Femoral shaft fractures and the prehospital use of traction splints

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ABSTRACT:

BACKGROUND: Traction splints are generally accepted as standard prehospital treatment of femoral shaft fractures. The effects of different splints are not sufficiently studied and the use of traction splints is not evidence-based. The aim of study was to determine the incidence and epidemiology of femoral shaft fractures and the prehospital use of traction splints in these fractures and to determine the force of traction exerted by traction splints over time.

MATERIAL AND METHODS: a) Retrospective study of all adult patients with femoral shaft fractures treated at a university hospital during a 5-year period. b) Study of traction force exerted by traction splints on ten healthy volunteers.

RESULTS: Femoral shaft fractures were caused by low energy trauma in 77% of the cases.

There were no significant differences in age, gender, and mechanism of injury or on scene time between patients treated with tractions splints and patients not treated with traction splints. In the experimental study the initial force of traction decreased by 58% during the first 30 min, with the fastest rate of decline within the first five minutes.

CONCLUSIONS: Low energy trauma may today be the most common cause of femoral shaft fractures. Traction splints were in this study probably not used on all patients were this was indicated. The force of traction exerted by the traction splint decrease considerably after application. Future studies need to investigate the clinical significance of this.

KEY WORDS: **traction splints, femur, fracture, prehospital, prevalence, mechanism of injury, traction force**

Introduction

Femoral shaft fractures (FSF) are associated with considerable morbidity and mortality whether they are caused by high- or low-energy trauma. FSF resulting from high-energy trauma are often associated with concomitant injury on internal organs (1). In the elderly FSF are to a high proportion caused by low energy trauma (2,3) and has a reported complication rate of 46% and mortality rate of 20-54% (4,5).

Generally recommended prehospital treatment of femoral shaft fractures includes reduction, immobilization and application of traction. The use of traction splints is included in all major trauma courses (ATLS®, PHTLS®, TNCC®). However, little is documented in the literature about the actual use of traction splints (6).

Four different types of traction splints are used in Sweden (Hare® traction splint, Sager® splint, Qviksplint®, Nordic arms® splint). They differ in design and whether the applied traction can be monitored on a scale or not. There is no scientific support to favour one splint before the other. Written instructions for prehospital use of traction splints are available for all splints.

The aim of this study was a) to determine incidence and epidemiology of femoral shaft fractures and use of prehospital traction splints on FSF and b) to evaluate traction force exerted by splints over time on healthy volunteers.

Material and methods

Epidemiological study

All patients 18 years or older with FSF that were transported with ambulance to, and treated at, a university hospital from Jan 1st 1997 until Dec 31st 2001 were included. Medical records were studied regarding information of age, gender, previous osteosynthesis/prosthesis in the affected limb, mechanism of injury, treatment on scene, concomitant injuries/fractures, and patient-to-hospital transport time. Mechanisms of injury were categorized into high- or low-energy trauma according to local guidelines.

Experimental study

The study group consisted of 10 healthy volunteers, five women and five men.

The study was conducted using the Hare® traction splint, as this was the only splint where traction over time could be monitored on a scale. The traction splint was applied to the volunteer in recumbent position. An electronic scale (MH10K10, KERN & Sohn GmbH, Germany) was mounted in line between the hook of the traction splint and the ankle sling. An initial traction force of 10% of the bodyweight of the volunteer was applied. The traction force was recorded after 1,2,3,4,5,10,15,20,25 and 30 minutes.

Statistics was analysed using Microsoft Excel and QuickCalcs (GraphPad Software, Inc). Statistical method used was Student's t-test and Fisher exact test. A p value of <0.05 was considered significant.

The study was approved by the ethics committee at the university.

Results

57 patients (36 female and 21 male) with 58 femoral shaft fractures were included in the study. The incidence of FSF was 12,2 per 100 000 person years. The mean age was 69,1 years (SD ± 22,8). 18 patients had previously had surgery, osteosynthesis or hip arthroplasty, to the fractured limb. A complete ambulance file was retrieved in 43 patients (75%). All fourteen patients whose ambulance files were missing had femoral shaft fractures from domestic falls. Two of these had received treatment with prehospital traction splint according to the orthopaedic medical record.

