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Comparing the Outcome of Immobilizinglower Limbinjuriesusing Standard-Sized and Half-Length Short Legsplints

Mohammadreza Yasinzadeh[1], Afshin Shokoh Saremi[2], Seyed Mohammad Hosseini Kasnavieh[3], Saeed Golfiroozi[4], Amir Noyani[5],Mahdi Rezai[6*]
[1] Trauma and Injury Research Center, Iran University of Medical Sciences, Tehran, Iran.
[2] Medical Resident, Student Research Committee, Iran University of Medical Sciences, Tehran, Iran.
[3] Trauma and Injury Research Center, Iran University of Medical Sciences, Tehran, Iran.
[4] Emergency Physician, Research and Development Center of Firoozgar Hospital, Iran university of Medical Sciences, Tehran, Iran.
[5] Clinical Research Development Unit, Imam Hossein Hospital, Shahroud University of Medical Sciences, Shahroud, Iran.
[6] Emergency Medicine Management Research Center, Iran University of Medical Sciences, Tehran, Iran.

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Abstract

Background: *Soft tissue injuries (STIs) of lower extremities are considered as a very common complaint in those patients that were admitted to the emergency department. One of the main purposes in these patients' treatment strategies is early returning to work and regular activities. This study purpose was to compare the results of two lower limb (leg) splinting methods: standard-sized short leg splinting, and also half-sized short leg splinting.*
Methods: *In this randomized controlled clinical trial research, we enrolled those patients with STI of the lower limb and without bone fracture. The setting was Haftom Tir trauma center and all patients signed the written consent before the study starting. We categorized participants into two groups: standard-sized short leg splint and half-sized short leg splint. The data were entered into SPSS 18 software and also were analyzed using that.*
Results: *300 patients were included in this study totally. The splinting complications were similar in two groups, but the splint fracture and skin burn frequency were significantly lower in half-sized short leg splint (P.V<0.005). The mean score of pain and swelling frequency had no significant differences in both groups (P>0.005).*
Conclusions: *The results indicated that the performance of standard-sized and half-sized short leg splinting was similar in lower limbs STIs. The difficulties were less in half-sized short leg splint. Therefore, this study recommend that emergency physicians could consider half-sized short leg splinting in STIs, but the recommendation may be considered as valuable when this study results reassess in other clinical trials with multicenter researches and more sample size.*

Keywords: Soft tissue injury, Splint, Complication.
***Corresponding to:** M Rezai**, Email:** mah_re@yahoo.com
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Introduction

All bones in a human body can bear a certain amount of force. Whenever a force is exerted on them larger than the bones' capacity, it leads tobone deformation or a soft tissue injury (STI). This type of injury is categorized into different classes and degrees depending on the force type causing it, the crushing severity, the incident site, and the injury severity that occurred for the surrounding soft tissue.[1,2]

Lower limb soft tissue injuries are amongst the causes of referring to the emergency departments (EDs), accounting for many patients referring to the EDs.[3] A STI and a limb fracture often occur because of a force applied directly by an effect, twisting, falling, or jumping.[4]

The signs and symptoms in terms of the lower limb soft tissue injuries include pain in the leg that would be increased by moving, tenderness around the injured soft tissue, the injured person inability to easily walk and ecchymosis and swelling around the injury location. A fracture or a dislocation combined with vascular injuries has to be immediately diagnosed and treated; otherwise, the limb will be lost because of the collaterals inadequacy.[5] The most important primary care for a limb suspected of fracture and soft tissue injury is the limb immobilization with a splint.[6] A splint is an instrument, which is either made in advance in order to serve this purpose or is made by a care provider by the use of the tools on the accident site and also is fixed on the limb in order to support and stabilize it.

