

World Journal of *Orthopedics*

World J Orthop 2021 November 18; 12(11): 811-960



OPINION REVIEW

- 811 Revisiting Pauwels' classification of femoral neck fractures
Nandi S

ORIGINAL ARTICLE**Case Control Study**

- 816 Paraspinal strength and electromyographic fatigue in patients with sub-acute back pain and controls: Reliability, clinical applicability and between-group differences
Koumantakis GA, Oldham JA

Retrospective Cohort Study

- 833 Preseason elimination impact on anterior cruciate ligament injury in the National Football League
Patetta M, Mayo B, Martini OZ, Sullivan B, Onsen L, Hutchinson M

Retrospective Study

- 842 Risk of methicillin-resistant staphylococcus aureus prosthetic joint infection in elective total hip and knee arthroplasty following eradication therapy
Kapur BP, Tonge X, Kumar G

- 850 Reliability of a simple fluoroscopic image to assess leg length discrepancy during direct anterior approach total hip arthroplasty
Caus S, Reist H, Bernard C, Blankstein M, Nelms NJ

- 859 Anthropometric method for estimating component sizes in total hip arthroplasty
Sahemey R, Moores TS, Meacher H, Youssef B, Khan S, Evans CR

- 867 Treatment of knee osteochondritis dissecans with autologous tendon transplantation: Clinical and radiological results
Turhan AU, Açıl S, Gül O, Öner K, Okutan AE, Ayas MS

Clinical Trials Study

- 877 Direct anterior approach *vs* Hardinge in obese and nonobese osteoarthritic patients: A randomized controlled trial
Macheras G, Stasi S, Sarantis M, Triantafyllou A, Tzeferonis D, Papadakis SA

Observational Study

- 891 Work-related musculoskeletal injuries among upper extremity surgeons: A web-based survey
Alzahrani MM, Alqahtani SM, Pichora D, Bicknell R

EVIDENCE-BASED MEDICINE

- 899** Implementation science for the adductor canal block: A new and adaptable methodology process
Crain N, Qiu CY, Moy S, Thomas S, Nguyen VT, Lee-Brown M, Laplace D, Naughton J, Morkos J, Desai V

SYSTEMATIC REVIEWS

- 909** Femoral lengthening in young patients: An evidence-based comparison between motorized lengthening nails and external fixation
Hafez M, Nicolaou N, Offiah AC, Giles S, Madan S, Fernandes JA

META-ANALYSIS

- 920** Role of coatings and materials of external fixation pins on the rates of pin tract infection: A systematic review and meta-analysis
Stoffel C, Eltz B, Salles MJ

CASE REPORT

- 931** Allergic dermatitis after knee arthroscopy with repeated exposure to Dermabond Prineo™ in pediatric patients: Two case reports
Robinson J, Smidt KP, Houk G, McKie J, Barton RS, Massey P
- 938** Pathological humerus fracture due to anti-interferon-gamma autoantibodies: A case report
Yang CH, Kuo FC, Lee CH
- 945** Spontaneous pneumothorax in a 17-year-old male patient with multiple exostoses: A case report and review of the literature
Nakamura K, Asanuma K, Shimamoto A, Kaneda S, Yoshida K, Matsuyama Y, Hagi T, Nakamura T, Takao M, Sudo A
- 954** Management of acute length-unstable Monteggia fractures in children: A case report
Evola FR, Di Fede GF, Bonanno S, Evola G, Cucuzza ME

ABOUT COVER

Editorial Board Member of *World Journal of Orthopedics*, Christiaan JA van Bergen, MD, PhD, Senior Researcher, Surgeon, Department of Orthopaedic Surgery, Amphia, Breda 3000, Netherlands. cvanbergen@amphia.nl

AIMS AND SCOPE

The primary aim of *World Journal of Orthopedics* (WJO, *World J Orthop*) is to provide scholars and readers from various fields of orthopedics with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJO mainly publishes articles reporting research results and findings obtained in the field of orthopedics and covering a wide range of topics including arthroscopy, bone trauma, bone tumors, hand and foot surgery, joint surgery, orthopedic trauma, osteoarthritis, osteoporosis, pediatric orthopedics, spinal diseases, spine surgery, and sports medicine.

