

# Retrospective analysis for treatment of proximal tibial fractures with a complete metaphyseal component in two centers with different distinct strategies: Open reduction and internal fixation (ORIF) and Ilizarov frame (Odense, Denmark) versus ORIF and locking plates (Freiburg, Germany)

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**Background:** The purpose of this study was to compare two methods of fixation, external fixation with the Ilizarov wire frame and internal fixation with locking plates, for proximal tibial fractures with a complete metaphyseal component.

**Materials and Methods:** We carried out a retrospective cohort study with patients from two level 1 trauma centers treated with either external fixation or internal fixation. Adult patients with nonpathological fractures classified as Schatzker type VI or OA 41 A2-A3, C1-C3 were included. Combined clinical and radiological bone healing was the primary outcome. Secondary outcomes included infection rate, range of motion of the knee, axial alignment of the knee, re-operation rate after 6 months, heterotopic ossification and signs of post-traumatic osteoarthritis. Minimum follow up time was 3 months. All data was gathered from patient records and radiographs.

**Results:** 62 patients were treated with external fixation and 68 with plate fixation. Time of healing was slightly shorter in the plate fixation group concerning a higher proportion of patients healed after 3-6 months compared to external fixation (67.7% vs 47.1%, p=.017). No difference was seen in the rates of non-union (p=.099). Heterotopic ossification was more prevalent following plate fixation (13.2% vs 1.6%, p=.013). External fixation was associated with a higher rate of superficial infections (40.4% vs 2.9%, p=.000). The initial displacement and the injury severity (ISS) significantly influenced the incidence of non-unions in both groups.

**Conclusions:** Locking plates might have a shorter time of healing, but otherwise these methods are comparable with different complication profiles.

## 1. Principals of fixation and clinical examples



Figure 1: a.) AP and lateral view of an AO 41 C3 fracture in a 50 years old male patient. b.) The same fracture fixed with the Ilizarov wire frame. c.) AP and lateral view of an AO 41 C3 fracture in a 34 years old female patient. d.) The same fracture as in c fixed with locking plates

## 2. Results

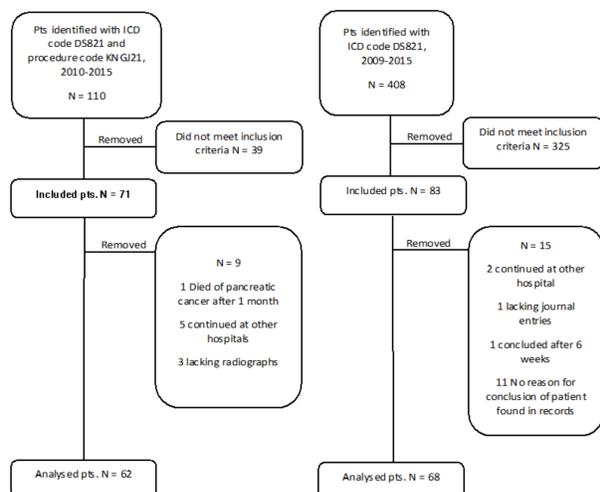


Figure 2: Flowchart of patient identification and selection

		External fixation (N=62)	Plate fixation (N=68)	P-value
Mean age		55.74 ± 14.3	50.44 ± 14.7	.96
Mean BMI		25.56 ± 4.77	25.6 ± 4.27	.447
Gender	Male : Female	30 : 32	36 : 32	.88
ASA score (%)	ASA 1	21 (33.8)	16 (23.52)	.414
	ASA 2	29 (46.77)	38 (55.88)	
	ASA 3	12 (19.35)	14 (20.58)	
Smoking (%)	Smokers	26 (41.9)	14 (20.6)	.008

