Casts and Splints

Tid bits from the Orthopaedic Literature

John A. Schlechter, DO, FAOAO, FAAOS, FAOA

Children's Hospital Orange County, Orange, CA

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tid·bit

a small and particularly interesting item of gossip or information

Does he really need a cast?

Maybe…it depends

Buckle Fractures of the Distal Radius Are Safely Treated in a Soft Bandage

A Randomized Prospective Trial of Bandage Versus Plaster Cast

Simon West, FRCS (Tr & Orth), John Andrews, FRCS (Tr & Orth),† Andrew Bebbington, MRCS,‡ Owain Ennis, MRCS,§ and Phillip Alderman, FRCS (Orth)¶*

- Results were highly positive for treatment in bandage, with no reported adverse effects and a highly desirable result for the patient

- The authors suggest a change in treatment policy for such fractures

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J Pediatr Orthop Volume 25, Number 3, May/June 2005

CMAJ RESEARCH

Cast versus splint in children with minimally angulated fractures of the distal radius: a randomized controlled trial

Kathy Boutis MD, Andrew Willan PhD, Paul Babyn MD, Ron Goeree MA, Andrew Howard MD

- 96 children age 5 -12y , ≤ 15˚ angulated greenstick / transverse fx wrist
- Angulation @ 4w not statistically significant (9.8˚ splint group v 8.2˚ cast group
- Splint was as effective as a cast with respect to recovery of physical function and comparable in maintenance of fracture stability and the occurrence of complications

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Evidence into Practice: Pediatric Orthopaedic Surgeon Use of Removable Splints for Common Pediatric Fractures

Kathy Boutis, MD, MSc, Andrew Howard, MD, MSc,† Erika Constantine, MD,‡§*
Anna Cuomo, MD,‖ Zeeshanefatema Somji, BSc, and Unni G. Narayanan, MBBS, MSc†*

- Removable splints when compared with circumferential casts in randomized trials have been shown to be a safe and cost-effective method for Distal Radius and Fibula Fxs
- Cross-sectional survey POSNA members
- 558 (67.6%) responded to the survey

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J Pediatr Orthop 2014 May 30 Epub

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- 29.1% would use removable splint to treat a buckle fx
- 5.9% and 1.5% would use such splints for minimally displaced greenstick and transverse fractures of the distal radius, respectively.
- For distal fibular avulsion fractures - 22.5% would use a removable splint
- 10.5% for nondisplaced Salter-Harris I fractures of the distal fibula

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- Concerned about patient compliance
- Concerned about potential complications
- Medicolegal implications
- Cost/reimbursement issues
- Do not feel evidence is strong enough
- Lack of availability of commercial devices in my practice

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J Pediatr Orthop 2014 May 30 Epub

If you have to put a cast on why do you have to push on it?

It may fall off!!

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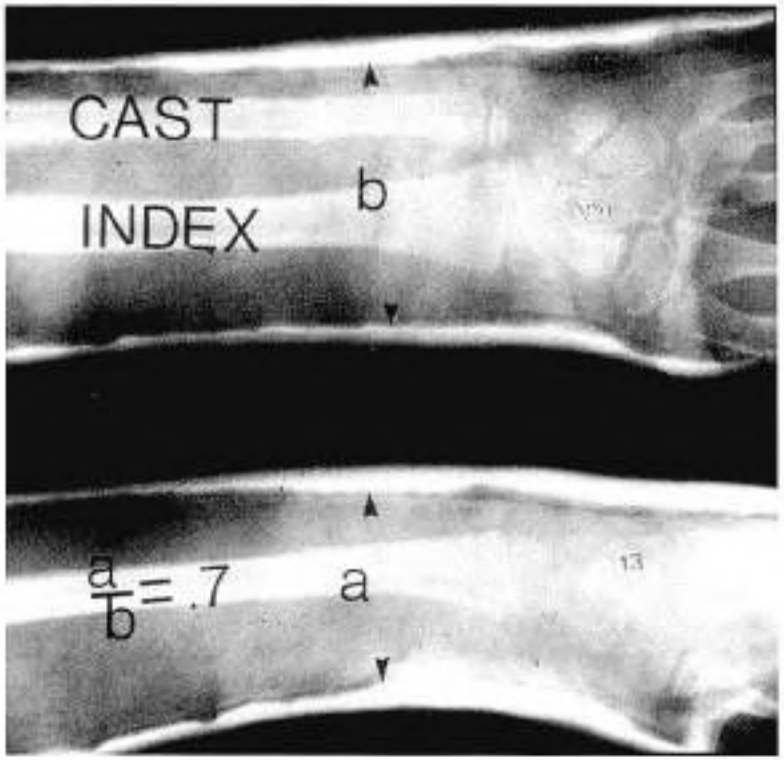
Short Arm Plaster Cast for Distal Pediatric Forearm Fractures

D. G. Chess, F.R.C.S. C., *J. C. Hyndman, F.R.C.S. C., *J. L. Leahey, F.R.C.S. C., *D. C. S. Brown, F.R.C.S. C., and *A. M. Sinclair, F.R.C.S. C.

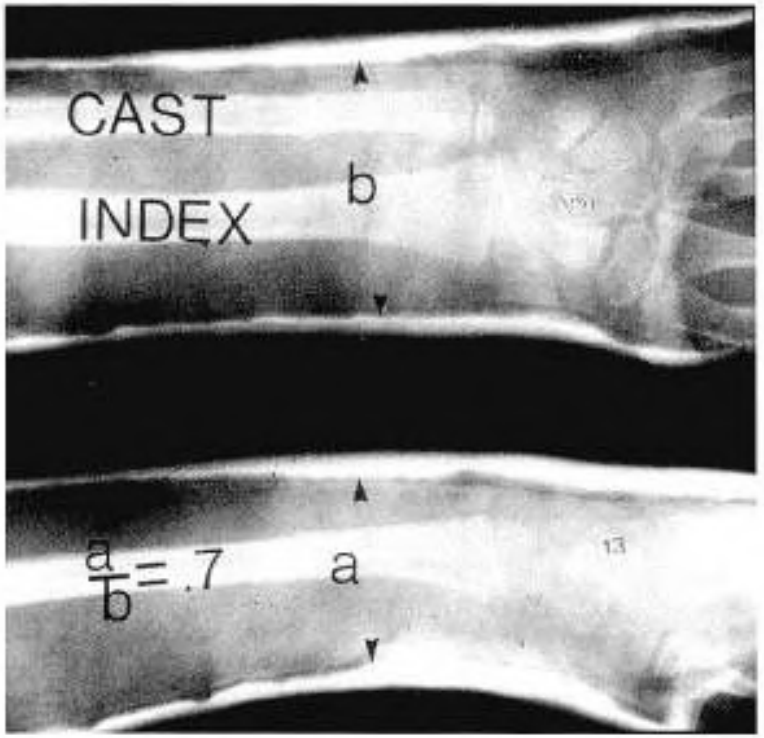
*Hand and Upper Limb Centre, St. Joseph's Health Centre, University of Western Ontario, London, Ontario; and *Izaak Walton Killam Hospital, Dalhousie University, Halifax, Nova Scotia, Canada*



↑cast index = ↑risk of displacement

Cast index = x/y

Magic Number = 0.7



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Chess et al. JPO 1994

Bad

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Indian Journal of Orthopedics 2011: 45 (4); 341-346

Good

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Indian Journal of Orthopedics 2011: 45 (4); 341-346

Straight Ulna Border

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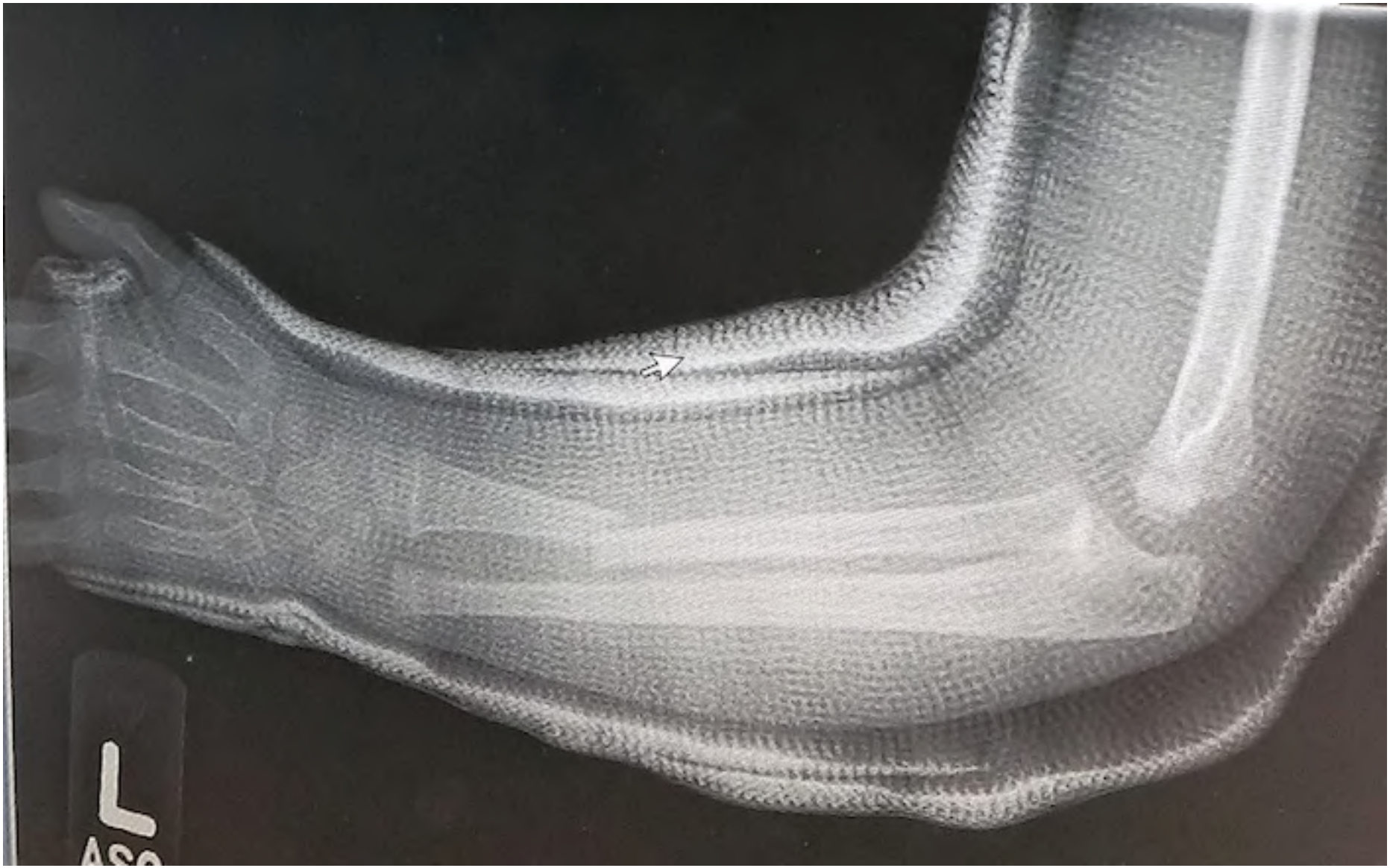
Avoid the Banana



