

Use of Botulinum Toxin in the Management of Golf-Related Task-Specific Dystonia (“The Yips”)

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Abstract

Task specific dystonia is a rare neurological condition which can present in certain occupations and activities. Sports-related dystonia's are increasingly recognised as task-specific movement disorders occurring in highly trained athletes and are characterised by involuntary, patterned muscle contractions that emerge only during the execution of a particular sporting action. The “yips, which is an involuntary wrist and forearm spasm and affects golfers usually when chipping or putting is such a task specific dystonia. The condition can have a limiting affect on performance and career. The use of targeted botulinum toxin as a muscle blocking agent is a treatment option in resistant cases of task specific dystonia, such as the “yips”.

Keywords: Yips, task specific dystonia, golf, botulinum toxin, EMG diagnosis, EMG guided therapy

Background

The “yips” is a well-recognised, task-specific movement disorder affecting golfers, most commonly during putting or chipping. It is characterised by a sudden, involuntary spasmodic contraction of the wrist and forearm musculature at the moment of stroke execution. In 2020 a landmark paper establishing that many yips represent a task-specific dystonia rather than anxiety (1) Further research demonstrates abnormal motor patterns and co-contraction in yips-affected golfers. (2) and is in essence a focal dystonia. (3)

Clinically, this phenomenon shares features with other focal dystonia's, including writer's cramp,(4) and is distinct from performance anxiety alone, although the two may coexist. It commonly occurs when a golfer is putting or chipping but has also been seen when driving or striking long shots. It significantly impacts on a golfer's performance and can occur in both elite and recreational golfers. (1,2,3)

Sports Related dystonias

Sports-related dystonias are increasingly recognised as task-specific movement disorders occurring in highly trained athletes and are characterised by involuntary, patterned muscle contractions that emerge only during the execution of a particular sporting action. (5) Classic examples include the yips in golf, in which abnormal co-contraction of wrist and forearm muscles disrupts putting or chipping, and billiards-related dystonia, where involuntary upper-limb activation interferes with cue delivery.

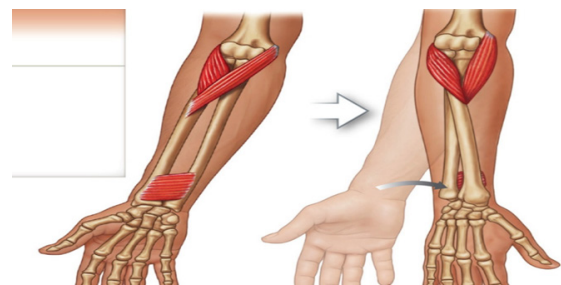


Figure 1: Pronator Quadratus Dystonia. The sudden and uncontrolled contraction of the pronator quadratus muscle results in an abrupt pronation of the right wrist resulting in club face of the putter closing and the golf ball pulled to the left of target.

Pistol-shooting dystonia has also been described, typically manifesting as finger flexion or wrist deviation at the moment of trigger pull, while runner's dystonia presents as task-specific lower-limb or truncal posturing that appears only during running and not walking. Similar phenomena have been reported in racquet sports, including tennis, where repetitive high-precision strokes may provoke focal hand or forearm dystonia, and in table tennis, which demands rapid, fine motor wrist and finger control. Across these sports, the unifying features are extreme task specificity, occurrence in expert performers, and a pathophysiology thought to involve maladaptive cortical plasticity and impaired inhibitory motor control rather than primary structural pathology. (5,6)

Identification of the specific muscles affected by sports-related dystonia is clinically important, as management strategies—including task modification, sensorimotor retraining, and, in selected cases,

carefully targeted botulinum toxin injections—differ substantially from those used for anxiety-driven performance problems or overuse injuries.

