

DISTRACTIONS

**The Newsletter of
The Limb Lengthening and Reconstruction Society: ASAMI North America**

Volume 9, Number 2 April/May 2003

13th Annual Scientific Meeting
July 25–27, 2003
Fairmont Copley Plaza Hotel
Boston, Massachusetts, USA

Registration

The registration form is available at www.asaminorthamerica.org. Members who are in good standing may fax the completed form to (512) 301-4751.

Accommodations

Guest rooms have been blocked at the **Fairmont Copley Plaza Hotel** in Boston, MA. The address is 138 St. James Avenue, 02116. The resort is in compliance with the American Disabilities Act (ADA). The discounted room rate of \$209.00 plus tax, per night is available through **June 24, 2003** or until all rooms are sold. Call the hotel directly at (800) 866-5577 and refer to *LLRS: ASAMI-North America* to make a reservation.

Travel

The resort is accessible via Logan International Airport. Each of the following companies offers discounted rates to LLRS Participants. Contact them directly to make a reservation.

Continental Airlines – (800) 468-7022, refer to Agreement Code **VVZ1B1** and Z Code **ZAQX**

Avis Rental Car – (800) 331-1600, refer to AWD Number **J991347**

Continuing Medical Education

The Joe W. King Orthopedic Institute is accredited by the American Council of Continuing Medical Education (ACCME) to offer continuing education to physicians.

Additional Information

Contact Karen Syzdek, Society Manager, at (512) 301-7328 or assocandconv@yahoo.com, or visit www.asaminorthamerica.org.

Abstracts in A Minute

The purpose of Abstracts in A Minute is to facilitate members' self-study. Because of the brevity, these abstracts are not intended to be an authoritative or critical review.

Basic Science

Davidson AW, Mullins M, Goodier D, Barry M. **Ilizarov wire tensioning and holding methods: a biomechanical study.** *Injury* 2003; 34:151–154. This study compared wire tensioning with bolt twisting to tensioning with mechanical tensioners. The mechanical tensioners were accurate but inefficient. The Russian hexagonal head bolts were the most efficient. The standard cannulated and slotted bolts resulted in wire breakage when twisted ninety degrees.

Eckardt H, Bundgaard KG, Christensen KS, et al. **Effects of locally applied vascular endothelial growth factor (VEGF) and VEGF-inhibitor to the rabbit tibia during distraction osteogenesis.** *J Orthop Res* 2003; 21:335–340. Rabbits underwent tibial lengthening by distraction osteogenesis. VEGF, VEGF-inhibitor, and vehicle alone were delivered to the regenerate via a mini-osmotic pump. VEGF and VEGF-inhibitor increased and decreased blood flow, respectively, to the adjacent bone, but had no effect on regenerate blood flow, torsional stiffness, bone mineral content, and histomorphometric indices.

Kaspar D, Neidlinger-Wilke C, Holbein O, et al. **Mitogens are increased in the systemic circulation during bone callus healing.** *J Orthop Res* 2003; 21:320–325. Sera from nine patients being treated for fractures with external fixation were added to osteoblastic cell line SaOS-2. The levels of transforming growth factor- β 1 (TGF- β 1) and insulin-like growth factor (IGF-1) were assayed. In the first week after surgery, the sera caused decreased proliferation of the SaOS-2 cells, but in the fourth or fifth week, there was increased proliferation and elevated levels of TGF- β 1 and IGF-1. Similar activity has been observed in previous studies of distraction osteogenesis but not in fractures treated with a stable plate. The release of these mitogens at the fracture site is attributed to mechanical stimulation by the interfragmentary movement of fracture ends.

Kinner B, Pacicca DM, Gerstenfeld LC, et al. **Expression of smooth muscle actin in cells involved in distraction osteogenesis in a rat model.** *J Orthop Res* 2003; 21:20–27. Alpha-smooth muscle actin (SMA) is a contractile muscle actin isoform. This immunohisto-chemical study revealed the expression of SMA in cells participating in distraction osteogenesis in a rat model. SMA activity was seen in all zones of the distracted tissue within five days of the distraction period.

Basic Science continued

Kusec V, Jelic M, Borovecki F, et al. **Distraction osteogenesis by Ilizarov and unilateral external fixators in a canine model.** *Int Orthop* 2003; 27:47–52. Distraction osteogenesis was performed in dogs using the Ilizarov and AO unilateral fixators. Both endochondral and intramembranous ossification were found in both groups. No difference in histomorphometric parameters existed between the groups.