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There's More Than a Cast Index

Predicting initial treatment failure of fiberglass casts in pediatric distal radius fractures: utility of the second metacarpal-radius angle

- Emphasize the importance of not only the cast index, but also the ulnar deviation mold as measured by the second metacarpal-radius angle.

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Edmonds et al. J Child Orthop (2009) 3:375–381

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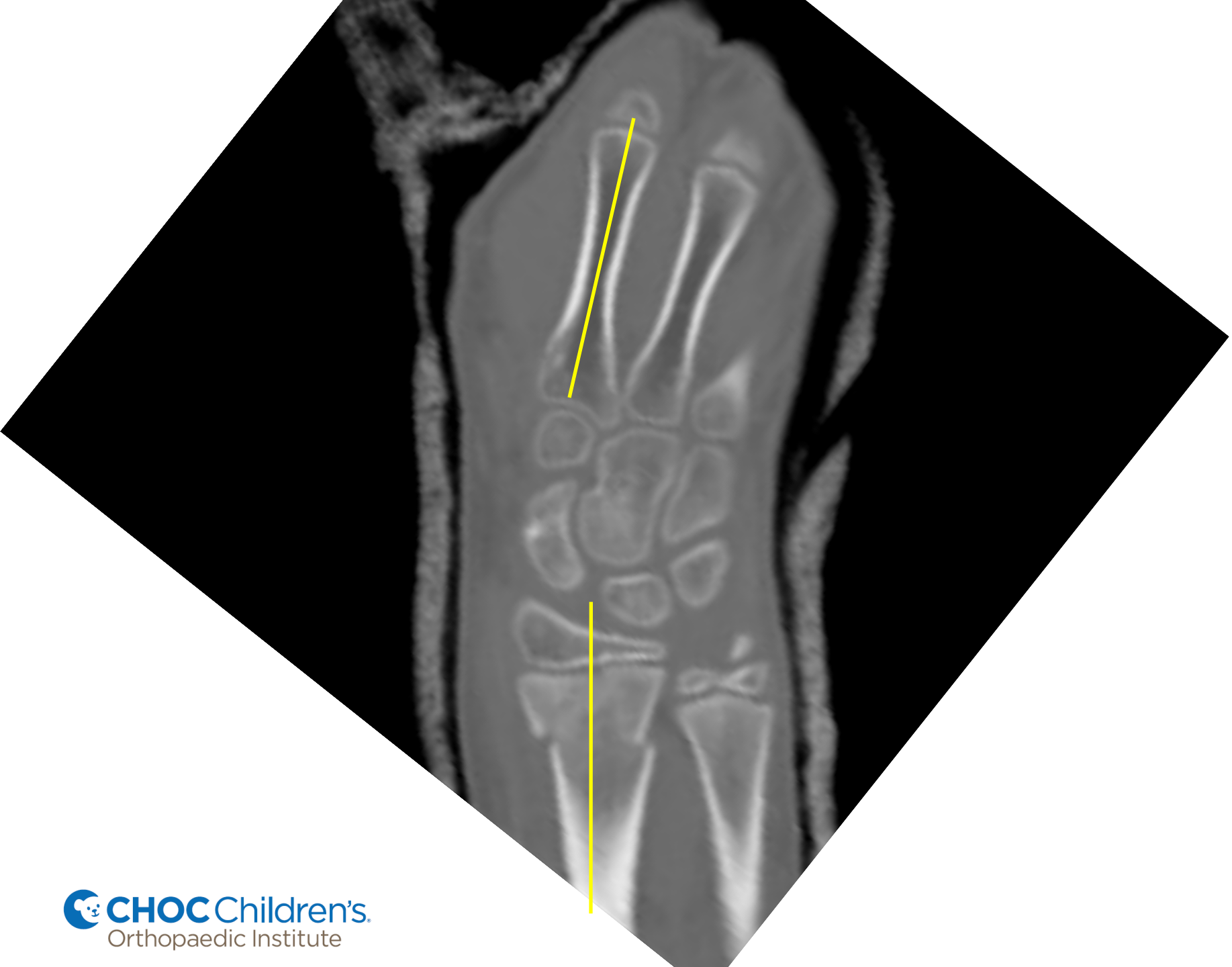

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Canterberry “padding” index

- Cast Index + padding index
- Cutoff = 1.1
- Indirect measure of three-point fixation
- The greater the padding thickness at the fracture site the poorer the three-point fixation

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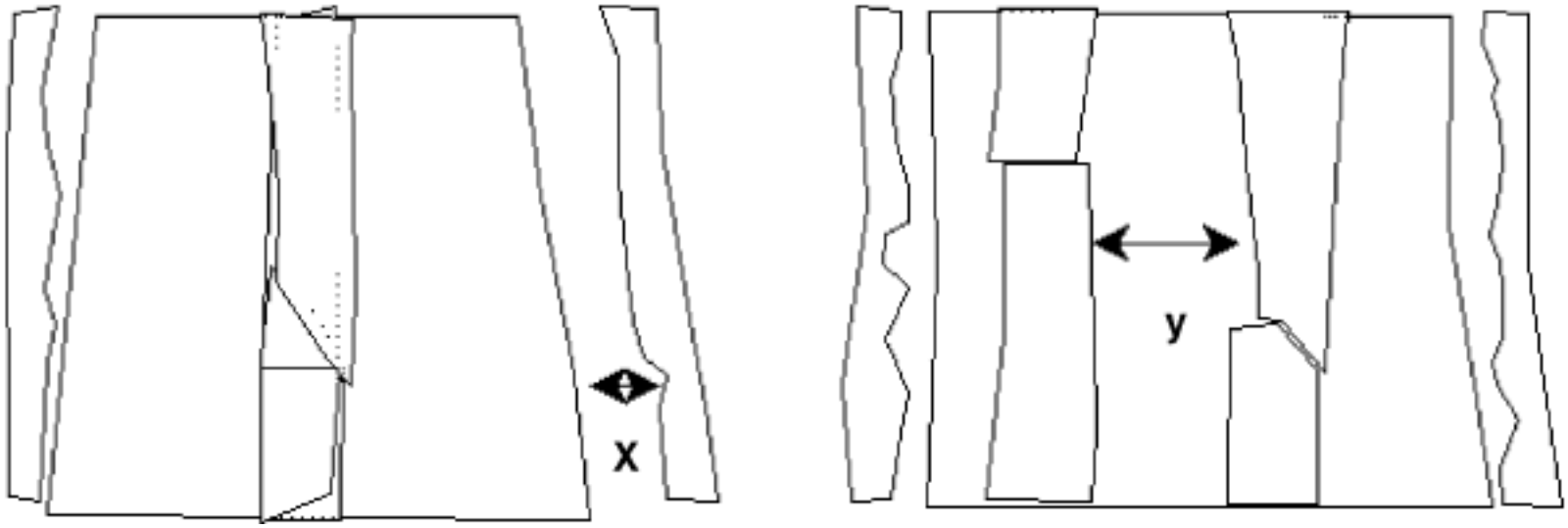
Bhatia et al. Injury, Int. J. Care Injured (2006) 37, 259—268

“Padding Index”



- Padding index (x) Padding thickness in plane of deformity correction on lateral radiograph (y) maximum interosseous space on AP radiograph.

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Bhatia et al. Injury, Int. J. Care Injured (2006) 37, 259—268

Does she really need a reduction?

Maybe not. Is she from Hawaii?

