

Comparative ultrasound study of acute lateral ankle ligament injuries rehabilitated with conventional and jump stretch flex band programmes

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Abstract

The purpose of this study was to establish the difference in rehabilitation outcomes between the Jump Stretch Flex Band (JSFB) programme and conventional ankle rehabilitation programmes of acute lateral ankle ligament injuries. This study compares the process of healing under the guidance of ultrasound in both groups. The return to competitive level of sport dates were also documented and compared. A single blind randomised control study comparing the JSFB rehabilitation programme with conventional ankle rehabilitation programmes was used. Ultrasound examinations were done on all first time lateral ankle ligament injuries 72 hours post injury and repeated every two weeks during rehabilitation. Patients were divided into two groups: JSFB group and Control group. The JSFB group had a six (6) day head start to rehabilitation as ankles were rehabilitated following the Compression, Elevation, Mobilisation and Traction (CEMT) methods with the flexbands. Grade 1 injuries from the JSFB group were compared with grade 1 injuries from the Control group and grade 2 injuries with grade 2 injuries from both groups. The time from injury to return to sport (competitive level) was documented and ligaments were compared by means of swelling, thickness and appearance. With the JSFB programme the general fluid collection in the anterior recess for grade 1 injuries improved significantly ($p = 0.0426$). Fluid from the posterior recess tended to decrease more for both grade 1 and 2 injuries within the JSFB group. The thickness of the ligaments significantly increased in size ($p = 0.0025$ for grade 1; $p = 0.0038$ for grade 2), the ligament appearances tended to return to normal sooner and the return to sport time was significantly shorter ($p = 0.0026$ for grade 1; $p = 0.0081$ for grade 2). The study illustrated that with acute grade 1 and 2 lateral ankle ligament injuries the return to competitive level of sport was shorter with the JSFB programme with an earlier start to rehabilitation. Furthermore the fluid from the anterior as well as posterior recess of the ankle tended to decrease with the JSFB programme and ligaments significantly increased in size. It was perceived that ligaments returned to normal sooner with the JSFB programme than with conventional ankle rehabilitation programmes. However this was the subjective interpretation of the investigator.

Keywords: Jumps stretch flex bands, ultrasound, ankle injuries, ankle rehabilitation.

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Introduction

Ankle injuries are common and account for approximately 10 to 30% of all sports injuries. Eighty-five percent of these involve the weaker lateral ligaments, while only 3 to 5% involve the medial ligament (Zoch, Fialka-Moser & Quittan, 2003). The high incidence of ankle ligament injuries requires clearly-defined acute care and a broad knowledge of new methods of rehabilitation to reduce time spent off from the training and competition field. In addition to rapid pain relief, the main objective of treatment is to restore the range of motion of the ankle without any major loss of proprioception, thereby restoring full activity as soon as possible (Zoch, Fialka-Moser & Quittan, 2003). A combination of isokinetic strength training with proprioception training shortens rehabilitation and serves as secondary prophylaxis. Immediate treatments are aimed at reducing the inflammation and pain and may include analgesics, non-steroidal gels, ankle strapping, cold therapy, interferential or pulsed electromagnetic radiation, short-wave diathermy and ultrasound (Zoch, Fialka-Moser & Quittan, 2003). Exercise rehabilitation programmes have previously been shown to be effective in the management of injured ankle ligaments (Van der Wees, Lenssen, Hendriks, Stomp, Dekker & De Bie, 2006).

Rehabilitation is commonly divided into four phases: the initial phase, early rehabilitation, late rehabilitation, and the functional phase (Zoch, Fialka-Moser & Quittan, 2003). Each phase is completed before the patient returns to competitive sport again. The duration of each phase may vary according to the degree of injury and the patient's physiological way of adapting to treatment. Ankle sprains are classified according to severity in three grades (Wolfe, Uhl, Mattacola & McCluskey, 2001). Grade 1 injuries are the least severe with partial ligament rupture and no joint instability. Incomplete ligament tears with mild to moderate joint instability refer to grade 2 injuries. The most severe being grade 3 ligament injuries refers to complete ligament tears with mechanical joint instability. These patients are unable to bear weight and normally require surgical repair (Wolfe, Uhl, Mattacola & McCluskey, 2001).

In this study, the Jump Stretch Flex Band (JSFB) rehabilitation programme was compared with conventional ankle rehabilitation programmes. JSFB are the original continuous loop bands used by professional baseball, football and basketball teams as well as power lifters. JSFB are used in a variety of settings for strength training and rehabilitation (Shimmer & Hartzell, 2007). The bands provide variable isotonic exercise (dynamic variable resistance), meaning that the pressure changes throughout the range of motion (relative force output of the muscle remains constant, but the resistance varies due to the change in absolute load and length of the band) making this a safe and effective alternative training method (Picture 1). JSFB are 105cm (41") in length and come in six sizes with resistances varying from 2.2kg (5lb) to 90kg (200lb) per band (Shimmer & Hartzell, 2007).



Picture 1: Jump Stretch Flex Bands

Both early mobilization and immobilization programmes are effective in managing ankle ligament injuries (Eiff, Smith & Smith, 1994). The treatment of first time grade 1 and 2 ankle sprains with immobilization combined with an elastic wrap provides an earlier return to pre-injury function compared to immobilization alone or elastic wrap alone (Beynon, Renstrom, Haugh, Uh, & Barker, 2006).

