

Ergonomics:
Interface Between
Humans, Work Objects, +
Environment

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Cumulative Trauma Disorders (CTD's)

- Musculoskeletal disorders
- Repetitive use injuries to:
 - Tendons, tendon sheaths
 - Bones
 - Muscles
 - Nerves
- Dentistry: upper extremity CTD's
= most common

The Nature of Carpal Tunnel Syndrome

- **Anatomy**
 - **Narrow, unyielding carpal tunnel contains:**
 - Median nerve
 - 9 flexor tendons
 - Blood vessels
 - **Swelling, inflammation causes compression within tunnel**

Carpal Tunnel Symptoms

- Hand, wrist numbness, first noticed at night
- Thumb, forefinger, part of middle finger (NOT little finger!)
- Progresses to weakness, pain
- Prolonged condition: loss of motor control of areas innervated by median nerve: clumsiness, burning
- Forearm: tenderness, pain, swelling

CTS Symptoms

- Hand hypesthesia (loss of sensation)

Causes of Carpal Tunnel Syndrome

- **Repetitive use**
 - **Forceful finger exertion**
 - **Deviated wrist positions increase pressure in tunnel:**
 - **Flexion: two fold**
 - **Extension: four fold**
 - **Inflames tendon, synovial sheaths**
 - **Thickens, swells synovium**
 - **Causes compression neuropathy**

CTS Causes

- Wrist injury
- Arthritis
- Pregnancy
- Diabetes neuropathy
- Hypothyroidism
- Smoking
- Obesity
- Caffeine intake

CTS Work Risks

- Force
- Posture
- Wrist alignment
- Repetition
- Temperature
- Vibration

Tenosynovium Thickening

Irritation or inflammation → ischemia,
progresses to inner nerve

> Time > permanent damage

Thenar Muscle Loss

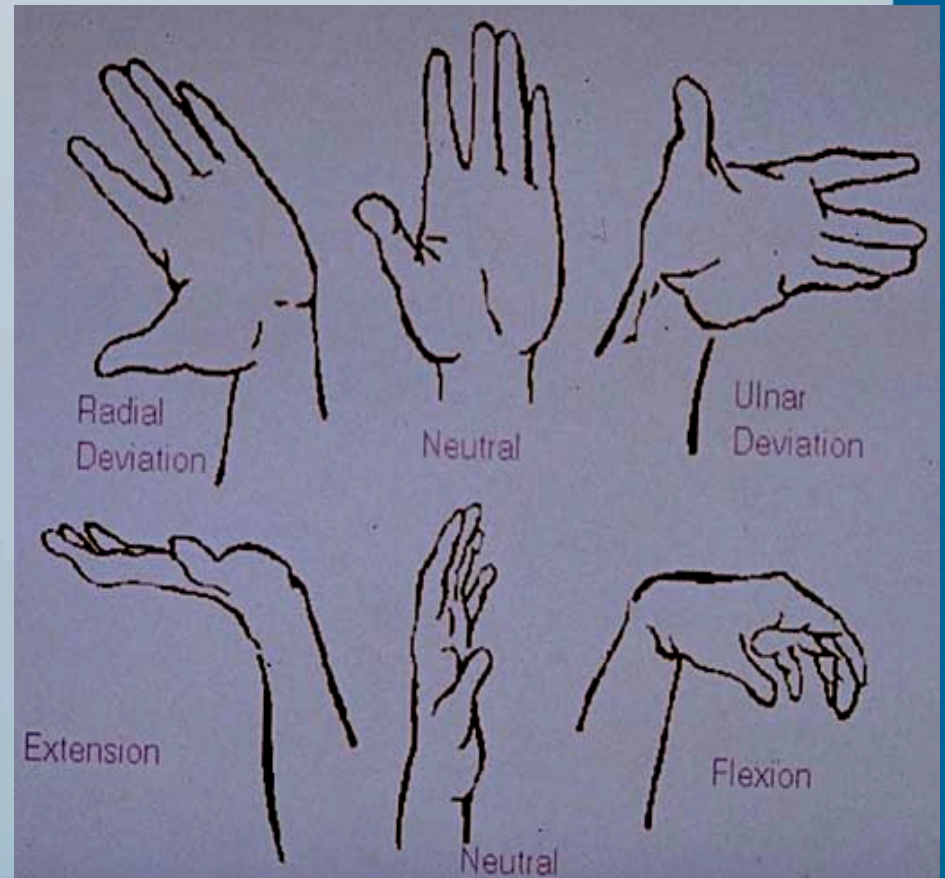
- Weakness, atrophy

CTS Treatment

- Wrist brace
- Anti-inflammatory meds
- Cortisone injection
- Work task corrections
- Surgery (open release or endoscopic release)

Wrist Postures

- **Deviated wrist positions increase pressure in Carpal tunnel:**
 - **Flexion: two fold**
 - **Extension: four fold**



TOS Symptoms

- Pain in neck, shoulder, face, head
 - Clavicle, shoulder, inside arm, hand: ring & pinky
- Numbness, weakness, tingling, clumsiness in arm / hands
- Symptoms worsen with use, arms lifted
- Vascular symptoms = serious!
 - Arm, shoulder = heavy, cold, blue, swollen

TOS

- Confused with other disorders
 - CTS (hand), cervical spine dis. (neck), nerve root compression (spine), tumors, bursitis (shoulder)
- Difficult to diagnose
- Pain:

TOS Risks

- Trauma to shoulder, neck
- Postural distortions
- Congenital anomalies (extra rib, band syndrome)
- Prolonged, static positioning, force

Enhanced Visualization What's important?