Closed Treatment of Overriding Distal Radial Fractures without Reduction in Children

Scott N. Crawford, MD, Lorrin S.K. Lee, MD, and Byron H. Izuka, MD

Investigation performed at Children's Orthopaedics of Hawaii, Pali Momi Medical Center, Aiea, Hawaii

- Consecutive patients three to ten years of age presenting between 2004 and 2009 with a closed overriding fracture of the distal radial metaphysis were followed prospectively x 1 year

Protocol → no analgesia, no sedation, and a short arm fiberglass cast gently molded to correct only angulation

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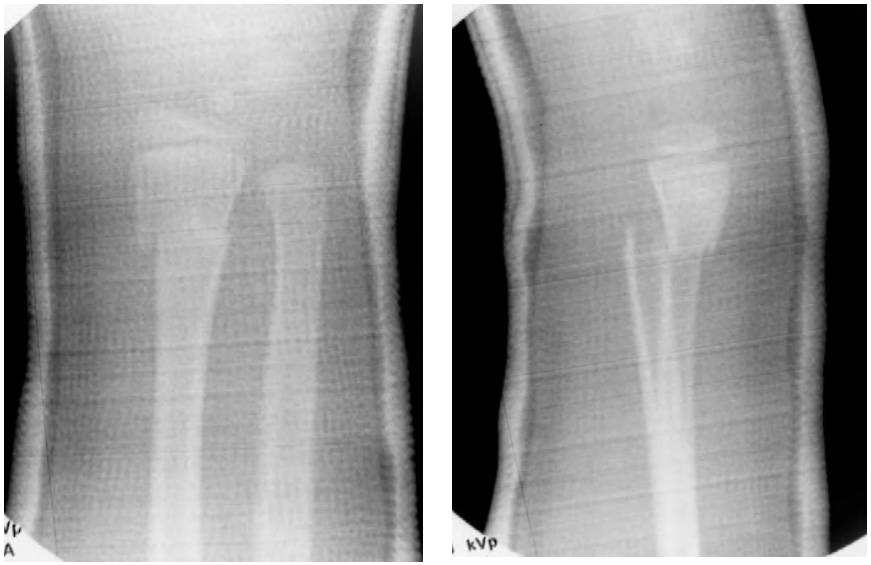
J Bone Joint Surg Am. 2012;94:246-52

- 51 children avg age of 6.9 years were included
- Initial radial shortening averaged 5.0 mm. Initial sagittal and coronal angulation averaged 4.0° and 3.2° , respectively.
- The average duration of casting was forty-two days



J Bone Joint Surg Am. 2012;94:246-52

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Cost Analysis

Treatment	Cost ($)
Office visit with application of short arm cast	1027
Emergency room with sedation, closed reduction, and casting	4846
Operating room with general anesthesia, closed reduction, and casting	6415
Operating room with general anesthesia, closed reduction with percutaneous pinning, and casting	8742

J Bone Joint Surg Am. 2012;94:246-52

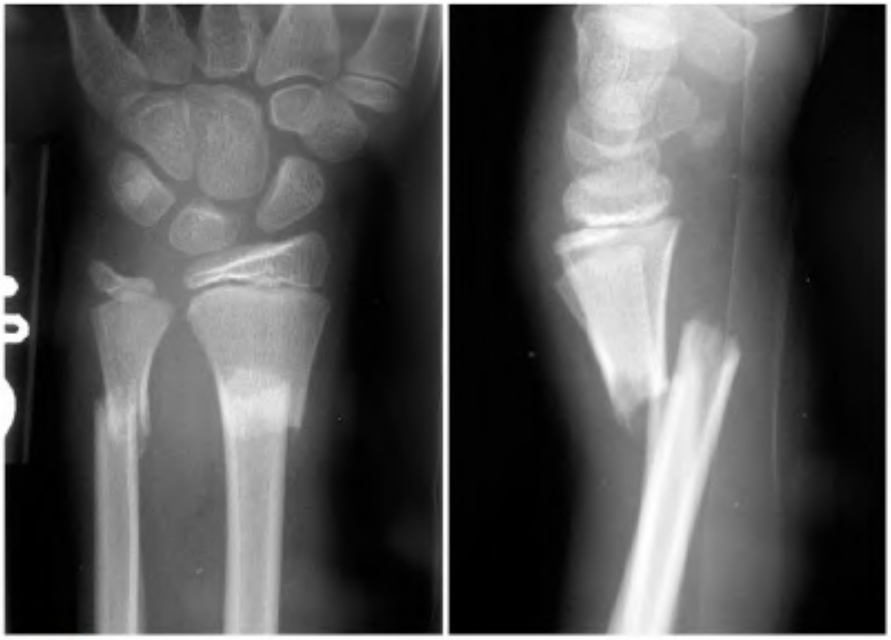
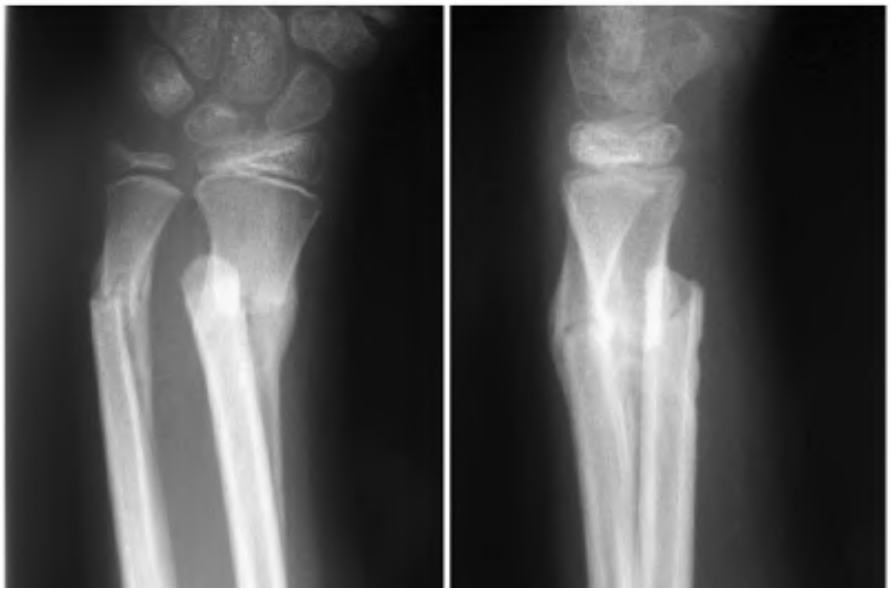
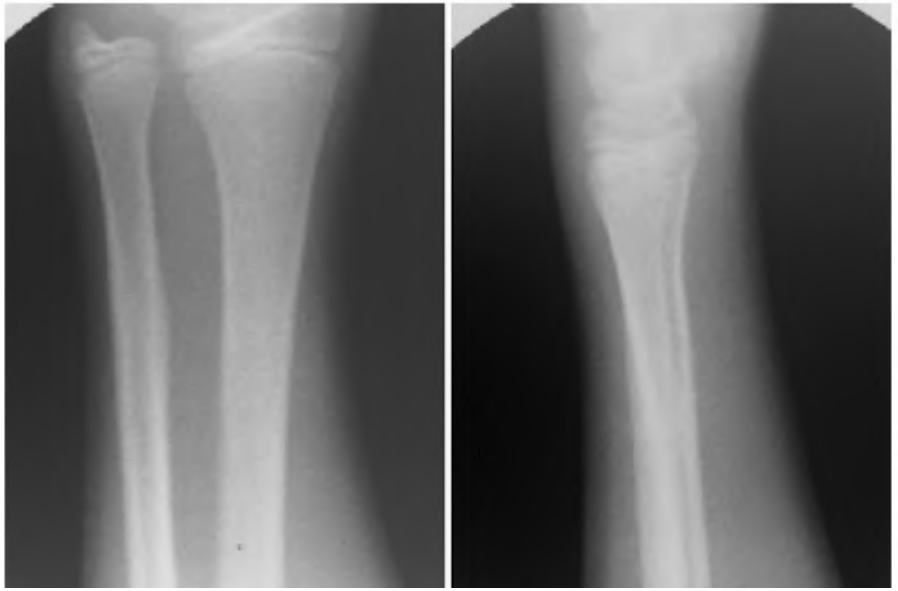


Fig. 2-A

Fig. 2-B





Closed Treatment of Overriding Distal Radial Fractures without Reduction in Children

Scott N. Crawford, MD, Lorrin S.K. Lee, MD, and Byron H. Izuka, MD

Investigation performed at Children's Orthopaedics of Hawaii, Pali Momi Medical Center, Aiea, Hawaii

- Conclusions:
  - Residual sagittal and coronal angulation at the time of final follow-up averaged 2.2° and 0.8°, respectively.
  - All 51 patients achieved clinical and radiographic union with a full range of wrist motion.
  - All parents and guardians answered the questionnaire and were satisfied with the treatment.

J Bone Joint Surg Am. 2012;94:246-52

Closed Treatment of Overriding Distal Radial Fractures without Reduction in Children

Scott N. Crawford, MD, Lorrin S.K. Lee, MD, and Byron H. Izuka, MD

Investigation performed at Children's Orthopaedics of Hawaii, Pali Momi Medical Center, Aiea, Hawaii

- Conclusions:
  - This treatment protocol presents an alternative approach to overriding distal radial fractures in children and provides the orthopaedic surgeon a simple, effective, and cost and time-efficient method of treatment.

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J Bone Joint Surg Am. 2012;94:246-52

Does it need to be longer?

Short versus Long ?

