### SECTION ON ORTHOPAEDICS
#### 1999 ANNUAL MEETING
October 9–10, 1999

**SCHEDULE**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>9:24 a.m.</td>
<td>Discussion</td>
</tr>
</tbody>
</table>
| 9:27 a.m.  | Fusionless Correction of Lumbar Scoliosis by Anterior Vertebral Osteotomy  
            | Thomas F. Kling, Jr., MD, FAAP; Richard E. Lindseth, MD |
| 9:33 a.m.  | Discussion                                                            |
| 9:36 a.m.  | Endoscopic Mechanical Spinal Hemi-epiphysiodesis for Correction of Idiopathic Scoliosis  
            | Donata I. Bylski-Austrow, Ph.D; Eric J. Wall, MD, FAAP; Ronald J. Kolata, DVM; Alvin H. Crawford, MD |
| 9:42 a.m.  | Discussion                                                            |
| 9:45 a.m.  | Endoscopic Pelvic Osteotomy—First Ten Cases                            |
| 9:51 a.m.  | Discussion                                                            |
| 9:54 a.m.  | * Septic Hip Arthritis in Children: Four Decades of Treatment         |
| 10:00 a.m. | Discussion                                                            |
| 10:03 a.m. | * Differentiating between Septic Arthritis and Transient Synovitis of the Hip in Children: An Evidence-Based Probability Algorithm  
            | Mininder S. Kocher, MD; David Zurakowski, PhD; James R. Kasser, MD |
| 10:09 a.m. | Discussion                                                            |
| 10:12 a.m. | The Demographics of Atypical and Idiopathic Slipped Capital Femoral Epiphysis (SCEFE): The Age-Weight Test and Implications for Further Diagnostic Evaluation  
            | Randall T. Leder, MD, FAAP; Mary Lou VH Greenfield, MS, MPH |
| 10:18 a.m. | Discussion                                                            |
| 10:21 a.m. | Delay in Diagnosis of Slipped Capital Femoral Epiphysis              |
| 10:27 a.m. | Discussion                                                            |
| 10:30 a.m. | BREAK                                                                |
| 10:30 a.m. | * Value of Portable Mini-Fluoroscopy in the Pediatric Orthopaedic Clinic  
            | William L. Hemmikus, MD, FAAP; Brian A. Shaw MD, FAAP; Joseph A. Gerardi DO |
| 10:36 a.m. | Discussion                                                            |
| 10:41 a.m. | * The Functional Health Status and Orthopaedic Manifestations of Children with Costello Syndrome  
            | Walid K. Yassir, MD; Brian E. Grotkau, MD; Michael J. Goldberg, MD, FAAP |

### SATURDAY, OCTOBER 9, 1999

**8:00 a.m.** Welcome  
*David D. Aronsson, MD, FAAP*

**8:05 a.m.** Remarks  
*Robert B. Cady, MD, FAAP*

**Scientific Presentations—Session I Spine & Hip**  
Moderator: Richard J. Haynes, MD, FAAP

1) **8:15 a.m.** Multicomponent Pheresis and Autologous Platelet Gel in Adolescent Spinal Surgery  
*B. Gillingham, MD; G. Palston, MD T. Hannon, MD; S. McKinlay, MD; G. McCullen, MD*

2) **8:24 a.m.** *New Lead “Wonderbra” to Help Decrease the Risk of Breast Cancer in Females with Adolescent Idiopathic Scoliosis  
*Twee Do, MD; Dana Wechsler, MS, OTR*

3) **8:33 a.m.** *Pancreatitis After Scoliosis Surgery in Children and Adolescents: Incidence and Evaluation of Risk Factors  
*S. Feitly, MD; F.J. Laplaza, MD; K.E. Schneider, MD; P.J. Millet, MD; R.F. Widmann, MD*

4) **8:42 a.m.** Characteristics of Anterior Spinal Surgery Complications in Children with Neuromuscular Scoliosis  
*J.F. Sarwark, MD, FAAP; A. Aminian, MD; J.J. Grayhack, MD; A. Win, MD*

5) **8:51 a.m.** * Anterior/Posterior Spinal Fusion Same Day Versus Staged Procedures  
*Kenneth J. Guidara, MD; Nancy Pisciotto RN, OCN; Stuart J. Ekkowitz, MD; Carrie Gill-Murdoch, MD*

6) **9:00 a.m.** * Routine Preoperative MRI in Adolescent Idiopathic Scoliosis: A Prospective Study of 327 Patients  
*Christian Fras, MD; Twee Do, MD; Stephen Burke, MD; Bernard Rawlins, MD; Roger Widmann, MD; Ozenbba Boachie-Adjei, MD*

7) **9:09 a.m.** Evaluating Congenital Spine Deformities for Intraspinal Anomalies With MRI  
*J.F. Sarwark, MD, FAAP; S. Suh, MD; B.K. Huang, BS; J.J. Grayhack, MD*

8) **9:15 a.m.** Juvenile Postural Kyphosis Treated with a Figure-of-Eight Clavicle Strap: A Preliminary Report  
*Yaseen Oweis; Robert Bright, MD*

9) **9:24 a.m.** Discussion  
Fusionless Correction of Lumbar Scoliosis by Anterior Vertebral Osteotomy  
Thomas F. Kling, Jr., MD, FAAP; Richard E. Lindseth, MD

10) **9:33 a.m.** Discussion  
Endoscopic Mechanical Spinal Hemi-epiphysiodesis for Correction of Idiopathic Scoliosis  
Donata I. Bylski-Austrow, Ph.D; Eric J. Wall, MD, FAAP; Ronald J. Kolata, DVM; Alvin H. Crawford, MD

11) **9:42 a.m.** Discussion  
Endoscopic Pelvic Osteotomy—First Ten Cases  
Eric J. Wall, MD, FAAP; Ron Kolata, DVM; Dennis Roy, MD, FAAP; Charles T. Mehleman, DO; Alvin H. Crawford, MD

12) **9:51 a.m.** Discussion  
* Septic Hip Arthritis in Children: Four Decades of Treatment  
Kerwyn Jones, MD; Dennis S. Weiner, MD; William C. Schrader, MD

13) **10:00 a.m.** Discussion  
* Differentiating between Septic Arthritis and Transient Synovitis of the Hip in Children: An Evidence-Based Probability Algorithm  
Mininder S. Kocher, MD; David Zurakowski, PhD; James R. Kasser, MD

14) **10:09 a.m.** Discussion  
The Demographics of Atypical and Idiopathic Slipped Capital Femoral Epiphysis (SCEFE): The Age-Weight Test and Implications for Further Diagnostic Evaluation  
Randall T. Leder, MD, FAAP; Mary Lou VH Greenfield, MS, MPH

15) **10:12 a.m.** The Demographics of Atypical and Idiopathic Slipped Capital Femoral Epiphysis (SCEFE): The Age-Weight Test and Implications for Further Diagnostic Evaluation  
Randall T. Leder, MD, FAAP; Mary Lou VH Greenfield, MS, MPH

16) **10:18 a.m.** Discussion  
Delay in Diagnosis of Slipped Capital Femoral Epiphysis  
Daniel W. Green, MD; Richard A.K. Reynolds, MD; Safdar N. Khan, MD; Vernon T. Tolo, MD

17) **10:27 a.m.** Discussion  
Delay in Diagnosis of Slipped Capital Femoral Epiphysis  
Daniel W. Green, MD; Richard A.K. Reynolds, MD; Safdar N. Khan, MD; Vernon T. Tolo, MD

18) **10:30 a.m.** BREAK
11:15 p.m. Discussion
27) 2:03 p.m. A Retrospective Long-Term Study on Dynamic Plantar Pressure in the Treated Clubfoot
J. Thometz, MD; X.C. Liu, PhD

11:18 a.m. * Increased Prevalence of Scoliosis in Turner’s Syndrome
Joanne Y. Kim, MD; Samuel R. Rosenfeld, MD; Joyce H Kayak, PhD
2:09 p.m. Discussion

11:24 a.m. Discussion

11:27 a.m. Hip Dislocation In Down Syndrome
Stephen B. Sundberg, MD

11:33 a.m. Discussion

11:36 a.m. *The Incidence of Radiographic Findings in and Clinical Significance of Protusio Acetabuli in Marfan Syndrome
Tuvee Do, MD; Phillip Giampetro, MD; Stephen Burke, MD; Oheneba Boachie, MD; Robert Schneider, MD; Cathleen Raggio, MD; Jessica Davis, MD

11:42 a.m. Discussion

11:45 a.m. * The Effectiveness of Seat Belts at Reducing Injury Severity to School-Age Children
Stephen Halman BASc, MSc, MDCM; Mary Chipman, MSc; Patricia Parkin, MD, FRCP (C); James Wright MD, MPH, FRCS (C)

11:51 p.m. Discussion

11:54 a.m. * An Exploration of Quality of Life Outcomes Measurement in Scoliosis and Cerebral Palsy
Michael G. Vitale, MD; David P. Royle, Jr, MD, FAAP; Douglas E. Levy, MPH; Annette C. Gelins, PhD; Alan J. Moskowitz, MD; William R. Pufferbarger, MD

12:00 p.m. Discussion

12:03 p.m. * Diagnostic Performance of Clinical Examination and Selective MRI in the Evaluation of Knee Disorders in Children and Adolescents
MS Kocher, MD; D Zurakowski, PhD; J. Di Canzio, MS; LJ Micheli, MD

12:09 p.m. Discussion

12:12 p.m. Anterior Translation of the Knee in School-Aged Children
Richard Y. Hinton, MD, MPH, PT; Matthew Pautz, DO; Paul Sponseller, MD; Leslie S. Matthews, MD; Janet A. Yu-Yahiro, PhD

12:18 p.m. Discussion

12:30 p.m. LUNCH

Scientific Presentations—Session III Foot
Moderator: Thomas F. Kling, M.D., FAAP

25) 1:45 p.m. * Radical Postero medial and Plan tar Releases in Treatment of the Arthrogrypotic Clubfoot
Tuvee Do, MD; Safdar Khan, MD; Roger Widmann, MD; Stephen Burke, MD

1:51 p.m. Discussion

26) 1:54 p.m. The Purple Hallux: Prelude to Necrosis Following Clubfoot Surgery
Russell J. Crider, Jr., MD; David R. Hootnick, MD; David S. Packard, Jr, PhD; Mark Levinsohn, MD; David D. Aronsson, MD

2:00 p.m. Discussion

28) 2:12 p.m. * Tarso-Metatarsal Mobilization Comined with Anterior Tibialis Transfer: A Salvage Procedure for Supination Deformity in Clubfeet
Kerwyn Jones, MD; Dennis S. Weiner, MD; William C. Schrader, MD

Discussion

29) 2:18 p.m. * Efficacy of Tendo Achilles Lengthening in the Treatment of Idiopathic Toe Walking
George Papacostas, AB; Eric Wall, MD, FAAP; Rolando Izquierdo, MD

2:27 p.m. Discussion

29) 2:30 p.m. * The Stubbed Great Toe: Osteomyelitis or Open Fracture?
James T. Guille, MD; Daniel Kensing ter, BS, B. David Horn, MD

2:36 p.m. Discussion

30) 2:39 p.m. * Evans Calcaneal Lengthening in Pediatric Equinov alg us Foot Deformities
Tuvee Do, MD; Gaia Georgopoulou, MD; Frank Chang, MD

31) 2:45 p.m. Discussion

32) 2:48 p.m. Soft Tissue Abnormalities as a Clue to Ter atogenesis in the Human Lower Limb
David R. Hootnick, MD; David S. Packard, Jr. PhD; E. Mark Levinsohn, MD

2:54 p.m. Discussion

33) 3:00 p.m. Distinguished Service Lectureship Presentation
Howard H. Steel, MD

3:30 p.m. BREAK

Scientific Presentation Session IV Trauma
Moderator: Paul W. Esposito, MD, FAAP

33) 4:00 p.m. *Cast Treatment of Minimally Displaced Lateral Condyle Fractures in Children
William L. Henrikus MD, FAAP; Brian A. Shaw MD, FAAP; Joseph A. Gerardi, DO; Zhang-Ping Gu, MD

4:05 p.m. Discussion

34) 4:08 p.m. * Pins and Plaster as a Viable Alternative in the Management of Unstable Pediatric Forearm Fractures
Joseph Duncan, MD; Dennis Weiner, MD; William Schrader, MD

4:13 p.m. Discussion

35) 4:16 p.m. Changing Patterns of Pediatric Pelvic Fractures with Skeletal Maturation: Implications for Classification and Management
J. Silber, MD; J. Flynn, MD

4:21 p.m. Discussion

36) 4:24 p.m. *Displaced Hip Fracture in Children Managed with Early Operative Intervention

Downloaded from http://pediatrics.aappublications.org/ by guest on October 18, 2017
4:29 p.m. Discussion

37) 4:32 p.m. * Complications of Flexible Intramedullary Fixation of Pediatric Femur Fractures and Their Prevention
Joshua E. Hyman, MD; Unni Narayanan, MD; Francis Lee, MD; Mercer Rang, MBBS; Benjamin Alman, MD

4:37 p.m. Discussion

38) 4:40 p.m. A Prospective Outcome Study of Pediatric Femur Fractures: Titanium Elastic Nailing vs. Traction and Casting
JM Flynn, MD; J Dawson, RN; J D'italia, RN; DS Drummond, MD; RS Davidson, MD; TJ Ganley, MD; B Teti, RN; JP Dernons, MD; JR Gregg, MD; ML Ecker, MD

4:45 p.m. Discussion

39) 4:48 p.m. *Femur Fractures in Children: A Cost Comparison of Three Treatment Options
David Saxton, BS, MBA; Virginia Casey, BA; J. Andy Sullivan, MD

4:53 p.m. Discussion

40) 4:56 p.m. *Immediate Hip Spica Application for Closed Isolated Pediatric Femur Fractures
Michael C. Albert, MD; Anthony F. Infante, Jr. DO; W. Bryan Jennings, DO; James T. Lehner, MD

5:01 p.m. Discussion

41) 5:04 p.m. The Cast Brace Revisited: Immediate Cast Brace For the Treatment of Children's Femur Fractures
William J. Estes, MD; Richard H. Gross, MD, FAAP

5:09 p.m. Discussion

5:15 p.m. SECTION BUSINESS MEETING

6:00 p.m. RECEPTION

SUNDAY, OCTOBER 10, 1999

8:00 am–12:15 pm
Room 37, Washington Convention Center

8:00 a.m. Section Business Meeting

9:00 a.m. Symposium: New Perspectives in the Diagnosis and Management of DDH
Introduction: Robert B. Cady, MD, FAAP

