1st CMC Arthroplasty Joint Rehabilitation

Surgical Indications and Considerations

Anatomical Considerations: Carpometacarpal (CMC) joint of the thumb is a saddle joint located at the very base of the thumb, and is subject to large physical stresses throughout life. Primary source of stability is gained from the ligaments embedded within the joint capsule, therefore excess laxity in the ligaments is a primary cause of instability at this joint and can be a precursor to degeneration of the articular cartilage. The anterior or palmar oblique ligament, also termed the "beak" ligament, is an important stabilizing structure, if lax, can be responsible for CMC subluxation. Furthermore, studies suggest that the trapezium bone of women is shallower, less congruent, and is lined with a thinner layer of articular cartilage than men – which may account for the higher incidence of instability and subsequent CMC joint arthritis in women.

Pathogenesis: Structural instability and impairment of the CMC joint is often caused by osteoarthritis (OA), rheumatoid arthritis (RA), and postmenopausal laxity of the capsular ligaments. OA develops relatively frequently at the CMC joint as a result of posttraumatic injury or cumulative trauma, as well as idiopathically. Synovitis associated with RA may eventually erode and soften the ligaments that protect the articular surfaces. Limited contact surface area on the palmar ulnar surfaces of the trapezium can create large and potentially damaging pressure within the joint for motions such as seen in a lateral key pinch. In both RA and OA subluxation of the CMC joint often initiates a kinematic imbalance in the other more distal joints of the thumb as well as influencing the moment arms of the muscles that cross the region. Intrinsic muscles such as the adductor pollicis may become fibrotic and permanently contracted thereby maintaining the deformity of the CMC joint and a narrowing of the first web space. Thumb deformities are commonly classified using the Nalebuff classification system which includes four deformities and their respective pathomechanics.

Epidemiology: Age and gender are major determinant in the prevalence of OA in the CMC joint as well as the other joints commonly affected by OA. Greater frequency of generalized OA is observed in females compared to males typically in their fifth and sixth decades, and this increased prevalence increases dramatically after menopause. This gender-related propensity is likely associated with postmenopausal laxity in the joint's ligaments as well as thinner articular cartilage observed in the trapezium bone in women. Women are also affected more frequently than males in RA with the onset usually occurring between the ages of 20and 60 years of age.

Diagnosis:

- Pain or aching around the base of the thumb, may radiate distally on the thumb or proximally towards the forearm (this pain is most intense during pinch)
- Tenderness over volar aspect of CMC joint and
- Stiffness in CMC joint in morning or after inactivity
- Adduction contracture (web space contracture) is common
- Hyperextension deformity of MCP joint often follows adduction contracture
- "Squaring" appearance around the margin of the joint caused by subluxation

- Positive Grind Test (palpating the CMC joint while compressing and rotating the first metacarpal in the CMC joint)
- Radiographic confirmation
- When in doubt, a small amount of local anesthetic injected into CMC joint w/ a resolution of pain will confirm the dx;
- Pain is aggravated by pinching, grip, twisting (wringing out clothes or washcloth) and prehension activities, nonprehension force application with the hell of the hand, (stapling paper, sqeezing oranges)
- Differential diagnosis: The most common condition mistaken for OA of CMC joint is de Quervain's tenosynovitis of the first dorsal compartment. Positive Finkelstien's test to rule in de Quervain's tenosynovitis.

Nonoperative Versus Operative Management: Nonoperative interventions would include splinting, pain control, exercises, nonsteroidal anti-inflammatory drugs, corticosteriod injections, and joint protection utilizing assistive devices. Surgical intervention is typically used when conservative therapy is unable to retard the progression of instability. Goals of surgery would be to relieve pain, improve function, restore the thumb web space, correct deformity, slow disease progression, improve cosmesis, and prevent consequences of arthritis. Primary indication for surgery is pain or deformity that interferes with daily function. There are many surgical intervention options with the most common being ligament reconstruction with or without tendon interposition (LRTI), hemiarthroplasty, arthrodeis, and simple trapeziectomy. Silicone arthroplasties are no longer used due to the infection, rejection and subluxation of the implant. In a recent study by Kunhs et. al hematoma and distraction arthroplasty for CMC joint reported that at 6 months 73% of patients reported complete relief of pain and at 24 months 92% were entirely pain free. Significant improvements were also note in range of motion including adduction and opposition to the base of the fifth finger. Comparisons between preoperative and 24-month postoperative strength measurements showed an average 47% increase in grip strength, 33% increase in key pinch strength, and a 23% increase in tip pinch strength over preoperative values.

