
**International Journal of Innovative Technologies in Social Science**

e-ISSN: 2544-9435

**Operating Publisher**
**SciFormat Publishing Inc.**
ISNI: 0000 0005 1449 8214

2734 17 Avenue SW,
Calgary, Alberta, T3E0A7,
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+15878858911
editorial-office@sciformat.ca

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| **ARTICLE TITLE** | SPORT-RELATED DYSTONIA – CURRENT STATE OF KNOWLEDGE IN DIAGNOSIS AND TREATMENT |
| **DOI** | https://doi.org/10.31435/ijitss.1(49).2026.4795 |
| **RECEIVED** | 28 November 2025 |
| **ACCEPTED** | 17 January 2026 |
| **PUBLISHED** | 29 January 2026 |
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# SPORT-RELATED DYSTONIA – CURRENT STATE OF KNOWLEDGE IN DIAGNOSIS AND TREATMENT

***Jan Puliński*** *(Corresponding Author, Email: jasiek.1999@wp.pl)*
*Specialist Hospital named after F. Ceynowy in Wejherowo, Wejherowo, Poland*
*ORCID ID: 0009-0007-6914-1978*

***Paulina Lewaśkiewicz***
*Specialist Hospital named after F. Ceynowy in Wejherowo, Wejherowo, Poland*
*ORCID ID: 0009-0008-2361-4917*

***Klaudia Płudowska***
*PCK Maritime Hospital, Gdynia, Poland*
*ORCID ID: 0009-0002-3845-8167*

***Maksymilian Czarnota***
*PCK Maritime Hospital, Gdynia, Poland*
*ORCID ID: 0009-0002-9322-4494*

***Monika Rogowska***
*PCK Maritime Hospital, Gdynia, Poland*
*ORCID ID: 0000-0002-9617-7307*

***Karol Sikora***
*Specialist Hospital named after F. Ceynowy in Wejherowo, Wejherowo, Poland*
*ORCID ID: 0009-0009-5610-3547*

***Wiktoria Boral***
*Specialist Hospital named after F. Ceynowy in Wejherowo, Wejherowo, Poland*
*ORCID ID: 0009-0007-6047-2033*

***Marek Dróżdż***
*Specialist Hospital named after F. Ceynowy in Wejherowo, Wejherowo, Poland*
*ORCID ID: 0009-0007-1737-151X*

***Alicja Czyszczoń***
*Podhale Specialist Hospital in Nowy Targ, Nowy Targ, Poland*
*ORCID ID: 0009-0009-1305-6971*

***Wiktoria Marzec***
*F. Ceynowy Specialist Hospital in Wejherowo, Wejherowo, Poland*
*ORCID ID: 0009-0006-6395-6263*

**ABSTRACT**

Sports-related dystonia (SRD) is believed to arise as a consequence of repetitive motor activity, often involving tens of thousands of movement repetitions performed during high-level athletic training. Professional sports practice is characterized by prolonged physical exertion and the frequent execution of specific motor tasks, repeated hundreds or even thousands of times in pursuit of technical perfection. This intensive regimen may lead to both physical and mental fatigue, potentially resulting in overuse injuries. SRD has been most frequently described in golfers, runners, cricketers, basketball players, and gymnasts. Despite growing awareness of its clinical presentation, SRD remains a diagnostic and therapeutic challenge.The aim of this study is to provide a comprehensive review of the current state of knowledge regarding SRD, based on publications available in the PubMed database.A literature search was conducted using relevant keywords to identify scientific publications not older than five years, retrieved from academic databases.

SRD represents a complex clinical syndrome that requires a multidisciplinary and individualized approach. The absence of specific diagnostic tests, combined with the variability and subtlety of symptoms, often results in significant diagnostic challenges. Effective treatment must be tailored to the specific symptom profile presented by each athlete, taking into account both motor and non-motor aspects of the condition. Currently, further research is needed to improve both the diagnostic criteria and therapeutic strategies for managing SRD. Early identification and preventive strategies—particularly in young athletes—should be emphasized. Educational efforts aimed at raising awareness of the potential career-threatening nature of SRD may facilitate earlier recognition of symptoms and help prevent premature discontinuation of athletic careers.Treatment of this disorder must be individualized and focused on the specific range of symptoms present in each athlete. Currently, further research on the diagnosis and therapeutic options for patients affected by this condition is necessary.