9:05 a.m. Risk Factors for DDH
Harold Lehmann, MD, FAAP

9:25 a.m. The Role of Ultrasound in the Diagnosis and Management of DDH
H. Theodore Harcke, MD, FAAP

9:45 a.m. The Early Diagnosis and Management of DDH—A Pediatric Orthopedist Perspective
Dennis R. Roy, MD, FAAP

10:05 a.m. Questions and Answer Panel

10:30 a.m. BREAK

Scientific Presentations—Session V Neuromuscular
Moderator: William L. Henriksen, MD, FAAP

42) 11:00 a.m. The Effect of Preoperative Gait Analysis on Orthopedic Decision-Making

11:05 a.m. Discussion

43) 11:08 a.m. *Rectus and Hamstring Surgery in Cerebral Palsy
David Yngve, MD; Nancy Scarborough, PT; Richard J. Haynes, MD

11:13 a.m. Discussion

44) 11:16 a.m. The Impact of Postoperative Gait Analysis on Orthopedic Care of Pediatric Patients
Robert M. Kay, MD; Sandra Dennis, PT, MS; Susan Rethlefsen, PT; Richard A.K. Reynolds, MD; David L. Skaggs, MD; Vernon T. Tolo, MD

11:21 a.m. Discussion

45) 11:24 a.m. Are All Paraplegic Children Osteoporotic?
Krystyna Tuckerman, MD; Mario Turi, MD; Clifford Rosen, MD

11:29 a.m. Discussion

46) 11:32 a.m. *The Hoffer Procedure For Brachial Plexus Palsies
Duc P. Vo, MD; James Bennett, MD; Richard Haynes, MD

11:37 a.m. Discussion

47) 11:40 a.m. Pressure Mapping and Seating Modifications in Myelomeningocele
Kenneth J. Guidera, MD; Marvin Williams, MSBME; Paige Mutual, PT

11:45 a.m. Discussion

48) 11:48 a.m. Congenital Kyphosis in Myelodysplasia: Long Term Review
S. Zimbler, MD; T. Hresko, MD; L. Karlin, MD

11:53 a.m. Discussion

49) 11:56 p.m. *Perioperative Mortality in the Cerebral Palsy Population
Douglas A. Barnes, MD, FAAP; Richard J. Haynes, MD, FAAP

12:01 p.m. Discussion

12:05 p.m. Presentation of Resident/Student Awards
Robert B. Cady, MD, FAAP

12:15 ADJOURN

* Resident/student presentation for consideration for an award.

ABSTRACTS

1

MULTICOMPONENT PHESIS AND AUTOLOGOUS PLATELET GEL IN ADOLESCENT SPINAL SURGERY

B. Gillingham, MD*; G. Polston, MD*; T. Hannon, MD*; S. McKinlay, MD*; C. McCullen, MD, * (*Naval Medical Center, San Diego, California and * St. Vincent's Hospital, Indianapolis, Indiana).

Background: To assess the efficacy of perioperative multicomponent pheresis (PMP) as a method of blood conservation in scoliosis surgery.

Robert M. Kay, MD; Sandra Dennis, PT, MS; Susan Rethlefsen, PT; Richard AK Reynolds, MD; David L. Skaggs, MD; Vernon T. Tolo, MD

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MULTICOMPONENT PHESIS AND AUTOLOGOUS PLATELET GEL IN ADOLESCENT SPINAL SURGERY

B. Gillingham, MD*; G. Polston, MD*; T. Hannon, MD*; S. McKinlay, MD*; C. McCullen, MD, * (*Naval Medical Center, San Diego, California and * St. Vincent's Hospital, Indianapolis, Indiana).

Background: To assess the efficacy of perioperative multicomponent pheresis (PMP) as a method of blood conservation in scoliosis surgery.
Methods: A retrospective review of blood utilization in 25 patients [16 idiopathic (IP), 9 neuromuscular (NM)] undergoing spine surgery with PMP and intraoperative blood salvage (IBS) was performed and compared to 14 (8 IP, 6 NM) historical controls with IBS alone. Age and weight were comparable, but avg. number of operated levels were greater in the study group (11.5 vs. 15). All patients underwent PMP: isovolemic hemodilution with separation of whole blood into packed red cells, plasma and platelets. PRBC were returned to maintain moderate hemodilution. Plasma was returned for PT/PTR > 1.5 control, prior to decortication and at closure. Platelets were returned at closure. 20 % (60 cc) of platelets were combined with thrombin and calcium to form autologous platelet gel (APG) which was applied to bone edges, tissue planes and allograft if used. APG contains cytokines which act as tissue sealants and may promote fusion. Equipment cost per PMP case is equivalent to one preoperative autologous donated (PAD) unit.

Results: (presented in tabular form)

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<th>Group</th>
<th>N</th>
<th>EBL (cc)</th>
<th>EBL/Level</th>
<th>IBS (cc)</th>
<th>PAD¹</th>
<th>Used²</th>
<th>PRBCs³</th>
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<td>IP-control</td>
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<td>161</td>
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<td>NM-control</td>
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<td>156</td>
<td>494</td>
<td>0.8</td>
<td>0.28</td>
<td>0.43</td>
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¹ PAD = Number of autologous PRBC units obtained pre-op. ² PAD units transfused ³ PRBCs = homologous packed red blood cells transfused.

Conclusions: The study group received less blood products (both autologous and homologous) than controls. (IP: 0.55 vs 2.5; NM: 0.9 vs 5.1). This decreased allogeneic exposure as well as the expense and inconvenience of preoperative autologous donation. Advantages of PMP also include: flexibility of blood product return; cost effectiveness and provision of hemostasis and growth factors by APG.

2

NEW LEAD "WONDERBRA" TO HELP DECREASE THE RISK OF BREAST CANCER IN FEMALES WITH ADOLESCENT IDIOPATHIC SCOLIOSIS

Twee Do, MD* and Dana Wechsler, MS, OTR.** (*Dept. of Pediatric Orthopaedics and **Occupational Therapy, The Hospital for Special Surgery, New York, NY).

Background: Recent reports have shown a 41% increase in breast cancer deaths among females with adolescent idiopathic scoliosis compared to the national average. This increased risk is associated with the amount of spinal radiographs necessary for the diagnosis and management of their scoliosis. Proper shielding of the radiosensitive breast can greatly help reduce the adverse effects of radiation including direct tissue damage and cancer induction, however, the current available breast shields are large, loose garments that fit poorly and tend to shift during positioning. This leads to inadequate shielding of the breast, or radiographic obliteraton of the spine which necessitates repeat radiographs and further exposure to ionizing radiation. To avoid the unnecessary radiation exposure to the radiosensitive breast, we have developed a new "lead wonderbra", an adjustable lead garment that is form-fitting, contoured to protect the breast in both AP and lateral spinal radiographs, and can move with the patient.

Materials & Methods: Patients with scoliosis needing AP and lateral radiographs of the spine were recruited to use this new lead bra. A radiosensitive marker was placed on the bra as well as below the bra to determine the amount of radiation to which each patient was exposed and protected, respectively. The radiographs were evaluated by scoliosis surgeons for adequacy. A patient survey was obtained to assess comfort and ease of the garment. A radiology technician survey was obtained to assess the ease and feasibility of the garment for spinal radiographs.

Results: When applied by properly trained technicians, the garment shielded the breast tissue of all 30 patients evaluated without obscuring the important spinal elements. No repeat radiographs were necessary. The amount of radiation avoided by the use of the garment averaged 100mrad per set of AP and lateral radiographs. Patients reported no discomfort with the shield and were more satisfied with the protection it afforded to their budding breasts. The technicians had no difficulty with the use of the lead bra.

Conclusions: The new contoured form-fitting lead "wonderbra" protects the radiosensitive breast tissue of adolescents undergoing repeated serial spinal radiographs. Regular use during spinal radiographs may help decrease the cancer inducing effects of the excessive ionizing radiation, which may eventually translate to a decrease risk of breast cancer in later adult life.

3

PANCREATITIS AFTER SCOLIOSIS SURGERY IN CHILDREN AND ADOLESCENTS: INCIDENCE AND EVALUATION OF RISK FACTORS

S. Fealy, MD, F.J. Laplaza, MD, K.E. Schneider MD, P.J. Millett MD, R.F. Widmann MD. (Hospital for Special Surgery, New York, NY, 10021).

Background: Acute pancreatitis has been documented as a postoperative complication in both, the general surgery and orthopaedic literature. Most of the orthopaedic cases reported involve some type of spinal procedure (laminectiony and scoliosis). The etiology of this type of postoperative pancreatitis is not clear. The purpose of this study was to determine the incidence and possible predisposing factors for acute pancreatitis following scoliosis surgery in immature patients.

Methods: Retrospective review of records and radiographs of patients with congenital or idiopathic scoliosis and kyphosis undergoing surgery over a three-year period (1995-1997). Neuro muscular and syndromic cases were excluded. Twenty-one clinical and radiological parameters were assessed in each patient. These included but were not limited to, body mass index, instrumentation type, type of operation, length of surgery, blood loss, intraoperative mean arterial pressure, levels of fusion and percentage of curve correction. Ninety-seven patients were included. Their mean age was 13 years (118 yr.). There were 83 females and 14 males.

Results: Nine patients (9.3%) had elevated serum amylase and lipase levels. All of them were adolescent idiopathic cases. The only parameter found to be statistically different was age; 15.6 ± 1.6 yr. for the pancreatitis group versus 13.2 ± 2.9 for the asymptomatic group (p = 0.002). No further differences between the two groups were encountered. Estimated blood loss and low mean arterial pressure was nearly identical for both groups.

Conclusion: In this retrospective study, 9 out of 97 patients (9.3%) with congenital or adolescent scoliosis developed chemical pancreatitis. The only significant factor was age (asymptomatic patients were older). There were no other positive predictive factors associated to post-operative pancreatitis. Despite a delay in reaching a regular diet there was not difference in length of stay or physical therapy regimen between groups.
CHARACTERISTICS OF ANTERIOR SPINAL SURGERY COMPLICATIONS IN CHILDREN WITH NEUROMUSCULAR SCOLIOSIS

J.F. Sarwark, MD, FAAP; A. Aminian, MD; J.J. Grayhack, MD; A. Win, MD. Children's Memorial Hospital; Chicago, IL.

Background: We evaluated the perioperative complications of open anterior spinal surgery in children with neuromuscular scoliosis as a standard in light of developing thoracoscopy procedures.

Methods: 93 patients under the age of 18 who had an anterior procedure for the spine for the treatment of neuromuscular scoliosis between 1988 and 1995 were reviewed. Diagnosis, associated medical conditions, surgical procedure (1 stage or 2 stage), surgical technique (combined or single), surgical approach (thoracic, thoracoabdominal, retroperitoneal), duration of anterior procedure, the use of instrumentation and the type of instrumentation, estimated blood loss and the need for intraoperative transfusion, operative transfusion, duration of thoracotomy tube, and other complications resulting from the anterior procedure. Complications were categorized as Pulmonary, Cardiovascular, Gastrointestinal, Hematological, Genito-Urinary, Neurological, Wound Site Related, minor and major dependent upon its effect on the course of recovery. Results: Forty-eight (51.6%) of the patients exhibited at least one perioperative complication. There were a total of 60 and 24 (40%) were major complications and 36 (60%) were minor complications. Two patients (2%) experienced more than one major complication. No deaths occurred from any of these procedures or their subsequent complications. The most common major complication type was pulmonary (28% of all complications). Seventeen (18%) patients experienced a major pulmonary complication. Two (2%) of the patients overall had a major genitourinary complication. Two (2%) patients had a major hematological complication. One patient (1%) experienced a major wound related complication. One patient (1%)experienced a major cardiac complication.

<table>
<thead>
<tr>
<th>Complications</th>
<th>Major (40%)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary</td>
<td>Pneumonia, need for 2nd CT, failure to wean off ventilation for more than 3 days, pulmonary effusion requiring CT &gt;7 days.</td>
<td>18</td>
</tr>
<tr>
<td>Neurological</td>
<td>Persistent neurodeficit</td>
<td>1</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Bowel ischemia</td>
<td>1</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>CHF, pulm HTN</td>
<td>2</td>
</tr>
<tr>
<td>Hematologic</td>
<td>DIC</td>
<td>2</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>Hematuria, urinary obstruction</td>
<td>2</td>
</tr>
<tr>
<td>Minor (60%)</td>
<td>Atelectasis, transient hypoxia, mild effusion, URI, spontaneously resolving pneumothorax</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Paraesthesia, neuropraxis</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Wound dehiscence, superficial infection</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Ileus, gastritis, c. difficile colitis</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Transient arrhythmias</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Transient coagulopathy, blood transfusion rxn</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>UTI</td>
<td>21.5</td>
</tr>
</tbody>
</table>

Conclusion: Our data suggest that rate of major pulmonary complication in the same day (7/33, 21.2%) vs. the staged procedure was (6/35, 17.1%) is not significantly different. The data serves as a standard of reference for newly developing thoracoscopy procedures. Additionally, by focusing prevention strategies on common complications—especially pulmonary ones—the rates of complications can be reduced further.

ANTERIOR/POSTERIOR SPINAL FUSION SAME DAY VERSUS STAGED PROCEDURES

Kenneth J. Guidera, MD, Nancy Pisciotto RN, ONC, Stuart J. Elkowitz, MD, Carrie Gill-Murdoch, MD. Shriners Hospitals for Children, Tampa, FL.

Background: Large scoliosis curves frequently require anterior and posterior spinal fusion. This is true for both idiopathic and neuromuscular curves. This is a review of pediatric patients undergoing anterior/posterior spinal fusions to assess if there is any difference in the overall outcome with staged versus same day anterior/posterior fusion.

Methods: This is a retrospective review of 48 pediatric patients all treated for idiopathic and neuromuscular scoliosis at this institution. The medical records and radiographs were reviewed and the patients examined.