Surgical Procedure:

- LRTI: typically divides the tendon of the flexor carpi radialis in half and uses half to replace the anterior oblique ligament and the remaining half as an interpositional spacer to help fill the void created completely or partially removing the trapezium. Sometimes this procedure is followed by a resection arthroplasty in which bone is removed to allow the first metacarpal to assume an abducted position. The thumb metacarpal is fixed to a Kirschner wire cast in a thumb spica to promote healing. An important consideration for this surgery is that the CMC joint must be immobilized in the thumb spica for 4 weeks.

- Hemiathroplasty: CMC joint is stabilized by weaving the tendon of the flexor carpi radialis throught the trapezium and donated cartilage, then anchoring it to the proximal thumb metacarpal. This surgery provides a very stable reconstruction of the CMC joint without the long-term fixation required for the LRTI. This procedure most commonly describes the insertion of an allograft costochondral cartilage between the partially resected trapezium and base of the thumb metacarpal. Procedure generally indicated for

with marked arthritis and associated instability limited primarily to the CMC joint in contrast to the whole thumb.

- Arthrodesis: CMC joint fused so that the distal phalanx of the thumb rests on the middle phalanx of the index finger when the hand is fully fisted. On average adduction and abduction motion is lost by 72%, and flexion and extension movements are reduced by 61%. This surgery is indicated for person with posttraumatic arthritis and with persons whose vocation requires extensive physical use with the hands. LRTI procedure would not be appropriate for this population because it would overstretch and weaken the tendons overtime.

Preoperative Rehabilitation

- Further injury protection using a splint or cast – with the wrist in 20°-30° of extension, CMC joint in relative palmar abduction, and the metacarpalphalangeal joint in 30° of flexion, with the interphalangeal joint remaining unconstrained.
- Education on post-operative procedures
- Exercises to maintain strength and function of nonimmobilized joint and contralateral extremity.

POSTOPERATIVE REHABILITATION for LRTI

Note: The following rehabilitation progression is a summary of the guidelines provided by Neumann and Biefeld in the Journal of Orthopaedic and Sports Physical Therapy 2003. Refer to their publication to obtain further information regarding criteria to progress from one phase to the next, and nonoperative interventions.

Phase I for *Traditional* Postoperative Rehabilitation: Day 1- Week 4

Goals: Control edema and pain
Protect repair
Minimize deconditioning

Intervention:

- Apply thumb spica in position of abduction to ensure good capsular healing
- Continuous elevation of upper extremity
- Perform active range of motion (ROM) to nonimmobilized digits as well as wrist, elbow and shoulder

Phase II for *Traditional* Postoperative Rehabilitation: Weeks 4-8

Goals: Control any residual symptoms of edema and pain
Continue to protect repair
Minimize deconditioning

Intervention:

- Remove cast, fabricate wrist-carpometacarpal immobilization thermoplastic thumb splint: to be worn at all times except during exercise or bathing.
- Continue to elevation and ice
- Continue to perform active range of motion (ROM) to nonimmobilized digits as well as wrist, elbow and shoulder
- Perform passive ROM to the CMC joint; include abduction and extension only
- Flexion and adduction must be avoided to protect the surgically incised dorsal side of the capsule

Phase III for *Traditional* Postoperative Rehabilitation: Week 8

Goals: Limit scar tissue adhesions
Initiating active ROM
Improve strength of surrounding thenar musculature

Intervention:

- Progress exercise to include active thumb palmar abduction, opposition, and circumduction
- Perform isometric thenar strengthening in the direction of palmar abduction
- Exercise in warm water help to enhance motion in early exercise phase
- Light functional activities initiated (i.e. buttoning clothes)
- Progressive passive stretching to painfree tolerance
- If the patient has only tip opposition to the small finger at 8 weeks -ok

Phase IV for *Traditional* Postoperative Rehabilitation: Week 12

Goals: Isotonic exercises initiated
Continue to limit scar tissue adhesions

Intervention:

- Progress strengthening exercises to include nonisometric thenar abduction and lateral pinch

- Remove splint for light activities
- Progress the patient to pinch strengthening using putty or clothespins, with careful instructions on proper technique. Look for a balance of flexion in all 3 joints of the thumb during pinch.

Phase V for *Traditional* Postoperative Rehabilitation: Week 13-16

Goals: Wean off splint
Back to work
Initiate functional activities

Intervention:

- Discontinue wrist-CMC immobilization splint as indicated
- Continue thenar abduction and key pinch strengthening exercises
- Return to work with light duty restrictions
- Engage in moderate functional activities

Phase VI for *Traditional* Postoperative Rehabilitation: Weeks 16-24

Goals: Back to work
Prior level of function

Intervention:

- Resume vocational or avocational activities

Specific postoperative instructions for rehabilitation for **Arthodesis**:
Thumb immobilized in thumb spica with CMC and MCP joint stabilized and the IP joint left free. Immobilization is continued for 3-4 months until radiographic results indicate evidence of trabecular bridging across the CMC joint.

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