

Original Article

Ankle Brace V/s below Knee Slab in Lateral Ankle Sprains (Grade I and II)

Dipesh Pariyar ^{1*}, Rishi Bista ², Rajaram Maharjan ³

1. National Trauma Centre, Kathmandu ,Nepal
2. National Trauma Centre, Kathmandu ,Nepal
3. National Trauma Centre, Kathmandu ,Nepal

* Correspondence: dipeshpariyar74@gmail.com

Abstract: Ankle ligament injuries are the most common injuries in sports and physical activity. In spite of high frequency of such injuries and the potential for significant morbidity, no treatment is considered to be the gold standard for the management of such sprains. Traditionally, ankle sprains were treated with strict immobilization in below knee posterior slab but nowadays, functional treatment with immediate weight bearing has been advocated. We assessed the use of ankle stirrup brace versus below knee posterior slab for treatment of lateral ankle sprains employing the VAS scoring for pain assessment and Karlsson scoring for functional assessment. This is a Comparative intervention Study done at National Trauma Centre. 44 Patients eligible for inclusion were assigned to either the ankle stirrup brace group or the posterior slab group after applying randomization. Characteristics such as age, dominant ankle, and gender were assessed at baseline. Pain assessment was done using the visual analog scale (VAS) at baseline and at 3rd week and functional assessment was done using Karlsson score (KS) at the 3rd week. SPSS version 16 was used for analysis, and $p < 0.05$ was taken to indicate significance. The mean ages were 31.41 ± 8.09 in the slab group and 31.45 ± 7.15 in the ankle stirrup brace group. There was a slight male predominance. Right ankles were mainly involved in both groups. There was no significant difference in pain reduction at 3 weeks between two groups ($p < 0.064$) however the mean differences in swelling ($p < 0.02$) and Karlssons Score ($p < 0.031$) between the two groups were statistically significant at the end of the study. The results of our study indicate that treatment with ankle stirrup brace provides better functional support and reduction of swelling than a below-knee posterior slab in management of lateral ankle sprains (grade I and II).

Keywords: ankle brace, knee slab, ankle sprains

1. INTRODUCTION

Ankle ligament injuries are the most common injuries in sports and physical activity [1]. The ankle and foot injuries are among the most common sports injuries and extremity complains presenting to the emergency department [2]. Sprains of the lateral ligaments of the ankle joint account for between 3-5% of all ER visits in the UK, and 7-10% of them in the USA [3]. The mechanism of such injury is secondary to an inversion of a planter flexed foot [4]. The grading of such injuries was proposed by Crichton on the basis of its severity [5]. GRADE I – the ligament is stretched but not torn and the anterior talofibular ligament is usually involved. The anterior draw test is negative. GRADE II – the ligaments are partially torn; laxity may be present and there is moderate swelling. GRADE III – complete rupture of the ligament resulting in joint instability. The anterior draw test is positive. In spite of high frequency of such injuries and the potential for significant morbidity, there is no single acceptable treatment that is

preferable to other current treatments [6,7]. Hence timely diagnosis and treatment of such injuries are helpful in the final outcome of such treatment [8]. The PRICE (Protection, Rest, Ice, Compression and Elevation) treatment protocol is commonly used for the initial treatment of acute ankle sprain [9]. The common modes of treatment include surgical repair of injuries, plaster immobilization, elastic bandage, steroid injection and prescription of non-steroid analgesics [10]. Decreasing the time period, achieving a stable ankle joint, preventing recurrence and repetition of such injuries are the most important objectives to be attained during treatment of acute ankle sprains [7]. Conventional treatment includes early mobilization with weight bearing with or without the use of external support [11]. External supports in the form of tape, brace or elastic bandages, is preferred over plaster of Paris (POP) as they have better functional outcomes as per previous studies [9]. However, long-term cast immobilization makes the soft tissues around the joint tender and short, thus, increasing the disability, especially in case of athletes [12]. Those who propose immobilization with plaster emphasize that the treatment bring about further stability for the ankle joint; while who believe in the functional treatment point out to regain the pre-injury range of motion faster and to reduce the incidence of muscular atrophy [13]. Immobilization is defined as any therapy that prevents movement of ankle joint in both flexion/extension and inversion and eversion in cast, posterior slab or boots [14]. We at our institution commonly immobilize the limb in below knee posterior slab. These management strategies have been passed from senior to junior ranks with only anecdotal evidence to justify their use. With the medical community moving towards evidence-based practice, research is required to validate current treatment concepts to determine optimum functional outcome. This study assesses use of ankle stirrup brace versus below knee posterior slab immobilization for treatment of lateral ankle sprains (Grade I and II), employing the VAS scoring for pain assessment and Karlsson scoring for functional assessment, the effect of ankle brace in reduction of Pain by VAS score and swelling by measuring Ankle girth in Lateral ankle sprain grade I and II, the effect of Posterior Slab in reduction of Pain by VAS score and swelling by measuring Ankle girth in Lateral ankle sprain grade I and II, to Compare the effect of Ankle brace and Posterior Slab in reduction of Pain and Swelling in Lateral ankle sprain grade I and II and to compare the functional outcome by Karlssons score between Ankle Brace and Posterior Slab in patient with lateral ankle sprain grade I and II.

