



CONCUSSION PREVENTION – LESSONS FROM THE NFL

INNOVATIONS TO MAKE THE GAME SAFER

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Chief Medical Officer
National Football League

THE TEAM BEHIND THE TEAM

30 GAME DAY MEDICAL STAFF

ON AVERAGE EACH TEAM HAS:



4 ATHLETIC TRAINERS

Assess and treat player injuries in conjunction with team doctors



2 PRIMARY CARE PHYSICIANS

Evaluate players for general medical conditions and concussions



2 ORTHOPEDISTS

Evaluate and treat players for injuries to the bones and joints



1 UNAFFILIATED NEUROTRAUMA CONSULTANT

Evaluates players for possible head injuries and concussions



1 CHIROPRACTOR

Provides back/spinal adjustments for players and treats muscular injuries

STADIUM MEDICAL TEAM:



2 INDEPENDENT ATHLETIC TRAINERS

Notify on-field medical staff of possible injuries from press box. The independent AT spotters can call a medical timeout to stop the game to have a player receive medical attention



1 RADIOLOGY TECHNICIAN

Takes x-rays of injured players at the stadium



1 OPHTHALMOLOGIST

Treats eye injuries



2 EMTS/PARAMEDIC CREW

Transport players to hospital in the event of serious injuries



1 UNAFFILIATED NEUROTRAUMA CONSULTANT

Monitors broadcast video/audio and notifies on-field UMCS of possible head, neck or spine injuries



1 DENTIST

Treats dental issues



1 VISITING TEAM MEDICAL LIAISON

Local emergency physician certified to practice medicine in the state where the game is being played. The VTML works with the team to provide access to care, medication and first-rate medical facilities



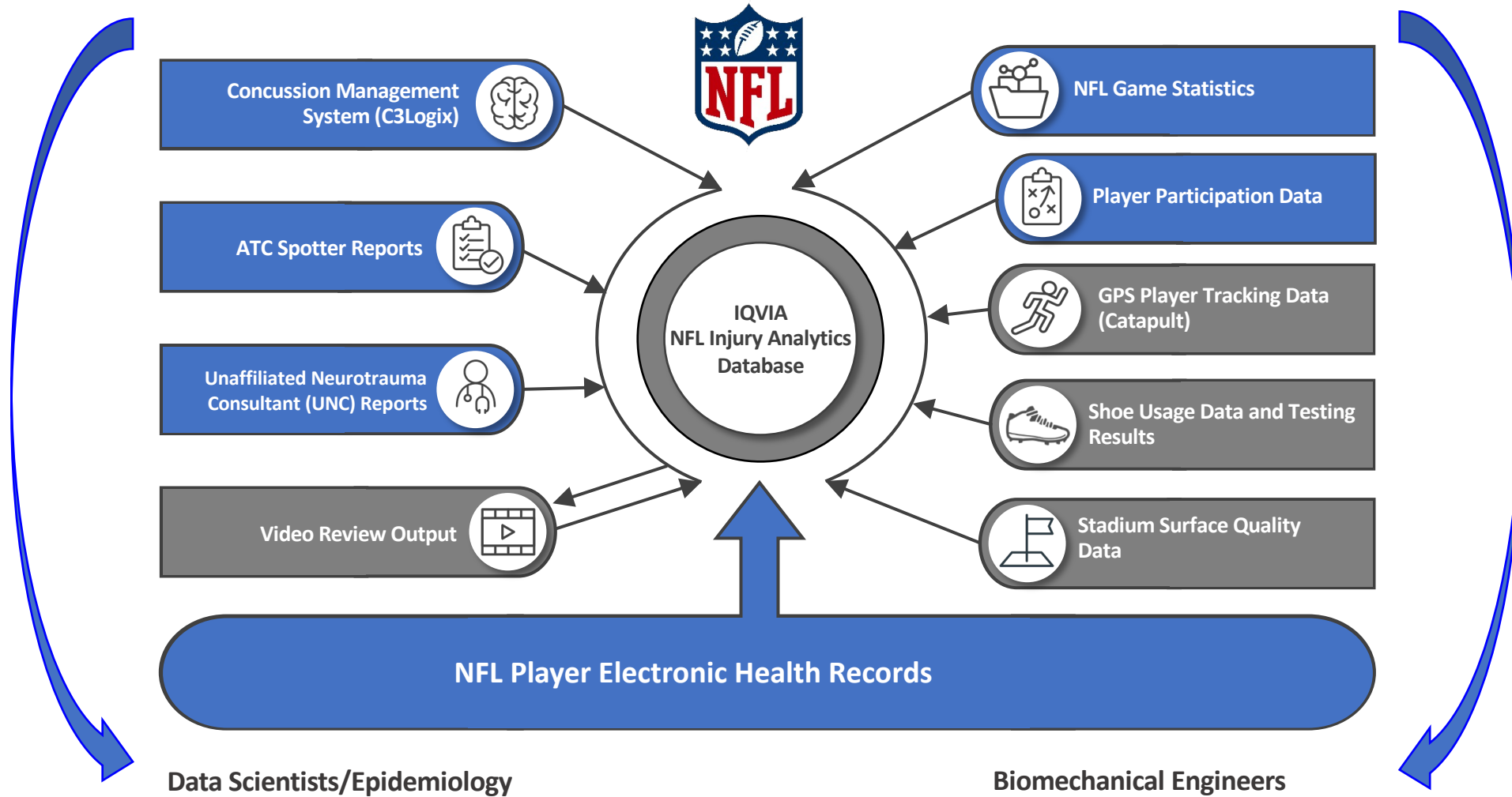
1 AIRWAY MANAGEMENT PHYSICIAN

Provides emergency intubation to severely injured, non-breathing players





DATA SOURCES



NFL CONCUSSION PROTOCOL

THE PROTOCOL MAY BE TRIGGERED BY:



NFL CONCUSSION PROTOCOL

PLAYER IS REMOVED TO:



LOCKER ROOM



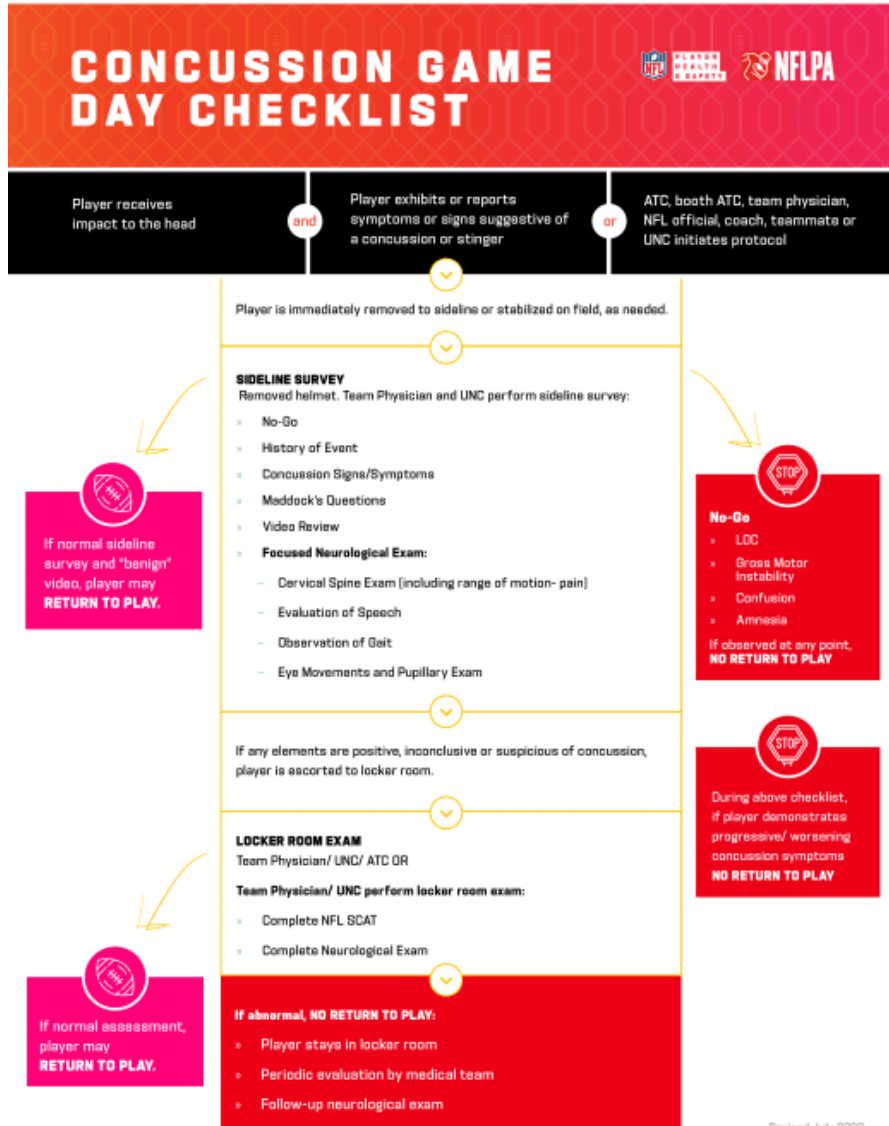
SIDELINE
MEDICAL TENT



(If any element of Sideline Medical Survey is positive, inconclusive, or suspicious of concussion, then the player is escorted to the locker room for further evaluation)

