Musculoskeletal Hand Complications in Diabetes

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Review Aims

- Most common MSK conditions in "Diabetic Hand"
- Epidemiological characteristics
- Predisposing factors
- Pathogenesis
- Clinical presentation and diagnosis
- Treatment principles
- Role of physical therapists

Background

- Diabetes is a chronic metabolic condition
- Presented as Type I or II
- Regardless of type is characterized by:
  - Persistent hyperglycaemia
  - Micro- and macro-vascular complications
  - Peripheral neuropathies
  - **Various musculoskeletal complications**

(Larkin et al., Diabetes Care, 2014)

UE Musculoskeletal Complications

- Limited Joint Mobility
  - **Shoulder** – Adhesive Capsulitis
  - **Hand:**
    - Diabetic hand stiffness
    - Diabetic "cheiro-arthropathy"
- Dupuytren's Contracture
- Flexor Tenosynovitis
  - Trigger Finger
- Carpal Tunnel Syndrome

(Chammas et al., 1995; Papanas & Maltezos, 2010; Redmond et al., 2012; Mustafa et al., 2016)

Historical Perspective

Effects of Diabetes in the hand known since the 70-80's
- "diabetic hand syndrome"
- "diabetic cheiro-arthropathy"

- Jung Y, Hohmann TC, Gerneth JA et al. Diabetic hand syndrome. Metabolism 1971; 20: 1008–15.
- Ceruso M, Lauri G, Bufalini C et al. Diabetic hand syndrome. J Hand Surg 1988; 13A:765-70.
- Rosenbloom AL. Limitation of finger joint mobility in diabetes mellitus. J Diabet Complications 1989; 3: 77-87.
- Poirier JL, Herisson C, Guillot Bet al. La cheiroarthropathie diabetique. Rev Rheum Mal Osteoartic 1989; 56: 511-7.
- Jennings AM, Milner PC, Ward JD. Hand abnormalities are associated with the complications of diabetes in type II diabetes. Diabetic Med 1989;6:43-7.
- Rosenbloom AL. Limitation of finger joint mobility in diabetes mellitus. J Diabet Complications 1989;3:77–87.

"The forgotten complication"

- Limited research
- PubMed search (1970 – current):
  - 'Diabetic foot' = 27,000 citations!!!!!
  - 'Diabetic hand' = 167 citations

"Diabetic Hand" Predisposing Factors

- Associated with:
  1. Advancing age
  2. Duration of diabetic symptoms
  3. Levels of glycaemic control
  4. HbA1C index (LJM & DC)
  5. Presence of neuropathies
  6. Type I > II
  7. Decreased physical activity (Type II)

(Larkin et al., Diabetes Care, 2014; Rajendran et al., 2011; Ramchurn et al., 2009)

Epidemiology

MSK Disorder	Gender	Prevalence With Diabetes	Prevalence w/out Diabetes
Limited Joint Mobility (LJM)	F>M	8-58%	0-25%
Dupuytren's Contracture (DC)	F=M	16-42%	3-13%
Carpal Tunnel Syndrome (CTS)	F>M	12-30%	1-8%
Flexor Tenosynovitis/Trigger Finger (TF)	F>M	11-28%	1-2%

Common Multiple Disorders	Prevalence
LJM & TF	33%
CTS & TF	30%
DC & TF	13%
CTS & ADH Capsulitis	17%

(Chammas et al., 1995; Cagliero et al., 2002; Smith et al., 2002; Papanas & Maltezos, 2010; Redmond et al., 2012)

Pathogenesis

- Natural history not well-understood & multifactorial

- Advanced collagen glycosylation levels
- Hypoxia micro-angiopathy
- ↓ collagen degradation
- ↑Fibroblast & Myofibroblast
- ↑ Growth factors
- ↑ ratio of Type I collagen

→ **↑ connective tissue**
- Cross-linking
- Proliferation & Thickening

(Chammas et al, 1995; Papanas & Maltezos, 2010; Rajendran et al., 2011)

