# Whole-Person Impairment in Younger Retired NFL Players

**Background:**This study reports the total whole person impairment (WPI) percentages in a cohort of retired NFL players based on the standardized American Medical Association (AMA)impairment guidelines. We hypothesize there will be a high orthopedic burden based on WPI percentages,related to impairment reported in retired NFL players.

**Methods:**During the study period of February 2011 toAugust 2013, 65 retired NFL players presented for impairment evaluations. A complete history and physical exam was performed on all symptomatic joints based on the AMA (5th Ed.) Guides to the Evaluation of Permanent Impairment.A retrospective chart review was conducted on 100% of presenting players to assess orthopedic burden. Body Part Impairment (BPI) percentage for each affected joint was generated. The impairment data for each extremity was then combined with spine impairment data to create WPI percentage. Player demographics, including age, position and playing timewas also recorded.

**Results:** The average whole person impairment percentage was 37% (range 19%-53%). Players participating in greater than 30 games had a statistically significant (p = 0.004) higher WPI than those playing in less than thirty games. Players playing greater than five seasons were 1.8 times more likely to have a WPI greater than 35%. The most common joints players reported as symptomatic were lumbar (n=63 or 97%) and cervical spine (n=58 or 89%). The average age at evaluation was 33.6 years old (range 27-42), and average number of seasons played was 7.9 (range 3 – 14), and the average number of games was 93 (range 2 – 236).

**Conclusion:** Our study demonstrated a very high burden of orthopedic injuries related to symptomatic jointsin a cohort of retired NFL players.These orthopedic injuries take a cumulative toll on the player, leading to significant whole body impairment by the end of a professional football career.

**Key Words:** Football, National Football League, impairment, disability

**What is known about the subject:**

Professional football is a physically demanding, high-impact sport with an elevated risk of injury. Many studies have examined specific orthopedic injuries, clinical outcomes and return to sports for professional athletes, including NFL players. The injury receiving the most attention in retired NFL players is concussions or mild traumatic brain injury (MTBI). However, minimal literature exists on the impact orthopedic injuries have on NFL players, both in the short and long-term.

**Combined Values Chart**

The values are derived from the formula A + B(1−A) = combined value of A and B, where A and B are the decimal equivalents of the impairment ratings. In the chart all values are expressed in percents. To combine any two impairment values, locate the larger of the values on the side of the chart and read along that row until you come to the column indicated by the smaller value at the bottom of the chart. At the intersection of the row and the column is the combined value.

For example, to combine 35% and 20%, read down the side of the chart until you come to the larger value, 35%. Then read across the 35% row until you come to the column indicated by 20% at the bottom of the chart. At the intersection of the row and column is the number 48. Therefore, 35% combined with 20% is 48%. Because of the construction of this chart, the larger impairment value must be identified at the side of the chart.

If three or more impairment values are to be combined, select any two and find their combined value as above. Then use that value and the third value to locate the combined value of all. This process can be repeated indefinitely, the final value in each instance being the combination of all the previous values. In each step of this process the larger impairment value must be identified at the side of the chart.

Note: If impairments from two or more organ systems are to be combined to express a whole person impairment, each must first be expressed as a whole person impairment percent.

## What this study adds to existing knowledge:

Injury and health data on retired players is minimal and predominantly focuses on post concussion syndrome or diagnoses developed later in life. This study addresses the orthopedic burden on a young cohort of retired NFL players, a population which has received minimal attention. Our results pose the challenge of how to best interpret and mitigate the high level of orthopedic burden prevalence in retired NFL players and its impact on the transition from a professional sports career. Increased knowledge, timelier diagnosis and appropriate interventions for orthopedic injuries have the potential to improve short and long-term outcomes.

## Introduction

Minimal literature exists on the short and long-term impact of orthopedic injuries on retired NFL players.Halchin et al.8report over 65% of NFL players may be injured on an annual basis, which can contribute to a cycle of worsening injuries and long-term consequences. Many recent studies and much media attention have focused on the long-term effects of concussions on the lives of former NFL players2, 7, 8. While football is a high-collision sport, well known to cause frequent orthopedic injuries, the long-term effects of those injuries on professional football players remain poorly defined. Additionally, most research on retired players focuses on an older cohort and less research has been done examining the impacts of injuries and related impairment of younger populations following their transition from the NFL to the next stages of life.