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Comparison of Short and Long Arm Plaster Casts for Displaced Fractures in the Distal Third of the Forearm in Children

By Gavin R. Webb, MD, Robert D. Galpin, MD, FRCSC, and Douglas G. Armstrong, MD

Investigation performed at The Women's and Children's Hospital of Buffalo, Buffalo, New York

- Prospective randomized trial
- 60 LA vs 53 SA casts
- Avg age 9.8y (4-16y)

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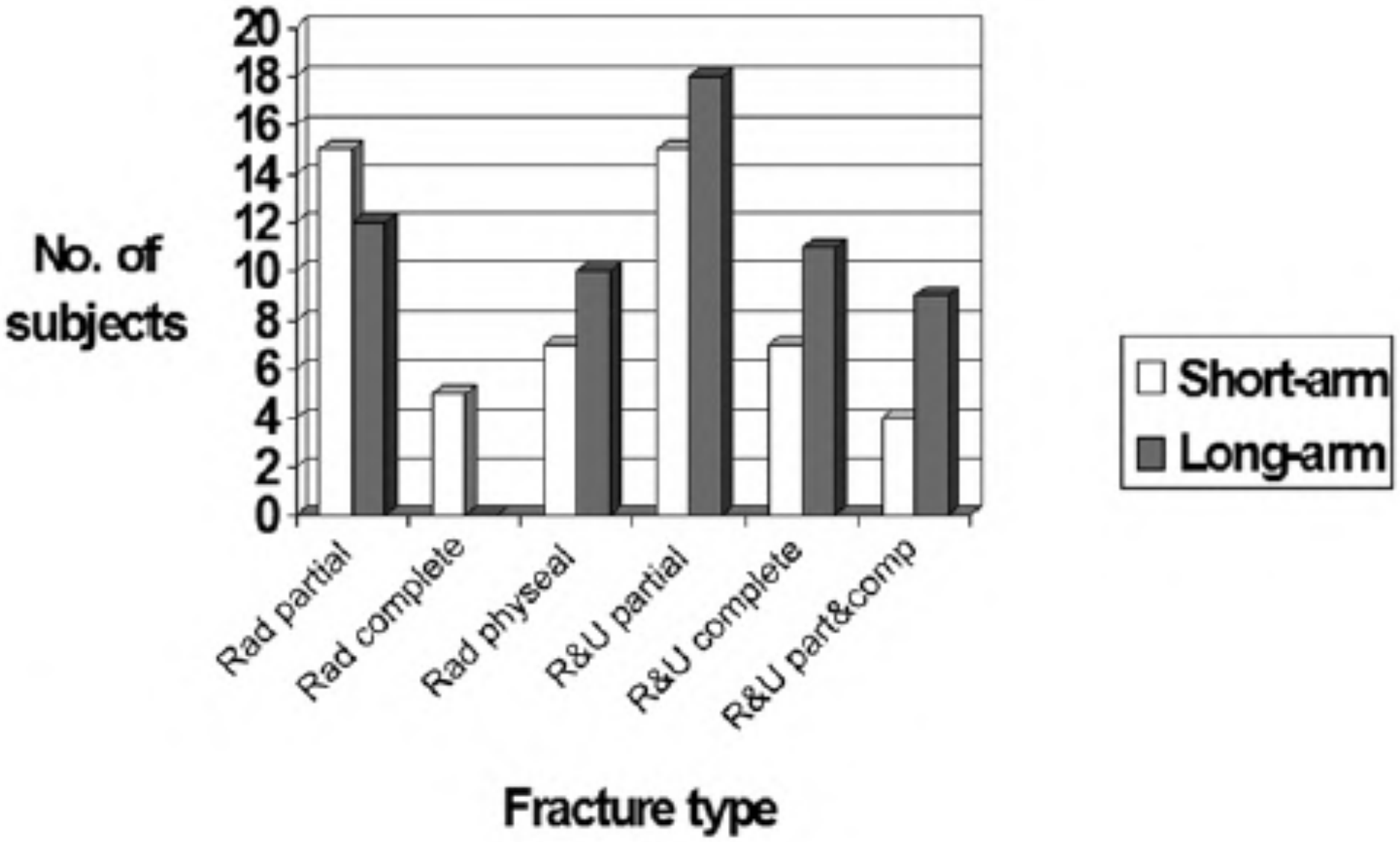
J Bone Joint Surg Am. 2006;88:1 (9-17)



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J Bone Joint Surg Am. 2006;88:1 (9-17)

- Fractures that lost reduction in the cast had significantly higher cast indices, indicating poor cast molding
- No difference if fracture was partially or completely displaced with regard to the change between the postreduction and final amount of displacement
- Patients treated with a short arm cast missed fewer school days and were less likely to require assistance with various activities of daily living

J Bone Joint Surg Am. 2006;88:1 (9-17)

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Investigation performed at The Women's and Children's Hospital of Buffalo, Buffalo, New York

- A well-molded short arm cast can be used as effectively as a long arm cast to treat fractures of the distal third of the forearm in children four years of age and older, and they interfere less with daily activities.

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J Bone Joint Surg Am. 2006;88:1 (9-17)

Why does the cast feel so hot?

Thermal Injury with Contemporary Cast-Application Techniques and Methods to Circumvent Morbidity

By Matthew A. Halanski, MD, Amy D. Halanski, MD, Ashish Oza, BS,
Ray Vanderby, PhD, Alejandro Munoz, PhD, and Kenneth J. Noonan, MD

Investigation performed at the Department of Orthopaedics and Rehabilitation, University of Wisconsin, Madison, Wisconsin

- Excessively thick plaster and a dip-water temperature of >24° C should be avoided

- Splints should be cut to a proper length and not folded over

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J Bone Joint Surg Am. 2007;89:2369-77

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Investigation performed at the Department of Orthopaedics and Rehabilitation, University of Wisconsin, Madison, Wisconsin

- Overwrapping of plaster in fiberglass should be delayed until the plaster is fully cured and cooled
- Placing the limb on a pillow during the curing process puts the limb at risk

J Bone Joint Surg Am. 2007;89:2369-77

Will it swell?

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Most likely…Yes

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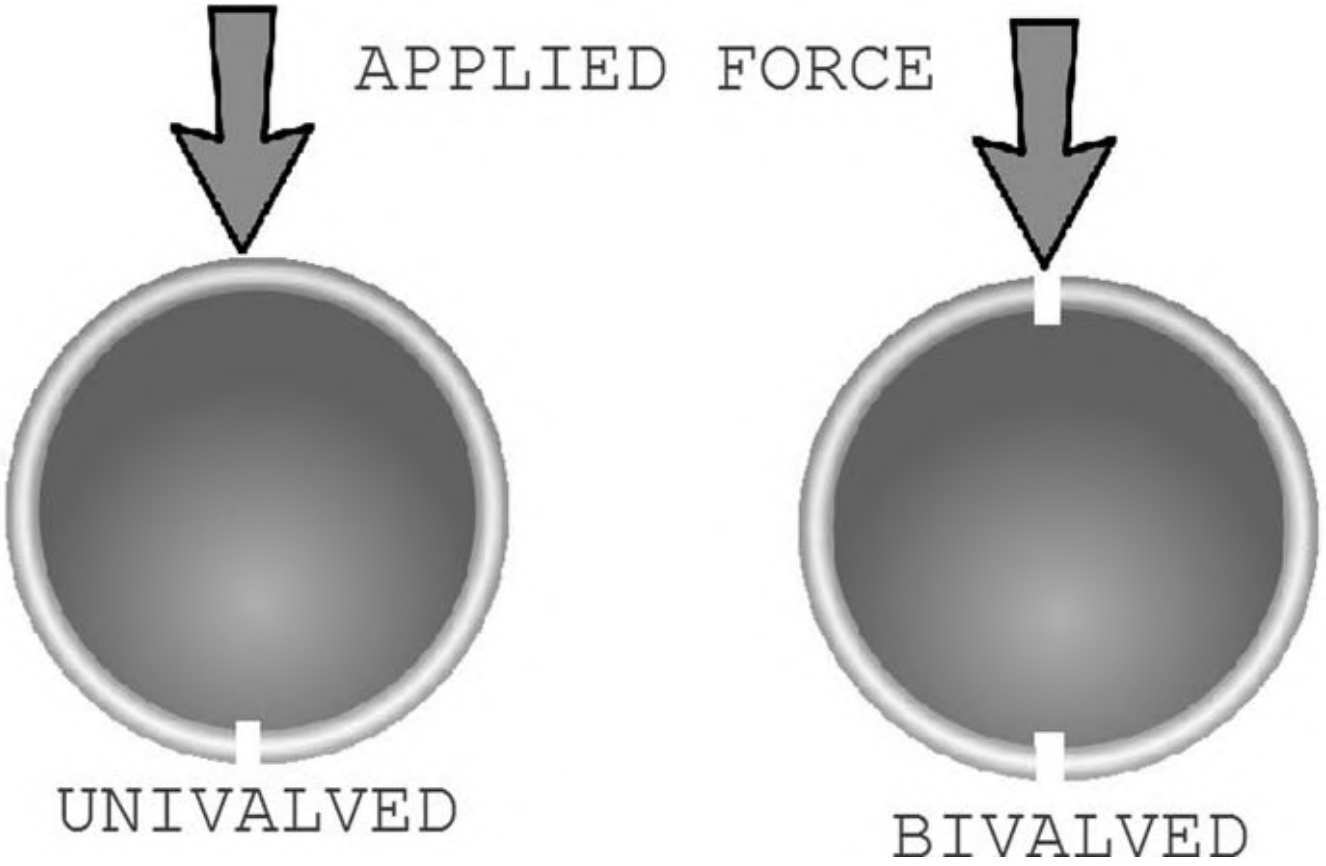
Analysis and Comparison of the Biomechanical Properties of Univalved and Bivalved Cast Models

