Arthritis and Joint Reconstruction in the Hand
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Baltimore, MD
October 6-8, 2017

Learning Objectives
• Pathomechanics of Rheumatoid Arthritis (RA) and Osteoarthritis (OA)
• Conservative Treatment
• Surgical Treatment and Pre/Post Surgical Therapy

Pathomechanics of RA and OA
• RA vs OA
• Rheumatoid arthritis
• Patterns of arthritic deformity
• Osteoarthritis

RA versus OA
Rheumatoid Arthritis
• Systemic autoimmune disease
• Multiple joints involved and bilateral/symmetrical
• Periods of exacerbations and remission
• Commonly presents in PIP, MCP, and wrist

Osteoarthritis
• Disease of wear and tear but...
• Genetic component
• May be associated with past trauma
• Commonly seen in 1st CMC and DIP
• Osteophytes

Rheumatoid Arthritis
• Three out of four cases occur in women
• 1-3% of the population affected
• Chronic progressive inflammatory disease that is systemic and autoimmune in nature
• May be accompanied by fatigue, fever, stiffness
• Onset usually between ages of 40-60

Rheumatoid Arthritis
• RA is a disease that creates inflammation that affects synovial tissue
• Histological changes occur in synovium
• Synovial tissues interaction with the tissues in our joints
• Causes joint destruction
Stages of Rheumatoid Arthritis

<table>
<thead>
<tr>
<th>Stage</th>
<th>Symptom</th>
<th>Radiographic Changes</th>
<th>Splinting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I Early Active Inflammatory</td>
<td>Joint swelling, heat, redness, and pain are most severe</td>
<td>No destructive changes, but synovitis may be present</td>
<td>Resting splints as needed for pain</td>
</tr>
<tr>
<td>Stage II Acute Subacute Flattening</td>
<td>Synovitis begins to invaginate the soft tissues, causing decreased mobility</td>
<td>Tenderness</td>
<td>Night splints as an attempt to preserve potential function and to decrease pain</td>
</tr>
<tr>
<td>Stage III Subacutely Chronic active</td>
<td>Joint deformity and soft tissue involvement</td>
<td>Loss of joint motion</td>
<td>Night splints and functional day splints</td>
</tr>
<tr>
<td>Stage IV Chronic -active Chronic collagen and deformity Chronic</td>
<td>Joint dehiscence and sequestrum destruction</td>
<td>Loss of bone, joint, and cartilage destruction, with osteoporosis</td>
<td>Splinting at this stage cannot reverse deformations, but may provide joint stability during activities and comfort at night</td>
</tr>
</tbody>
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Patterns of Deformity in RA

- Delicate balance between muscle and tendon system in the normal hand
- Disrupted due to lengthening or destruction of stabilizing structures of joints
- Due to invasion of pannus
  - Proteins from thickened synovium may damage cartilage, bone, tendons and ligaments, leading to instability

Patterns of Deformity in RA

- Wrist
- MCP
- PIP
- DIP
- Often multiple joints are affected.
- Resultant deformities occur from changes to those joints adjacent.

Wrist

- Radially diseased synovium affects RSC and SL
  - What happens = flexion of scaphoid, carpus pulled radially, loss of carpal height, loss of balance between extrinsics and intrinsics
- Ulnar-volar translocation of the carpus on the radius: ligamentous laxity at the wrist allows carpus to slip down volar slope of the radius
  - Results in pronounced ulna (Caput Ulna)

Wrist

- Extensor Tendon Ruptures =
  - Vaughn Jackson Syndrome
- FPL rupture over scaphoid =
  - Mannerfelt Lesion

Wrist

- Extensor Tendon Ruptures =
  - Vaughn Jackson Syndrome
- FPL rupture over scaphoid =
  - Mannerfelt Lesion
MCP

- Ulnar deviation of fingers at MP joints: due to
  - RD at wrist
  - Instability at collateral ligaments
  - EDC decentralization
  - Dorsal apparatus stretched out
  - Radial sagittal fibers and collateral ligaments become stretched
  - Imbalances in intrinsic (tightness)
  - Forces of ADL use/radial pinch.

