



13, 3, 2000 7

The Journal of the Korean Society of Fractures  
Vol.13, No.3, July, 2000

-

-

. . . . .

&lt; &gt;

:

14 mm , 8 10mm  
35cm 44 cm .

AO universal nail

AO unreamed femoral nail

:

(starting reamer, 9mm) 가

( 423.8 mmHg),

290 mmHg 가

(p = 0.001).

가 136.6 mmHg

(p = 0.005).

가가

가 .

: , , , ,

, (interlocking)

(intramedullary nail)

:

2가 50

(700-721)

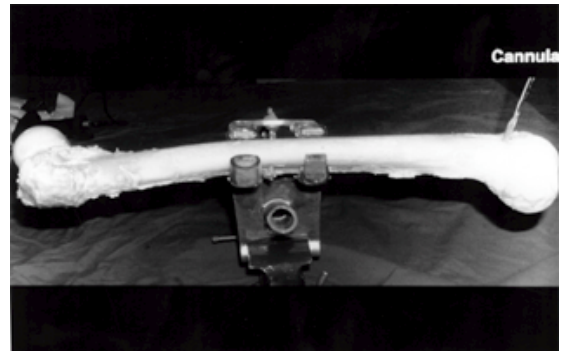
Tel : (053) 420 - 5630

Fax : (053) 422 - 6605



**Table 1.** Diameter & Length of Femur

	diameter of isthmus (mm)	length of femur (mm)
1	10.5	40.5
2	13.5	43
3	13	40.6
4	10	39
5	11	40.5
6	9.8	34.3
7	11	40.4
8	14	42.5
Mean	11.6	40.1

**Fig 1.** This shows the cannula insertion point of the femur.

stability) , (biomechanical  
(fat embolism)  
1,4,11,12,13,14)

AO universal nail  
AO unreamed femoral nail

1) 8 , 가  
(isthmus) ,  
14 mm , 10mm  
(Table 1). 35cm 44 cm

12

2)

(supracondylar area)  
3.5mm (metal cannula)

(Fig. 1).

3 way

(pressure transducer, Gould Statham P23 ID Pressure  
Transducer, Gould, USA)  
Physiographer(Grass Model 79E, Grass, USA)

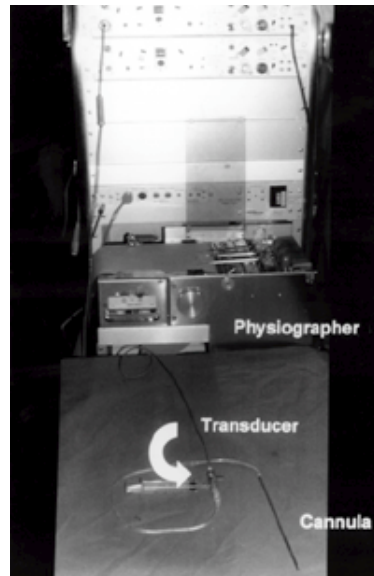
(air bubble)  
1000 mmHg  
100mmHg

2mm/sec

(Fig. 2).

3) (nailing instrument)

AO (reamer), (reaming  
rod), (reamer), (hollow nail)  
, AO  
(centering pin), (cannulated cutter), 13 mm  
(proximal reamer), (solid nail)



**Fig 2.** Pressure was recorded continuously during the nailing procedure, electronically and on a chart recorder.

13 mm (lesser trochanter) 1mm .

4)

SAS 6.12 ,

1)

(starting reamer, 9mm) 가 ( 423.8 mmHg), 가

(Table 2, Fig 3-1, 3-2).

290 mmHg 가

가 136.6 mmHg

(shaft) ,

9 mm

가

1mm

(Table 3, Fig. 4-1, 4-2).

0.5mm 가

0.5mm

2)

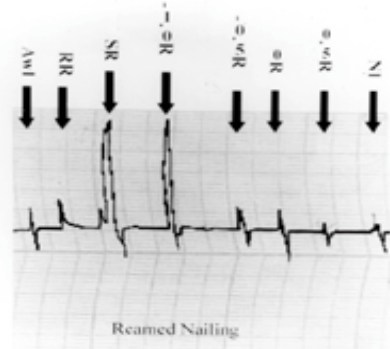
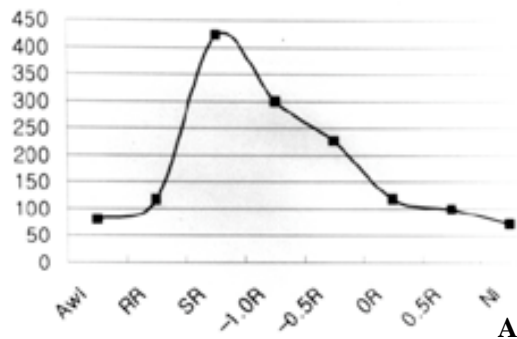
**Table 2.** Reamed Nailing