2. MATERIALS & METHOD

This is an Interventional Comparative Study done at National Trauma Centre, Mahabodhi Sample size was calculated as

$$(z^2/d^2) pq$$

$$Z=1.96(z=\text{confidence interval})$$

$$d\text{-error rate}=0.05$$

$$P=\text{Prevalence rate}=0.03$$

$$q=1-p=1-0.03=0.97$$

$$n=44$$

44 patients were randomly divided into 2 groups: 22 in Ankle Brace Group (AB) and 22 in Posterior Slab group (PS)

PS group: below-knee posterior slab group

AB group: ankle stirrup brace group

The study was started after acceptance of study Proposal by Institutional Review Board (IRB), National Academy of Medical Sciences (NAMS). Patients presenting with Lateral Ankle Sprain were evaluated with Standard radiographs for Ankle (Anteroposterior, Lateral and Mortise Views) to exclude the fracture. Then Patient's informed written consent was taken before enrollment. The Patients were randomized by asking to pick a chit from a closed box containing label as PS for Immobilization in Posterior Slab and AB for ankle brace. The baseline character including demographic patterns (Age, Sex, Injured Site and occupation) were recorded. Severity of Pain was assessed by VAS score and swelling was measured with measuring tape that was recorded in the Proforma. The standardized treatment based on RICE (rest, ice, compression and elevation) protocol was given to all patients. The patients in the functional treatment group were put on ankle brace and subjected to early mobilization and range of motion exercises from day 4. The stirrup ankle brace consists of two contoured thermoplastic lateral straps lined with foam pads and designed to fit against the medial and lateral malleoli of the ankle joint. At the ankle joint, the padding is contoured to fit the malleoli. The rigid sidewalls are held in place with Velcro strapping. The brace is self-applied, reusable, adjustable, and can be worn during rehabilitation phase. The below knee posterior slab splint consists of plaster of Paris splint applied extending from tibial tuberosity to the base of toes. Analgesia and Crutches were given as required. Review arrangements were made for 48-72 hours (for assessment of complication due to swelling), 2 weeks and 3 weeks Below knee slab was removed at two weeks and brace removed after 2nd week. Rehabilitative physiotherapy was started after 2 weeks in both groups. Pain was again recorded on the visual analog scale (VAS) and also Karlsson score was noted at 2 weeks and 3 weeks. The Outcome measured was the ankle joint function. This was assessed at the end of 3rd week using a modified version of the Karlsson scoring scale.

	Degree	Score
Pain	None	20
	During exercise	15
	Walking on uneven surface	10
	Walking on even surface	5
	Constant	0
Swelling	None	10
	After exercise	5
	Constant	0
Instability	None	25
	1-2 / year (during exercise)	20
	1-2 / month (during exercise)	15
	Walking on uneven ground	10
	Walking on uneven ground	5
	Constant (severe) using ankle support	0
Stiffness	None	5
	Moderate (morning, after exercise)	2
	Marked (constant, severe)	0
Stair climbing	No problems	10
	Impaired (instability)	5
	Impossible	0
Running	No problems	10
	Impaired	5
	Impossible	0
Work activities	Same as pre-injury	15
	Same work, less sports, normal leisure activities	10
	Lighter work, no sports, normal leisure activities	5
	Severe impaired work capacity, decreased leisure activities	0
Support	None	5
	Ankle support during exercise	2
	Ankle support during daily activities	0

