Treatment of Swan Neck Deformity in Cerebral Palsy

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Swan neck deformity in patients with cerebral palsy can result from hand intrinsic muscle spasticity or overpull of the digital extensors. After accurate identification of the etiology of the deformity, surgical treatment is directed at correcting the underlying muscle imbalance. Intrinsic lengthening can be used to treat intrinsic muscle spasticity, whereas central slip tenotomy is employed when digital extensor overpull is the deforming force. Accurate diagnosis and application of the proper surgical technique are essential when treating swan neck deformity in patients with cerebral palsy. *(J Hand Surg Am. 2014;39(4):768–772.*

Key words Cerebral palsy, swan neck deformity, intrinsic tightness, extensor tendons.

SWAN NECK DEFORMITY IS characterized by hyperextension of the proximal interphalangeal (PIP) joint and extensor lag of the distal interpahalageal joint (DIP). In cerebral palsy (CP), this deformity has 2 etiologies resulting in slightly different presentations: (1) hand intrinsic muscle spasticity or (2) overpull of the extrinsic digital extensors. Both of these etiologies cause stretching of the PIP volar plate over time, allowing for PIP hyperextension and subsequent DIP flexion. Treatment should be directed to the cause of the deformity, which makes identification of the etiology essential.

The 2 variants of swan neck deformity can be differentiated based on the position of the metacarpophalangeal (MCP) joints during digital extension. Patients with intrinsic muscle spasticity will present with MCP joint flexion and PIP hyperextension upon active digital extension, because the intrinsics lie volar to the center of rotation of the MCP joint and dorsal at the PIP joint. The Bunnell test will confirm intrinsic spasticity. With the wrist in flexion to relax possible tight digital flexors, passive PIP flexion is first measured with the MCP flexed and subsequently with the MCP extended. Patients with intrinsic tightness will exhibit more passive PIP flexion with the MCP flexed.

Patients presenting with swan neck deformity and full MCP extension upon active digital extension have deformity resulting from overpull of the extensor digiti communis (Fig. 1). These patients have flexor carpi ulnaris spasticity, weak wrist extensors, and resultant wrist flexion deformity. Over the years, as they attempt to extend their fingers and wrist, they overpull the digital extensors to augment wrist extension, and over time stretch the volar plates of the PIP joints, allowing for hyperextension. The Bunnell test is negative in these patients.

SURGICAL ANATOMY

The extensor mechanism is a complex confluence of the extrinsic digital extensors and the intrinsics of the hand. These tendons work in concert to allow independent extension of the MCP and PIP joints. The extrinsic digital extensors originate at the lateral epicondyle of the distal humerus and travel in the dorsal compartment of the forearm, crossing the wrist

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FIGURE 1: Preoperative patient with swan neck deformity of the index and middle fingers, resulting from overpull of the extrinsic extensors.

through their respective dorsal wrist compartments: the extensor indicis proprius and extensor digitorum communis in the fourth dorsal compartment and the extensor digiti quinti in the fifth dorsal compartment. They traverse the dorsum of the hand and enter the extensor hood at the MCP joint. The sagittal bands center the extensor tendon over the dorsum of the MCP joint. Over the proximal phalanx, the extensor mechanism divides into a single central slip and 2 lateral slips. The lateral slips continue distally, where they are joined by the lateral band contribution from the interossei and lumbricals at the level of the distal proximal phalanx. After crossing the PIP joint, the conjoined lateral bands (lateral slip plus lateral bands) join at the dorsum of the middle phalanx to form the terminal tendon, which crosses the DIP joint and inserts onto the distal phalanx. The central slip continues distally across the PIP joint after dividing from the lateral slips, and inserts onto the base of the middle phalanx.

The 4 dorsal interossei are bipennate muscles that originate from the metacarpal shafts of all digits. The dorsal interossei insert onto the ulnar aspect of the middle and ring fingers and the radial aspect of the index and middle fingers. Their deep heads insert onto the lateral band and become the lateral tendon while the superficial heads insert onto the proximal phalanx. The 3 volar interossei originate from the ulnar aspect of the second metacarpal shaft and the radial aspect of the fourth and fifth metacarpal shaft. They insert into the ulnar lateral band of the second digit and the radial lateral band of the ring and little fingers. The interossei travel volar to the center of rotation of the MCP joint and are the primary intrinsic flexors of the MCP joint. All of the interossei are innervated by the deep motor branch of the ulnar nerve.

The lumbricals originate on the tendon of the flexor digitorum profundus and insert onto the oblique fibers and the radial lateral bands of each digit except the thumb. They are primarily extensors of the interphalangeal joints, and less so, flexors of the MCP joints. The lumbricals to the index and middle fingers are bipennate and are innervated by the median nerve; those to the ring and little fingers are unipennate and innervated by the deep motor branch of the ulnar nerve.

INDICATIONS

Treatment of swan neck deformity should be considered if the deformity is functionally limiting. In severe cases, patients are unable to flex the PIP joints actively from the hyperextended position. In milder cases, patients have annoying clicking and catching when trying to actively flex the PIP joints out of full extension. Often, the swan neck deformity is also of aesthetic concern to the patient. Preoperatively, the surgeon can demonstrate the clinical effects of reducing PIP hyperextension by extension blocking figure-of-8 splints at the PIP joint. In addition, an ulnar nerve block can demonstrate the correction of MCP joint contracture expected by intrinsic lengthening alone.

We address swan neck deformity in CP patients only when active PIP hyperextension is greater than or equal to 20°. For deformities resulting from hand intrinsic spasticity, we perform intrinsic fractional lengthening. For deformities caused by overpull of the digital extensors, we perform central slip tenotomy.

Other procedures for the treatment of swan neck deformity in patients with CP have been reported. Swanson[1] described a sublimis tenodesis, using a slip of the sublimis tendon for PIP joint tenodesis. Tonkin et al[2] and Van Heest and House[3] reported using lateral band translocation from the dorsally subluxated position to a volar position in patients with CP and swan neck deformity.

CONTRAINDICATIONS

Patients with fixed MCP joint contracture not relieved by ulnar nerve block may not benefit from intrinsic release. Arthrodesis may be more appropriate in this clinical scenario.

Intrinsic release should not be performed in patients with weak finger flexion. These patients may rely solely on their intrinsics to effectively flex the MCP joints.

Patients must be able to actively flex the PIP joint with the joint placed in a neutral position with