**KEYWORDS**

Task Specific Dystonia, Sports Related Dystonia, Sports Dystonia, Treatment, Ypis

**CITATION**

Jan Puliński, Paulina Lewaśkiewicz, Klaudia Płudowska, Maksymilian Czarnota, Monika Rogowska, Karol Sikora, Wiktoria Boral, Marek Dróżdż, Alicja Czyszczoń, Wiktoria Marzec. (2026) Sport-Related Dystonia – Current State of Knowledge in Diagnosis and Treatment. *International Journal of Innovative Technologies in Social Science*. 1(49). doi: 10.31435/ijitss.1(49).2026.4795



## 1. Introduction

SRD is classified as a subtype of task-specific dystonia (TSD). [1] A movement disorder characterized by sustained or intermittent muscle contractions, abnormal postures, and often alterations in sensorimotor integration. It typically develops as a consequence of performing repetitive motor actions—common in sports training, occupational tasks, or physical practice—over thousands of repetitions. One of the most frequently reported manifestations of SRD is the motor impairment known as "the yips," which affects up to 50% of professional golfers. The yips occur during precision-demanding movements, particularly putting strokes, and are marked by involuntary movements or muscle tightness that disrupt motor control. While the exact pathophysiology remains unclear, several hypotheses exist. The condition may reflect a focal movement disorder or a complex interplay of neurological and psychological factors.[2] Psychological stress, competitive pressure, and performance anxiety are believed to contribute to its onset, along with abnormal muscle activation that impairs fine motor skills.[3]

Neurophysiological mechanisms proposed to underlie SRD include maladaptive sensorimotor reorganization caused by overuse or injury, leading to hyperactivity in the cortical motor areas and basal ganglia. Excessive training is thought to result in neuroplastic changes in motor maps and impaired cortico-striatal inhibition, ultimately producing dysfunctional coordination and co-contraction of antagonist muscles. TSD is a multifaceted disorder that requires an integrative approach involving neurology, psychology, and physical therapy. Current knowledge is largely based on case reports and survey-based studies; robust, population-based randomized trials with quantitative outcome measures—such as electromyography (EMG) or movement analysis—are still lacking. Interestingly, in self-reflective studies involving elite golfers, the yips are often described more as a manifestation of psychological tension and cognitive overload than as a direct consequence of physical injury.[4]

## 2. Methods

### 2.1. Literature Search Strategy

A comprehensive literature search was conducted using major electronic databases including PubMed, Scopus, Web of Science, Wiley Online Library, ACS Publications, and SciFinder. The search strategy combined Medical Subject Headings (MeSH) with free-text keywords related to recovery strategies in sport. Boolean operators (AND, OR) were employed to optimize sensitivity and specificity of the search. The search aimed to identify peer-reviewed articles published between 2010 and 2026.

### 2.2. Inclusion and Exclusion Criteria

To ensure scientific rigor and relevance, inclusion criteria comprised peer-reviewed articles, systematic reviews, meta-analyses, and randomized controlled trials (RCTs) published in English. Studies lacking full text, control groups, or those with low methodological quality were excluded. An initial screening of titles and abstracts was performed to exclude irrelevant records, followed by full-text assessment based on predefined research questions.

### 2.3. Timeframe and Language

Only articles published in English within the timeframe of 2020 to 2026 were included.

### 2.4 AI

AI was utilized for two specific purposes in this research. Text analysis of clinical reasoning narratives to identify linguistic patterns associated with specific logical fallacies. Assistance in refining the academic English language of the manuscript, ensuring clarity, consistency, and adherence to scientific writing standards. AI were used for additional linguistic refinement of the research manuscript, ensuring proper English grammar, style, and clarity in the presentation of results. It is important to emphasize that all AI tools were used strictly as assistive instruments under human supervision. The final interpretation of results, classification of errors, and conclusions were determined by human experts in clinical medicine and formal logic. The AI tools served primarily to enhance efficiency in data processing, pattern recognition, and linguistic refinement, rather than replacing human judgment in the analytical process.

## 3. Research result

### 3.1 SRD epidemiology:

To date, scientific research on sports-related dystonia has primarily focused on specific disciplines such as golf (particularly the “yips”) and running. Depending on the study methodology, the prevalence of yips among professional golfers is estimated to range from 20% to 50%. Factors that appear to increase the likelihood of developing this condition include a long athletic career, high skill level, history of injury, and intense emotional pressure associated with performance tasks.A large-scale survey conducted by Revankar et al. (2021) among approximately 1,300 professional golfers in Japan revealed that 35% of respondents had experienced symptoms of the yips during their careers. The incidence of symptoms increased proportionally with the number of years spent in the sport, suggesting a strong association with prolonged exposure to repetitive motor tasks and the cumulative stress of competitive environments. Despite reporting symptoms commonly associated with dystonia—such as involuntary muscle contractions, jerks, or motor freezing—57% of athletes attributed their difficulties to psychological factors such as stress or over-focusing, rather than to a primary neurological disorder. These findings indicate that the yips may be significantly more prevalent than classical focal dystonias and underscore its mixed etiology, involving both psychological and neurological components.Globally, the reported prevalence of the yips among professional golfers ranges from 20% to 48%, further confirming the clinical and athletic significance of this condition across populations.[5] An interesting example is a case report describing a 52-year-old professional billiards player who developed hand dystonia specifically triggered during cueing. Notably, his symptoms emerged only after approximately 25 years of athletic career. The epidemiology of sports-related dystonia in disciplines other than golf remains poorly characterized, with most of the current knowledge derived from isolated case reports.There is a clear need for multidisciplinary analysis of motor dysfunctions affecting professional athletes across various sports, as well as individuals in other task-intensive professions such as writers or musicians. A broader investigation of these task-specific motor impairments is necessary to better define the clinical spectrum of SRD and, more broadly, Task-Specific Dystonia TSD.[6]