Results: In Group A, the same-day surgery group, there were 23 patients (11 males, 12 females). The diagnosis included: 13 idiopathic scoliosis, 1 kyphoscoliosis, 5 myelomeningocele, 2 cerebral palsy, 1 congenital scoliosis, and 1 congenital kyphosis. The average age was 14.4 years with a range of 7.3-18.6 years. There were 15 with Cotrel Dubousset rods, 1 with an insitu fusion, and 7 had Unit or Luque rods. The average follow-up was 3.1 years. The average hospitalization was 20 days. There were 5 patients requiring revision procedures, including hardware revision and irrigation and debridemnts for wound breakdowns. Group B consisted of 25 patients who underwent staged anterior/posterior fusion with an average of 8 days between the 2 procedures. There were 11 males and 14 females. The diagnosis included 11 idiopathic scoliosis, 7 myelomeningocele, 2 cerebral palsy, 3 other neuromuscular scoliosis, 1 juvenile idiopathic scoliosis, and 1 Scheurmann’s kyphosis. The average age was 14.5 years with an average length of stay of 29.5 days. The average follow-up was 5 years. There were 5 patients requiring revision procedures; 3 for the instrumentation, and 2 with irrigation and debridements of wounds. The wound patients all had neuromuscular scoliosis. All implant reivisions in both groups were with the CD instrumentation.

Conclusion: There were no significant differences between either group in regards to postoperative respiratory complications, hospital course, nor outcome. There were slightly more complications and revisions in the same day surgery group but this may have been related to the patient’s diagnosis. Issues such as pulmonary care, weight loss, pain management, and nutrition will be presented. There appeared to be no statistical differences between the 2 groups in regards to these factors. The choice of staged versus same day surgery appears to remain patient and surgeon dependent. It also related to the hospital, as in some institutions the longer hospitalization for the staged procedure may be financially prohibitive.

ROUTINE PREOPERATIVE MRI IN ADOLESCENT IDIOPATHIC SCOLIOSIS: A PROSPECTIVE STUDY OF 327 PATIENTS

Christian Fras, MD; Twee Do, MD; Stephen Burke, MD; Bernard Rawlins, MD; Roger Widmann, MD; Oheneba Boachie-Adjei, MD Department of Orthopaedic Surgery, Hospital for Special Surgery, New York, NY.
Background: The routine use of MRI examination of the spine and spinal cord pre-operatively in adolescent idiopathic scoliosis (AIS) is controversial. It is generally agreed that young patients, those with abnormal neurologic findings, left thoracic curves, or atypical curves should undergo MRI or myelographic examination before management of their scoliosis to rule out intraspinal pathology. The need for such studies in AIS is uncertain. Some have recommended that such studies be routinely performed pre-operatively. Previous preliminary results from our prospective study examining all pre-operative patients with AIS suggested that MRI may not be as helpful as previously thought. We now report the results of this ongoing prospective study evaluating a much larger group of patients.

Methods: From December 1, 1991, to March 1, 1999, all patients for whom operative treatment of AIS was recommended underwent MRI examination of the entire spine. Further inclusion criteria for this study were: (a) normal physical examination (other than scoliosis), with normal neurologic examinations, including superficial abdominal reflexes; (b) right thoracic, thoracolumbar, or double major curve; and (c) age 10–20 years at the time of surgery.

Results: A total of 327 patients met the criteria for inclusion in this study; 83 boys and 244 girls. Mean age was 13.7 years (range 10 to 19). Mean primary curve Cobb angle was 57 degrees (range 40 to 98). All patients underwent spinal fusion with instrumentation without neurologic complications. No cases of tethered cord or tumor were identified. Abnormal findings included: two cases of thoracic spinal cord syrinx (evaluated by pediatric neurosurgery and neurology services, and felt to be stable, not requiring surgery); 4 cases of Arnold-Chiari Type 1 Malformation; one finding of a fatty collection in a vertebral body; and 4 cases of equivocal MRI interpretation that required CT-myelogram for interpretation (subsequently read as normal). No neurosurgical or other therapeutic intervention was necessitated by any results noted in these imaging studies.

Conclusions: The group of patients reported in this study represents the largest ever evaluated with MRI before surgery for routine AIS. Previous reports based on smaller numbers of patients have drawn conflicting conclusions about the need for pre-operative MRI in AIS. The large number of patients in this prospective study, combined with the lack of significant pathology found on MRI, would strongly suggest that MRI is not routinely indicated in AIS if the patient has a normal neurologic examination and a typical curve pattern.

7

EVALUATING CONGENITAL SPINE DEFORMITIES FOR INTRASPINAL ANOMALIES WITH MRI

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Background: The incidence of the intraspinal abnormalities associated with congenital spinal anomalies using magnetic resonance imaging (MRI) is becoming more defined. The purpose of this study is to define further the incidence of intraspinal anomalies and to determine whether all children presenting with congenital vertebral anomalies should have MRI evaluation of the spine on or after initial evaluation.

Method: Forty-one children with congenital vertebral anomalies (excluding myelomeningocele) who underwent complete MRI were reviewed.

Results: Of the 41 congenital spinal deformities, 37 demonstrated congenital scoliosis, with failure of formation in 19, failure of segmentation in 4 and mixed defects in 14. The remaining 4 deformities were cases of congenital kyphosis. Thirteen patients with congenital spine anomalies were noted to have intraspinal abnormalities identified by MRI: tethered cord in 12 patients, syringomyelia in 3 patients, diastematomyelia in 5 patients. Of the 12 patients with tethered cord, 2 patients had neurologic deficits. Urorectal anomaly was one of the most common associated findings (15%).

Conclusion: Considering a rate of intraspinal anomalies of 31% with congenital vertebral anomalies, MRI evaluation is strongly recommended at initial evaluation of congenital spinal deformity patients 1) especially when clinical neurological signs are present (to assess need for neurosurgical interventions), 2) for those without neurological signs and 3) for patients who are undergoing corrective spinal surgery.

8

JUVENILE POSTURAL KYPHOSIS TREATED WITH A FIGURE-OF-EIGHT CLAVICLE STRAP—A PRELIMINARY REPORT

Yaseen Oweis and Robert Bright, MD

Postural round back deformity is not infrequently seen in our younger adolescent population, and forward shoulder flexion is usually noted in the patients with this diagnosis. Some years ago, when trying to decrease shoulder rounding with a figure-of-eight clavicle strap, it was noted that a concomitant decrease in the degree of thoracic kyphosis occurred in these selected patients. Thus, a prospective study to evaluate the effects of using a figure-of-eight clavicle strap to decrease the kyphosis angle in adolescents with postural round back deformities was developed. Preliminary results in 31 patients are reported here. Skeletally immature patients were offered a figure-of-eight clavicle strap to treat their round back deformities if their kyphosis angles (T2-T12) exceeded 45 degrees, 16 otherwise normal females and 15 otherwise normal males chose to try this method, wearing the strap during all waking hours, excluding sports time and gym class. Their average pretreatment curves measured 54 degrees for boys and 48 degrees for girls. They were seen in follow up at 2 month intervals with erect lateral x-rays being taken in the harness. Arms were held forward at not more than a 45-degree angle to avoid artificially straightening the thoracic spinal curvatures. As with any clinical study involving teenagers, compliance was a problem, such that only 22 patients were following the protocol after the first two-month follow up and that number decreased to 11 patients still using the strap after the third visit. The average curve improvement or decrease in males after 2 months was 15 degrees, while being 12 degrees for 9 females. After their third visit compliant boys had a 23-degree decrease in their kyphotic angle, while girls had an 18-degree decrease. These degrees of improvement brought the compliant adolescent down to a mid range kyphotic angle of around 30 degrees in both groups. Fortunately, almost all of these patients maintain their final kyphosis angle within the normal range or under 40 degrees six months after discontinuing treatment, although most lost a few degrees of the improvement achieved with discontinuation of the brace. Even a few juveniles who were weaned from the harness after a year of use (but long before reaching skeletal maturity) seem to maintain correct posture within the normal parameters of 20 degrees to 40 degrees even through their adolescent growth spurt. We have continued to apply this $20 orthotic device to selected adolescents in order to expand our experience, as well as our data base. We are encouraged by our preliminary results in this small study conducted during the last 5 years, and would encourage our colleagues to consider this treatment modality for their patients with flexible postural excessive thoracic kyphosis. It is much cheaper than the standard TLSO, and in compliant adolescents, for the most part, has been clinically effective. For some teenagers the threat of having to wear a Milwaukee brace as an alternative has served as sufficient incentive to improve compliance for the use of the figure-of-eight clavicle strap.
FUSIONLESS CORRECTION OF LUMBAR SCOLIOSIS BY ANTERIOR VERTEBRAL OSTEOTOMY

Thomas F. Kling, Jr., MD, FAAP; Richard E. Lindseth, MD
Indiana University, Indianapolis, Indiana.

Current lumbar scoliosis surgery has a disadvantage of fusing the spine. While it is not clear what problems will arise long after spine fusion, problems related to fusion can be avoided if scoliosis is corrected without fusing the spine. Between 1992 and 1996, we have corrected 17 adolescents lumbar scoliosis with an anterior, U-shaped, closing wedge osteotomy of 3–4 apical vertebrae. No discs were invaded and no permanent instrumentation was used. Average age was 13.3 yrs. (12–15yrs.) and average follow-up was 3.9 years (minimum 2 yrs.). Five patients had 4 levels and 12 patients had 3 level osteotomies between T1 and L3. Four level curves average 58° (45°–65°), and were corrected to 24° (20°–30°) or 8.7° per osteotomy. Three level curves average 52° (40°–66°) and were corrected to 27° (12°–46°) or 8.1° per osteotomy. The osteotomized vertebrae were secured with an absorbable Vicryl suture and an ambulatory cast for 4 weeks. Range of motion of the osteotomized vertebrae measured 29° pre-op and 30° one year after surgery. Complications included: loss of correction in 2 patients; (1 immature patient < Risser 3 and a sharp 3 segmental curve); foot drop in 1 patient (partially recovered); 2 patients with paresthesia—completely recovered; and lumbosacral pain in 1 patient. We conclude that Fusionless correction of lumbar scoliosis is technically demanding but feasible; should be done after Risser 3, and maintains motion and alignment of the spine in this preliminary study.

ENDOSCOPIC MECHANICAL SPINAL HEMIEPIPHYSIODESIS FOR CORRECTION OF IDIOPATHIC SCOLIOSIS

Donita I. Bylski-Austrow, PhD, Eric J. Wall, MD, FAAP, *Ronald J. Kolata, DVM, Alvin H. Crawford, MD. Children’s Hospital Medical Center, 3333 Burnet Ave., Cincinnati, Ohio 45229-3039; *Ethicon Endo-Surgery, Inc., 4545 Creek Rd., Cincinnati, OH 45242.

Introduction: Spinal hemiepiphyseodesis for correction of idiopathic scoliosis has been largely unsuccessful, however the reasons for the failure are not completely understood. The purpose of this study is to re-evaluate the potential of anterior, endoscopic hemiepiphyseal stapling for scoliosis correction without fusion, and identify the reasons for failure.

Methods: In seven live adolescent pigs, orthopaedic staples were implanted across the growth plates of one side of the spine just anterior to the rib heads using endoscopic procedures approved by an IACUC. Each pig received a single staple design in at least five successive mid-thoracic levels. Three designs have been tried to date in four pigs, modified commercial orthopaedic staples were implanted across an intervertebral disc and two growth plates. In another, bone screws were added to the cross member of smaller staples, which were implanted across one growth plate only. Finally, two pigs received implants designed specifically for pig spinal anatomy; these crossed the intervertebral disc and two growth plates and included screw fixation. Lateral and distraction anterior-posterior radiographs were taken immediately after surgery then repeated biweekly for 6 weeks. In selected specimens, CT scans were taken after spine harvest, then histologic sections were cut.

Discussion and Conclusion: With the first staple design, the disc space was narrowed at the levels of the most stable staple, but most of the staples partially displaced from the vertebrae. Little to no curvature developed. Radiolucentcies indicated blade migration in bone. With the second design, all devices remained securely in place, and vertebral growth slowed, yet no curvature developed. With the third design, the curve measured 20° at 6 weeks, with discernible compensatory curves.

Results: The third design of spinal hemiepiphyseodesis induced a moderate thoracic curvature in two normal pigs within 6 weeks. The response of the spine depended on device design. Initial fixation and incorporation of device into bone have improved over the course of these early pilot experiments. This study demonstrates the potential for idiopathic scoliosis intervention with a simple endoscopic implant.

ENDOSCOPIC PELVIC OSTEOTOMY—FIRST TEN CASES

Eric J. Wall, MD, FAAP, Ron Kolata, DVM, Dennis Roy, MD, FAAP, Charles T. Mehiman, DO, Alvin H. Crawford, MD.

Background: Rotational pelvic osteotomies can improve hip biomechanics and forestall the onset of arthritis in patients with hip dysplasia. However, open pelvic osteotomy is highly invasive and can be complicated by excessive blood loss and prolonged recovery time. We have developed a technique of endoscopic triple pelvic osteotomy aimed at decreasing surgical invasiveness and speeding recovery. We review our first ten cases of endoscopic triple innominate osteotomies.

Methods: Pre-operative and post-operative charts and radiographs were reviewed on the first ten patients undergoing endoscopic pelvic osteotomy. Five patients had developmental dysplasia of the hip, two patients had myelomeningocele, two patients had Perthe’s disease, and one patient had Down syndrome.

Results: The average center edge angle improved from 2° preoperatively to 38° post-operatively. Adult acetabular index (AAI) improved from a pre-operative average of 50° and down to a post-operative average AAI of 27°. Only one patient was casted post-operatively and all of the patients were allowed early ambulation with crutches. Most patients passed physical therapy including crutch stair climbing on the first post-operative day. Patients were allowed touch down weight bearing until their iliac osteotomy healed at 6–12 post-operatively, and then they were allowed full weight bearing. There were no major complications secondary to the endoscopic pelvic osteotomy cuts. One patient suffered ureteral and bowel injury from placement of a percutaneous iliac fixation pin. Two patients had asymptomatic delayed healing of their pubic rami or iliac osteotomy.

Conclusion: Endoscopic pelvic osteotomy, although technically difficult, gives excellent radiographic improvement for severe acetabular dysplasia.

SEPTIC HIP ARTHRITIS IN CHILDREN: FOUR DECADES OF TREATMENT

Kerwyn Jones, MD, Dennis S. Weiner, MD and William C. Schrader, MD. Children’s Hospital Medical Center of Akron Dept of Orthopaedics, Akron, OH.

Background: Septic arthritis of the hip is a relatively common disorder in children and adolescents. Often, the pediatrician is the first medical personnel to evaluate the child. The purpose of this study is to determine factors that effect the outcome after diagnosis and treatment of septic hip arthritis and to evaluate our results with treatment over a four decade period.

