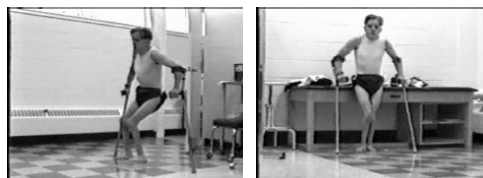


Understanding Gait Dysfunction in the Child Who has Cerebral Palsy & An Introduction to Management: *Help Those Muscles do the Work They Can*

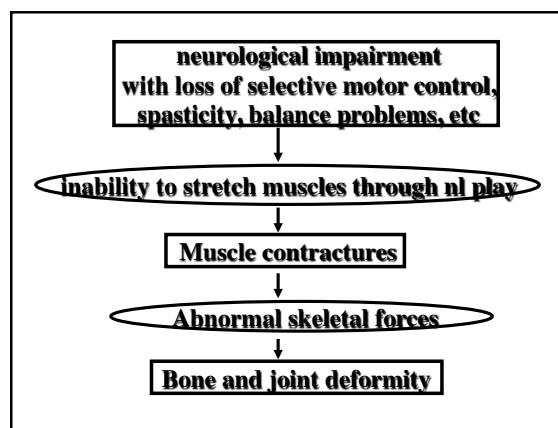
Tom F. Novacheck, MD
Pediatric Orthopaedic Surgeon
Director, Center for Gait and Motion Analysis
Gillette Children's Specialty Healthcare
St. Paul, MN, USA
Associate Professor, Univ of Minnesota Dept of Orthopaedic Surgery

In the past, ortho surgery alone ...

Multiple tendon lengthenings alone “the birthday syndrome”



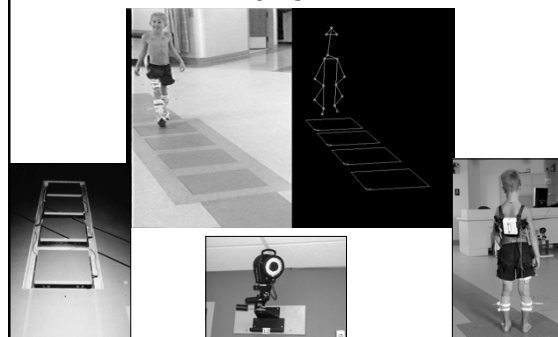
Pathology



Gait deviations in CP

- Primary
 - Spasticity
 - Motor control
 - Balance
 - Weakness
- Secondary musculoskeletal problems
 - Contractures
 - Bone deformities
 - Joint instability
- Tertiary compensations

Gait Analysis in the Management of CP



Management to maximize muscle function

- Manage/eliminate high muscle tone
- Correct contractures and lever arm problems
- Strengthen muscles
- Compensate for residual deficits (incapacities) with orthoses or assistive devices

Maximize Functional Capacity

Management scheme

- Constants
 - Physical therapy
 - Orthotics
 - Exercise & physical recreation
- Functional assessment
- Goal setting
- Gait analysis
 - Tone management
 - Bone & joint malalignment
 - Orthotic management

So, you want to be able to ...

- Walk
- Walk better
- Walk without assistive devices
- Walk farther

... Goal setting

Remember!

- The two primary purposes of moments (muscle force X lever arm distance)
 - stance phase stabilization (support)
 - propulsion (acceleration)
 - of body segments
 - of body mass

Gravity is powerful and constant.
What holds us up?

- The antigravity muscles:
 - Gluteus max
 - Gluteus medius
 - Vasti
 - Gastrocnemius
 - Soleus

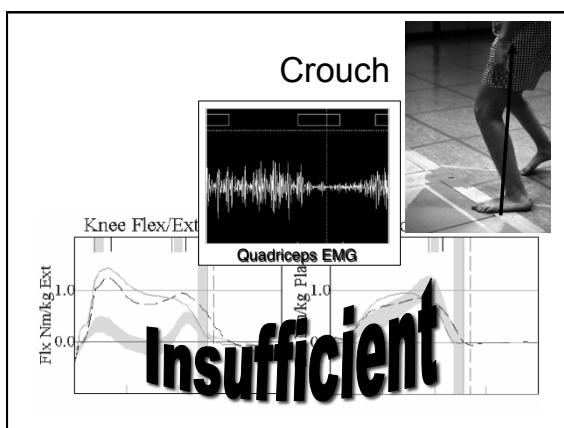
The
Plantarflexion/
Knee
Extension
Couple



Inappropriate PF/KE Couple

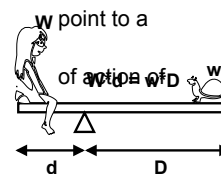
- Abnormal ankle moment (too little or too much)
 - excessive second rocker (inadequate muscle moment)
 - weak triceps surae
 - inadequate lever arm (midfoot break)
 - overactive triceps surae (restricted second rocker)

Inadequate PF/KE couple



But it's the moment that matters!