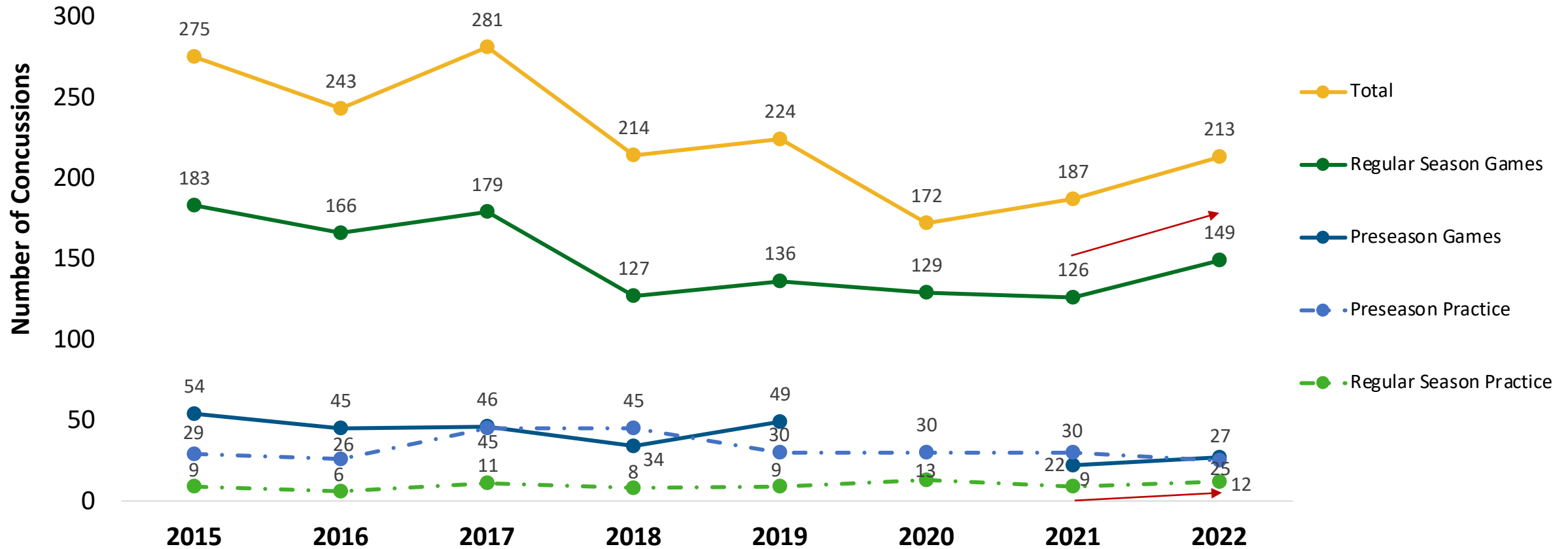


NFL Concussion Protocol



<https://www.nfl.com/playerhealthandsafety/health-and-wellness/player-care/concussion-protocol-return-to-participation-protocol>

Overall, concussions up 14%* (+26 vs. 2021)



Note: There were no preseason games played in 2020. The NFL season structure changed in 2021 to include 3 preseason games and 17 regular season games. Prior to 2021, the NFL season included 4 preseason games and 16 regular season games.

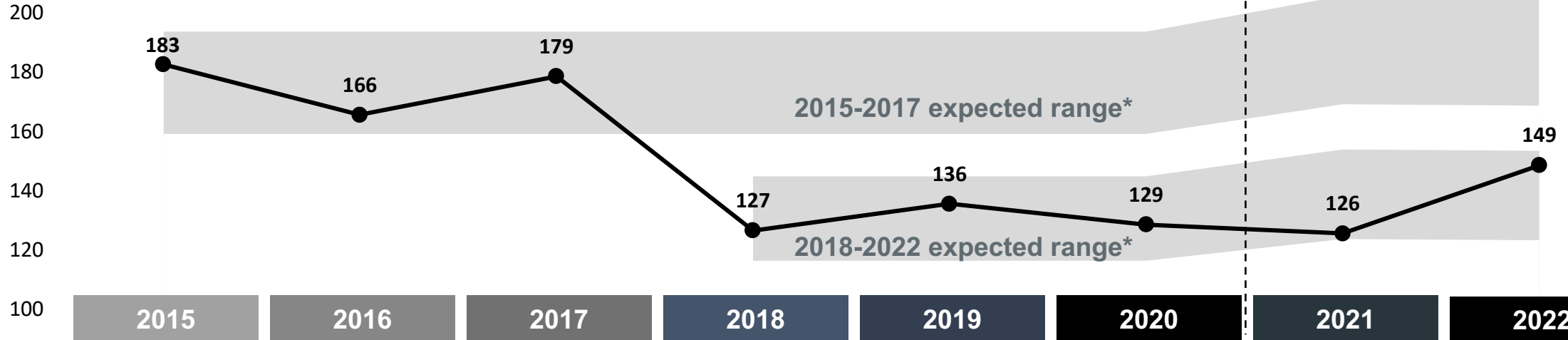
*Across preseason and regular season games and practices

Parallel Efforts: Diagnose, Report, and Reduce Concussions

Regular Season Game Concussions; 2015-2022^a

Change from 17-week to 18-week season^a

Number of Regular Season Game Concussions



Efforts to increase concussion detection, diagnosis and reporting

- | | | | | | | | |
|--|--|--|---|--|---|---|---|
| <ul style="list-style-type: none"> • Medical timeout (ATC Spotters) • Mandatory UNC involvement • Launch of NFL EMR • Launch of in-season audits for reporting | <ul style="list-style-type: none"> • Concussion evaluation of any neck injury • Additional ATC Spotter at each game • Additional IVRS tech on each sideline • Player and coach education to increase player-self-reporting | <ul style="list-style-type: none"> • Addition of on-field medical tent • Launch of pre-season UNC training | <ul style="list-style-type: none"> • Mandatory pre-game medical mtgs | <ul style="list-style-type: none"> • Real-time game concussion data alerts to CMO | <ul style="list-style-type: none"> • VTMLs trained as UNCs | <ul style="list-style-type: none"> • Emphasis on UNC/ATC/VTML integration and increased training | <ul style="list-style-type: none"> • Update to concussion protocol to include Ataxia |
|--|--|--|---|--|---|---|---|

Key Rules Changes

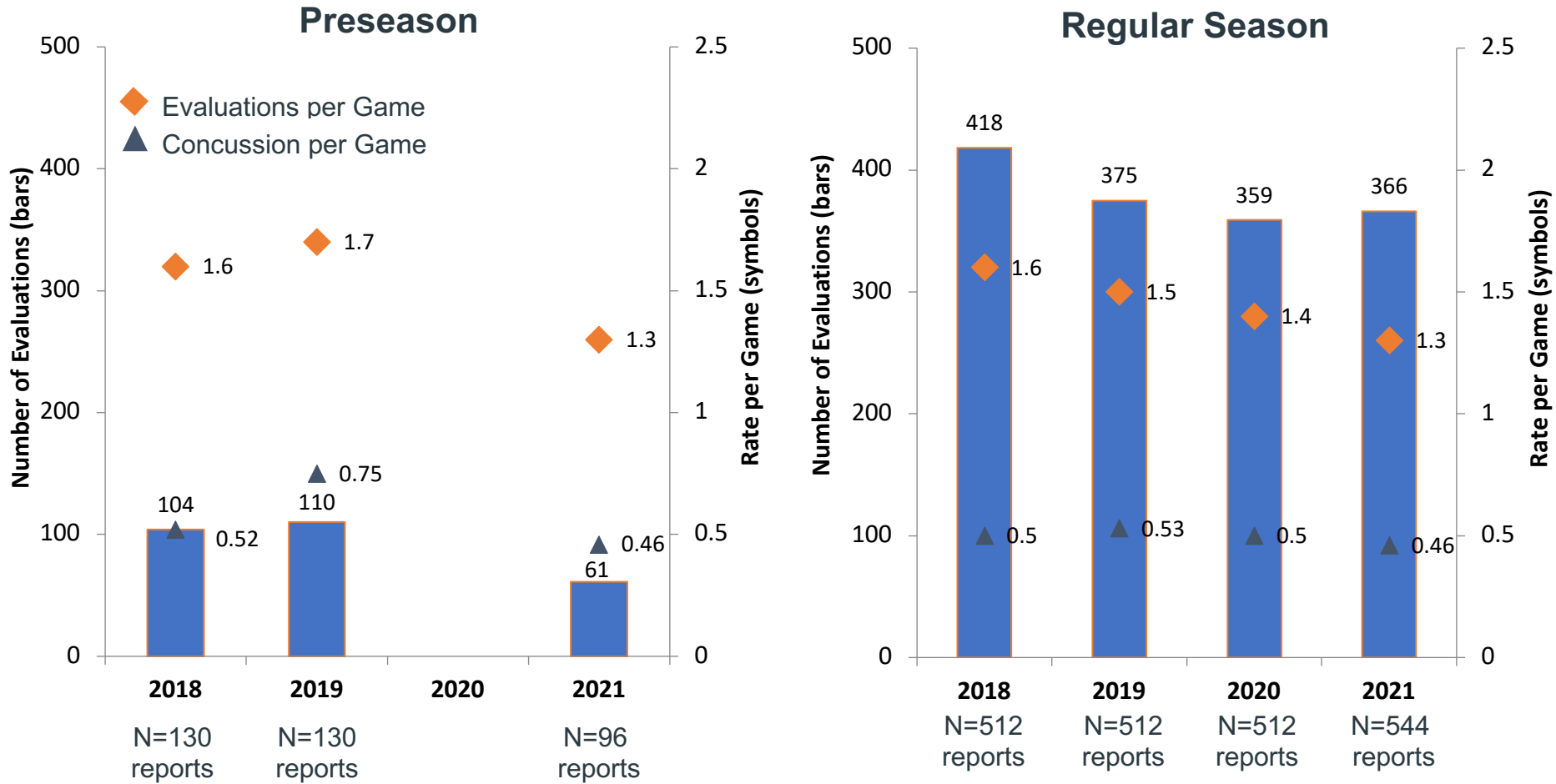
- | | | | | |
|---|---|---|--|---|
| <ul style="list-style-type: none"> • Prohibition of helmets - legacy exemptions • Updated kickoff rules • Use of helmet rule | <ul style="list-style-type: none"> • Prohibition of helmets – mandatory • Elimination of all blindside blocks | <ul style="list-style-type: none"> • Emphasis on use of helmet rules • Expansion of defenseless player protection | <ul style="list-style-type: none"> • Emphasis on use of helmet rules, especially to opponent's lower body | <ul style="list-style-type: none"> • Emphasis on use of helmet rules, specifically contact with helmet to opponent |
|---|---|---|--|---|