Table 1. High-energy trauma: mechanism of injury, patient data

Mechanism of injury	Age	Sex	On-scene time (min)	Fracture fixation	Other measures	Concomittant injuries
Collision car vs car	51	M	45	TS+VM	CID/IV	bil. tibiafr, costafr,
Horse accident	35	F	46	TS	CID/IV	lux right shoulder
Collision MC vs car	44	M	41	TS	CID/IV	radiusfr, MCfr, MTfr
Collision car vs lorry	23	F	42	none	CID/IV/IT	bil femurfr, tibiakondylfr,
Collision car vs car	53	F	52	none	CID/IV	multipel costafr,
Climbing accident	36	M	15	VM	IV	
Motorcross accident	18	M	18	unspec	CID/IV	
Collision car vs car	21	F	12	none	CID	
Motorcross accident	25	M	24	unspec		
Collision car vs car	20	M	26	VM	CID	epiduralbleeding, ankle fr
Collision car vs bus	80	M	data missing	VM	CID/IV	prox humerusfr, ulnafr
Collision car vs car	57	F	data missing	VM	CID/IV	thoraxinjury, diaphyseal+cervical femurfr, acetabularfr, hipluxation, comminute patellafr, radiusfr
Crush injury	56	M	30	none	IV	open tibiafr

Abbreviations*: fr, fracture; CID, cervical immobilisation device; IT, intubation; IV, IV access, MC, metacarpal; MT, metatarsal, TS, traction splint; VM, vacuum mattress*

Table 2. Patients treated with traction splints compared with patients not treated with traction splints; age, sex, mechanism of injury, previous osteosyntesis/hip arthropplasty, on-scene time

	Traction splint (n=12)	No traction splint (n=27)				
				No fracture fixation (n=18)		
Age						
Mean age	65,8 år	66,0 år	p=0,973	70,0 år	p=0,615	Student's t-test
SD	± 15,9	± 27		± 25,8		
Range	35-84 år	18-98 år		18-98 år		
Median age	68 år	80 år		81 år		
Sex						
Female	7 (58 %)	19 (70 %)	p=0,486	15 (83 %)	p=0,210	Fisher exact test
Male	5	8		3		
Mechanism of injury						
Low-energy trauma	9 (75 %)	20 (74 %)	p=1,000	15 (83 %)	p=0,660	Fisher exact test
High-energy trauma	3	7		3		
Previous osteosynthesis/ hip arthroplasty	2 (17 %)	6 (22 %)	p=1,000	6 (33 %)	p=0,419	Fisher exact test
On-scene time (mean)	29 min	20 min	p=0,110	19 min	p=0,096	Student's t-test
SD	± 11	± 16		± 17		

The fractures were caused by low-energy trauma (mainly from domestic falls) in 77% of the cases. Fractures after low energy trauma occurred mainly in elderly women (n=44, mean age 77,7 year, SD ± 17,7, women 72 %). 4 of 10 of these patients had previous hip arthroplasty or osteosynthesis in the fractured limb. The mean age among patients with fractures after high-energy trauma was 39,9 year (SD ± 18,8). Among these patients 62 % were men and the average ambulance time on scene of injury was 32 min (SD ± 13). 8 patients (62 %) received fracture fixation at scene of injury. One patient had bilateral femoral shaft fractures. Table 1.

Prehospital fracture fixation was documented in 23/43 patients. Four patients had concomitant injury that contraindicated use of traction splint. Twelve patients had traction splints, eight patients had vacuum splints and in three patients the method of fixation was not documented. No complications of traction splints or of other types of fracture fixation were documented. There were no differences regarding age, sex, mechanism of injury, previous osteosynthesis/hip arthroplasty, and on-scene time between patients who received traction splints (n=12) and those that did not although the use of traction splint was indicated (n=27). Table 2.

The average on-scene time was 29 min, SD ± 11 when traction splint was applied compared to 20 min, SD ± 16 when traction splints were not used (NS).

In the experimental study the initial traction force varied between 8,6% and 11,6 % of body weight (mean 10 %, SD ± 1). After 30 min the traction force had declined with in average 2,8 kg (SD ± 1,2) to 58 % (SD ± 12) of the initial traction force. The fastest rate of decline was during the first five minutes with in average 2,5 kg (0,5 kg/min). The following 25 minutes the decline was slower at a rate of 0,04 kg/min (Fig 1).