Colin V. Crickard, MD, LCDR, MC, USN, Anthony I. Riccio, MD, LCDR, MC, USN, Joseph R. Carney, MD, LCDR, MC, USN, and Terrence D. Anderson, MD, LT, MC, USN



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J Pediatr Orthop 2011;31:39–43

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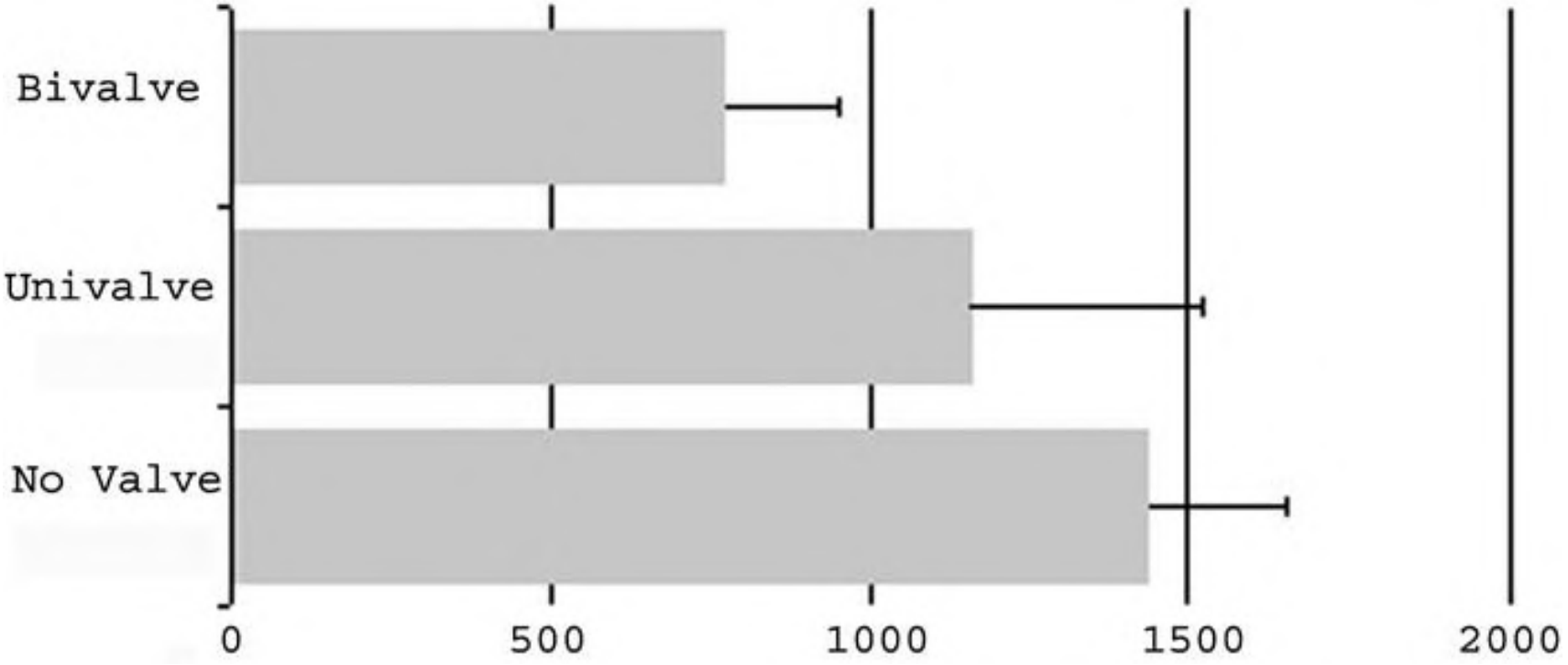

Failure loads (N) for 3 types of cast models

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J Pediatr Orthop 2011;31:39–43

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- Valving significantly decreases the bending stiffness and load to failure of fiberglass casts.
- Univalved casts have a higher load to failure than bivalved casts
- May impair a cast's ability to effectively immobilize an extremity or maintain a fracture reduction

J Pediatr Orthop 2011;31:39–43

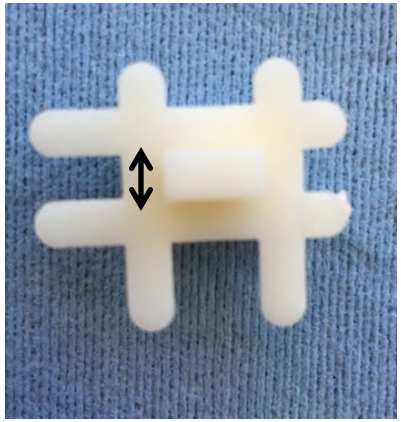
Under Pressure: The Utility of Spacers in Univalved Fiberglass Casts

Kevin Kleis, DO, John A. Schlechter, DO,† Joshua D. Doan, MEng,‡ Christine L. Farnsworth, MS,‡ and Eric W. Edmonds, MD‡*

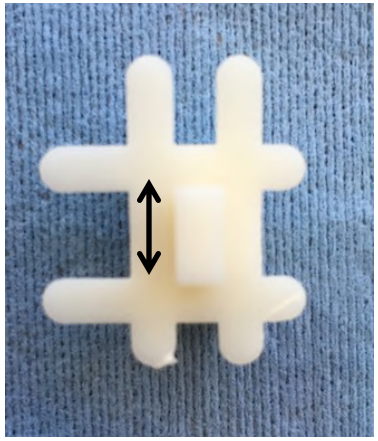
- Univalving fiberglass casts after fracture manipulation or extremity surgery is commonly performed to reduce the risk of developing compartment syndrome
- Purpose → correlate cast spacer width within a uni-valved cast as it relates to decreasing intra-compartmental pressure

Cast Spacers

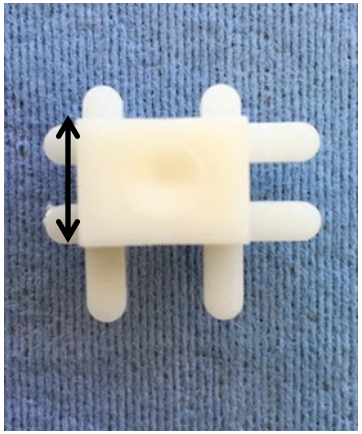
Position 1
3mm



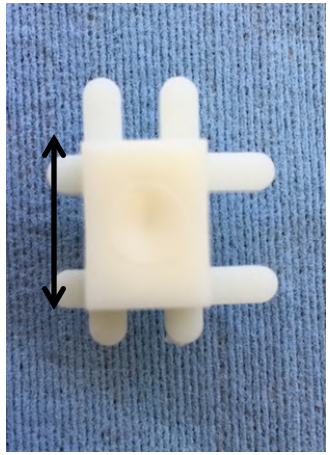
Position 2
6mm



Position 3
9mm



Position 4
12mm



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Under Pressure: The Utility of Spacers in Univalved Fiberglass Casts

Kevin Kleis, DO, John A. Schlechter, DO,† Joshua D. Doan, MEng,‡*
Christine L. Farnsworth, MS,‡ and Eric W. Edmonds, MD‡

- 2 Groups (n=5 each) of clinical compartment syndrome (CS):
  - *Low Pressure CS (*range 28-31mmHg)
  - *High Pressure CS* (range 64-68mmHg)

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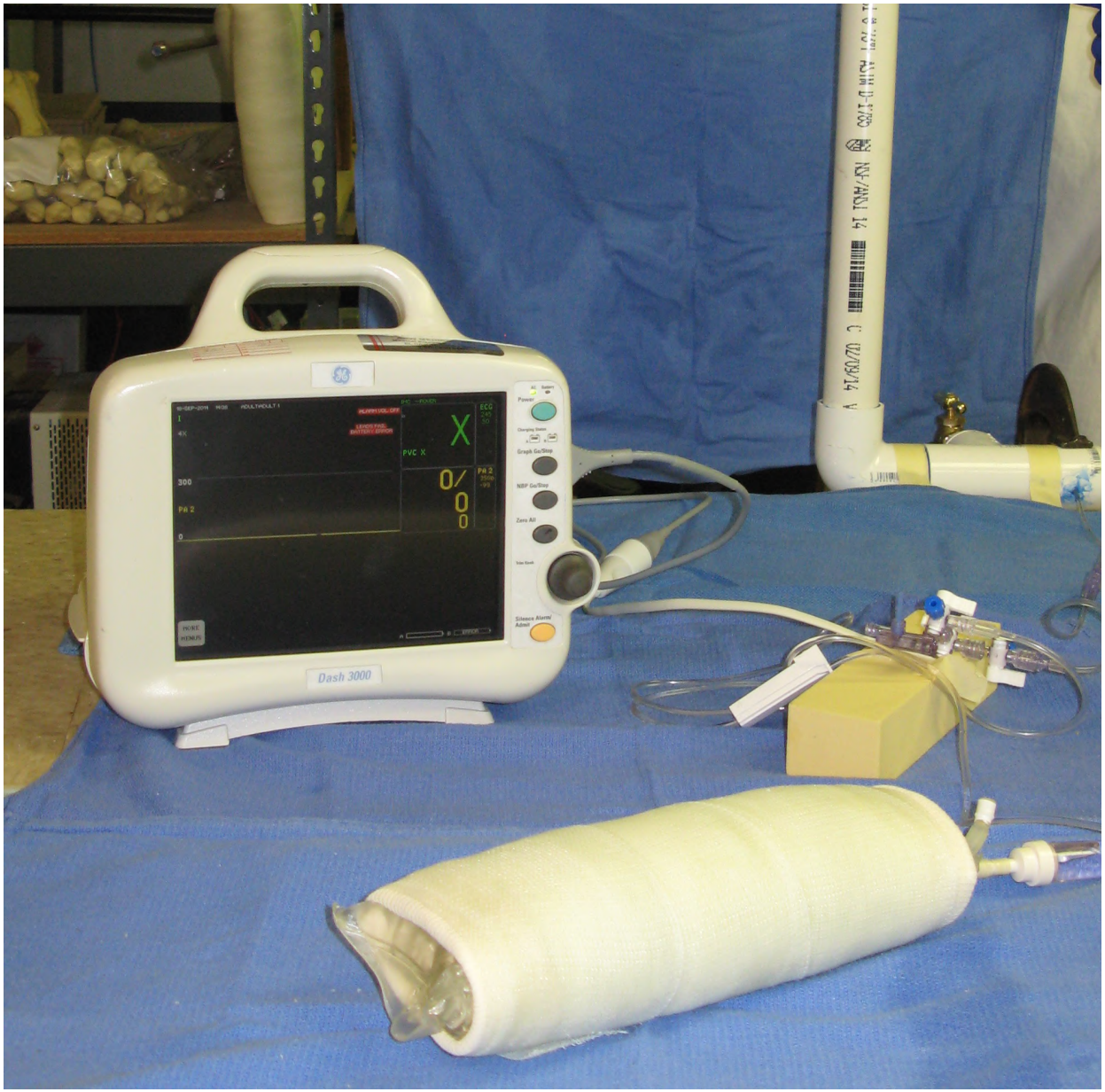
JPO 2016