^a The NFL season structure changed in 2021 to include 17 regular season games instead of 16 regular season games in prior years. The 2022 week 17 Bills vs Bengals canceled game was counted as 0.15 games after taking into account the number of minutes and plays played relative to a typical game for these Clubs.

* Expected ranges based on regular season game concussion rates within the years defined. Ranges were calculated using log-Poisson regression with generalized estimating equations to account for within-Club correlations in observed injury rates.

UNC Concussion Evaluations

2018-2021; Preseason and regular season games



UNCs evaluate between 3 - 4 players to diagnose 1 concussion

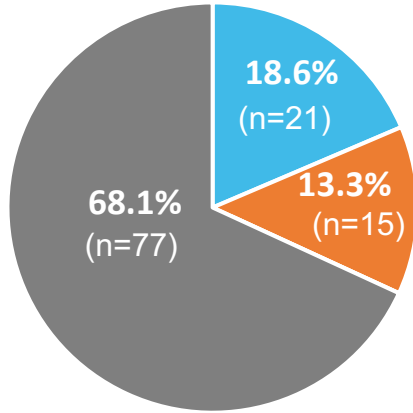
^a All UNC evaluations, including those that are stinger-associated, or occurred during Hall of Fame and international games. UNC reports were cleaned for data analysis, including removal of potential duplicate report submissions, or documentation of no UNC evaluation.

^b The 2020 Preseason was markedly different than other years. There were no preseason games, and all practices occurred during Training Camp

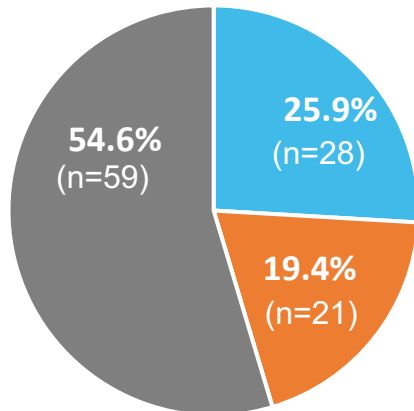
>40% of Evaluations of Concussed Players Triggered by Self-Report

2019-2021; Regular season games; UNC evaluations^a resulting in a concussion

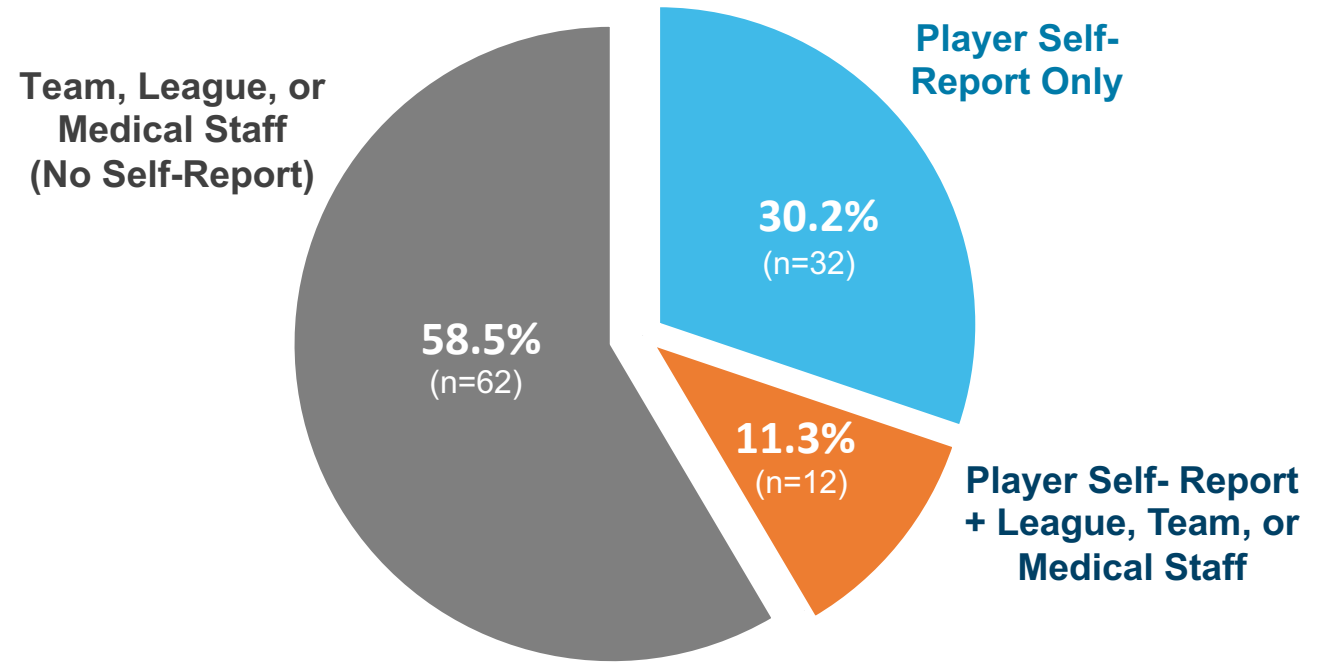
2019 Regular Season Evals Resulting in a Concussion (N=113)



2020 Regular Season Evals Resulting in a Concussion (N=108)



2021 Regular Season Evals Resulting in a Concussion (N=106)

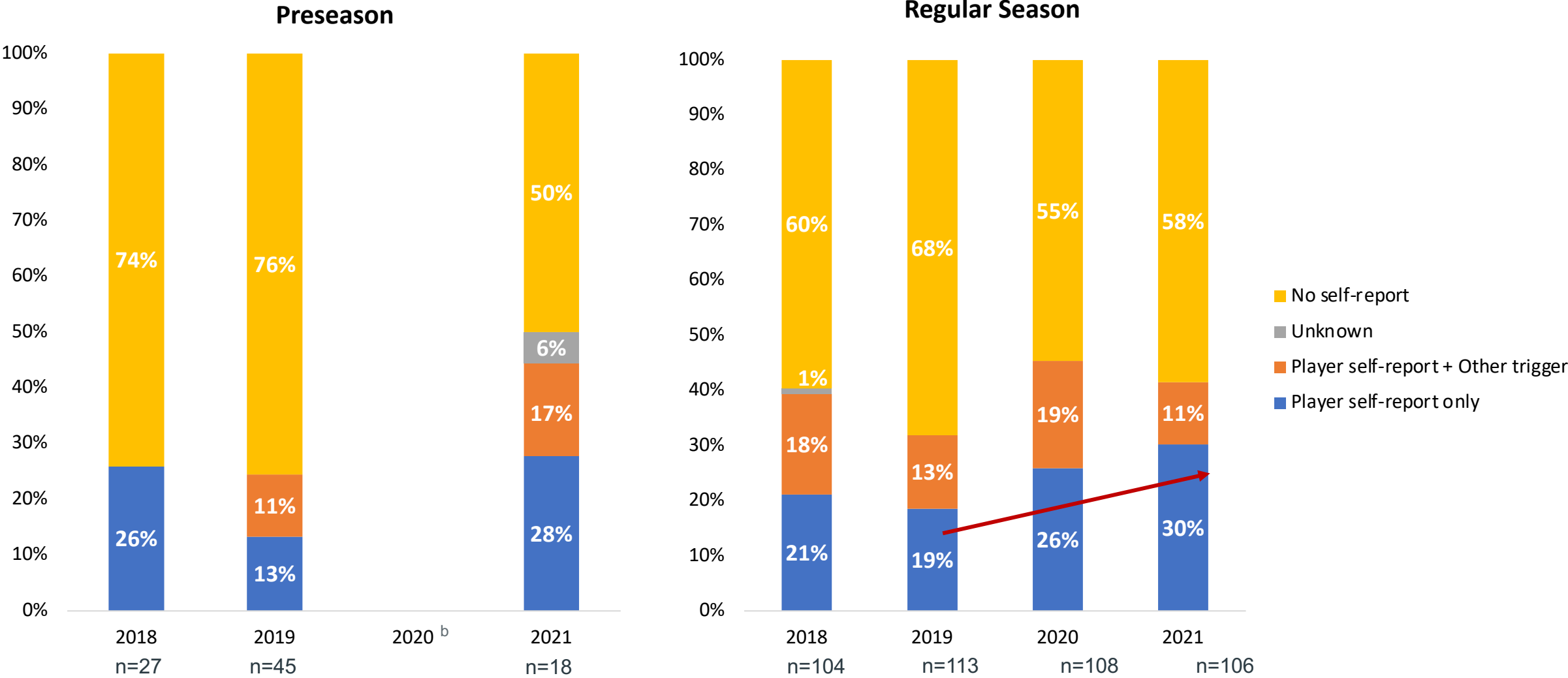


In 2021, 30% of regular season evaluations that resulted in a confirmed concussion were triggered *only* by a player self-reporting symptoms.

