***Gait Analysis Post Clubfoot Treatment: What Can It Tell You***

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*Prior to 1990, many studies published good results following clubfoot surgery (PMR)*

*Results graded on need for reoperation and XRay measurements*

*No measure of function*

*Foot function can be measured in a gait lab*

*Our research with clubfoot started in 1994*

*1997 J Pediatr Orthop (TSRH) :*

23 patients with ave. 10 yr f/u after PMR

All asymptomatic unilateral clubfeet

*1997 STUDY*

*Diminished motion of ankle in 20/23 after clubfoot release*

*Equinus or calcaneus (2nd rocker)*

Internal foot progression angle in 65% (red)

*Gastrocsoleus weakness in 16/21 pts*

*Ave weakness 23%*

*9/21 quadriceps weakness*

*Concluded that there were gait disturbances in good surgical results at 10 yr f/u*

*So gait analysis told us to rethink our treatment*

*Began PT and then Ponseti programs to decrease surgery*

*NONOP STUDY*

French daily physical therapy

Ponseti casting ± achilles tenotomy

*105 children with 154 clubfeet*

*75 PT / 79 Ponseti feet*

*Tested ave age 2.3 yrs*

*Dimeglio Score 10-17*

*Pre-treatment clubfoot rating*

Dimeglio’s numeric scoring system and grouping

Moderate: 6-10

Severe: 11-15

Very Severe: 16-20

*SAGITTAL ANKLE KINEMATICS*

*EQUINUS – 8.6%*

*Equinus in stance phase seen in PT group (15% pink) but 85% had normal dorsiflexion.*

*Excess Dorsiflexion – 28.6% Ponseti (blue)*

*INTERNAL ROTATION – mild but common!*

*CONCLUSIONS at age 2*

*Normal ankle movement can be achieved in >50% of nonoperated feet*

*Surgery does not result in a “better” gait.*

*So gait analysis told us to continue nonoperative treatment, and to treat equinus in the PT feet with tenotomy*

*Pedobarograph*

e*asier to obtain in toddlers*

*Can help plan surgery too*

*Pedobarograph masks*

*Data collected in 9 “masks”*

*Multiples variables from each mask are collected-*

Peak pressure

Contact time

Mean force

Contact area

*Methods*

*154 Clubfeet (age 2+3 yr old)*

Both groups had decreased pressure beneath calcaneus compared to normals

Increased peak pressure over lat midfoot (esp in PT group) like mild clubfeet!

*PEDOBAROGRAPH*

*Equinus Group*

Residual Deformity

Example:PT *No heel cord*

*IncDF Group*

Flatfoot Pattern

*Example:Ponseti case*

*Why Gait Analysis in Recurrent Feet?*

*Won’t help surgeon decide if SHOULD operate*

*Might help surgeon decide which operation to do!*

*Soft tissue release vs tendon transfer*

*Bony osteotomy*

*Recurrent Equinus*

Sagittal plane: Relapse results in ankle equinus (decreased stance phase dorsiflexion) and Knee hyperextension

Verifies need for tendoachilles release/lengthening

Can also reveal swing phase foot drop

*Transverse Plane*

*Most useful in identifying level of rotation*

*Can quantify intoeing seen in recurrence*

*Is it tibial torsion, metatarsus adductus, or muscle imbalance?*

*Typical rotational profile:*

External hip rotation

Mild internal tibial torsion

Dynamic internal foot rotation due to overpull of tibialis anterior

Overall, internal foot progression angle

*Tibialis Anterior Tendon Transfer*

*Can use pedobarograph to plan tendon transfers*

*EMG of tib anterior and ankle kinematics help too*

*Kinematics: internal foot rotation and internal foot progression angle*

*May have equinus (which will require tendoachilles surgery)*

*Pedobarograph shows lateralization in midfoot due to supination*

*Confusion test may be helpful*

*GAIT AT 5 YRS*

*Compared gait in 34 Ponseti feet, 40 PT feet, and 51 surgical feet*

*Kinematics and kinetics*

Force exerted by joints of the body on the floor during gait

Measured from force plates embedded in floor

*ANKLE KINETICS*

*Gastrocsoleus concentric contraction produces power to push off ground and initiate swing.*

*If gastroc doesn’t work, calcaneus gait.*

*Conclusions at 5 years…*

* *So what did gait analysis tell us?*
* *No functional penalty to heel cord tenotomy so do it when needed*
* *Nonoperative treatment still best*
  + Better power
  + Better motion
  + Less intoeing

*Outcomes at 10yrs*

*Testing Protocol*

Ankle Kinematics/Kinetics

Plantar Pressures

Multi-segment Foot Motion

Biodex Ankle Strength

StepWatch Activity Monitors

*Walking and hopping*

*Conclusions/Future Directions*

*Clubfeet are not normal feet*

*Some residual weakness seen which correlates with their gait analysis*

*Ankle motion in patients who were successfully treated without surgery are better*