Cerebral Palsy (CP)
- Non-progressive lesion in an immature brain
- Progressive disorder of posture and movement

Incidence 2.0-2.5 per 1000 live births

Spastic type 85%
- Spastic hemiplegia, spastic diplegia, spastic quadriplegia

Dyskinetic type 15%
- Athetoid
PRIMARY CONDITION

- Loss of connection of lower motor neuron pathways
  - Positive upper motor neuron syndrome
    - Spasticity, hyper-reflexia, clonus, co-contraction
  - Negative upper motor neuron syndrome
    - Weakness, fatigability, poor balance, sensory deficits

- Musculoskeletal (MSK) dysfunction
  - Muscle shortening, bony torsion, joint instability, soft tissue degeneration, joint degeneration
SECONDARY CONDITIONS

- Injury, impairment, or functional disability resulting from a primary condition
  - Includes social, physical, and mental problems
- Acute and chronic pain among most common secondary conditions for individuals with CP
Secondary Pain

- Schwartz, Engle, and Jensen (1999)
  - Surveyed 93 adults with all types of CP
  - Age range 18-76 years
  - 67% of respondents reported chronic pain
  - Average of 3 pain sites noted
Jahnsen and Villien, 2003
- Surveyed 406 persons with CP of all types
- Inquired about MSK pain and domain of bodily pain on Short Form 36 (SF-36)
- Results compared to general Norwegian population

- 30% CP population reported chronic pain compared to 15% of general population
- CP group had diminished life satisfaction and deteriorating physical function over time.
- Back pain most common pain complaint in both groups
Dyskinetic type CP
- Neck, back, shoulder pain, and headache most common

Diplegic type CP
- Foot, back, and ankle pain most common

Quadriplegic type CP
- Knee and back pain

Arm and hip pain even across all groups
Women had significantly more pain across all groups.

Headache, back and hip pain worst among women.

Most respondents had pain in more than one site.

Three pain sites average with mean 3.6 women and 2.9 men.

86% of respondents reported reduced range of motion in at least one joint.
Domain of bodily pain by SF-36

- Almost 50% responders had moderate to severe pain
- Approximately 30% reported moderate to severe impact of pain on daily life
- Women had significantly more impact of bodily pain than men
149 of original group of CP participants resurveyed 7 years later

Survey items looked at pain type, location, functional status, and impact of pain

- 39% had deteriorated walking function in 1999
- 52% had deteriorated walking function in 2006
- 24% noted pain as reason for decline in function
MSK pain increased across all groups

<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>2006</th>
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<tbody>
<tr>
<td>Pain Increased</td>
<td>23%</td>
<td>31%</td>
</tr>
<tr>
<td>Pain Seldom</td>
<td>52%</td>
<td>41%</td>
</tr>
<tr>
<td># Pain Sites</td>
<td>3</td>
<td>3</td>
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</table>
MSK pain sites 2006

<table>
<thead>
<tr>
<th>Pain sites</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
<td>67%</td>
</tr>
<tr>
<td>Neck</td>
<td>57%</td>
</tr>
<tr>
<td>Feet</td>
<td>50%</td>
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</table>
Possible causes for increased pain

- Worsening joint mechanics
- Prolonged exertion
- Inactivity
- Less access to healthcare especially specialists
- Reduced social integration and participation in work and sports
HEALTH BEHAVIORS

- Studies show overall good access to general medical care among adults with CP
- As aging occurs individuals less likely to adhere to exercise programs
  - Main recreational activity TV, reading
  - Poor access to adequate exercise facilities
  - Lack of money
  - Low perceived efficacy
**HEALTH BEHAVIORS**

- Physician visits general in nature
  - Increased ER visits among adults with CP
  - Fewer specialist visits than general population
- Progression of MSK conditions not monitored
- Not likely to see PT, OT, MSK specialists
Analyzed 2009 study

- Exertion was most important factor in increased pain
- Participation in physical therapy was most important factor in decreased pain
- Positive correlation between number of pain sites and psychological health among general population but not among CP group
<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>2006</th>
<th>General Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Seldom</td>
<td>Monthly</td>
<td></td>
</tr>
<tr>
<td>Chronic (&gt;1yr)</td>
<td>20%</td>
<td>24%</td>
<td>15%</td>
</tr>
<tr>
<td>Bodily Pain SF-36*</td>
<td>62 (Median)</td>
<td>61 (median)</td>
<td></td>
</tr>
</tbody>
</table>