INDEXING/ABSTRACTING

The WJO is now abstracted and indexed in PubMed, PubMed Central, Emerging Sources Citation Index (Web of Science), Scopus, China National Knowledge Infrastructure (CNKI), China Science and Technology Journal Database (CSTJ), and Superstar Journals Database. The 2021 edition of Journal Citation Reports® cites the 2020 Journal Citation Indicator (JCI) for WJO as 0.66. The WJO's CiteScore for 2020 is 3.2 and Scopus CiteScore rank 2020: Orthopedics and Sports Medicine is 87/262.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Lin-YuTong Wang*; Production Department Director: *Xiang Li*; Editorial Office Director: *Jim-Lai Wang*.

NAME OF JOURNAL

World Journal of Orthopedics

ISSN

ISSN 2218-5836 (online)

LAUNCH DATE

November 18, 2010

FREQUENCY

Monthly

EDITORS-IN-CHIEF

Massimiliano Leigheb

EDITORIAL BOARD MEMBERS

<http://www.wjgnet.com/2218-5836/editorialboard.htm>

PUBLICATION DATE

November 18, 2021

COPYRIGHT

© 2021 Baishideng Publishing Group Inc

INSTRUCTIONS TO AUTHORS

<https://www.wjgnet.com/bpg/gerinfo/204>

GUIDELINES FOR ETHICS DOCUMENTS

<https://www.wjgnet.com/bpg/gerinfo/287>

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH

<https://www.wjgnet.com/bpg/gerinfo/240>

PUBLICATION ETHICS

<https://www.wjgnet.com/bpg/gerinfo/288>

PUBLICATION MISCONDUCT

<https://www.wjgnet.com/bpg/gerinfo/208>

ARTICLE PROCESSING CHARGE

<https://www.wjgnet.com/bpg/gerinfo/242>

STEPS FOR SUBMITTING MANUSCRIPTS

<https://www.wjgnet.com/bpg/gerinfo/239>

ONLINE SUBMISSION

<https://www.f6publishing.com>

Retrospective Cohort Study

Preseason elimination impact on anterior cruciate ligament injury in the National Football League

Michael Patetta, Benjamin Mayo, Omar Zaki Martini, Breanna Sullivan, Leonard Onsen, Mark Hutchinson

ORCID number: Michael Patetta 0000-0001-6456-7899; Benjamin Mayo 0000-0003-1821-697X; Omar Zaki Martini 0000-0001-6298-7347; Breanna Sullivan 0000-0002-5733-0487; Leonard Onsen 0000-0003-4325-8768; Mark Hutchinson 0000-0002-7313-1736.

Author contributions: All authors solely contributed to this paper.

Institutional review board statement: This study was exempt from institutional board review as it was conducted using publicly available information.

Informed consent statement: This study does not require informed consent statement.

Conflict-of-interest statement: None of the authors feature potential conflicts of interest nor have they received any sort of support to carry out this study.

Data sharing statement: No individual participant data was shared.

STROBE statement: The authors have read the STROBE Statement – checklist of items, and the manuscript was prepared and revised according to the STROBE Statement – checklist of items.

Country/Territory of origin: United

Michael Patetta, Benjamin Mayo, Omar Zaki Martini, Breanna Sullivan, Leonard Onsen, Mark Hutchinson, Department of Orthopaedics, University of Illinois Chicago College of Medicine, Chicago, IL 60612, United States

Corresponding author: Omar Zaki Martini, BSc, Research Fellow, Department of Orthopaedics, University of Illinois Chicago College of Medicine, 835 S. Wolcott Avenue E270 MSS MC 844, Chicago, IL 60612, United States. omarti29@uic.edu

Abstract

BACKGROUND

Anterior cruciate ligament (ACL) injuries represent detrimental injuries in the National Football League (NFL). A significant portion of these injuries often occur in preseason exhibitions. The Coronavirus disease 2019 pandemic presented a unique disruption to preseason NFL football with the cancelation of all preseason games.

AIM

To compare the incidence of ACL tears through the first eight weeks of the NFL season in 2020 to the mean incidence over the previous 5 seasons (2015-2019) and determine if there was any change in incidence with the elimination of the preseason.

METHODS

NFL players who suffered ACL tears during the preseason and first eight weeks of the NFL season from 2015-2020 were identified. The number of ACL injuries for the 2015-2019 seasons was compared to the 2020 season for four different timeframes. For each analysis, the cumulative number of ACL injuries to that time point was used to calculate the percent difference for descriptive analysis. Additionally, the number of teams with at least one player suffering an ACL tear were identified and compared using Chi-Squared testing. Finally, a cumulative relative risk was calculated for each week played.