^a Includes any evaluation in which 'self-reported symptoms' is indicated as a trigger for a UNC evaluation; confirmation of concussion diagnosis according to NFL EMR.

>40% of Evaluations of Concussed Players Triggered by Self-Report

2018-2021; Preseason and regular season games; UNC evaluations^a resulting in a concussion



^a Includes any evaluation in which 'self-reported symptoms' is indicated as a trigger for a UNC evaluation; confirmation of concussion diagnosis according to NFL EMR.

^b There were no preseason games in 2020.

UNC Concussion Evaluation Outcomes

2018-2021; Preseason and regular season games

Evaluation Outcome ^a		2018		2019		2020 ^b		2021	
		Pre N=104 evals ^c	Reg N=418 evals	Pre N= 110 evals	Reg N= 375 evals	Pre N= N/A	Reg N= 359 evals	Pre N= 61 evals	Reg N= 366 evals
UNC report	EMR dx								
Removed from Play ^d	Conc	25 (24%)	98 (23%)	43 (39%)	106 (28%)	-	107 (30%)	17 (28%)	97 (27%)
	No Conc	1 (1%)	1 (<1%)	2 (2%)	10 (3%)	-	4 (1%)	0 (0%)	7 (2%)
Cleared to Return ^e	Conc	2 (2%) ^b	6 (1%)	1 (1%)	7 (2%)	-	1 (<1%)	0 (0%)	8 (2%)
	No Conc	76 (73%)	312 (75%)	63 (57%)	250 (67%)	-	245 (68%)	43 (70%)	252 (69%)

In 2021, 8 players were cleared to return^d but were later diagnosed with a concussion.

^a Evaluation outcome (removed vs. cleared to return) was derived based on information entered in the Comments field, in cases where discrepant information was entered into the UNC report.

^b The 2020 Preseason was markedly different than other years. There were no preseason games, and all practices occurred during Training Camp

^c 1 player was evaluated twice during the same game and was cleared to return by the UNC from both evaluations. A concussion was subsequently diagnosed for this player, according to the EMR

^d Removed from play for suspected concussion; not removed from play for other injuries.

^e In cases where players were evaluated twice during the same game, a diagnosed concussion in the NFL EMR was manually linked to the second of the 2 UNC evaluations. This method may result in underestimation of players cleared to return who were diagnosed with concussion in the EMR (2018: PS n=2 players, 1 with dx conc, RS n=5 players, 5 with dx conc; 2019: PS n=2 players, 2 with dx conc, RS n=6 players, 5 with dx conc; 2020: RS n=5 players, 4 with dx conc; 2021: PS n=3 players, 2 with dx conc, RS n=5 players, 1 with dx conc).

Risk modification – head impacts

*Can we reduce the incidence
and severity of **ALL** head
impacts in football?*



Risk reduction strategies

- **Equipment**
- **style of play/rules**
- **training and teaching**
- **Supervision and medical support**

HEAD IMPACT IN SPORTS

- **Intentional** – rules, culture
 - Challenge of judging intent
 - Look for outcome that carries high risk of serious injury
- **Inadvertent** – common to all sports
 - Player strikes head on ground
 - Unplanned collision between 2 players
- **Avoidable**
 - Technique dependent
 - Role of coaching
 - Effectiveness
 - Rules may also inform

HEAD IMPACT REDUCTION

- **Volume**

- How many times the head is contacted
- Games AND practices
- Possible cumulative effect
- Blocking AND tackling

- **Intensity**

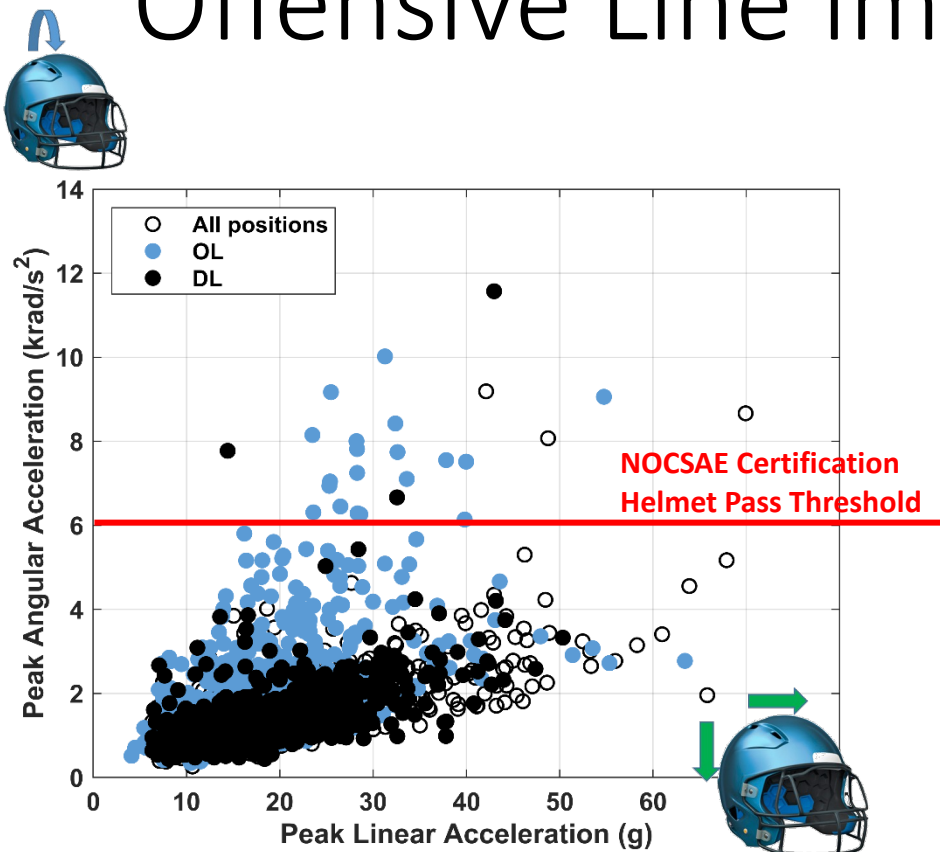
- Decrease the force transmitted to the brain for any impact that does occur
- Role of equipment - innovation

- **Density**

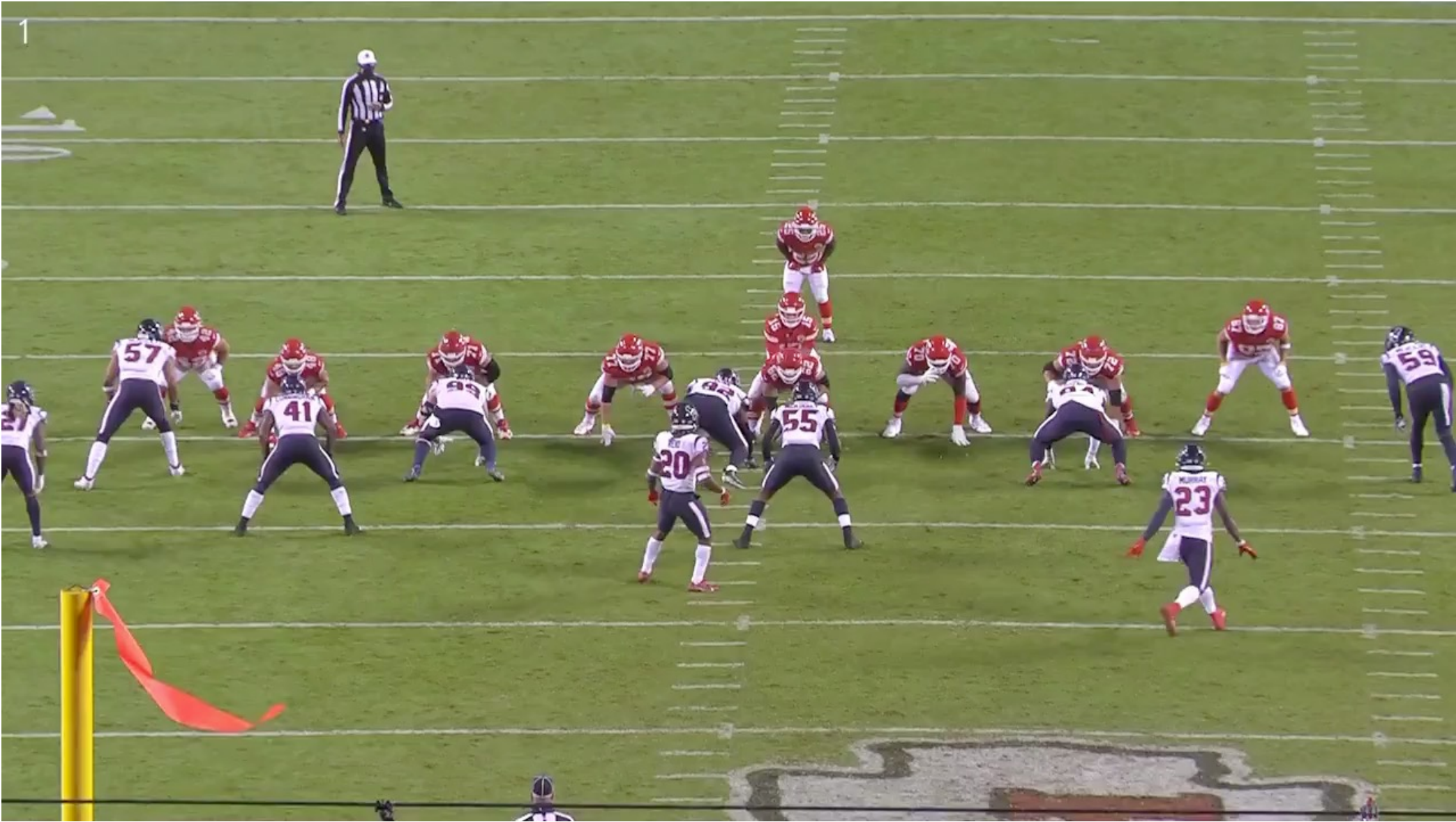
- How many impacts in a given period of time
- More research needed
- Game and practice schedule
- Real time monitoring



