

Note: Usually when the TMJ Disc is dislocated, cartilage is covering the condylar bone. By the time the cartilage wears, exposing the bone, the retrodiscal tissue no longer has a blood supply. The tissue has adapted into fibrous tissue. Bone rarely contacts inflamed tissue.

**All Clicking joints are damaged**

Not so dangerous Clicks:

- Unchanging click for 2 or more years
- Consistent, easy reduction of Disc
- Good range of motion with clicking
- Stable occlusion with clicking

Clicks that need further Evaluation- Order Scans

- Clicking that has stopped 2 yrs or less
- Clicking has changed in the last 2 years
- Wiggling jaw to open. Locking.
- Chronic Painful click
- Unstable Occlusion

**Questions to ask Patients with clicks**

- Has the clicking changed in the past year?
- Any pain with the clicking?
- Any difficulty opening your mouth?
- Any problems chewing food?

**Limited Opening Needs Immediate Treatment**

- Rule out masseteric space infection- Check molar area
- Rule out muscle spasm- Anterior deprogrammer, TENS
- Rule out TMJ pain avoidance- Auriculotemporal nerve block
- Tx mechanical joint obstruction- Arthrocentesis
- Post-op anterior repositioning orthotic

**Two very important Question in diagnosing Pain around the TMJ:**

Does the joint damage have anything to do with the discomfort or dysfunction that the patient is feeling?

It appears to be \_\_\_\_\_, but what else could it be?

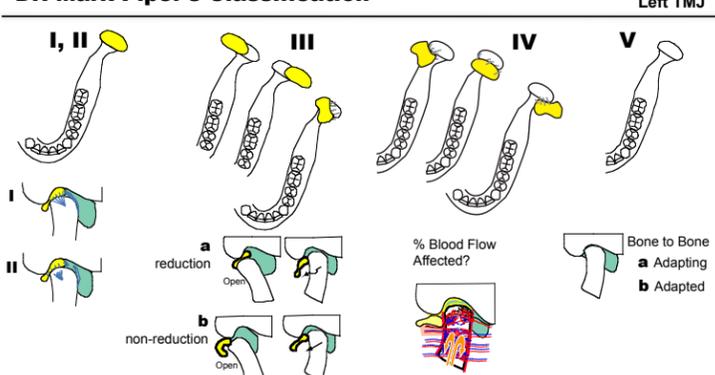
**Specific Diagnosis of Damaged TMJs**

- Ligaments- Stretched, Partial Tear, Complete tear
- Disc- Piper 1,2,3a,3b,4a,4b,5a,5b, Size, Location
- Cartilage Wear, Necrosis, Tear
- Synovium Inflamed- Synovitis, Hyperplasia, Fibrotic, Adhesed
- Bone Osteolytic, Hypertrophy, Ossification, OsteoNecrosis
- Remodel/ Adaptation, HyperCalcification
- Marrow Inflamed, Necrotic

**MRI Scan Information**

- T1 shows more fat than water- TE 15, TR 400
- T2 shows more water than fat- TE 110, TR 3500
- PD (Proton Density) is between a T1 and T2 and shows the disc- TE 15, TR 2500
- STIR (Short T1 Inversion Recovery) is more sensitive for water- TE 15, TR 4000

**Dr. Mark Piper's Classification**



- 1 Normal Healthy Disc, Ligament and Cartilage
- 2 Normal Disc Position but damage: Ligaments damage, Cartilage Fibrillation, Disc Distortion Perforation of Disc, Disc unstable from contralateral TMJ
- 3ae Early Partial disc subluxation, with reduction
- 3a Partial disc subluxation, with reduction
- 3b Partial disc subluxation, non-reducing
- 4ae Early Complete disc dislocation, with reduction
- 4a Complete disc dislocation, with reduction
- 4adh Adhesed disc to eminence
- 4b Complete disc dislocation, non-reducing- Risk AVN 1st year
- 4b/a Complete disc dislocation, non-reducing in function
- 5a No Disc, Bone to bone- Adapting- OA Active
- 5b No Disc, Bone to bone- Adapted- OA adapted

