



# Therapeutic Exercise: An Evidenced Based Approach

---

Dr. Thomas Eberle PT, KTCC, FAAOMPT

Dr. Eric Douglass PT, KTCC, OCS FAAOMPT

Dr. Matt Waggoner PT, KTCC, FAAOMPT

# History of Physical Therapy



- Nursing Profession Sub-specialty U.S. (1920s)





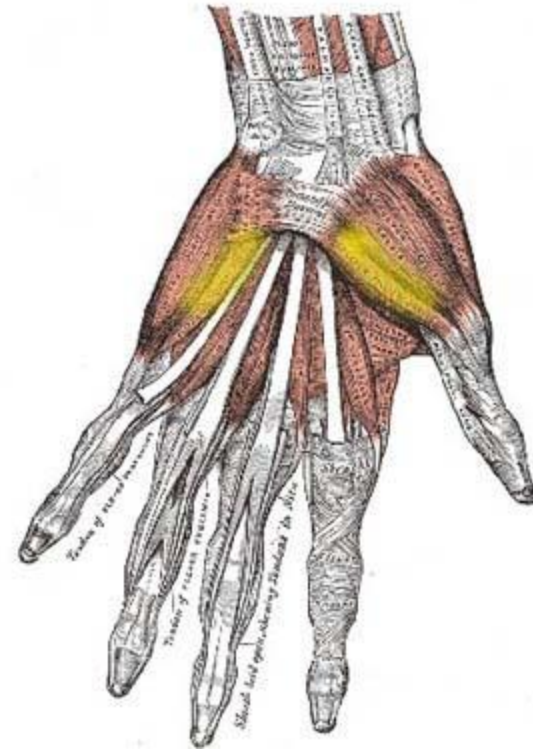
# History of Physical Therapy

---

- Physical Therapy as its own Profession (1940s)
- Prerequisite:
  - Nursing
  - Physical Education

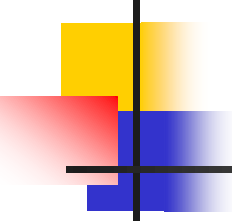
# Physical Therapy Evaluation

- James Cyriax M.D.  
(1904-1985)



- Tissue Specific

# Examination: Flow of Procedures

- 
- 1. Initial Observation
  - 2. History
  - 3. Structural
    - Quick tests
    - Screenings
    - 3 Positions
    - (Neuro/Precautionary?)
  - 4. AROM
  - 5. PROM
  - 6. Resisted ROM
    - 3 Positions
  - 7. Palpation
    - 5 steps
  - 8. Neurology
    - Myo/Derm
    - Reflexes
  - 9. Special Tests
  - 10. Mobility/  
Segmental Testing
  - 11. Diagnostic Testing
  - 12. Correlation/  
Prognosis

# Orthopedic Assessment

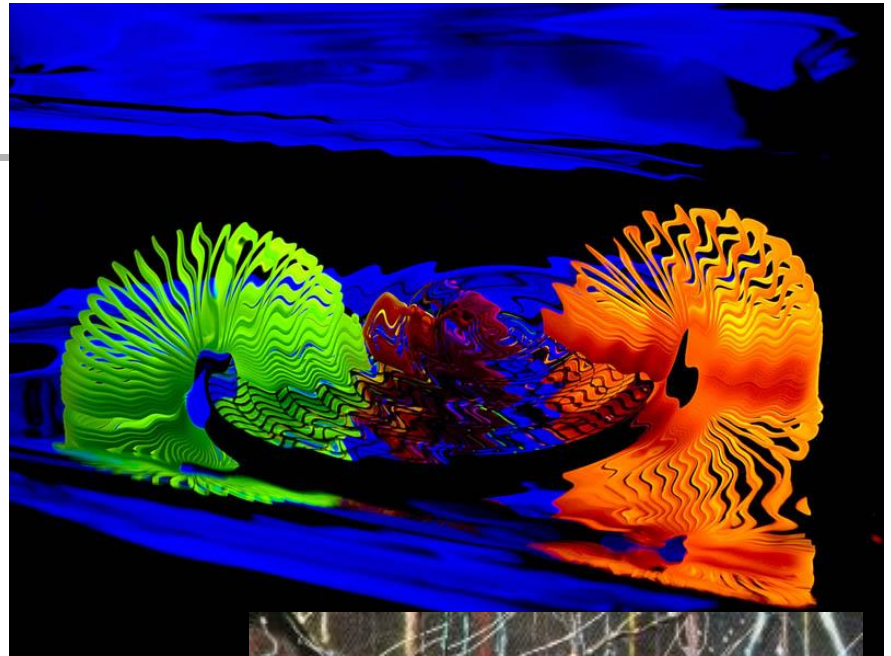
(Guide to Physical Therapy Practice 2001)

- ▶ History
  - Demographics
  - MOI/MIV
- Symptoms:
  - Location
  - Type  
(Pain/Numb/Tingling/  
weakness)
  - Quality  
(Burning/Dull/etc)
  - Better/Worse
  - Review of Systems
    - Red Flags
    - Yellow Flags
    - Blue Flags
  - PMH/Meds
  - Family Medical Hx
  - Hobbies/ADLs

**MAKE A TISSUE PATHOLOGY  
HYPOTHESIS!**

# Examination: Basic Theory

- Continually ask yourself:
  - What is being Stretched?
  - What is being Compressed?
  - Which Muscles Contribute to this Motion?
  - What is the Segmental Innervation?



