The Ankle Stirrup Splint for Post-Operative Immobilization

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Abstract

There are a wide variety of splints for fracture immobilization and in the post-operative setting. Nothing is more frustrating than to finish a successful surgery to only have it ruined by a secondary complication from the splint applied post-operatively. The ankle stirrup splint was used with 357 patients post-operatively from 2002 to 2008 following an ankle scope and Brostrom procedure. They were left in the splint for two weeks or until their first post-operative appointment. None of the patients had a complaint about the splint during this time period. The splints tested for time and price were a fiberglass posterior splint, plaster posterior splint, plaster ankle stirrup splint, plaster ankle stirrup with a posterior splint, and finally a fiberglass cast. The ankle stirrup splint provides the best results of all splints for post-operative immobilization and stabilization in terms of ease of application, accounts for swelling, reduces the risk of calcaneal pressure sores, and immobilization when compared to the other splints.

Introduction

Splinting the lower extremity has become very common in the emergency department for stabilizing fractures, also to stabilize fixation or to protect delicate soft tissue following surgery. Splinting is a more effective way to deal with trauma or to immobilize post-operative procedures than a cast. There have been examples of complications in literature from improper placement of a cast. One of these examples would include severe soft tissue necrosis as a result of compartment syndrome in a 5-year-old child who was placed in a cast following a lower extremity fracture (1).

The types of splints that are commonly used are the posterior splint and the sugar tong/ankle stirrup type splint or a combination of the two. The ankle stirrup splint is preferred for a couple of reasons which include: cost, time and ease of application, decreased chance of pressure sore, and effectiveness of the splint. Studies have also indicated that a sugar-tong or ankle stirrup splint is more effective at keeping the ankle in a neutral position without breaking down the splint in the process (2).

Complications from splints and casts, which would include pressures ulcers, can increase medical cost from $500 to $40,000 and even up to $70,000 (3). Medicare and Medicaid reimbursement will, possibly, no longer be provided when a press ulcer develops during a hospital stay or is not documented upon admission (3,4). The formation of a pressure ulcer secondary to a cast or splint following an elective surgery can have catastrophic consequences. Many times placing a cast or splint can cause increased harm to the patient post-operatively because it causes the patient to be on the operating table longer while receiving anesthesia. Usually, it takes multiple people to apply a splint or cast in the operating room, which can be cumbersome.

In this manuscript the authors will discuss the application of the ankle stirrup splint and show its advantages over a posterior splint, the combination posterior splint with an ankle stirrup splint/ sugar-tong, and fiberglass cast.

Patients and Method

The 357 patient's that were included in the study were seen and treated between 2002 and 2008 for lateral ankle instability secondary to an ankle sprain. They underwent a modified Brostrom procedure with an ankle arthroscopy. Immediately following the procedure, while the patients were still under anesthesia, an ankle stirrup splint was applied to the lower extremity that was operated on. The patients were left in the stirrup splint for approximately two weeks. Patients who had a wound other than the incision from surgery were excluded from the study.

When the splint initially came off, the patient's lower extremities were examined for areas of skin break down, areas of friction or any areas of nerve irritation that would be a direct cause from the splint placement.

The different types or splints and casts were applied to lower extremities and the application process was timed from start to finish. The results were compared with each type of splinting and cast. To evaluate application times of a splinting, the surgeon/author was timed when the splints and cast were applied using standard techniques. The splinting techniques that were timed were the ankle stirrup splint, posterior splint with the fiberglass, posterior splint using plaster, sugar tong/ ankle stirrup splint and posterior splint with plaster and a fiber glass cast. The materials that were used and compared for the ankle stirrup ankle splint was splint plaster extra fast, 5 x 30 in sheets. The posterior splint used was a fiberglass splint 4 x 30.

To evaluate the cost differences of the ankle stirrup splint to other splints that are commonly applied the purchasing department at the hospital was asked to report what the hospital purchase price is of the materials used for splinting. The costs were recorded and compared.

Technique

A stockinette can be applied after the surgical dressing or directly over the lower extremity. Four rolls of cast padding are applied from the toes to the level of the mid calf. Care is used to make sure the malleoli are well padded. Ten sheets of the plaster material, which is five inches wide by 30 inches long, are soaked in warm water, (not too hot as the curing of the plaster will also generate heat and may cause a burn) wrung out, and straightened and then applied to the lower extremity. By holding both ends with each hand the plaster is applied to the foot just distal to the posterior aspect of the calcaneus. The edges are then laid against the medial and lateral aspect of the leg. The plaster is then contoured to the malleoli and lower leg.

