Going to Great Lengths for the Elderly: Magnetic Limb Lengthening Nails in Patients Older Than 60 Years

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Introduction

- Limb lengthening is not common in the older population
- Challenges of reconstruction:
  - Reduced bone mineral density
  - Osteoporotic bone
  - Comorbidities
  - Decreased physiologic reserves
- Choices are bulky external fixation or intramedullary lengthening

Hypothesis

- Using magnetic intramedullary (IM) lengthening nails in the older population will produce similar outcomes as younger population when evaluating:
  - Distraction index
  - Consolidation index
  - Maturation index
  - Adverse events

Methods

- Multicenter, retrospective study (2012-–2019)
- Outcomes compared to younger, diagnosis-matched control groups

60+ YEAR-OLD PATIENT CHARACTERISTICS

Patient	*Sex*	*Age*	*Etiology of LLD*	*Comorbidities*	*Goal Lengthening (cm)*	*Bone Operated*
1	M	60	Congenital		6.0	Tibia
2	F	60	Infected Nonunion	Prior infection	4.9	Femur
3	M	60	Acquired		5.6	Femur
4	F	61	Post-traumatic		5.0	Femur
5	M	63	Post-traumatic		3.0	Femur
6	M	65	Post-traumatic	Obesity	4.0	Femur
7	F	66	Post-traumatic	Remote infection, depression	3.0	Tibia
8	M	67	Post-traumatic		3.6	Tibia
9	M	69	Prior knee arthrodesis	Peripheral neuropathy, CAD	1.5	Femur
10	M	71	Post-traumatic		3.0	Femur
11	F	72	Post-traumatic	Obesity, Prior infection	2.5	Femur

LLD: limb length discrepancy; CAD: Coronary artery disease

Results

349 nails (253 patients)

OLDER POPULATION (≥60 YEARS OLD)	YOUNGER POPULATION (<60 YEARS OLD)
• 11 nails in 11 patients • Mean age: 65 years • 7 men 4 women • 8 femora 3 tibiae	• 338 nails in 242 patients • Mean age: 18 years • 177 men 161 women • 249 femora 89 tibiae

DISTRACTION AND HEALING PARAMETERS

	Age 60+ year (n=11)		Age<60 years, large nails (n=258)	
	Mean	95% CI	Mean	95% CI
Distraction Days	67.5	42.5, 92.4	72.1	68.3, 75.8
Length Achieved (mm)	40.0	27.9, 51.9	45.2	43.4, 47.1
Consolidation Days	140.5	106.2, 174.8	144.3	135.7, 152.9
Consolidation Index	34.1	27.7, 40.5	35.5	32.4, 38.5
Maturation Days	68.6	48.9, 88.3	72.3	65.0, 79.5
Maturation Index	16.9	11.6, 22.2	18.7	16.2, 21.3

- **80 smaller diameter nails were excluded in the table above, which may influence clinical decision to allow early weight bearing.**
- **Healing parameters were not clinically different between the cohorts.**

Results (continued)

DISTRACTION AND HEALING PARAMETERS SPECIFIC AGE GROUPS

	AGE 60+ YEARS NAILS (N=11) *MEAN*	AGE 20 – 39 NAILS (N=55) *MEAN*	AGE 40 – 59 NAILS (N=22) *MEAN*
DISTRACTION INDEX	0.65	0.69	0.66
CONSOLIDATION INDEX	34	36	41
MATURATION INDEX	17	19	21

- Dividing the younger cohort into specific age ranges
- ≥60 year old group similar to patients aged 20-39 and 40-59
- Trend toward equivalency.