Table 1: Epidemiological characteristics

		External fixation (N=62)	Plate fixation (N=68)	P-value
Open fractures (%)		7 (11.3)	12 (17.6)	.305
OTA classification (%)	A2	3 (4.8)	9 (13.2)	.099
	A3	0	5 (7.4)	.036
	C1	9 (14.5)	5 (7.4)	.188
	C2	16 (25.8)	9 (13.2)	.069
	C3	34 (54.8)	40 (58.8)	.647
Trauma energy (%)	High	47 (75.8)	59 (86.8)	.108
	Low	15 (24.2)	9 (13.2)	.108
Mean ISS		10.08 ± 3.074	13.56 ± 8.9	.006
Mean displacement mm		12.07 ± 7.38	12.85 ± 8.39	.765
Severity (%)	Monotrauma	42 (67.7)	34 (50)	.04
	Multiple injuries	15 (24.2)	18 (26.5)	.76
	Polytrauma	5 (8.1)	16 (23.5)	.017
Compartment sy. (%)	Pre-op	11 (16.2)	6 (9.7)	.272
N. peroneus paresis (%)	Pre-op	2 (3.22)	7 (10.29)	.106

Table 2: Injury characteristics

		External fixation (N=62)	Plate fixation (N=68)	P-value
Healing (%)	0-3 months	17 (27.4)	27 (39.7)	.139
	3-6 months	42 (67.7)	32 (47.1)	.017
	> 6 months	3 (4.8)	9 (13.2)	.099
Non-union (%)	All fractures	3 (4.8)	9 (13.2)	.099
	C1-3	3 (5)	4 (7.4)	.45
	A2-3	0	5 (35.7)	.324
Median ROM		107.5 ± 19	117.5 ± 20.9	.091
Mean MPTA		88 ± 4.25	88.32 ± 2.09	.677
Mean PPTS		9.3 ± 4.2	10.9 ± 4.5	.084
Extension deficit (%)	1-9 degrees	10 (16.12)	10 (14.7)	.822
	>= 10 degrees	8 (12.9)	10 (14.7)	.766
Knee stiffness (%)		7 (11.29)	9 (13.23)	.736
Varus misalignment (%) more than 5 degrees from 90		5 (8)	2 (2.9)	.184
PPTS misalignment (%)		13 (20.1)	13 (19.1)	.792
Total misalignment (%)		16 (25.8)	15 (22)	.616
Knee instability (%)		5 (8)	3 (4.41)	.309
Superficial infection (%)		25 (40.4)	2 (2.9)	.000
Deep infection (%)		6 (9.67)	5 (7.35)	.634
Re-operation (%)		8 (12.9)	10 (14.7)	.766
HO (%)		1 (1.6)	9 (13.2)	.013
Signs of PO		42 (67.8)	34 (50)	.02
PO difference (%)	0	42	45	
	1	10	17	
	2	9	4	.273
	3	1	2	
Mean Difference PO		.5 (.80)	.45 (.74)	.933
Compartment sy. (%)	Post-op	0	0	
N. peroneus paresis (%)	Post-op	3 (4.83)	0	.106
DVT (%)		2 (3.22)	1 (1.47)	.465

Table 3: Parameters characterizing consolidation and complications

		Non-union (N=12)	Union within 6 months (N=118)	P-value
Mean ISS		16.1 ± 7.95	11.46 ± 6.75	.0015
Mean displacement mm		19.49 ± 6.35	11.89 ± 7.79	.0002
Smoking (%)		2 (16.6)	38 (32.2)	.222
ASA grade (%)	ASA 1	3 (25)	34 (28.8)	.47
	ASA 2	5 (41.6)	62 (52.5)	
	ASA 3	4 (33.3)	22 (18.6)	
Age		50 ± 15.19	53.27 ± 14.72	.46
Deep infection (%)		3 (25)	8 (6.7)	.065
Open fracture (%)		4 (33.3)	15 (12.7)	.075

Table 4: Parameters characterizing influential factors regarding disturbed healing

Proximal tibia fractures are associated with a complication rate. Our results indicate that healing might occur slightly earlier with plate fixation. Superficial infections are typical complications of external fixation, and heterotopic ossification of plate fixation. The risk for non-unions increases with degree of displacement and higher injury severity score. This might be taken into consideration when choosing a particular fixation method.