**CT Scan- Normal**

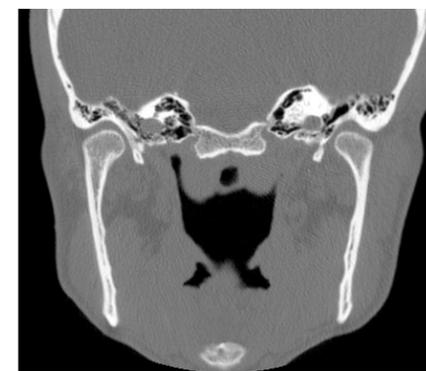
- Cortex intact- No cysts, no hypercalcification
- Trabecular bone has a good pattern
- Normal Size and shape of right and left condyle (70% condyle to fossa)
- Non congruent ovoid shape of condyle
- No flat areas
- CR Load Zone- Condyles load on superior medial condyle
- Closest bone distance superior medial surface
- Condyles are centered medial-laterally.
- The Mandible sits centered under the skull base
- Inferior border mandible Right/Left equidistant to the fossa
- Condyles centered in fossa in sagittal axial, and coronal views
- The joint space indicates adequate room for a disc
- No lesions or tumors in the TMJ and surrounding areas

**MRI- Normal**

- Disc is in a proper position on both the medial and lateral pole
- If not; Off both medial and lateral?
- Where is it? Size of disc?
- Recaptures? Does Disc move in open view (Adhesed?)
- PseudoDisc formation (fibrosis)?
- Cortex intact- No cysts,
- No areas indicative of either sclerotic or necrotic bone
- Normal Size and shape of right and left condyle
- 70% condyle to fossa
- Non congruent ovoid shape of condyle
- No flat areas, No lipping
- Condyles are centered anterior-posteriorly in fossa
- No edema in the joint, synovial tissue or bone marrow
- T2 and STIR images.
- No lesions or tumors in the TMJ and surrounding areas

Tissue	T1	T2
Fat	Bright	Intermediate
Water	Dark	Bright
Tissue	Intermediate	Dark
Meniscus	Dark	Dark
Bone	Dark	Dark
Fibrotic Tissue	Dark	Dark
Necrotic Tissue	Dark	Dark
Air	Dark	Dark

**Healthy Joints**

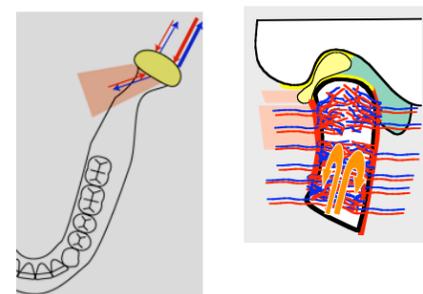


**Normal TMJ Bone**

- Bone Density
- Intact Cortex
- Even pattern Trabecular bone
- Normal Size/Shape Condyle/Fossa
- Ovoid Condylar Shape
- Non-Congruent Condyle/Fossa
- Condyle 70% Size Fossa
- Condyle Centered in Fossa
- Coronal and Sagittal
- Room for Disc
- Stable CR load Zone
- Condyle closest to fossa

**Normal TMJ Condyle Blood Flow**

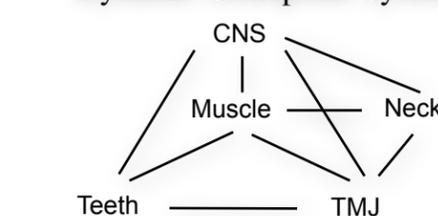
- Condylar head limited collateral circulation
- Marrow is fatty tissue with blood vessels
- Marrow contains the precursor for blood cells
- No Blood vessel inside joint



**Detecting TMJ Health**

- Palpation and Load- No Pain
- anterior lateral pole, posterior lateral pole, indirect through ear
- Load in CR
- History- No: Click, Limited opening, pain, trauma
- Motion- Full, Smooth Range of Motion
- 40-55 mm, 300mm/sec velocity, straight path, consistent arc
- Sounds/Vibrations
- Stethoscope - No Sounds
- No abnormal subtle sounds- paper, sand, pebbles, rocks, crackle
- Doppler Auscultation- No joint vibrations
- Joint Vibration Analysis- No joint vibrations
- Mechanical Stability- Pass the DATPAS test 24/7 3-7 days
- Not occlusally hypersensitive
- Stable Occlusion- No changes over one year