Figure 01: Karlssons Score

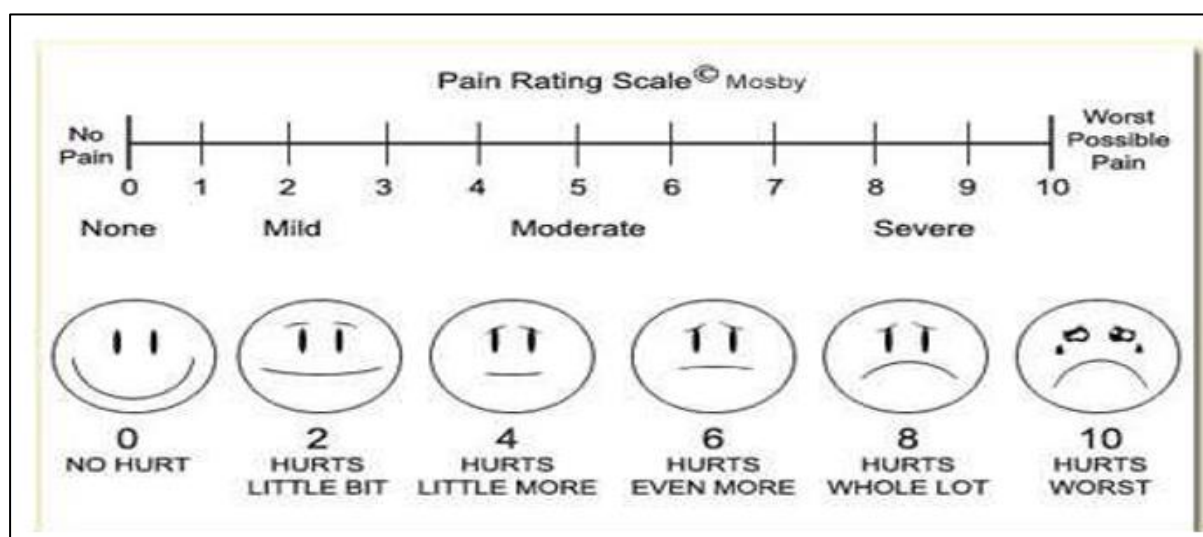


Figure 02: 0-10 VAS Numeric Pain Distress Scale

Patients who sustained grade I and grade II ankle sprain were enrolled in the study. They were followed up for a period of three weeks and assessed for functional outcome, improvement in pain scores and decrease in swelling. The data was entered in SPSS version 16 and analyzed using this software. The continuous data was expressed as the mean +SD and categorical data was expressed as frequency. The

swelling and Pain score was analyzed using ANOVA test and Karlsson score was analyzed using student T test. The statistical test was considered significant when p value <.05

3. RESULTS & DISCUSSION

22 patients were included in each group of this study. Patients were strictly advised for regular follow up and data was collected in each follow-up. After systemic analysis of the data in SPSS program, the following observations were made and the results are presented in form of tables, bar diagrams, pie charts without any duplication.

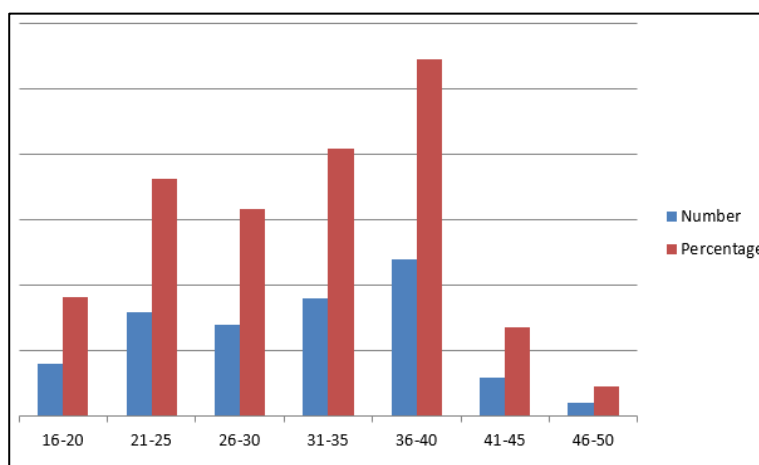


Figure 03: Age distribution of study groups

The age of the patients ranged from 19 to 48 years, with a mean age of 32.43 ± 7.54 years. The maximum number of patients were in productive age groups i.e. 31-35 (12) followed by 36-40 (9) age group.