Sport / Task	Commonly Affected Muscles	Triggering Activity	Characteristic EMG Findings During Task	What EMG indicates clinically
Golfer (Putting / Chipping – “Yips”)	Pronator quadratus, pronator teres, wrist flexors/extensors, intrinsic hand muscles	Putting stroke, short chip	<ul style="list-style-type: none"> • Co-contraction of wrist flexors & extensors • Prolonged, irregular bursts during stroke initiation • Overflow into forearm muscles not normally active • Normal EMG at rest 	<ul style="list-style-type: none"> • Differentiate dystonia from anxiety/tremor • Identify target muscles for botulinum toxin
Cyclist (Pedalling / Sustained Effort)	Tibialis anterior, gastrocnemius, soleus, hamstrings, hip flexors; sometimes intrinsic foot muscles	Sustained pedalling, high cadence or climbing	<ul style="list-style-type: none"> • Abnormal prolonged firing during pedal phase • Loss of reciprocal inhibition (e.g. TA firing during plantarflexion) • Task-specific activation only at cycling cadence 	<ul style="list-style-type: none"> • Distinguish dystonia from neuropathy or overuse • Guide cadence- or position-related management
Cyclist (Upper Limb / Handlebar Control)	Forearm flexors/ extensors, intrinsic hand muscles	Grip pressure, vibration, braking	<ul style="list-style-type: none"> • Overflow activation with grip • Co-contraction increasing with fatigue • Normal SNAPs and CMAPs 	<ul style="list-style-type: none"> • Exclude ulnar/median neuropathy • Support diagnosis of task-specific dystonia
Musician – Keyboard / Piano	Finger flexors/extensors, lumbricals, interossei	Rapid finger sequences, trills	<ul style="list-style-type: none"> • Excessive recruitment of non-task fingers • Prolonged bursts replacing phasic firing • Co-contraction of antagonists 	<ul style="list-style-type: none"> • Localise dystonic finger(s) • Injection planning
Musician – String (Violin / Guitar)	Forearm flexors, intrinsic hand muscles, shoulder stabilisers	Bowing, fretting, sustained postures	<ul style="list-style-type: none"> • Overflow into proximal muscles • Sustained tonic firing rather than phasic bursts 	<ul style="list-style-type: none"> • Separate dystonia from overuse syndromes
Musician – Wind / Brass	Orofacial muscles, tongue, embouchure muscles	Sustained notes, articulation	<ul style="list-style-type: none"> • Abnormal prolonged activation of embouchure muscles • Task-specific tonic activity 	<ul style="list-style-type: none"> • Distinguish dystonia from weakness or fatigue
Other Precision Sports (Darts, Archery, Snooker)	Wrist flexors/extensors, finger flexors	Aim and release phase	<ul style="list-style-type: none"> • Co-contraction at release point • Irregular firing disrupting fine motor control 	<ul style="list-style-type: none"> • Objective confirmation of dystonia

Table 1: Sports Specific EMG findings and clinical significance in activity dystonia.

Activity dystonia is also common among other performers such as musicians. Charlie Chaplin was reported to have to give up the violin due to the condition. Keith Emerson the renowned rock key board player similarly was afflicted by an activity specific dystonia, as have many classical and concert musicians.

The career of several professional golfers has been threatened or terminated because of yips. This term “yips” is believed to be popularized by Tommy Armour, a professional golfer, who described it as a motor impairment during putting which made him retire early from golf (7). Based on his experience and description (“once you’ve had ‘em, you’ve got ‘em”),

Musicians

Highly trained, repetitive fine motor task
Sudden loss of automaticity
Co-contraction on EMG
Task-specific
Often misdiagnosed as anxiety
Botulinum toxin effective when targeted

Golfers

Highly trained, repetitive fine motor task
Sudden loss of automaticity
Co-contraction on EMG
Task-specific
Often misdiagnosed as anxiety
Botulinum toxin effective when targeted

Table 2: Clinical parallels between golfer and musicians with activity dystonia.

Pathophysiology

The prevailing view is that the yips represent a form of focal, task-specific dystonia involving abnormal motor cortical processing and impaired inhibition of agonist–antagonist muscle groups. (8). There is a loss of the normal surround inhibition, that accompanies a muscle contraction, and this can be associated with abnormal EMG observed co-contraction. This results in inappropriate muscle activation, leading to a brief but disruptive motor "tick" and loss of fine motor control at a critical moment in the golf stroke.

Several muscles can be affected focally or in combination with other muscles. The pronator quadratus, pronator teres, as well as the intrinsic muscles of the hand and the forearm. The flexor digitorum superficialis (FCS) and the extensor digitorum communis (EDC) muscles commonly involved. There is a Classic EMG patterns directly analogous to yips; relevant for pronator quadratus over-activity. (9)

EMG characteristic in sports-related dystonia such as the "yips", specific changes will be observed in the affected muscle or muscles.

- Premature muscle activation just before or at the moment of execution (e.g. just before putter impact)
- Brief dystonic bursts ("motor ticks") that coincide with the failed movement
- Muscle-specific overactivity, often highly stereotyped and reproducible
- Identification of the primary dystonic muscles is essential when guiding treatment to avoid unnecessary weakness in secondary or compensatory muscles
- Dystonia produces a stable, task-locked physiological error; functional disorders produce a variable, context-dependent one. This has to be differentiated from Psychogenic (Functional) where the EMG recordings can be inconsistent and variable, with variation in muscle activation pattern changes between exercise repetitions.