RESULTS

There were 14 ACL tears through the first four games of the 2020 season, a 118.8% (14 vs 6.4) increase in comparison to the 5-year average over the first 4 regular season weeks of 2015-2019. However, when accounting for injuries occurring during the preseason from 2015-2019, there were 18.6% (14 vs 17.2) fewer total ACL injuries through regular season week 4 with no significant difference in

States

Specialty type: Sport sciences

Provenance and peer review:

Unsolicited article; Externally peer reviewed

Peer-review report's scientific quality classification

Grade A (Excellent): 0

Grade B (Very good): B

Grade C (Good): 0

Grade D (Fair): 0

Grade E (Poor): 0

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

Received: June 6, 2021

Peer-review started: June 6, 2021

First decision: July 28, 2021

Revised: August 3, 2021

Accepted: September 15, 2021

Article in press: September 15, 2021

Published online: November 18, 2021

P-Reviewer: Kurniawan A

S-Editor: Wu YXJ

L-Editor: A

P-Editor: Wang LYT



percentage of teams impacted when these preseason injuries were accounted for $P = 0.394$. Results were similar (19 *vs* 17.2) over 8 total games played (whether regular season or preseason), and over 8 regular season games ($P = 0.196$, $P = 0.600$).

CONCLUSION

The elimination of the NFL preseason resulted in a higher rate of injuries during the first 4 games of the regular season. However, these increases are offset by the injuries typically sustained during the preseason. This suggests there may be front-loading of injuries over the course of an NFL season, such that players may be more prone to injury when the intensity of play suddenly increases, whether in the preseason or regular season.

Key Words: Anterior cruciate ligament; National football league; Player safety; Ligamentous injury; Preseason; COVID-19

©The Author(s) 2021. Published by Baishideng Publishing Group Inc. All rights reserved.

Core Tip: The coronavirus disease 2019 pandemic presented a unique disruption to preseason National Football League (NFL) football with the cancelation of all preseason games. This study compared the incidence of anterior cruciate ligament (ACL) tears through the first eight weeks of the NFL season in 2020 to the mean incidence over the previous 5 seasons and found that there was indeed an increase in ACL tears through the first four games of the 2020 season with no significant difference when accounting for the preseason. This suggests that there may be front-loading of injuries over the course of an NFL season. In summary, this study suggests that if preseason games are eliminated, players can expect similar rates of ACL tears overall when compared to conventional seasons, but with more ACL tears in the first four weeks of the regular season.

Citation: Patetta M, Mayo B, Martini OZ, Sullivan B, Onsen L, Hutchinson M. Preseason elimination impact on anterior cruciate ligament injury in the National Football League. *World J Orthop* 2021; 12(11): 833-841

URL: <https://www.wjgnet.com/2218-5836/full/v12/i11/833.htm>

DOI: <https://dx.doi.org/10.5312/wjo.v12.i11.833>

INTRODUCTION

Anterior cruciate ligament (ACL) injuries are among the most common knee injuries in American football players, and their incidence increases with increased level of competition. In one survey, 14.2% of retired National Football League (NFL) players reported a history of ACL injury[1]. Because of the high incidence of ACL injuries and their potential to end players' seasons or careers, extensive research has been conducted to identify risk factors that may contribute to ACL injury and modifications to improve player safety. One of these modifiable risk factors may be preseason training.

Over the last decade, NFL and National Football League Players Association have disputed the importance and number of preseason games necessary before the NFL season. Since 1978, NFL teams participated in a 4-game stretch of weekly exhibition games to prepare for the upcoming season. However, in 2020 the coronavirus disease 2019 (COVID-19) pandemic presented a unique disruption to this sequence, with all preseason games cancelled prior to the beginning of the season.

ACL tears are catastrophic and common injuries in football, with athletes estimated to have a ten times higher risk of rupture in participation when compared to other sports[2]. A recent systematic review reported the overall return to play rate in NFL athletes after an ACL tear at only 67.2%, with significant variability depending on the position and experience of the athlete[3-5]. Additionally, of players able to return, the financial impact of these injuries on player earning potentials is well documented, with salary losses of roughly \$2 million per year after injury[6].

The purpose of this study was to compare the incidence of ACL tears through the first eight games played of the NFL season in 2020 to the mean incidence over the previous 5 seasons (2015-2019) and determine if there was any change in incidence with the elimination of the preseason.

MATERIALS AND METHODS

NFL players who suffered ACL tears during preseason games and first eight regular season games played of the NFL season for the years 2015-2020 were identified and confirmed using reports from official NFL team websites. Only injuries occurring during regular and preseason games were included. Injuries occurring in organized team activities, practices, or individual training sessions were not included in the analysis, as regimens and activities of individual players and teams inherently vary considerably. The five-year total and yearly mean number of ACL injuries were calculated for the 2015-2019 seasons and compared to the 2020 season for four different timeframes.