Orthosis techniques for MP ulnar deviation and palmar subluxation

MCP, PIP, and DIP: Swan Neck

- swan-neck deformity:
  - PIP hyperextension with DIP extension lag
  - Due to MP/PIP synovitis in combination with intrinsic muscle tightness
  - Also due to destruction of PIP volar supporting structures by synovitis
  - PIP becomes destabilized and is pulled into hyperextension; the condition is worsened by the forces of the intrinsic at MP joints and FDP at DIP.

MCP, PIP, and DIP: Swan Neck

- Early treatment:
- Rebalance with intrinsic stretches in early stages
- Protect PIP from hyperextension with ring type splint

MCP, PIP, and DIP

- Avoid function and activities in this position
MCP, PIP and DIP
Boutonniere

- PIP flexion contracture with DIP hyperextension contracture
- occurs due to synovitis causing destruction within the extensor system (central slip and lateral bands)
- central slip loses ability to extend PIP, lateral bands slide volar and become PIP flexors.

Thumb deformities

- Type I:
  - MP Flexion with IP hyperextension
  - “Boutonniere”
- Type II:
  - MP Flexion with IP hyperextension and CMC joint flexed and adducted

Type III:

- MP hyper extended with IP flexion and CMC flexed, adducted, and subluxated
- “Swan Neck”

Type III Thumb Deformities

Type IV:

- CMC flexion and adduction and MP ulnar collateral ligament unstable
Type V
- MP joint hyper extended due to a lax volar plate
- CMC not typically involved
  - Type VI
- Bone loss at any level
- Arthritis mutilans

Psoriatic Arthritis
- Auto-immune
- Inflammation of the skin and joints
  - Sausage like digits
- Skin patches of thick red and scaly skin
- Reduced motion – Spontaneous ankylosis of PIP and DIP joints
- Nails may be pitted
- Ages of 30-50

Osteoarthritis
- Common factor is deterioration of articular cartilage causing joint destruction and osteophyte formation
- Etiology behind cartilage degeneration not fully understood – primarily thought of as “wear and tear”
- Genetic component

Osteoarthritis
- Women affected > men
- DIP joints and first CMC joints are most often involved
- Age related, incidence increases with age
- Secondary DJD (degenerative joint disease) /OA
  - May occur at any age
  - Etiologic factor is known (e.g. trauma)
  - Intra-articular fracture

Conservative Treatment
- Overarching themes
- Orthoses
- Exercise
- Joint Protection

Over Arching Themes
Therapeutic Intervention
- Based on the individual needs of each patient
- Determined by the stages of the disease process
- Patient education is important
- Goals of therapy:
  - reduce inflammation,
  - decrease trauma to the joints
  - decrease pain
  - facilitate proper joint alignment
**Conservative Treatment**

**Orthoses**

- Reduce pain and joint wear/stress
  - Orthosis to decrease joint stress
  - Joint protection techniques
  - Modalities as appropriate (e.g. paraffin, moist heat)
- Pain free ROM

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**Evidence - Orthoses**

- Reducing pain and joint wear/stress
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**Evidence: Prefabricated vs. Custom CMC splinting**

  - Patients prefer pre-fabricated
  - Custom does better job at reducing subluxation
  - Better pain relief with prefabricated

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**Prefabricated wrist orthosis - evidence**

  - CONCLUSION: Prefabricated wrist working splints are highly effective in reducing wrist pain after 4 weeks of splint wearing in RA patients with wrist arthritis.

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**Evidence for Orthoses**

  - CONCLUSION: The use of a night-time hand positioning splint reduces pain, improves grip and pinch strength, upper limb function and functional status in patients with rheumatoid arthritis

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**Conservative Treatment**

**Exercise**

- Maintain/Increase muscle strength and ROM
  - AROM exercises
  - Isometric strengthening
- Increase functional independence
  - Assistive equipment (jar openers, key turners)
  - Energy conservation/work simplification, joint protection

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Evidence for Exercise


- CONCLUSION: A significant improvement in hand force and hand function in patients with rheumatoid arthritis was seen after 6 weeks of hand training; the improvement was even more pronounced after 12 weeks. Hand exercise is thus an effective intervention for rheumatoid arthritis patients, leading to better strength and function.