Methods: A radiographic outcome analysis was used to evaluate the 68 patients that had minimum radiographic follow-up of 12 months. Results: In regards to timing those patients which were evaluated within 5 days of the initial onset of symptoms had better radiographic results. Expedient timing of surgical
drainage within 5 days of onset of symptoms also had better long term radiographic results. Finally, there was radiographic evidence of overall better results in the group which underwent surgical drainage and antibiotic therapy compared to the group that received only antibiotic therapy. There also appeared to be a correlation with age with the neonatal group demonstrating worse long term radiographic results. Overall results for the study group showed improvement in results over the four decades.

**Conclusion:** In summary, early diagnosis and prompt surgical drainage are essential to assure the best possible results for septic hip arthritis in children.

13

DIFFERENTIATING BETWEEN SEPTIC ARTHRITIS AND TRANSIENT SYNOVITIS OF THE HIP IN CHILDREN: AN EVIDENCE-BASED PROBABILITY ALGORITHM

Mininder S. Kocher, MD; David Zurakowski, PhD; James R. Kasser, MD. Department of Orthopaedic Surgery, Children's Hospital, Harvard Medical School.

**Background:** The presentation of a child with an acutely irritable hip can pose a diagnostic challenge. An accurate diagnosis is essential for optimal care. The purpose of this study was to determine the diagnostic value of screening variables in differentiating between septic arthritis and transient synovitis of the hip in children and to develop an evidence-based probability algorithm for this differentiation.

**Methods:** We retrospectively reviewed all children who presented to a major tertiary-care children's hospital from 1979 to 1996 with an acutely irritable hip (n = 278). All included patients (n = 164) had complete clinical and laboratory evaluation. The diagnosis of true septic arthritis (TSA) (n = 38) was assigned for positive joint fluid culture or joint fluid WBC > 50 × 1000/mm³ with positive blood culture, presumed septic arthritis (PSA) (n = 44) was assigned for joint fluid WBC > 50 × 1000/mm³ with negative cultures, and transient synovitis (TS) (n = 86) was assigned for joint fluid WBC < 50 × 1000/mm³ with negative cultures and resolution of symptoms without antimicrobial therapy. Univariate analysis and multiple logistic regression were used to compare SA (TSA + PSA) versus TS groups and to compare TSA versus PSA groups. A probability algorithm for differentiation between SA and TS based on the independent multivariate predictors of SA was constructed and tested.

**Results:** SA patients differed significantly (p < 0.05) from TS patients with regard to ESR, WBC, blood differential (PMN, lymphocytes, basophils), non-weight bearing status, history of fever, effusion on radiograph, history of chills, history of recent antibiotic use, hematocrit, and male sex. TSA patients differed significantly (p < 0.05) from PSA patients with regard to history of recent antibiotic use, history of chills, ESR, history of fever, male sex, and blood differential (bands, basophils). Four independent multivariate predictors were identified to differentiate between SA vs TS: history of fever, refusal to bear weight, ESR/40 mm/hr, and WBC > 12 × 1000/mm³. The probability of SA vs TS was determined for all 16 combinations of these four predictors and summarized as < 0.02% for 0 predictors, 3.0% for 1 predictor, 40.0% for 2 predictors, 93.1% for 3 predictors, and 99.6% for 4 predictors. The chi-square test for trend and the area under the receiver operating characteristic curve indicated excellent diagnostic performance of this group of multivariate predictors in identifying septic arthritis. Two independent multivariate clinical predictors were identified to differentiate between TSA vs PSA: history of chills and male sex.

**Conclusion:** Several variables differed significantly between the SA and TS groups, however substantial overlap in the intermediate ranges made differentiation difficult on the basis of individual variables alone. By combining variables, we were able to construct a probability algorithm from a set of independent multivariate predictors which had excellent diagnostic performance in differentiating septic arthritis and transient synovitis of the hip in children.

14

THE DEMOGRAPHICS OF ATYPICAL AND IDIOPATHIC SLIPPED CAPITOL FEMORAL EPIPHYSIS (SCFE): THE AGE-WEIGHT TEST AND IMPLICATIONS FOR FURTHER DIAGNOSTIC EVALUATION

Randall T. Loder, MD, FAAP, and Mary Lou VH Greenfield, MS, MPH. Section of Orthopaedic Surgery, University of Michigan, Ann Arbor, MI.

**Background:** When presented with a new case of SCFE, the physician must decide if further diagnostic evaluation is needed to exclude an underlying metabolic abnormality. It was the purpose of this study to investigate the demographics of both idiopathic and atypical SCFE to determine if further evaluation is warranted.

**Methods:** The demographic data of 433 children with 612 SCFEs was compiled and divided into 4 subgroups: 1-idiopathic (ID), II-renal failure (RFA), III-radiation therapy (RTA), and IV-endocrine disorders (ENDA). Statistical analyses consisted of univariate, bivariate, and multiple logistic regression analyses. Results: There were 285 ID, 31 RFA, 32 RTA, and 85 ENDA children. For each of these 4 subgroups respectively, the average age at diagnosis of SCFE was 12.8 ± 1.6, 11.4 ± 4.4, 10.5 ± 3.3, and 15.3 ± 5.3 years (p = 2 × 10⁻⁹); the average weight at diagnosis of SCFE was 69 ± 17, 41 ± 14, 27 ± 10, and 64 ± 23 kg (p = 1 × 10⁻⁹); and the eventual proportion of bilaterality was 35%, 90%, 28%, and 61% (p = 4 × 10⁻¹⁰). There was no difference by gender. A stepwise forward multiple logistic regression analysis demonstrated that at the time of initial presentation both age and weight were predictive of a patient having an atypical (RFA, RTA, ENDA) SCFE. For two patients of equal weights, those < 10 or > 16 years of age are 4.2 times more likely to have an atypical SCFE (p = 0.0003); for two patients of equal age, those < 50th percentile weight are 8.4 times more likely to have an atypical SCFE (p < 0.001). On the basis of this regression analysis, we have defined the AWT (age-weight test):

<table>
<thead>
<tr>
<th>Age ≤16 years</th>
<th>Age &gt;16 years</th>
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<tbody>
<tr>
<td>Wght ≥50th %ile</td>
<td>AWT (−)</td>
</tr>
<tr>
<td>Wght &lt;50th %ile</td>
<td>AWT (+)</td>
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</table>

The chances of a child with a negative AWT having an idiopathic SCFE is 93% (negative predictive value). The chances of a child with positive AWT having an atypical SCFE is 52% (positive predictive value). We encourage further evaluation for those children with a positive AWT. **Conclusion:** A simple evaluation of the child’s age and weight can be very useful when considering the necessity for further evaluation into the etiology of the SCFE.

15

DELAY IN DIAGNOSIS FOR SLIPPED CAPITAL FEMORAL EPIPHYSIS.


**Background:** The purpose of this study was to evaluate the incidence of missed diagnosis and the delay in referral by the primary care system for children and adolescents with SCFE.
Methods: A retrospective medical records review from 1989 to 1997 of children treated surgically for SCFE at our institution was done. Reviews of emergency room records, outside medical charts, radiographs and interviews with patients and their families completed our analysis. The primary care system was defined as outside emergency room visits, urgent care clinics and private offices.

Results: 102 patients (mean age: 11.9 years; range: 6.7 to 17 years) were included in our series. 68% of patients were above the 95th percentile mean weight for age. Knee and/or thigh pain was documented in 40% of children. 26 of 102 (25.5%) patients presented directly to our clinic or emergency room while the remaining 72 patients visited 100 outside physicians. The data on 4 patients was unavailable. 53 (69%) saw a single primary care provider while 22 (30%) and 11 (1%) had visits to two and three different primary care providers, respectively. Of these 100 visits only 48 referrals to an orthopedist were made. Duration of symptoms prior to presentation at our institution averaged 140 days (range: hours to 1.5 years) and the mean delay after the first primary care visit till presentation was 76 days (range: hours to 1 year). Of 97 pre-op radiographs available, 72 (74%) had mild slips of which 41 (57%) had slips of <10%. 11 (11%) had severe slips.

Conclusions: The subtle clinical and radiographic findings in mild cases of SCFE may elude health care personnel not trained specifically in orthopedics. This study demonstrates a 2 month delay and a 52% failure rate of the primary care system to diagnose this common cause of hip pathology. We conclude that there appears to be a need for increased orthopedic education for primary care providers who must have a high index of suspicion for SCFE when evaluating obese adolescents with hip, thigh or knee pain.

16

VALUE OF PORTABLE MINI-FLUOROSCOPY IN THE PEDIATRIC ORTHOPAEDIC CLINIC
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Background: Portable mini-fluoroscopy has been previously reported as safe, valuable, and effective in the ER for fracture reduction and in the OR for hand and foot surgery. The purpose of this study is to report the value of portable fluoroscopy in the orthopaedic clinic within a hospital setting.

Methods: All fluoroscopic studies were performed using an OEC Med Systems Mini 6600 Digital Mobile C-arm. Shielding of the patient and staff were used to minimize radiation exposure. The fluoros images are printed on paper and attached to the medical record. Selection of patients appropriate for fluoros imaging was made by the attending surgeon and included extremity fracture follow-up, fracture reductions, pin removal, location of foreign bodies, and joint stability stress exams. The orthopaedic surgeon’s interpretation of the fluoros images was recorded in the visit dictation.

Results: From 1 April 98 to 31 March 99, 12,198 patients were evaluated at our orthopaedic clinic. 6,065 patients had a radiographic exam: 4,859 (80%) were conventional radiographic exams, and 1,196 (20%) were portable fluoros exams. 1,064 (89%) upper extremity and 132 (11%) lower extremity fluoros exams were done. Monthly radiation badge monitoring was normal for all individuals performing fluoroscopy. The fluoros unit cost the hospital $78,000.

Conclusions: Previous studies have demonstrated that portable fluoroscopy is convenient, rapid, accurate and saves time, money, and radiation exposure in the ER and OR setting. A leadlined room is not necessary. In the clinic setting, as patient volumes increase, methods to improve patient flow are vital. In the present study, 50% of patients visiting our clinic required a radiologic exam. Portable mini-fluoro was used successfully in 20% of these patients. Fluoro exams in the orthopaedic clinic eliminated a trip to the radiology department in 1 of 5 patients and improved overall clinic time efficiency. The orthopaedic surgeon’s interpretation of the fluoros images was immediate, accurate, recorded in the chart, and made a significant impact on the patient’s care. The hospital’s technical component charge for the fluoros images was about $45 per patient. The cost of the machine is achieved in 1 year, 4 months.

17

THE FUNCTIONAL HEALTH STATUS AND ORTHOPAEDIC MANIFESTATIONS OF CHILDREN WITH COSTELLO SYNDROME
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Background: Costello Syndrome is a rare condition characterized by short stature, developmental delay, curly thinning anterior hair, a characteristic facies, and redundant skin of the neck, palms, soles, and fingers. A number of musculoskeletal manifestations of the condition have been described in case reports. 18 children and adolescents were evaluated at the International Costello Syndrome Conference in Birmingham, Alabama. This study reports on their functional health status and the spectrum of orthopaedic conditions that afflict them.

Methods: 16 participants in the International Costello Syndrome Conference underwent a complete history and physical examination. All available medical records and radiographs were reviewed. A medical history and record review was carried out on 2 additional children who were not examined. Photographs were taken of all children. The MODEMS Baseline Assessment was administered to the parents of all 18 participants.

Results: Of the 18 children in the study, 16 were examined by two of the authors. The ages of the participants ranged from 3 to 23. All children demonstrated delayed walking and a characteristic gait pattern. None of the participants was able to run. They tended to hold their elbows and wrists flexed at 90 degrees and most complained of difficulty with overhead activity. Ligamentous laxity was noted in all of the participants. Foot problems were clearly the most prevalent, with tight heel cords seen in 9 of the 18 participants (50%). Of these, 5 were treated surgically (56%), while 3 were treated with serial casting (33%). Congenital vertical talus was seen in 5 of those evaluated (28%), and was bilateral in 4 of these 5. All cases were treated surgically. 7 individuals had bilateral planovalgus feet (39%), while 6 (33%) had bilateral overriding 2nd toes. Three children (17%) had hip subluxations with 2 requiring surgery. Both were noted to recur with 1 requiring reoperation. Three individuals with kyphosis were encountered (17%). Two children had a thoracic kyphosis that was never treated, while a third had a lumbar kyphosis that was braced until skeletal maturity. Three children (17%) had scoliosis: only one of which required surgery. One child had what appeared to be infantile scoliosis, with a 30-degree curve treated by bracing for one year with regression of the curve to 15 degrees. One of the older children was noted to have bilateral radial head subluxations. This individual also developed a wrist flexion/pronation deformity treated with a pronator release and extensor transfer. He has since developed a wrist extension deformity. Two children had no orthopaedic complaints.

Conclusions: This represents the largest group of individuals with Costello Syndrome that has ever been studied. In these individuals, foot problems were the most prevalent. An unusually high incidence of congenital vertical talus was noted. Hip subluxation and kyphosis or scoliosis, although less common, did occur in a number of patients, and were in several cases severe enough
to warrant surgical intervention. Orthopaedic problems are a significant part of Costello Syndrome, and these individuals should be evaluated and followed regularly by an orthopaedist. Funded by travel grants from the Department of Orthopaedic Surgery, Tufts-New England Medical Center, Boston, MA and Scandinavium, Inc., Birmingham, AL.

18

INCREASED PREVALENCE OF SCOLIOSIS IN TURNER'S SYNDROME

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Turner’s syndrome is associated with multiple skeletal abnormalities. However, the prevalence of scoliosis in children with Turner’s syndrome has not been reported in the orthopaedic literature. The purpose of this study was to determine the prevalence and characteristics of scoliosis in these patients. We performed a retrospective study of forty-three patients with Turner’s syndrome at Children’s Hospital of Orange County and Kaiser Permanente of Anaheim and found five children with a curve greater than 10 degrees. The prevalence of scoliosis in this Turner’s syndrome population, 11.6%, was significantly greater than the reported prevalence of idiopathic scoliosis in normal children, 4% (p = 0.04). The mean age of onset was 9 years, 11 months (range, 3yr 3mo to 13yr 7mo). All curves presented greater that 34 degrees with curves consisting of a right thoracic or S-shaped (larger lumbar segment) pattern. At the time of scoliosis presentation, two patients were not on growth hormone therapy. The results of this study suggest that children with Turner’s syndrome need to be examined for and closely monitored for progression of scoliosis by orthopaedists. Although curve progression can occur during growth acceleration, a direct causal association with growth hormone has not been established.

