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= Abstract =

Analysis of Metal Failures for the Femur Shaft Fractures

Kyung-Jin Song, M.D., Hwang-Jik Kim, M.D.,
Jeong-Ryul Kim, M.D., Joo-Hong Lee, M.D., and Byung-Yun Hwang, M.D.

*Department of Orthopedics Surgery, College of Medicine,
Institute for Medical Science, Chonbuk National University, Chonju, Korea*

The purpose of this investigation was to analyze the causes of the metal failures, and to suggest reasonable methods that can prevent metallic failures in the treatment of femur shaft fractures.

There were 27 metal failures in 25 patients who underwent internal fixation for the femur shaft fracture between May of 1990 and May of 1996. We analyzed the causes of injury, fracture site, associated injury and used implants for the femur shaft fractures. And also analyzed the interval since operation to metal failure, method of treatment, and complications following surgery for the metallic failures. There were 13 stainless steel DCP(dynamic compression plate), 4 titanium LC(low contact)-DCP, 7 interlocking IM(intramedullary) nails, 2 Kütscher nails, and 1 anatomical plate.

The metal failure occurred on average 6.1 months after internal fixation. Eight stainless steel

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Tel : 0652) 250 - 1760 Fax : 0652) 71 - 6538

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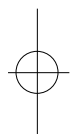




DCP, 4 LC-DCP and 1 anatomical plate failed at the empty hole located at the fracture site. With interlocking IM nail, 4 cases of failure occurred at the proximal 1/3 of femur and other 3 cases showed failure on distal interlocking hole in distal femoral shaft fractures. All failures developed at the fracture site in Kuntcher nail. For the treatment of metal failures, we used stainless steel DCP in 12 cases, interlocking IM nail in 7 cases, Kuntcher nail in 2 cases, Ender nail in 1 case, dual plate in 1 case, and external fixation in 2 cases. Autogenous cancellous iliac bone graft applied in 20 cases for the augmentation of fracture site or to fill the defect area. There were 2 cases of re-failure, 2 chronic osteomyelitis, 1 fracture site infection, 2 delayed union and knee joint ankylosis in 1 case.

Accurate preoperative evaluation of fracture site, fracture pattern and proper implant selection will be essential for the prevention of metal failures. Minimal soft tissue dissection, anatomical reduction and rigid internal fixation will be necessary for the satisfactory outcome in the treatment of femur shaft fractures. Augmentation with autogenous cancellous bone graft should be followed after internal fixation for the comminuted fractures or bony defect over the fracture site. Postoperative rehabilitation program should be individualized according to the preoperative fracture pattern, used implant, and fracture stability.

Key Word : Femur, Shaft fracture, Metal failure.



1990 5 1996 5 6
183 , 188

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25 27 (7)

, 가
가
(metal failure)

38.5 20-30 21 62 ,
60%
가 21 , 가 6
가 20

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2 1/3
7 , 1/3 10 , 1/3 8 , Gustilo
Anderson¹²⁾ 1 2 3a 1

3 ,



Table 1. The cases of metal failure after internal fixation for femur shaft fractures

Case No.	Age/ Sex	Cause location of Fx. femur Fx.	Associated Injury	Implant Op & Metal failure	Interval between metal failure	Extrinsic cause of	Site of metal failure	Treatment of metal	Complication	
1	27/M	TA	dis 1/3	Pelvic bone Fx. Chest contusion	DCP	6M	slip down	empty hole	DCP BG	infection
2	27/M	TA	mid 1/3	Abdominal contusion	DCP	15M	TA	screws breakage	Ilizarov	chronic OM
3	45/M	TA	mid 1/3	Femur neck Fx. plevic bone Fx.	DCP	8M	PT	empty hole	Dual plate BG	
4	62/F	TA	dis 1/3		Anatomical plate DCP	5M	unknown	empty hole	DCP BG	
5	21/M	TA	mid 1/3	Tibiofibular Fx. Cbr. contusion	DCP	7M	unknown	screws breakage	DCP BG	nonunion
6	41/M	TA	prox 1/3		DCP	10M	unknown	empty hole	Hip spica cast DCP BG	
7	44/M	TA	mid 1/3		LC-DCP	5M	unknown	empty hole	DCP BG	
8	41/M	fall down	prox 1/3	Pelvic bone Fx. Calcaneal Fx.	DCP	5M	fall down	screws breakage	Interlocking IM nail	
9	61/M	TA	mid 1/3		DCP	5M	PT	empty hole	Interlocking IM nail	
10	39/M	TA	mid 1/3	Radioulnar Fx.	DCP	9M	slip down	empty hole	K..utscher nail BG	
11	20/M	slip down	mid 1/3		DCP	4M	slip down	screws breakage	DCP, BG hip spica cast	
12	38/M	TA	mid 1/3	Femur neck Fx.	DCP	11M	early exercise	screws breakage	DCP, BG	

