

Considerations in the Management of Upper Extremity Spasticity



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KEYWORDS

- Spasticity • Surgical management • Management considerations • Cerebral palsy
- Spinal cord injury • Stroke

KEY POINTS

- Spasticity is a movement disorder characterized by a velocity-dependent increase in muscle tone and a hyperexcitable stretch reflex.
- Treatment plans for spasticity depend on several patient and disease-specific considerations.
- Patient characteristics include goals of treatment, age, intellect, resources/support system, and associated neurologic conditions.
- Spasticity characteristics include duration, severity, and pattern of motor involvement.
- The underlying cause of spasticity has implications for its treatment.

INTRODUCTION

Spasticity is as a motor disorder characterized by a velocity-dependent increase in muscle tone with exaggerated tendon jerks, resulting from a hyperexcitable stretch reflex.^{1–4} These characteristics limit the functional use of the upper extremity in patients with central nervous system (CNS) disorders or injury. Spasticity is a common, but not inevitable, component of the upper motor neuron (UMN) syndrome: a collection of positive and negative signs that occur following a CNS injury (eg, cerebral hypoxia, trauma, spinal cord injury [SCI]).^{1,5} It is characterized by muscle overactivity and hypertonicity, which, if left untreated, lead to muscle and soft tissue contractures.^{3,6} Impaired intraspinal processing of primary afferent signals is responsible for the clinical manifestations of spasticity and the UMN syndrome.⁷ Spasticity alone can lead to significant disability but may be exacerbated by coexisting features of the UMN

syndrome. The clinical picture of the UMN syndrome depends on the characteristics of the injury, such as location, onset, and size. Spasticity is a positive sign, which, along with hyperreflexia, spastic dystonia, and clonus, creates a clinical picture of increased muscle activity. Negative signs include paresis, early hypotonia, loss of dexterity, and fatigability.⁸

For the hand surgeon, the most commonly encountered causes of spasticity include cerebral palsy (CP), SCI, and cerebrovascular accident (or stroke). Spasticity is estimated to affect 17% to 38% of patients following stroke, 34% of patients with traumatic brain injury, and up to 78% of patients with spinal cord injury.^{8–17} These patients are at risk for development of soft tissue contractures and painful deformities of the upper limb. The muscle imbalances that develop often lead to characteristic postures, such as the flexed elbow and clenched fist, which hinder functional

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use of the upper extremity. The impairments of a patient suffering from the UMN syndrome contribute to their baseline functional limitations in posture, hygiene, mobility, and other activities of daily living.

In this article, the authors discuss the pathophysiology of spasticity as well as general considerations regarding surgical management. Specific considerations for common causes of spasticity, namely, SCI/tetraplegia, CP, stroke, and traumatic brain injury (TBI), are presented.

PATHOPHYSIOLOGY OF SPASTICITY

Patients with spasticity are affected by impaired motor function (paresis), muscle overactivity (hypertonia), and, eventually, soft tissue contractures.^{3,6} Immediately following a neurologic injury, paresis (or paralysis) occurs. Paresis is defined by the inability to voluntarily recruit skeletal muscles to generate movement. If the paretic limb is immobilized in a shortened position and not stretched sufficiently, myo-static shortening and muscle fibrosis occur alongside loss of functional muscle units.¹ Furthermore, poor posturing in conjunction with myofibrosis leads to joint contractures and disuse atrophy, further exacerbating the paresis. Over time, these shortened and stiff muscles develop increased tone (hypertonia) and abnormal responses to stretch, including velocity-dependent resistance to stretch. The hypertonia further exacerbates soft tissue contracture, which, in turn, worsens the spasticity.

Spasticity affects muscles of the upper extremity in characteristic patterns,¹⁸ predominantly the flexor and adductor muscles, resulting in the characteristic flexion-pronation deformity of the upper limb. Furthermore, spasticity is typically more pronounced in the distal extremity. In the shoulder, adduction and internal rotation predominate; in the elbow, the biceps, brachialis, and brachioradialis contribute to the flexion deformity.¹⁹ The wrist flexors are the most commonly involved muscles in upper limb spasticity; spasticity of the flexor carpi ulnaris is common and leads to a wrist flexion and ulnar deviation deformity. Hand and finger involvement varies depending on which muscles are predominantly affected but most often appear clenched into a fist. The thumb typically assumes an adducted posture because of increased adductor pollicis activity; but the flexor pollicis longus may also be affected, leading to metacarpophalangeal and interphalangeal joint flexion. As discussed later, the optimal treatment of spasticity depends on several factors and requires a highly individualized approach to patient management.

CONSIDERATIONS IN SPASTICITY MANAGEMENT

There are several guiding principles when considering how and when to manage patients with spasticity. In all patients, therapy to prevent soft tissue contractures and combat spasticity is critical. Therapists can work with patients on strengthening weakened muscles, maintaining proper joint alignment, and preventing soft tissue contractures. Weakening of a spastic muscle alone, without appropriate strengthening or alignment, is of little functional benefit.²⁰ Patients who fail conservative management or are inadequately managed early in the course of their disease often present to the hand surgeon for assistance. The most important, and occasionally most difficult, decision is whether or not patients are indeed surgical candidates. Patients with spasticity needing surgery require a comprehensive approach to treatment planning. Further, as with most upper extremity surgeries, a well-planned postoperative rehabilitation program will improve outcomes.

Defining Goals of Treatment

Before a discussion of surgical intervention, the priorities and needs of patients and caregivers must be assessed in the context of the patients' baseline function. Often, the underlying cause of spasticity can help guide preoperative discussions and define the goals of treatment. It is essential to clearly outline the treatment goals and surgical plan before intervention. Failure to set reasonable expectations before surgery will result in an unhappy patient and surgeon.

Although spasticity is often considered a hindrance to function, its mere presence is not an indication to operate. Spasticity should only be treated if there is a reasonable expectation of improvement in mobility, self-care, hygiene, or relief from painful contractures. Some patients adapt well to increased motor tone and depend on spastic muscle groups to assist with transfers or other activities. In such patients, a reduction in muscle tone would be detrimental to overall function. Other patients may lack the voluntary motor control necessary to achieve a substantial functional benefit after reconstruction. It is, therefore, essential to observe patients performing tasks of daily living to ensure that function is not lost by a well-intentioned surgery.

Patterns of Motor Involvement

In order to develop a treatment plan, the surgeon must first be able to correctly identify which spastic muscles are adversely affecting motor function.

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