19

HIP DISLOCATION DOWN SYNDROME.

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Purpose of Study: A review of children with Down Syndrome treated at Gillette Children’s Specialty Healthcare and the Twin Cities Shriners Hospital for Children between 1923 and the current time was undertaken.

Methods: 122 children with Down Syndrome were studied. 20 patients had either subluxable dislocatable dysplastic or dislocated hips.

Results: Of the 20 patients with hip instability, age at identification of instability averaged 146 months. Eleven were females and 9 males. Thirteen had bilateral involvement. Length of follow-up averaging 48 months. Radiographic assessment included acetabular index and angle, acetabular depth, CE angle of Wiberg and neck shaft angle. Acetabular angles and acetabular indexes were within normal range. Acetabular depth was found to be less than normal in the involved hips. Treatment for hip instability included observation in two patients, both of whom developed fixed dislocations. Three patients were treated with abduction, bracing or casting. In neither of these cases was a stable, located hip achieved. Two required subsequent surgical treatment and both achieved stability with surgical treatment. One patient underwent surgical treatment with posterior capsulorrhaphy alone. Both hips remain stable in this patient. Femoral and pelvic osteotomies alone were formed in seven patients (10 hips). In this group, four patients (6 hips) were stable and located. Two patients (3 hips) had stable, but subluxated hips and one patient with spastic hemiparesis developed progressive degenerative disease and underwent total hip arthroplasty. Combined capsulorrhaphy and bony procedures were performed in eight patients (14 hips). Seven hips were stable at follow-up, three were subluxated, and four dislocated. Salvage procedures were performed in two patients including Schanz osteotomies bilaterally in one patient. Ten patients (15 hips) had clinically stable hips after their index surgical procedure. Eleven of these hips were located, but four were still subluxated. Three patients required additional surgery to gain stability (5 hips). At final follow-up, 50% of all hip studies were stable and located, 22.5% were stable, but subluxated, 25% were dislocated, and 4% had undergone total arthroplasty. Of those hips treated to gain stability, 56% were stable and located at follow-up, 26% were subluxated, and 18% were dislocated.

Conclusion: Management of hip instability in Down Syndrome is difficult due to the high rate of recurrent subluxation or dislocation. Multiple surgical procedures can be required to gain stability. This needs to be emphasized to families preoperatively. Long-term prognosis for these hips remains guarded, as current stability is not a guarantee of future stability.

20

THE INCIDENCE OF RADIOGRAPHIC FINDINGS IN AND CLINICAL SIGNIFICANCE OF PROTRUSIO ACETABULI IN MARFAN SYNDROME

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Background: Marfan syndrome is an autosomal dominant disorder of connective tissue that affects 1:10,000. The alteration on the long arm of chromosome 15q21 leads to abnormal fibrillin, affecting predominantly the ocular, cardiovascular and skeletal systems. The orthopaedic manifestations of Marfan syndrome have been well defined. This may range from minimal involvement such as arachnodactyly and ligamentous laxity to severe structural deformities including kyphoscoliosis, pectus carinatum and symptomatic pes planus. Steel was first to note the presence of protrusio acetabuli in his patients with Marfans syndrome and recommended triradiate epiphyseodesis to arrest, if not reverse, the protrusio. Since this initial report, other isolated case studies and small series have been the published establishing the incidence of protrusio acetabuli at 50% to 100%

Purpose: To evaluate pelvic radiographs from a large group of Marfan patients to determine the incidence, etiology, radiographic parameters and clinical significance of protrusio acetabuli.

Materials & Methods: Twenty one patients with a diagnosis of Marfan was enrolled in an IRB approved study. There were 6 males and 15 females. The age ranged from 3 years to 63 years. All patients had pelvic radiographs and 18 patients had bone density scans. The measurement for protrusio include 5 of the established radiographic parameters for determining protrusio (distance from femoral head to acetabulum; teardrop crossing the ilioischial line, acetabular line crossing the ilioischial line, acetabular line crossing Kohler’s line and acetabular line crossing the iliopectineal line). The standard for determining protrusio was by official reading from a consensus of radiologists. This was then compared to results established based the 5 radiologic parameters.

Results: The incidence in our series is 31%. The single radiographic parameter that had the highest correlation with protrusio was crossing of the acetabular line by the iliopectineal line (PPV = 100%, NPV = 94%). A positive combination of 4/5 radiographic parameters was accurate in diagnosing protrusio (PPV = 100%, NPV = 100%). Bone density in Marfan patients were lower than aged matched controls, but did not significantly differ between patients who developed protrusio and those who did not. (~0.27 vs ~0.21). No patients had hip symptoms in the protrusio group.

Conclusions: Our incidence for protrusio acetabuli in Marfan syndrome is 31%, which is lower than that previously reported.
The best method to diagnose protrusio is by satisfying 4/5 radiographic measurements for protrusio. A diagnosis of radiographic protrusio does not correlate with clinical symptoms and in itself does not necessitate treatment. The need to surgically intervene in cases of protrusio in the child should not be predicted on appearance of the radiographs, but in combination with a good physical exam and corresponding clinical symptoms.

21

THE EFFECTIVENESS OF SEAT BELTS AT REDUCING INJURY SEVERITY TO SCHOOL-AGE CHILDREN

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Background: Motor vehicle collisions (MVCs) are the leading cause of death to school-aged children in North America. However, there are no restraints designed specifically for them; instead, they are placed in adult seat belts. This study investigates which of the adult restraints (lap-torso belt or lap belt) is better for these children. Specifically, the purpose of this study was to determine (1) if adult restraints reduced injury severity to these children when compared to no restraint, (2) if lap-torso belts were better than lap belts, and (3) if children were as well protected as adults.

Methods: Linear and logistic multiple regression analyses were performed using data from Transport Canada’s Passenger Car Study in order to evaluate the Injury Severity Score (ISS) for 200 children involved in MVCs, while adjusting for belt type, Barrier Equivalent Velocity (BEV), age, and seat position.

Results: Results for school-age children demonstrated that the lap-torso belt, in the front right seat reduced the mean ISS by 2.64, from 3.42 (95% CI: 1.96 to 6.29) to 0.78 (95% CI: 0.48 to 1.18). Similarly, the lap belt in the rear left seat reduced the mean ISS by 1.07, from 2.05 (95% CI: 1.17 to 3.61) to 0.98 (95% CI: 0.58 to 1.55). These reductions compared favourably with adults who realised injury reductions of 1.38 (from 3.03 to 1.65) and 1.09 (2.16 to 1.07), respectively. The odds ratio of sustaining at least a moderately severe injury (ISS ≥ 4) for unrestrained children compared to children restrained by the lap-torso belt was 9.81 (95% CI: 2.43 to 39.4) and 2.74 (95% CI: 1.21 to 6.18) compared to those wearing the lap belt. Again, these odds ratios were at least as good for children as they were for adults (i.e. adult odds ratios of 2.39 for the lap-torso belt, and 2.57 for the lap belt). Finally, there was no statistical difference in the mean ISS for children restrained by the lap-shoulder belt in any seat (ISS = 1.54; 95% CI: 0.47 to 5.06) as opposed to the lap belt (ISS = 1.15; 95% CI: 0.70 to 1.83). Similarly, the odds ratio of sustaining at least a moderate injury while wearing the lap belt as opposed to the lap-torso belt was 1.35 (95% CI: 0.75 to 2.34), which was not statistically different.

Conclusion: The analyses demonstrated that lap-torso and lap belts protected school-aged children better than no restraint; however, there was no difference between the two restraints in injury reduction. Moreover, school-age children were as well protected as adults by these restraints.

22

AN EXPLORATION OF QUALITY OF LIFE OUTCOMES MEASUREMENT IN SCOLIOSIS AND CEREBRAL PALSY

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Background: Many, but not all, orthopaedic procedures performed on children aim to improve quality of life. Thus, it is important to identify pediatric quality of life measures that are sensitive to the issues in this unique population and equally important to understand areas of pediatric orthopaedic intervention in which quality of life assessment may be less appropriate.

Methods: As part of an ongoing prospective study examining issues relating to quality of life in children, the current effort focused on two clinical diagnoses: scoliosis and cerebral palsy (CP). Parents of children (age 3–18) with either of these diagnoses completed both the American Academy of Orthopedic Surgeons’ Pediatrics Outcomes Instrument (POI) and the Child Health Questionnaire PF-28 (CHQ-28). Scoliosis patients were asked to complete the Scoliosis Research Society’s Patient Outcomes Instrument (SRS). Subjective scores regarding physical and psychosocial health were given to each patient by the clinical staff. Traditional clinical measures appropriate to each diagnosis were also collected. The population was then stratified by diagnosis, comorbidity scores, and clinical measures to create patient subgroups that would be expected to have differences in disease severity. The POI, CHQ, and subjective scores were then calculated for each subgroup. Differences in scores were assessed using Student’s t-test.

Results: Among scoliosis patients, curve location and number of vertebral levels were not highly correlated with any QOL scores (Pearson’s r < 0.3). Degree of curvature, however, was significantly correlated with SRS Self Image (r = -0.34, p = .009). Cerebral palsy patients with quadriplegia scored significantly worse than those with diagnoses of diplegia or hemiplegia in all physical function domains as well as Family Activities (p < 0.05). CP patients who were non-ambulatory likewise scored significantly lower than ambulatory patients in all physical function domains (p < 0.05). Several domain scores (particularly from the POI) for patients in the lower functioning strata were low enough to suggest floor effects.

Conclusion: Given the heterogeneity of children presenting for evaluation of pediatric orthopaedic problems, it is evident that no single measure of outcome will suffice for every patient group. Moreover, given that some procedures serve to avert morbidity in the long term rather than to effect a short term change in health status, the use of short term quality of life endpoint will not always be appropriate. Nevertheless, both the CHQ and the POI represent a significant improvement in assessment methodology for some of our patients, and will serve a valuable role in the assessment and comparison of outcomes for these patient groups.

23

DIAGNOSTIC PERFORMANCE OF CLINICAL EXAMINATION AND SELECTIVE MRI IN THE EVALUATION OF KNEE DISORDERS IN CHILDREN AND ADOLESCENTS

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Background: The accuracy of MRI and clinical exam for diagnosing knee disorders is well established in adults, but less well characterized in children and adolescents. In addition, knee injuries are being seen with increased apparent frequency in children and adolescents. The purpose of this study was to determine the diagnostic performance of clinical exam and selective MRI in the evaluation of knee disorders in children and adolescents.

Methods: A consecutive series of patients treated for an intra-articular knee disorder between 1990 and 1997 in the sports medicine clinic of a major children’s hospital were reviewed. Included cases (118 knees in 113 patients) were ≤16 years of age (mean = 11.9, range 3–16), had no prior history of knee surgery, and had an initial clinical diagnosis, followed by an MRI diagnosis, followed by arthroscopic findings. Clinical diagnosis was thus made without MRI input and MRI studies were ordered selectively. Agreement was assessed between clinical exam and arthroscopy and
between MRI and arthroscopy. Sensitivity, specificity, and accuracy of clinical examination and MRI were determined overall and for each major type of injury. Stratification effects by patient age and MRI center were examined.

Results: There were 142 clinical lesions, 130 MRI lesions, and 138 arthroscopic lesions. Of the arthroscopic lesions, there were 35 ACL tears, 31 medial meniscal tears, 25 lateral meniscal tears, 24 OCD, 19 lateral discoid menisci, and 4 other. Patients with lateral discoid menisci were significantly younger (p < 0.01). There was no significant difference (p > 0.05) for agreement comparing clinical exam and MRI (to arthroscopy); complete or partial agreement (clinical exam: 70.3%; MRI: 73.8%) and disagreement (clinical exam: 29.7%; MRI: 26.3%). There was no significant difference (p > 0.05) between clinical exam and MRI for overall diagnostic performance; sensitivity (clinical exam: 71.2%; MRI: 72.0%), specificity (clinical exam: 90.3%; MRI: 93.0%), and accuracy (clinical exam: 86.2%; MRI: 73.6%). Analysis by diagnosis revealed differences only for sensitivity for lateral discoid meniscus (clinical exam: 88.9%; MRI: 38.9%; p = 0.002) and specificity (clinical exam: 80.7%; MRI: 92.0%; p = 0.028) and accuracy (clinical exam: 76.1%; MRI: 88.9%; p = 0.010) for medial meniscal tears. For children less than 12 years old, sensitivity, specificity, and accuracy of both clinical exam and MRI were significantly (p < 0.05) lower than children 12–16 years old. There was no effect of MRI center.

Conclusion: In children and adolescents with knee disorders, clinical exam and selective MRI have similar diagnostic performance, with decreased accuracy in children (<12 years old) as compared to adolescents (12–16 years old). Clinical exam appears to be more sensitive for lateral discoid meniscus. MRI appears to be more specific and accurate for medial meniscal tears. Thus, except for medial meniscal tears, MRI does not provide enhanced diagnostic utility over clinical exam for knee disorders in children and adolescents.

24

ANTERIOR TRANSLATION OF THE KNEE IN SCHOOL-AGED CHILDREN

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Background: There is little age- and gender-specific data concerning anterior translation of the knee in school-aged children. Increasingly, anterior cruciate ligament tears are being recognized in the skeletally immature, and it appears that gender may play a significant role in anterior cruciate ligament function and injury predisposition. Establishing normative data is an important initial step in improving the diagnosis and treatment of knee ligament injuries. The goals of the current study were: 1) to determine age- and gender-specific, normative data for anterior translation of the knee (total translation and endpoint compliance) in girls and boys, grades 5 to 12; and 2) to determine the correlations between anterior knee translation and a) generalized joint laxity, b) skeletal bone age, and c) menstrual status for school-aged girls.

Methods: In 92 girls and 107 boys, grades 5 to 12, we determined anterior knee translation (measured via the KT-2000 knee arthrometer; MedMetric, San Diego, CA), generalized joint laxity (measured via physical examination and the 9-point Beighton scale for hypermobility), and bone age (by blinded radiologist review of wrist/hand radiographs).

Results: Both girls and boys showed a significant age-proportionate decline in anterior knee translation (p ≤ 0.05). Although not statistically significant, girls had higher mean anterior translation values at each grade level and, as a group, they had a significantly greater (p ≤ 0.004) compliance index (a measure of ligament endpoint elasticity) than age-matched boys. Among girls, there was no significant correlation between anterior knee translation and overall joint laxity or degree of knee hyperextension.