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Christine L. Farnsworth, MS,‡ and Eric W. Edmonds, MD‡

- In LPCS and HPCS groups, after univalve and placement of spacer position #1, pressure dropped by a mean of 52% and 58%, respectively.
- Spacer #2, decreased the pressure by a mean of 78% and 80%, respectively. Both spacer sizes significantly decreased the underlying pressure in both groups.

- Univalving and taping little to no effect
- Increasing the univalved cast spread by 9mm of the initial cast diameter will reduce pressure to a pre-CS level; however, a spread of only 6mm can effectively reduce the pressure to <30mm Hg
- Position #2 (6mm) *Can be used for most scenarios*
- Position #3 (9mm) may be employed in more high risk scenarios
- Position #4 (12mm) little change in pressure drop and likely weakens cast too much

The Pressure Is on: Dorsal Versus Volar Univalves for Long-arm Casts

Dallyn Udall, DO, Remy Zimmerman, BS,† Tracey Bastrom, MS,‡ and John Schlechter, DO*†§*

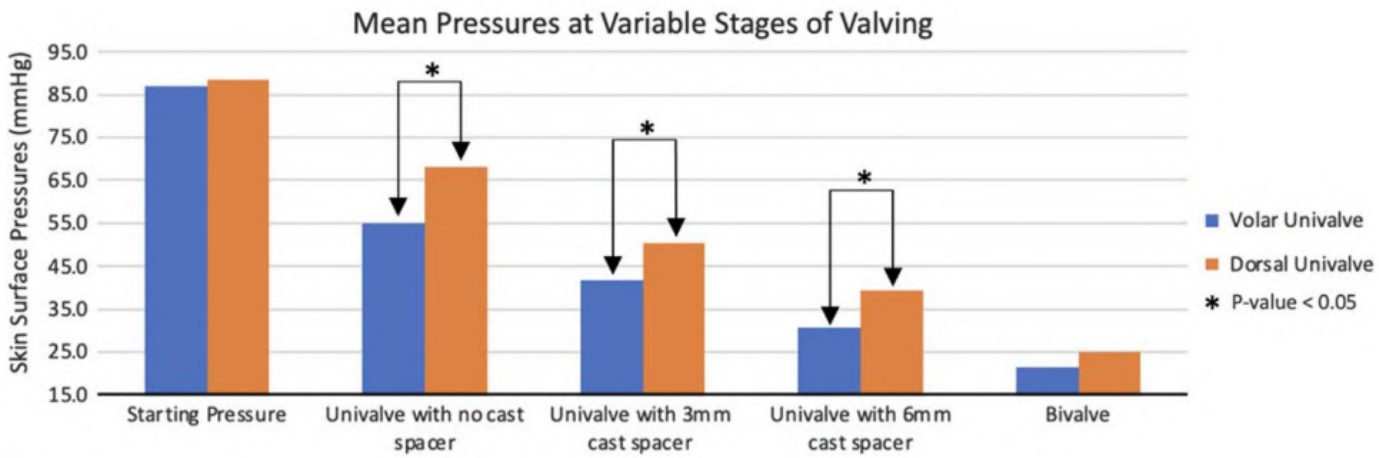

FIGURE 3. The mean pressures of each group at each stage of the experiment.

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(J Pediatr Orthop 2023)

Does the saw hurt?

Look it doesn’t cut me

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Cast Saw Injuries

- Thermal injuries and cuts
- Dependent on
  - Competency and technique of the user
  - Layers of padding
  - Blade condition
  - Thickness of cast

Cast-Saw Burns: Evaluation of Skin, Cast, and Blade Temperatures Generated During Cast Removal

By Franklin D. Shuler, MD, PhD, and Frank N. Grisafi, MD

Investigation performed at the Department of Orthopaedics, West Virginia University, Morgantown, West Virginia

- Cadaveric study – temp at the skin-padding interface
- Poor technique (blade never leaving cast during cutting), fiberglass material, and thinner padding resulted in significantly higher skin temperatures
- Poor technique increased skin temp by an avg 5.0° C ($p < 0.05$)
- Fiberglass casting materials increased skin temperatures by an avg 7.4° C ($p < 0.05$)

Cast-Saw Burns: Evaluation of Skin, Cast, and Blade Temperatures Generated During Cast Removal

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Investigation performed at the Department of Orthopaedics, West Virginia University, Morgantown, West Virginia

- Four layers of cast padding decreased skin temperatures by 8.0° C ($p < 0.05$)
- The highest skin temperatures were recorded for fiberglass casts with two layers of padding
- The lowest skin temperatures were recorded for plaster casts with four layers of padding

Cast-Saw Burns: Evaluation of Skin, Cast, and Blade Temperatures Generated During Cast Removal

By Franklin D. Shuler, MD, PhD, and Frank N. Grisafi, MD

Investigation performed at the Department of Orthopaedics, West Virginia University, Morgantown, West Virginia

- 4 layers of cast padding compared with 2 layers significantly reduced skin temperatures for both plaster and fiberglass casts

ORTHOPAEDIC
FORUM

Epidemiology and Prevention of Cast Saw Injuries

Results of a Quality Improvement Program at a Single Institution

Benjamin J. Shore, MD, MPH, FRCSC, Sarah Hutchinson, OTC, Marie Harris, MPH, Donald S. Bae, MD, Leslie A. Kalish, ScD, William Maxwell III, OTC, and Peter Waters, MD

- Investigation performed at Boston Children's

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J Bone Joint Surg Am. 2014;96:e31(1-8)

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- Department of Orthopaedic Surgery set an aggressive goal of making cast saw injuries a "never event."
- Quality Improvement Initiative

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J Bone Joint Surg Am. 2014;96:e31(1-8)

Epidemiology and Prevention of Cast Saw Injuries

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- Resident training - a 1-hour lecture and a 1/2-hour hands-on training session in the cast room that focused on cast application and removal
- A new certification requirement was introduced for all midlevel providers and ortho techs

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- Trainees were required to demonstrate safe cast saw use and equipment maintenance skills before their competency checklist was signed by the lead orthopaedic technician and the clinical chief of the department

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Epidemiology and Prevention of Cast Saw Injuries

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- 29 injuries in 23,615 exposures
- Increased risk in the ED by ortho residents.
- Improving education and training in cast saw use has the potential to decrease the prevalence of cast saw injuries over time

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J Bone Joint Surg Am. 2014;96:e31(1-8)

Cast Saw Injuries

- “A Never Event”
- Gore DeFlex Strip
- Need for training and certification

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TOPICS IN TRAINING

Development of a Cast Application Simulator and Evaluation of Objective Measures of Performance

Joel Moktar, BS, Charles A. Popkin, MD, Andrew Howard, MD, FRCSC, and M. Lucas Murnaghan, MD, MEd, FRCSC
Investigation performed at the Division of Orthopaedic Surgery, The Hospital for Sick Children, Toronto, Ontario, Canada

- Simulation offers a low-risk learning environment with repetitive practice opportunities for orthopaedic residents