Li G, Dickson GR, Marsh DR, Simpson H. **Rapid new bone tissue remodeling during distraction osteogenesis is associated with apoptosis.** *J Orthop Res* 2003; 21:28–35. During distraction osteogenesis, new bone forms and undergoes rapid remodeling. Apoptosis may be one of the regulatory mechanisms for removal of redundant callus. Apoptotic cells were located mainly in the transitional regions between the fibrous tissue and the new bone in the mineralization front and close to or on the new bone surface near the center of the regenerate. The localization of apoptotic cells at different regions of the regenerate, accompanied by osteoclastic activities, suggests that apoptosis is closely related to bone formation and remodeling during distraction osteogenesis.

Mullins MM, Davidson AW, Goodier D, Barry M. **The biomechanics of wire fixation in the Ilizarov system.** *Injury* 2003; 34:155–157. Authors found that orthopedic surgeons usually tighten bolts to 5–10 Nm, recommended tightening to at least 10 Nm. Authors now use a calibrated torque wrench. Wires are tightened up to 1275 N with the dynamometric tensionometer. With multiple wires on a single ring and with weightbearing, tensions may reach 2000 N. The load required to cause wire failure varies considerably depending on the applied torque and the bolt configuration.

Wang B, Liu YY, Zheng JB, Chen GX. **Component changes of calcium and phosphorus in osteogenesis by lengthening procedures in adult canines.** *Chin J Traumatol* 2003; 6:32–36. The calcium/phosphorus ratios were measured in the regenerate of lengthened dog bones at 2, 4, 6, 8, and 12-week intervals. The Ca/P ratio was lower than the control region up to 12 weeks after lengthening. Authors concluded that other inorganic ions play an important role in the mineralization process.

Yamazaki H, Abe M, Kanbara K. **Changes of fiber type ratio and diameter in rabbit skeletal muscle during limb lengthening.** *J Orthop Sci* 2003; 8:75–78. The tibialis anterior muscles were examined after 20% lengthening of the rabbit tibia. The number of type I fibers increased; the number of type IIB fibers decreased. The average diameter of type I fibers increased; the diameter of type IIB fibers decreased. The diameters reverted to normal within one month after lengthening, whereas the ratio of fiber types remained altered.

Basic Science continued

Yang L, Nayagam S, Saleh M. **Stiffness characteristics and inter-fragmentary displacements with different hybrid external fixators.** *Clin Biomech (Bristol, Avon)* 2003; 18:166–172. The stiffness of various hybrid external fixators was measured. The Ilizarov fixator with one wire and one screw on each ring behaved more like a unilateral fixator. A bar–ring hybrid fixator was too flexible. Reinforcing the bar–ring hybrid with diagonal struts improved the performance. A two–ring hybrid fixator most closely resembled an Ilizarov fixator.

Yokota A, Doi M, Ohtsuka H, Abe M. **Nerve conduction and microanatomy in the rabbit sciatic nerve after gradual limb lengthening–distraction neurogenesis.** *J Orthop Res* 2003; 21:36–43. The sciatic nerves of rabbits following 30% (30mm) lengthening of the femur were examined, comparing a daily rate of 0.5 mm (Group I) to a daily rate of 2.0 mm (Group II). The mean diameter of myelinated fibers was unchanged in Group I, decreased in Group II. A mild conduction slowing occurred in Group I; a conduction block occurred in Group II. The internodes were lengthened by 22.1% in Group I and 20.77% in Group II. These results indicate that the myelinated nerve fibers adapt to gradual elongation by lengthening each Schwann cell body, not by proliferation of Schwann cells.

Lengthening

Dudkiewicz I, Schindler A, Ganel A. **Elongation of long bones for short stature in patients with hypophosphatemic rickets.** *Isr Med Assoc J* 2003; 5:66–67.

Lower Extremity

Atesalp AS, Komurcu M, Basbozkurt M, Kurklu M. **The treatment of infected tibial nonunion with aggressive debridement and internal bone transport.** *Mil Med* 2002; 167:978–981. Fourteen cases of infected tibial nonunions treated with aggressive debridement, circular external fixation, and bone transport. Mean defect length was 4.4 (2.5 – 8) cm. Union occurred in 6.8 (4.5 – 15) months. In two cases, reinfection occurred, and hyperbaric oxygen was used.

