

Stem Cells and Wharton's Jelly for Tendon and Muscle Injuries in Sports Medicine: A Narrative Review

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BACKGROUND: Muscular and tendinous injuries represent a highly prevalent class of pathology within athletes at all levels. Due to the poor healing capacity of these tissues, increasing attention has been placed on stem cell-based therapies such as mesenchymal stem cells (MSCs). MSCs are multipotent stromal cells capable of migrating or being implanted into injured tissue to potentially accelerate healing in the damaged tissue. These cells may be extracted from a wide variety of tissues including bone marrow and adipose tissue, with unique appeals regarding concentration, ease of harvest, proliferative capacity, and anti-inflammatory properties. Wharton's Jelly (WJ) has also emerged as a potential source for MSCs with unique characteristics in their proliferative and immunomodulatory properties.

OBJECTIVES: This narrative review seeks to synthesize the preclinical and clinical evidence on the efficacy of MSCs and Wharton's Jelly in promoting muscle and tendon healing, while investigating challenges with the standardization and preparation of these biologics.

METHODS: A structured literature review was conducted for recent in vitro and in vivo studies in PubMed, Embase, Scopus, and Web of Science for articles between the years of 2016 and 2025. Additional targeted literature searches and citation chaining were applied to search for literature pertaining to tendinous and muscular injury with emphasis on efficacy, product standardization, delivery strategies, and barriers to clinical translation.

RESULTS: The present study identified 141 published articles evaluating MSCs and WJ in vitro or in vivo. Within those studies, only 36 articles utilized human subjects, including 9 randomized controlled trials (RCT), 14 case reports/series, and 13 cohort studies. 30 of the 36 studies performed on human subjects evaluated MSCs in the setting of musculotendinous pathology. Of these, 90% (27/30) found significant differences between treatment group and control, in measures of pain, functionality, and imaging. 70% of these studies employed autologous MSCs while the other 30% used an allogenic cell source. The most common type of MSCs used in human studies was adipose-derived MSCs (46.7%) followed by bone marrow-derived MSCs (30.0%). Our results yielded only five studies examining the effects of WJ on human subjects. Among these, four were case series/reports and only one cohort. All five studies demonstrated improvement in pain and function with a lack of adverse events.

CONCLUSIONS: MSCs and WJ present a promising approach to management of soft tissue injuries in athletic populations. However, research is currently focused primarily on animal models with human studies being limited by small sample sizes, lack of controls, and reliance on patient-reported outcomes. Evaluation of efficacy is heavily limited by the variability in tissue source, isolation and processing techniques, preservation methods, and administration methods.