	Awl	GD*	Starting Reamer	under 1.0	under 0.5	same	over 0.5	Nail insertion
1 (10)	0	250	480	same	260	270	250	200
2 (13)	160	0	490	130	110	100	70	60
3 (13)	0	40	130	40	30	20	20	10
4 (10)	0	370	530	same	520	160	150	110
5 (11)	0	30	240	90	50	40	20	20
6 (10)	130	60	450	same	210	100	100	30
7 (10)	110	150	550	same	550	130	120	100
8 (13)	240	30	520	120	80	110	50	40
Mean	80	116.3	423.8	298.8	226.3	117.5	97.5	71.3

GD\*, Guide Drill

\* mmHg





**Fig 3-1.** Intramedullary pressure data from the reamed groups at different time points of the nailing procedures. (RR:Reaming Rod, SR:Starting Reaming, -1.0 R:Reaming of lower than 1.0 diameter of measured femoral isthmic diameter, NI:Nail Insertion)

### 3-2. Samples of the reamed groups.

**Table 3.** Unreamed Nailing

	Awl	Centering Pin	Proximal Reamer	Nail Insertion
1	10	10	10	550
2	0	0	30	270
3	0	10	120	150
4	0	0	0	550
5	10	0	90	140
6	10	0	250	180
7	40	30	560	300
8	0	0	30	180
Mean	8.8	6.3	136.3	290

\* mmHg

Küntscher  
가

,

가

2,3,6).

,

423.8 mmHg

290 mmHg  
(p=0.001),

(p=0.005),

(p=0.01).

(reaming rod)

가

,

가

가

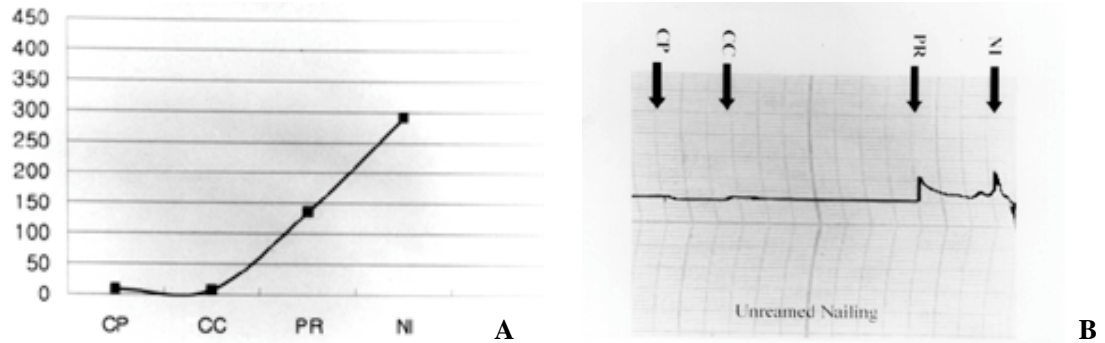
,

가

가

,

가



**Fig 4-1.** Intramedullary pressure data from the unreamed groups at different time points of the nailing procedures. (CP:Centering Pin, CC:Cannulated Cutter, PR:Proximal Reaming, NI:Nail Insertion)

#### 4-2. Samples of the unreamed groups.

80mmHg 116mmHg

8.8mmHg 6.3 mmHg

, 290 mmHg

가 0.5 mm

, 71.3 mmHg

가

3).

(reaming procedure)

9mm

가

, Heim <sup>3)</sup>

423.8 mmHg

가

가

(isthmus)

0.5mm

가

97.5 mmHg

Müller <sup>9,10)</sup>

가

Heim <sup>3)</sup>

(flexible and thinner shaft)

가

, Müller <sup>8)</sup>

가

가

가

13mm

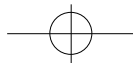
136.3 mm Hg



,  
가가  
가가  
가 .