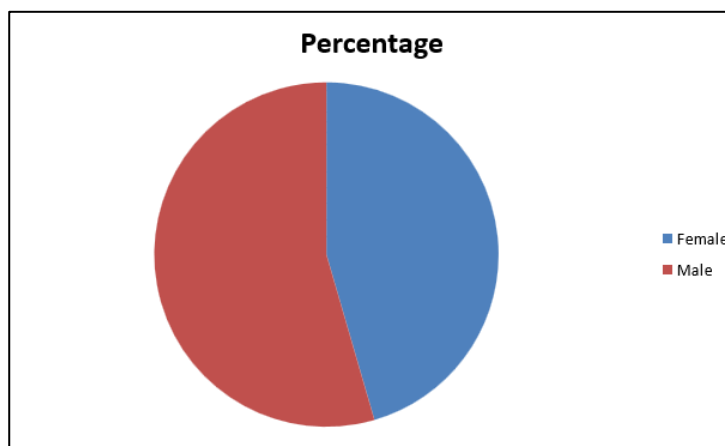


Figure 04: Gender wise distribution of study groups

Of the patients enrolled in the study, 24 were males (55%) and 20 were females (45%). The male to female ratio was 1.2

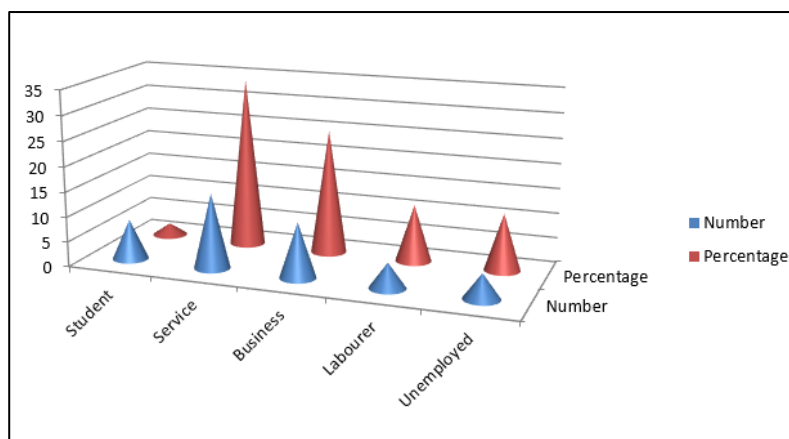


Figure 05: Occupation of study groups

In this study maximum number of patients 15(34.1%) belonged to professional category followed by those involved in business. The service holders represented the patients involved in civil services, managers, security guards, electricians, teachers, mechanic, driver.

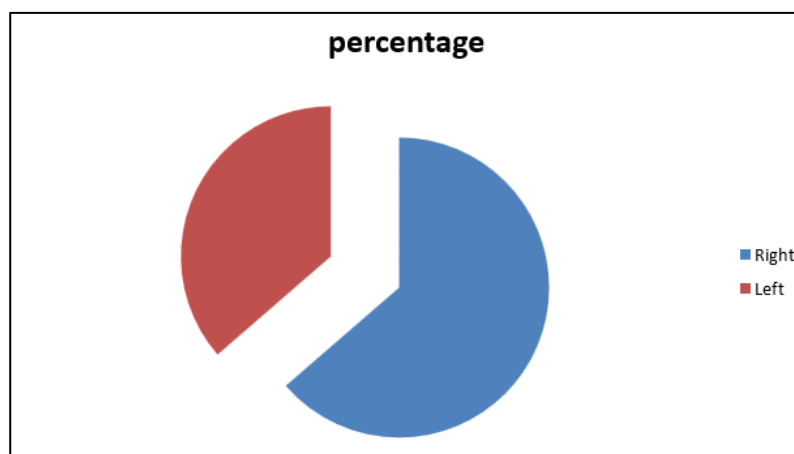


Figure 06: Side of lateral ankle sprain

Involvement of the right extremity was more common with 28(64%) of patients with right sided affection while in left was 16(36%) patients.

