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Whole-Person Impairment in Younger Retired NFL Players

The Orthopaedic Toll of a Professional Football Career

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Investigation performed at the American Hip Institute, Westmont, Illinois, USA

Background: Professional American football is a physically demanding, high-impact sport with an elevated risk of injury. Orthopaedic injuries may impose acute, short-term or cumulative consequences throughout a player's lifetime. Several studies have addressed health and psychosocial concerns of an older, retired population of players in the National Football League (NFL); however, minimal research has examined the orthopaedic toll on younger, retired players.

Purpose: This study reports total whole-person impairment (WPI) percentages in a cohort of younger, retired NFL players who presented for disability evaluations based on the use of standardized American Medical Association (AMA) impairment guidelines.

Study Design: Case series; Level of evidence, 4.

Methods: During the study period of February 2011 to August 2013, 65 younger retired NFL players presented for impairment evaluations. The mean time between retirement and impairment evaluation was 3.1 years (range, 0.3-16.4 years). A complete history and physical examination was performed on all symptomatic joints. A retrospective chart review was conducted on 100% of presenting players to assess orthopaedic burden. Body-part impairment (BPI) percentage for each affected joint was generated. The impairment data for each extremity were then combined with spine impairment data to create WPI percentage. Player demographics, including age, position, and playing time, were also recorded.

Results: The average WPI percentage was 37% (range, 19%-53%). Players participating in >30 games (n = 54) had a higher mean WPI percentage (38%) than those playing in <30 games (31%; n = 11) ($P = .004$). Players competing in >5 seasons (n = 46) were 2.4 times more likely to have a WPI of at least 37% ($P = .007$). The most common joints players reported as symptomatic were lumbar (n = 63; 97%) and cervical spine (n = 58; 89%). The mean age at evaluation was 33.5 years (range, 27-42 years), and the mean number of seasons played was 7.5 (range, 3-14 seasons). The mean number of games played was 98.4 (range, 2-236 games).

Conclusion: This study demonstrated high WPI percentages related to symptomatic joints in a cohort of younger, retired NFL players. Further research is warranted to study potential cumulative physical and quality of life factors related to high impairment percentages in younger, retired NFL players.

Keywords: football; National Football League; impairment; disability; retired; orthopaedic

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Professional American football is a physically demanding, high-impact sport with an elevated risk of injury. Football is a high-collision sport, well known to cause frequent musculoskeletal and orthopaedic injuries.^{2,6,8,9,13,14,21} Orthopaedic injuries may impose acute, short-term, or cumulative consequences throughout a player's lifetime. Halchin¹² reported that more than 65% of players in the NFL may be injured on an annual basis, which can contribute to a cycle of worsening injuries and long-term consequences. Many recent studies and media attention have focused on the long-term effects of concussions on the lives of former National Football League (NFL) players.^{3,11,12} Whereas several studies have addressed physical and psychosocial concerns in an older, retired population of players, limited research has examined the orthopaedic toll

