 ± 1.5	-1.1 ± 2.6	.239
4 years post	0.2 ± 1.7	-1.5 ± 3.8	.752
Assists per season			
Index year	0.1 ± 1.8	-0.6 ± 1.3	.203
1 year post	0.5 ± 2.1	-0.2 ± 3.8	<.05
2 years post	0.4 ± 2.3	0.4 ± 3.7	.422
3 years post	0.6 ± 2.0	-0.1 ± 4.7	.104
4 years post	-0.3 ± 1.4	2.8 ± 7.0	.802
Points per game			
Index year	0.1 ± 0.8	-0.2 ± 0.7	.324
1 year post	0.1 ± 0.6	-0.4 ± 0.9	.156
2 years post	-0.1 ± 0.7	-0.3 ± 0.8	.671
3 years post	0.2 ± 0.6	-0.5 ± 0.8	.061
4 years post	-0.2 ± 0.5	-0.5 ± 1.2	.862

^aData indicate changes in player performance metrics (mean difference ± SD) as compared with 1 year before index year (ie, time point of injury for players with AC separation and index year for matched controls). Bolded *P* values indicate statistically significant differences between groups (*P* < .05). AC, acromioclavicular; post, postinjury.

TABLE A5
Goalkeeper Metrics Compared With 1 Year Before Index Year^a

Player Metrics	Control	AC Injury	<i>P</i>
Games played per season			
Index year	-1.0 ± 10.6	-1.3 ± 10.9	.101
1 year post	-0.1 ± 13.7	-0.4 ± 12.7	.057
2 years post	-1.4 ± 15.2	-0.2 ± 13.6	.468
3 years post	-0.4 ± 14.9	-2.5 ± 14.3	.800
4 years post	-1.7 ± 14.8	-1.6 ± 12.5	.806
Minutes played per season			
Index year	-370.4 ± 587.9	929.4 ± 1465.2	.072
1 year post	-1156.0 ± 1477.7	1364.5 ± 1049.2	.057
2 years post	0.0 ± 0.0	1283.5 ± 1270.2	.468
3 years post	90.0 ± 0.0	995.5 ± 1052.7	.800
4 years post	0.0 ± 0.0	163.0 ± 511.3	.806
Minutes played per game			
Index year	-27.5 ± 42.9	3.7 ± 60.6	.362
1 year post	-30.4 ± 51.6	26.7 ± 43.9	.4
2 years post	0.0 ± 0.0	3.6 ± 11.3	≥.999
3 years post	90.0 ± 0.0	5.5 ± 74.3	.468
4 years post	0.0 ± 0.0	-17.0 ± 49.8	≥.999
Clean sheets per season			
Index year	-1.9 ± 3.3	4.0 ± 5.0	.068
1 year post	-5.7 ± 4.9	4.8 ± 3.0	<.05
2 years post	0.0 ± 0.0	3.8 ± 4.1	.468
3 years post	0.0 ± 0.0	2.8 ± 2.5	.468
4 years post	0.0 ± 0.0	0.8 ± 1.5	.724
Conceded goals per season			
Index year	-4.4 ± 11.5	9.0 ± 23.1	.098
1 year post	-13.0 ± 24.4	18.0 ± 19.7	.154
2 years post	0.0 ± 0.0	18.8 ± 20.8	.468
3 years post	3.0 ± 0.0	18.3 ± 22.2	.8
4 years post	0.0 ± 0.0	0.5 ± 8.7	.806

^aData indicate changes in player performance metrics (mean difference ± SD) as compared to 1 year before index year (ie, time point of injury for players with AC separation and index year for matched controls). Bolded *P* value indicates statistically significant differences between groups (*P* < .05). AC, acromioclavicular; post, postinjury.