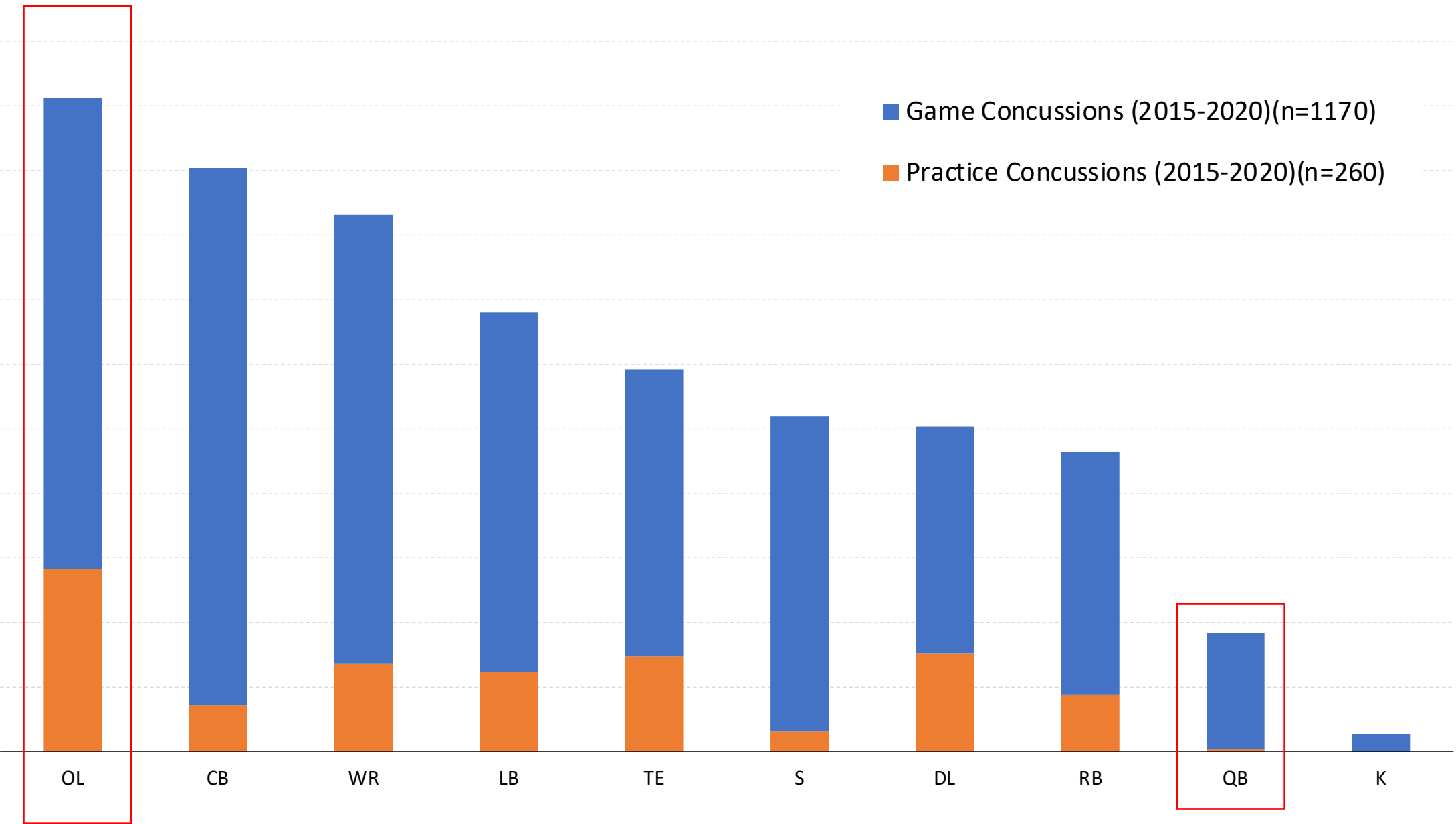
Offensive Line Impact – Sensor and Video



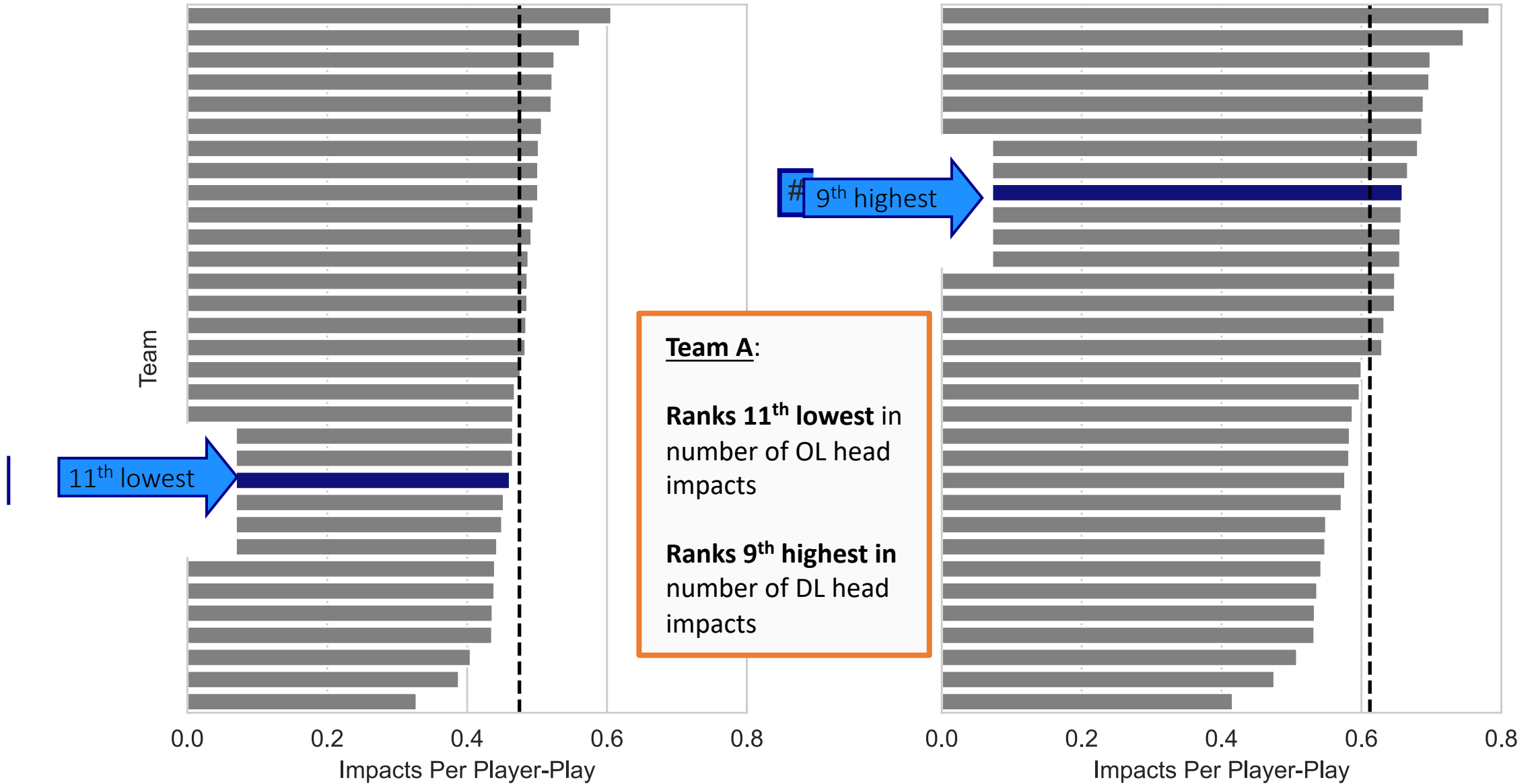
Helmet Impact Detection – Data Source for Exposures



Who's Sustaining Concussions?