First, the first four regular season games of the 2020 season were compared to the first four regular season games of 2015-2019 season, excluding any preseason injuries. Second, the first four regular season games for the 2020 season were compared to first four regular season games played of the 2015-2019 season, including injuries sustained in the four preseason games accrued in 2015-2019. Third, the first 8 regular season games played for the 2020 season were compared to the first eighth regular season games played of the 2015-2019 season, including injuries sustained in the four preseason games. Lastly, the cumulative number of injuries through 8 wk of any gameplay were compared, and a relative risk was calculated for player injuries per game played by each week. In other words, the first 4 preseason games of 2015-2019 were analyzed in combination with the first 4 games of their respective regular seasons and compared to the first 8 regular season games of 2020.

For each analysis, the cumulative number of ACL injuries to that time point was used to calculate the percent difference for a descriptive analysis. Additionally, the number of teams with at least one player suffering an ACL tear were identified and compared using Chi-Squared testing. All collected data was then analyzed using IBM SPSS Statistics Version 25 (Armonk, NY, United States). *P* values < 0.05 were considered statistically significant.

RESULTS

Comparison of first four regular season games

There was a total of 14 ACL tears through the first four games of the 2020 season, a 118.8% increase in comparison to the 5-year average over the first 4 wk of the 2015-2019 seasons (Table 1 and Figure 1A). More teams (11) were impacted with an ACL tear in 2020 during the first 4 wk of the season than any season from 2015-2019. Chi squared testing demonstrated a significant difference in rates of teams impacted (Table 1; *P* = 0.039) in 2020 compared to 2015-2019.

Comparison through the first four regular season games, including preseason

When accounting for injuries occurring during the preseason from 2015-2019, there were 18.6% fewer total ACL injuries through regular season week 4 (Table 1 and Figure 1B). There was no significant difference in percentage of teams impacted when these preseason injuries were accounted for (Table 1; *P* = 0.394).

Comparison through the first eight regular season games, including preseason

Repeat analysis through 8 wk comparing the 2020 season to the 2015-2019 averages including the preseason demonstrated similar results to week 4 analysis, with overall tears down 16.7% with no significant difference in the number of teams affected (Table 1; *P* = 0.196).

Comparison of the first eight games played

When comparing an equivalent number of games, regardless of regular or preseason designation, there was a 10.5% increase in ACL tear occurrence in the 2020 season (Table 1 and Figure 1C), but no significant difference in the number of teams impacted (Table 1; *P* = 0.600), or injury rate at any timepoint through eight weeks (Table 2).

Table 1 Cumulative anterior cruciate ligament tear count

Season	Total ACL tears	Percent difference	Teams impacted	P value ¹
Through four regular season games, excluding preseason				
2020	14	+118.8%	11	0.039
2015-2019 average	6.4		5.8	
Through four regular season games, including preseason injuries				
2020	14	-18.6%	11	0.394
2015-2019 average	17.2		13.6	
Through eight regular season games, including preseason injuries				
2020	19	-16.7%	12	0.196
2015-2019 average	22.8		16.0	
Through eight games played, regular or preseason				
2020	19	+10.5%	12	0.600
2015-2019 average	17.2		13.6	

¹P value calculated using Chi-squared analysis. Bold indicated statistical significance.
 ACL: Anterior cruciate ligament.

Table 2 Week by week comparison of cumulative anterior cruciate ligament tear rate for the first 8 games played

	Year	Total injuries	Total games	Rate	RR	95%CI	P value
Game 1	2020	3	16	0.188	1.071	0.348-3.302	0.904
	2015-2019	14	80	0.175			
Game 2	2020	10	32	0.313	1.724	0.937-3.174	0.08
	2015-2019	29	160	0.181			
Game 3	2020	13	48	0.271	1.477	0.865-2.524	0.153
	2015-2019	44	240	0.183			
Game 4	2020	14	63	0.222	1.317	0.781-2.22	0.301
	2015-2019	54	320	0.169			
Game 5	2020	15	77	0.195	1.237	0.745-2.055	0.412
	2015-2019	63	400	0.158			
Game 6	2020	17	91	0.187	1.338	0.826-2.169	0.237
	2015-2019	67	480	0.140			
Game 7	2020	19	105	0.181	1.333	0.844-2.107	0.218
	2015-2019	76	560	0.136			
Game 8	2020	19	119	0.160	1.181	0.748-1.864	0.476
	2015-2019	86	636	0.135			

RR: Relative risk; CI: Confidence interval.