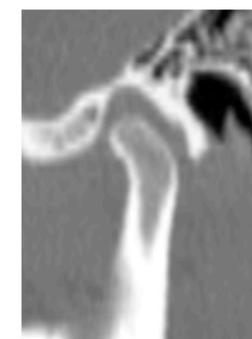
**Dynamic Orthopedic System**



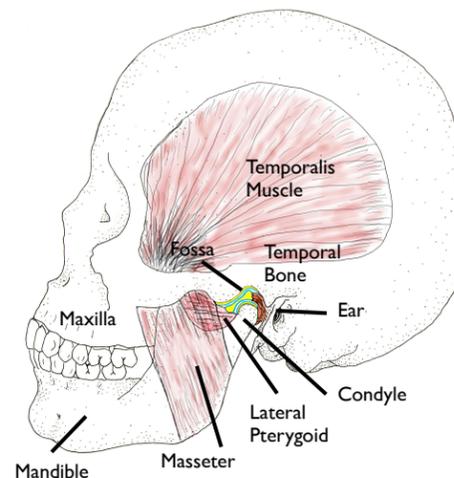
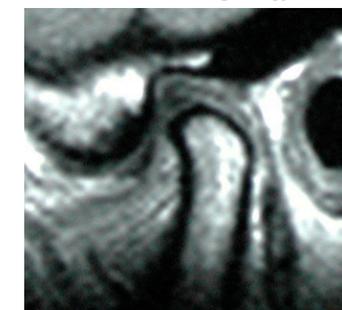
A change in any one area will affect the others

**TMD Diagnosis Supersheet**

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**Normal MRI**



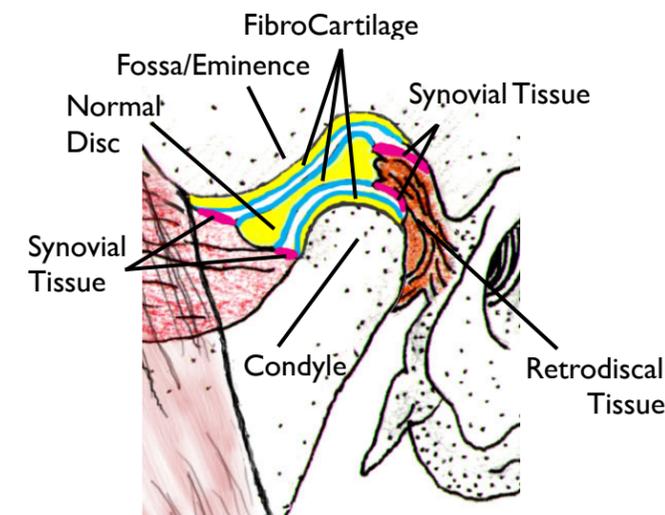
**Normal Synovial Tissue**

- Synovial Tissue lines inside periphery of joints
- Synovial Tissue makes Synovial Fluid
- Filters out Red Blood Cells from plasma
- Adds Hyaluronic Acid and Lubricin to the plasma
- Synovial fluid lubricates the joint
- Synovial fluid provides nutrition to cartilage cells

**Healthy Cartilage**

- Water layer in blue covers Fibrocartilage
- There are no blood vessel in joints
- Synovial Fluid brings in nutrition and O<sub>2</sub>

Cartilage is 80% water. The surface of cartilage is fluid (surface active phospholipids). When cartilage slides against cartilage, the surfaces never touch- it is fluid sliding against fluid- very little friction, no wear.



Occlusal Muscle Disorder Diagnostic Flow sheet for a General Dentists

1. Exam/Differential Diagnosis: ★★★★★  
 What is sore- Is it joint, muscle or neck?  
 Take History, Palpate TM Joints, Palpate TM muscles, Palpate Neck  
 Rule out dental causes. What are the choices?
2. Diagnostic Tests:  
 D-PAS Orthotic for 1 week PM wear only- Test for clenching  
 D-PAS Orthotic for 2 days, 24/7 wear, except to eat  
 Tests joint mechanical stability.  
 Tests elimination of posterior occlusal interferences.  
 Rules out painful Centric Relation Load Zone  
 If day D-PAS helped: Full coverage Centric Relation orthotic 3-6 weeks, 24/7 wear  
 Same benefits as above plus testing a fully functioning occlusion  
 Repeat Step 1. If all the pain has gone away then step 3.
3. Occlusal Analysis. Alter Occlusion- See LD Pankey 3 Rules of Occlusion  
 2 days before adjust occlusion, use D-PAS 24/7 to verify joint stability.

