## High Prevalence of Hip and Knee Arthroplasty in Former Professional American Style Football Players: A Call to Action

Bryan Cortez, BA;<sup>1</sup> Jillian Baker, MPH;<sup>1</sup> Joanne Borg-Stein, MD;<sup>1,2</sup> Meagan Wasfy, MD;<sup>1,3</sup> Aaron L. Baggish, MD, FACSM;<sup>1,3</sup> Ross Zafonte, DO;<sup>1,2</sup> and Adam S. Tenforde, MD, FACSM<sup>1,2</sup>

American style football (ASF) combines intelligence, skill, strength, physicality, and explosiveness. These factors make football a popular sport but contribute to unique health concerns for these athletes, including neurological illness from concussion and musculoskeletal injuries that can result in pain and long-term impairment. Increased public awareness of injuries in current and former football players has led to a stronger impetus to characterize the health of this population, determine mechanisms of injury, and devise strategies to advance treatment and prevention.

The Football Players Health Study at Harvard University aims to understand the overall health and well-being of former ASF players. The study has reported findings on anterior cruciate ligament tears and cardiovascular disease (1), cognitive function and mental health (2), neuropsychiatric health (3), multisystem afflictions (4), and race in association with mental and physical health (5) in a population of former National Football League (NFL) players. The study is guided by the charge "to understand the whole player for their whole life," recognizing that health concerns are not explained by physical trauma alone.

We recently reported that former ASF players have higher prevalence of total knee arthroplasties (TKAs) and total hip arthroplasties (THAs) than other professional athletes and are likely to undergo these surgical interventions at younger ages than their counterparts in the general public (6). In a cohort of 3913 former players with an average age of 52 years, the prevalence of TKA was 12.3%, and THA was 8.1%. Compared with men in the general United States population, former NFL players younger than 50 years were over 10 times more likely to have undergone a THA or a TKA. Former ASF

1537-890X/2002/67–68 *Current Sports Medicine Reports* Copyright © 2021 by the American College of Sports Medicine players in our study had similar arthroplasty rates as has been reported in other athlete populations, but importantly, surgery was performed at younger ages.

Posttraumatic osteoarthritis may explain a subset of these athletes who received arthroplasty at this younger age; however, we believe that trauma is only one of multiple explanations for these findings. The high prevalence in our cohort and the reduced quality of life that this population faces are alarming; we call for continued research to understand potential mechanisms contributing to advanced joint disease and efficacy of clinical interventions to extend time to arthroplasty for current and former ASF players. Physicians, team trainers, and other medical personnel working with this population should consider factors beyond exposures to cumulative trauma and diagnosed injury over a playing career. The current literature suggests that weight/body mass index (BMI) (7), intense physical activity (8), traumatic joint injuries (9), use of corticosteroids (10), and previous surgeries (11) may be factors that lead to osteoarthritis and the eventual need for arthroplasty. Pain perception in ASF may be different than the general population, and aspects of mental health (e.g., anxiety, depression) may heighten response to pain with joint disease (12). Many of these characteristics are observed in active and former players, suggesting that arthritis may be multifactorial.

Our team is comprised of researchers and clinicians across specialties of cardiology, orthopedics, and physical medicine and rehabilitation. Player advisors and family advisors inform a patient-centered approach to developing a framework that focuses on former players' health. The focus on the whole player includes accounting for the before, during, and after participation in ASF — periods that encompass early sports participation, an active professional career, and life as a former player — with the understanding that each of these stages influences long-term health. Nonmodifiable factors include age, race/ethnicity, and male sex. Behavioral health determinants in the athlete may include age of first exposure, duration of playing years, number of games played, position(s) played, other characteristics in play environment (play on artificial turf), and prior injuries and weight gain at different stages of participation. Finally, following a former player's career,

<sup>&</sup>lt;sup>1</sup>Football Players Health Study at Harvard University, Harvard Medical School, Boston, MA; <sup>2</sup>Department of Physical Medicine and Rehabilitation, Spaulding Rehabilitation Hospital, Boston, MA; and <sup>3</sup>Cardiovascular Performance Program, Massachusetts General Hospital, Boston, MA

Address for correspondence: Adam S. Tenforde, MD, FACSM, Spaulding Rehabilitation Hospital, 300 1st Ave, Charlestown, MA 02129; E-mail: atenforde@mgh.harvard.edu.

preservation of muscle mass, continued physical activity, access to health care, comorbidities, and weight changes are other aspects to consider. Each of these aspects of the life of a former NFL player affects not only the joint health but also the overall well-being.

Understanding characteristics of the sport and health behaviors that synergize to create clinically relevant pathology present an opportunity for prevention that is vital for the health of former football players and for the health of future generations of football players. Prevention of joint injuries and their chronic sequalae during sports participation is of paramount importance. Preventative measures, such as mandatory knee braces for offensive linemen and teaching rugby style tackling, have been two such approaches to prevention of musculoskeletal injuries in the sport. Management of recognized joint injuries may help enhance tissue healing and address risk factors for progression to advanced arthritis. For example, the chondrotoxic and tenotoxic effects of corticosteroids and anesthetics suggest that alternative strategies to modify inflammation may be more appropriate. Lifestyle factors, including diet, sleep, excess weight gain, and other behaviors, may influence both injury management and prevention. There is a clear association with metabolic syndrome and osteoarthritis. In addition, reduced mental health is associated with increased OA pain and pain flares. Targeted interventions may improve quality of life, particularly as it relates to joint health in current and former NFL players. For example, recognizing weight gain may be required for certain playing positions to optimize performance during active playing years and may create opportunities for prevention by targeting this after active playing years. This could include weight loss programs targeted at reducing BMI after completing professional careers that may reduce demand on joints and soft tissue. Similar post-career models have been proposed and are being studied on deconditioning former elite male athletes to improve their cardiovascular function and reduce left ventricular hypertrophy (13). Such interventions may have influence on global health, including nonsurgical management of arthritis. While weight loss and strengthening exercises are part of the standard of care for those with symptomatic osteoarthritis (14), these preventative interventions may be even more important for former NFL players who are recently retired.

As we prepare to explore and report more on these topics, we note a responsibility in the medical community to provide tailored and meaningful treatment for those who have the disease state of arthritis. Education to our peers on the most upto-date treatment options in nonsurgical treatment of arthritis is important, and our goals are to provide direction and guidance for future preventative measures. As we have outlined above, we have a duty to redirect the conversation on joint health in former NFL players away from a one-dimensional view of trauma and collisions to a more nuanced understanding of the whole life of an athlete. As we move toward this "whole player, whole life" model, we create numerous opportunities and checkpoints for prevention and treatment of joint pain that will lead to a decreased burden of joint replacement and an increased quality of life. Thus, we urge all physicians and health professionals working with this special population to be cognizant and thoughtful of each individual player's specific history, target treatments to manage both arthritis and global health, and provide the best quality of care possible.

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