

# Does Retrograde Intramedullary Metacarpal Nailing Weaken Extensor Tendon Biomechanical Properties?

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## INTRODUCTION:

Intramedullary fixation has become increasingly popular for surgical treatment of metacarpal fractures. Retrograde percutaneous placement of headless compression screws or threaded intramedullary nails may injure the extensor mechanism. Alternatively, mini-open tendon-sparing approaches may be utilized, with instrumentation placed through the sagittal band or a longitudinal split of the tendon. Our study evaluates extensor mechanism biomechanical properties after utilizing different techniques for retrograde threaded intramedullary nail insertion.

## METHODS:

Sixty-four cadaveric fingers were divided into control group and 3 testing groups based on implant drilling/insertion technique: trans-tendinous, longitudinal tendon split with repair, and trans-sagittal band. After instrumentation was applied, extensor mechanisms were dissected and loaded for tensile testing to determine maximum load to failure (LTF), stiffness, and site of failure. Statistical analyses comparing LTF and stiffness were conducted utilizing a mixed-effects linear regression model, adjusting for metacarpal number and cadaver age. Fischer's exact test assessed differences in failure scenario.

## RESULTS:

There were no significant differences in LTF comparing each test group versus control: control 398.4 N (77.0 N), trans-tendinous 355.0 N (94.7 N), longitudinal split-repair 347.9 N (123.4 N), trans-sagittal band 384.6 N (110.4 N). LTF of extensor tendons from index and long metacarpals was significantly higher compared to the fifth metacarpal. Mean stiffness was 43.2 N/mm (10.3 N/mm), with no difference between groups. Tensile failure occurred at the implant insertion site in 44% trans-tendinous, 25% longitudinal split-repair, and 13% trans-sagittal band specimens.

## DISCUSSION AND CONCLUSION:

Retrograde intramedullary implant placement directly through the extensor tendon, a longitudinal tendon split, or the sagittal band does not significantly decrease extensor mechanism maximum LTF or stiffness. Implant insertion potentiates a tensile failure site, but only under tension far exceeding physiologic loads. Any method of retrograde insertion for intramedullary metacarpal nails likely has minimal clinical impact on extensor mechanism integrity during early functional motion.

Figure 1: Cadaveric left hand with assistance placement based on test group.  
 A) Trans-tendinous (TT) B) Longitudinal Split Repair (LSR) C) Trans-sagittal Band (TSB) with extensor tendon retracted proximally.

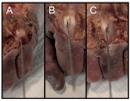


Figure 2: Extensor mechanism loaded for tensile testing with tendon oriented parallel to the proximal phalanx.



Table 1: Maximum Load to Failure (LTF) and stiffness for test group in index, hand and the middle metacarpal for trans-tendinous, longitudinal, split-repair, repair and sagittal band techniques.

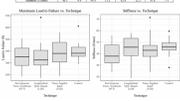


Table 2: Maximum Load to Failure (LTF) and stiffness for trans-tendinous, longitudinal split-repair, and trans-sagittal band techniques for index, hand and middle metacarpal.

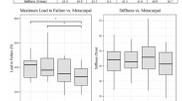


Table 3: Cadaveric demographics and cohort performance.

Parameter	Mean	SD
Maximum Load to Failure (N)	371.9	102.7
Stiffness (N/mm)	43.2	10.3
Displacement (mm)	8.9	3.3
Time (min)	31.1	10.1
CI (95%)		
Sex		
Female	1	10%
Male	3	30%
Ethnicity		
Caucasian	4	70%
Black	1	10%
Hispanic	1	10%

Table 4: Failure scenario during tensile loading by test group.

Failure Scenario	TT	LSR	TSB	Control	P Value
Site of Failure	1 (25%)	1 (25%)	1 (25%)	1 (25%)	0.001*
Site Not Reported	1 (25%)	1 (25%)	1 (25%)	1 (25%)	0.001*
Control (TSB)	1 (25%)	1 (25%)	1 (25%)	1 (25%)	0.001*