At any point if pain increases, or if the pain has not fully resolved after 6 weeks of therapy, a full facial pain diagnostic work up is needed including TMJ imaging.

★★★★★  
Joints are either Healthy or Damaged  
 If Damaged they will be either:  
 Actively Breaking Down  
 Adapting  
 Adapted Favorably  
 Adapted Unfavorably

If Adapted Unfavorably:  
 Mechanically unstable on moving  
 Mechanically unstable on loading  
 Painful muscles and/or joints  
 Occlusal Muscle Disorder

70% of damaged joints adapt favorably w/out therapy

Increased Risk of unfavorable adaptation:

- Large Disc anteriorly dislocated nonreducing
- Distalized condyle
- Limited opening
- Already has Anterior Open bite
- Bone Marrow edema on T2/STIR of MRI

LD Pankey's 3 Rules of Occlusion

1. With the condyles fully seated in the fossa, all the posterior teeth touch simultaneously and even, with the anterior teeth lightly touching.
2. When you squeeze, neither a tooth nor the mandible moves.
3. When you move the mandible in any excursion, no back tooth hits before, harder than, or after a front tooth.

Evaluate every TM joint for: ★★★★★

1. Comfort
2. Movement
3. Mechanical stability.- does the joint wobble on loading
4. Structural stability- will the joint lose bone with a resulting occlusal shift.

Comfort- The TMJ should not be painful. If the TMJ is painful, I order imaging, both MRI and CT. See CT/MR Rx on my website.

Movement- The TMJ should have a full range of motion. If no full ROM, more diagnostic info is needed. Is it muscle or joint? If muscle, usually progress can be made with datpas or an anterior deprogrammer. If the joint is the problem, get imaging, need MRI.

Mechanical stability- I use a datpas orthotic for 24/7 for 3-7 days. If pain does not increase, the joints are mechanically stable.

Structural stability- There are two ways to determine

1. Monitor occlusion.
2. Monitor bone on CT or CBCT.

If you can determine that the occlusion and condylar bone have not changed over a one year period, the joints are stable. In patients that I suspect may not be stable, I use a mounted set of models in CR and take a bite record every 1-2 months over a year and compare the various bite records with a vericheck. Structural condylar bone loss will manifest as a change in occlusion. ANY CHANGE IN OCCLUSION needs a CBCT and an MRI. If you do not want to monitor over a year, a CT scan will give you instant information on joint stability. Any break in the condylar cortex is an indication of joint structural instability. The most sure way to verify structural stability, two CBCTs one year apart showing no changes in bone. Orthodontics makes it hard to detect a change in occlusion from condylar bone loss since all the teeth are moving from the orthodontics. For orthodontic cases I like to have a start CT or CBCT so if the case is not going as planned (taking longer than expected), we can get a follow up CBCT and compare the two scans. Patients heading to ortho are given the option of getting a CBCT and explained risk/ benefit. A CBCT will identify many unstable joints before orthodontics is started, minimizing the risk of a less than desirable outcome.

7 Basic Rules for Diagnosing Pain

1. Listen to the patient
  - Get both written and oral History
2. Patients can have more than one disease.
3. Develop a differential diagnosis
  - Ask: It appears to be ....., but what else could it be?
4. Run tests that will increase or decrease the pain
  - Palpate, Diagnostic blocks, Diagnostic Orthotics
  - Verify in more than one way if possible
  - Radiographs, Doppler, Joint Vibration Analysis
5. Develop a working diagnosis
6. Diagnosis confirmed after Tx
  - Confirm that the patient got better
7. Don't chase a diagnosis too long before ruling out cancer. Cancer is rare but can mimic other diseases.

Suspect Cancer if:

- Sudden onset headache in 50+ year old
- Numbness
- Past history of cancer elsewhere in the body
- Pain description not quite the same as other TMD patients.
- Pain does not resolve with TMD therapy.

Top Diseases of the TMJ

Physical Damage Disc and Ligament:

See Piper Classification on back page

Osteoarthritis:

The wearing out of a joint. Cartilage is damaged from either too much force, too much friction or lack of nutrients. Subchondral bone reacts and adapts. Damage occurs in the cartilage first and then affects the bone. Occurs slowly over time.