# Screening of Extremities

- Shoulder



- Elbow



- Hand

- Quick Tests

- Apleys
- Combined AROM
- Resistive ROM
- Indicated Special Tests



# Screening of Extremities



- Ankle



- Closed Chain Testing
  - Heel/Toe Walking
  - Squatting

- Knee



- Hip

# Screening of the Cervical Spine

## AROM

- Rotation and SB/Extension
- With over pressure (if necessary)



- Precautionary Testing
  - Applicable with trauma and neuro Signs/Sx

# Screening of Lumbar Spine

- Disc/Ligament/Facet?

- Sx location
- Time of Day
- Positional



- Posterior Buttock
  - Lumbar
  - HIP
  - Sacraliliac

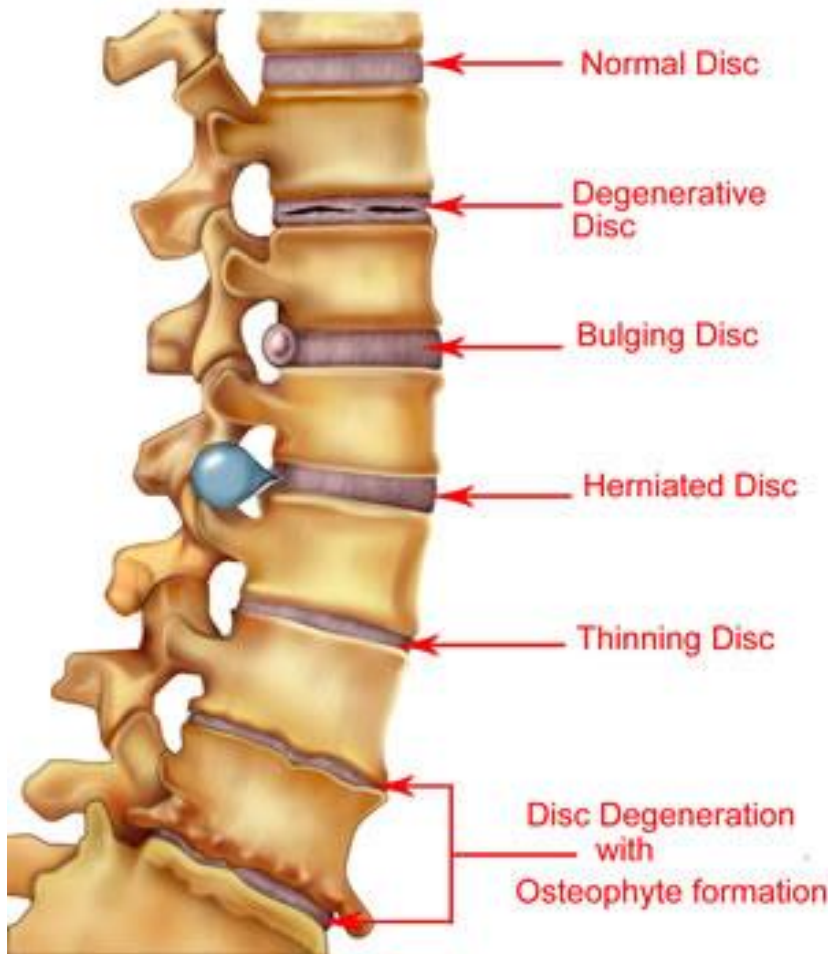
# Screening of the Thoracic Spine

- Thoracic
  - Assess with ANY C/S or L/S Pathology



# Spinal Influence on the Extremities

## SPINE CONDITIONS



- Cervical Spine
- Thoracic Spine
- Lumbar Spine
- Referred pain is pain perceived in a region separate from the location of the primary source of the pain (Bogduk 1982).
- Is it the Disc?
- HNP or DDD?