*Bodily pain score of SF-36 represents pain impact on daily life*
SECONDARY PAIN CONDITION SUBTYPES

- Pain generators
  - Arthritis
  - Musculoskeletal disorders
    - Hip subluxations
    - Foot abnormalities
    - Patella alta
    - Scoliosis
    - Pelvic obliquity
    - Contractures
  - Fractures
  - Overuse and nerve entrapments
Arthritis

- Uneven muscle contraction across joint and altered muscle firing
- Leads to altered relationship of joint surfaces
- Articular cartilage degenerates
- Earlier onset arthritis in CP
  - 27% of subjects 15-25 years old had clinical evidence of arthritis
  - More common in ambulators than nonambulators (Cathels and Reddihough, 1993)
Hip dislocation
- Most common in spastic athetoid CP
- More common in “neurologically mature” people
- Treatment involves surgical reduction, tendon transfers, pelvic/femoral osteotomies
- Surgery results in lack of joint congruency leading to early OA
MUSCULOSKELETAL DEFORMITIES

- **Foot pain**
  - More common in spastic diplegic individuals
  - Toe walking/cavus foot causes metatarsal head pain
  - Varus/valgus deformities cause pain along lateral/medial side of foot

- **Knee pain**
  - Overactive quadriceps with knee flexion contracture causes superior displacement patella
  - Abnormal contact of patella in condylar groove causes chondromalacia
Scoliosis

Most common in spastic quadriplegics
Progressive throughout life due to neuromuscular weakness
C-shaped curves progress more rapidly than S-shaped curves
Poorer prognosis for progression if >50 degrees at skeletal maturity
Musculoskeletal Deformities

- **Scoliosis**
  - Relationship between scoliosis and pain not definitive
    - Pelvic obliquity can lead to ischial skin breakdown, pressure with weight bearing, and hip dislocation
    - Rib cage resting on iliac crest can also lead to skin breakdown
OVERUSE SYNDROMES AND NERVE ENTRAPMENTS

- Repetitive motion causes tendonopathies, myofacial pain and nerve entrapments
  - Small repertoire of movement patterns leads to over exertion of few patterns
  - Causes inflammation, micro trauma, and injury to soft tissue structures
    - Ulnar nerve entrapment, Carpal Tunnel Syndrome
  - More common in dyskinetic type CP
Cervical disc herniations, radiculopathies, myelopathies

- Most common in athetoid type CP
- Repetitive flexion, extension, and rotation creates shearing forces leading to disc derangement
- Clinical disc derangement presents at earlier age in CP versus general population
Fractures

- More common in individuals with severe CP
- Long bone fractures most common
  - Long lever arm
  - Osteoporosis due to low activity/disuse
  - Joint and muscle contractures create stress riser across bones
  - Non-traumatic fractures most likely
Retrospective record review of fractures (Brunner, 1996)

- Common age 12-16 years
- Typically occurred in severely affected nonmobile individuals
- Supracondylar fracture of distal femur most common
- Contractures of knee and hip dislocations often noted in individuals with fractures
- 41% occurred within 9 months of surgery
  - Osteoporosis of disuse/casting
- Occurred most frequently during physical therapy or daily care
FRACTURES

- Falls most common mechanism of fracture in ambulators
  - Dyskinetic > spastic CP affected
- Patellar stress fracture noted in individuals with crouched gait
  - Overactive quadriceps muscle
  - Lack graded exertion of postural muscles for balance correction
MUSCULOSKELETAL DEFORMITIES
Surgical outcomes (Boldingh, 2005)

- **Hip reduction**
  - 50% of patients had chronic pain after reduction
- **Triple arthrodesis**
  - Majority of patients had chronic foot pain post op
MEDICATIONS

- Pain medication survey (Engel et al, 2002)
  - 50% used NSAIDS with poor effect to manage pain
    - Ceiling effect
  - 30% used opiates or muscle relaxers
    - CNS effects
    - CNS plasticity with long term opiates
  - Majority of responders less than satisfied with medication management
Muscle Relaxers
- Tizanidine, baclofen, dantrium, benzodiazepines
- Treat spasticity via multiple mechanisms
- Less clear that they have a role in pain reduction
- May not acclimate to sedative side effects
- May weaken key muscles of postural control
- Increase drooling

Intrathecal baclofen has been demonstrated to be effective in pain management as well as spasticity
MEDICATIONS