Avascular Necrosis:

Blood supply to bone marrow is compromised, bone marrow dies, trabecular bone dies. Cortical bone collapses up to 1-year after marrow dies. Damage is to marrow first, then bone, then cartilage.

Progressive Condylar Resorption:

When bone comes directly in contact with the inflammatory system, osteoclasts are activated and bone resorbs. Inflammatory cells must contact bone directly. There are 3 main types:

- Inflammatory Tissue Bone Resorption (ITBR):

With a displaced disc, the retrodiscal tissue is dragged up on top of the condyle. If the cartilage covering the condyle is also damaged exposing subchondral bone, osteoclasts can be activated. A joint is very susceptible to this following AVN bone collapse if the cartilage tears during the collapse. Note that tissue in contact with cartilage covering bone does not elicit the bone resorption response

- Rheumatoid arthritis- An overgrowth of synovial tissue stops synovial fluid flow through joint. Cartilage dies exposing subchondral bone. Bone is now in direct contact with inflamed tissue. Damage is to the synovium first, then to the cartilage, then to the bone.

- Joint Infection- The synovium releases inflammatory and immune cells into the bacteria laden synovial fluid. Cartilage is destroyed, exposing bone. Cartilage and bone are not in direct contact with tissue, but they are in direct contact with inflammatory cells in the synovial fluid.

- Others- Crystalline deposition disease, Psoriatic Arthritis, Cancer

Differential Diagnosis- What are the choices?

TMD/Facial Pain Non Joint related

Cervical Damage- Atlas Misalignment  
 Referred pain from neck muscles  
 Migraine Headaches

Muscle

Overuse Myalgia- hypoxia  
 Myofascial pain- Trigger points  
 Myositis- infection  
 Causalgia- tissue damage  
 Fibromyalgia  
 Articular Myalgia  
 Exercise Myalgia  
 Dysfunction/Disharmony movement  
 Hyperactivity- Bracing, Clenching

Occlusal Muscle Disharmony (OMD)

Infection: Sinuses, Ear, Teeth, Periodontal  
 Pulpitis  
 Fibromyalgia  
 CRPS/RSD  
 Centrally Mediated Pain  
 Trigeminal Neuralgia  
 Cancer; Head, Neck, Central  
 Coronary Artery Disease  
 Temporal Arteritis  
 NICO  
 Dystonia  
 Bell's Palsy

TMD with Damaged TM Joints

Physical Damage to Disc & Ligaments  
 Osteoarthritis  
 Avascular Necrosis  
 Inflammatory Tissue Bone Resorption  
 Rheumatoid Arthritis  
 Lyme Disease  
 Joint Infection- Staph, Strep, Syphilis  
 Compromised Condylar Perfusion  
 Osteochondritis Dissecans  
 Fracture/Crush condylar head or fossa  
 Psoriatic Arthritis  
 Crystalline Deposition Diseases  
 Cancer TM Joint/ TM Bones  
 Scleroderma  
 Ganglion (Synovial) cyst

TMD Muscle Hyperactivity Choices

Occlusal Muscle Disharmony (OMD)  
 Posterior Interferences  
 Disharmonious Anterior Guidance  
 Clenching  
 Parafunctional Grinding- CNS mediated  
 Pain avoidance- TMJ Pain  
 Joint Stabilization- CR Subluxation  
 Translatory Slippage  
 Neck Stabilization  
 Dystonia

Condylar Bone Loss Choices

Slow- Progressive (Occlusion Adapts)  
 Osteoarthritis- Lose 0.2mm/yr or less.  
 Not Slow- Single Event (Anterior Open-Bite Develops)  
 Avascular Necrosis  
 Not Slow- Progressive (Anterior Open-Bite Develops)  
 AVN followed by Inflammatory Tissue Bone Resorption  
 Rheumatoid Arthritis  
 Infection- Lyme Disease, Syphilis  
 Others- Crystalline Deposition, Cancer, Psoriatic Arthritis

Note: If see disease early may not have lost bone to change occlusion. Adaptation after rapid bone loss may close open-bite over time.