Table 3: EMG findings in cases of task specific dystonia.

Identification of the involved muscle is achieved by needle EMG examination of the upper limb muscles.

Pronator quadratus dystonia is a specific form and the most common cause of golf related focal dystonia or "the yips" that affects golfers, causing involuntary pronation (inward turning) of the forearm. (see figure 2)

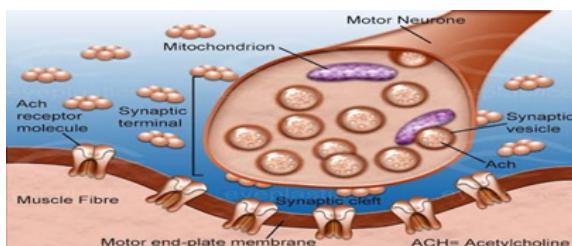


Figure 2: Botulinum toxin blocking the release of acetylcholine (Ach)

This neurological movement disorder of the pronator quadratus muscle typically manifests during fine motor skills like putting or chipping, hindering performance. Other muscle can be involved in combination with the pronator quadratus or focally (on their own). The EMG in the affected muscles demonstrates phasic dystonic bursts and inappropriate activation during fine motor tasks. (10)

Diagnosis of sports related dystonia

Electromyography (EMG) plays a supportive but important role in the diagnosis and characterisation of dystonias, including sports-related task-specific dystonias, by demonstrating abnormal patterns of muscle activation rather than structural neuromuscular disease. In focal dystonia, EMG typically reveals inappropriate co-contraction of agonist and antagonist muscle groups, prolonged muscle bursts, and overflow activation in muscles not normally recruited for the task.(11).

In sports-related dystonia's, these abnormalities are often strictly task dependent and may be absent during routine clinical examination, requiring sport-specific or simulated task performance (e.g. putting stroke, trigger pull, running on a treadmill, cueing motion) to elicit the dystonic pattern. Needle EMG is an essential diagnostic aid for task-specific muscle selection (12)

Surface EMG can document abnormal timing and synchrony of muscle activation across multiple muscle groups, while needle EMG may assist in excluding neuropathic or myopathic processes and in identifying the most pathologically overactive muscles. Surface ENG can also be employed during the activity, such as chipping and putting. EMG aids clinical assessment and should be utilized in combination, it is particularly valuable in confirming the physiological signature of dystonia, distinguishing it from tremor or anxiety-related motor instability, and in guiding targeted interventions such as botulinum toxin injection by differentiating dystonic from compensatory muscle activity.

Needle EMG in the "yip" usually reveals task-specific, sustained, and inappropriate motor unit firing with agonist–antagonist co-contraction and overflow, in the absence of denervation—providing physiological evidence of focal dystonia rather than peripheral neuromuscular disease.

Rationale for Botulinum Toxin Therapy

Botulinum toxin acts by inhibiting presynaptic acetylcholine release at the neuromuscular junction, producing a temporary, focal reduction in muscle overactivity. When injected in low, carefully titrated doses into selected wrist or forearm muscles, it can dampen the pathological muscle contraction while preserving sufficient strength and coordination for functional movement. Botulinum toxin works by targeting the neuromuscular junction (NMJ) to block the release of the neurotransmitter acetylcholine (ACh), preventing nerve signals from reaching muscles, which results in temporary muscle paralysis or weakening. (13)

It does this by interfering with "Soluble N-ethylmaleimide-sensitive factor Attachment Protein Receptors", known as SNAREs proteins. (13, 14) SNARE proteins are essential proteins that mediate the fusion of vesicles with target membranes, a fundamental process for cellular communication and neurotransmitter release. The botulinum toxin interrupts their function which are essential for ACh-containing vesicles to fuse with the nerve terminal membrane. Blocking the SNARE protein reduces ACh neurotransmitter release resulting in the halting muscle contraction. (13,14,15)

Clinical Use of botulinum toxin and Evidence for its affective ness in treating sports related dystonia

Botulinum toxin therapy (BoNT) has been used intermittently in the treatment of the yips, with several published case reports and small series describing symptomatic improvement.