Table 01: baseline characteristics of patients compared between two groups

Characteristics		Brace(n)	Brace (%)	Slab(n)	Slab (%)
Sex	Female	12	27.3	8	18.2
	Male	10	22.7	14	31.8
Occupation	Student	5	11.4	3	6.8
	Service	8	18.2	7	15.9
	Business	15	34.1	6	13.6
	Laborer	2	4.5	3	6.8
	Unemployed	2	4.5	3	6.8
Injury Side	Right	28	64.1	13	29.5
	Left	16	35.9	9	20.5
Age (Mean ±SD)		31.45±7.15		31.41±8.09	

20 of the 44 participants were females of whom 8 were in the slab group and 12 in the ankle brace group. Out of the 24 male participants, 14 was in the slab group while 10 were in the brace group. Most of the patients were service holders. The differences in mean age in years was not different in both groups.

Table 02: baseline pain by vas score and swelling of study groups

	Ankle Brace(n)	Posterior Slab(n)	p-value
Pain	6.27±1.72	6.50±1.65	0.658
Swelling	3.00±0.69	2.84±0.75	0.467

The mean of baseline Pain before application of any support was not statistically significant. And similarly, there was no statistically difference in baseline swelling in between two groups.

Table 03: effect of ankle brace in reduction of pain by vas score and swelling at 3 weeks

	Baseline	At 3 weeks	p-value
Pain	6.27±1.72	2.63±1.73	0.001
Swelling	3.00±0.69	0.89±0.58	0.001

There mean of Pain and Swelling was statistically significant($p < 0.05$) at 3 weeks compared to the baseline with the application of ankle brace.

Table 04: effect of posterior slab in reduction of pain by vas score and swelling at 3 weeks

	Baseline	At 3 weeks	p-value
Pain	6.27±1.72	2.63±1.73	0.001
Swelling	3.00±0.69	0.89±0.58	0.001

There mean of Pain and Swelling was statistically significant($p < 0.05$) at 3 weeks compared to the baseline with the application of below knee posterior slab.

Table 05: comparison of ankle brace and posterior slab in reduction of pain by vas score and swelling at 3 weeks

	Ankle Brace	Posterior Slab	p-value
Pain	2.63±1.73	2.86±1.46	0.64
Swelling	0.89±0.58	1.48±0.59	0.02

The mean of the pain score at 3rd week is statistically not significant when compared between the ankle brace and posterior slab with p value of 0.64. However, the difference of mean of the swelling at 3rd week between the group applied with brace and slab is statistically significant with p value 0.02. Thus, there is significant difference in the swelling of patients in between application of brace and slab.

Table 06: results of Karlsson score

Type of Support	Mean Karlssons Score	p-value
Ankle Brace	85.64±7.74	0.031

Posterior Slab	78.27±13.37	
----------------	-------------	--

The Karlssons score mean for brace group is 85.64±7.74 and for posterior slab group is 78.27±13.37. The p-value is 0.031. Thus, there is a significant difference in Karlssons score between the two groups.