Evidence - Exercise

  - Review of literature to develop exercise recommendations from biomechanical studies
  - Strengthen thumb intrinsics, long thumb extensors and abductors, and wrist extensors to avoid adduction deformity
  - Preserve mobility
  - Avoid Key Pinch

Evidence - Exercise

  - 35 charts reviewed
  - Combination of orthosis, strength, joint protection, and soft tissue releases
  - Decreased pain and disability as measured by Quick DASH more than
**Instructions**

- Do the exercises as taught by your therapist
- Move the joints as far as you can without forcing them
- Always stretch gently. Hold for about 30-60 sec at the point of feeling tightness or slight discomfort
- Do not bounce. You should feel a stretch but not pain
- Perform each exercise for at least four repetitions
- Exercises should be performed 2-3 d per week

Valdez and Von der Hyde (Nieduski), JHT 2012
AROM: Thumb flexion
1. Start with thumb extended as far as possible away from the palm
2. Flex the tip of the thumb to the base of the small finger
PROM: Same as AROM but assist with the other hand

Valdez and Von der Hyde (Nieduski), JHT 2012

Thumb Abduction
1. Start with thumb lying flat against palm in line with the index finger
2. Spread thumb as far away from the palm as possible in the same line as the index finger

Valdez and Von der Hyde (Nieduski), JHT 2012

Thumb opposition
Touch thumb to the tip of each fingertip alternately

Valdez and Von der Hyde (Nieduski), JHT 2012

CMC Extension
Spread out thumb as far as possible from palm
** Caution – do not Hyperextend the MP Joint**

Valdez and Von der Hyde (Nieduski), JHT 2012

Thumb IP and MP Flexion
• Bend only the single joint

Valdez and Von der Hyde (Nieduski), JHT 2012

Resistive exercises
• Exercises should be performed one set for 10-15 repetitions, 2-3 d a week with a recovery period of 48 h between exercise sessions
• Isometric exercises can be performed if exercise against resistance causes pain
• Lateral-pinches and key-pinches strengthening exercises should be avoided in patients with advanced CMC OA who have instability and deformity
• Exercises should be performed pain free

Valdez and Von der Hyde (Nieduski), JHT 2012
Thumb extension against rubber band or manual resistance

• 1. Wrap rubber band around metacarpals with hand flat on table
• 2. Spread rubber band out as far possible

Thumb abduction against rubber band or manual resistance

• 1. Wrap rubber band around metacarpals with hand resting on small finger
• 2. Spread rubber band out as far possible

Strengthening Exercises

Conservative Treatment

JOINT PROTECTION

• Maintain muscle strength, ROM, endurance
• Respect pain
• Use larger/stronger joints as able
• Avoid tight/prolonged grasp

First Dorsal Interosseous Strengthening

Conservative Treatment

JOINT PROTECTION

• Avoid positions of deformity
• Avoid remaining in one position for a long time
• Balance rest and activity, conserve energy
• Use adaptive equipment & techniques as appropriate
Avoiding Positions of Deformity

Adaptive Equipment

Evidence – Joint Protection (JPE)

- *Volume 23, Issue 4, Pages 334-351 (October 2010)* (JHT) *A Systematic Review of Conservative Interventions for Osteoarthritis of the Hand* Kristin Valdes, OTD, OTR, CHT, Tambra Marik, OTD, OTR/L, CHT

- Studies for the intervention of JPE and adaptive device provision were of fair to moderate quality and provide moderate support for the intervention of JPE.

Surgical Treatment and Pre/Post Surgical Therapy

- Pre Operative Therapy
- Surgical Interventions and Post Operative Therapy
  - Wrist
  - MCP
  - PIP
  - CMC

Pre-operative Therapy

- Patient education surgical goals/expectations
- Introduction to post-op regimen
- Objective assessment
- Functional assessment
- Pre-op orthosis fabrication as indicated

Think Before You Treat

- What brought them to need the surgery?
- What disease process are you dealing with?
- What are the goals of the surgery?
- What is the expected outcome?
Reconstructive Surgical Procedures and Therapeutic Management