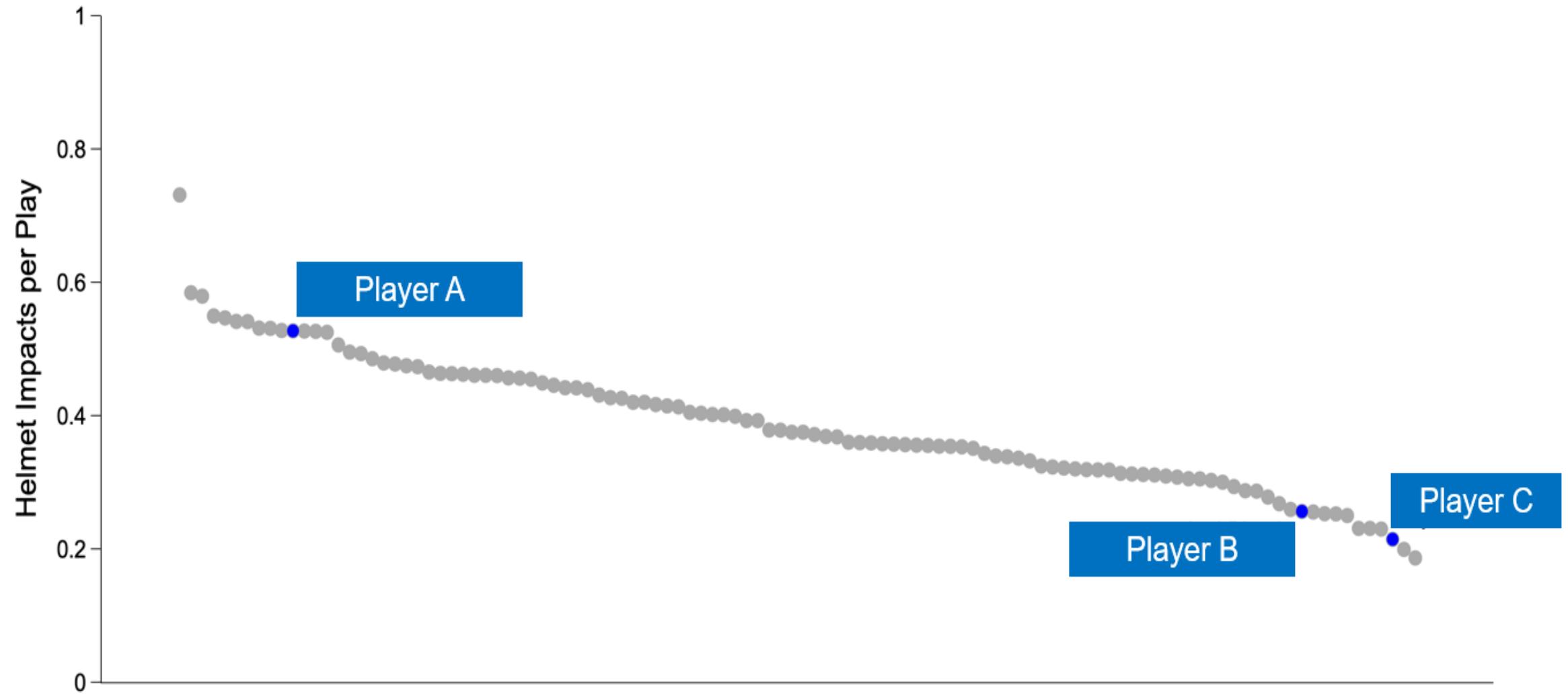


Example Team: Rush/Pass OL and DL Helmet Impacts



Player Specific Helmet Impact Data

2022: Guards, Rush Plays



3D kinematic study of Blocking Techniques & Drills

Stance



Mobile blocks



Head Impact
Frequency
and Head
injury risk

Run blocking techniques



Drills



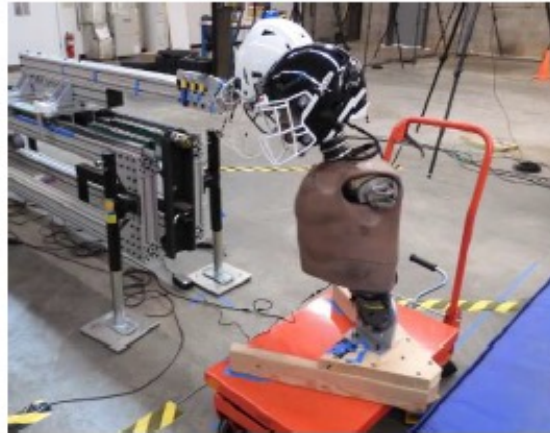


“Hands First”



Hands or shoulder initiate contact before helmet

- Test eccentric (small overlap) impacts
- Two helmet Models (SpeedFlex Precision, Vengeance Z10 LTD)



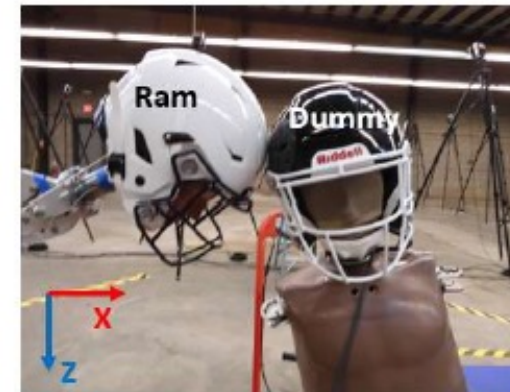
Add-on Conditions

- No cap vs. Cap
- Cap vs. No Cap
- No cap vs. Cap
- Cap vs. Cap



Test Condition #1 (5cm eccentric)
Ram Front to Dummy Front Oblique

Test Condition #2 (10 cm eccentric)
Ram Front to Dummy Rear Eccentric



Test Condition #3
Ram Front to Dummy Side Upper



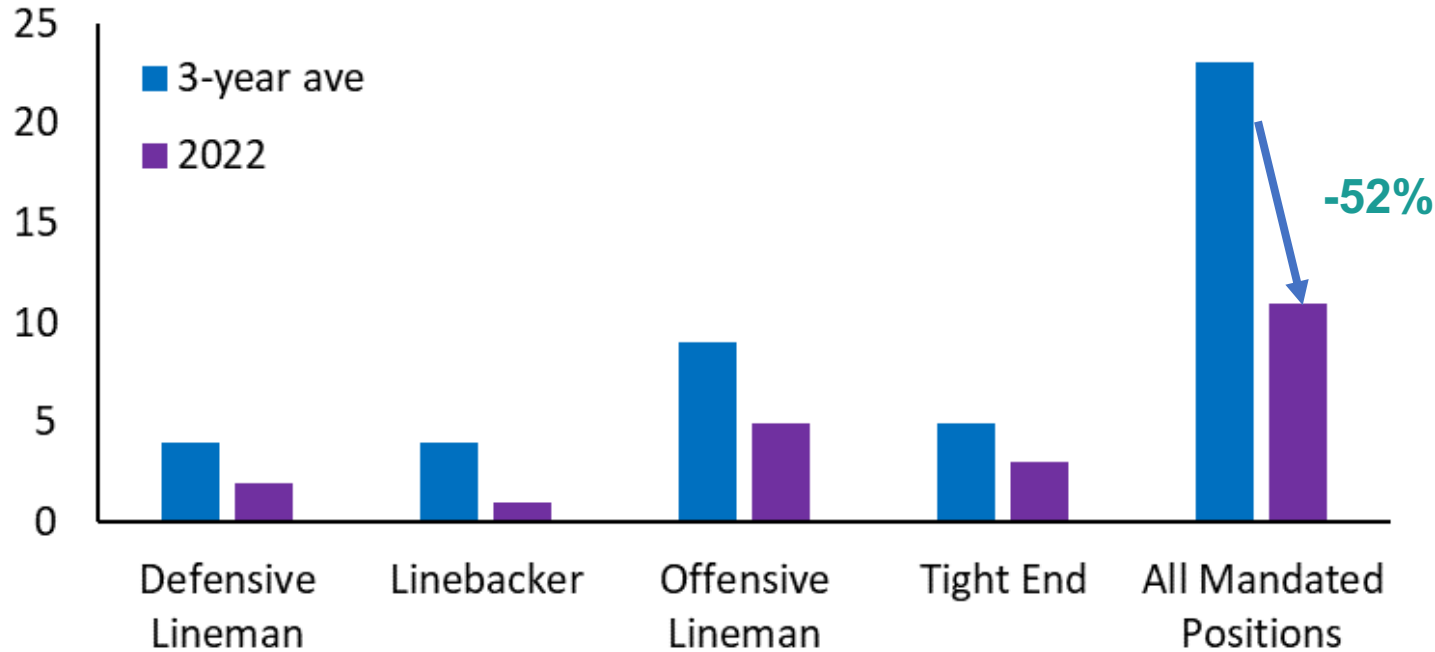


Guardian Cap Reduced Preseason Practice Concussions

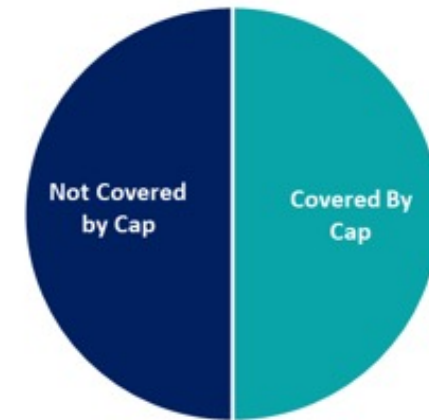
Over 1500 Linemen, Tight Ends, & Linebackers wore in preseason, 150+ players in regular season