### 3.2 SRD symptoms

SRD is described as a multifaceted syndrome in which two parallel components contribute to the decline in performance and outcomes among affected athletes. On the one hand, individuals report disturbances in muscle control—typically involving the overused limb musculature, depending on the specific sport. On the other hand, psychological difficulties emerge, largely attributed to the high levels of stress, competitiveness, and performance pressure inherent in elite sports.

Clinically, SRD manifests as involuntary muscle contractions occurring during the execution of highly specific, often precision-based, motor tasks. These contractions may involve co-contraction of antagonistic muscle groups, leading to a characteristic "jerk-like" movement, commonly described by athletes as sudden, involuntary twitches or disruptions. This abnormal activation disrupts the smooth execution of movement and undermines motor accuracy. Additional reported symptoms include tremors, tics, increased muscle tone, or a sensation of movement 'freezing'.[7] Uncontrolled muscular tremors and jerky, irregular movements—often resulting from co-contraction of antagonistic motor units—are hallmark features of sports-related dystonia. Athletes frequently describe a phenomenon referred to as "freezing," which reflects an inability to initiate or execute a precise motor task. On a psychological level, the condition may involve disruption of motor memory and impaired decision-making processes. Psychological tension, as well as feelings of pressure and anxiety related to training and competition, are also integral components of the symptom complex associated with SRD.[8] The phenomenon of "choking," caused by psychological factors, manifests as a sensation of being "blocked," preventing the execution of a movement. This condition may resemble or even coexist with sports-related dystonia in athletes during competition.[9] It is described as an "extreme form of anxiety prior to competition" and improper task execution due to excessive self-focused attention, which leads to distraction. This phenomenon may function as a primary component of the yips or be part of its symptomatology.[10]

### 3.3 Diagnosis of SRD

The diagnosis of SRD is primarily based on a detailed patient history and video observation of movement choreography. Diagnosis relies heavily on the characterization of symptoms, as no definitive method exists for confirming dystonia. The identification of muscle co-contraction can be substantiated through electromyographic (EMG) studies, which detect simultaneous excessive activation of antagonist muscles—referred to as co-activation—characteristic of this disorder. In the context of task-specific dystonia diagnosis in sports, surface electromyography (sEMG) combined with co-contraction indexes (CCI) has gained increasing importance. Recording the activity of agonist and antagonist muscles during sport-specific tasks—such as putting or throwing—allows for the detection of abnormal muscle activation patterns. The CCI, calculated using established algorithms, enables comparison with normative values and identification of neuromuscular coordination impairments. Excessive co-contraction may indicate the presence of a dystonic component, aiding differentiation of dystonia from psychologically based disorders such as choking. Due to its accessibility and relatively straightforward interpretation, sEMG coupled with CCI analysis represents a valuable diagnostic tool that supports both functional assessment and monitoring of therapeutic effectiveness.[11] Kinetic studies and motion analyses also hold significant importance. These symptoms differ from typical movement disorders in that they do not manifest during everyday activities. Differential diagnosis with primarily psychological disorders such as choking is therefore essential. Considering the vast heterogeneity of dystonia presentations, an interdisciplinary approach based on the expertise and experience of specialists from various fields is indispensable.[12] Neurological examination may reveal no abnormalities. Tremors and pain symptoms might be absent, and muscle tone can remain within normal limits. Screening laboratory tests may not detect any irregularities despite the presence of dystonia symptoms.[13] Currently, there are no specific laboratory or imaging biomarkers for sports-related dystonia; however, neuroimaging techniques such as MRI may be employed to exclude other neurological pathologies. Therefore, diagnosis primarily relies on thorough clinical observation and neurophysiological assessments conducted during the execution of symptom-provoking movements.[14]Due to the lack of standardized protocols for diagnosing dystonia, further research is necessary to develop reliable diagnostic frameworks.