# HISTOLOGY OF COMMON TISSUES IN LESION

---

- Type 1 Collagen
  - Test and treat with tensile forces
- Type 2 Collagen
  - Test and treat with compression forces



# Type 1 Collagen

---

- Found in Muscle Tendons, Ligaments and the Annulus of the Intervertebral Disc
- Optimal Stimulus For Regeneration: Modified **Tension** in the Line of Stress



# Type 2 Collagen

---

- Found in Articular Cartilage, Nucleus of the Intervertebral Disc
- Optimal Stimulus For Regeneration:  
**Compression and Decompression with Glide**





# Bone

---

- Type 1 and Type 2 Collagen with Mineralization
- Optimal Stimulus for Regeneration: Compression and Decompression

# Hypomobility vs. Hypermobility



- Implications for treatment



## Type IV Mechanoreceptors: Pain Receptors

---

### ■ C Fibers

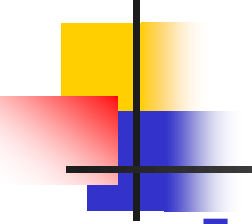
- Unmyelinated, slow speed of conduction
- Heat travels along this path
- Non adaptive- pain may continue after stimulus removed

### ■ A Fibers

- Myelinated, fast conducting
- Cold travels along this path

### ■ Location

- Blood vessels, bone, type I collagen
- Not found in muscles



# Clinical Neurology: Mechanoreceptors

---

- Type I

- Firing: Beginning and end range
- Location: Fascia and Superficial Joint capsule
- Recruit/Inhibit Type I Muscle Fibers
- Decrease Pain
- Slow adapting, activate with HOLD/STRETCH

- Type II

- Firing: Beginning and mid range
- Location: Fascia and joint capsule
- Recruit/Inhibit Type II muscle fibers
- Decrease pain/Inc ROM
- Fast adapting, activate with mid range oscillation

(C) FIOMPT 2013



# Clinical Neurology: Mechanoreceptors

---

- Type III

- Firing: QUICK STRETCH in mid/end range (Thrust Manipulation)
- Location: Fascia and joint capsule
- SLOW adapting
- **Huge inhibitory affect over multiple spinal cord levels**
- Decrease pain/Inc ROM
- Recruit OR inhibit mm.
- Sympathetic Effects