Diabetic Cheiro-arthropathy

- **Diabetic stiff hand**
  - Painless limited joint mobility – MCP & IPs
  - Flexion contractures
  - ↓ Composite flexion for grasping
  - Thicker & tighter skin dorsal hand
  - Frequently **IV-Vth rays**
- **Histological studies**
  - Thickening of peri-articular tissues
  - ↑ collagen glycosylation levels

(Papanas & Maltezos, 2010; Smith LL. et al., 2002; Buckingham BA, 1984)

Limited Joint Motion Classification

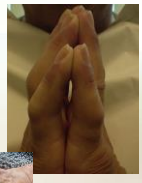
- LJM recognized as a diabetic complication since 80's
- Slow progression over-time through 3 stages

Stages	Level of limitation
Stage 1	**Mild limitation:** 1-2 joints IPs or MPs, Uni or Bil
Stage 2	**Moderate limitation**: ≥ 3 joints IPs or MCPs Uni or Bil
Stage 3	**Severe limitation**: Obvious hand deformity with multiple fingers

(Rosenbloom AL, 1989)

Diabetic Cheiro-arthropathy

- **Clinical Exam**
  - Visual observation for flexion contracture deformity
    - Passive extension restriction
  - **"Prayer sign":** Inability of palms to come together
  - **"Table-top sign":** Inability to get palm flat on table
- **DDX: Joint contracture vs. Dupuytren's**



Diabetes & OA

- **DDX: Stiffness vs. OA**
- **Type II Diabetes** associated with ↑ Hand OA radiologic findings
- Regardless of age, gender, and BMI


Journal of Diabetes and Its Complications

Type 2 diabetes and osteoarthritis: a systematic review and meta-analysis

Dupuytren's Contracture

- **Genetic:** Males - N. European & Scandinavian descent
- **Clinical presentation:**
  - Unilateral palmar fascia fibrosis & contracture
  - Nodule & cord
  - Tethering of skin & fascia over MCPs
  - Progressive digital flexion-contractures
  - Greatest at Vth
  - Require medical intervention
  - Increased success with collagenase enzymatic injection (Ziaflex)

(Al-Homood IA, 2013; Papanas & Maltezos, 2010)

Diabetic Dupuytren's Contracture

- **Atypical presentation:**
  - Frequently bilateral
  - Mostly at III & IV
  - Gender – No sig diff
  - Milder contractures
  - Respond to conservative mngt
  - Lower function deficits
- **Prevalence associated:**
  - Disease duration
  - Peripheral neuropathy
  - Aging

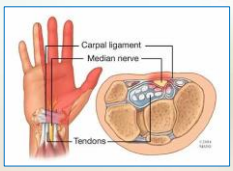
(Rajendran et al., 2011; Al-Matubsi et al., 2011)

Dupuytren's Contracture

- **Diagnosis:** Clinical exam
- **Management:**
  - **Early detection**
  - **Optimizing glycaemic control**
  - **Independent home program:**
    - Joint PROM/AROM
    - Tendon gliding
    - Night splinting:
      - Low-load prolong stretch

Diabetic Carpal Tunnel Syndrome

- **Etiology:**
  1. Compression of Median N. **(14%)**
     - Thickening transverse carpal ligament
  2. Diabetic neuropathy **(30%)**
  3. Both
- **Presentation:**
  - Sensory & motor changes
  - Median N. distribution
  - Paresthesia & pain – "Flick sign"
  - Worse at night



(Al-Homood IA, 2013)

CTS Diagnosis

- Clinical presentation
- Provocative testing:

Test	Specificity	Sensitivity
Phalen's Test	73%	68%
Tinel's Sign	77%	50%
Carpal Compression test	83%	64%

- *NCV/EMG studies
- *Diagnostic injection
- *Help to Dx & differentiate: compression vs. diabetic neuropathy