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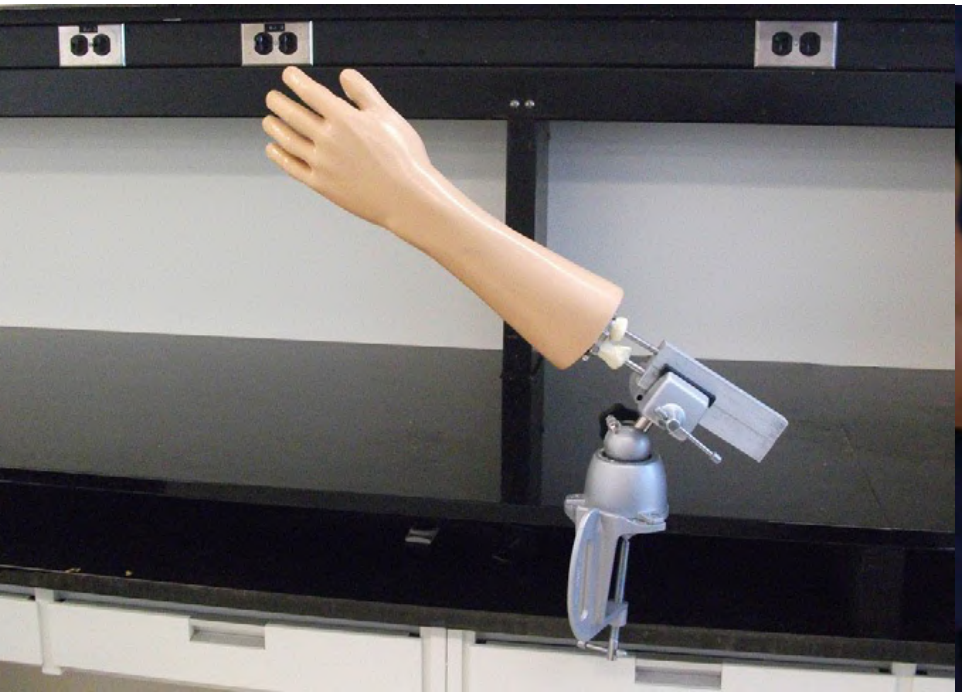
J Bone Joint Surg Am. 2014;96:e76(1-6)



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Development of a Cast Application Simulator and Evaluation of Objective Measures of Performance

- Objective Structured Assessment of Technical Skill checklist
- 9 experts (5 orthopaedic surgeons and 4 orthopaedic technologists)
- De-identified videos of cast application were recorded and were utilized to test
- Participants were grouped by training level

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J Bone Joint Surg Am. 2014;96:e76(1-6)

Development of a Cast Application Simulator and Evaluation of Objective Measures of Performance

- Casting simulation model and evaluation instrument is a reliable assessment of casting skill in applying a short arm cast

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How to change a cast saw blade

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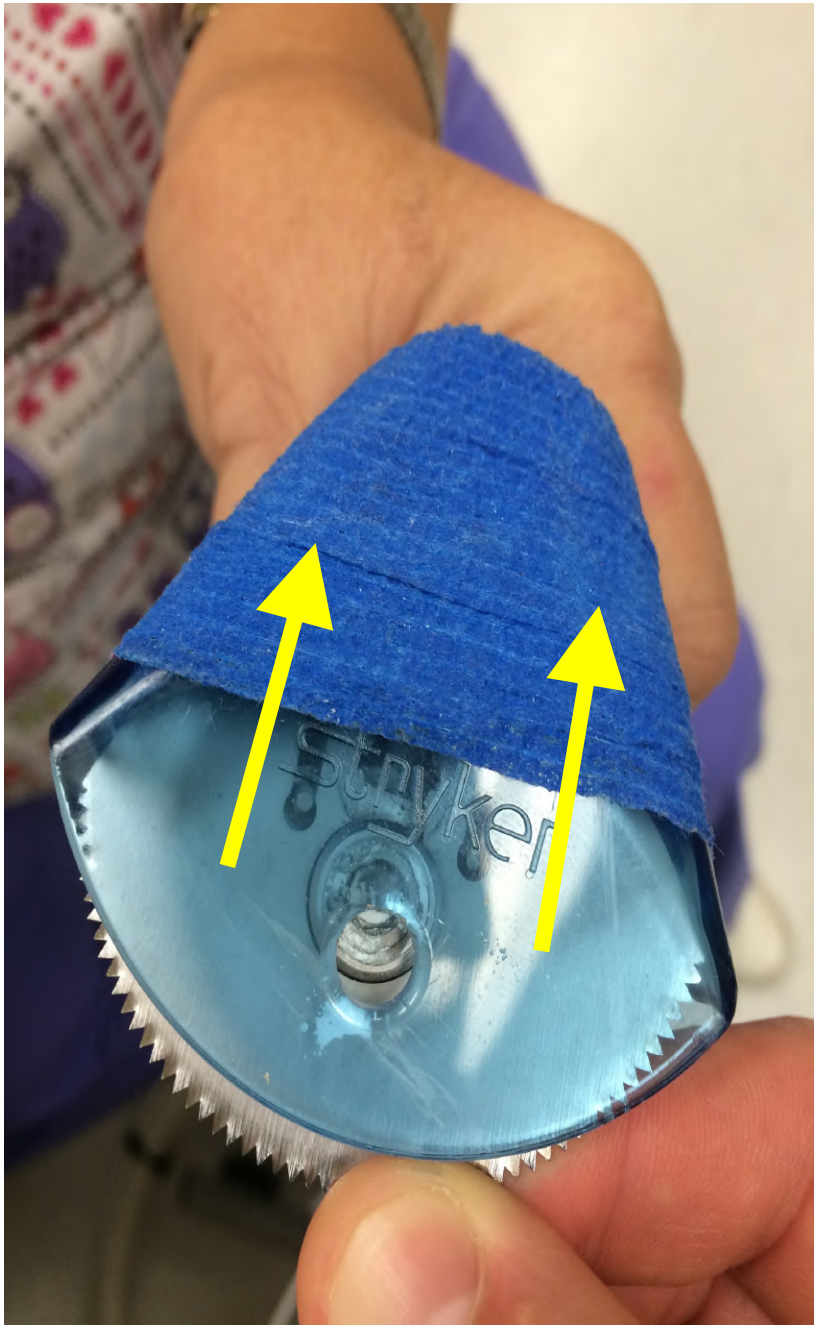
940-23
stryker

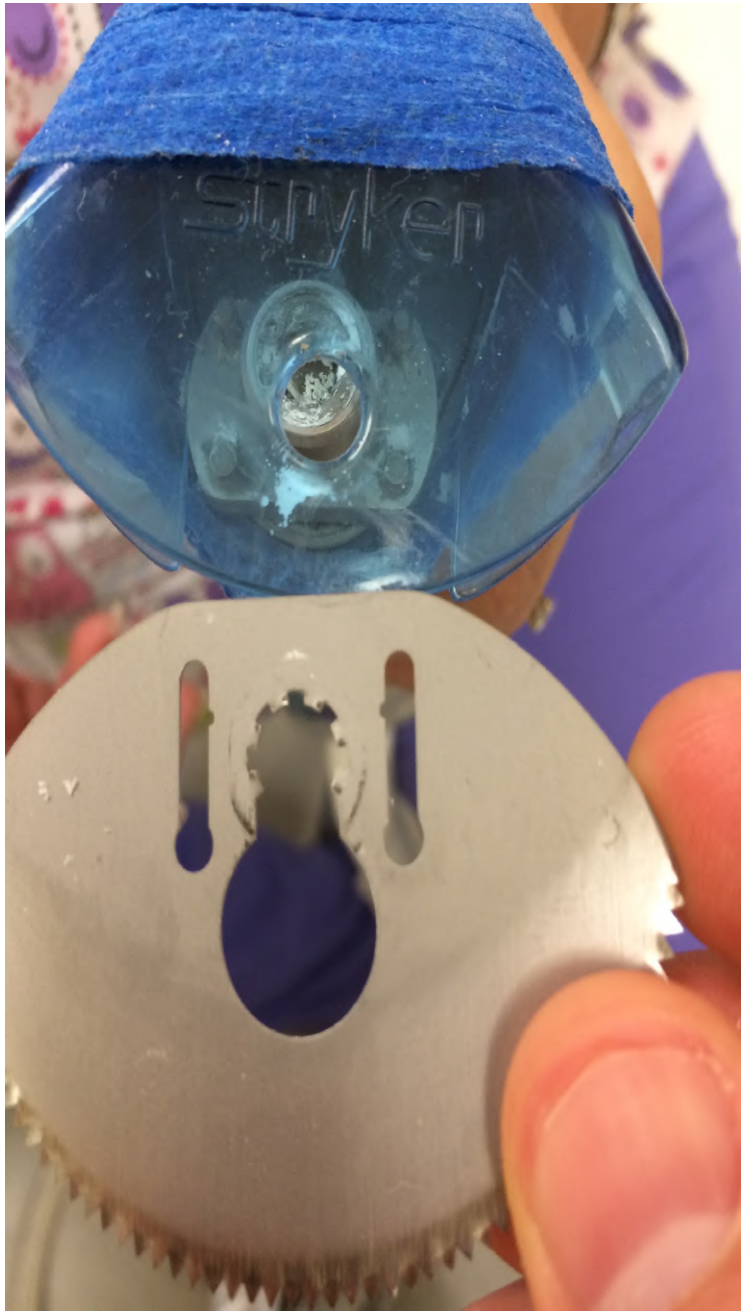
stryker
Cast Cutter Blades
REF 0840-023-000
0840-040-200
0840-040-250
0840-040-300
0840-040-350
0940-023-000
0940-025-000
0940-035-000
Instructions For Use
℞ ONLY
940-23
stryker
SUOMI
POLSKI
ΕΛΛΗΝΙΚΑ
2010/08


Stryker


Who
BID


Stryker

Pull blade towards body


Stryker

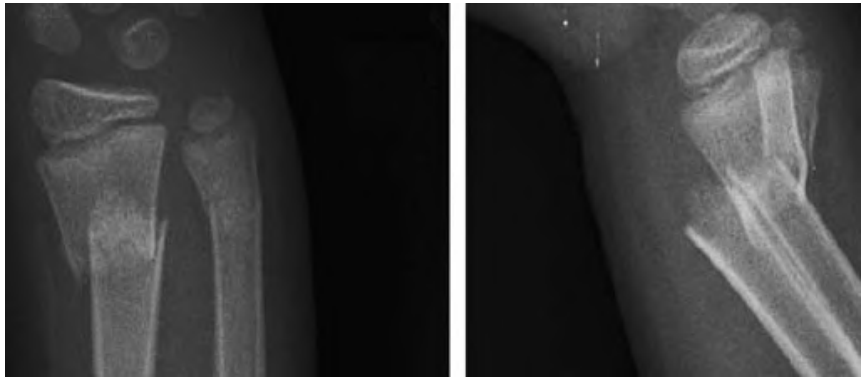
Can we get it wet?

