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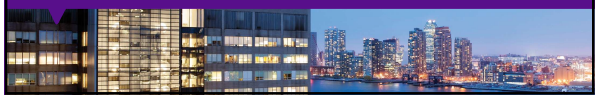
Clavicle Fractures

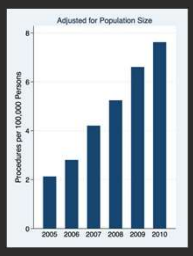
Should We Be Fixing More and How?

Eric J. Strauss, MD



Incidence Rates and Trends

- Clavicle fractures are common
  - 4% of all fractures
  - 75% midshaft
- Most cases managed nonoperatively
  - > 95% (historically)
- Operative fixation growing
  - 290% growth from 2005-2010*



*Schairer et al. Operative fixation for clavicle fractures. JOT. 2017. 31 (6): e167-72.

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Nonoperative Treatment

- Traditional standard of care
- More than 200 methods of closed reduction
- Reduction impossible to maintain
- Immobilization varies
- Deformity and malunion expected
- Nonunion rates relatively low
- Cosmetic issues minor
- **Functional results acceptable?**

McKee et al. Midshaft malunions of the clavicle. JBJS Am (2003). 85 (5): 790-7.

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CLOSED TREATMENT OF DISPLACED MIDDLE-THIRD FRACTURES OF THE CLAVICLE GIVES POOR RESULTS

JAMES M. HILL, MICHAEL H. McGUIRE, LYNN A. CROSBY *From Creighton University, Omaha, USA*

J Bone Joint Surg [Br] 1997;79-B:537-9.
Received 17 December 1996; Accepted after revision 10 April 1997

- Retrospective review of 242 consecutive clavicle fractures
- 66 (27%) acute displaced middle third clavicle fractures
- 52 included at mean of 38 months:
  - Nonunion: 8 (15%)
  - Unsatisfactory results: 16 (31%)
- "We now recommend open reduction and internal fixation of severely displaced fractures of the middle third of the clavicle in adult patients"

***Initial* shortening > 20 mm highly associated with nonunion and unsatisfactory result ($p < 0.0001$)**

DEFICITS FOLLOWING NONOPERATIVE TREATMENT OF DISPLACED MIDSHAFT CLAVICULAR FRACTURES

BY MICHAEL D. MCKEE, MD, FRCS(C), ELIZABETH M. PEDERSEN, MD, CAROLINE JONES, BSC, PT, DAVID J.G. STEPHEN, MD, FRCS(C), HANS J. KREDER, MD, FRCS(C), EMIL H. SCHEMITSCH, MD, FRCS(C), LISA M. WILJI, BSCN, AND JEFFREY POTTER, BSC

Investigation performed at the Division of Orthopaedics, Department of Surgery, St. Michael's Hospital and the University of Toronto, Toronto, Ontario, Canada

JB&JS
JOURNAL OF BONE & JOINT SURGERY · JBJS.ORG
VOLUME 88-A · NUMBER 1 · JANUARY 2006

- 30 patients with a displaced midshaft clavicle fracture
- Mean of 55 months:
  - DASH: mean 24.6
  - Constant: mean 71
  - Objective Strength Testing: 61-85% of contralateral arm*
- **"We detected residual deficits in shoulder strength and endurance… which may be related to the significant level of dysfunction detected by the patient-related outcome measures."**

Is Nonoperative Treatment Benign?

1. Malunion

- Deformity and malunion affect shoulder biomechanics and kinematics
- Clavicular shortening results in altered position and rotation of the scapula during arm elevation and abduction
- Scapular dyskinesia can lead to functional deficits and symptoms

2. Nonunion

- Not uncommon (5.9% of all clavicle fractures)
- Higher for certain subtypes (15% in high risk patterns/patients)
- Can be painful and symptomatic

3. Other

- Time to union, return to work/play/sport, refracture risk, etc…

Is Operative Management Better?

Morgan et al. Evolving management of middle-third clavicle fractures in the national football league. AJSM. 2010. 38(10: 2092-6.