COMPLICATIONS

COMPLICATIONS	*OLDER ≥ 60*	*YOUNGER AGE 7-59*	*YOUNGER AGE 20-39*	*YOUNGER AGE 40-59*
TOTAL	11	282	45	20
% OF SEGMENTS COMPLICATIONS	64%	62%	56%	55%

60+ PATIENT LENGTHENING OUTCOMES

Patient	Distraction Index	Length Achieved (mm)	At goal	Complications	Reoperations
1	0.47	60	Yes	Regenerate procurvatum, Malunion	Malunion repair
2	0.51	44	5mm under	Sciatic neuralgia	None
3	0.77	79	2.3cm over*	Broken nail, bent regenerate	Exchange nailing, LISS plate
4	0.89	50	Yes	None	None
5	0.81	30	Yes	ERC malfunction	None
6	0.73	40	Yes	None	None
7	0.79	30	Yes	Preconsolidation, osteomyelitis	Antibiotic coated IMN
8	0.29	36	Yes	Delayed union	Bone marrow aspirate
9	0.65	15	Yes	Unrelated toxic megacolon, death	None
10	0.65	30	Yes	None	None
11	0.57	25	Yes	None	None

* Patient deliberately overlengthened; ERC: External remote controller; LISS:less invasive stabilization system; IMN: intramedullary nail

Case Example

- 70-year-old man with history of right femoral fracture with IM nail fixation
- Subsequent intertrochanteric femoral fracture with sliding hip screw fixation
- 3.0-cm femoral discrepancy
- Right femoral osteoplasty with magnetic IM nail lengthening
- Achieved 3-cm lengthening goal

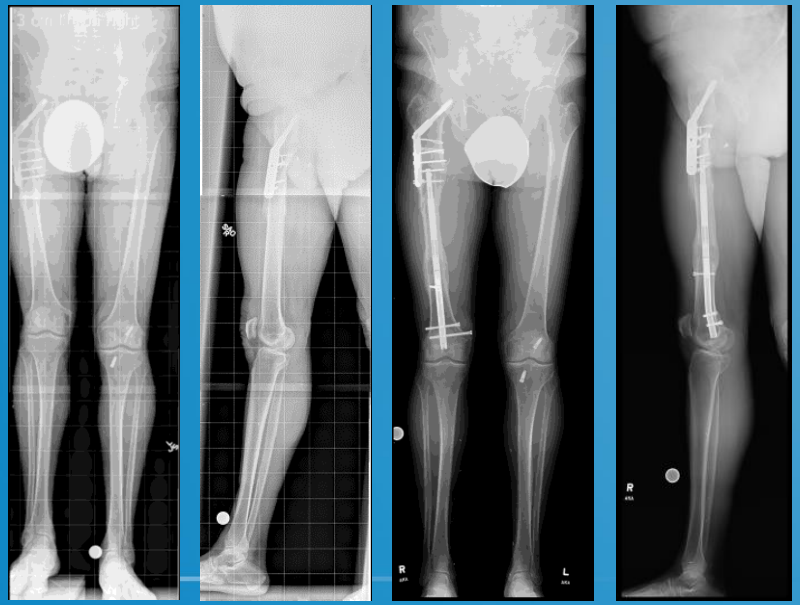

Fig. 1.
A and B: Posttraumatic radiographs of 71-year-old patient before insertion of femoral magnetic IM lengthening nail
C and D: Final follow-up after consolidation of regenerate with lengthening nail in place

Discussion

- Results appear comparable to other studies of the general population
- IM lengthening nails in older population:
  - Alternative to external fixation
  - Similar outcomes to younger population
  - May allow for better quality of life
- For more information: Dr. John Herzenberg (jherzenberg@lifebridgehealth.org)

HEALING INDICES IN LITERATURE

ARTICLE	*DI (MM/DAY)*	*CI (DAYS/CM)*	*MI (DAYS/CM)*
THIS STUDY	0.7	34	17
Hammouda et al, J Orthop Trauma 2017		32	
Wagner et al, SICOT J 2017	0.6	36	22
Paley et al, Techniques in Orthopaedics 2014	0.8	28	
Shabtai et al, Clin Orthop Relat Res 2014	1	27	
Horn et al, ACTA Orthopaedica 2015		45	
Rozbruch, Clin Orthop Relat Res 2008		24	
Paley, JBJS 1997		42	
Sangkaew, SICOT 2004		44	
Nakase et al, Arch Orthop Trauma Surg 2007		51.4	
Ganger et al, SICOT 2009		66	