Conclusions: Objective values for anterior translation of the knee in school-aged children show significant age and gender variation. Increased generalized joint laxity and knee hyperextension should not be used as a surrogate for increased anterior knee translation.

25

RADICAL POSTEROMEDIAL AND PLANTAR RELEASES IN TREATMENT OF THE ARTHROGRYPOtic CLUBFOOT

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Introduction: Arthrogryposis is an anterior horn cell disorder commonly associated with resistant clubfeet. The teratologic nature of the condition responds poorly to standard posteromedial clubfoot surgery. Recurrences commonly occur secondary to both scar tissue formation and progressive tendon contractures. Complete radical releases including circumferential tendon resections have been described, but long term results have not been reported.

Purpose: To evaluate the radiographic and clinical results of arthrogrypotic clubfoot treated by complete radical posteromedial and plantar releases (RPMPR).

Methods: Seven patients with bilateral arthrogrypotic clubfeet underwent RPMPR. All patients were followed for more than 2 years (average 5.9 years, range 2-9 years). The surgical technique included a complete posteromedial and plantar releases with 2 cm tendinous resection of the anterior tibialis, posterior tibialis, flexor digitorium longus and hallucis longus, achilles and plantaris tendons.

Results: Average age at surgery was 7.3 months. At final follow-up, all patients were ambulating independently with a plantigrade foot in AFOs. All patients/caregivers were satisfied with the procedure. Good to excellent results were obtained on the modified Lehtman assessment scale. The average AP talocalcaneal angle (TCA) improved from 10.1° to 20.9°. The average lateral TCA improved from 19.5° to 22.6°. The lateral tibiocalcaneal angle improved from 53.5° to 108.4°. All patients were able to wear normal shoes. They were limited only by their other arthrogrypotic joints. Two patients complained of occasional foot aches, which did not interfere with activities. Variable degrees of flexor tendon power was present in all but one patient. One patient had a recurrence of equinus. This was treated with resection of an intact plantaris tendon. This patient is currently ambulating independently with a plantigrade foot and no evidence of a recurrence.

Conclusions: The complete RPMPR achieved correction of the 14 arthrogrypotic feet in our series at mid term follow up (average 5.9 years, range 2-9 years). None of these patients required talectomy in order to achieve correction. Plantigrade position was maintained at final follow up and all patients were able to wear standard shoes.

26

THE PURPLE HALLUX: PRELUDE TO NECROSIS FOLLOWING CLUBFOOT SURGERY

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Background: Necrosis following clubfoot surgery is an uncommon complication. We have previously hypothesized that such necrosis may result from vascular deficiency, since 90% of limbs with idiopathic clubfoot have congenital vascular deficiencies.

Methods: We reviewed the detailed records of the care of 13 limbs in 12 patients with necrosis following clubfoot surgery. The data included affected side, associated anomalies, number and type of previous surgeries, age at surgery, type of incision, number of days to necrosis, anatomical distribution of the necrosis, the number of subsequent operations and final functional status.

Results: The average time between surgery and the appearance of the necrosis was 11 days (range 4 to 27 days). In all limbs, the necrosis involved primarily the medial side of the foot; loss of the hallux occurred in 10 of 13 limbs. Three limbs underwent amputation and 4 were braced for ambulation. Only 1 patient underwent vascular mapping including arteriography. Both the anterior and posterior tibial arteries in that patient's affected limb had reduced diameters with delayed flow.

Conclusion: The characteristics of these limbs suggest a defined syndrome. Since cyanosis of the hallux or the second toe precedes the necrosis following clubfoot surgery, we have named this entity the “Cyanotic Hallux Syndrome.” This syndrome appears to result from a combination of marginal blood supply to the foot with superimposed oxygen demands of wound healing.

27

A RETROSPECTIVE LONG-TERM STUDY ON DYNAMIC PLANTAR PRESSURE IN THE TREATED CLUBFOOT

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Background: Complete subtalar release (CSTR) in idiopathic clubfoot usually provides satisfactory radiographic and clinical outcomes. However, static radiography and physical examination are insufficient to assess foot function. Dynamic plantar pressure provides a quantitative, objective method which increases the precision of diagnosis and treatment follow-up. A retrospective long-term study of dynamic plantar pressure was conducted to evaluate function of treated clubfoot.

Methods: Twenty-six idiopathic clubfeet in seventeen children were examined by radiography, physical examination, and the EMED foot pressure system (Novel Electronics, St. Paul, MN). Mean length of follow-up of CSTR for clubfoot was 7.5 years (from 4.3 years to 14.1 years). A total of 68 normal children (6 years to 16 years) were tested as a control group. Subjects were asked to step on the EMED pressure system (4 sensors/cm², 50 Hz) three times with each foot during normal walking. Each foot was divided into 8 regions. We obtained values for contact area (cm²), peak pressure (N/cm²), and pressure-time integral (NS/cm²).

Results: There were significant differences in specific regions of the foot (P < 0.05). The mid-MT of clubfoot had an increased plantar contact area as compared to normals (19.6 vs 17.8), and the 1st MT and hallux had a lesser contact area (4.3 vs 5.9, 6 vs 7.4, respectively). The greatest difference of peak pressure and loading between the clubfeet and normal feet was in the regions of the midfoot and hallux. The midfoot had an increased peak pressure and loading (9.8 vs 6.7, 2.9 vs 1.8, respectively), and the hallux had a decreased peak pressure and loading (15.5 vs 26.9, 3.6 vs 5.8, respectively).

Discussion: Dynamic plantar pressures demonstrated a shift of the center of pressure to the lateral side in the region of the forefoot. Our results indicated increased loading in the region of the midfoot after a long-term evaluation of CSTR, even in patients with clinically normal feet.

Conclusion: Results from the current study indicate that dynamic plantar pressure metrics provide a useful mean for examining dynamic characteristics of clubfoot gait and for monitoring foot kinetics. Significant differences in foot kinetics are noted in the mid-foot, 1st MT and hallux region.

28

TARSO-METATARSAL MOBILIZATION COMBINED WITH ANTERIOR TIBIALIS TRANSFER: A SLAVAGE PROCEDURE FOR SUPINATION DEFORMITY IN CLUBFEET

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Background: The most common deformity seen after one stage full posterior-medial release is a rigid supination deformity of the forefoot and midfoot.

Methods: Tarso-metatarsal mobilization (Heyman-Herndon Procedure) combined with anterior tibial tendon transfer and osteotomy of the second metatarsal has been performed on 143 feet in 99 children treated at Children’s Hospital Medical Center of Akron. All procedures were conducted between the ages of one and five years with an average of 31 months. The follow-up ranged between 1 year and 7 years with a mean follow-up of 3.

Results: Satisfactory results (good and excellent) were obtained in 127 feet and unsatisfactory results (fair and poor) were obtained in 14 feet. Complications included 6 cases of localized cellulitis and a single case of osteomyelitis, all resolving with appropriate care.

Conclusion: These results support the contention that this combination operative procedure represents the best currently available approach for recurrent rigid supination deformity after primary posterior medial release in the management of patients with clubfoot.

29

EFFICACY OF TENDOACHILLES LENGTHENING IN THE TREATMENT OF IDIOPATHIC TOE WALKING

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Background: Idiopathic Toe Walking (ITW) is an uncommon pediatric orthopaedic problem, which can require surgical tendon lengthening. The purpose of this study is to evaluate tendoachilles lengthening (TAL) as a treatment for ITW with respect to efficacy as well as patient/parental satisfaction.

Methods: A comprehensive medical record search of all musculotendinous lengthening procedures performed at Children’s Hospital Medical Center (CHMC) of Cincinnati between 1983 and 1998 was carried out. 78 patients underwent TAL without associated procedures of the foot or leg during this time period. All patients with a history of cerebral palsy, spastic diplegia, or any other neurological disorder known to involve contractures were excluded. Children undergoing surgery before the age of 10 months were also excluded. The charts of the remaining 30 patients were reviewed, and a total of 10 patients (18 surgical releases) were available for follow-up.

Results: 7 patients (12 releases aged 1–12 years [mean 5.5 years]) were found to toe walk with no regularity and the parents of these patients were either satisfied (2) or very satisfied (5). 3 patients (6 releases aged 4–8 years [mean 7.33 years]) had recurrence of toe-walking with decreased frequency from the pre-surgical state, but the parents remained unsatisfied.
with the surgical results. Mean follow up for all patients was 7 years 4 months (5 months to 11.5 years).

Conclusion: Tendoaehilles lengthening improved 100% of patients with ITW. However, despite improvement in 30% of patients status post TAL, parents remained unsatisfied with the surgical results.

30

THE STUBBED GREAT TOE: OSTEOMYELITIS OR OPEN FRACTURE?

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Introduction: Stub toe injuries to the hallux are common in summer months when children do not wear shoes. Due to the uncertainty of the actual injury these children often are delayed in their presentation. Post-injury osteonecrosis about the physis of the distal phalanx of the hallux is often interpreted as osteomyelitis or resorption secondary to the fracture.

Methods: We reviewed all children seen at our hospital from Jan 1, 1998 to Dec 31, 1998 with this diagnosis. Five boys with this diagnosis were identified, all seen between June and August. Three injuries were on the left side, and two on the right. Age at the time of injury ranged from 9–12 years. Patients presented from 1–14 days after injury. The number of days to orthopaedic consult was 2–22 days. Two patients presented to the emergency room, and 3 to their pediatrician.

Results: The initial diagnosis was open fracture in two patients, cellulitis in one, and osteomyelitis/open fracture in two. The WBC and ESR were normal in all patients. Two wounds were cultured: one grew Staph aureus and the other nothing. All patients were immobilized, made nonweightbearing and instructed in wound care. Three patients were treated with oral antibiotics and two had PICC line placement for IV antibiotics. Antibiotic treatment lasted from 3–5 weeks. All patients healed their fracture and wound within 6 weeks and there were no patients who developed chronic osteomyelitis.

Discussion and Conclusions: The stubbed great toe is an open physeal fracture of the distal phalanx of the hallux. It is unclear whether osteomyelitis is a constant feature of this injury. All of our patients healed without infection. We feel these injuries can be treated successfully with oral antibiotics, avoiding the cost, inconvenience and complications of IV therapy.

31

EVANS CALCANEAL LENGTHENING IN PEDIATRIC EQUINOVALGUS FOOT DEFORMITIES

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Background: To avoid the problems associated with fusions in the treatment of pediatric equinovalgus deformities, we have selected a method of lateral column lengthening as described by Evans. This is a distraction lengthening based on the windlass mechanism of the intact plantar fascia. The purpose of this paper is to retrospectively review the results of Evans calcaneal lengthening.

Methods: Twelve males and 3 females with a total of 25 equinovalgus deformities underwent Evans lengthening. The most common underlying diagnosis was cerebral palsy (60%) followed by myelomeningocele (20%). Average time of follow up was 34 month. Preoperative lateral talofirstmetatarsal angle, talohorizonal angle and calcaneal pitch were measured and compared to post-operative radiographs at the time of operation and on latest follow up. Satisfaction scores were obtained based on the appearance of the foot, presence of pain or callosus, and subtalar range of motion.

Results: Significant correction was initially obtained with gradual collapse of the longitudinal arch over time. However, the radiographic improvement remained statistically significant. Two major complication included loss of graft in 2 patients necessitating a redo operation. An excellent result, characterized by presence of an arch, no pain or callosity and at least 20 degrees of subtalar ROM was obtained in 14 feet. A good result consisting of presence of an arch, no pain and limited subtalar ROM was obtained in 7 feet. A fair result occurred in 3 feet demonstrating clinical and radiographic planus, thickened skin and limited subtalar ROM. One poor result occurred in a patient who had extrusion of the graft and healed in malunion.

Conclusions: Despite the spastic or flaccid nature of neuro-muscular children with equinovalgus foot deformities, Evans calcaneal lengthening achieved good to excellent results in 89% and thus, is a viable option to improve the appearance of the foot, minimize pain and problems with shoe wear, while simultaneously avoiding the pitfalls associated with arthrodesis.

32

SOFT TISSUE ABNORMALITIES AS A CLUE TO TERATOGENESIS IN THE HUMAN LOWER LIMB

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Background: Attempts to categorize human congenital limb defects have led to the Frantz and O’Rahilly classification, based on the radiography of the bony anatomy. This system has allowed development of treatment regimens, but has not helped to advance our knowledge of the etiology of such defects. Our research has demonstrated a consistent association between a wide variety of congenital bony dysplasias of the human lower limb and the absence or reduction of the anterior tibial artery and its derivatives. We have suggested that such arterial anomalies are important to the understanding of the etiology of the limb defects.

Method: As part of our studies, we have performed several detailed dissections of therapeutically amputated limbs, which represent a variety of congenital bony malformations. These observations were supplemented with clinical evidence of soft tissue changes noted surgically and radiographically.

Results: Consistent arterial anomalies were found associated each of the malformed limbs that were examined. Limbs with clubfoot, congenitally short limbs with tibial and/or fibular deficiency, pedal duplication and polydactyly, all exhibited the same arterial malformation, namely absence or reduction of the anterior tibial artery. Other abnormalities of the muscles, tendons and nerves were noted. These latter soft tissue defects were concentrated on the medial side of the foot to the midline.

Conclusion: Careful examination of the soft tissues of congenitally malformed limbs is necessary in order to elucidate the underlying mechanisms responsible for the development of such defects. The presence of both the arterial and other soft tissue malformations in a medial location on the foot, near where the the dorsalis pedis and medial planter arteries normally coalesce, suggests the position of a vascular teratogenic event.
CAST TREATMENT OF MINIMALLY DISPLACED LATERAL CONDYLE FRACTURES IN CHILDREN

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Background: The purpose is to report the incidence of fracture displacement and re-fracture after casting minimally displaced lateral condyle fractures (LCF), and to identify criteria for prophylactic pinning.

Methods: Minimally displaced LCF were defined as having less than 2 mm of displacement on AP, LAT, and oblique radiographs. Radiographs were classified into Group A: the fracture line did not enter the elbow joint, and Group B: the fracture line entered the elbow joint. Arthrograms were not performed. The elbow was placed into a long arm fiberglass cast, elbow flexed 90°, and forearm supinated. A sling and swathe were used. At 3 weeks x-rays out of the cast were performed. If healing was present, the cast was discontinued. If displacement of >2 mm occurred, pinning was performed. If healing was absent, and <2 mm displacement had occurred, a new cast was applied and x-rays were repeated out of cast every 2 wks until healing occurred.