The purpose of our study is to describe and report the total whole person impairment (WPI) percentages in a cohort of recently retired NFL players based on the standardized American Medical Association (AMA) 5th edition impairment guidelines. We hypothesize there will be a high burden of orthopedic injuries in this cohort, leading to significant physical impairment.

## Methods

During the study period of February 2011 to August 2013, 65 retired NFL players presented to an orthopedic clinic for impairment evaluations. For the evaluation, a complete history, physical exam and radiographic imaging was performed on all symptomatic joints based on the American Medical Association (5th Ed.) Guides to the Evaluation of Permanent Impairment. A retrospective chart review was conducted on 100% of presenting players to assess the orthopedic burden using standardized impairment reports. Player demographics, including age, position, seasons and games played were also recorded. Institutional Review Board approval was received for this study.

Body part impairment (BPI) percentages for each affected joint, on right and left sides, were generated. Upper extremity (UE) and Lower extremity (LE) are combined for left and right sides giving a total UE and LE number.Range of motion for each affected joint is the most common measurement used to calculate UE impairment. Range of motion, previous surgery, or arthritis measured by joint space narrowing on x-ray can be used to calculate the total LE impairment score. For the spine, an impairment percentage is assigned most commonly by an MRI but can also be calculated based on medical history, clinical examination and history of a fracture. Using the combined values chart (CVC) as defined by the AMA, the BPI percentages for affected joints are used to calculate upper extremity (UE) and lower extremity (LE) impairments. The impairment data for each extremity was then combined with spine impairment data to create a WPI percentage. The CVC was used again in order to provide a formula-derived algorithm to combine multiple impairments and avoid ratings greater than 100% for WPI. Treatment options and recommendations were provided based on clinical findings and final impairment report.
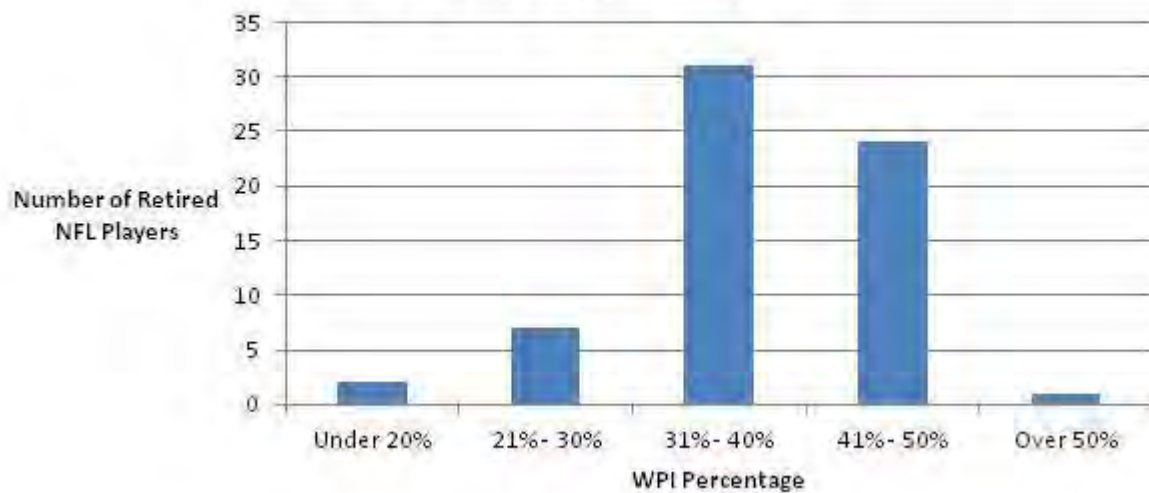


## Statistical Analysis

Descriptive statistics, such as percentage and mean were the predominant method of assessing data. Frequencies and descriptive statistics were calculated using Microsoft Excel 2010. The independent student t-test wasused for the comparison of means between groups. One-way analysis of variance (ANOVA) was performed to compare the means for three groups based on number of seasons played. A p value of $< 0.05$ was considered statistically significant.