In the case of putting related "yips" targeted BoNT injections to pronator teres (15) and pronator quadratus (16) were reported as giving "excellent response," allowing continued play and a cessation of the uncontrollable dystopia, which severely compromised this motor skill. (16, 17)

EMG Feature	Finding	Clinical Interpretation / Significance
Resting activity	Usually normal	Distinguishes dystonia from neuropathic or myopathic disorders
Voluntary activation	Abnormal muscle firing during specific task	EMG abnormalities are task-specific
Co-contraction	Simultaneous activation of agonist and antagonist muscles	Hallmark of dystonia
Prolonged muscle bursts	Sustained, excessive motor unit firing	Leads to abnormal posturing or movement
Overflow activation	Recruitment of muscles not normally involved in the task	Reflects impaired motor inhibition
Irregular firing pattern	Variable frequency, poorly modulated discharges	Unlike rhythmic tremor
Burst duration	Longer than expected for task	Especially during fine motor control
Recruitment pattern	Excessive or inappropriate recruitment	Despite normal strength
Motor unit morphology	Normal MUP amplitude, duration, and configuration	No primary neuropathy or myopathy
Denervation potentials	Absent	Helps exclude axonal loss
Reinnervation changes	Absent	Differentiates from chronic neuropathic processes
Reciprocal inhibition	Reduced or absent (physiological studies)	Central motor control abnormality
Sensory trick effect	EMG activity may reduce with “geste antagoniste”	Supports dystonia diagnosis
Fatigue effect	Worsening with repetition	Common in task-specific dystonia
Passive movement	Reduced or absent abnormal firing	Differentiates from spasticity

Table 4: EMG features which assist the diagnosis of activity dystonia .

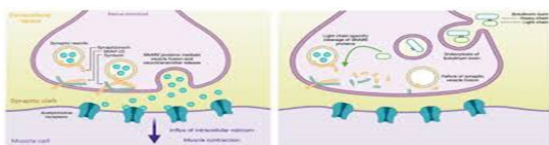


Figure 3: Botulinum toxin blocking (BoNT) through interference of SNARE protein.

Left: in the absence of BoNT, synaptic vesicles containing acetylcholine fuse with the presynaptic nerve terminal membrane mediated by SNARE proteins. Acetylcholine is released into the synaptic cleft where it binds to post-synaptic acetylcholine receptors, leading to muscle contraction.

Right: when BoNT is present, it is endocytosed into the cholinergic nerve terminal. Botulinum toxin light-chain cleaves SNARE proteins, resulting in the failure of synaptic vesicle fusion and acetylcholine release.

Benefits include reduction in involuntary spasms and improved stroke smoothness. Treatment requires precise muscle selection, often guided by clinical examination and, in some cases, electromyography. Effects are temporary, typically lasting 3–4 months, and repeat injections may be required.

Dosing is also a critical element in obtaining a successful outcome and titration of the Botulinum toxin to reduce the unwanted dystonic contraction which maintaining good muscle function requires skill and experience.

EMG guided therapy also ensures accuracy of therapy and minimum toxin dose. Similarly, ultrasound can be employed as an additional guidance modality to improve accuracy of toxin placement. (18,19) in a

complex neuromuscular anatomical area, where specific location of the dystonic muscle is critical to accurate diagnosis and therapy placement. (see figure 4)

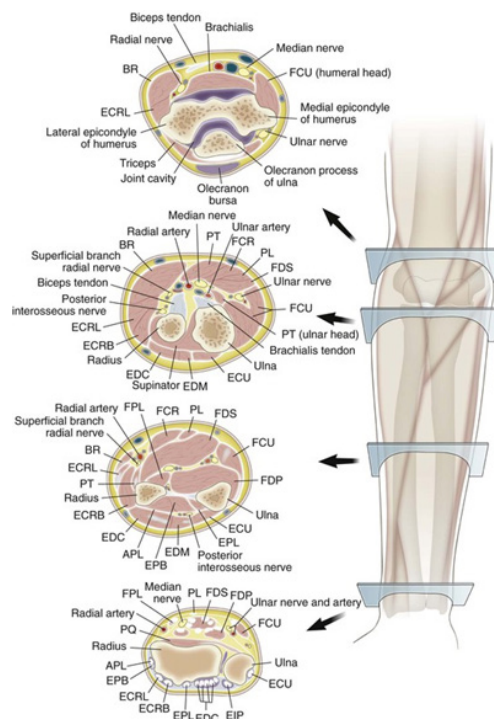


Figure 4: Forearm musculature location for Ultrasound and EMG guided Botulinum therapy for activity dystonia.

Conclusion

Activity-related dystonia is not psychological failure, loss of talent, or “choking.” It is a neuroplastic disorder of motor control occurring in elite performer such as musicians and athletes. It can have a devastating effect on the longevity of a sports career and can be a precursor to early retirement, due to loss of function.

In selected patients with disabling, task-specific golf dystonia, botulinum toxin represents a rational and evidence-supported therapeutic option. Its use should be individualised, with careful dosing to balance symptom control against the risk of excessive weakness and ideally undertaken by clinicians experienced in movement disorders and focal dystonia management.

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