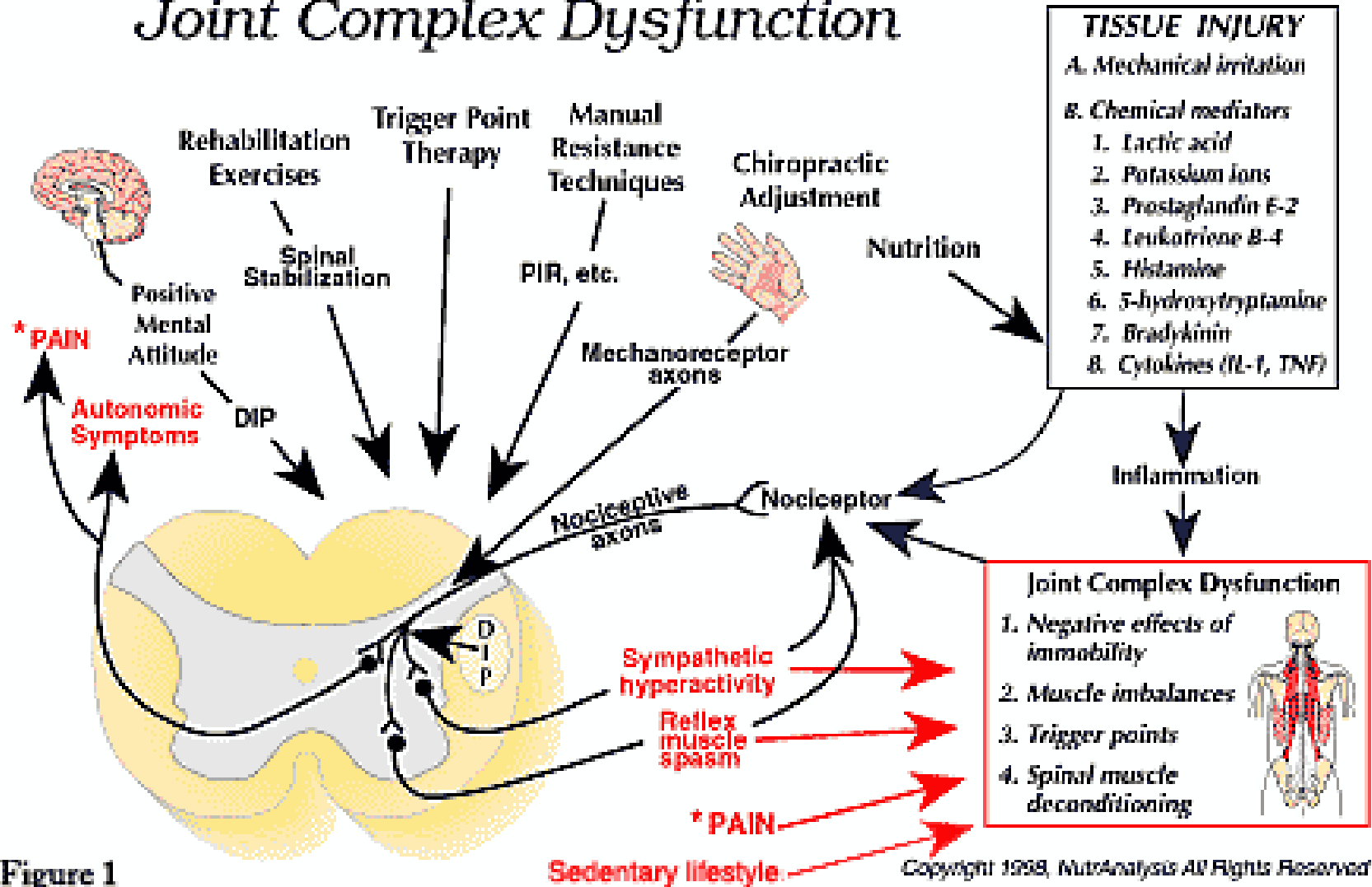
**Table 1** Mechanoreceptors in fascia

Receptor type	Preferred location	Responsive to	Known results of stimulation
<b>Golgi</b> Type Ib	<ul style="list-style-type: none"> <li>● Myotendinous junctions</li> <li>● Attachment areas of aponeuroses</li> <li>● Ligaments of peripheral joints</li> <li>● Joint capsules</li> </ul>	<ul style="list-style-type: none"> <li>● <i>Golgi tendon organ</i>: to muscular contraction.</li> <li>● <i>Other Golgi receptors</i>: probably to <b>strong stretch</b> only</li> </ul>	<b>Tonus decrease</b> in related striated motor fibers
<b>Pacini and Paciniform</b> Type II	<ul style="list-style-type: none"> <li>● Myotendinous junctions</li> <li>● deep capsular layers</li> <li>● spinal ligaments</li> <li>● <b>investing muscular tissues</b></li> </ul>	<b>Rapid pressure changes</b> and vibrations	Used as proprioceptive feedback for movement control (sense of <b>kinesthesia</b> )
<b>Ruffini</b> Type II	<ul style="list-style-type: none"> <li>● Ligaments of peripheral joints,</li> <li>● Dura mater</li> <li>● outer capsular layers</li> <li>● and other tissues associated with <b>regular stretching</b>.</li> </ul>	<ul style="list-style-type: none"> <li>● Like Pacini, yet also to <b>sustained pressure</b>.</li> <li>● <b>Specially responsive to tangential forces (lateral stretch)</b></li> </ul>	<b>Inhibition of sympathetic activity</b>
<b>Interstitial</b> Type III and IV	<ul style="list-style-type: none"> <li>● <b>Most abundant receptor type.</b> Found almost everywhere, even inside bones</li> <li>● Highest density in periosteum.</li> </ul>	<ul style="list-style-type: none"> <li>● Rapid as well as sustained pressure changes.</li> <li>● 50% are <b>high-threshold</b> units, and 50% are <b>low-threshold</b> units</li> </ul>	<ul style="list-style-type: none"> <li>● <b>Changes in vasodilation</b></li> <li>● plus apparently in <b>plasma extra-vasation</b></li> </ul>

**Schleip 2002**

# Clinical Neurology

## Joint Complex Dysfunction



# Clinical Neurology (cont)

## ■ Tissue Injury

- Type IV Mechano receptors
- Input into Dorsal Horn of corresponding Spinal Cord level

## ■ Inflammatory Cascade

- in the tissue: perpetuates pain via thermal, mechanical, ph

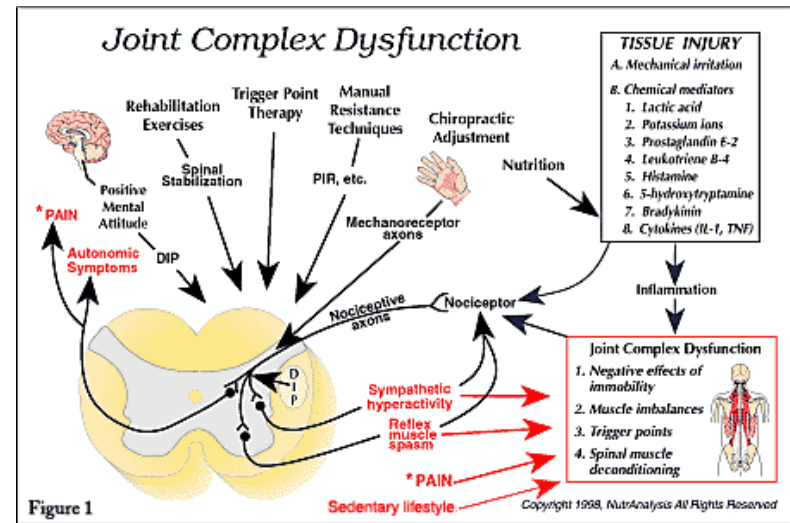
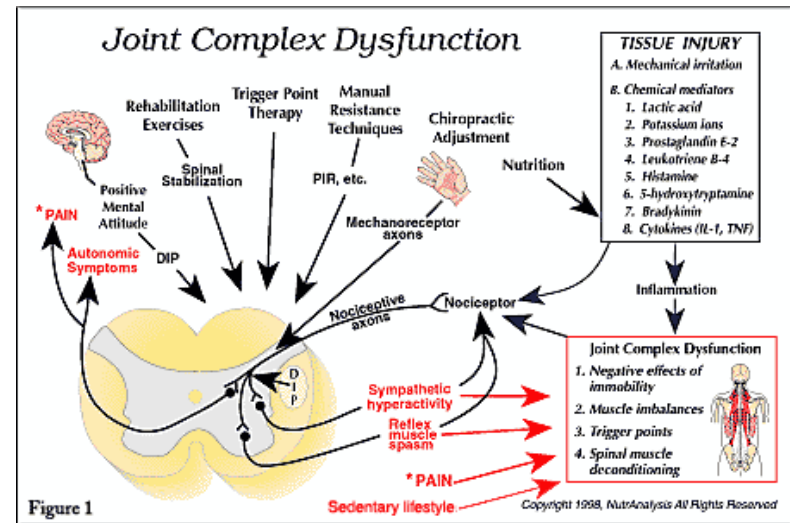