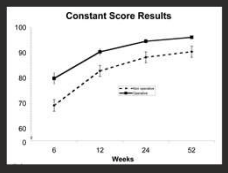
Nonoperative Treatment Compared with Plate Fixation of Displaced Midshaft Clavicular Fractures

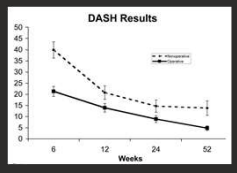
A Multicenter, Randomized Clinical Trial

By the Canadian Orthopaedic Trauma Society

JB&JS
The Journal of Bone & Joint Surgery · jbjs.org
Volume 89-A · Number 1 · January 2007

Multicenter, prospective, randomized trial comparing ORIF to sling in 132 patients with displaced midshaft clavicle fractures





- Higher "satisfaction" – greater at each time point in operative group (OR 3.2 – 4.4, $p < 0.05$)
- Shorter mean time to union – 16.4 weeks (operative) vs 28.4 weeks (nonoperative) ($p = 0.001$)
- Less nonunion – 2 patients (3%, operative) vs 7 patients (11%, nonoperative) ($p = 0.04$)
- Less symptomatic malunion – 0 patients (0%, operative) vs 9 patients (14%, nonoperative) ($p = 0.001$)
- More complications – symptomatic hardware (7%), wound infection (4%)), mechanical failure (1%)

The International Experience…

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The Clavicle Trial

A Multicenter Randomized Controlled Trial Comparing Operative with Nonoperative Treatment of Displaced Midshaft Clavicle Fractur

Philip M. Ahrens, FRCS(TrR&Orth), Nicholas L. Garlick, FRCS(TrR&Orth), Julie Barber, PhD, Emily M. Trites, MSc, and The Clavicle Trial Collaborative Group

Investigation performed at the Department of Trauma and Orthopaedics, Royal Free Hampstead NHS Foundation Trust, London,

J Bone Joint Surg Am. 2017;99:1345-54 • http://dx.doi.org/10.2106/JBJS.16.01132

Treatment of Displaced Midshaft Clavicle Fractures: Figure-of-Eight Harness Versus Anterior Plate Osteosynthesis

A Randomized Controlled Trial

Marcel Jun Sugawara Tamaoki, MD, PhD, Fabio Teruo Matsunaga, MD, PhD, Adelino Ricardo Ferreira da Costa, MD, Nicole Archetti Netto, MD, PhD, Marcelo Hide Matsumoto, MD, PhD, and Joao Carlos Belloti, MD, PhD

Performed at the Department of Orthopedics and Traumatology, Universidade Federal de Sao Paulo Escola Paulista de Medicina (Unifesp/EPM), Sao Paulo, Brazil

J Bone Joint Surg Am. 2017;99:1558-65 • http://dx.doi.org/10.2106/JBJS.16.01184

Open Reduction and Plate Fixation Versus Nonoperative Treatment for Displaced Midshaft Clavicular Fractures

A Multicenter, Randomized, Controlled Trial

C.M. Robinson, FRCS(Ed)(TrR&Orth), E.R. Goudie, BMedSci(Hons), MRCS(Ed), I.R. Murray, BMedSci(Hons), P.S. Jenkins, FRCS(Ed)(TrR&Orth), M.A. Ahktar, MRCS(Ed), E.O. Read, BMedSci(Hons), C.J. Foster, MRCS(Ed), A.J. Brookhouse, FRCS(TrR&Orth), A. Arthur, FRCS(TrR&Orth), M.A. Crowther, FRCS(TrR&Orth), I. Packham, BMBS, BMedSci, FRCS(TrR&Orth), and T.J. Clutton, FRCS(TrR&Orth)

Investigation performed at The Edinburgh Shoulder Clinic, The New Royal Infirmary of Edinburgh, Little France, Edinburgh, and Orthopaedics, Glasgow Royal Infirmary, Glasgow, and Department of Orthopaedic Surgery, Frenchay Hospital, Brist

J Bone Joint Surg Am. 2013;95:1576-84 • http://dx.doi.org/10.2106/JBJS.

Sling Compared with Plate Osteosynthesis for Treatment of Displaced Midshaft Clavicular Fractures

A Randomized Clinical Trial

Kaisa I. Virtanen, MD, Ville Remes, MD, PhD, Jarkko Pajarinen, MD, PhD, Vesa Savolainen, MD, PhD, Jan-Magnus Björkenheim, MD, PhD, and Mika Paavola, MD, PhD

Investigation performed at Helsinki University Central Hospital, Helsinki, Finland

J Bone Joint Surg Am. 2012;94:1546-53 • http://dx.doi.org/10.2106/JBJS.J.01999

The International Experience…

- Randomized controlled trials of 60 – 301 patients with acute displaced midshaft clavicular fractures randomized to nonoperative treatment or primary open reduction and plate fixation with interval follow-up up to 1 year
- **Results for Operative Treatment:**
  - **Nonunion rates substantially lower (~10 x)**
  - **Functional outcome and disability scores better**
  - **Better cosmetic result and satisfaction**
  - **Relatively low complication rate**
  - **Similar subsequent operation rate (usually for hardware removal)**
  - **Cost of treatment higher**

What About Athletes?