Perhaps.

A Prospective Study on the Effectiveness of Cotton Versus Waterproof Cast Padding in Maintaining the Reduction of Pediatric Distal Forearm Fractures

Christopher E. Robert, MD, Jimmy J. Jiang, MD, and Joseph G. Khoury, MD

- 100% displaced FA fxs
- 36 cotton-lined
- 23 Gore-Tex-lined



- Gore-Tex and cotton-lined casts are equally effective in their ability to maintain the reduction

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J Pediatr Orthop Volume 31, Number 2, March 2011

A Comparison of Various Contemporary Methods to Prevent a Wet Cast

Mitch McDowell, DO, Shawn Nguyen, BS, and John Schlechter, DO

Investigation performed at the Riverside County Regional Medical Center, Moreno Valley, California, Western University of Health Sciences, Pomona, California, and Children's Hospital of Orange County, Orange, California

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J Bone Joint Surg Am. 2014;96:e99(1-5)

A Comparison of Various Contemporary Methods to Prevent a Wet Cast

Mitch McDowell, DO, Shawn Nguyen, BS, and John Schlechter, DO

Investigation performed at the Riverside County Regional Medical Center, Moreno Valley, California, Western University of Health Sciences, Pomona, California, and Children's Hospital of Orange County, Orange, California

- Casts were submerged in water for two minutes and were weighed. Each group had ten individual trials.
- Effectiveness was measured by calculating the amount of water absorption using cast weights before and after submersion

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A Comparison of Various Contemporary Methods to Prevent a Wet Cast

Mitch McDowell, DO, Shawn Nguyen, BS, and John Schlechter, DO

Percentage of Prevented Water Absorption	
Group	Water Absorption Prevented
Control	0%
Glad Press'n Seal Wrap	72%
Single Plastic Bag + rubber band	62%
Single Plastic Bag + Duct Tape	96%
Double Plastic Bag + Duct Tape	100%
CVS cast protector	100%
Dry Pro cast cover	100%

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A Comparison of Various Contemporary Methods to Prevent a Wet Cast

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Group	Cost per single use	Cost per 6 weeks (theoretical)	Cost per 6 weeks (actual)
A - Press and Seal	$0.14	$6.07	$8.67
B - single bag + band	0.10	3.38	8.24
C - single bag + tape	0.15	6.30	9.91
D - double bag + tape	0.30	12.6	12.85
E - CVS Cast Protector	12.99	12.99	12.99
F - DryPro Cast Cover	37.95	37.95	37.95

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J Bone Joint Surg Am. 2014;96:e99(1-5)

Efficacy of DIY Cast Covers: An In Vivo Study

Dallyn Udall, DO, Remy Zimmerman, BS,† Nicholas Bast, DO,* and John Schlechter, DO*†‡*

Background: Casting is routinely used in orthopaedics. Preventing a wet cast is crucial for maintaining structural integrity and reducing unwanted complications like unnecessary skin irritation/ulceration, bacterial overgrowth, and unnecessary emergency department visits. Using experimental models, studies have tested various contemporary methods to prevent a wet cast. One such study found that in comparison the most effective and cost-conscious approach was to use a Do-It-Yourself cast cover using a double-bag technique sealed with tape. There is a paucity of literature on the utility of this technique in vivo. The purpose of this study was to investigate the efficacy of the Do-It-Yourself cast cover on human test subjects.

Methods: Ten volunteers for the study were obtained. Each received one short arm cast and one short leg cast. Each cast was removed after they were deemed dry. These casts were subsequently weighed until they achieved a stable weight. Each cast was then reapplied to the subject's arm and held together with Scotch tape. A trash bag was then applied around the cast and then secured with Duct tape to the skin. This was repeated to create a

Casting is an effective and ubiquitous staple for fracture stabilization, postoperative support, and deformity correction. A standard cast involves an inner core of adequate cast padding with an outer rigid shell of either plaster or fiberglass. However, regardless of the technique and skill of the provider, the cast integrity and function are dependent on proper cast care practices of the patients and their families.

Multiple studies[1,2] have shown that often the primary reason rigid casts need to be switched is due to the cast being wet, increasing the burden on the health care system. It has been well-documented that water exposure deteriorates the cast's structural integrity, potentially compromising the desired function of the cast.[3,4] In addition, due to the cotton inner core, casts retain moisture and never fully dry, leading to adverse patient outcomes such as infections, odor, maceration, and/or dermatitis.[5–7] While some dampness can never be fully

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(J Pediatr Orthop 2024;44:164–167)

Summary

- Be aware of complications
- Employ a shared decision making process
- Methods to prevent a wet cast

Summary

- Pay attention to cast mold
- Univalving with a spacer
- “There are no hypochondriacs in a cast”
- Don’t stick anything in the cast

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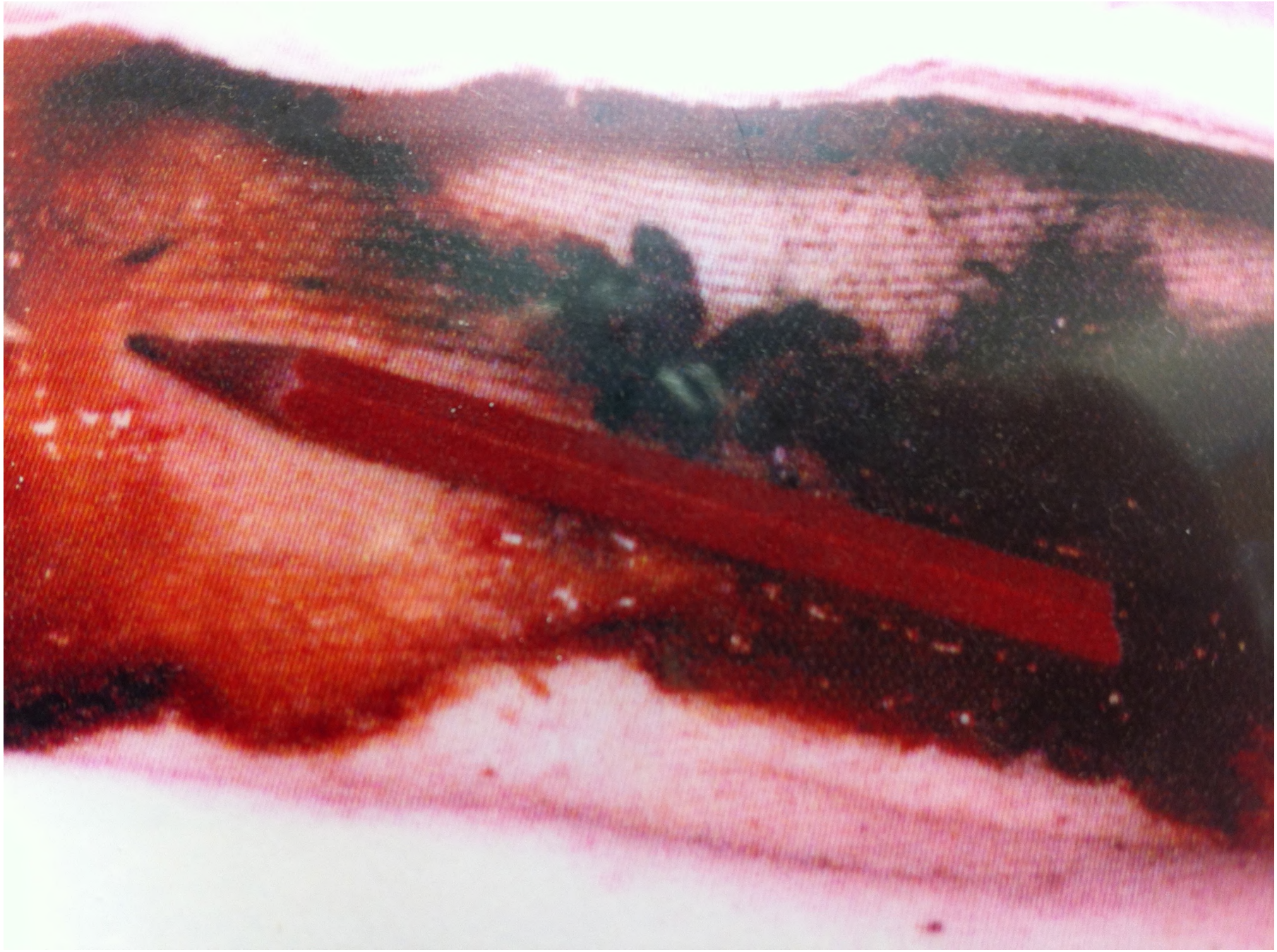

Be prepared

YouTube cast application

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Thank You

www.youthsportsortho.com

email – info@youthsportsortho.com

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