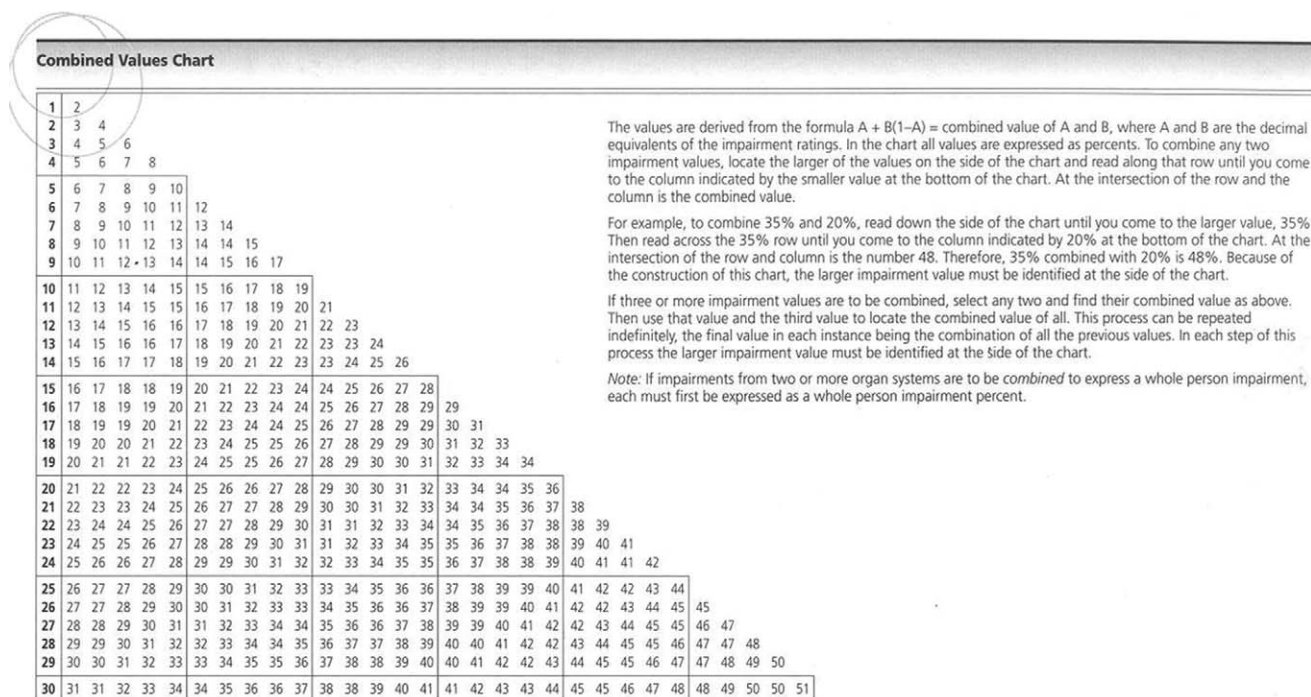


Figure 1. Abbreviated combined values chart from the American Medical Association *Guides to the Evaluation of Permanent Impairment*, 5th edition. Reprinted with permission from Cocchiarella and Andersson.⁴

on younger, retired players from the NFL.^{5,10,16,19} Minimal literature exists examining the impact of orthopaedic injuries during their transition from the NFL to the next stages of life. The purpose of this study was to describe and report the total whole-person impairment (WPI) percentages in a cohort of younger, retired NFL players based on the standardized American Medical Association (AMA) *Guides to the Evaluation of Permanent Impairment*, 5th edition.⁴ We hypothesize there will be a high burden of orthopaedic injuries based on impairment percentages in this cohort.

METHODS

During the study period of February 2011 to August 2013, 65 retired NFL players presented to an orthopaedic clinic for disability evaluations. The study population was an inclusive, purposive sample, which began with the first disability evaluation performed. A retrospective chart review was conducted on 100% of presenting players to assess the orthopaedic burden using standardized impairment reports based on AMA impairment guidelines.⁴ Player demographics, including age, position, seasons, and games played, were also recorded. Institutional Review Board approval was received for this study.

Often an impairment assessment is the first step in determining disability.^{4,18} For the evaluation, a complete history, physical examination, and radiographic imaging was performed on all symptomatic joints based on AMA impairment guidelines.⁴ Although not without weaknesses, such as subjectivity, ambiguity, and lack of research, these

guidelines are the predominantly used rating guide on a national and global level.^{7,17,18,20} Strengths include a common metric between medical conditions and a mechanism to describe the impact on a whole person, instead of limiting the impact to the specific, symptomatic body part evaluated.¹⁷ Additionally, the AMA guidelines use a construct allowing interpretation of impairment ratings related to the extent activities of daily living are affected, which are based on a consensus of expert opinions.^{17,18}

