Hex-based lengthening over the nail (LON) and bone transport over the nail (BTON)

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http://rniito.org



http://spbu.ru





ExFix+ IntFix





Complications

LON Complications	%
Non-union	4,5-27,3
Hardware breakage	3,1-27,5
Premature union	0,5-24
Pin-tract infection	2,4-100
Deep infection	2.4-17.6

* Paley D., 1997; Simson A.H.C.W., 1999; Gugenheim, 2003; Kocaoglu M. et al.,2004, 2012, 2015; Watanabe K., 2005; Motallebizadeh N.,2006; Escalda C. 2006; Berebstein M., 2005; Kovar F. 2005; Leon Mora H., 2007; Mahboubian Sh. Et al., 2012

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Premature consolidation



Femoral Lengthening over an Intramedullary Nail. A Matched-Case Comparison with Ilizarov Femoral Lengthening

DROR PALEY, JOHN E. HERZENBERG, GUY PAREMAIN and ANIL BHAVE J Bone Joint Surg Am. 1997;79:1464-80.

24%





- possible reasons
- possible solution
- hex-based LON & BTON features

Conventional LON



Conventional LON





Nail-bone collision: violation of technology



Nail-bone collision: violation of technology





Nail-bone collision: technology flaws



Solution: different levels of osteotomy



Solution: straight rimming and straight (short) nail



M. Chaudhary, 2016

but ... the physiological curvature



Solution: distraction according nail curvature



Pin-nail collision: technology flaws



So: possible solutions



Hex-base LON

Hex assembly: conventional and reverse



Hex assembly: conventional and reverse



Hex-based LON (1-1)



Hex-based LON (1-2)





Hex-based LON (1-3)



Hex-based LON (1-4)





Hex-based LON (1-5)



Hex-based LON (1-6)



Hex-based LON (1-7).



Hex-based LON (2-1)



Hex-based LON (2-2)



Hex-based LON (2-3)





Hex-based LON (2-4)



Hex-based LON (2-5)



Hex-based LON (2-6)



Hex-based LON (2-7)



Hex-based LON (2-8)





Hex-based LON (2-9).



Hex-based LON (3-1)






Hex-based LON (3-2)





Hex-based LON (3-3)



Hex-based LON (3-4)





Hex-based LON (3-5)

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Hex-based LON (3-6)

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Hex-based LON (3-7)

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Hex-based LON (3-8)

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○ Angle 1 0,5 Angle 2 6,4 4 + + + + +





Hex-based LON (3-9)





Hex-based LON (3-10)







Hex-based LON (3-11).









Hex-based LON (4-1)







Hex-based LON (4-2)







Hex-based LON (4-3)





Hex-based LON (4-5)







Hex-based LON (4-6)







Hex-based LON (4-7)







Hex-based LON (4-8)







Hex-based LON (4-9)







Hex-based LON (4-10).









Hex-based LON (5-1)





Hex-based LON (5-2)



Hex-based LON (5-3)

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Hex-based LON (5-5)

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Hex-based LON (5-6)

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Hex-based LON (5-7)

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Hex-based LON (5-8)

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Hex-based LON (5-9)





External fixation assisted nailing & plating (EFAP & EFAN) Sequential External Fixation and Nailing (SEFaN)

Lengthening and then nailing/plating (LATN)

Hexapod + Internal fixation

Lengthening Over Nail (LON)



Conventional BTON



Conventional BTON



Hex-based BTON (1-1)







Hex-based BTON (1-2)



Hex-based BTON (1-3)



Hex-based BTON (1-4)



Hex-based BTON (1-5)


Hex-based BTON (1-6)



Hex-based BTON (1-2)



Hex-based BTON (1-3)





Hex-based BTON (1-4).





Hex-based BTON (2-1)





Hex-based BTON (2-2)







Hex-based BTON (2-3)



Hex-based BTON (2-4)





Hex-based BTON (2-5)



Hex-based BTON (2-5)



Hex-based BTON (2-6)







Hex-based BTON (2-7).





Hex-based BTON (3-1)









Hex-based BTON (3-2)





Hex-based BTON (3-3)







Hex-based BTON (3-4)







Hex-based BTON (3-5)

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residual Total

Str6

+1

+1

+0

- 1

239,00

Str5

+1

+1

+1

 ± 0

283,00

- 8 ×

Hex-based BTON (3-6)



Hex-based BTON (3-7)



Hex-based BTON (3-8)



Hex-based BTON (3-9)





Hex-based BTON (3-10)







































Take-home message: SUV clamp







Thank you!

Discussion

Possible solution: the guide excluding jamming of the nail by the half-pins (not only blocking screws)





Smith&Nephew

Discussion

Possible solution: pinless fixator





Discussion

Possible solution: pinless fixator



Cheung KY et al., 2001

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multi Total residual Software



Complications

	LON	BTON	LATN	SEFAN	Refer.*
Number (patients/segments)	38/41	18/18	15/15	37/38	
Non-union	2 (4.9%)	2 (11.1%)	1 (6.7%)	2 (5.3%)	4,5-27,3
Breakage frame / nail parts	2 (4.9%) / 0	7 (38.9%) / 0	1 (6.7%) / 2 (13.3%)	1 (2.6%) / 3 (7.9%)	3,1-27,5
Premature union	3 (7.3%)	0	0	0	0,5-10
Pin-tract infection	3 (7.3%)	0	1 (6.7%)	2 (5.3%)	2,4-100
Deep infection	3 (7.3%)	0	0	0	2,4-17,6
Joint stiffness	4 (9.3%)	0	4 (22.7%)	4 (10.5%)	\setminus /
Total	15 (36.6%)	7 (38.9%)	7 (46.7%)	10 (26.3%)	\bigvee

* Paley D., 1997; Simson A.H.C.W., 1999; Gugenheim, 2003; Kocaoglu M. et al.,2004, 2012, 2015; Watanabe K., 2005; Motallebizadeh N.,2006; Escalda C. 2006; Berebstein M., 2005; Kovar F. 2005; Leon Mora H., 2007.