Results: Between Dec 96 and Dec 98, 37 patients were entered into this protocol. 15 were girls and 22 were boys. Ave age was 4 years (range 1 to 11). On injury x-rays, 33 cases were classified as Group A and 4 as Group B. The ave number of days in a cast was 29 (range 21 to 46). On follow-up 3 week x-rays, 13 fractures (35%) were healed, 1 fracture (3%) displaced 4 mm and underwent surgery. This fracture was initially classified as Group B. 23 fractures (62%) did not show solid healing and were recasted. 6 of these 23 were re-classified as Group B but remained minimally displaced and were recasted until healed radiographically. 5 patients (13%) re-fractured after a subsequent fall 4 to 10 months later (ave 7 mo). 4 of these 5 had been reclassified to Group B and recasted.

Conclusions: Treatment of minimally displaced LCF is controversial. Only 1/3 of fractures healed with 3 weeks of casting. 3% displaced >2 mm in the cast and required surgery. 16% demonstrated subtle displacement or de-calcification with the fracture line now entering the elbow joint. 4 of these 6 cases subsequently sustained a refracture. Incomplete healing of the original injury probably contributed to the second LCF. We advocate prophylactic pinning for all Group B fractures at injury and fractures that change classification to a Group B while in the cast. Following these criteria would limit prophylactic pinning to 10 of 37 cases (27%) without the need to perform an arthrogram on every LCF.

PINS AND PLASTER AS A Viable ALTERNATIVE IN THE MANAGEMENT OF UNSTABLE PEDIATRIC FOREARM FRACTURES.

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Background: A retrospective review was undertaken to evaluate the non-operative treatment of both bone forearm fractures in children (open physis). The treatment of these fractures remains a controversial subject. Open reduction/internal fixation with plates and screws and intermedullary nailing have been proposed as operative means of management.

Methods: This study reviewed 32 forearm fractures that failed primary closed reduction and underwent a pins and plaster salvage procedure between the years 1970 and 1998.

Results: All fractures healed uneventfully in good alignment without associated complications.

Conclusion: Pins and plaster is a preferable alternative to internal fixation in that the fracture site is not invaded in the operative procedure.

CHANGING PATTERNS OF PEDIATRIC PELVIC FRACTURES WITH SKELETAL MATURATION: IMPLICATIONS FOR CLASSIFICATION AND MANAGEMENT

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Introduction: Orthopaedic traumatologists have long recognized the unique fracture patterns and injury constellations of pediatric pelvic fractures. However, an understanding of the change of pelvic fracture patterns with advancing skeletal maturation is needed to avoid applying adult classification and management to pediatric pelvic fractures. We sought to determine how pelvic fracture patterns and management change with advancing skeletal maturity.

Methods: Using the Trauma Registry at our regional Level I pediatric trauma center, we identified 166 consecutive pelvic fractures that presented over a 9 year period. 133 (80%) of these cases had plain radiographs of sufficient quality to evaluate the triradiate and proximal femoral physis, and the greater trochanteric, iliac and ischial apophyses. Fractures were scored as open, narrowed or closed. We recorded the Risser sign, the fracture pattern, associated injuries, and need for ORIF.

Results: 97 patients had an “immature pelvis”: all fractures were open and they were Risser 0. The mean age of this group was 5.7 y/o (range 0.5–13 y/o). Isolated pubic rami (52.6%) and iliac wing (28.8%) fractures predominated. Acetabular fractures (6.2%) and diastasis (pubis or SI) (5.2%) were rare, and none required ORIF. 32 patients had a closed triradiate cartilage. In this “mature pelvis” group, with a mean age of 14.0 y/o (range 11–18), acetabular fractures (43.8%) and diastasis (pubis or SI) (18.8%) were much more common, while iliac wing fractures (6.2%) were rare. All four patients in our consecutive series of 166 pelvic fractures who required ORIF had a “mature pelvis”. Four patients had a narrow triradiate and represented a transitional group.

Conclusion: In this large consecutive series of pediatric pelvic fractures, closure of the triradiate cartilage was associated with a change in pelvic fracture patterns. In the immature pelvis, the pelvic bone (iliac wing) seems to fail after the pelvic ligaments, explaining the rarity of unstable pediatric ring fractures. Management of fractures to the immature pelvis should focus on associated injuries; fracture management is generally non-operative. Once the triradiate cartilage has closed, adult pelvic fracture classification and principles are appropriate.

DISPLACED HIP FRACTURE IN CHILDREN MANAGED WITH EARLY OPERATIVE INTERVENTION

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Introduction: Pediatric hip fractures have a notoriously high complication rate. Avascular necrosis has been reported to be as high as 43% (Canale et al., 1977) and 47% (Davis, 1992). Coxa vara was reported in 23/75 (32%) of fractures (Lam, 1971). For the past 20 years, in hopes of improving on this high complication rate, we have treated these fractures with urgent reduction, optimal internal fixation using modern implants and spica casting. This study was designed to analyze the results of this treatment philosophy for pediatric hip fractures.

Materials & Methods: We reviewed every displaced, non-pathologic hip fracture in children under the age of 16 years that presented to our regional Level 1 pediatric trauma center in the past 20 years. Twenty-three cases were identified, but only 18
patients had adequate follow-up. Charts and x-rays were reviewed and follow-up exams or interviews were conducted at a minimum of 2 years after fracture. Patients' ages ranged from 2 to 13 years, with a mean of 8 years. The average follow up was 8 years, with a range of 2 to 17 years. All patients were treated with urgent reduction (closed, or open when indicated) and internal fixation followed by supplemental spica casting.

Results: All 18 fractures had significant displacement. Using Delbet's classification, there were one type I, eight type II, eight type III, and one type IV. There were no complications in 12 patients. Avascular necrosis occurred in two patients (1 type I, 1 type II), mild coxa vara (121 degrees) in one patient with type III fractures, nonunion in one patient with type II fractures, and premature physeal closure in one patient (type I). There were no cases of infection or complications related to casting.

Discussion & Conclusion: During the past 20 years, we have treated displaced femoral neck fractures in children with urgent operative reduction, internal fixation and spica casting. In this group, avascular necrosis occurred in 2/18 (11%), while coxa vara occurred in 1/18 (6%), representing a substantial improvement on the rates of these complications reported in other large published series of similar fractures.

37

COMPLICATIONS OF FLEXIBLE INTRAMEDULLARY FIXATION OF PEDIATRIC FEMUR FRACTURES AND THEIR PREVENTION

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Background: Recent reports on flexible intramedullary fixation of femur fractures in children documented excellent clinical results and promoted the advantages of this technique over casting, external fixation, and rigid nailing. The purpose of this retrospective study was to analyze treatment results and complications associated with flexible intramedullary fixation of femur fractures.

Methods: A retrospective review of 54 femur fractures in 53 children was performed.

Results: Mean age was 10 years 2 months (2.11-15.8). 51 fractures were closed and 3 were open. 34/54 resulted from a high energy injury. 8/54 fractures had >50% comminution. All were fixed with titanium nails. 6 patients had nail pairs of unequal size. 42 fractures underwent retrograde medial/lateral nailing and 12 underwent lateral antegrade nailing. Follow up ranged from 3u37 months (mean 10.6 months). Mean time to full motion was 8.3 weeks. All fractures healed. Radiographic union occurred at an average of 10 weeks. 37 patients underwent hardware removal; 26 of whom had nail-related complaints at the entry site. 17 patients with retained nails remain asymptomatic. Complications included pain or prominence at the insertion site, migration requiring either advancement(1) or trimming(3), refracture after premature removal requiring reoperation(1), loss of reduction necessitating reoperation(3), temporary pudendal nerve palsy secondary to fracture table use(1), and superficial infection (1). Only 8 femurs healed with residual deformities greater than 10° of coronal angulation and/or 20° of sagittal angulation; they are all asymptomatic.

Conclusions: 20/37 sets of nails bent at the entry site were symptomatic compared with 5/17 left un bent. 5/8 femurs with greater than 50% comminution went on to malunion. 4/6 femurs with unequal sized nails had loss of reduction resulting in either reoperation (2) or malunion(2). We advocate the use of equal-sized pairs of nails. Severely comminuted fractures need close follow up to monitor loss of reduction. Leaving the ends of the nails flush against the metaphysis of the femur decreases the likelihood they will require removal. Routine removal of asymptomatic flexible nails is unnecessary. Despite the complications, no patient has had any change from preinjury function that is related to their femur fracture.

38

A PROSPECTIVE OUTCOME STUDY OF PEDIATRIC FEMUR FRACTURES: TITANIUM ELASTIC NAILING VS. TRACTION AND CASTING

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Introduction: The standard treatment of femoral shaft fractures in young children (immediate spica casting) and in skeletally mature adolescents (rigid antegrade IM nailing) is widely accepted. For children between these ages (~6-16 y/o), traction and spica casting has traditionally been used. There is growing enthusiasm for Titanium Elastic Nails (TEN) for this age group, but no prospective outcome studies have compared TEN to standard traction and casting.

We designed a prospective outcome study to compare the clinical, radiographic, functional, emotional, social and financial consequences of femur fracture management in children 6-16 y/o.

Methods: After IRB approval, every child 6-16 y/o who presented to our institution with a femoral shaft fracture was enrolled. Surgeon preference determined treatment method, and some surgeons would not use TEN for any fracture. Each family was asked to complete the AAOS Pediatric Outcome Instrument (Baseline and 6 wks., 3 mo., 6 mo., and 1 year Follow Up). In addition to clinical and radiographic information, we documented important recovery milestones (e.g. time absent from school). Complications (unacceptable alignment or leg length inequality, refracture, unplanned re-operation, decubitus ulcers, etc) were recorded.

Results: To date, 21 fractures (in 21 children, mean age 8.5 y/o) treated with traction and casting (T&C) and 28 fractures (27 children, mean age 9.9 y/o) treated with TEN have been followed to the clinical endpoint of fracture union and return to full activity. Compared to T&C, children treated with TEN were discharged sooner (4 vs. 19 days), walked sooner (16 vs. 65 days), walked independently sooner (60 vs. 105 days), and returned to school sooner (55 vs. 99 days). Complication, as described above, occurred in 11/21 (52 %) T/C group patients and in 3/28 (9%) fractures treated with TEN.

Conclusion: Children 6-16 y/o who had their femoral shaft fracture treated with Titanium Elastic Nailing were mobilized more quickly, returned to school and other normal activities more quickly, and had a lower complication rate than those treated with traction and casting.

39

FEMUR FRACTURES IN CHILDREN: A COST COMPARISON OF THREE TREATMENT OPTIONS.

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Background: Controversy exists as to optimum treatment of femoral shaft fractures in children 6-12 years old. The ideal method should lead to healing in acceptable alignment, restoration of normal function, and the least number of complications. Ideally, it should also be the most cost effective and lead to the least amount of disruption of the lives of the patient and family.

Method: We prospectively studied 20 patients ages 6-12 with an isolated femoral shaft fracture. They were divided into three treatment groups: Femoral traction followed by a spica cast (9 patients), Intramedullary fixation with flexible nails (5 patients) and External fixation (6 patients).
**THE CAST BRAKE REVISTED: IMMEDIATE CAST BRACE FOR THE TREATMENT OF CHILDREN’S FEMUR FRACTURES**

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**Background:** Currently, there are a number of accepted options for treating femoral shaft fractures in children and adolescents. Treatment ranges from nonoperative measures such as traction, traction with delayed spica casting, and immediate spica casting, to operative procedures such as external fixation, compression plating, and intramedullary fixation. The cast brace, once a reasonable option for the treatment of pediatric femur fractures, appears to be all but forgotten as a treatment option for pediatric femur fractures.

**Methods:** Ten children and adolescents, 5–12 years of age, sustaining femoral shaft fractures between September 1996 and October 1998 were treated with immediate cast bracing at our institution. Physical therapy saw the patients the following day to begin ambulation if there were no associated injuries. Ability to ambulate 20 feet was a prerequisite for discharge. Prior to discharge, standing and traction radiographs were obtained. Patients are followed weekly with radiographs for the first two to four weeks. Sitting is not permitted until adequate fracture callus appears because hamstring tension can result in fracture shortening. Patients could return to school when allowed to sit upright. After adequate callus was felt to be present and the patient could hop on the injured leg without pain the cast brace was removed.

**Results:** A total of 10 patients were involved in the study. The average age was 8 years ± 0 months. Patients were hospitalized an average of 8.2 days. They were discharged an average of 6.4 days after being placed in a cast brace. The average length of immobilization was 60.1 days. All fractures went on to union. No patient had a clinically significant deformity.

**Conclusion:** The cast brace combines the safety of conservative management of femur fractures in children with the advantage of early ambulation and relative patient independence of operative treatment.

42

**THE EFFECT OF PREOPERATIVE GAIT ANALYSIS ON ORTHOPEDIC DECISION-MAKING**

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**Background:** Computerized gait analysis provides a significant amount of data for the evaluation of patients with movement disorders. In recent years preoperative gait analysis has been used increasingly for planning surgical intervention. We undertook this study to evaluate the frequency with which preoperative gait analysis results in changes in surgical intervention in pediatric patients.

**Methods:** A retrospective chart review was carried out for 97 consecutive pediatric patients who underwent preoperative gait analysis. Of these 97 patients, 86 patients had a static encephalopathy. Average patient age at the time of preoperative gait analysis was 9.2 ± 4.2 years (range: 2.8 to 20.8 years). In 70 cases, a specific surgical plan was outlined on the gait laboratory referral form prior to gait analysis. Ultimate care rendered was compared to that outlined on the gait lab referral form.

**Results:** For the 70 cases in which a specific treatment plan had been outlined before the preoperative gait study, the treatment plan was altered in 62 cases (89%) following the gait analysis study. Of the 273 surgical procedures recommended prior the gait

41

**IMMEDIATE HIP SPICA APPLICATION FOR CLOSED ISOLATED PEDIATRIC FEMUR FRACTURES**

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**Background:** The treatment of isolated pediatric femur fractures has become very controversial over the past five years. Recently some orthopaedic surgeons are advocating surgery for isolated pediatric femur fractures. These treatment modalities include external fixation, Kuntschner type intramedullary nails, compression plates and small diameter, flexible nails. These surgeries are now being performed on the isolated pediatric femur fracture as well. Hip spica casting for the child with an isolated femur fracture is being challenged. This study was developed to test the hypothesis that immediate closed reduction and application of a well-molded hip spica is a safe and effective treatment option for closed, isolated pediatric femur fracture in children weighing from 10 to 100 pounds.