DISCUSSION

The results of this study demonstrate that without participation in preseason games, NFL players sustain ACL injuries at a higher rate during the early portion of the regular season. However, when accounting for injuries sustained in preseason, the differences quickly equilibrate and there is no difference in the total number of ACL injuries, or the ACL injuries per game played. Additionally, the injury rate per game

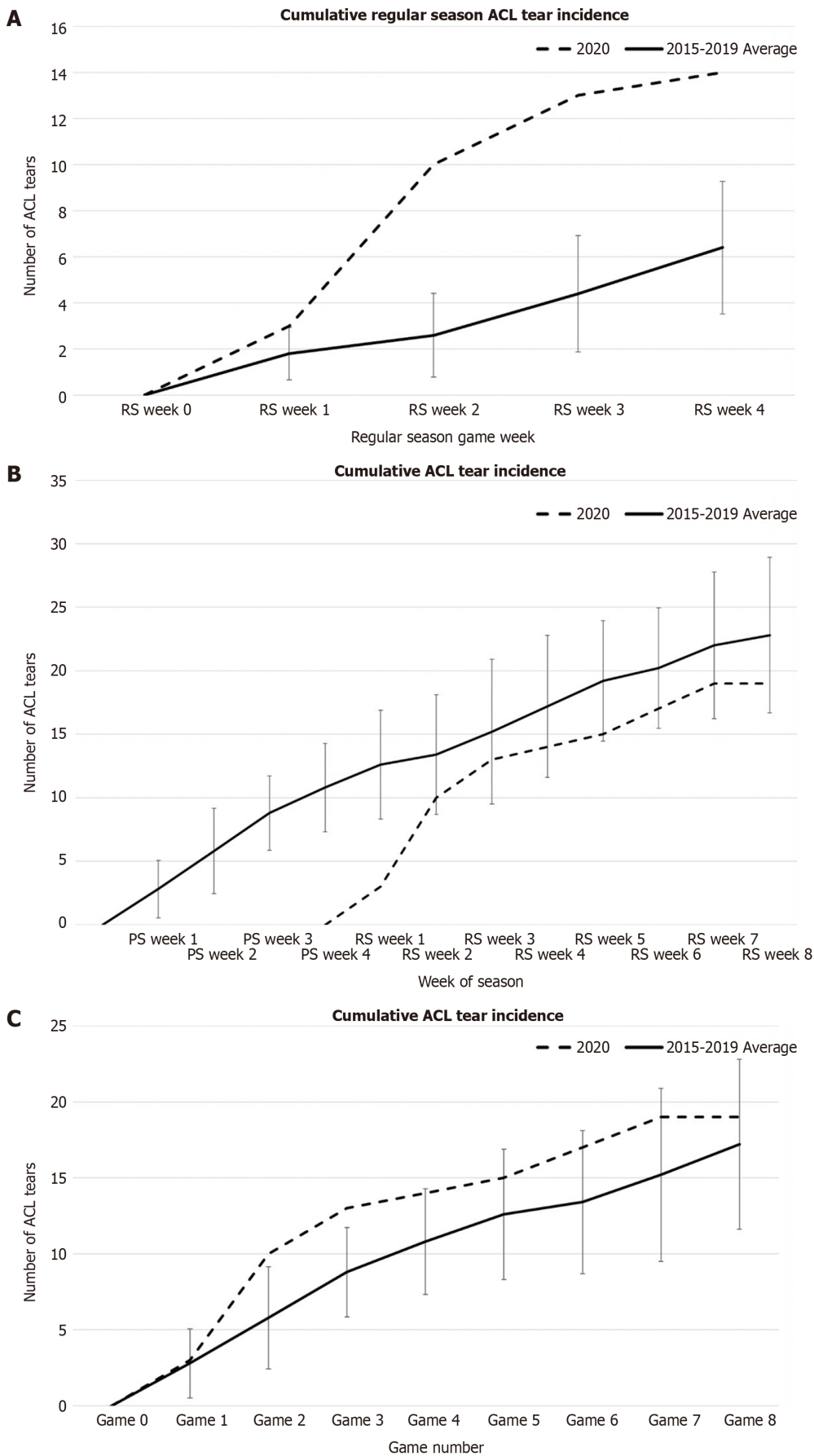


Figure 1 Cumulative plot comparing the number of anterior cruciate ligament tears. A: In the first four regular season (RS) games of the 2020 season to the 2015-2019 RS; B: In the 2020 season to the 2015-2019 average for the preseason (PS) and first 8 wk of the RS. C: In the 2020 season to the 2015-2019 average over the first 8 games played (PS or RS) in each group. Error bars designate the CI above and below the mean. ACL: Anterior cruciate ligament; RS:

Regular season; PS: Preseason.

played is not statistically different between seasons with and without a preseason.