- Neurotoxin
  - Botox, Myobloc
  - Block AcH release at neuromuscular junction
  - Onset 1-7 days after injection into skeletal muscle
  - Duration of action 3-6 months
  - Low incidence of adverse effects
    - Rash, fatigue, undesired spread
Neurotoxins
- Helps control spasticity related to primary condition
- Best offense is good defense

Direct analgesic effect postulated
- Decreased shoulder pain after stroke by injecting Botox into subscapular muscle (Yelnik, 2007)
Consider the causes of pain:
- Abnormal joint and muscle biomechanics
- Overexertion leading to soft tissue disorders
- Inactivity leading to worsening contractures
- Increased fatigue
- Less access to healthcare over individual’s lifespan
- Reduced mobility over time with less social integration and participation
Best offence is a good defense
  - Aggressive preservation of MSK alignment, ROM, tone
  - Balance between over exertion and inactivity
  - Maintain access to good MSK supervision through transition into adulthood
  - Ensure adequate facilities for adaptive adult healthcare and fitness
  - Education about the effectiveness of ongoing rehabilitative services throughout the lifespan
Interrupt purely sensory distal afferent nerves, typically the articular nerves.

Consider interruption of mixed sensory-motor nerve where the loss of motor function is clinically unimportant.

Avoid lesion of mixed nerve where the loss of motor function would have significant adverse clinical consequences.

Use anatomically reliable landmarks determinable by fluoroscopy, ultrasound or electrical stimulation of the nerves.

Plan surgical approach to avoid injury to overlying or adjacent visceral and neurovascular structures.
Femoral nerve
Obturator nerve
Saphenous nerve
Common fibular nerve
Posterior cutaneous nerve
Sciatic nerve
Tibial nerve
Common fibular nerve
Medial sural cutaneous nerve
Lateral sural cutaneous nerve

GENICULAR BLOCK TECHNIQUE

- Place patient in a comfortable supine position with sterile prep and drape
  - Knee undergoing procedure may be elevated slightly with the use of a foam bolster, pillow or sandbag
    - Advantageous for lateral image
- Obtain true AP image
- Identify 3 target sites
  - Superior lateral geniculate nerve where the lateral femoral shaft meets the epicondyle
  - Superior medial geniculate nerve where the medial femoral shaft meets the epicondyle
  - Inferior medial geniculate nerve where the medial tibia shaft meets the epicondyle
- Anesthetize skin and soft tissues with 1% Lidocaine
- At each target advance the needle using “tunnel technique” until bony contact is made
- Transition to lateral image
- At each target make fine adjustments to confirm needle tip is 50% of the diaphysis
- Inject 0.5-1.0 ml local anesthetic
GENICULAR NERVE RADIOFREQUENCY
- **Size:** 10-12mm
- **Shape:** Spherical
CHRONIC HIP PAIN: OSTEOARTHRITIS

www.sonoranhipcenter.com
INNERRVATION OF THE HIP JOINT

- Anteromedial innervation supplied by the articular branches of the obturator nerve
- Anterior hip joint capsule innervated by sensory articular branches of the femoral nerve
- Posterior innervation supplied by articular branches derived from the sciatic nerve
  - Posteromedial hip joint capsule innervated by articular branches from the nerves to the quadratus femoris muscle
  - Posterolateral hip joint capsule innervated by articular branches from the superior gluteal nerve

Figure 1 Articular branches of the obturator nerve and target region for radiofrequency denervation. Covering the right hip are tracings of the anteroposterior projections of the metal wires used to mark the location of the articular branches in cadavers. In each cadaver, articular branches were spread across band-like areas. The bold lines represent the upper boundary of each area, and the dotted lines represent the lower boundary. The stem of each band was located below the teardrop shape of the inferior end of the acetabulum. Over the left hip, the matrix of lesions required to coagulate the articular branches is illustrated. Its medial margin lies opposite and below the teardrop silhouette of the acetabulum. For reference, tracings of wires covering the obturator nerve have been depicted.

Secondary conditions have effects on health outcomes throughout the life span of individual.

CP should be viewed as lifetime disability not a pediatric problem.

Appropriate specialists should be utilized regardless of age pathology presents.

Medications and surgery can be helpful.

Adolescents aging out of pediatric services need help transitioning into an adaptive and responsive adult health delivery system.

Standard pain interventions should be considered for secondary pain problems regardless of age of onset.