- Moment = Force x lever-arm
- The lever arm is
 - one of the components of a moment
 - a “Distance” from a force
 - Perpendicular to line the force



Tone Management

Unleashing
the
muscles

Botulinum toxin

- Inhibits release of acetylcholine at the neuromuscular junction



Neurosurgery

- Selective Dorsal Rhizotomy (SDR)
- Intrathecal Baclofen Pump (ITB)



Orthopaedic surgery

Fixing
the
levers

What is “lever-arm dysfunction”?

- the “lever-arm” portion of the moment is abnormal
- Several types of lever-arm dysfunction exist:
 - Short lever-arm
 - Flexible lever-arm
 - Mal-rotated lever-arm
 - Unstable fulcrum
 - Positional lever-arm dysfunction

Femoral Anteversion

- Measurement methods
 - Physical exam
 - Magilligan xrays
 - CT scan
 - Fluoroscopy



POSNA 2001

Narayanan, Novacheck, Schutte, Gilbert

The intra-operative method of estimating femoral anteversion is as accurate as the current “gold standard” of CT scanning.

Surgical management

- Femoral Derotational Osteotomy (FDO)

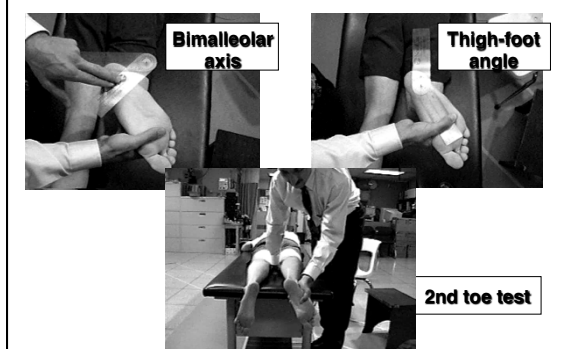
<u>Anteversion</u>	<u>Surgery</u>
20-30°	Never
30-40°	+/-
40-50°	Usually
>50°	Almost always

Femoral Derotational Osteotomy

- Don't underderotate in diplegics and quadriplegics!
- Don't overderotate hemiplegics!
- Rigid fixation
- Early mobilization!

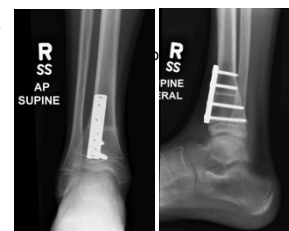


Tibial Torsion



External Tibial Torsion

- Must correct the etiologic mechanism to prevent recurrence (FDO, hams. lengthening, rectus transfer)
- **Correction should be considered even if torsion is relatively minimal ($>10^\circ$).**
- Supramalleolar osteotomy
 - Decide pre-op amount of place pins
 - AO plate
 - +/- fibular osteotomy
 - SLC in all

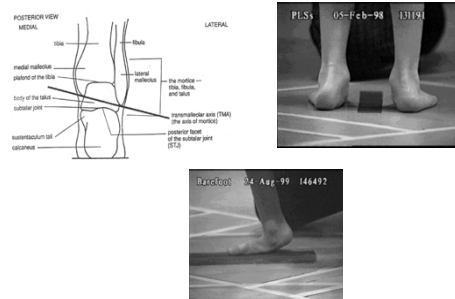


Talipes Equinovarus clinical exam

- Hindfoot equinus
- Hindfoot valgus
- Midfoot abduction
- Assess forefoot deformity



Ankle - Subtalar Joint - Midtarsal Joint



Finding non-weight bearing subtalar neutral



Forefoot varus (relative to hindfoot in corrected position)



Summary

3 Major Problems in CP *that compromise muscle function and mobility*

- High muscle tone
- Contractures
- Lever arm deformities

Management to maximize muscle function

- Manage/eliminate high muscle tone
- Correct contractures and lever arm problems
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Maximize Functional Capacity