Arthritis and Joint Reconstruction in the Hand
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Learning Objectives
- Pathomechanics
- Rheumatoid Arthritis (RA)
- Osteoarthritis (OA)
- Conservative Treatment
- Surgical Treatment
- Pre/Post Surgical Therapy

Pathomechanics
RA & OA

<table>
<thead>
<tr>
<th>Rheumatoid Arthritis</th>
<th>Osteoarthritis</th>
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<tbody>
<tr>
<td>Systemic, autoimmune</td>
<td>Disease of wear and tear but...</td>
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<tr>
<td>Multiple joints bilateral/symmetrical</td>
<td>Genetic component</td>
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<tr>
<td>Exacerbations and remissions</td>
<td>May be associated with past trauma</td>
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<tr>
<td>Presents in PIP, MCP, and wrist</td>
<td>Commonly seen in 1st CMC and DIP</td>
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<td></td>
<td>Osteophytes</td>
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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>Inflammatory</th>
<th>Synovial inflammation</th>
<th>Synovial tissue damage</th>
<th>Synovial tissue destruction</th>
<th>Synovial tissue degeneration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I</td>
<td>Early</td>
<td>Acute</td>
<td>Persistent</td>
<td>Chronic</td>
<td>Progressive</td>
</tr>
<tr>
<td>Stage II</td>
<td>Moderate</td>
<td>Subacute</td>
<td>Protracted</td>
<td>Deforming</td>
<td>Progressive</td>
</tr>
<tr>
<td>Stage III</td>
<td>Severe</td>
<td>Deformative</td>
<td>Disfiguring</td>
<td>Destructive</td>
<td>Deteriorative</td>
</tr>
<tr>
<td>Stage IV</td>
<td>End-stage</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<table>
<thead>
<tr>
<th>Stage</th>
<th>Symptoms</th>
<th>Radiographic changes</th>
<th>Splinter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I</td>
<td>Joint swelling, heat, redness, and pain are most severe</td>
<td>No destructive changes, but osteoporosis may be present</td>
<td>Night splint to prevent pain</td>
</tr>
<tr>
<td>Stage II</td>
<td>Synovium begins to invade the soft tissue, causing increased mobility</td>
<td>May cause slight bone and soft tissue destruction</td>
<td>No definitive \</td>
</tr>
<tr>
<td>Stage III</td>
<td>Joint instability and soft tissue destruction</td>
<td>Bowing, joint and cartilage destruction, with osteoporosis</td>
<td>Night splints and functional aid splint</td>
</tr>
<tr>
<td>Stage IV</td>
<td>Joint destruction and severe deformities</td>
<td>Synovial, joint, and cartilage destruction with joint instability, destruction, and fusion</td>
<td></td>
</tr>
</tbody>
</table>

Splitting or this stage cannot rescue destruction, but may preserve joint stability during activities and control of pain.
**RA Patterns of Deformity**

- Delicate muscle and tendon balance
  - Disrupted due to lengthening or destruction of stabilizing structures of joints
- Invasion of pannus
  - Proteins from thickened synovium may damage cartilage, bone, tendons and ligaments, leading to instability

**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)

**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 intrinsics (tightness)
  - Forces of ADL use/radial pinch.

**RA Patterns of Deformity Joints Affected**

- Wrist/DRUJ
- MCP
- PIP
- DIP

- Multiple joints are often affected at once.
- Some deformities occur from changes to adjacent joints.
Orthosis techniques for MP ulnar deviation and palmar subluxation

RA Deformities MCP, PIP, and DIP
Swan Neck
- 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 intrinsics at MP joints and FDP at DIP.

RA Deformities MCP, PIP, and DIP
Swan Neck
- Early treatment:
  - Rebalance with intrinsic stretches in early stages
  - Protect PIP from hyperextension with ring type splint

RA Deformities MCP, PIP and DIP
Boutonniere
- PIP flexion contracture with DIP hyperextension contracture
- Synovitis causes destruction within the extensor system (central slip and lateral bands)
- Central slip can’t extend PIP, lateral bands slide volar and become PIP flexors.
RA Thumb Deformities

Type I:
- MP Flexion
- IP Hyperextension
- "Boutonniere"

Type II:
- MP Flexion
- IP Hyperextension
- CMC Joint flexed and adducted

Type III:
- MP Hyperextended with IP flexion and CMC flexed, adducted, and subluxed
- "Swan Neck"

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:
  1. reduce inflammation,
  2. decrease trauma to the joints
  3. decrease pain
  4. facilitate proper joint alignment
OA Conservative Treatment Orthoses

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

Evidence - Orthoses

- 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
- Wearing a splint to immobilize the CMC joint of the thumb can improve hand function and decrease pain
- Some studies established those whom received a CMC orthotic could postpone or avoid CMC surgery
- Many preferred the short flexible orthotic over the longer version
- High to moderate evidence to support the intervention of orthotics

Evidence CMC Support Prefabricated vs. Custom

  Splinting the degenerative basal joint: custom-made or prefabricated neoprene?
  Weiss S, Lastayo P, Mills A, Bramlet D.
  1. Patients prefer pre-fabricated
  2. Custom does better job at reducing subluxation
  3. Better pain relief with prefabricated

Prefabricated Wrist Orthosis

  Efficacy of wrist working splints in patients with rheumatoid arthritis: a randomized controlled study.
  Veehof MM, Taal E, Heijnsdiik-Rouwenhorst LM, van de Laar MA.
- CONCLUSION: Prefabricated wrist working splints are highly effective in reducing wrist pain after 4 weeks of splint wearing in RA patients with wrist arthritis.