Figure 1



# Clinical Neurology (cont)

- Dorsal Horn to:
  - I. Lateral Spinal Thalamic Track (LSTT)
    - to Sensory Humunculus of Cortex
  - II. Anterior Horn Cells
    - Motor area
    - Reflexive mm. spasm
  - III. Anterior-Lateral Area
    - Sympathetic Nervous System
      - Visceral/ Vascular/
      - Efferent System Only





# The Manual Therapy Lesion

(Grimsby/Wyke)

---

- Receptor Damage
- Decrease Tonic Mm recruitment
- Tonic mm atrophy
- Weakness
- Movement around a non-physiological axis
- Joint Compression/abnormal loading
- Tissue damage (Cartilage/Capsule-Ligament)
- Pain
- Reflexogenic Mm guarding

(C) FIOMPT 2013

# Manual Orthopedic PT

- Osteopathic Physicians- England (1950s)
- Kaltenbourn
  - Thrust Manipulation
  - Non Thrust Manipulation/  
Mobilisation
- Norwegian Training





# Manual OMPT US

---

- Original OMPT Programs (1980s)
  - St. Augustine/Paris
  - Maitland
  - Grimsby
  
- Formation of AAOMPT
  - 1991
  
- FIOMPT (2012)



# Manual Therapy Treatment Paradigm

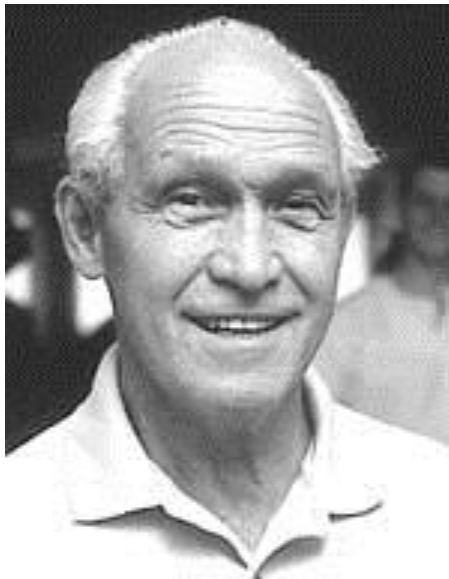
---

- Manual Treatment
  - Medical Exercise Training (MET) and Scientific Therapeutic Exercise Progressions (STEP)
- Education
  - HEP
  - Positioning
  - Posture
  - Nutrition