Chiodo CP, Jupiter JB, Alvarez G, Chandler HP. **Oblique osteotomy for multiplanar correction of malunions of the femoral shaft.** *Clin Orthop* 2003; 406:185–194. Six cases of posttraumatic femoral malunions were treated with oblique osteotomies, which allowed for correction in the coronal, transverse, and sagittal planes. Healing occurred in an average of 2.9 (2.5 – 4.0) months. Fixation was achieved with lag screws and a neutralization plate. AP angulation improved from 21.6 degrees to 4.2 degrees varus. Lateral angulation improved from 22.5 degrees to 7.0 degrees antecurvatum. In all patients, limb lengths were within 0.5 cm of each other and axial alignment was within 10 degrees of each other.

Lower Extremity continued

Houshian S, Skov O, Weeth RE. **Correction of congenital brachymetatarsia by gradual callus distraction.** *Scand J Plast Reconstr Surg Hand Surg* 2002; 36:373–375. Two children with congenital short fourth metatarsals were lengthened by the Ilizarov technique. Both were cosmetically improved.

Kitson J, Eyres KS. **Simultaneous leg lengthening and knee arthrodesis using an external ring fixator—a case report.** *Acta Orthop Scand* 2002; 73:712–714.

Koshino T, Murase T, Saito T. **Medial opening–wedge high tibial osteotomy with use of porous hydroxyapatite to treat medial compartment osteoarthritis of the knee.** *J Bone Joint Surg Am* 2003; 85–A:78–85. Twenty–one osteoarthritic knees in eighteen patients with a mean age of 66.6 years underwent medial opening wedge osteotomy with insertion of hydroxyapatite wedges. The lateral cortex remained intact. Two plates were used for fixation. The goal was to achieve ten degrees of anatomic valgus. All patients had pain relief and improvement in walking ability. Limb alignment was corrected from 180 ± 2.9 degrees preoperatively to 169.7 ± 3.7 degrees postoperatively. There were no cases of wedge collapse or recurrence of varus.

Rozbruch SR, Blyakher A, Haas SB, Hotchkiss R. **Correction of large bilateral tibia vara with the Ilizarov method.** *J Knee Surg* 2003; 16:34–37. Case report of a 22–year–old woman with 70° varus of right leg, 75° varus of the left leg, attributed to type IV infantile tibia vara. Fixation time was 5.5 months on the right, 6.5 months on the left. Mechanical axis deviation at follow–up was 31 mm medial on the right, 44 mm medial on the left. She reported mild intermittent pain. Although simple knee x–rays were used at the time of this procedure, exact radiographs of the hip, knee, and ankle are currently used and would probably result in more accurate deformity correction.

Sakurakichi K, Tsuchiya H, Uehara K, Kabata T, Yamashiro T, Tomita K. **Ankle arthrodesis combined with tibial lengthening using the Ilizarov apparatus.** *J Orthop Sci* 2003; 8:20–25. Ankle arthrodesis and tibial lengthening were performed on six patients. Mean age was 47 (25 – 66) years. Three patients had an active infection. In the compression–distraction group, the mean length gained was 1.9 cm; the mean external fixation index (EFI) was 144 days/cm. In the bone transport group, the mean length gained was 6.2 cm; the mean EFI was 35.4 days/cm. There were no infections, nonunions, or deformities at follow–up.

continued on page 4

Lower Extremity continued

Sen C, Kocaoglu M, Eralp L, Cinar M. **Correction of ankle and hindfoot deformities by supramalleolar osteotomy.** *Foot Ankle Int* 2003; 24:22–28. Eleven patients with mean age of 15 (4 – 35) underwent supramalleolar osteotomy and Ilizarov fixation for treatment of ankle and hindfoot deformities. At follow-up (13 – 26 months), there was no malalignment or malorientation. One patient had a leg length discrepancy.

Singhania AK, Lovisetti L, Maguire J, Catagni MA. **Use of the Ilizarov technique to improve limb function following hemipelvectomy.** *Eur J Surg Oncol* 2003; 29:64–68. Authors describe a reconstructive technique after first stage tumor resection and ischiofemoral arthrodesis. Distal femoral and distal tibial lengthenings were combined with valgus subtrochanteric femoral osteotomy. Controlled varus correction at the distal femur was performed to maintain a horizontal joint line at the knee.

Sluga M, Pfeiffer M, Kotz R, Nehrer S. **Lower limb deformities in children: two-stage correction using the Taylor spatial frame.** *J Pediatr Orthop B* 2003; 12:123–128. Report of five cases of lower extremity deformities treated with the Taylor spatial frame.