### 3.4 SRD treatment

Standardized therapeutic protocols are lacking; an essential factor in treating SRD is the implementation of a multidisciplinary approach and tailoring interventions to the predominant symptomatology of each individual patient, aiming to personalize the therapeutic strategy.[15]A primary technique that may yield positive effects in reducing symptoms in affected muscle groups is modifying the execution of motor tasks. This can be achieved through individualized training aimed at altering motor habits and muscle memory, as well as by changing the equipment used. The goal is to modify movement characteristics and engage alternative motor patterns, thereby preventing the exacerbation of fatigue in overused muscle groups. Recommended methods, especially when anxiety and excessive pressure predominate, include relaxation training, visualization, and cognitive-behavioral therapy (CBT). Improvement in mental skills is associated with increased stress resilience and better performance under psychological strain.The use of botulinum toxin A has demonstrated effectiveness in approximately 50–60% of athletes, although most evidence is derived from case reports.[16]

Medications commonly used include benzodiazepines, baclofen, and trihexyphenidyl. In severe, treatment-resistant cases, deep brain stimulation (DBS) and ablative procedures targeting motor nuclei have been implemented, yielding promising results. When symptoms exhibit a dystonic character, pharmacotherapy is applied. Drugs such as benzodiazepines, baclofen, and anticholinergics can alleviate dystonia symptoms. Beta-blockers, for example propranolol, are used to manage tremors. One of the most effective treatments involves the administration of botulinum toxin (e.g., onabotulinumtoxin A, incobotulinumtoxin A, abobotulinumtoxin A, or type B toxin) directly into the overactive muscles, which helps reduce involuntary contractions and limit uncontrolled movements. [17] .The application of both invasive and non-invasive techniques still requires a greater number of standardized studies to determine their efficacy[18]

Considering the treatment of professional athletes, a very important aspect of therapy is adherence to the guidelines set by sports organizations regarding anti-doping controls and permitted substances for use by athletes. Failure to comply with these regulations may lead to disqualification or suspension, which can remove a professional athlete from competition more effectively and decisively than the symptoms of sports-related dystonia.

## 4. Discussion

Most of the published studies on SRD focus on selected aspects of the dystonia spectrum. There is a need for more extensive research on SRD therapy, taking into account the prevalence of symptoms across various sports disciplines. Such studies should rely on standardized research protocols rather than the subjective perceptions of athletes.[19] On the other hand, conducting survey-based research on the subjective experiences of professional athletes is justified due to the possibility of gathering a large sample size.[20] Research focusing specifically on athletes performing overhead movements is particularly needed.[21] Before a diagnosis of SRD is established, movement disorders must be excluded, taking into account other possible conditions such as Parkinson's disease. Patients should be informed that the recovery process after diagnosis may be prolonged.[22]The diagnosis of SRD is complex due to its wide range of symptoms.[23] Neurological examination and auxiliary tests may show no abnormalities despite the presence of symptoms.[24]

## 5. Results

SRD is a syndrome of symptoms that requires a multifaceted approach and collaboration with specialists from various fields. The lack of specific tests and the diversity of symptoms pose diagnostic challenges. Treatment of this disorder must be individualized and focused on the specific range of symptoms present in each athlete. Currently, further research on the diagnosis and therapeutic options for patients affected by this condition is necessary. Emphasizing cooperation with young athletes, implementing preventive measures, and raising awareness about the risks to sports careers among young athletes may enable earlier detection of symptoms and prevention of negative consequences.

**Disclosures**

Author's contribution
Conceptualization: Jan Puliński
Methodology: Jan Puliński, Wiktoria Marzec
Software: Jan Puliński,
Formal analysis: Marek Dróżdż, Wiktoria Marzec
Investigation: Alicja Czyszczoń
Resources:Klaudia Płudowska, Paulina Lewaśkiewicz
Check: Maksymilian Czarnota
Writing -rough preparation:Monika Rogowska
Writing -review and editing: Karol Sikora, Paulina Lewaśkiewicz
Supervision: Wiktoria Boral

All authors have read and agreed to the published version of the manuscript.

**Financing Statement:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement**: Not applicable.

**Data Availability Statement:** The authors confirm that the data supporting the findings of this study are available within the article's bibliography.

**Conflict of Interest:** Authors declare no conflict of interest.

**Declaration of the Use of Generative AI and AI-Assisted Technologies in the Writing Process:** In preparing this work, the authors used ChatGPT by OpenAI to improve language, readability, and text formatting. Following the use of this tool, the authors thoroughly reviewed and edited the content as necessary and accept full responsibility for the final version and all substantive content of the publication.

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