NPC- Nail / Plate Combo: Merging Two Concepts to Yield Improved Results

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PURPOSE

• Discuss current uses of Retrograde Nailing for Peri-prosthetic Fractures
• Discuss the challenges with this currently
• Discuss potential solutions to these problems
• Discuss taking this concept to “the next level”

CURRENT USES / BENEFITS OF RetroIMN for PP FEMUR FXs

• Distal 1/3 Fx’s around Primary TKR
  – No “box” (CR)
  – If “box” (PS) with:
    • Removable polyethylene plug
    • Pre-existing hole
      – Try to avoid “making a hole” with a metal cutting b
• Less Invasive?
• More biologically friendly?
CHALLENGES

• Lack of access
  – “Box” (PS) without ability to pass
  – Revision TKR
  – THR above

• Iatrogenic damage
  – Patella or tibia polyethylene

• Limited Distal Fixation

• Limited offerings that actually “Dial-in-Deformity”
  – Worse with CR or PS ???

DEFORMITY

Due to entry access
APEX-POSTERIOR

Lack of purchase in distal fragment
VALGUS

PS
Need for INDIVIDUALIZED ANGULATION DISTAL END: 5 & 10 DEGREE

Intramedullary Nails

- Are they more stable than plates?
  - Traditionally suggested to be biomechanically more advantageous to plates \(\Rightarrow\) SHAFT FX’s
  - Immediate WB’ing?
Comparison of the LISS and a retrograde inserted supracondylar intramedullary nail for fixation of a periprosthetic distal femur fracture proximal to a total knee arthroplasty
Bong M et al J Arthroplasty 2002

• Laboratory biomechanical model

• Nail
  – Greater resistance to varus load and torsional load

• LISS
  – Greater resistance to valgus load w/ bone loss

• BUT...
  – Did not address osteoporotic model
  – Did not address all types TKR or LOW peri-prosthetic fracture
  – Did not address model w/ varus bone loss
Biomechanical Evaluation of the Less Invasive Stabilization System, Angled Blade Plate, and Retrograde Intramedullary Nail for the Internal Fixation of Distal Femur Fractures

Michael Ziadieb, MD,* Scott Williamson, MS,† Peter A. Cole, MD,* Lulu D. Zambelias, PhD,‡ and Philip J. Krueger, MFT

Cyclical Loading: LISS vs. IMN

ELASTIC

LISS > IMN DEFORMATION W/ CYCLICAL LOADING

PLASTIC

IMN & LISS SIMILAR PERMANENT DEFORMATION
Nails CAN BE very FORGIVING at times…

Patient has full extension and >90 degree flexion!

LOL – Seriously?
SS Left Side

10 months from IMN
Limited ROM

"Why am I in PAIN !!!"

Nails CAN BE very FORGIVING at times… but NOT ALWAYS !!!

INADEQUATE STABILITY W/CURRENT IMN ALONE

SS Left Side

Nails CAN BE very FORGIVING at times… but NOT ALWAYS !!!

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INADEQUATE STABILITY W/CURRENT IMN ALONE
SOME ANSWERS FOR DENSITY OF FIXATION

- Multi-lock screws
  - Multi-directional support with fixed angle screw within a screw
    - LISS vs Blade idea

- Screw configuration
  - Additional screws
  - Take advantage of PM and PL condyles

- Plate attachment to Nail
  - ALL OF THE ABOVE !!!

SCREW CONFIGURATION

REFERENCING TO AVOID CORONAL DEFORMITY & MAINTAIN WHILE LOCKING
Discussion Point: Attach from "Top-Down" or "Bottom-Up"
WHERE COULD WE GO WITH THIS?

• Plate – Nail combo’s for varying length of bone
  – Fx “need”ing a nail with a THR above or rev TKR below
  – Metaphyseal Nonunions requiring better fixation
  – Osteoporosis
  – Avoid deformity (Distal Femur, Proximal & Distal Tibia)

• Potentially beneficial to have LINKAGE of JIGS to facilitate LINKED NAIL / PLATE COMBOS…

Patient BP

Periprosthetic tibia

Subtroch fx above stemmed tkr
JV – 77 yo male

3 time failed distal femoral nonunion

ALL surgeries with lateral plate

Previous Hip Fx short IMN above

SOLUTION ???

STEP 1 – BIOPSY (significant history)

NOTE ALLOGRAFT FIBULA INTRAMEDULLARY ST!

NEGATIVE FOR INFECTION
1 year
LINKED CONSTRUCT
Appropriate Stability
HEALED
NO PAIN !!!

JZ
Distal Femoral Fracture 10 yrs ago w/ 4 time nonunion s/p platings above TKR
THR above that had previous fx at stem tip
Non-ambulator x 2.5 years
***INFECTED***
2.5 months post-definitive op
Uses walker – 1st time in 2.5 yrs
Proximal and Distal N/P Linkage

CALLUS

What about osteoporosis & adequate purchase?

SOME ANSWERS FOR DENSITY OF FIXATION

• Screw configuration
  – Additional screws
  – Take advantage of PM and PL condyles

• Plate attachment to Nail
  – Best of Both Worlds !!!
WHERE COULD WE GO WITH THIS?