Evidence for Orthoses

  Effectiveness of a night-time hand positioning splint in rheumatoid arthritis: a randomized controlled trial.
  Silva AC, Jones A, Silva PG, Natour J. Rheumatology Division, Federal University of São Paulo, Brazil.
- 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

Conservative Treatment OA & RA

- 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
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


- Eight of the nine studies found those performing exercises demonstrated gains in grip strength ranging from 1.94kg to a 25% improvement from the baseline.
- Studies for the intervention of exercise were of moderate quality and provide moderate support for the intervention of exercise to increase hand strength and decrease pain.

Obrien, VH & Giveans, MR. Effects of a dynamic stability approach in conservative intervention of the carpometacarpal joint of the thumb: A retrospective study. JHT 26(2013) 44-52.

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

Conservative Treatment

**JOINT PROTECTION**

- Maintain muscle strength, ROM, endurance
- Respect pain
- Use larger/stronger joints as able
- Avoid tight/prolonged grasp
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:
  1. Synovectomy
  2. Distal Ulna Resections
  3. Arthroplasty
  4. Partial Wrist Fusions
  5. 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

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

Wrist Tenosynovectomy

Extensor
1. Immobilized with MCP in extension for 2-3 weeks to ensure no lag develops
2. Occasionally when synovectomy is performed tendon is already compromised and surgeon must also address injured tendon

Flexor
1. May also see median nerve symptoms
2. For both Flexor and Extensor any bony 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

**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

**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 (6 weeks)
- Edema control
- Scar management
- ROM to non-involved joints

**MP**

- Synovectomy and Soft Tissue Reconstruction Arthroplasty
- Arthroplasty
**MP Joint Synovectomy/Soft Tissue Reconstruction Arthroplasty**

- Surgical procedure:
  1. extensor mechanisms incised along ulnar border
  2. ulnar intrinsics released if indicated
  3. joint capsules incised
  4. synovium removed
  5. capsules closed
  6. radial collateral ligaments may be repaired or shortened
  7. extensor tendons may be centralized

**Post-op therapy**

- Early phase (0-2 weeks)
  1. Gentle AROM
  2. PROM initiated if no extensor tendon reconstruction
  3. Protective resting orthosis between exercises
  4. Dynamic MP extension orthosis may be utilized if indicated

- Intermediate/late phase
  1. ROM and strengthening exercises progressed as tolerated
  2. Dynamic flexion orthosis as indicated
  3. Goal is full ROM

**Sx: MP Arthroplasty**

- Indications / Goals
  1. Reduce pain
  2. Restore motion
  3. Restore more normal joint alignment
  4. 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**
  1. Joints are fixed or stiff
  2. Radiographic evidence of joint destruction or subluxation
  3. Ulnar drift not correctable by soft tissue surgery alone
  4. Pain due to destructive arthritis

- **Procedure**
  - 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 Therapy**

- **First Postoperative Week**
  - Note condition of incision at first dressing change
  - Patients on steroids or immunosuppressants 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

- Dynamic MP extension/alignment splint is applied
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

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

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

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
- Arthroplasties
  1. Silicone/Swanson
  2. Ascension/Pyrocarbon
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

Swan Neck – allow flexion immediately – block extension

PIP Arthroplasty Post Op

Boutonniere Deformity - continuous splint 4-6 weeks (DIP ROM ONLY)

- Emphasis initially on maintaining/ maximizing PIP extension, developing stiffness and stability at PIP

PIP Arthroplasty (OA)
Post Op Therapy Silicone

3-5 days post-op

- AROM initiated
- Some MD’s wait longer to start
- ROM= greater stability
- Digital based extension orthosis
- PIP immobilized in 10-20 degrees flexion if swan-neck reconstruction done
- Or buddy taping
- Edema control
- Wound care

Silicone PIP Arthroplasty Post Op Therapy

3-4 weeks post op

- 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 or 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 “Hyper”- extension
- 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
- **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
  1. Goal is 0-75 degrees of AROM
  2. Splinting
  3. Light ADL
  4. 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

- 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**
- 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**
- **4 Weeks Post Op**
  - AROM may be initiated
  - May be delayed until 6 weeks with some procedures
  - Radial Abduction avoided
- **6 weeks Post Op**
  - AROM/PROM
  - Orthosis continued between exercises in most cases
  - Some physicians progress to a hand based splint

**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 prehension

**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

**Thank you!!!**
References