Song HR, Kale A, Park HB, et al. **Comparison of internal bone transport and vascularized fibular grafting for femoral bone defects.** *J Orthop Trauma* 2003; 17:203–211. Thirty-seven patients with bone loss of the femur were reviewed. Twenty were treated with internal bone transport; seventeen were treated with vascularized fibular grafting. Lengths of defects in the two groups were similar. External fixation index was 1.4 months/cm with bone transport; 1 month/cm with the vascularized grafts. Functional results are presented. With vascularized fibular grafting, careful monitoring of the circulation and early intervention surgery is necessary to avoid vascular failure. With bone transport, radical debridement until infection control is achieved, bone grafting of the docking site, and avoiding stress fracture are recommended to improve bone results.

Tsuchiya H, Tomita K. **Distraction osteogenesis for treatment of bone loss in the lower extremity.** *J Orthop Sci* 2003; 8:116–124. This paper describes the use of distraction osteogenesis for the treatment of nonunion and bone loss after tumor excision. It is a safe, useful, and efficient treatment. It can address the multiple problems which occur after tumor excision. It is the most conservative limb-saving surgery available at present.

Trauma

Inan M, Tuncel M, Karaoglu S, Halici M. **Treatment of type II and III open tibial fractures with Ilizarov external fixation.** *Acta Orthop Traumatol Turc* 2002; 36:390–396. Forty-five patients with type II and III tibia fractures were reviewed. Mean fixator time was 17.2 (6.8–55.7) weeks. Types IIIB and IIIC required significantly more time to union than type IIIA. The most frequent complication was pin tract infection (27.1%). Refracture occurred in 4 (8.8%) patients. Despite problems, the authors recommend this technique for open tibia fractures.

Johnson EC, Strauss E. **Recent advances in the treatment of gunshot fractures of the humeral shaft.** *Clin Orthop* 2003; 408:126–132. The treatment of gunshot wounds depends on the extent of soft tissue disruption and the location of the fracture. Low energy fractures that require stabilization can be treated successfully with compression plating or intramedullary nailing. Complex high-energy open fractures associated with neurovascular injury present a challenge; they are often comminuted, unstable, and are associated with bone loss. For those cases, external fixation is the treatment of choice.

Kerkhoffs GM, Kuipers MM, Marti RK, Werken Vd V. **External fixation with standard AO-Plates: technique, indications, and results in 31 cases.** *J Orthop Trauma* 2003; 17:61–64. The standard AO-plate was used as an external fixator in 31 patients with an infected nonunion or open fracture, mainly of the upper extremity. It is inexpensive, relatively simple, and low profile.

Maier M, Maier-Heidkamp P, Lehnert M, Wirbel R, Marzi I. **Results of femoral shaft fractures in childhood in relation to different treatment modalities.** *Unfallchirurg* 2003; 106:48–54. Authors reviewed 101 children treated for femoral shaft fractures with external fixation (32%), elastic stable intramedullary nailing (ESIN) (17%), other forms of internal fixation (12%), and nonsurgical methods (38%). External fixation is recommended when ESIN is not possible due to local soft tissue damage, additional injuries, or complex fractures.

Miller PR, Moore PS, Mansell E, et al. **External fixation or arteriogram in bleeding pelvic fracture: initial therapy guided by markers of arterial hemorrhage.** *J Trauma* 2003; 54:437–443. Optimal therapy in the face of bleeding pelvic fractures requires early determination of arterial bleeding. Angiography should not be delayed by the application of external fixation. The response to initial resuscitation as well as the presence of contrast blush on CT aid in the decision for immediate angiography vs. external fixator application, regardless of fracture pattern.

Trauma continued

Mitkovic MB, Bumbasirevic MZ, Lesic A, Golubovic Z. **Dynamic external fixation of comminuted intra-articular fractures of the distal tibia (type C pilon fractures).** *Acta Orthop Belg* 2002; 68:508–514. Report of 28 C3 pilon fractures, treated with dynamic external fixation. Mean time to union was 14 (12 – 20) weeks. There were three cases of angulation (7 – 20 degrees). There were no infections or nonunions. Authors recommend this treatment for comminuted intra-articular distal tibial fractures.