Recent studies of rugby, Australian rules football, and European soccer teams showed that increased participation in preseason training sessions was associated with a lower in-season injury burden[7-9]. One study of European soccer teams found that every 10 additional preseason training sessions that team members participated in was associated with significantly fewer in-season layoff days due to injury and significantly fewer severe in-season injuries[9]. This highlights the potential benefits of increased preseason training in reducing in-season injury burden. With no preseason games in the 2020 season, NFL players participated in less preseason training. This was associated with an increased risk of injury during their early regular season games compared to a traditional year. However, when comparing the first games played of the 2020 season *vs* the preseason games in prior seasons, there is no significant difference in total number of injuries or injury rate.

The above information suggests that the elimination of preseason and pre-season training would increase the incidence of ACL injury, which is consistent with the results of our study. Additionally, some studies suggest that targeted training and warm-up exercises can reduce the incidence and risk of ACL injuries[10,11]. One study of American National Collegiate Athletic Association soccer by Silvers-Granelli *et al* [10] demonstrated that the FIFA 11+ injury prevention program, a 15-20 min dynamic warm-up program performed before training and games, resulted in a 4.25-fold reduction in the likelihood of ACL injury. This highlights the importance of warm-up training directly before vigorous training or exercise. Currently, the NFL does not have a standardized warm-up program, and there have been little to no studies on the impact of warm-up training in the NFL. Thus, the implementation of a similar program into NFL preseason training, regular season training, and NFL games should be explored in future studies, as it may help reduce the incidence of ACL injury.

Another study by Li *et al*[12] investigated the relationship between soft tissue injury and training load in American football. Player training load was measured using wearable global position system devices outfitted to record acceleration in various axes. They found that a sudden increase in training load was associated with more soft tissue injuries, including ankle ligamentous injury, knee ligamentous injury, hamstring strain and other muscle strain. They concluded that soft tissue injuries during the regular season occurred most often during weeks with increased training loads, as compared to the training load over the month prior to injury[12]. These findings are consistent with the results demonstrated in our study, as a large workload increase in 2020 relative to limited offseason participation may have predisposed NFL athletes to early-season injury. The results of our study show a significant increase in the number of teams with ACL tears in the first four weeks of the 2020 season, as compared to the average number of teams with ACL tears from the first four regular season weeks of the 2015 through 2019 seasons (Table 2). Seeing as regular season games are often played with greater intensity due to the increased level of competition[12], it is likely that NFL players in the first four weeks of the 2020 season experienced increased physical demands, or in the words of Li *et al*[12], “training loads”, as compared to the weeks leading up to the regular season since there were no preseason games. This sudden increase in physical demand may contribute to the increased ACL tears in the first four weeks of the 2020 regular season in comparison to the recent historic average.

However, it is notable that when including ACL injuries from the preseason and the first four weeks of the regular season in 2015 to 2019 in comparison to injuries in the first four weeks of the 2020 season, there was no significant increase in teams impacted by ACL injury through the first four or eight regular season games of the season. Thus, this higher susceptibility to ACL injury due to increased training demand may simply occur in the preseason instead of the regular season historically. In fact, when including preseason games, descriptive reports in this study demonstrated an 18.6% decrease in ACL injuries in the first four weeks of the 2020 season in comparison to 2015-2019 and a 16.7% decrease through the first eight weeks. Results remained inconclusive when looking at injury incidence over an equivalent timespan, with a 10.5% increase in 2020 ACL tear frequency compared to the running average of the preceding 5 NFL seasons with no significant difference in the number of teams impacted. This highlights that there may be front-loading of injuries, such that players may be more prone to injury when the intensity of play suddenly increases, whether that is in the preseason or regular season. This is further supported in our chronologic analysis, which demonstrated no change in the relative risk at any timepoint in the

first 8 games of NFL play, regardless of if they were preseason or regular season games. Thus, players are likely at increased risk of injury when they engage in full contact play, whether it is in the preseason or regular season. Steiner *et al*[13] found that full contact preseason practice and scrimmages correlated with a significant increase in practice injuries among college football players, as compared to non-contact practice. This was true of in-season full contact practices and scrimmages as well. This is substantiated by the fact that the majority of ACL injuries in American football are from contact[1].