**Spine Impairment**

| Extremity | Joint / Body Part | No. Presenting | Percentage Presenting | Average Whole Person Impairment (WPI) |
|---|---|---|---|---|
| Spine | Cervical | 58 | 89% | 8% |
| | Thoracic | 11 | 17% | 5% |
| | Lumbar | 63 | 97% | 8% |

## Results

The average whole person impairment percentage was 37% (range 19%-53%). The most common joints players reported as symptomatic were lumbar (n=63 or 97%) and cervical spine (n=58 or 89%). Spine impairment data is presented in Table 1. For UE, the right shoulder (n=52 or 80%) was the most symptomatic joint evaluated and the left hip (n=46 or 71%) for LE evaluation. The number of symptomatic joints and corresponding impairment percentages are presented in Table 2. The knee had the highest incidence of previous surgical treatment with 32 (49%) players totaling 64 operations (range 1-5). For patients with prior knee operations, the average knee BPI was 7.5%, compared to 2.6% for players without surgical intervention on the knee.

The average age at retirement was 30.8 years (range 26-37) and theaverage age at impairment evaluationwas 33.6 (27-42) years old. The average time between retirement and impairment evaluation was 2.8 years with players averaging a reported WPI of 37%. The majority of players played on defense (56%), followed by offense (42%) and special teams (2%). The average number of years played professionally was 7.5 seasons (Table 3) and the median number of games played was 93 (range 2 – 236). Players participating in greater than 30 games had a statistically significant (p = 0.004) higher WPI than those playing in less than thirty games. Based on our cohort, thirty games was the minimum threshold at which statistically significant differences were observed in WPI. However, players playing less than 30 games had an average WPI of 32%, still signifying a high orthopedic burden because of impairment.

When comparing the cohort based on number of professional seasons played, a statistically significant difference was found between players playing five years or less compared to players with six or greater seasons related to WPI (p0.001). Additionally, for players who played a minimum of five seasons, 75% had a WPI score greater than 35%. For players with less than five years, 42% had a WPI greater than 35%. Players playing greater than five seasons, were 1.8 times more likely to have a WPI greater than 35%. When comparing players who played 3 – 5, 6 – 10, and 11 – 15 seasons, there was a statistically significant difference (p < 0.05) in WPI for players with longer careers.

There was no statistical difference found in WPI when comparing offensive (n=27) versus defensive (n=37) and special teams (n=1) players. Skill position players(n=49) had higher average WPI than lineposition players (n=16), a trend that did not reach statistical significance (p=0.078). Offensive and defensive line positions were categorized as line, while positions such as wide receiver, running back, tight end, linebackers and defensive back were classified as skill positions. Comparisons between specific positions could not be assessed due to a small denominator at some positions, such as quarterback and kicker.

| Extremity | Joint / Body Part | Left | | | Right | | |
|---|---|---|---|---|---|---|---|
| | | No. Presenting | Percentage Presenting | Average Body Part Impairment (BPI) | No. Presenting | Percentage Presenting | Average Body Part Impairment (BPI) |
| Upper | Shoulder | 49 | 75% | 8% | 52 | 80% | 9% |
| | Elbow | 18 | 28% | 2% | 18 | 28% | 3% |
| | Wrist | 21 | 32% | 6% | 34 | 52% | 5% |
| | Hand and Fingers | 15 | 23% | 6% | 16 | 25% | 7% |
| Lower | Hip | 46 | 71% | 9% | 40 | 62% | 9% |
| | Knee | 35 | 54% | 8% | 37 | 57% | 8% |
| | Ankle | 30 | 46% | 8% | 33 | 51% | 8% |
| | Foot and Toes | 2 | 3% | 9% | 5 | 8% | 7% |

Average Body Part Impairment (BPI) Percentages in Retired NFL Players in a Number of Symptomatic Joints

| No. Years Professional | No. Presenting | Whole Person Impairment (WPI) |
|---|---|---|
| 3 | 3 | 27% |
| 4 | 7 | 35% |
| 5 | 5 | 32% |
| 6 | 5 | 34% |
| 7 | 12 | 40% |
| 8 | 8 | 35% |
| 9 | 11 | 41% |
| 10 | 6 | 40% |
| 11 | 1 | 31% |
| 12 | 4 | 37% |
| 13 | 1 | 40% |
| 14 | 2 | 40% |

| Knee Procedure | Number of procedures on left knee | Number of procedures on right knee |
|---|---|---|
| Microfracture | 3 | 6 |
| Meniscectomy | 10 | 7 |
| Meniscus repair | 2 | 1 |
| ACL reconstruction | 2 | 5 |
| ACL repair | 1 | 0 |
| MCL repair | 1 | 0 |
| PCL repair | 0 | 1 |
| OCD repair | 5 | 0 |
| Unknown (procedures not specified in clinic note) | 16 | 13 |