- Treatment protocols may vary
- Those presented are guidelines only and need to be tailored to the patient’s specific needs and the surgeon’s philosophy of treatment

Wrist

- Possible Surgical Interventions:
  - Synovectomy
  - Distal ULna Resections
  - Arthroplasty
  - Partial Wrist Fusions
  - Arthrodesis

Sx: Synovectomy (RA)

- Synovitis tissue mass distends capsule and ligament mechanically
- May become trapped between bones, blocking motion.
- May restrict tendon gliding within flexor sheaths and pulleys causing decreased ROM, crepitus, triggering

Synovectomy: General Principles

- Cannot prevent progression of disease
- Can relieve symptoms/forestall joint destruction
- Surgical goals
  - pain relief
  - decrease inflammation/swelling
  - return of ROM
  - improve function through elimination of pain

Tenosynovectomy at Wrist

- Extensor
  - Immobilized with MCP in extension for 2-3 weeks to ensure no lag develops
  - Occasionally when synovectomy is performed tendon is already compromised and surgeon must also address injured tendon
- Flexor
  - May also see median nerve symptoms
  - For both Flexor and Extensor any boney prominences are addressed as well

Wrist

- Distal ULna Resections
  - Options
    - Darrach with soft tissue stabilization ECU
    - Suave Kapandji
    - Bower’s hemi resection Interposition
  - Purpose
    - Pain relief
    - Instability
    - Arthritic changes at DRUJ
    - Compromised extensor tendons/rupture
Wrist

• Arthroplasty
  – Varied types of implants
  – Initial metal implants had issues with failure
  – Low demand patient
  – Need sufficient bone stock
  – Remember realistic expectations with these patients

Ortho / Joint • Wrist

• Partial wrist fusions
  – S-L-R fusion
  – L-R fusion


Arthrodesis

• Indications
  – Debilitating deformity
  – Mutilans deformity
• Goals of surgery
  – Relieve pain
  – Provide stability
  – Correct non-functional deformity
• Joints commonly treated by arthrodesis
  – Wrist
  – Thumb MP joint
  – PIP joints
  – DIP joints

Arthrodesis: Post Op therapy

• Use of wrist Orthosis until fusion complete
• Edema control
• Scar management
• ROM to non-involved joints

MP Joint Synovectomy/
Soft Tissue Reconstruction Arthroplasty

• Surgical procedure:
  – extensor mechanisms incised along ulnar border
  – ulnar intrinsics released if indicated
  – joint capsules incised
  – synovium removed
  – capsules closed
  – radial collateral ligaments may be repaired or shortened
  – extensor tendons may be centralized
MP Joint Synovectomy/
Soft Tissue Reconstruction Arthroplasty
Post-op therapy

- Early phase (0-2 weeks)
  - Gentle AROM
  - PROM initiated if no extensor tendon reconstruction
  - Protective resting orthosis between exercises
  - Dynamic MP extension orthosis may be utilized if indicated
- Intermediate/late phase
  - ROM and strengthening exercises progressed as tolerated
  - Dynamic flexion orthosis as indicated
  - Goal is full ROM

Sx: MP Arthroplasty

- Indications / Goals
  - Reduce pain
  - Restore motion
  - Restore more normal joint alignment
  - Improve functional use

Flexible Implant Resection Arthroplasty

- Basic Concepts
- "bone resection + implant + encapsulation = new joint"
- Early guided motion essential
- Biodynamics of scar formation
- Balance of mobility and stability

Bone resection + implant + encapsulation = functional joint

- Correct surgical balancing of the soft tissue structures is required
- Controlled motion allows desired orientation of the collagen fibers

Swanson Implant

MCP Arthroplasty (RA)

- Indications
  - Joints are fixed or stiff
  - Radiographic evidence of joint destruction or subluxation
  - Ulnar drift not correctable by soft tissue surgery alone
  - Pain due to arthritis
MCP Arthroplasty (RA)

- Surgical procedure
  - transverse incision over dorsum of MP joints or dorsal longitudinal incisions between MC heads
  - dorsal hood incised to displace extensor tendons
  - metacarpal head excised
  - implant inserted as joint spacer
  - other reconstructions of soft tissue as indicated: intrinsic release, extensor realignment (recentralization), collateral ligament reconstruction, tenosynovectomy