The major limitation of the current study is that it is observational and retrospective. While this data shows an interesting association between the number of ACL injuries, as well as number of teams with ACL injuries with and without a preseason, we cannot draw conclusions on the causative effect of a preseason since many factors affect a player's risk for ACL injury. These include external factors, such as playing surface and cleat design, as well as internal factors, such as previous injury, age, body composition, knee alignment, intercondylar notch width, muscle flexibility, foot biomechanics, and movement patterns[14-17]. This study also did not account for injuries that occurred during practices, off-season training, and organized team activities, though these occur at much lower rates than in-game injuries. Additionally, we only have one season of data in which no preseason games were played. Finally, there are additional variables that complicate the 2020 season, including multiple players opting out of the season entirely, other players missing time due to COVID-19 protocols, and game scheduling delays as a result of COVID-19.

CONCLUSION

While the COVID-19 pandemic is first and foremost a calamity, it has provided a unique opportunity to examine the rates of ACL injuries in the NFL with a complete elimination of the preseason. The results of this study suggest that if preseason games are eliminated, players can expect similar rates of ACL tears overall when compared to conventional seasons, but with more ACL tears in the first four weeks of the regular season.

ARTICLE HIGHLIGHTS

Research background

In 2020, the National Football League (NFL) preseason was eliminated due to the coronavirus disease 2019 pandemic. The purpose of this study was to determine if this unique elimination of the preseason resulted in a change in incidence of anterior cruciate ligament (ACL) tears.

Research motivation

Prior to the pandemic, there had been many discussions regarding the need of the NFL preseason, with the main concern being player safety. Our goal was to obtain relevant data on the impact of the preseason on ACL injuries that can be used for future discussions around that topic.

Research objectives

The main objective of this study was to compare the incidence of ACL tears through the first eight weeks of the 2020 NFL season to the mean incidence over the previous 5 seasons (2015-2019) and determine if there was any change in incidence in 2020. Though this objective was realized, this data can be strengthened if future studies are performed for a greater number of NFL seasons, as we were only able to obtain 5 years of data for this study.

Research methods

NFL players who sustained ACL tears during the preseason and first eight weeks of the NFL season from 2015-2020 were identified using online publicly available data. The number of ACL injuries for the 2015-2019 seasons was compared to the 2020 season.

Research results

A 118.8% increase in ACL tears was noted through the first four games of the 2020 season in comparison to the previous 5-year average over the first four regular season weeks of 2015-2019. However, when accounting for injuries occurring during the preseason from 2015-2019, there were 18.6% fewer ACL injuries through regular season week 4.

Research conclusions

There may be front-loading of injuries over the course of an NFL season, such that players may be more prone to injury when the intensity of play suddenly increases, whether in the preseason or regular season. This study also suggests that although the elimination of the preseason results in similar rates of ACL tears overall, it is correlated with increased ACL tears in the first four weeks of the regular season.

Research perspectives

Future research should be performed comparing the 2020 NFL season with a greater number of NFL seasons, as further data is needed to obtain more definitive results. Additionally, warm-up training has not been studied extensively in American football and is certainly a topic that should be studied for ACL injury prevention.