Body-part impairment (BPI) percentages for each symptomatic joint, on right and left sides, were generated. Upper extremity (UE) and lower extremity (LE) were combined for left and right sides, giving a total UE and LE number. Range of motion for each affected joint was the predominant measurement used to calculate UE impairment. Based on the AMA guidelines,⁴ range of motion, previous surgeries such as joint replacement or meniscectomies, or arthritis measured by joint space narrowing on radiographs can be used to calculate the total LE impairment score. A cross-usage chart defines which impairment ratings may be combined for an LE impairment score.⁴ For the spine, an impairment percentage is assigned most commonly by magnetic resonance imaging (MRI) but can also be calculated based on medical history, clinical examination, and history of fracture.⁴

Using the combined values chart (CVC), as defined by the AMA, the BPI percentages for affected joints were used to calculate UE and LE impairments. A sample CVC chart can be seen in Figure 1. The impairment data for upper and lower extremities were then combined with spine impairment data to create a WPI percentage. The CVC was used

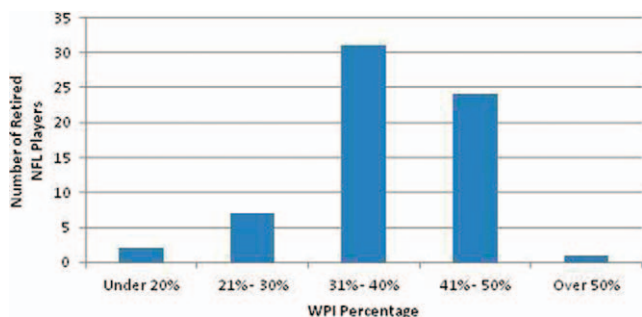


Figure 2. Whole-person impairment (WPI) percentages of retired National Football League (NFL) players.

again to provide a formula-derived algorithm to combine multiple impairments and avoid ratings over 100% for WPI.

Statistical Analysis

Descriptive statistics, such as percentages and means, were the predominant method of assessing data. Frequencies and descriptive statistics were calculated using Excel 2010 (Microsoft Corp, Redmond, Washington, USA). The independent Student *t*-test was used for the comparison of means between groups to establish the minimum threshold for number of games and seasons played at which a statistically significant difference in mean WPI percentages was demonstrated. One-way analysis of variance (ANOVA) was performed to compare the means for 3 groups based on number of seasons played. A *P* value of <.05 was considered statistically significant.

RESULTS

The average WPI percentage of the 65 players that presented to the clinic for impairment evaluation was 37% (range, 19%-53%). Figure 2 shows the number of retired NFL players within specific intervals of WPI percentages. The mean age at retirement was 30.4 years (range, 26-37 years), and the mean age at impairment evaluation was 33.5 years (range, 27-42 years). The mean time between retirement and impairment evaluation was 3.1 years (range, 0.3-16 years).

The most common joints players reported as symptomatic were lumbar (n = 63; 97%) and cervical spine (n = 58; 89%). Spine impairment data are presented in Table 1. For UE, the right shoulder (n = 52; 80%) was the most symptomatic joint reported. For LE, the left hip (n = 46; 71%) was the most symptomatic joint. 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 operations), the majority being arthroscopic procedures (Table 3). For patients with prior knee operations, the average knee BPI was 7.5%, compared with 2.6% for players without surgical intervention on the knee.

TABLE 1
Spine Impairment

Joint/Body Part	Number (%) Presenting	Mean Spine Impairment, %
Cervical spine	58 (89)	8
Thoracic spine	11 (17)	5
Lumbar spine	63 (97)	8

The positions played are depicted in Figure 3, with a majority of players on defense (56%), followed by offense (42%) and special teams (2%). The average number of seasons played professionally was 7.5, and the median number of games played was 93 (range, 2-236 games). Players participating in more than 30 games (n = 54) had a mean WPI percentage of 38% (range, 19%-40%), which was greater than those playing in fewer than 30 games (n = 11), who had a mean WPI percentage of 31% (range, 19%-53%) (*P* = .004). Table 4 shows the mean WPI percentages of retired NFL players according to the number of professional games played. Based on our cohort, 30 games was the minimum threshold at which statistically significant differences were observed in WPI. However, the mean WPI percentage (31%) of players playing less than 30 games still signifies a high orthopaedic burden related to impairment.