Magnification

- No industry standard in measuring
- Manufacturing tolerances vary
- Magnifying power varies with working distance
- Optical prescriptions affect magnification
- Trade-off: with $>$ magnification -
 - need more light
 - More weight
 - Less depth of field

Depth of Field

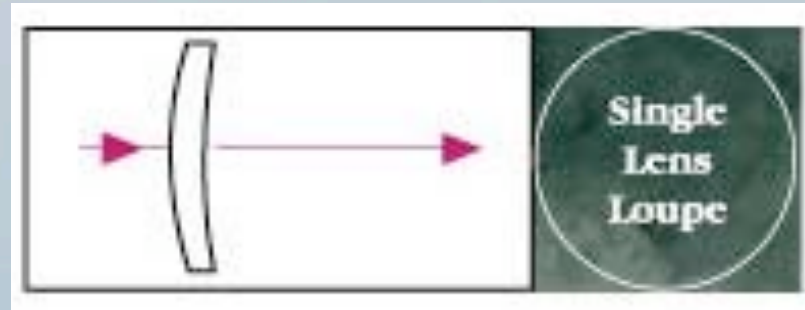
- > Range of focus allows movement, less neck, back, eye strain
- Depends on:
 - Light
 - Optical design, quality
 - Magnifying power
 - Accomodation (unique to user)

Loupes: Consider

- Weight
 - Absolute weight
 - Nose bridge fit
 - Lens barrel location (flip-ups distribute weight forward, feel heavier, also less depth, width, light)
- Angle of declination (loupes must be fit to reduce eye strain)
- Magnifying power: 2.5 - 4.8

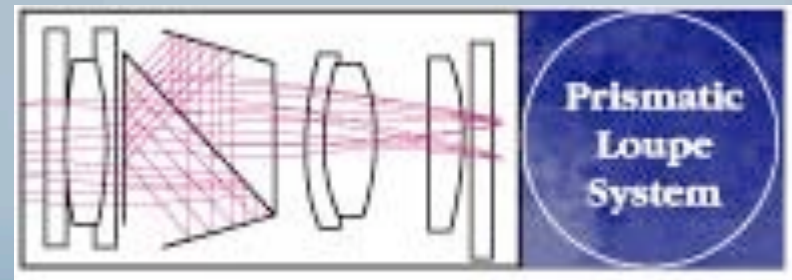
Lens Complexity

“Flat plane” loupes.
Refractive power is
measured in diopters.



Compound loupes (more
than one lens) in the 2x or
3x range.

Compound loupes with a
prism lens in the 3x or 4x
range.



Chairs

- Variety of adjustments
- Height, tilt, arms, back up & down, in & out
- Models for short, tall workers



Ergonomic Recommendations

- **Use neutral hand positions**
 - **Avoid bent hand - wrist positions**
- **Minimize need for intense gripping, pinching**
 - **Use mechanical scaling devices**
 - **Use sharp instruments**
- **Use non - restricting gloves**
- **Avoid prolonged, static working position: (move, stand, sit)**

Ergonomic Recommendations

- **Use relaxed grasp**
- **Use larger handled instruments**
- **Use balanced instruments**
 - **Manage cords**
- **Adjust dental chair + patient as needed**

Ergonomic Recommendations

- **Sit close to patient's head**
- **Sit in adjustable chair:**
 - **Seat: up, down**
 - **Back: in, out, up, down**
 - **Foot rest**
 - **Arm rest: movable**
- **Sit with thighs horizontal, both feet flat**

Ergonomic Recommendations (Hygienists)

- Adjust all equipment to minimize hand forces, awkward positions
- Manage lighting, vision
- Limit work - load *if hand scaling*:
 - 2 days / week: \leq 10 patients
 - 3 days / week: \leq 9 patients
 - 4 days / week: \leq 8 patients
- Spread out heavy calculus patients

Ergonomic Recommendations

- **Take rest breaks**
- **Avoid fatigue:**
 - **Injury is more common when fatigued**
 - **Poor habits develop**
- **Use non - dominant hand when possible**
- **Do hand, arm, neck, back stretching exercises often**

Ergonomic Recommendations

- **Avoid non - work repetitive, stressful hand / wrist activities**
 - Sports, hobbies, chores
- **Seek medical help for predisposing health conditions**
- **Reduce stress, eat properly**

Resources

- eOrthopod.com
- http://www.nismat.org/ptcor/thoracic_outlet/