REFERENCES

- 1 **Rothenberg P**, Grau L, Kaplan L, Baraga MG. Knee Injuries in American Football: An Epidemiological Review. *Am J Orthop (Belle Mead NJ)* 2016; **45**: 368-373 [PMID: [27737282](#)]
- 2 **Dragoo JL**, Braun HJ, Durham JL, Chen MR, Harris AH. Incidence and risk factors for injuries to the anterior cruciate ligament in National Collegiate Athletic Association football: data from the 2004-2005 through 2008-2009 National Collegiate Athletic Association Injury Surveillance System. *Am J Sports Med* 2012; **40**: 990-995 [PMID: [22491794](#) DOI: [10.1177/0363546512442336](#)]
- 3 **Ross BJ**, Savage-Elliott I, Brown SM, Mulcahey MK. Return to Play and Performance After Primary ACL Reconstruction in American Football Players: A Systematic Review. *Orthop J Sports Med* 2020; **8**: 2325967120959654 [PMID: [33195714](#) DOI: [10.1177/2325967120959654](#)]
- 4 **Cinque ME**, Hannon CP, Bohl DD, Erickson BJ, Verma NN, Cole BJ, Bach BR Jr. Return to Sport and Performance After Anterior Cruciate Ligament Reconstruction in National Football League Linemen. *Orthop J Sports Med* 2017; **5**: 2325967117711681 [PMID: [28680893](#) DOI: [10.1177/2325967117711681](#)]
- 5 **Shah VM**, Andrews JR, Fleisig GS, McMichael CS, Lemak LJ. Return to play after anterior cruciate ligament reconstruction in National Football League athletes. *Am J Sports Med* 2010; **38**: 2233-2239 [PMID: [20610771](#) DOI: [10.1177/0363546510372798](#)]
- 6 **Secrist ES**, Bhat SB, Dodson CC. The Financial and Professional Impact of Anterior Cruciate Ligament Injuries in National Football League Athletes. *Orthop J Sports Med* 2016; **4**: 2325967116663921 [PMID: [27631017](#) DOI: [10.1177/2325967116663921](#)]
- 7 **Windt J**, Gabbett TJ, Ferris D, Khan KM. Training load--injury paradox: is greater preseason participation associated with lower in-season injury risk in elite rugby league players? *Br J Sports Med* 2017; **51**: 645-650 [PMID: [27075963](#) DOI: [10.1136/bjsports-2016-095973](#)]
- 8 **Murray NB**, Gabbett TJ, Townshend AD. Relationship Between Preseason Training Load and In-Season Availability in Elite Australian Football Players. *Int J Sports Physiol Perform* 2017; **12**: 749-755 [PMID: [27834571](#) DOI: [10.1123/ijssp.2015-0806](#)]
- 9 **Ekstrand J**, Spreco A, Windt J, Khan KM. Are Elite Soccer Teams' Preseason Training Sessions Associated With Fewer In-Season Injuries? *Am J Sports Med* 2020; **48**: 723-729 [PMID: [31990574](#) DOI: [10.1177/0363546519899359](#)]
- 10 **Silvers-Granelli HJ**, Bizzini M, Arundale A, Mandelbaum BR, Snyder-Mackler L. Does the FIFA 11+ Injury Prevention Program Reduce the Incidence of ACL Injury in Male Soccer Players? *Clin Orthop Relat Res* 2017; **475**: 2447-2455 [PMID: [28389864](#) DOI: [10.1007/s11999-017-5342-5](#)]
- 11 **Acevedo RJ**, Rivera-Vega A, Miranda G, Micheo W. Anterior cruciate ligament injury: identification of risk factors and prevention strategies. *Curr Sports Med Rep* 2014; **13**: 186-191 [PMID: [24819011](#) DOI: [10.1249/JSR.0000000000000053](#)]
- 12 **Li RT**, Salata MJ, Rambhia S, Sheehan J, Voos JE. Does Overexertion Correlate With Increased Injury? *Sports Health* 2020; **12**: 66-73 [PMID: [31469616](#) DOI: [10.1177/1941738119868477](#)]
- 13 **Steiner ME**, Berkstresser BD, Richardson L, Elia G, Wang F. Full-Contact Practice and Injuries in College Football. *Sports Health* 2016; **8**: 217-223 [PMID: [26755741](#) DOI: [10.1177/1941738115626689](#)]
- 14 **Hewett TE**, Zazulak BT, Krosshaug T, Bahr R. Clinical basis: Epidemiology, risk factors, mechanisms of injury, and prevention of ligament injuries of the knee. In: *The Knee Joint*. Springer; 2012: 53-70 [DOI: [10.1007/978-2-287-99353-4_6](#)]
- 15 **Kiesel K**, Plisky PJ, Voight ML. Can Serious Injury in Professional Football be Predicted by a

- Preseason Functional Movement Screen? *N Am J Sports Phys Ther* 2007; **2**: 147-158 [PMID: [21522210](#)]
- 16 **Mehl J**, Diermeier T, Herbst E, Imhoff AB, Stoffels T, Zantop T, Petersen W, Achtnich A. Evidence-based concepts for prevention of knee and ACL injuries. 2017 guidelines of the ligament committee of the German Knee Society (DKG). *Arch Orthop Trauma Surg* 2018; **138**: 51-61 [PMID: [28983841](#) DOI: [10.1007/s00402-017-2809-5](#)]
 - 17 **Nessler T**, Denney L, Sampley J. ACL Injury Prevention: What Does Research Tell Us? *Curr Rev Musculoskelet Med* 2017; **10**: 281-288 [PMID: [28656531](#) DOI: [10.1007/s12178-017-9416-5](#)]



Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA

Telephone: +1-925-3991568

E-mail: bpgoffice@wjgnet.com

Help Desk: <https://www.f6publishing.com/helpdesk>

<https://www.wjgnet.com>