When comparing the cohort based on number of professional seasons played, a statistically significant difference was found between players playing 5 years or less compared with players with 6 or more seasons related to WPI (*P* < .001). Players who had played professionally for 5 seasons or less (n = 19) had a mean WPI percentage of 32% (range, 19%-53%), while players who had played professionally for 6 or more seasons (n = 46) had a mean WPI percentage of 39% (range, 25%-49%). Players competing in 6 or more seasons (n = 46) were 2.4 times more likely to have a WPI of at least 37%, which was the cohort average (*P* = .007). When comparing players who played 3 to 5 (n = 19), 6 to 10 (n = 39), and 11 to 14 (n = 7) seasons, there was a statistically significant difference (*P* < .05) in WPI for players with longer careers (Table 4). Players who had played professionally for 3 to 5 seasons had a mean WPI percentage of 32% (range, 19%-53%), players who played for 6 to 10 seasons had a mean WPI percentage of 39% (range, 25%-49%), and players who had played for 11 to 15 seasons had a mean WPI percentage of 38% (range, 30%-47%).

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 line position players (n = 16), a trend that did not reach statistical significance (*P* = .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 because of a small denominator at some positions, such as quarterback and kicker. However, all positions were

TABLE 2
Average Body-Part Impairment in Younger, Retired Players by Joint

Extremity	Joint/Body Part	Left		Right	
		Number (%) Presenting	Mean Body-Part Impairment, %	Number (%) Presenting	Mean Body-Part Impairment, %
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

TABLE 3
Cohort Surgical Intervention in Knees^a

Knee Procedure	Procedures on left knee, n	Procedures on right knee, n
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

^aACL, anterior cruciate ligament; MCL, medial collateral ligament; PCL, posterior cruciate ligament; OCD, osteochondritis dissecans.

TABLE 4
Whole-Person Impairment Averages by Number of Seasons Played

Years Played Professionally	No. Presenting	Whole-Person Impairment, %
3	3	26
4	10	36
5	6	30
6	5	42
7	9	36
8	6	39
9	11	41
10	8	38
11	1	47
12	3	34
13	1	40
14	2	40

included in the study analysis as this represents an inclusive, purposive study population.

DISCUSSION

National Football League players are at risk for orthopaedic injuries because of the high-impact nature of the sport along with the biomechanical movements required; however, injury and health data on retired players are minimal and focus on postconcussion syndrome or diagnoses such as arthritis.^{3,10,12} Previous research on retired players also focuses on an older cohort, and minimal research has been done examining the impact of orthopaedic injuries shortly after retirement, while players are relatively young. We hypothesized that we would find a significant orthopaedic burden based on impairment percentages in a cohort of 65 recently retired NFL players. We found a relatively high rate of impairment among young retired NFL players soon after retirement. Further research requires examination on progression and cumulative effects from a high orthopaedic burden in both short- and long-term contexts.

