Risk Factors for Advanced Skeletal Maturity in Children and Adolescents with Myelomeningocele

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Background

• Skeletal development is affected in patients with myelomeningocele (MM).
  – Decreased bone density
  – Atypical skeletal maturity

• Likely multifactorial; possibly related to:
  – Mechanical loading
  – Nutrition
  – Bone metabolism
  – Endocrine system
Background

- Advanced skeletal maturity has been observed in the spina bifida population.
  - Hydrocephalus
    - Diminished bone age (Feeley 2003)
    - No association (Kalen 1994)
  - Neurosegmental level
    - No association
  - Sex
    - No association
• To assess skeletal maturity, as measured by bone age, in children and adolescents with myelomeningocele.
• Examine the effects of sex, BMI, shunt status, and functional level.
Methods - Population

• 92 children with MM
  – 52 males; average age 10.1 years, range 6.0-15.8 years
    • 10 sacral, 6 low lumbar, 28 mid lumbar, 8 high lumbar and above
  – 40 females; average age 9.9 years, 6.2-16.9 years
    • 12 sacral, 7 low lumbar, 17 mid lumbar, 4 high lumbar and above
Methods - Clinical Measures

- Height, weight, manual muscle testing completed by a PT.
- Tanner Stage of Sexual Maturity completed by a pediatric endocrinologist.
Methods - Bone Age

- X-rays of left wrist/hand
- All x-rays read by 1 reviewer
  - Greulich and Pyle method
  - Blinded to participants’ chronological age
Methods - Statistics

• Paired t-tests to identify differences in bone and chronological age.
• Spearman’s rho to analyze factors influencing bone age, namely neurosegmental level, FMS data, Tanner Stage.
• Multiple linear regression to determine relative effect of Tanner Stage, BMI, sex and shunt presence/absence.
Results

- Bone age is significantly advanced for both males and females.
  - Males mean difference: \(-0.64 \pm 1.6\); range: \(-3.93\) to \(2.89\)
  - Females mean difference: \(-0.82 \pm 1.61\); range: \(-4.39\) to \(2.28\)
Results - Multivariate Analysis

- Bone age was initially delayed, but became advanced after 9.5 years for males and 9.1 years for females.
• No significant effects of neurosegmental level or shunt status were found.
• BMI was correlated with advanced bone age.
  – Males: $r^2=-0.59$; $p<0.001$
  – Females: $r^2=-0.55$, $p<0.0001$
Discussion

• Advanced bone age as great as 4.4 years was observed.
• In this population, abnormal bone age was:
  – *Not associated* with ambulation or shunt presence.
  – *Positively associated* with BMI, Tanner Stage.
• Skeletal development is altered in children and adolescents with MM.

• Advanced bone age was seen in both males and females after about 9 years of age.
  – May be related to onset of puberty

• Skeletal maturity determination is important for timing of orthopaedic interventions common in this population.

• A better understanding of bone age in children with MM may aid in surgical planning.
Future Directions

• Implications for adults with MM - advanced bone age as a youth, increased fractures, osteoporosis risk as adults?
THANK YOU!!!

QUESTIONS?