MacDermid JC, J Hand Ther, 2004

CTS Treatment – Equivocal Evidence

- Same as non-diabetic population
  - Analgesics
  - Therapy & night splints
  - Ergonomic & activity changes

  Mild Cases
  - *Local steroid injection
  - *Surgical decompression

  Mod - Severe Cases
- *Decreased efficacy if diabetic neuropathy

Shi Q & MacDermid JC, 2011; Piazzini DB et al., Clin Rehabil, 2007; Assmus et al., 2007; Michlovitz SL. Phys Thera, 2004

Flexor Tendons Tenosynovitis

- **Most common hand-type: Trigger-Finger**
  - Fibrous tissue proliferation – thickening tendon sheath
  - **A1 Pulley**
  - Tendon inflammation and swelling
  - Limited FDS/FDP tendon gliding
  - Prevalence ↑ with diabetes duration
  - Multi fingers frequent in diabetes
    - **Thumb, III and IVth mostly**

(Papanas & Maltezos, 2010; Rajendran SR et al., 2011)

Flexor Tenosynovitis Progression Classification

Stages	Symptoms
1	Normal function
2	Painful palpable nodule
3	Triggering
4	PIP locking – unlock PIP actively
5	PIP locking – Unlock PIP passively only
6	Fixed PIP in flexion – unable to unlock

(Patel MR, JHS, 1992)

Trigger Finger Diagnosis

Clinical Examination

- Local tenderness & swelling
- Palpable nodule over MCP joint
- Tendon catching or locking

Clinical case (Stage 4):

75 yo retired female with h/o 25 years DM Type II

(Ryzewicz & Moriatis, 2006)

TF Conservative Management

➢ **Optimizing glycaemic control**

- Same as non-diabetics:
  - **Activity modification:** avoid aggressive gripping
  - **Exercises:**
    - Tendon gliding
    - Long flexors flexibility
  - **Hand-based Blocking orthosis**

(Lunsford D. et al., 2017)

Efficacy of Blocking Orthosis for TF

- Block PIP - **Single digit**
- Block MCP - **Multi fingers**
- 46 patients – 11% Diabetics
- 6 wks Tx
- Success rate 87%
- 1 year f/u
- Only 4% surgery

(Valdes K, JHT, 2012)

TF Medical Management

- **Controversial when conservative tx fails**
  - Identify the most cost-effective treatment
- **Local injection**
  - 70% success – 8 years f/u – Non diabetics
  - Lower efficacy in diabetics
  - > 35% failure rates
- **Immediate surgical release A1 pulley**
  - Considered most cost-effective tx for diabetics

(Castellanos et al., 2015; Luther et al., 2016; Kuczmarski et al., 2018)

Can't Overlook Diabetic Hand Neuropathy

- Overall prevalence of hand neuropathy: 82-92%
  - **Decreased sensibility & Function**
- **50-70% Poly-neuropathy** (Median & Ulnar)
  - Especially with **Type II**
- **20-42% Mono-neuropathy** (Median or Ulnar)
  - **~ 75% Median**
  - ~ 25% Ulnar

(Bertora et al., 1998; Rota et al, 2005; Tesfaye et al., 2010; Yang et al., 2017)

Decreased Sensibility

- Decreased light-touch perception
  - Protective sensation preserved
- Dominant hand
- **Median N.** > Ulnar & Radial N.
- **Associated with:**
  - Age & disease duration
  - Decreased function (DASH, MHQ)
  - Poor physical health quality (SF-36)
  - Decreased dexterity (9-hole peg board)

(Redmond et al, 2012; Yang CJ et al., 2015)

Decreased Dexterity

- Diabetes leads to sig. decline of hand dexterity scores
  - **9-Hole Peg Test**
    - Reliability (.82-.91)
    - Criterion Validity (.73-.90)
- Associated with peripheral neuropathy
- Deficit greater with poly-neuropathy

(Yang CJ. et al., 2017; Carvalho de Almeida Lima et al., 2017)