An additional layer of cast padding is then applied followed by four or six inch ace wraps. The leg can then be held without assistance in the desired position until the plaster sets in three to four minutes. The other splints and cast were applied in standard fashion.

Results

There were 357 patients within the research group that followed through within the study from start to finish. Of the 357 patients, 186 were male and 96 were female. The average age of the patient cohort was 39.71

Of the 357 patients that were splinted using the ankle stirrup technique when questioned about the splint reported the splint being comfortable and secure. There were very few complications noted with a rate of 2.8%. All of the complications were not attributed to the splinting technique and were from the procedure that was performed. This is a significant improvement of complication secondary to the splinting technique when compared with complications attributed to splinting in literature (5).

The average times of application of ankle stirrup splint, posterior splint, ankle stirrup with a posterior splint and a normal below knee cast were recorded. These were applied and timed in the operating room, multiple times, while the patients were still under anesthesia. The average times were then calculated and recorded for each splinting technique. The ankle stirrup plaster splint had an average time of application of 5:05 minutes, the fiberglass posterior splint application time was 4:40 minutes, plaster posterior splint was 4:54 minutes, and plasterer ankle stirrup with a posterior splint was 6:00 minutes, and the fiberglass cast was 7:18.

At the local hospital, the price for one fiberglass splint (3M One step fiberglass, 4 in x 30 in) would be $11.11. For a box of 50 sheets of plaster (splint plaster extra fast, BSN medical 5 in x 30 in) the cost is 12.89 dollars per box. The splint that is used requires ten sheets per splint which would make the cost per splint to be about $2.58. The posterior splint with plaster will have the same cost as the ankle stirrup splint $2.58. The ankle splint with a posterior splint will cost $5.16. The cost of a cast, with 3 rolls of 3 inch fiberglass casts is 2.40 per role. The other materials used, like web roll, are constant in all splints and cast and were not included in the total cost.

Analysis/ Discussion

The main finding in this study is that the ankle stirrup splint is a successful, cost effective, time saving, effortless technique of splinting with minimal complications, especially when comparing these criteria to the same characteristics found in research and literature. Fiberglass splints are popular due to the extra padding with the splints and the ease of application. The price of the fiberglass is a problem as well as the lack of stability with this type of splint.

Pressure sores are caused by prolonged pressure over a boney prominence. The heel is vulnerable to pressure ulcers due to the relative width of the surface area and little amount of subcutaneous fat, which acts as padding between the calcaneus and skin. The majority of these pressure sores are due to pressure and moisture remaining on the foot (6). A cohort study performed in Italy in 2009 showed that patients staying on the Orthopedic floor of a certain hospital with a posterior splint had a pressure ulcer incidence of 12.9% (16/124) (5). Heel pressure sores account for 30.3% of all pressure sores, and lower extremity surgeons need to be aware of this with cast and splint applications, and limited mobility of post-operative patients. The incidence of pressure sores in elderly post-operative patients was 3.5% in seven days (3). The cost of treatment for full thickness pressure ulceration can be as high as $70,000 (3). By avoiding direct pressure over the calcaneus, like with a sugar tong splint, will decrease the risk of developing a pressure sore.

Halvorson et al did a comparison study of 4 different plaster splints to determine which type of splint, the posterior, ridged posterior, modified figure-of-eight, or the sugar tong (ankle stirrup splint) was the best in regards to resistance of plantar flexion 30 minutes after application (2). Pressure was measured under the metatarsal heads or the amount of force compared to the degrees of active plantar flexion. This was done 5 different times with each splint. The amount of force compared to degree of plantar flexion was recorded. The sugar tong splint required the maximum pressure, 250mmHg, with the least degree of plantar flexion. Halvorson et al determined that the sugar tong splint provided the best immobilization of the four different splints in the study (2). In the post-operative period immobilization is a key factor for healing, especially around the ankle where the incisions are subject to increased movement, and the sugar tong splint provides this added immobilization (7).

In conclusion, the ease of application of the ankle stirrup splint, such as being independent of extra hands, decreased time, reduced cost, strength and low complication rates, make it a more advantageous splinting option over other described techniques as well as casting. The authors lost no notable surgical correction due to this type of splinting method.

The authors understand that there are limitations to this study that include no control group to compare the other splinting techniques to the ankle stirrup as well as having no trauma patients in the study group. In the future other comparative studies would need to be performed with control groups that compare outcomes for traumatic events as well as post-operative patients. Understanding the limitations, the ankle stirrup splint is still a successful technique for lower extremity splinting.

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