Surgical Management of Spasticity of the Thumb and Fingers

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KEYWORDS

• Spasticity • Surgery • Hand • Cerebral palsy

KEY POINTS

- Hand spasticity prevents prehension and grasp, which are critical for activities of daily living and hand hygiene.
- Surgical management is elective and should be tailored to patient cognitive and physical functioning.
- Assessing active and passive digital flexion and extension should be assessed to identify spasticity and determine the need for additional tendon transfers to augment wrist and digital extensors and flexors.

INTRODUCTION

Spasticity of the hand and upper extremity often occurs secondary to central nervous pathologic condition, including cerebral palsy (CP), stroke, traumatic brain injury (TBI), and spinal cord injury. Spasticity of the hand is particularly debilitating because it prevents prehension and grasp, which are critical for independently performing activities of daily living (ADLs). Furthermore, hand postural deformities resulting from spasticity can result in poor hygiene and hand appearance. In this review, the authors describe surgical options for spastic conditions of the hand, specifically, wrist and digital flexion deformities, thumb-in-palm deformities, and swan-neck deformities caused by intrinsic and extrinsic spasticity.

PATIENT EVALUATION

For many patients, surgical intervention can improve hand function, effective grip and release, hand appearance and posture, hand hygiene, and ultimately, quality of life.[1] Surgical options for spasticity can be undertaken in an elective fashion, underscoring the importance of careful preoperative evaluation to tailor the treatment plan according to the patient's abilities, preferences, and needs. The indications for surgery differ based on cognitive ability, function, and sensation. For patients with cognitive challenges such as little voluntary hand control and poor sensation, hand hygiene is the primary indication for surgery. In contrast, patients with greater cognitive ability, normal sensation, and some degree of voluntary upper extremity control can derive more functional benefit from surgery.

Physical examination is often challenging in the setting of spasticity. It is, nonetheless, important to identify the muscles involved, weakness of antagonist muscles, and degree of joint and muscle contracture. In contrast to contracture, patients with isolated spasticity will have full range of motion with relaxation (eg, with botulinum toxin A injection or selective nerve blockade), and

Disclosure Statement: No disclosures.
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Hand Clin 34 (2018) 473–485
https://doi.org/10.1016/j.hcl.2018.06.005

increased muscle tone can often be overcome with gentle counterpressure/resistance in the opposite direction. Observing patients performing common ADLs can be useful in surgical planning. In addition, surgical decision making may also be impacted by patient and caregiver input regarding activities that are challenging and those that can be accomplished with ease. Recent evidence also supports the role of videotaping clinic evaluations and multiple preoperative assessments to get an accurate assessment of upper extremity function.[2] Finally, sensation should be assessed, including stereognosis, 2-point discrimination, and proprioception.

Selective nerve blocks can be used to sequentially assess spasticity and contracture of muscle groups.[3,4] For example, the ulnar nerve can be blocked either above the elbow (for spasticity of the flexor digitorum profundus [FDP] of the ring and small fingers or the flexor carpi ulnaris [FCU]) or at the wrist (to assess intrinsic muscle spasticity). In addition, the median nerve can be blocked above the elbow to determine the contribution of spasticity of the flexor digitorum superficialis (FDS), flexor carpi radialis (FCR), median-innervated FDP, and palmaris longus (PL). Similarly, muscle groups can be blocked sequentially to assess individual muscles after removing spasticity of the antagonists or co-contractions of adjacent muscles. For example, injection of spastic pronator teres can differentiate spasticity from contracture of the interosseous membrane. In this way, selective nerve blocks can be used to differentiate spasticity from contracture.

Various classification systems exist to describe upper extremity function, and these can be useful for both preoperative planning and postoperative assessment, primarily in the context of CP.[5] Classification systems largely focus on active and passive use of the hand as it relates to the ability to complete ADLs. The classification system described by House categorizes upper extremity function into 9 groups based on active and passive motion, grip, and assistance from the contralateral hand[6] (**Table 1**). The Manual Abilities Classification System is briefer and evaluates hand function across 5 simple categories:

- Handles objects with ease,
- Handles objects but with reduced speed and ability,
- Handles objects with difficulty requiring modification,
- Handles objects only in adapted situations, and
- Does not handle objects.[7]

Table 1
House classification of hand function for patients with cerebral palsy

Class	Description	Activity
0	No use	Patient does not use hand for activities
1	Poor passive assist	Patient uses hand to stabilize
2	Fair passive assist	Patient is able to hold object placed in hand
3	Good passive assist	Can hold object in hand for use by contralateral hand
4	Poor active assist	Weak active grasp and hold
5	Fair active assist	Active grasp and stability
6	Good active assist	Active grasp with stability and manipulation against other hand
7	Partial spontaneous use	Bimanual activities performed and occasional spontaneous use
9	Full spontaneous use	Independent use of hand

From House JH, Gwathmey FW, Fidler MO. A dynamic approach to the thumb-in palm deformity in cerebral palsy. J Bone Joint Surg Am 1981;63(2):222; with permission.

Finally, the Shriners Hospital for Children Upper Extremity Evaluation integrates video assessment to describe spontaneous function, position, and grasp. Overall, measures focused solely on impairment, such as range of motion or stereognosis, are less predictive than measures that focus on activity limitations, and defining ability in the context of ADLs is likely more sensitive when considering surgical planning.[8]

NONOPERATIVE MANAGEMENT

Surgical intervention for spasticity of the hand and upper extremity is elective. It is essential to coordinate surgical planning in a multidisciplinary fashion to integrate physical medicine and rehabilitation, occupational and physical therapy, neurology, and primary care as indicated to ensure readiness for surgery, compliance with postoperative protocols, and smooth transitions of care. Among adult patients with acquired central nervous system injuries (eg, TBI or stroke), definitive surgical