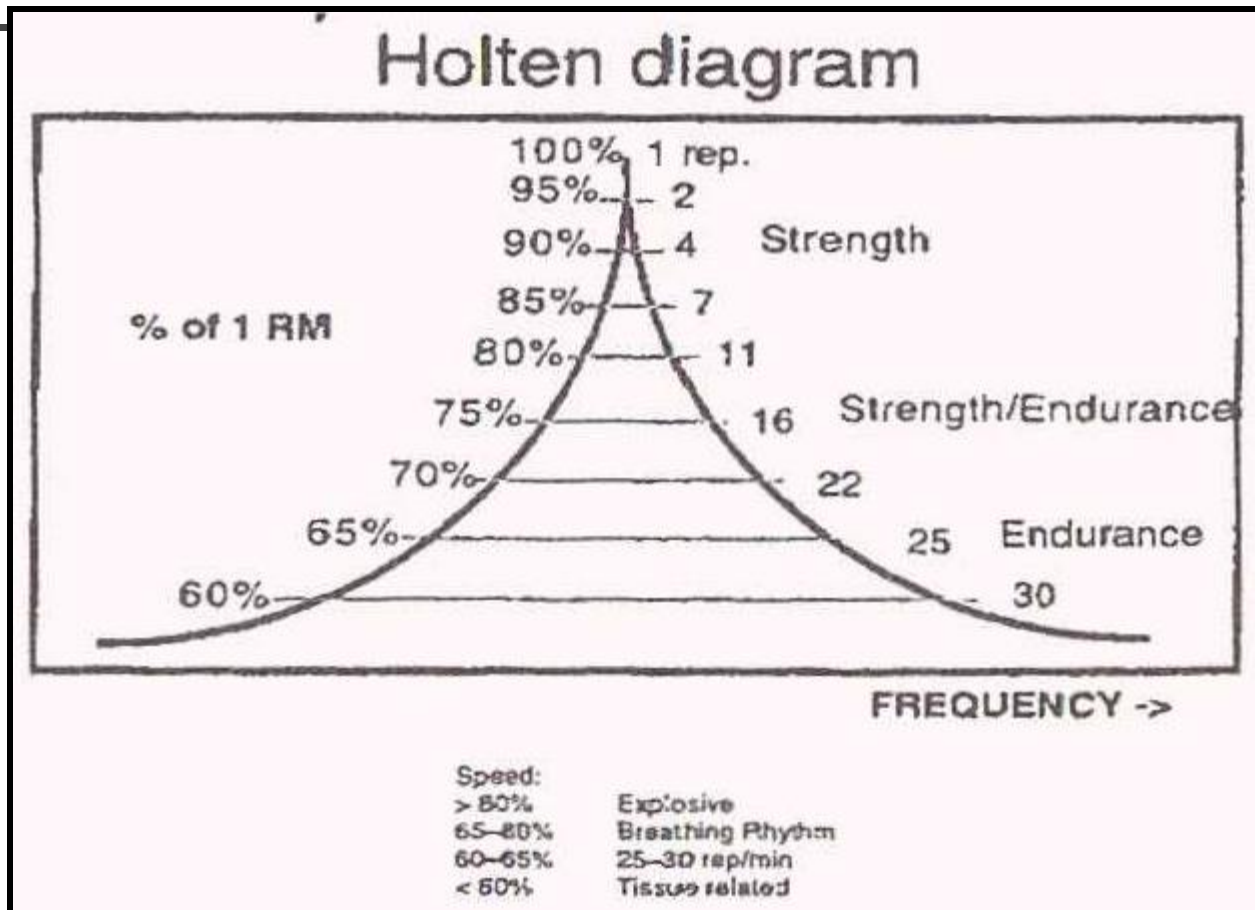
# Development of M.E.T./S.T.E.P.

- Oddvar Holten  
(1960s)
  - MET

- Ola Grimsby  
Institute (1980s-  
present)
  - STEP



# Holten's Curve/ Diagram





# Holten Curve Key Indicators

---

- Power/Strength 90% 1 RM/5 reps
- Strength 80% 1 RM/10 reps
  - Isolated Phasic Muscles
- Str/Endurance 75% 1 RM/15 reps
- Coord/Endurance 60% 1RM/30 reps
  - Isolated Tonic Muscles
  
- Vascular/Tissue Healing 50% 1RM/30+
  - WITHOUT FATIGUE





# Stages of Progression

---

- Stage I
- Stage II
- Stage III
- StageIV

# Functional Qualities



---

- The number of repetitions dictates the functional quality influenced
  - Stage I 50% of 1 RM
    - Vascularity: 30+repetitions
      - Acute patient presentation
      - Mm. spasm and swelling
      - Without fatigue or provoking more swelling
    - Tissue Healing
      - Ligaments/Tendons/Cartilage
    - Coordination/Endurance (Low Level)



# Functional Qualities

---

- Stage II-IV
- 60% 1RM
- 25-30 repetitions  
for endurance  
and co-ordination
- Tonic muscles
  - 1 set per minute



# Functional Qualities

---

- Stage II-IV
- 75% of 1 RM
- 15 repetitions for strength/endurance  
(Breathing 1 set per minute and 1/2)



# Functional Qualities

---

- Stage III
- 80% 1 RM
- 10 repetitions for strengthening



# Functional Qualities

---

- Stage IV
- 5 repetitions for power and strength
- Explosive Training



# Variables In Exercise Performance

---

1. Specific Exercise/Start position
  2. Apparatus/Equipment
  3. Resistance where in the Range
    4. Range Of Motion
5. Type Of Contraction and Duration
  6. Resistance Amount
  7. Speed Of Motion
  8. Sets and Repetitions
  9. Work : Rest Ratio
  10. Exercise Frequency

# 1. Specific Exercise/ Start Position



- Exercise choice dependant on tissue in lesion
  - Specific tissue diagnosis essential
  - Optimal Stimulus of Repair
- Stage of Injury
  - Not necessarily from subjective Date Of Injury
  - Tissue/Pt. Tolerance