Degreased Grip & Pinch Strength

- Most recent Evidence:
  - Decreased grip & pinch associated with Sig. functional disability
  - Primarily with Type II DM
  - Regardless age & gender
- **Attributed to:**
  - Poly-neuropathy
  - **Sarcopenia**

(Savas et al., 2007; Fernanda De Carvalho e Silva, 2014; Shah et al., 2015; Gundmi et al., 2018)

Sarcopenia in Diabetes

- **Sarcopenia** is natural age-related muscle mass progressive loss
  - Onset at the age of 30
- **Type-2** diabetes: **3x sarcopenia levels**
- Underlying mechanism unclear:
  - ↓ muscle glucose regulation
  - ↑ Hyperglycemia (HbA1C)
  - **Increased muscle protein degradation**
  - Lower muscle strength

(Umegaki H, 2015; Kalyani et al., 2015)

Monitor Functional Disability

- No specific hand-outcome tool for "Diabetic Hand"
- Measured with UE validated outcome measures:
  - **Disability Arm Shoulder Hand (DASH)**
  - **Michigan Hand-Outcome Questionnaire (MHQ)**
  - **SF-36: Quality of life and level of physical health**
- **Sig Hand disability & lower quality of life**
  - **Poly-neuropathy > Mono-neuropathy**
  - Combined with hand deformities

(Ovayolu et al., 2008; Yang CJ. et al., 2015; Yang CJ. et al., 2017)

Gradual Development of Disability

- May require > 2-year observation to capture sig change
- Attributed:
  - Adaptation to gradual development of impairments
  - Impairments easily ignored or neglected


Journal of Diabetes and Its Complications

Deteriorating tactile sensation in patients with hand syndromes associated with diabetes: A two-year observational study

(Redmond et al., 2012)

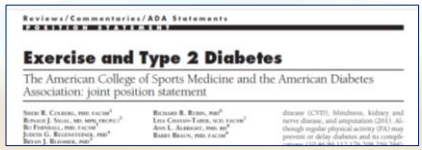
Hand Deformity Optimal Management

- Early detection
  - Frequent visual screening
- Optimized glycaemic control
  - Monitoring HbA1C levels
- Promotion physical activity & exercise

(Boule et al., 2011; Ramchurn et al., 2009; Thomas et al., 2007)

Exercise Effect

- PA & weight loss can lower risk for Type II diabetes
- Resistance & aerobic exercise can sig. improve diabetic management


Reviews/Commentaries/ADA Statements

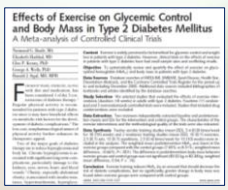
Exercise and Type 2 Diabetes

The American College of Sports Medicine and the American Diabetes Association: joint position statement

Colberg et al., Diabetes Care, 2010

Positive Exercise Effect

- SR & Meta analysis
- Exercise Training with type-2 Diabetes
  - Aerobic & resistive training
  - Improved glycaemic control
  - Decreased HbA1C levels
  - **Decreased risk of diabetic complications**

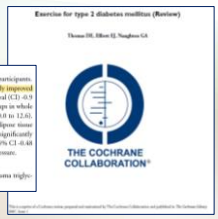

Effects of Exercise on Glycemic Control and Body Mass in Type 2 Diabetes Mellitus

A Meta-analysis of Controlled Clinical Trials

(Boule NG. et al., JAMA, 2001)

Exercise Effect on Type II

- Cochrane Systematic Review 2007
  - Aerobic & progressive resistance exercises
  - 3x week


Exercise for type 2 diabetes mellitus (Review)

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Clinical Implications

- **Clinicians should take pro-active roles:**
  - Screen for hand complications
  - Early recognition of hand deformity & neuropathy
  - Educate for optimal glycaemic control
  - Recognize & promote effects of exercise
  - Monitor long-term function
    - Hand-grip strength – strong predictor of function

Thanks for your Attention