The limb splinting and immobilization that was suffering from a soft tissue injury and inflammation would result in the inflammation cessation or mitigation,[7] because further damage to the vessels around the injury is prevented following the injured limb splinting and immobilization.[8] There are different splints types for lower limb fractures and soft tissue injuries. Some of these splints include hard splints (like a plank or a metal plate), soft splints (like a pillow or a multifold sheet), traction splints, and pneumatic or plastic splints. Sphygmomanometer's cuff and pneumatic anti-shock garments can also be applied as pneumatic splints.[9]

This method has some pitfalls and despite all of the splinting advantages, there have been reports accomplished on skin burns, compartment syndrome, venous thrombosis, etc.[10,11] Hence, this study purpose was to compare the lower limb injury immobilization outcomes using the standard-sized and half-length short leg splints.

Materials and Methods

This study was a controlled randomized clinical trial (ethics code: IR.IUMS.REC.1395.9311307019). In addition, written consent was acquired before each patients enrolling.

The participants included patients suffering from isolated lower limb injuries, who lacked bone fractures and also were admitted to Haftom Tir trauma center in the duration of April 2016 to March 2017. Exclusion criteria have the lack of consent for participating in this study, no need for splinting, patient's failure in order to follow the treatment, having a

fracture, concurrent dislocation, laceration needing suturing and soft tissue injuries requiring reconstructive surgeries.

After obtaining the pati ents consent, this study was accomplished on 300 patients who were suffering from soft tissue injuries to the lower limbs and required splints. The lack of bone fractures in each patient was confirmed through radiography before including the patients. After that, the patients were categorized into the intervention and control groups by the use of the random number table. Half-length short leg splints were used in the intervention group, while standard-sized short leg splints were applied in the control group. The other treatments (ice pack, elevation, analgesics) did not vary by group. At this study beginning, the patients' characteristics including their age, gender and clinical information (e.g. the trauma mechanism, injury type, interval between the accident and splinting) was documented using a predesigned checklist. Then, the patients received a one-month follow-up. During this one-month follow-up, the patients were asked about the outcomes of concern on the phone, but face-to-face meetings were held in order to continue the follow-up when it was required. Skin burns, compartment syndrome, the pain severity, swelling and splint fractures were the primary outcomes that formed the basis for the comparison between these two groups.

The mean and the standard deviation values were applied in order to describe the quantitative variables, however, the quantitative variables were described by the use of the count and percent. Furthermore, the t-test and chi-square tests were performed in order to compare these two groups in terms of the outcomes. All of the statistical analyses were accomplished using SPSS 18. The significant level was set at 0.05.

Results

This research was a randomized controlled trial conducted on 300 patients who were suffering from STIs. In this study, 67.5% and 68.4% of the participants were male in the intervention and control groups, respectively. The average age of the participants in the intervention and control groups was 30.2 (13.3) and 31.0 (12.8), respectively (P.V=0.641). The most frequent trauma mechanism was the sprain in both groups. The sprains prevalence was 33.7% and 37.5% in the intervention and control groups, respectively. Consequently, in this regard there was no significant difference between these two groups (P.V=0.153). The mean and the standard deviation of the interval was 578 (912.3) and 556 (909.8) minutes between the onset of injury and splinting in the intervention and control groups, respectively. Hence, accordingly there observed no significant difference between these two groups (table 1).

Table 1. Participants' characteristics in intervention and control groups

	Control group	Intervention group
Gender (male)count (percent)	104 (68.4)	100 (67.5)
Age(mean±SD)	31 (12.8)	30.2 (13.3)
Time between injury to slinting(mean±SD)	556 (90.9.8)	578 (912.3)

Splint-induced burns were observed in 4.7% of the participants in the intervention group, however the rate of that was 9.8% of the patients in the control group. Therefore, the difference between these two groups was statistically significant (P.V=0.046). Furthermore, splint fractures were observed just in 3.3% of the patients of the intervention group, who were using half-length splints. However, the splint fractures were observed in 9.8% of the control group patients (P.V=0.039). Although, the incidence of lower limb swelling was comparatively lower in the standard-sized splint group (intervention group=30.4%; control group=25.0%), also there was no significant difference between these two groups (P.V=0.352) (table 2).