MCP Arthroplasty Post Op Therapy

First Postoperative Week

- Note condition of incision at first dressing change
- Patients on steroids or immunosuppresants may need to have the splint application delayed

MCP Arthroplasty Post Op Therapy Orthoses

- Dynamic extension orthosis - allows patient to actively flex fingers with active-assisted extension to neutral
- Worn to retrain and protect healing structures for approximately 6 weeks
- Active and passive ROM to MPs, PIPs and DIPs

Night Orthosis

- Full (or nearly full) MP Extension
- Proper Alignment
- Wrist in Neutral or Slight Ulnar Deviation
• Dynamic flexion may be initiated at 3 weeks post op if flexion remains tight

MCP Arthroplasty
Post Op Therapy
• Hourly daytime AROM exercises
  – MP flexion
  – Gentle opposition to each digit tip with the thumb
  – Radial finger walking
  – PIP/DIP flexion and extension

MCP Arthroplasty
Post Op therapy
• Progress to intermittent protected ROM out of orthosis between 3 and 6 weeks
• Scar management, edema control
• ROM goals: IF 0-45 degrees, MF 0-60 degrees, RF/SF 0-80 degrees
• IF MP may be fused to protect other digits and allow functional, stable pinch

Scarf Management

MCP Arthroplasty
Post Op Therapy
• 6 - 8 weeks post surgery
  – continue orthosis wear, and exercises
  – increase MP flexion to 60 degrees in the dynamic orthosis
  – Limited functional strengthening, avoid ulnar deviating forces (especially lateral pinch)
  – resume light ADL while wearing the dynamic orthosis
  – gradually increase light activity out of the dynamic orthosis under the supervision of the therapist

MCP Arthroplasty
Post Op Therapy
• 12 weeks post surgery
  – therapy as required
  – increase ADL outside of the dynamic orthosis
  – many protocols do not flex MP joints beyond 60 degrees for 1 year
  – static night orthosis at least for one year and beyond to maintain digit alignment and extension
Teach patient functional grasp avoid the forces of radial pinch and gravity with forearm in neutral position.

3 Months After Surgery
- Continue Scar management
- Joint protection
- Night splint continues
- Day soft alignment splint

PIP
- Arthroplasties
  - Silicone/Swanson
  - Ascension/Pyrocarbon

Proximal Interphalangeal Joint (PIP) Arthroplasty (OA)
- Indications
  - pain due to destructive arthritis
  - instability/subluxation of PIP joints
  - stiffness and functional loss of PIP joints
  - may be a component of swan-neck or boutonniere reconstruction

Proximal Interphalangeal Joint Arthroplasty (OA)
- Surgical procedure
  - volar or dorsal access to PIP
  - volar plate and collateral ligament may be released
  - head of proximal phalanx resected; reaming of proximal and middle phalanges
  - implant inserted
  - capsular closure; extensor tendon reconstructed as indicated to balance tension between central slip and lateral bands in joints with collapse deformity, collateral ligaments reconstructed

PIP Arthroplasty Post Op
Postoperative Course Dependent Upon the Preoperative Condition
- Stiff PIP
- PIP with lateral deviation
- Boutonniere deformities
- Swan neck deformities (rarely)
**PIP Arthroplasty Post Op**

PIP with Lateral Deviation – delay motion until good stability achieved
- Immobilize in full extension with lateral stability
- Buddy tape through ROM
- Or fit with a hinged orthosis for lateral stability

**PIP Arthroplasty Post Op**

• Boutonniere Deformity
  - continuous splint 4-6 weeks (DIP ROM ONLY)
  - Emphasis initially on maintaining/maintaining PIP extension, developing stiffness and stability at PIP

**PIP Arthroplasty Post Op**

Swan Neck – allow flexion immediately – block extension

**PIP Arthroplasty Post Op**

Swan Neck – allow flexion immediately – block extension

**PIP Arthroplasty (OA) Post Op Therapy Silicone**

• 3-5 days
  - AROM initiated
  - Some MD’s wait longer to start ROM if greater stability
  - Digital based extension orthosis
    - PIP immobilized in 10-20 degrees flexion
    - or buddy taping
    - Edema control
    - Wound care