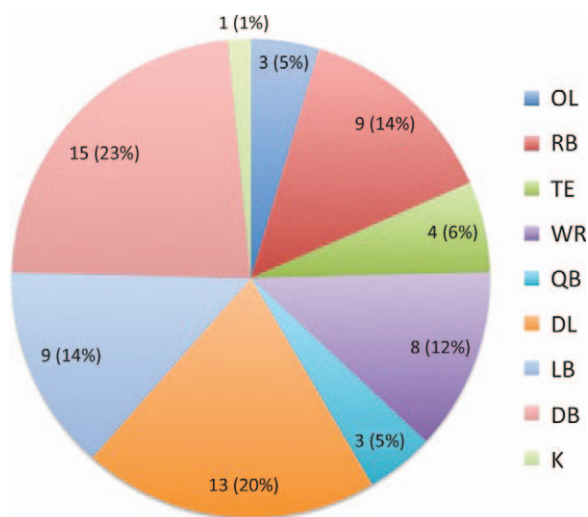


Figure 3. Cohort study makeup by National Football League (NFL) position. DB, defensive back; DL, defensive linemen; K, kicker; LB, linebacker; OL, offensive lineman; QB, quarterback; RB running back; TE, tight end; WR, wide receiver.

Difference Between Disability and Impairment

A discussion related to the definitions of impairment and disability is required in assessing our study results. Robinson et al¹⁷ 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 or loss of function of a body part, whereas disability refers to a broader, conceptual definition. According to Melhorn,¹⁵ 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. This study adds to the knowledge on impairment percentages in a younger cohort of retired NFL players; however, it is difficult to assess the impact that impairment has on function, psychosocial health, or disability in terms of short- and potential long-term cumulative health.

Information regarding employability, health status, and quality of life is currently not available, which makes the assessment of impairment in relation to physical and psychosocial domains challenging. Such data are needed to assess potential relationships between injuries suffered and chronic health problems related to impairment.¹² Whereas this study reports WPI, the relationship to disability and subsequent outcomes such as future earnings and quality of life is challenging to assess and requires future research.

Health Conditions in Retired NFL Players

Cottler et al⁵ studied opioid use in a cohort of retired NFL players to gain understanding of perceived and management of pain. Most common injuries were to the knee, shoulder, and back, similar to our study findings. The mean age was 48 years, and 93% of the sample (n = 644) reported pain, with 81% classifying their pain as moderate to severe. This level of pain is more than 3 times that of pain reported in the general population (26%), and current opioid use was low (7%) but significantly higher than the general population.¹ Factors contributing to opioid misuse in the past 30 days were younger age, retired fewer years, 3 or more related NFL injuries, and problematic drinking.¹ The results of Cottler et al⁵ were similar to ours, as pain and impairment may be related, and both studies demonstrated orthopaedic concerns in younger, retired players. Further evaluation of impairment percentages and the relationship to pain could shed further insight on how to better interpret our findings, as several of our participants were recently retired and have multiple musculoskeletal and orthopaedic injuries.

In our study, the most common joints players reported as symptomatic were the lumbar and cervical spine. Whereas more attention is attributed to catastrophic spinal injuries in NFL and other elite athletes, Mall et al¹⁴ reported an increased 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 nonmedical injuries. The authors state that 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. In relation to the injury rates by Mall et al,¹⁴ our cohort's presentation of the spine as the most symptomatic body part suggests a need for increased study and knowledge related to prevention and treatment for minor and severe spinal injuries and how these injuries impact players throughout their lifetimes.

Garrigues and Moorman⁹ theorized that specific positions predisposed 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. In contrast to the previous study, our results indicated no difference in the amount of WPI between offensive and defensive players or skill versus line positions, although there was a trend for greater 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.

Limitations

Players came to our center on a referral basis and were not a randomized or controlled sample; although the final patient sample was consecutive and all-inclusive, it does not accurately represent a cross-section of retired NFL players. All of the players presented for a disability evaluation; selection bias and players with significantly worse pain or symptoms may skew our results and present higher than average WPI percentages. Additional multicenter sites would provide important data to further understand the true physical impairment of recently retired NFL players. The challenge of interpreting impairment and disability within the context of such factors such as quality of life, employability, future earnings, and health remains a significant challenge.

CONCLUSION

Our study demonstrated high WPI percentages related to symptomatic joints in a cohort of younger, retired NFL players. Further research is warranted to study potential cumulative physical and quality of life factors related to high impairment percentages in younger, retired NFL players.

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