13	46/M	TA	prox 1/3	DCP	4M	slip down	empty hole	interlocking IM nail, BG	
14 [†]	49/F	fall down	dis 1/3 IDK	DCP	4M	slip down	empty hole	DCP	re-metal failures
				DCP	3M	early exercise	empty hole	Interlocking IM nail	chronic OM
				Interlocking IM nail	8M	early wt. bearing	distal locking	EF	
15	48/M	TA	mid 1/3	LC-DCP	2M	early exercise	screw hole	empty hole	knee ankylosis
16	36/M	TA	dis 1/3	LC-DCP	4M	fall down	empty hole	Interlocking IM nail, BG	
17	40/M	TA	dis 1/3	LC-DCP	3M	slip down	empty hole	Interlocking IM nail, BG	
18	45/M	TA	prox 1/3	Interlocking IM nail	5M	early wt. bearing	Fx. site	Interlocking IM nail, BG	
19	38/M	TA	dis 1/3	Interlocking IM nail	15M	unknown	distal locking	DCP, BG	
20	23/M	TA	dis 1/3	Interlocking IM nail	8M	fall down	screw hole	Ender nail	
21	24/M	TA	mid 1/3	Kütscher nail	5M	early wt. bearing	Fx. site	DCP, BG	
22	35/M	TA	prox 1/3	Interlocking IM nail	6M	early exercise	Fx. site	DCP, BG	
23	42/M	TA	dis 1/3	Kütscher nail	6M	slip down	Fx. site	Kütscher nail BG	
24	65/M	slip down	prox 1/3	Interlocking IM nail	9M	TA	Fx. site	DCP, BG	Delayed union
25	39/M	slip down	prox 1/3	Interlocking IM nail	10M	slip down	Fx. site	DCP, BG	

* DCP: Dynamic Compression Plate

* LC-DCP: Low Contact Dynamic Compression Plate

* IDK: Internal Derangement of Knee

* PT: Physical Therapy

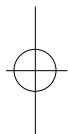
* TA: Traffic Accident

* BG: Bone Graft

[†] This patient had three times metal failure and reoperated with DCP in two times and with interlocking IM nail in one time



2 , . 5 , 2 , . , 3 1/3
 1 , 3 .
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 25 .
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 4.
 , stainless steel DCP 12 ,
 7 , (dual
 plate) 1 , Kütscher 2 , ender 1 ,
 2 , 가 가
 20 .
 1. 2 ,
 1 , 2 ,
 stainless DCP 13 , 2 , 1 .
 titanium LC-DCP 4 , Kütscher 2 , stainless steel DCP
 7 , 1 . 가 1 ,
 12 .
 2 ,
 15 , stainless steel DCP 6.9 .
 , titanium LC-DCP 4 , Kütscher 5.5 ,
 8.8 6.1 5.
 . - 가 12 ,
 가 ,
 2. ,
 - 5 ,
 가 13 , 7 , 가
 2 , , -
 가 5 . 5 , - , , ,
 3. 가 7 . ,
 , stainless steel DCP
 8
 1 titanium LC-DCP 4 .
 , 5
 .
 Kütscher 2
 , 1/3 4
 , 1949 Danis9)가





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1969 AO
dynamic compression plate(DCP), 5
, DCP
가,
Herbert¹³⁾가 .
1-3,5,20) . Pohler Straumann¹⁹⁾
가
, Jorge¹⁴⁾
가
, 1914 Burghard⁷⁾가
1940 Kütscher¹⁵⁾가
,
interlocking Ender PGP
. Mears¹⁷⁾ . Soto-Hall Maclog²¹⁾
,
27 18 10mm
가
가 13
5
4-6)
titanium LC-DCP 4 2 Kütscher
. Herbert¹³⁾ 7 1/3 4
, Dana⁸⁾ 3
, 1
가 3 7 1/3
Laurence¹⁶⁾
가 Zimmerman²²⁾ 4
가 가
가 (round) (cloverleaf)
가
6 1 가



Fielding¹⁰⁾

(compression stress)

20%

가

,

(tensile stress)

가

가

,

가

1/3

1/3

가

(piriformis fossa)

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가

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. Bucholz⁶⁾

(finite element analysis)

가 5cm

Perren¹⁸⁾

3-5

, Gozna¹¹⁾ 3

6.1

8.8

Gozna¹¹⁾

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1)

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(1), 12-43, 1979.

2)

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: Compression plate

Metallic failure 12

16:409-418, 1981.

3)

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, 22:899-907, 1987.

4)

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