Preseason Practice Concussions

Guardian Cap Mandated Period



Helmet Impact Locations for Concussions During Mandated Period



Average **16%** reduction in impact severity when wearing Guardian Cap vs. No Guardian Cap (matched cohort n=13)

Expanding Guardian Cap Mandate

2022

52% reduction in concussion among players for preseason mandated period



18 teams and **>150 players** wore during regular season

2023

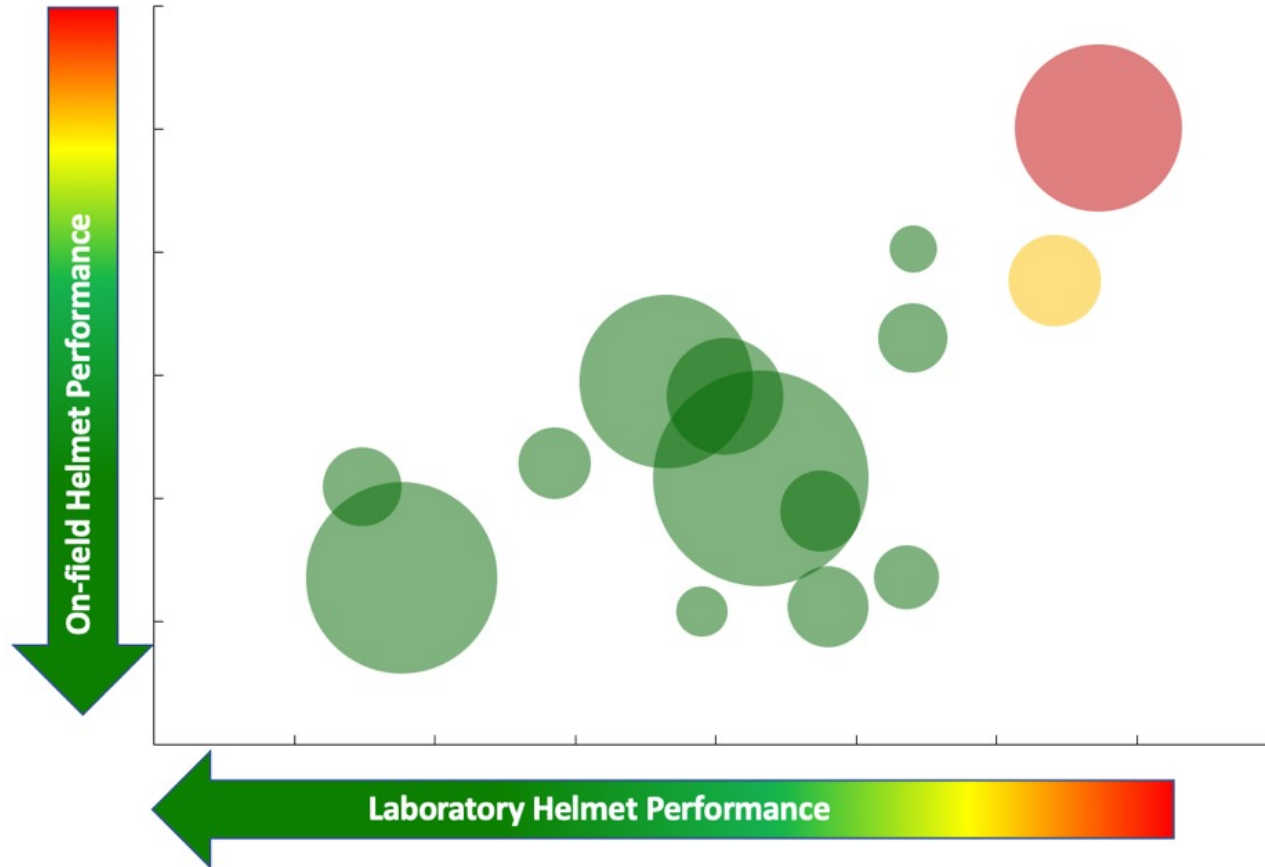
What: updated Guardian Cap NXT 1.8

Who: OL, TE, DL, LB, RB, FB

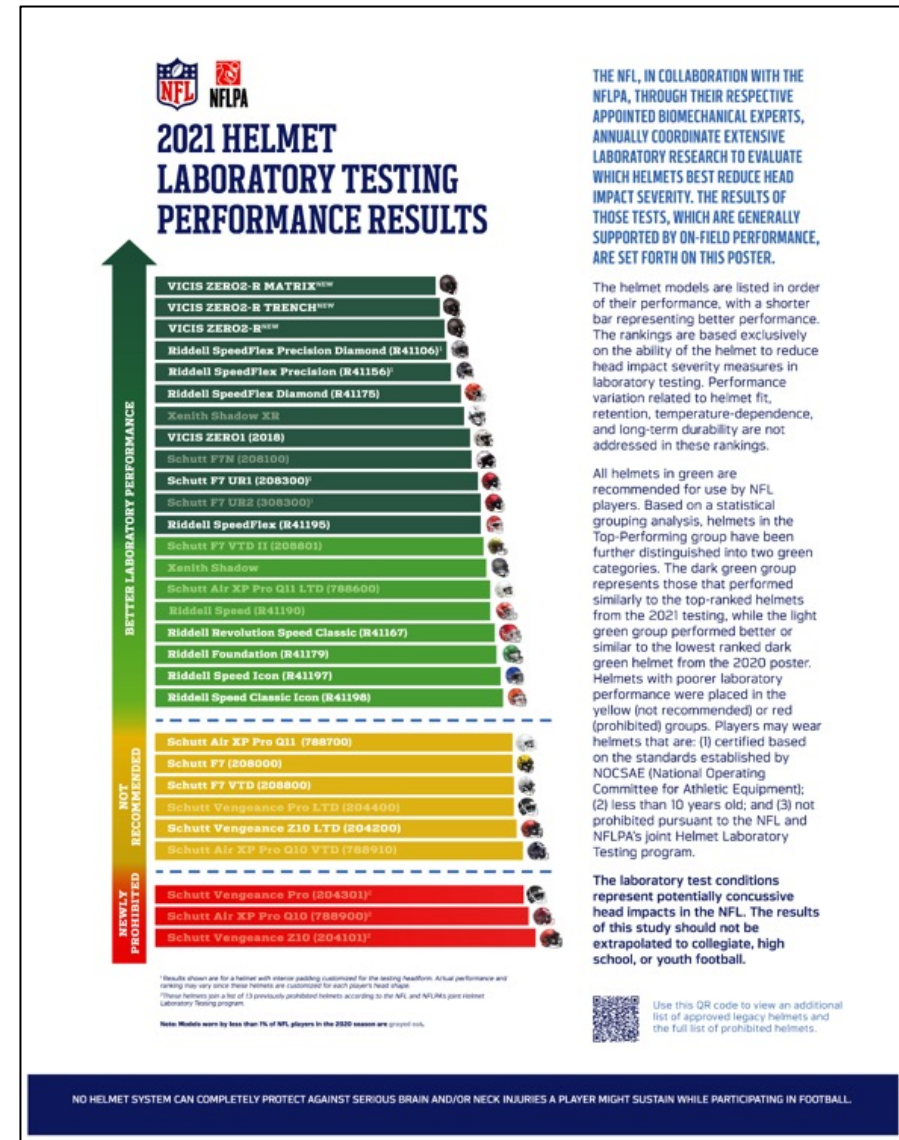
When:

- All helmeted preseason activities
- All contact practices: regular and post-season

NFL-NFLPA HELMET TESTING AND ON-FIELD PERFORMANCE



Each circle represents a helmet model (size of circle represents # plays in helmet)