**PIP Arthroplasty Post Op Therapy Silicone**

• 3-4 weeks
  - Discontinue day splint if joint stable and minimal extensor lag
  - Continue at night

• 6-12 weeks
  - Discontinue night splint as indicated
  - Graded strengthening
  - Progressive increase in functional use incorporating joint protection principles

**PIP Arthroplasty Post Op Therapy**

• AROM may be delayed if:
  - Soft tissue reconstruction completed
  - Index and middle digits delayed 1-2 weeks as greater stability is needed
Pyro Carbon PIP Post OP Therapy

- Generally used for
  - OA
  - Traumatic Arthritis
- RA patients may need up to three weeks of immobilization and follow an individualized program

Pyro Carbon PIP Post OP Therapy

- Short Arc Motion Protocol: Avoid Hyperextension
  - Resting Orthosis in Full PIP extension
  - Two Exercise template orthoses
    - One two allow active flexion to a limit followed by active extension
    - Second to allow DIP blocking with PIP in extension

Pyro Carbon PIP Post OP Therapy

- POW #1
  - Begin With Hourly PIP AROM
    - Limit to 30 degrees
- POW #2
  - Increase to 40 degrees
- POW # 3
  - Increase to 50 degrees

Pyro Carbon PIP Post OP Therapy

- POW #4
  - Increase to 70-75 degrees
- POW # 6
  - Initiate PROM to increase flexion
  - Splint as needed if a deformity is evident
  - Light activities with therapist out of the splint

Pyro Carbon PIP Post OP Therapy

- 6 Weeks to 3 Months Post Op
  - Goal is 0-75 degrees of AROM
  - Splinting
  - Light ADL
  - Avoid hyperextension
Evidence: 2 year follow-up

  - PIP avg. arc of motion = 47 deg
  - Pain = 1/10
  - 80% patient satisfaction rate
  - 28% require second procedure to improve motion or decrease pain

Evidence – Hemiarthroplasty Pyrocarbon

  - Retrospective Case Series (minimum 2 year follow up average 4.6)
  - Improvement in COPM and DASH scores
  - Improvement in VAS for pain
  - No significant improvement in strength
  - Bone Sparing

CMC Joint

- OA
- females >> males
- thumb 50% of hand function
- CMC inherently unstable joint due to shape
- Forces of pinch translate through CMC
  - wear and tear between 1st MC and trapezium

CMC Arthroplasty (OA)

- Indications
  - Grind Test: localized pain and crepitus during passive circumduction with axial loading
  - Loss of motion with decreased pinch and grip strength
  - Radiographic evidence of arthritic changes
  - Persistent pain of the CMC joint that is non-responsive to conservative management

CMC Arthroplasty Procedure

- Varies = different types of surgical reconstruction
- Longitudinal incision over trapezium
- SBRN retracted; first compartment of extensor retinaculum incised
- Partial or complete resection of trapezium

CMC Arthroplasty Procedure

- Interpositional structure placed
  - artificial implant (rare)
  - tendon - APL or FCR
- Ligamentous reinforcement if indicated
- Tendon interpositional arthroplasty may be stabilized with Kirschner wire
CMC Arthroplasty: Post Op Therapy

• Early phase (0-4 weeks)
  – Immobilization in thumb spica cast or thermoplastic orthosis
  – ROM to digits and proximal joints
  – Discuss precautions:
    • No motion of wrist or portion of thumb in orthosis
    • No resistive use even with orthosis in place especially not pinch give examples

CMC Arthroplasty Post Op Therapy

• Late phase (6-12 weeks)
  – light functional use progressively increased, incorporating joint protection principles
  – progressive grip and pinch strengthening, as tolerated, generally initiated at 8 week
  – goal is pain-free, stable joint for pre-hension

References


Conclusion

Postoperative Management

– The patient is an active participant
– Treatment is specific to the condition, postoperative week, stage of the disease process, and the deformity
– Treatment is individualized
  • Understand the surgery
  • Understand the postoperative care
  • Treat each patient as an individual

References