## REFERENCES

- 1) **Christie J, Robinson CM, Pell AC, McBrine J and Burnett R** : Transcardiac echocardiography during invasive intramedullary procedures. *J Bone Joint Surg*, 77-B:450-455,1995.
- 2) **Heim D, Regazzoni P, Tsakiris DA, Aebi T, Schlegel U, Marbet GA and Perren SM** : Intramedullary nailing and pulmonary embolism: does unreamed nailing prevent embolization? An in vitro study in rabbits. *J Trauma*, 38:899-906,1995.
- 3) **Heim D, Schlegel U and Perren SM** : Intramedullary pressure in reamed and unreamed nailing of the femur and tibia - an in vitro study in intact, human bones. *Injury* 24(Suppl 3):56-63,1993.
- 4) **Kim JJ, Jung CY, Chang JS, Lee SH and Park CJ** : The relationship between fat embolism and intramedullary reaming. *J of Korean Orthop Asso*,34:357-363,1999.
- 5) **Klein MP, Rahn BA, Frigg R, Kessler S and Perren SM** : Reaming versus nonreaming in intramedullary nailing: interfere with cortical circulation of the canine tibia. *Arch Orthop Trauma Surg*,109:314-316,1990.
- 6) **Kröpfl A, Davies J, Berger U, Hertz H and Schlag G** : Intramedullary pressure and bone marrow fat extravasation in reamed and unreamed femoral nailing. *J Orthop Res*,17:261-268,1999
- 7) **Müller C, Frigg R and Pfister U** : Effect of flexible drive diameter and reamer design on the increase of pressure in the medullary cavity during reaming. *Injury*,24(Suppl 3):40-47,1993.
- 8) **Müller C, McIff T, Rahn BA, Pfister U and Weller S** : Intramedullary pressure, strain on the diaphysis and increase in the cortical temperature when reaming the femoral medullary cavity - a comparison of blunt and sharp reamers. *Injury*, 24(Suppl 3):22-30,1993.
- 9) **Müller C, Frigg R and Pfister U** : Can modifications to reamer and flexible shaft design decrease intramedullary pressure during reaming? *Techniques Orthop*, 11 :18-27, 1996.
- 10) **Müller C, Schavan R, Frigg R, Perren SM and Pfister U** : Intramedullary pressure increase for the different commercial and experimental reaming systems:an experimental investigation. *J Orthop trauma*, 12:540-546,1998.
- 11) **Pape HC, Auf 'm ' Kolk M, Paffrath T, Regel G, Sturm JA and Tscherne H** : Primary intramedullary femur fixation in multiple trauma patients with associated lung contusion - a casue of posttraumatic ARDS? *J Trauma*, 34: 540-547, 547-548 (discussion),1993.
- 12) **Pape HC, Regel G, Dwenger A, Krumm K, Schweitzer G, Krettek C, Sturm JA and Tscherne H** : Influences of the different methods of intramedullary femoral nailing on lung function in patients with multiple trauma. *J Trauma*, 35:709-716,1993.
- 13) **Pape HC, Regel G, Dwenger A, Krumm K, Sturm JA and Tscherne H** : Influence of thoracic trauma and primary femoral intramedullary nailing on the incidence of ARDS in multiple trauma patients. *Injury*, 24(Suppl 3):82-103, 1993.
- 14) **Wenda K, Runkel M, Derief J and Ritter G** : Pathogenesis and clinical relevance of bone marrow embolism in medullary nailing demonstrated by intraoperative echocardiography. *Injury*, 24(Suppl 3):73-81,1993.



## Abstract

# **Intramedullary pressure changes in reamed and unreamed nailing systems -an experimental study in cadaveric femoral bones-**

**Chang-Wug Oh, Joo-Chul Ihn, Poong-Taek Kim,  
Il-Hyung Park, Sung-Jung Kim and Chung-Hyun Lee**

*Department of Orthopedic Surgery, College of Medicine,  
Kyungpook National University Hospital, Taegu, Korea*

**Purpose :** This study was designed to investigate whether intramedullary pressure is different in reamed compared with unreamed femoral nailing in cadaveric femoral bones.

**Materials & Methods :** Eight pairs of fresh-frozen cadaveric femoral bones were studied. The diameter of isthmus was checked from 10mm to 14mm and the length of femur was checked from 35cm to 44cm. Intramedullary pressure was measured in the distal femoral shaft at the supracondylar region. Data were monitored in femoral nailing procedures. We utilized the AO universal nail(reamed) and AO unreamed femoral nail.

**Results :** Intramedullary pressure increased in the reamed group to 423.8 mmHg(mean pressure) during reaming by starting reamer(9 mm) and in the unreamed group to 290 mmHg(mean pressure) during insertion of nails( $p=0.001$ ). In the unreamed groups, the next high intramedullary pressure is 136.6 mmHg during proximal reaming. A statistically significant difference in intramedullary pressure was found during the first reaming process in the reamed group compared with the proximal reaming process in the unreamed group( $p=0.005$ ).

**Conclusion :** The data indicate that the intramedullary pressure during unreamed nailing process is lower than reamed nailing process. So we can consider that the unreamed nailing in multiple fracture or pulmonary injured patients is a good modalities.

**Key Words :** Cadaveric Femur, Reamed Nail, Unreamed Nail, Intramedullary Pressure