QB POSITION-SPECIFIC HELMET

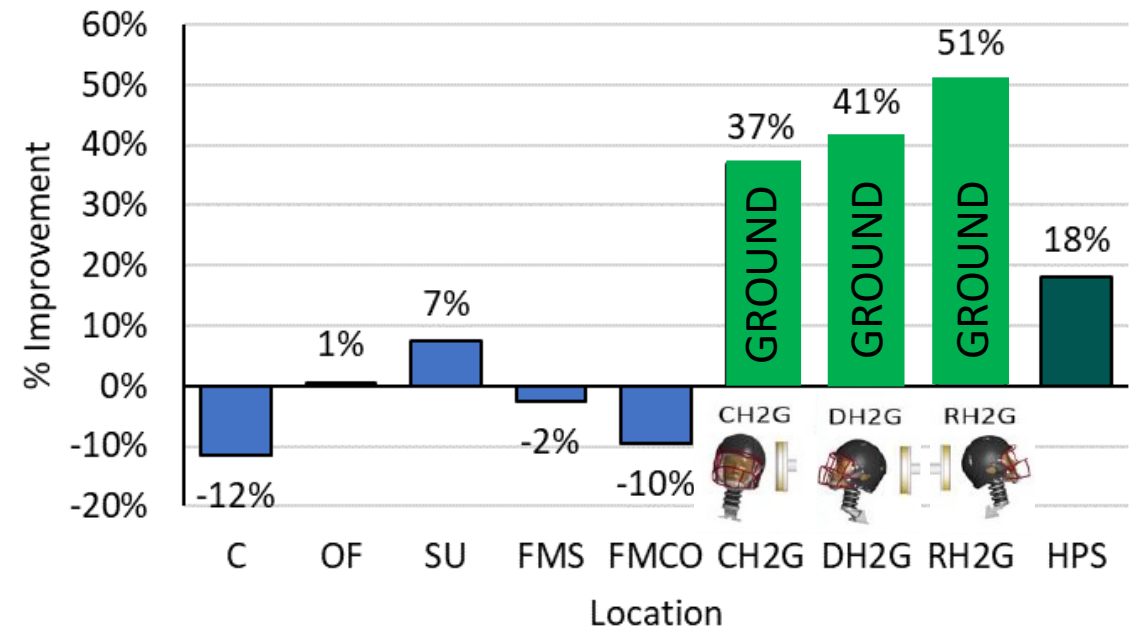
VICIS ZERO2 MATRIX QB



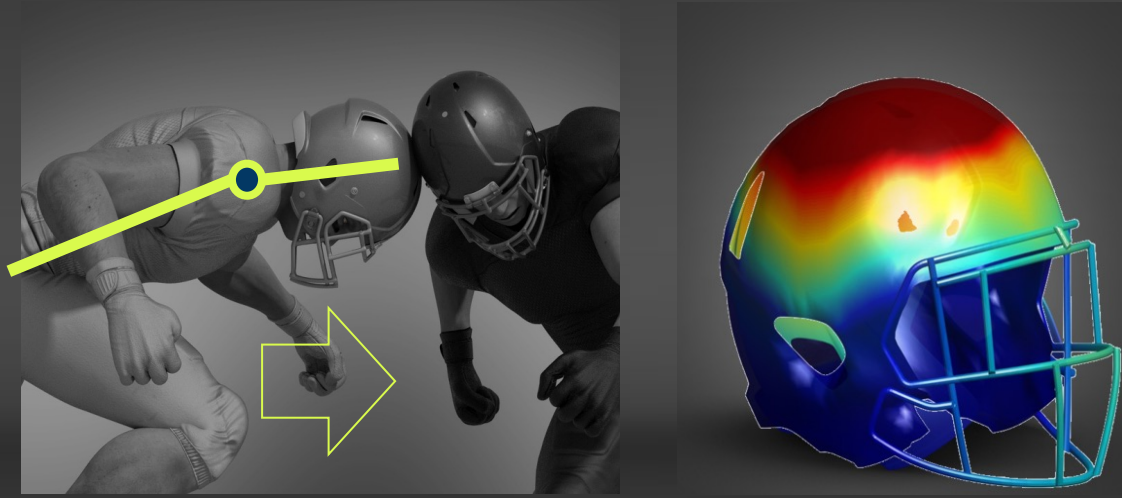
Tuned liner stiffness to perform better in helmet-to-ground impacts

➤ Improved performance (**18%**) in the QB-specific helmet test compared to standard version of the ZERO2

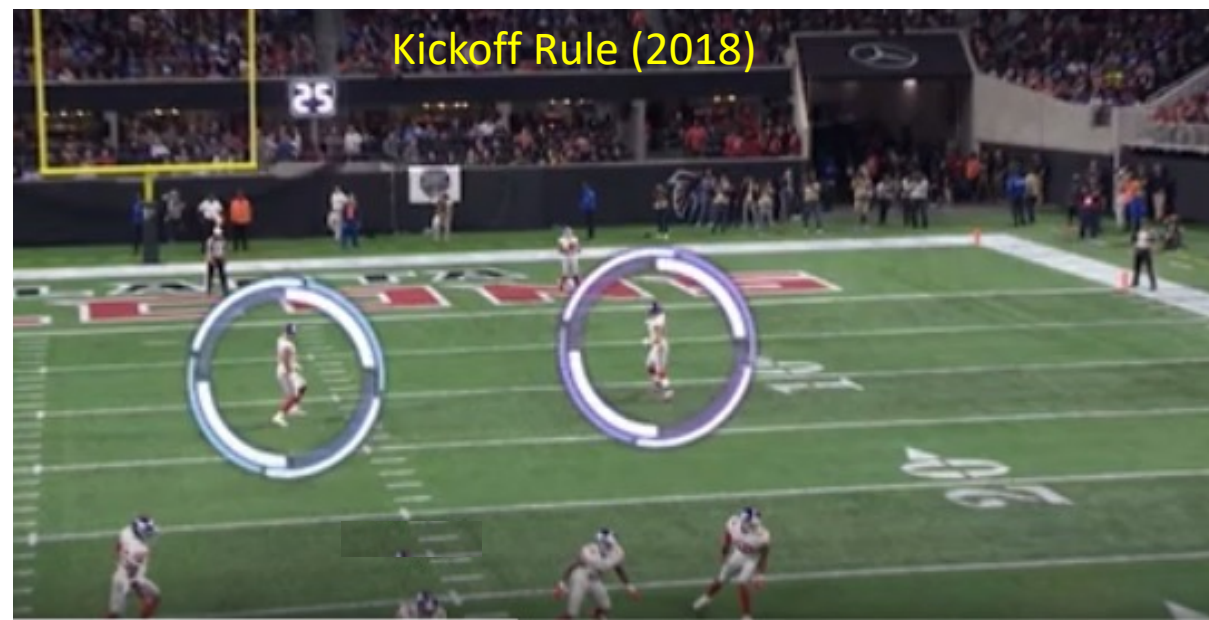
Weighted Difference MATRIX QB vs. MATRIX



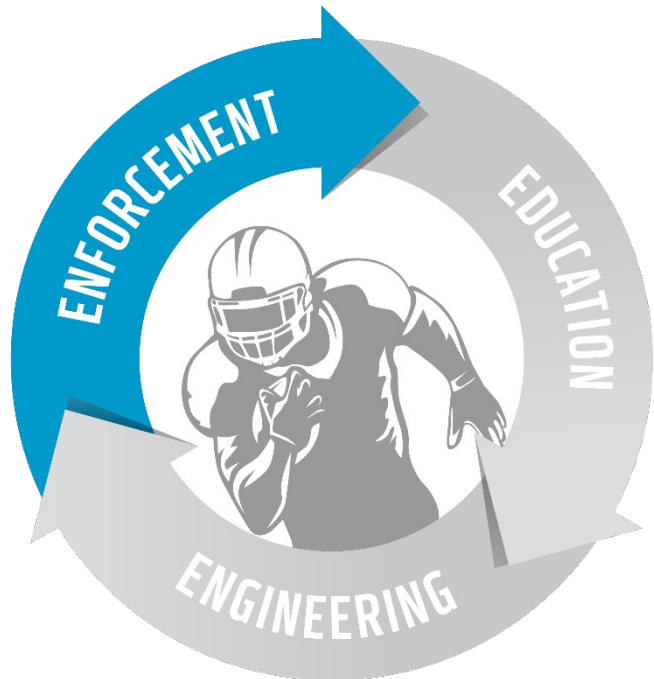
Use-of-Helmet Rule (2018)



Kickoff Rule (2018)



Blindside Block Rule (2019)



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Behind-the-Scenes on Game Day: The 60-Minute Meeting

As athletes across the country are preparing to take the field for the upcoming season, it's important that medical personnel, coaches and staff are getting ready, too.

For the NFL, the 60-Minute Medical Meeting is a crucial piece of game day preparations. Taking place at the stadium one hour before kickoff at every game throughout the NFL season, the meeting is an essential checkpoint to ensure officials, team medical staff, and gameday medical personnel are aware of all in-game player health and safety procedures and resources.

The following video is a training tool for participants in the meeting. It provides an overview of what is discussed during the 60-Minute Medical Meeting and shows how the meeting helps prepare medical staff and gameday personnel to be responsive to any player health and safety needs that may arise during the game.



As the video details, the meeting is a short but important component of each game day. It includes dedicated time introducing key staff to one another, reviewing logistics, assigning roles, and running through emergency action plan procedures. These sessions



Guardian Cap Requirement Sees Meaningful Results

The NFL's efforts to foster innovation to enhance player safety was on display this summer at training camp when, for the first time, offensive linemen, defensive linemen, tight ends, and linebackers were required to wear the Guardian Cap in practices until the second preseason game.

Based on laboratory research conducted by NFL engineering consultants and shared with experts representing the NFLPA, we were aware that the Guardian Cap had the potential to reduce the severity of head impacts. The lab results showed that if both players in a head-to-head impact were wearing the Guardian Cap, that the forces could be reduced by more than 20% compared to the same impact without it.

Early results from this preseason demonstrate that the Guardian Cap is making a meaningful difference for players' health and safety. The position groups required to wear Guardian Cap during the mandated period in the preseason saw a reduction of more than 50% in concussions versus a previous three-year average.



Jeff Miller, NFL Executive Vice President overseeing Player Health & Safety, discusses Guardian Cap Results on Good Morning Football





NFL Player Health & Safety