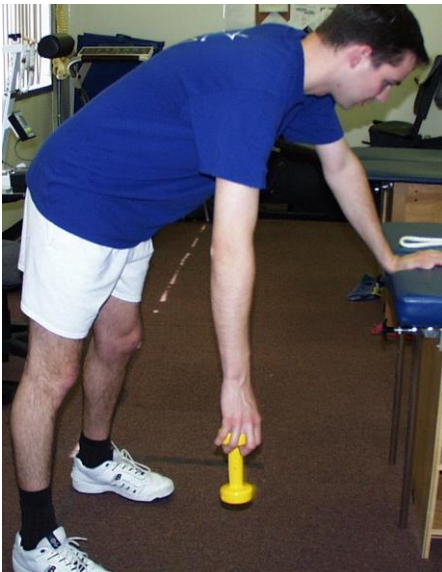


## 2. Apparatus/Equipment



# 3. Resistance in the ROM (Length Tension)

- Line of Pull 90 to Axis
- Parallel to mm. fibers (not acutely)
- Parallel to long axis of the limb (stabilisation)
- Lever arm 90 to the pull of gravity (strength)



(C) FIOMPT 2013

# Range Of Motion

- Training effects are range specific.



- Applied resistance should match the muscles ability to produce force.

# 4. Range of Motion



- I. Inner to Mid ROM
  - Vascularity
- II. Middle ROM
  - Stabilisation
  - Coordination
- III. / IV. Outer ROM
  - Self Mobilisation
  - End Range Holds
  - Plyometrics
  - Functional Patterns

# 4./5. Range of Motion (I)

## Type of Contraction

- Begin with Vascular then ex OPPOSITE the Pathological ROM (**INNER ROM**).
- May be AAROM, AROM, or Resistive
- Perform Concentrically without sx. exacerbation or more swelling



# 4./5. Range of Motion (II)

## Type of Contraction



- Follow with Vascular and then Stabilisation then ex TOWARDS the Pathological ROM (MID ROM).
- AROM against gravity or Resistive with an Apparatus.

# 4./5. Range of Motion (III)

## Type of Contraction



- Self Mobilisation  
Ther Ex TOWARDS  
Pathological ROM  
(OUTER ROM).
- Utilize Apparatus  
/Equipment to move  
Eccentrically;  
Progress with end  
range holds.

# 4./5. Range of Motion (IV)

## Type of Contraction

- Coordination or Strengthening Ther Ex TOWARDS the Pathological ROM
- Utilize Apparatus/Equipment to move concentrically (**OUTER ROM**)
- Progress with Outer ROM holds & Plyometrics