DISCUSSION

Acute ankle injuries are among the most prevalent injuries of the athletes' musculoskeletal system [17]. Leaving the ankle sprains untreated will cause chronic problems, reduced range of motion, pain and instability of ankle joint which impact activities of daily living [18]. On-time diagnosis and treatment are important to achieve fast recovery and to decrease the joint secondary damages [22]. However, despite their regular occurrence, management of this injury varies widely between Emergency departments and often between clinicians working in the same department. There is as yet no gold standard method of management used universally. Instead, clinicians rely on a combination of personal experience and clinical judgement [15]. The use of an ankle orthosis tends to be limited to sports groups or teams that are supervised by either physiotherapists or sports medicine practitioners. Little research has been directed towards management of such injuries in the general population, coordinated through a busy emergency department where resources will be restricted and orthosis use limited [15]. Management strategies can be divided into three main categories: cast/splint immobilization, functional treatment (bandage or ankle brace and mobilization) and operative repair. A diverse array of studies is present in the literature comparing one of these methods against another. As a result of the heterogeneous nature of various research projects they perform poorly under meta-analytical review. It is difficult to compare the results of studies directly, but a few common themes have emerged [15]. Most patients (75-100%) who suffer a sprain of the lateral ligaments of the ankle have a 1-year outcome that is excellent or good and completely acceptable to the patients irrespective of the therapy they receive (surgical repair and cast, casting alone or early controlled mobilization with the use of external support); however, the short-and intermediate term outcome was unclear [23]. Therefore the objective of our study was to determine the short-term outcome of first time Grade I and II Lateral ankle sprains and identify the best means of external support with the goal of returning patients to their preinjury activity levels. In our study, ankle sprain was more common among males (55%). An author [24] organized their review of prospective investigations of ankle-ligament injury risk factors as intrinsic (those from within the body) and extrinsic (those from outside the body) based on classification system introduced by an author [22]. The increase in height and weight proportionally increases the magnitude of inversion torque that must be resisted by the ligaments and muscles that span the ankle complex. A researcher [25] also found that male soccer athletes who sustained ankle sprains had greater height than those who did not. An author [26] reported similar findings on male military recruits who were taller and heavier were at increased risk of suffering an ankle injury. An author [27] found that the joint laxity measured with increase talar tilt was associated with increased risk of injury among men. The taller height and comparatively greater weights along with more involvement in outdoor and sports activities of males in our population could explain our finding. The incidents in females are also associated with extrinsic causes of high heels. A researcher [28] noted that dominant leg sustained significantly more ankle injuries in male soccer players, with 92% of ankle injuries affecting the dominant leg. Limb dominance has been implicated as a risk factor for lower extremity trauma because most athletes place a greater demand on their dominant limb, therefore, they produce increased frequency and magnitude of moments about the knee and ankle, particularly during high-demand activities that place the ankle and knee at risk [29]. Another study [30] reported limb dominance was unrelated to risk of ankle sprains for male and female. The mean visual analog scale score was slightly higher in the posterior slab group in comparison to ankle brace group at baseline, in the 3rd week. The difference between the two groups

was statistically insignificant in the 3rd week. A prospective study conducted with use of elastic wraps for lateral ankle sprains showed much faster reduction in pain by third week of treatment [20]. A meta-analysis showed that functional treatment provided better outcomes in terms of pain reduction than cast immobilization for mild to moderate injuries, however immobilization can hasten recovery for severe sprains [21]. Most authors believe that continuing pain in long term after injury depends on the initial injury severity and does not depend on the treatment type [31,32]. Thus, using anti-inflammatory drugs may be effective to control pain in both the groups. Similarly, the mean of the swelling at 3rd week between the group applied with brace and slab was statistically significant with Anova test (p value of 0.000). The grades I and II ankle are considered stable and functional rehabilitation can begin immediately limiting the debilitating consequences of decreased range of motion and thus persistent swelling [4]. Thus, there was significant difference in the swelling of patients in between application of the brace and slab in our study. This is most probably because with use of brace patients could easily apply cold compression. The movement of the toes and ankle allowed quicker and better mobilization of edema fluids and assisted lymphatic drainage. Our study showed that starting the initial movements after ankle sprain is necessary and facilitates people's return into work and is free of negative impacts in ankle joint stability. A study represented that the functional treatment immediately after surgery is not only useful to maintain the range of motion, but also it increases power of muscles around the ankle during certain movements such as plantar flexion [33], while long-term immobilization of ankle causes muscular atrophy and negative impacts on muscular fibers type I. In a study found that Fibroblast cells proliferation is increased subsequent to damaging ligaments and collagen synthesis is boosted [22]. [33] in their study concluded that joints motion after injuries is effective to direct collagen bundles which accelerate the repair procedure; however, reinforcing such ligaments may last several months. According to other evidence, our results indicated that the functional treatment not only keeps the joint range of motion, but protects ligaments against next injuries. Usually, feet are injured upon circling inward or when it is in plantar flexion state which accounts for 25% of musculoskeletal system's disease [12]. If the feet are kept fixed and motionless for a long time because of fixing by plaster, motions of ankle, particularly dorsi-flexion is limited. Therefore, the long-term physiotherapy treatments are necessary to recover the ability; however, sometimes athletes fail to return the professional sport again. Thus, bondage treatment or using brace along with the initial movements maintains range of motion. A systematic review showed that the short-term treatments without external supports for ruptured external ligaments of ankle will result in persisting various symptoms such as pain, inflammation and joint instability, while surgical treatment bring about better long-term outcomes [31]. The results of our study indicate that the functional treatment with ankle brace is a better treatment than a POP cast for lateral ankle sprains. We found that functional treatment provides better support in terms of reduction of swelling and provides more functional stability than a POP cast. Although many previous studies have compared one of the available treatments with another, none of them have provided sufficient evidence for the superiority of a particular treatment protocol, which may be the result of the use of poor study and assessment techniques. Cast immobilization, surgical repair, and functional treatments are considered the treatment options in the scientific literature [15, 19]. Cast immobilization utilizing a below-knee plaster cast is a double-edged sword, as it can help to speed up healing but can also result in functional impairment through muscle wasting (although evidence for such effects is lacking). A study [16] supports the usage of below-knee plaster cast immobilization. They found that functionality was improved at the 3-month interval when such a cast was used, but that all treatments (Air cast brace, Bledsoe boot, or 10-day below-knee cast and double-layer tubular compression bandage) were equally effective at the 9-month interval.