Table 2. Comparison of burns, fracture of splint and compartment syndrome incidence in these two groups

	Control group		Intervention group		P.V
Outcome	count	percent	count	percent	
Burning	15	9.8	7	4.7	0.05
Splint Fracture	15	9.8	5	3.3	0.04
Compartment Syndrome	14	9.2	18	12.1	0.18
Swelling	38	25	45	30.4	0.35

The mean pain scores of the intervention and control groups were 5.61 (1.2) and 5.7 (1.3), respectively. Therefore, there was observed no significant difference between these two groups in terms of this score (P.V=0.546) (table 3).

Table 3. Comparison between mean pain scores in two intervention and control groups

Outcome	Control group		Intervention group		P.V
	mean	SD	mean	SD	
pain score	5.72	1.3	5.61	1.2	0.55

Discussion

This study was accomplished on 300 patients who were visiting Haftom Tir trauma center in Tehran. This study participant was classified into the half-length splint group and standard-sized splint group by random, in order to compare the half-length and standard-sized splints effectiveness and complications. This study results indicated that splint-induced burns in the group that were used shorter splints were significantly fewer in comparison with the standard-sized splint group. Splint-induced burns and blisters are generally considered as rare phenomena.[12] In this study, less than 10% of the participants reported burns in both groups. This phenomenon generally was caused by the excessive pressure exertion on the skin, during the injury period, which would lead to a gap in the dermal-epidermal junctions. Furthermore, veno-occlusion caused by thrombosis in damaged veins lead to tissue hypoxia and also epidermal necrosis eventually.[13,14] Apparently, the use of more cast bands in standard-sized splints increases the pressure that was applied to the splinted site, while the increase in the contact surface and splint-induced skin abrasion could increase the skin burns incidence in patients who were used longer splints.

In this study, the number of splint fractures in the standard-sized splint group was significantly higher in comparison with the short splint group. A longer splint length generally increases the pressure put on the splint, thereby it could result in the likelihood of splint fractures increasing. Moreover, splint fractures were rare in both groups, accordingly it indicating that half-length and standard-sized splints had satisfactory outcomes.

With respect to this study, there was observed no difference between the intervention and control groups in terms of the pain severity, compartment syndrome, and lower limb swelling. In earlier studies, the lower limb inflammation incidence was not addressed, and only venous thrombosis in the lower limbs was treated with splints.[11] It seems that the pressure inside the splint is one of the factors involved in both lower limb swelling and venous thrombosis. Furthermore, venous thrombosis could

increase the lower limb inflammation. This study results are comparable to the previous research leads to this regard. The venous thrombosis incidence in the earlier studies differentiated between 10 and 20%.[15] The comparison of this study results to the current findings indicates that lower limb inflammation, as one of the lower limb thrombosis manifestations, was more frequent in both groups. Moreover, the most important reason for this difference was the use of different indices in different studies.

In this study, the pain severity and the compartment syndrome presence were also investigated. However, the results indicated no significant difference between these two groups. The earlier researches also suggest that splint could mitigate pain in those patients suffering from lower limb injuries. The main cause of the compartment syndrome incidence in those patients suffering from lower limb injuries is the progressive increase in pressure in the splint confined environment, which impairs the tissues performance inside the splint. Since more bands are applied in standard-sized splints, the likelihood of band hardening is higher in these splints, which may eventually lead to the compartment syndrome development.[16]

To the best of our knowledge, this study was the first study accomplished for comparing the effects of standard-sized splints with half-length splints on the lower limb injuries treatment. Although, this study novelty is its greatest strength, and also the findings from this study should be conservatively generalized. The major constraint on this study was the lack of similar studies, which reduced the possibility of comparing this study results with the previous research results.

Apparently, Splints improve the outcomes of treatment for lower limb injuries shorter than the standard-sized. However, the results of this study should be confirmed in the future studies through larger samples.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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