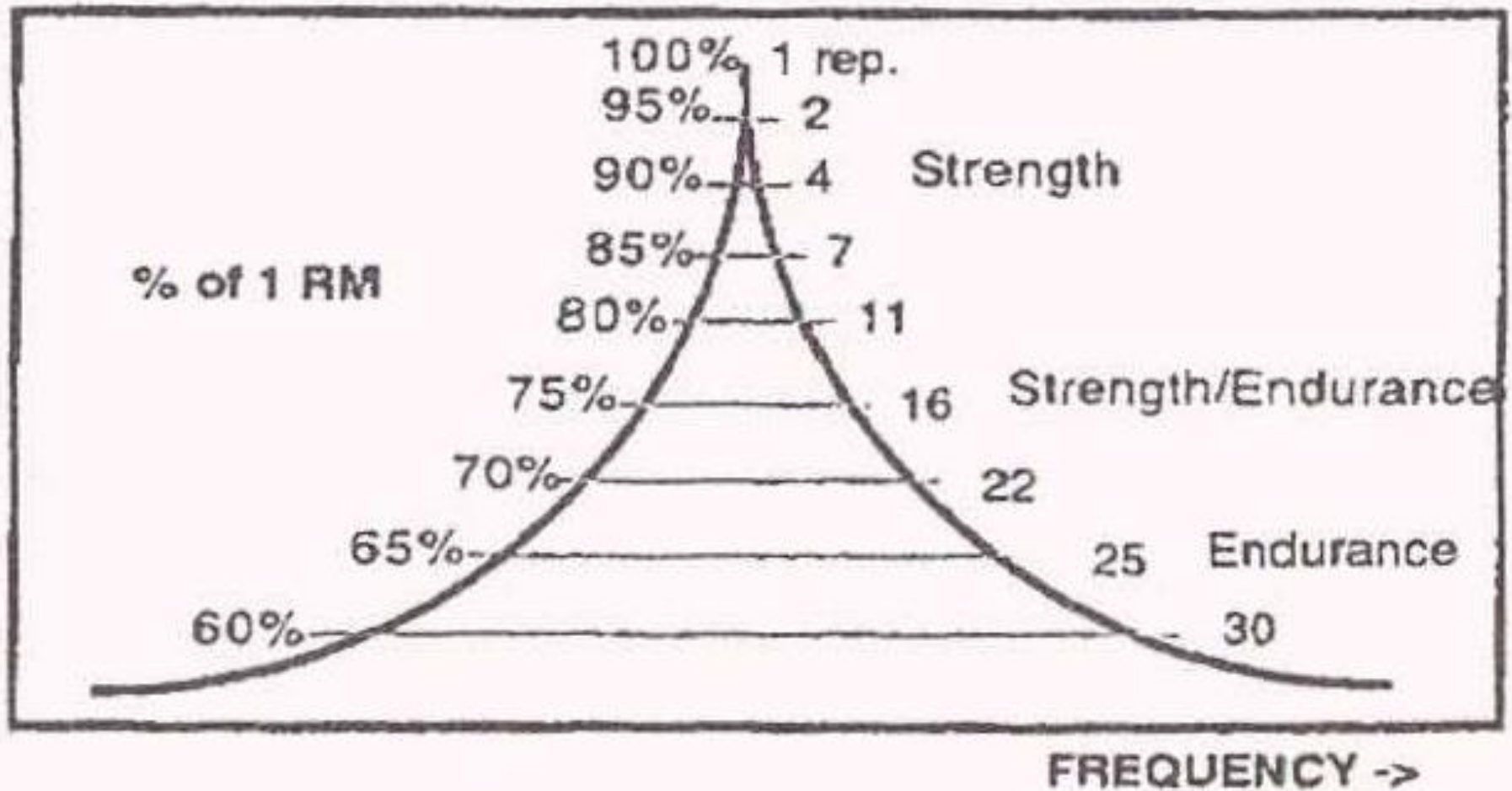


## 6. Resistance Amount

---

- Inversely related to each other.
- 1 Repetition Maximum (1RM) or 1 Maximal Voluntary Contraction (1MVC) is the maximum resistance that can be overcome once in a movement.

# Holten diagram



Speed:

> 80%

65-80%

60-65%

< 60%

Explosive

Breathing Rhythm

25-30 rep/min

(C) FIOMPT 2013

# 6./8. Resistance Amount Sets and Repetitions

The number of repetitions dictates the functional quality influenced.

- 30+ repetitions for vascularity (I)
  - Mm. spasm and swelling
  - Without fatigue or more swelling
- 25-30 repetitions for co-ordination(II-IV)
  - Tonic muscles; 1 set per minute
- 15 repetitions for strength/endurance (III-IV)
  - Breathing (1 set per minute)
- 4-12 repetitions for strengthening (IV)
  - Explosive Training



# 7. Speed of Movement

---

- Training effects are speed specific.
- Concentrically, slow speeds can produce more force.
- Eccentrically, high speeds produce more force.
- High speeds place more demands upon central nervous system processing to maintain stability.

# 8. Sets and Repetitions



- 5 x 30-45 for mobilisation
- 2-3 sets for vascular (30+), coordination (20-30), endurance (15), and strength ther ex (4-12)
- Mix 1 set of isometrics for 5-10 sec holds for strength in a specific ROM



## 9. Work: Rest Ratio

---

- $>80\%$  1RM: Explosive speed
- 60-80%: Respiratory Rate (1 set/min)
- $<60\%$ : 30 reps per minute (1 set/min)
  
- Rest period for  $>80\%$  work: 3-5 minutes per set.
- Rest period for 60% work: 30-60 seconds.



# 10. Frequency of Treatment

---

- Dictated by aim of treatment and restitution rate.
- Matwejew - 1976.
- <60% several times per day
- 60% 1RM 6-10 hours for full restitution.
- >80% takes 48-72hrs.



# Example of Exercise Progression Hypermobility (Early Phase).

---

- Target Functional Quality = Co-ordination.
- Resistance Dose = 60% 1RM or less.
- Repetitions = 25-30 reps or more.
- Range Of Motion = Middle to Inner.
- Type Of Contraction = Concentric - Eccentric.
- Speed Of Movement = Slow.
- Frequency Of Treatment = 2 or more times daily.
- Can begin with contrary motion





# Progression Of Hypermobility (Late Phase)

---

- Increase Range Of Motion to match physiological available range.
- Increase Speed.
- Add isometric holds throughout available range (1 set).
- Increase resistance to approximately 80% 1RM (if phasic).
- Increase Reactive (Perturbation) Component and Plyometrics



# Example of Exercise Progression Hypomobility (Early Phase).

---

- Target Functional Quality = Mobilisation.
- Resistance Dose = <60% 1RM or less.
- Repetitions = 30+ reps.
- Range Of Motion = Outer.
- Type Of Contraction = Concentric - Eccentric.
- Speed Of Movement = Slow.
- Frequency Of Treatment = 2 or more times daily.



# Progression Of Hypermobility (Late Phase)

---

- Increase Speed.
- Add isometric holds at end ROM (1 set).
- Increase resistance to 60% to 80% 1RM.
- Increase Reactive (Perturbation) Component and Plyometrics



# Case Studies

---