**Methods:** Between 1988 and 1996, 190 immediate hip spica casts were placed on children with isolated femoral shaft fractures who weighed between 10 and 100 pounds. Fifteen were lost to follow-up leaving us with 175 children who were evaluated and followed for at least two years after hip spica removal (2–10 years). Our patients were separated into 3 groups by weight: group 1 = 10–49 pounds (121 pts), group 2 = 50–80 pounds (42 pts) and group 3 = 91–100 (12 pts).

**Results:** All 175 femur fractures united within 8 weeks with only one complication. This was a refracture of a 25-pound child who fell one week out of his spica. The average shortening for groups 1, 2 and 3 on initial ER x-rays were 1.7 cm, 1.5 cm, and 2.1 cm respectively. Final average shortening for the 3 groups after cast removal was .731 cm, .976 cm and .75 cm, respectively. None of the children required external shoe lifts, epiphysiosis, antibiotics, irrigation and debride or limb lengthening procedures for leg length inequalities.

**Conclusion:** Due to radiographic and clinical results, we feel that weight is an important variable in the decision-making process of how to treat an isolated pediatric femur fracture. We feel that immediate closed reduction and placement of a well-molded hip spica cast is the safest and best treatment option for isolated, closed femur fractures in children up to 10 years old and under 80 pounds.

40

**RESULTS:** Costs were adjusted to 1997 U.S. dollars. The cost comparison of hospital related costs and professional fees showed no statistical difference. There were no significant leg length discrepancies in any group. The one major complication was a refracture at 14 weeks in a patient treated with traction and a spica. Both the traction/spica, and the external fixation groups had minor pin track and skin problems. Union times were longer in the group treated with external fixation. Intramedullary rods were removed at an average of 17 weeks and this group had no complications, and the shortest hospital stays.

**Conclusions:** The groups in this study are too small to make any meaningful conclusions. We also did not calculate indirect costs such as parental time off work, home health care, homebound tutoring, or childcare. These costs should be considered in any future study. It is hoped that this will serve as a stimulus for a multi-center study that would be necessary to generate sufficient numbers of patients in a short period of time to answer these questions.
study in these 70 patients, 106 of these procedures (39%) were not carried out when the gait data were also considered. An average of 1.5 procedures per patient which were planned prior to the gait study were ultimately not performed after addition of the gait data. An additional 1.6 procedures per patient were added to the plan after the gait lab data were obtained.

Conclusion: This study demonstrates that preoperative gait analysis can significantly influence the planned care of orthopaedic patients. The effect this has on patient outcome remains to be elucidated.

43

RECTUS AND HAMSTRING SURGERY IN CEREBRAL PALSY

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Introduction: The purpose of this study is to determine the effectiveness of hamstring and rectus surgery on children with cerebral palsy of different functional levels.

Methods: 99 children with spastic diplegia (80 children) or quadriplegia (19 children) who had rectus transfers and hamstring lengthenings in combination with other indicated procedures at the hip and ankle were studied with pre and 1 year post operative gait analyses. Ages ranged from 4 to 18 years. Patients were classified as independent community ambulators (39 children, 76 limbs), device dependent community ambulators (39 children, 76 limbs) and household/exercise ambulators (21 children, 39 limbs).

Results: Maximum knee extension in stance increased 13, 17 and 19° in the independent community, dependent community and household/exercise ambulators respectively (all p < .0001). Total range of knee motion increased 12, 10 and 8° (all p < .001). Peak knee flexion in swing was maintained in the independent group, but losses were seen in the dependent and household/exercise groups of 7 and 11° respectively (both p < .0001). Timing of peak swing knee flexion improved by 4, 6 and 6% respectively in the three groups (all p < .001). The independent and dependent groups maintained their walking speeds of 80% and 47% of age matched normals; the household/exercise group showed an increase from 22% to 33% normal (p < .001). 4 of 39 dependent community ambulators became independent and 13 of 21 household/exercise ambulators became dependent community ambulators.

Discussion and Conclusion: Significant improvements in knee extension were seen in children of all functional ambulation levels. Knee flexion in swing was maintained in the independent ambulators, but some loss was seen in the dependent and household/exercise ambulators. Consequently, the increase in total range of knee motion was equal to the increase in knee extension in the independent group only. Gains in extension in the dependent and household/exercise groups were accompanied by a loss of swing knee flexion. The slowest, most involved patient population experienced the greatest loss. This group, however, showed the greatest improvements in function with more than half of the household/exercise ambulators progressing to a dependent community level following surgery.

44

THE IMPACT OF POSTOPERATIVE GAIT ANALYSIS ON ORTHOPEDIC CARE OF PEDIATRIC PATIENTS

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Background: Computerized gait analysis provides a significant amount of data for the evaluation of patients with movement disorders. Though postoperative gait analysis has been viewed primarily as a tool for assessing surgical outcome, it can also identify ongoing gait deviations which may potentially be addressed by further active treatment. We undertook this study to evaluate the frequency with which routine postoperative gait analysis results in recommendations to alter the patient’s ongoing orthopaedic care.

Methods: A retrospective chart review was carried out for 57 consecutive patients undergoing postoperative gait analysis. Since 16 of these studies were carried out when postoperative gait interpretations were not dictated by the gait lab physicians for their own patients, 41 postoperative gait analysis interpretations were available for evaluation. Of the 41 patients, 38 patients had a static encephalopathy. Average patient age at the time of postoperative gait analysis was 9.8 ± 4.3 years (range: 4.3 to 22.1 years). Charts were reviewed to determine whether the gait lab physician recommended a change in treatment plan for the patient for surgery, bracing, and/or physical therapy.

Results: Alteration in treatment plan was recommended based on the gait analysis in 34 of 41 postoperative studies (83%). These included recommendations for surgery in 17 cases (41%), for bracing changes in 21 cases (51%), and for specific physical therapy in 9 cases (22%). Twelve patients (29%) had recommendations in at least 2 of these 3 areas.

Conclusion: This study demonstrates that postoperative gait analysis can significantly influence the ongoing care of orthopaedic patients, and does not serve merely as a method to evaluate treatment outcome. The outcome of these additional interventions would need to be evaluated with future research.

45

ARE ALL PARAPLEGIC CHILDREN OSTEOPOROTIC?

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Background: Many physicians assume that children who are unable to walk due to severe cerebral palsy have osteoporosis and are at increased risk of pathologic fractures.

Methods: Three different groups of children were studied. The first consisted of nine children with severe cerebral palsy and were nonambulatory due to their spasticity. Each child was involved in a program which promoted movement and upright positioning, including standing. All received the services of a dietician. The second group was three children with myelodysplasia who walked, but with an abnormal gait due to their underlying condition. The control group consisted of twenty neurologically normal children who were of similar age, gender and maturity to the study patients. All children had careful evaluations of their medical and medication histories. Dietary intake of calcium and vitamin D, plus each child’s typical exercise routine was recorded. Those with renal or hepatic disease, cystic fibrosis, or any endocrinopathy were excluded. No child utilized osteoporosis inducing medications such as phenytoin or corticosteroids. The bone mineral density of the lumbar spine of all children was measured by dual xray absorptiometry utilizing a Lunar DPX-L scanner. Pediatric software was used in those less than 20 kilograms. The scanner also measured the height and weight of the lumbar spine in order to allow calculation of volumetric bone densities.

Results: All children in this study had calcium intakes at or above their Recommended Daily Allowance. None had suffered a fracture. Areal bone densities of the lumbar spine closely correlated to body size as measured by height (R = 0.85), weight (R = 0.94) and body surface area (R = 0.95). Volumetric bone density measurements did not change with body size and therefore provided a more valid measurement of bone density. There was no significant difference in the volumetric bone density of the lumbar spine between the study group of nonambulatory children with...
cerebral palsy, those with myelodysplasia, and the control group of normal children. Calcium supplementation also did not effect volumetric bone density.

Conclusion: When volumetric bone densities were compared, no difference was found between the ambulatory and nonambulatory groups. This study was supported by a grant from the American Academy of Pediatrics.

46

THE HOFFER PROCEDURE FOR BRACHIAL PLEXUS PALSIES

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Background: Obstetrical palsies usually affect upper cervical roots, and often leads to adduction/external rotation contractures of the shoulder secondary to weakness of the deltoid, supraspinatus, and infraspinatus. These deficits severely limit function of the affected extremity. This study reports on functional outcomes of patients receiving the Hoffer tendon transfer about the shoulder.

Methods: Retrospective chart analyses of 16 patients receiving the Hoffer procedure from 1982 to 1998 were performed to document functional gains in active abduction and external rotation. By the 3-tiered grading scheme of Mallet, which assesses shoulder function based on the five criteria as follows: active abduction, external rotation, hand to head, hand to back, and hand to mouth, each patient was assigned a preoperative grade and postoperative grade. Additionally, objective data including passive range of motion in abduction and external rotation and muscle grade for deltoid and external rotators were gleaned from chart review.

Results: The average age of operation was 8.1 years. There were 12 boys and 4 girls. Right-sided brachial plexus lesions predominated the study group with 11 patients, compared with 5 left-sided lesions. The average follow-up period for retrieval of data was 5.8 years with the range from 5 months to 11 years. On average each patient gained a single functional level by satisfying at least two of the five criteria of Mallet. Passive motion increased for 11 patients in abduction and/or external rotation with 4 losing motion in abduction only. There was insufficient data in five patients to make any motion determinations. Moreover, passive range of motion deteriorated over the passing of years from the immediate postoperative state for 10 patients. Muscle testing showed no appreciable grade changes, however those patients with fair to good deltoid strength enjoyed an increase in overhead motion. Those with weak deltoid function had modest gains.

Conclusion: The Hoffer tendon transfer when applied with the appropriate indications can have a positive lasting effect on functional status of patients with Erb’s palsy. When combined with competent deltoid musculature, overhead motion and other motions employed for self-care have a greater potential for rehabilitation. Patients with fair abduction strength preoperatively will have more difficulty in rehabilitation with less potential for significant improvement. However it can be argued that any improvement is viewed favorably by most patients.

47

PRESSURE MAPPING AND SEATING MODIFICATIONS IN MYELOMENINGEALOCE

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Background: To determine if pressure mapping combined with seating modifications will affect healing of wounds in an insensate population.

Methods: This is a prospective study in which 12 myelomeningocele and paraplegic children underwent seating pressure mapping before and after wound healing. The pressure mapping was used to identify areas that needed seating contouring. The mapping was used post-healing to demonstrate the healed areas having adequate pressure relief.

Results: In all cases the mapping showed adequate soft tissue coverage post-treatment.

Conclusion: This technique is valuable in the treatment of paraplegic children with sacral wounds, allowing prediction of potential breakdown areas and guidance for treatment and seating modifications. The technique will be demonstrated and the results discussed.

48

CONGENITAL KYPHOSIS IN MYELODYSPLASIA: LONG TERM REVIEW

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Objectives: Evaluation of function, general health and quality of life in patients post vertebral resection (kyphectomy) and fusion for severe kyphotic deformity in myelodysplasia.

Method: Twenty patients from a group of fifty have been followed into adult life. All presented with open spina bifida and low thoracic or high lumbar paraplegia plus kyphosis of at least 60°. In each patient there was rapid progression of deformity during the early sitting period (average deformity to 120° kyphosis). Ten patients underwent apical vertebral resection with intervertebral wiring while a second group (ten) underwent resection and instrumentation with modified Luque rods. All surgery in both groups was performed by age two. Follow up with recent evaluation is 15–27 years.

Results: The Luque group had better initial correction. All patients went on to solid fusion with kyphosis in acceptable position (30°). These patients were all fully active in wheelchairs (one ambulatory) without further skin breakdown. The shortened spinal length has not resulted in any internal organ dysfunction. Pulmonary function studies show a decrease (60% of normal) but long term repeated respiratory problems have not developed. Complications post operatively were limited to skin breakdown over hardware (20%). All have resolved successfully. The patients in this study, treated with early correction, achieved good sitting balance and stability long term. This improved lifestyle is demonstrated by questionnaire and examination.

49

PERI-OPERATIVE MORTALITY IN THE CEREBRAL PALSY POPULATION

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Background: Caring for children with cerebral palsy (CP) is a significant portion of most pediatric orthopedic practices. Complex and simultaneously completed orthopedic surgical procedures are not without risk in this group of neurologically compromised children. Counseling parents pre-operatively is of paramount importance, and it is hypothesized that the frequency of orthopedic deaths is underreported in the orthopedic literature.

Methods: A questionnaire was sent to 635 pediatric orthopedists with 322 returned for a 51% response rate. The questionnaire assessed: (1) number of deaths, (2) causes of death, (3) patterns of involvement, and (4) associated orthopedic procedures.

Results: A total of 119 deaths occurred up to 12 weeks postsurgery, with the quadriplegic pattern accounting for 109 (92%), diplegic for 5 (4%), hemiplegic for none, and unspecified for 5 (4%). Of these deaths, 65 (55%) were associated with spine procedures and 51 (43%) with lower extremity procedures (11 soft tissue only, 17 bony only, and 23 combined), and 3 were unspecified with respect to procedure. The top six known pre-
cipitating causes of death are, in descending order of frequency: acute respiratory collapse, hematologic (hemorrhage, DIC), cardiac (arrhythmia, CHD, cardiomyopathy), CNS (seizures, herniation, CVA), aspiration, and cardiovascular collapse. By statistical measures relating the number of practice years and the average number of CP operative procedures completed yearly, it was determined that a child with CP is five times more likely to die peri-operatively following spine surgery than lower extremity surgery. The mean years in practice for those physicians reporting one or more deaths was the same as for those with no deaths (13.8 years).

**Conclusion:** Peri-operative deaths following orthopedic surgery in children with CP, although not common, are more frequent than the literature would suggest. Some are clearly related to difficulties in the intra-operative and post-operative management periods, but a disturbing number occurred with no apparent forewarning clinical events. Spine surgery in the child with CP is high risk, but lower extremity surgery is not without substantial risk, especially in the quadriplegic population. Parents need to be thoroughly counseled pre-operatively that peri-operative mortality is a known complication associated with aggressive and complex CP surgery.
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Robert B. Cady
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