**Study Cohort by NFL Position**

Legend: OL, RB, TE, WR, QB, DL, LB, DB, K

Data labels: 1, 1%; 3, 5%; 9, 14%; 15, 23%; 4, 6%; 8, 12%; 9, 14%; 3, 5%; 13, 20%
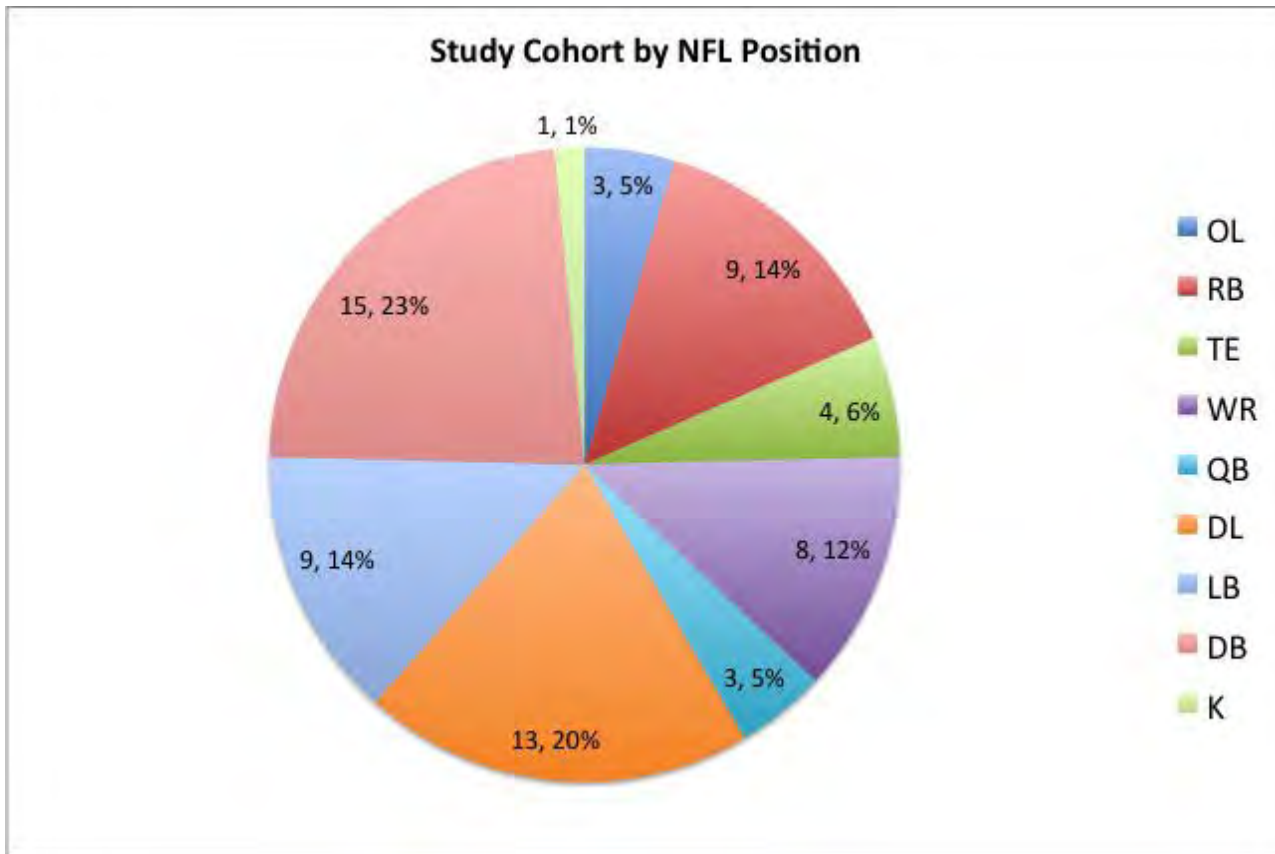
## Discussion

NFL players are at risk for orthopedic injuries because of the high impact nature of the sport along with biomechanical movements required; however, the orthopedic burden of retired NFL players has been an under-studied topic. Our study demonstrated a high level of WPI percentages in a cohort of young (average age 30.8) retired NFL players. Additionally, time from retirement to impairment evaluation averaged 2.8 yearssuggestsa serious acute impact, which many worsen with cumulative effects.Further research requires examination on progression and cumulative effects from a high orthopedic burden in both short and long-term contexts.