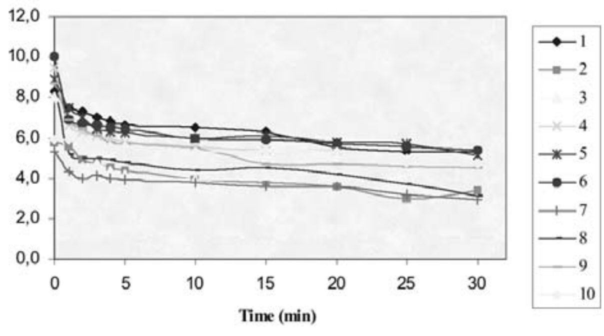

Figure 1. Changes of traction force over time

Discussion

Immobilisation of a fractured limb is pain relieving and reduces the risk for closed fractures to become open fractures. Traction splints are used for retaining correct position of the fractured bone after the fracture has been reduced and manual traction force has been applied. Traction splints facilitate transport of patients and decrease the risk of major bleeding and major soft tissue damage. Traction of the traumatized extremity should go on until the definitive care can be provided. (7,8,9,10). Traction splints have been used for prehospital treatment of femoral shaft fractures since World War I and are recognized by the Committee on Trauma, American College of Surgeons as essential equipment for ambulances since 1961 (6,11).

Traction splint is contraindicated in fractures involving joints, where there is suspicion of damage to the sciatic nerve or displacement of the hip or knee joint. However controversial, the use of traction on open fractures is recommended by several authors when traction is the only possibility as a mean to regain distal pulses (12, 13). Possible complications to traction splints are paralysis of n. peroneus and wounds caused by pressure (14).

Femoral shaft fractures were previously considered mainly to occur in young adults as a result of high-energy trauma, and only to a lesser extent in older patients with osteoporosis (10.13). However, the incidence of femoral shaft fractures, mostly in elderly women after low energy trauma, has increased in the last decades. Osteoporosis is a contributing factor among the older age group (2,15). In a Finnish study from 2000 low-energy trauma, defined as falls from a height less than one meter, was the mechanism of injury in 25% of the femoral shaft fractures (2). In the present study low-energy trauma (including according to local guidelines falls from a height less than six meters) was the mechanism of injury in 77% of FSF. A high proportion of elderly (21% of the study population was 65 years or older) and several patients with previous surgery in the fractured limb could contribute to this difference. In this study, there were only 13 patients with fractures resulting from high-energy trauma. A previous study from the same hospital 1976-1980 found 57 patients with femoral shaft fractures after high-energy trauma (17). This may indicate lack of documentation in present study but could also reflect improved road traffic safety. The incidence of FSFs in this study is in line with what has previously been published (2).

The use of traction splint was expected to be indicated in 10-11 patients annually in present study but use of traction splint was only documented in two to three patients per year. Since 25% of the ambulance files were not retrievable tractions splints could have been used more often than this study indicate. The reason why the files were missing is not addressed in this study. Hedges et al. found that fixation with traction splints and vacuum mattresses were more often used on patients with less severe physiological dysfunction (high Glasgow Come Scale score) and was correlated to longer on scene time (five to six minutes) (16). The latter was not verified in this study, we found no difference in on scene time between patients treated with prehospital fracture fixation and those who were not. It can be assumed that traction splints are used to a somewhat lesser extent on FSF resulting from low-energy trauma as the use of traction splints is taught in trauma courses that focus on high-energy trauma (i.e. ATLS®). However, in the present study there was no difference regarding mechanism of trauma between patients treated with traction splints and patients who did not receive traction splints.

According to the local guidelines for traction splints the applied force of traction should be approximately ten percent of bodyweight for FSF. Other guidelines stipulate that the force of traction should not exceed 15 lbs, i.e. 6,75 kg. In older women with osteoporosis most fractures may be adequately treated with just 2,3-3,2 kg (17). When traction splints are lacking scales paramedics are usually recommended to apply as much traction force as is needed to achieve pain relief. This could present a problem when treating patients concomitantly affected by other injuries. Is has been shown that it is very difficult to correctly estimate the applied traction force. In a study were people were instructed to apply 6,75 kg of traction force the true traction force varied between 1,6 and 50 kg (18). Excess traction force can cause injury on soft tissue, ligaments and joint capsules. In children epiphyseal growth zones can be damaged (11,17).

When traction splints were applied to healthy volunteers only half of the initial traction force remained after 30 minutes (Fig 1). This is probably due to change of position of the splint in regard to the limb. No conclusions can be drawn from these results how traction force changes in patients with FSF, but like all other medical equipment, the function must be checked several times especially during transportation. Future studies are needed to clarify this issue and the clinical consequences.

Conclusion

Femoral shaft fractures may today be more often caused by low-energy trauma than high-energy trauma. Traction splints are probably not used on all patients were this is recommended. Initial force of traction declines considerably during the first five minutes probably due to reposition of the limb. Further studies will show the clinical significance of this.

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