Anterior Open Bite Choices

Pre-Puberty  
 Genetic  
 Damage to TMJ growth center  
 Habit- Thumb, Finger, Pacifier, Tongue  
 Airway/ Mouth breather  
 Post-Puberty  
 TMJ has changed  
 TMJ Bone Loss (See bone loss choices)  
 Recent Large Disc Displacement  
 Condylar Fracture  
 Teeth have moved  
 Tongue- used as occlusal cushion  
 Tongue used to stabilize neck or TMJ  
 Iatrogenic- Orthotics, Retainers

Mandibular Asymmetry Choices

Pre-Puberty  
 Damage to TMJ growth center  
 Birth Trauma  
 Post-Puberty  
 Class2 = Condylar bone loss  
 Class 3 = Condylar Hyperplasia  
 Posterior Open Bite Choices  
 TMJ has changed  
 Condylar Hyperplasia  
 Synovial Hyperplasia  
 Acute Sprain joint effuion  
 Teeth have moved  
 Tongue- Used as cushion.  
 Iatrogenic- Orthotics, Retainer

D-PAS Interpretation

Pain improvement from PM only DATPAS wear  
 Pt clenches at night. Continue to use DATPAS as night guard.  
 Additional Pain improvement from 24/7 DATPAS wear  
 Occlusal Muscle Disorder  
 Verify Dx with 3-6w CR Orthotic 24/7  
 Tx- Occlusal Adjustment  
 Pain is Worse- Differential Dx:  
 Pain in CR Load Zone, tissue or bone.  
 Joint subluxation under load  
 Disharmonious anterior guidance/ condylar guidance  
 Pain not changed- not an occlusal problem

Symptom

Nonpainful click

Painful Click

Limited opening\*\*

TMJ tenderness

Sore Masseter

Sore Lateral Pterygoid

Sore Deep Temporalis  
 Pain on loading TMJ

No Pain on TMJ Load  
 Pain above the eyes

Migraine headache

Sudden Onset Headache:  
 Acute Pain Left jaw  
 Disharmonious Movement

Severe Chronic Pain

CR orthotic not working

Verify CR orthotic well executed:  
 No rocking- orthotic hard, solid fit  
 No Nonworking or working interferences  
 No Anterior Arc of Closure Interferences

Painful CR  
 Disharmonious Anterior Guidance- Condylar Guidance has changed  
 Joint Subluxation - CR joint subluxation on load  
 Joint Subluxation- Translatory disc slippage  
 Neck  
 Other- Not an Occlusal Problem

Differential Dx

Piper 4a well adapted  
 Piper 4a poorly adapted  
 Piper 3a well adapted  
 Piper 3a poorly adapted  
 Adhesed disc- Piper 4a  
 Adhesion click, Piper 4b  
 Sticky disc click  
 Eminence thud  
 Piper 4a poorly adapted  
 Piper 3a poorly adapted  
 Acute sprain  
 Retrodiscal impingement  
 Synovitis  
 Eminence thud/ sprain  
 Pain Avoidance  
 Arthralgia- sore joint  
 Myalgia- sore muscle  
 Muscle Spasm  
 Acute Nonreducing Disc- 4b,3b  
 Masseteric space infection- Molars  
 Joint Adhesions  
 Muscle Fibrosis  
 Metal Screw into Medial Pterygoid  
 \*\*Permanent damage to joint and muscles after 6 weeks  
 Synovitis  
 Cystic degeneration- OA  
 AVN  
 Acute sprain  
 Ear infection  
 Splinting/Clenching-TMJ Subluxation  
 Splinting/ Clenching- Neck Stabilize  
 Splinting/ Pain avoidance- OMD  
 Splinting/ Pain avoidance- TMJ pain  
 Splinting/ Pain avoidance- OMD  
 Splinting/ Pain avoidance- TMJ pain  
 Anterior Posturing severe Class 2  
 Splinting- TMJ Subluxation w/ load  
 Retrodiscal impingement  
 Cystic bone degeneration  
 Lateral Pterygoid splinting  
 May or may not be healthy/stable  
 Referred pain from neck  
 Sinus  
 C1 - C2 - Skull misalignment (90%)  
 10% something else  
 Brain Tumor  
 Heart Attack  
 Mechanical- disc in the way  
 Pain avoidance  
 Joint stabilization of subluxation  
 Neck stabilization  
 CNS: Dystonia, Brain Cancer, CVA  
 RSD/CRPS  
 Central Sensitization  
 Psychological- secondary gain