The majority of orthopedic research conducted with NFL players currently focuses on joints such as the knee, ankle, and shoulder and measures time lost and return to play data. Injury and health data on retired players is minimal and focuses on post concussion syndrome or diagnoses developed later in life.Halchin et el.[8]reported comprehensive data on the health of former players is not being collected or maintained, and information about employability, health status, and quality of life is not available. Such information is needed to assess potential relationships between injuries suffered and chronic health problems of impairments.[8]Additionally, most research on retired players focuses on an older cohort and less research has been done examining the impacts of injuries and related impairment of younger populations following their transition from the NFL to the next stages of life.

## Difference between Disability and Impairment

Impairment assessments are often linked to monetary benefits, as they are often the first step used in a disability evaluation.[4, 14]However, there is no direct correlation between impairment and subsequent disability status and benefits received. A discussion related to the definitions of impairment and disability is required in assessing our study results. Robinson et al. [13]concur that the ambiguities between impairment and disability pose many challenges in interpreting and applying findings. Impairment can refer to limitations on a person completing activities of daily living (ADL) or loss of function of a body part, whereas disability refers to a broader, conceptual definition. According to Melhorn[10], disability is a fluid concept and can be a temporary or permanent state, with varying degrees, creating a gap between what an individual

wants or needs to accomplish. Impairment can contribute to disability, but does not imply a causal factor in disability. The distinction is imperative to interpretation of the findings but also causes a challenge in interpreting the results in what these numbers suggest in terms of short and long-term consequences.

Much of the research and data assessing impairment, disability and earning losses has focused on workers' compensation and individual worker injuries, focusing on one BPI percentage, rather than an overall WPI percentage as a result of many, cumulative injuries. Several studies demonstrate a relationship between impairment and/or disability ratings to lower future earnings. However, our cohort's unique characteristics creates challenges comparing to other populations or cohorts studied. Halchin et al.[8]argue finding employment may be difficult for retired NFL players, and can be additionally challenging for a player with chronic health issues or impairments.

Several authors have assessed the relationship between impairment, disability, and earnings using data from California. Of note, California used a unique disability rating system until adoption of the AMA guidelines in January 2005. Pre-AMA guidelines, Bhattacharya et al., reported workers with higher disability rates are related to future lower earnings for a large population of claimants in California. However, they also concluded significant differences in average earning losses were seen for workers with similar impairment ratings. Individuals could have the same aggregate rating, but earning losses differed greatly based on what joint or body part was injured.

In 2002, Reville et al.[12]examined data from California's workers' compensation program to compare impairment and disability related to upper extremity injuries. California's program translates an impairment rating into a disability rating, accounting for age and occupation. The authors found the rating system was not able to correctly control for severity across upper extremity impairment categories, and earnings losses were not aligned with actual losses experienced by injured workers. Additionally, long-term earning losses and employability outcomes for workers with different impairments have not been estimated.

Seabury et al. analyzed data using the AMA Guides (5th ed.) and predictedfor each additional impairmentrating point a 1.1% higher average earning loss was associated. For the average impairment rating (7.7) the mean predicted earning loss was 18%. Adjusted estimates for predicted earning losses for ratings of one,10, and 20 were 9%, 22%, and 35% respectively. Cases with impairment ratings over 25 had an average 27.5% lower earning loss than cases with similar ratings, but these cases were considered outliers because of the small proportion of these cases related to overall sample. The authors found variations between earning losses in people with similar impairment ratings in different affected joints, consistent with previous studies. However, they cautioned impairment ratings alone are not sufficient to reflect actual earning losses.

**Health Conditions in Retired NFL Players**

Professional football is a demanding, high-impact sport with an elevated risk of injury. The injury receiving the most attention in retired NFL players is concussions or mild traumatic brain injury (MTBI). However, minimal literature exists on the impact orthopedic injuries have on players short and long-term. Schwenk et al.[15]assessed the prevalence of depression and pain in retired professional football players using a self-reported survey method to members of the National Football League Players Association (NFLPA). The mean age of respondents was 53.4 years and the most frequent problem reported was difficulty with pain, with 48% rating their pain as common to quite common.