Clavicle Fractures in Athletes

- 10% of sports-related fractures
- Historically managed nonoperatively
- Standard of care controversial
- Unique considerations:
  - Contact versus noncontact sports
  - Upper extremity athletes
  - Return to sport and return to play
  - Age, level of play, career length
  - Higher functional demands
  - Tolerance for deficits lower

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Evolving Management of Middle-Third Clavicle Fractures in the National Football League

Robert J. Morgan,*† MD, Larry S. Bamston Jr,‡ MD, Michael P. Hoenig,§ MD, and Patrick M. Connor,‖ MD
From † Resurgens Orthopaedics, Atlanta, Georgia, ‡ Baton Rouge Orthopaedic Clinic, Baton Rouge, Louisiana, §Orthopaedics Associates, Spartanburg, South Carolina, and ‖OrthoCarolina, Charlotte, North Carolina

The American Journal of Sports Medicine, Vol. 38, No. 10
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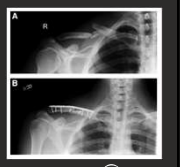
2003-2008: 19 NFL players with middle third clavicle fractures

- Non-/minimally-displaced (n = 6): nonoperative → 100% union
- 100% displaced (n = 13):
  - Nonoperative (n = 7) → 43% union, 57% refracture
  - Operative – IMN or ORIF (n = 6) → 100% at mean 8.8 weeks
- Players with refracture missed an average of 1.5 seasons

"It may be reasonable to consider acute surgical treatment of this injury in the NFL player to enable successful outcome in a predictable time frame"



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Which Fixation Method is Best?

Variety of implants and configurations… 2 major categories:

1. **Intramedullary Implant**

Eichinger et al. Intramedullary fixation of clavicle fractures. JAAOS. 2016. 24 (7): 455-464.

2. **Plate Fixation**

Jeray K. Acute midshaft clavicular fracture. JAAOS. 2007. 15(4): 239 – 248.

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Plates versus Nails

- Plate Fixation
  - Advantages: rigid fixation, rotational control, compression, choice of implant positioning, lower rate of hardware failure, less reoperation
  - Disadvantages: more invasive, plate prominence

- Intramedullary Fixation
  - Advantages: less invasive, less periosteal stripping, potential closed reduction, lower risk of early refracture
  - Disadvantages: technically challenging, implant failure or migration, hardware irritation, higher reoperation for hardware removal

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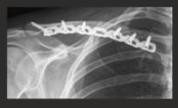
Plate Positioning?

Superior:

- Pros – theoretically* biomechanically stronger fixation on tension side of bone
- Cons – plate prominence, shorter screw length/purchase, dangerous screw trajectory

Anteroinferior:

- Pros – less hardware prominence, longer screws, safer screw trajectory
- Cons – lower familiarity, inferior biomechanical stability?



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Our Indications for Acute Operative Fixation

Absolute:

- Comminuted fractures
- Segmental fractures
- Open fracture
- Vertical fracture fragment
- Complete displacement (> 100%)
- Shortening (> 2 cm)
- Floating shoulder
- Neurovascular compromise

Relative:

- Polytrauma
- Skin tenting or impending compromise
- Athletes
- Manual laborers

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Should We Be Fixing More?

- Current data supports expanding indications for the operative treatment of midshaft clavicle fractures
  - Displaced (100%)
  - Shortened > 2 cm

How?

- Fracture pattern and patient body habitus may dictate best approach
- Bottom line → utilize the method you are most comfortable with
  - Superior plating with expectation of hardware removal at 1 year postop

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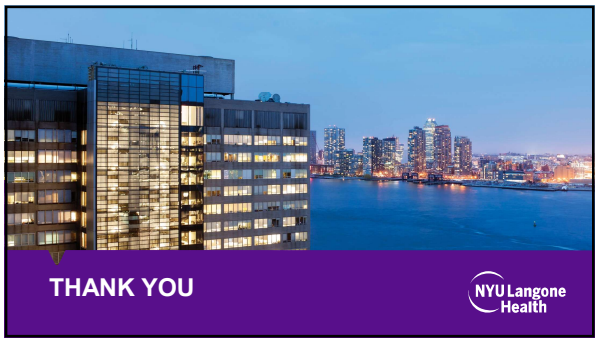

THANK YOU

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