4. CONCLUSIONS

The results obtained in this study suggests that the use of Ankle Brace in the treatment of Grade I and II lateral ankle sprains, that present within 24 hrs. of injury, produces significant improvement in ankle joint function, at 3rd week, compared with standard management with below knee posterior slab. There is also significant decrease in swelling (ankle girth) in patients treated with ankle brace though no statistically significant reduction in pain was noted in between the groups. Further research is required on a larger sample to confirm this hypothesis, with the opportunity of producing a cost-effective analysis of any perceived advantages. Functional treatment of Grade I and II lateral ankle sprain with ankle stirrup brace is recommended over immobilization in below knee posterior slab.

REFERENCES

- [1] B B, P R, L H, H UBB. Treatment of First Time Ankle Sprains. American Journal of Sports Medicine. 2006;34(9):1401-12.
- [2] Wedmore IS CJ. Emergency department evaluation and treatment of ankle and foot injuries. Emerg Med Clin North Am. 2000.
- [3] Lamb SE NR, Withers EJ, Clark M, Marsh JL, Wilson S, Hutton JL, Szczepura A, Dale JR, Cooke MW. Clinical and cost effectiveness of mechanical support for severe ankle sprains: design of a randomised controlled trial in the emergency department. BMC musculoskeletal disorders. 2005;6(1).
- [4] Wolfe MW UTea. Management of ankle sprains. American family physician. 2001;63(1).
- [5] KJ C, PA F, C P, AS W. Injuries to the pelvis and lower limb. Edited by: Bloomfield J, Fricker PA and Fitch KD. 1995, . Science and medicine in sport. 1995; Victoria, Australia, Blackwell Science Pty., Ltd., (2): 463-7.
- [6] Eiff M SA, Smith G. Mobilisation Vs Immobilisation in Ankle Sprains. American Journal of Sports Medicine. 1994;22(1):83-8.
- [7] MM A, J R. Comparison of Functional Treatment Vs Immobilisation in Treatment of Lateral Ankle Sprains (Grade I and II). IJSR. 2017;6(3):2288-91.
- [8] JC D, D C, RI M, RA D, E F. Lateral and syndesmotic ankle sprain injuries: a narrative literature review. Journal of Chiropractic Medicine. 2011;10(3):204-19.
- [9] K E, port Vd, B F, Niek vD. A systematic review on the treatment of Acute Ankle Sprain: Brace Versus other functional treatment types. Sports Medicine. 2011;41:185-95.
- [10] EF E, JJ F, S L. Efficacy of celecoxib Vs Ibuprofen in the treatment of acute pain. A multicentre, double-blind, randomised controlled trial in acute ankle sprains. Am J Orthop 2002;31(8):445-51.
- [11] Nahal Mostak Khan, Soheb Ahmed Robin, Lutfullahil Khabir & Sohel Mahmud (2024). Role of Vitamin C in Development of Age Related Cataract. Dinkum Journal of Medical Innovations, 3(01):26-34.
- [12] P K. Immobilisation or early mobilisation after an acute soft tissue injury? PhysSportsmed. 2000;28(3):21-8.
- [13] H M, H S, F S, H D. Functional Treatment Comparing with Immobilisation after Acute Ankle Sprain. Zahedan Journal of Research in Medical Sciences. 2013;15(2):28-31.
- [14] GMMJ K, BH R, WJJ A, KD K, PAA S. Immobilisation and Functional Treatment for Acute Lateral Ankle Ligament injuries in adults. Cochrane Database Syst Rev 3 2002;CD003762.
- [15] SH B, MA Q, S C. Management of anle sprains: a randomised controlled trial of the treatment of inversiion injuries using elastic support bandage or an Aircast ankle brace. British Journal of Sports Medicine. 2005;39(2):91-6.
- [16] Lamb SE, RA N, JL M, JL H, MW C. Collaborative Ankle Support Trial (CAST Group). Mechanical supports for acute, severe ankle sprain: a pragmatic, multicentre, randomised controlled trial. Lancet. 2009;373(9663):575-81.