- **Plate – Nail combo’s**
  - **INTERPROSTHETIC** - Fx "needing" a nail with a THR above or rev TKR below
  - **OSTEOPOROSIS**
  - **METAPHYSEAL NONUNION** requiring better fixation


- **25% union rate of nonunions with retrograde IMN alone**
- **AVOID DEFORMITY** (Distal Femur, Proximal & Distal Tibia)
- **"DIAL-IN" STABILITY**

**NEUTRAL AXIS**
Change location of NEUTRAL AXIS: INCREASE COMPRESSIVE SIDE
Let’s Look at some “Reasonable” operations that didn’t work out

77 yo male periprosthetic fracture

77 yo male periprosthetic
Locked screws in Fx Zone
Excessively Rigid Fixation
Short segment proximal fixation
NOT Balanced Fixation
Multiple cerclage
Dissection to get "Chicken Claw"
JV – 75 yo male
3 time failed distal femoral nonunion
ALL surgeries with lateral plate
Previous Hip Fx short hip IMN above
SOLUTION ???

STEP 1 – BIOPSY (significant history)
Bone Stimulator

NOTE ALLOGRAFT FIBULA INTRAMEDULLARY STRUT ???
NEGATIVE FOR INFECTION
2 years
LINKED CONSTRUCT
Appropriate Stability
HEALED
NO PAIN !!!
EV – vacation in Mexico gone wrong
JZ

Distal Femoral Fx 10 yrs ago w/ 4 time nonunion s/p platings above TKR

THR above that had previous fx at stem tip

Non-ambulator x 2.5 years

***INFECTED***
ROUND 2: Nail - Plate

Current IMN offering
Can promote
APEX POSTERIOR

Future Directions →
Distal angular options?

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LINKED Plate / Nail
BOTH:
Proximally &
Distally w/ IMN

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2.5 months post-definitive op
Uses walker – 1st time in 2.5 yrs
Proximal and Distal N/P Linkage

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CALLUS !!!
A couple of interesting scenarios

- Fracture
- Stem Loose?
- Infection?
  - Time since procedure?

Leg length?
90 year old
Open
Bone Quality?
Fall Risk?
Results

Data Summary:
45 pts / avg age 77y.o. / M:F 1:4.2

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<th>COMORBIDITIES</th>
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<td>Diabetes</td>
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<td>Smoker</td>
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<td>Dementia</td>
<td>4</td>
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Data Summary:
45 pts / avg age 77y.o. / M:F 1:4.2

<table>
<thead>
<tr>
<th>PRE-FX AMBULATORY STATUS</th>
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<tr>
<td>Independent</td>
<td>27</td>
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<tr>
<td>Assistive Device</td>
<td>15</td>
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<tr>
<td>Minimal</td>
<td>3</td>
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<tr>
<td>Non-ambulatory</td>
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</table>
Data Summary:
45 pts / avg age 77y.o. / M:F 1:4.2

WB'ING STATUS
IMMEDIATELY POST-OP

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<tr>
<th>WBAT</th>
<th>36</th>
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<tr>
<td>PWB</td>
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<td>NWB</td>
<td>2</td>
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INDICATIONS FOR NPC

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<tr>
<th>Type of Fracture</th>
<th>Count</th>
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<tbody>
<tr>
<td>Native Distal Femur Fx</td>
<td>10</td>
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<tr>
<td>Periprosthetic (above TKA)</td>
<td>16</td>
</tr>
<tr>
<td>Periprosthetic (below THA)</td>
<td>3</td>
</tr>
<tr>
<td>Interprosthetic</td>
<td>9</td>
</tr>
<tr>
<td>Nonunion / Infected</td>
<td>7</td>
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<tr>
<td>Nonunion</td>
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RESULTS

<table>
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<tr>
<th>Measurement</th>
<th>Value</th>
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<tbody>
<tr>
<td>Mean # holes of plate</td>
<td>16.9</td>
</tr>
<tr>
<td>% Retrograde Nail</td>
<td>97</td>
</tr>
<tr>
<td>% Linked fixation</td>
<td>84</td>
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<tr>
<td>Mean time to union</td>
<td>17.4 weeks</td>
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<tr>
<td>Healing Rate</td>
<td>100%</td>
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</table>
Data Summary:
45 pts / avg age 77 y.o. / M:F 1:4.2

<table>
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<tr>
<th>COMPLICATIONS</th>
<th>2%</th>
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<tr>
<td>Superficial Cellulitis</td>
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<td>Reoperations</td>
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<tr>
<td>Nonunion</td>
<td>0</td>
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<tr>
<td>Infection</td>
<td>0</td>
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PLATE-NAIL SUMMARY
• Improve “reliability” and “feasibility” of current retrograde IMN usage
  – Improve stability – DISTAL FRAGMENT
  – Decrease late deformity
• Allow for improvement with ease of REDUCTION
• PREVENTATIVE Tx of potential Interprosthetic fx
• Allow for expanded IMN nailing indications

THANK YOU