Upper Extremity

Bagatur AE, Dogan A, Zorer G. **Correction of deformities and length discrepancies of the forearm in children by distraction osteogenesis.** *Acta Orthop Traumatol Turc* 2002; 36:111–116. Ten forearms with shortening and/or deformity in nine patients were reviewed. Mean age at surgery was 10.2 (5–16) years. Multiple diagnoses were listed. Ilizarov fixators were used in seven cases; Orthofix fixators were used in three. Mean length gain was 36.7 mm (range 25–60). Mean length increase as 31.5% (14–66%). A satisfactory functional and cosmetic result was achieved in all. Callus deformity after fixator removal was the most common complication.

Boireau P, Laville JM. **Rotational osteotomy technique for congenital radio-ular synostosis with central medullary nailing and external fixation.** *Rev Chir Orthop Reparatrice Appar Mot* 2002; 88:812–815. The Hernigou–Goutallier procedure was used to treat six cases of congenital radioulnar synostosis. Two pins are placed in the ulna at the desired angle of correction. An osteotomy is performed between the pins and rotated around a previously inserted intramedullary nail. The ulna is rotated to make the pins parallel. The pins are attached to a fixator, parallel to each other. Bony union occurred within two months. Any over-correction leading to vessel or nerve injury can be reversed without losing the axis, allowing progressive correction if necessary.

Koch PP, Exner GU. **Supracondylar medial open wedge osteotomy with external fixation for cubitus varus deformity.** *J Pediatr Orthop B* 2003; 12:116–122. This study describes an incomplete distal humeral opening wedge osteotomy via a medial approach, fixed with four Schanz screws attached to a fixator.

Matsumoto K, Nakanishi H, Koizumi Y, et al. **Correction of a deformed thumb by distraction of the phalanx.** *Scand J Plast Reconstr Surg Hand Surg* 2002; 36:368–372. Six deformed thumbs in four patients were treated with distraction osteogenesis. Two had Apert syndrome; two had polydactyly. The mean healing index in Apert syndrome was 37.2 (24.2 – 41.5) days per centimeter and 64.3 (62.5–66.0) days per centimeter in polydactyly.

COMSS Report to LLRS Spring 2003 Meeting

The Spring COMSS meeting was held in Washington, D.C. April 24–25, 2003. Two sessions were conducted, in conjunction with the National Orthopedic Leadership Conference and the AAOS Board of Councilors meetings of April 23–26, 2003. LLRS was represented by Drs. Jim Binski and John Birch.

The Thursday April 24 session was dedicated to a discussion of advocacy issues for the American Academy of Orthopedic Surgeons, the American Association of Orthopedic Surgeons, and the Specialty Societies. The AAOS maintains a full-time, Washington-based Orthopedic PAC. The following topics were addressed and generally agreed upon during this session:

- a. AAOS and Specialty Society advocacy issues were essentially identical. Therefore, there was no need for the development of individual Specialty Society PAC's. Instead, each specialty society is strongly encouraged to support the AAOS Orthopedic PAC by:
 - i. Requesting that all Specialty Society Executive Board members contribute to the Orthopedic PAC on an annual basis (ideally at the \$1000 level). LLRS Executive Board voted to unanimously support the PAC at the Executive Meeting held in New Orleans;
 - ii. Encourage Specialty Society general membership to follow the leadership of their Executive Board, and support the PAC with contributions;
 - iii. Follow the leadership of the American Association of Hip and Knee Surgeons, which is restructuring as a 501(c)-3 and 501(c)-6 organization, and requesting a portion of membership dues payments be forwarded to the Orthopedic PAC (such payments are not tax deductible);
- b. The Orthopedic PAC will consider identifying specialty society contributions as such.

The Friday April 25 session was dedicated to a discussion of opportunities to partner with AAOS and other specialty societies in educational endeavors. These opportunities include:

- a. The AAOS Program Committee has expressed a willingness (although not as yet a firm commitment) to accept COMSS-sponsored "State of the Art" symposia topics for the AAOS annual meeting;
- b. The AAOS is willing to partner with Specialty Societies in the development of Orthopedic Knowledge Online (OKO) lectures (available on a subscription basis);
- c. Each Subspecialty society is encouraged to create a Core Curriculum to aid in the "Maintenance of Competence" ABOS initiative.

The Limb Lengthening and Reconstruction
Society: ASAMI-NA
P. O. Box 91868
Austin, TX 78709-1868 USA

DISTRACTIONS

Send contributions to J. John Gugenheim
jgg@fondren.com
(713) 383-9150 fax

Send course listings to Karen Syzdek at
ksyzdek@yahoo.com. For advertising
rates, contact Karen by e-mail or at
(512) 301-7328.

© 2003 Limb Lengthening and Reconstruc-
tion Society: ASAMI-North America.