- [17] JH N, BG Y, SR Y, SH L, CH S. Outcome of the functional treatment of first time ankle inversion injury. *Journal of Orthopaedic Science* 2010;15(4):524-30.
- [18] SB P, BE S, CL D, J S, W P. Differences in ankle range of motion before and after exercise in 2 tape conditions. *The American Journal of sports medicine*. 2009;37(2):383-9.
- [19] KM R, J R, SL K, L P, I H. The effect of ankle taping on detection of inversion-eversion movements in participants with recurrent ankle sprain. *The American Journal of sports medicine*. 2009;37(2):371-5.
- [20] DJ OH, M G. Treatment modalities for soft tissue injuries of the ankle:a critical review. *Clinical Journal of Sport Medicine*. 1995;5(3):175-86.
- [21] MP E, AT S, GE S. Early mobilisation versus immobilisation in the treatment of lateral ankle sprains. *The American Journal of sports medicine*. 1994;1:83-8.
- [22] R S, S M-B. Managing ankle sprains in primary care:what is best practice?A systematic review of last 10 years of evidence. *British medical bulletin*. 2010(1d028).
- [23] JN C. Ankle sprain discharge instructions from the emergency department. *Pediatric Emergency Care* 2005;21(8):498-501.
- [24] L L, C O. Sprains of the ankle and sprains of the knee. Paris:Masson et Cie. 1945.
- [25] B B, D M, D A. Predictive Factors for Lateral Ankle Sprains. *J Athl Train*. 2002;37(4):376-80.
- [26] W WA. Ankle sprains in players of the field-games Gaelic football and hurling. *J Sports Med Phys Fitness*. 1999;39:66-70.
- [27] C M, N S, A F. Risk factors for lateral ankle sprain:a prospective study among military recruits. *Foot Ankle*. 1991;12:26-30.
- [28] BD B, PA R, DM A, JF B, PM V. Ankle ligament injury risk factors:a prospective study of college athletes. 19. 2001:213-20.
- [29] J E, J G. Soccer injuries and their mechanisms:a prospective study. *Medicine and science in sports and exercise*. 1983;15:267-70.
- [30] BD B, DF M, DM A. Predictive factors for lateral ankle sprains:a literature review. *Journal of athletic training*. 2002;37(4):376.
- [31] I S, MP S, T N, C L. A fivefold reduction in the incidence of recurrent ankle sprains in soccer players using the Sport -Stirrup orthosis. 1994;22(5):601-6.. A P, CN V, PM B. Treatment of ruptures of the lateral ankle ligaments:A meta-analysis. *J Bone Joint Surg*. 2000;82(6):761-71.
- [32] V M, VD H. Diagnostic and Therapeutic aspects of inversion trauma of the ankle joint[dissertations]. Universiteit van Limburg. 1982.
- [33] J K, O L, K L, J S. Early mobilisation versus immobilization after ankle ligament stabilization. *Scand J Med Sci Sports*. 1999;9(5):299-303.
- [34] P P, al USe. A randomised,prospective study of operative and non-operative treatment of injuries of the fibular collateral ligaments of the ankle. *J Bone Joint Surg[Am]*. 1998;80(3):345-51.