Cottler et al.[3]studiedopioid use in a cohort of retired NFL players to gain understanding of perceived and management of pain. Most common injuries were knee, shoulder and back, similar to our findings. Average age was 48 and 93% of the sample (n=644) reported pain, with 81% classifying their pain as moderate to severe. According to Alaranta et al.,[1] this level of pain is over three times for pain reported in the general population (26%). Current opioid use was low (7%) but significantly higher than the general population. Factors contributing to opioid misuse in the past 30 days were younger age, retired fewer years, three or more related NFL injuries and problematic drinking. However, the level of pain and level of impairment was not related to opioid misuse.[3]Further research is warranted to examine relationships between pain, especially related to orthopedic injuries and other sequelae in retired professional football players, throughout the age continuum.

Nicholas et al. [11]studied 36 out of 41 players from the 1969 winning Super Bowl III team to assess their

perceived health status. The average age of participants was 62 and the most prevalent condition reported was arthritis (67%), followed by hypertension and chronic lower back pain (36% for both). The authors conclude the retired players in this cohort did not suffer from any major long-term health effects other than a higher prevalence of arthritis. A study by Golightly et al.[6] reported similar results to the previous discussed studies. Their study of over 2,500 retired NFL players (average age 53.8 year) demonstrated the rate of arthritis to be three times greater than that of the general population, and OA was more prevalent in players with knee injuries. Additionally, players with OA had higher rates of cardiovascular disease, diabetes, and depression. Based on their findings that OA was concentrated in the players under 60, the authors theorized that onset was accelerated, but leveled off over a players' lifespan. Whereas research has studied longer-term effects on NFL players, a gap exists examining the consequences and health status as players transition from professional sports. Our cohort demonstrates a substantial WPI impairment for players with an average age of 31 (range 26 – 37) at evaluation. How impairment influences pain, overall health, future earnings, and quality of life warrants additional research.

In our study, the most common joints players reported as symptomatic were lumbar and cervical spine. Whereas more attention is attributed to catastrophic spinal injuries, Mall et al.[9] reported a high number of minor and severe spinal injuries, over an 11-year span, which contributed to lost practice and playing time. Spinal injury estimates accounted for 7% of all injuries and 8% of non-medical injuries. The authors state tackling was related to cervical spine injuries and blocking contributed more to lumbar spine injuries. However, this study did not address impairment related to past injuries. Our cohort's presentation of the spine as the most symptomatic body part in relation to the injury rates presented in the Mall et al. study suggest a need for increased study and knowledge related to prevention and treatment for minor and severe spinal injuries.

Garrigues and Moorman[5] theorize specific positions predispose players to more specific injuries. For example, defensive backs, a position requiring quick transitions, sprinting, and back peddling are more prone to hip and thigh injuries. Our results indicated no difference in the amount of WPI between offensive and defensive players or skill versus line positions, although there was trending for higher impairment related to line positions. We were unable to draw any position-specific conclusions. A larger sample size would provide the opportunity to examine BPI and WPI by position specific characteristics, which may facilitate more effective prevention and treatment efforts.

The NFL has established several programs to address disability, however, they are not without controversy or challenges. Players classified in the "football degenerative" category automatically qualify for the NFL Player Supplemental Disability Plan benefits. Halchin et al.[8] discuss players under and over the age of 30 and how a change in criteria will affect eligibility criteria for the "football degenerative" effect. Implications of this change are unknown. Additionally 91% of total and permanent disabilities arise more than six months post-retirement. The average age of our cohort was 30.8 years with an average time of 2.8 years since retirement and most players presented with concerning WPI percentages. How these players fare long-term is unknown and requires additional examination.

Our study is limited by the lack of long-term data available to assess health and quality of life for our cohort. The challenge of interpreting impairment and disability within the context of such factors such as employability, future earnings, and health remains a significant challenge.

**Conclusion**

Our study demonstrated a very high burden of orthopedic injuries related to symptomatic joints in a cohort of retired NFL players. These orthopedic injuries take a cumulative toll on the player, leading to significant whole body impairment by the end of a professional football career. Increased knowledge and appropriate orthopedic interventions may improve short and long-term outcomes.

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