A non-invasive ultrasound technique has been established for the visualisation of acute ligament injuries to differentiate between partial and complete ligament tears (Campbell, Menz, & Isaacs, 1994). For specific indications, ultrasound (US) is an efficient and inexpensive alternative to magnetic resonance imaging (MRI) for evaluation of the ankle. Ankle ultrasounds allow for the detection of tenosynovitis, tendinitis, tendinopathy, as well as partial and complete tendon tears. Joint effusions, intra-articular bodies, ganglion cysts, ligament tears and plantar fasciitis can also be diagnosed (Fessell, Vanderschueren, Jacobson, Ceulemans, Prasad, Craig, Bouffard, Shirazi & van Hoisbeeck, 1998) (Morvan, Busson, Wybier & Mathieu, 2001). Given the need for affordable medical treatment, demand for ultrasound of the ankle may increase given its lower cost compared with that of MRI scans. In most cases, a focused ankle ultrasound examination can be performed more rapidly and efficiently than MRI (Torriani & Kattapuram, 2003). Familiarity with the technique of ankle ultrasound, normal ultrasound anatomy and the ultrasound appearances of pathologic conditions will establish the role of ultrasound as an effective method of imaging the ankle.

Ultrasonography can be used to visualise the process of healing and recovery time by documenting tissue swelling, tissue repair and fluid collections. In this study it was used to compare differences between the two rehabilitation protocols.

Methods

All active sport patients who visited a dedicated Sports Medicine Practice in Pretoria were notified about the study. Informed consent was obtained from all patients between the ages of 18 and 40 years with first time lateral ankle ligament injuries. All patients who presented with acute grade 1 and 2 lateral ankle ligament injuries underwent an ultrasound examination during the first 72 hours after injury to grade their ligament injury and to determine the amount of tissue damage. The ultrasound examinations were conducted using a Toshiba Xario Ultrasound machine (7.5 – 14 MHz linear probe) under the supervision of a medical practitioner experienced in musculoskeletal ultrasonography. The magnification for examining sizes was set to measure accurately to the closest of 0.01mm.

The patient is in a sitting position with legs stretched out on the bed; the tip of the lateral malleolus is the landmark for the examination of the lateral ligaments. The transducer should always be placed as parallel as possible to the examined ligament to avoid artifactual hypoechoic appearance that can mimic a tear (Bianchi & Martinoli, 2007).

The anterior talo-fibular ligament has a nearly horizontal orientation, the superior margin of the probe is placed at the anterior tip of the lateral malleolus, the inferior margin at the talar neck, the anterior talo-fibular ligament will be demonstrated as a thin hyperechoic fibrillar band which connects the lateral malleolus to the talus, the ligament can be slightly stretched by eversion and the anterior drawer manoeuvre to differentiate complete from partial ruptures (Bianchi & Martinoli, 2007).

The calcano-fibular ligament is examined by placing the transducer in an oblique coroner plain with its superior margin at the tip of the lateral malleolus and inferior margin slightly posterior to it. Unlike the anterior-talo fibular ligament it has a concave course which makes evaluation of the malleolar insertion more difficult, the ligament has a cord-like fibrillar structure and can be stressed by forced dorsi flexion of the foot for better evaluation (Bianchi & Martinoli, 2007).

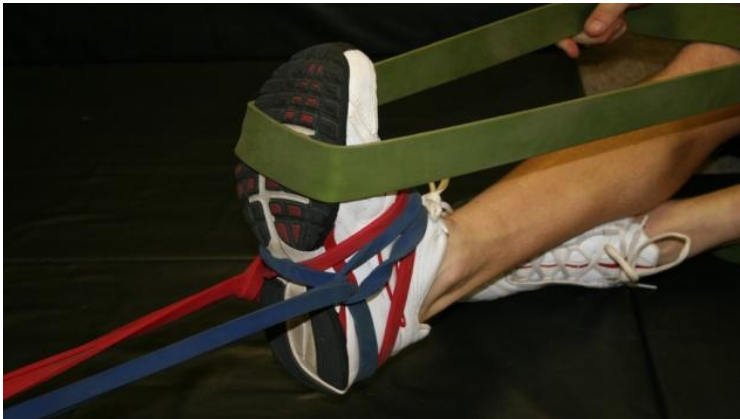
After the amount of tissue damage had been determined, a rehabilitation programme was started where the patients were divided into Group A (JSFB group) or Group B (Control group). Patients were randomly allocated to Group A or Group B after their level of injury had been graded. The randomisation process involved that every alternative patient with a grade 1 or grade 2 ankle ligament injury formed part of Group A. The patients remaining formed Group B.

Grade 1 ankle ligament injuries from Group A were compared with grade 1 ankle ligament injuries from Group B and grade 2 ankle ligament injuries from Group A were compared with grade 2 ankle ligament injuries from Group B. Both groups followed the RICE (Rest, Ice, Compression and Elevation) regime for the first 72 hours after injury.

Group A received a JSFB programme from day four post-injury onwards whereas Group B remained non weight bearing (injured ankle immobilised in an ankle immobilisation boot - "Air Walker") and started with a conventional ankle stabilisation and exercise rehabilitation programme from day 10 post injury onwards. Group A therefore had a six (6) day head start to active rehabilitation. Both groups were treated under supervision on Mondays, Wednesdays and Fridays for 30-minute sessions. The 13mm (Red) and 44mm (Green) flexbands were used on Group A and these patients followed a rehabilitation program comprised of Compression, Elevation, Mobilisation and Traction (CEMT). Ankles were compressed by circular wrap (Picture 2) with the 44mm flexband for 2 minutes and then mobilised (plantarflexion, dorsiflexion, inversion, eversion and circular movements of the ankle joint) while still being compressed for another 2 minutes. After three sets had been done the ankle was then elevated and given traction with two 13mm flexbands and one 44mm flexband (Picture 3). Patients then performed mobilisation exercises while under traction for 3 minutes and did this in sets of three. As the ankle became stronger the compressions were increased to 3 minute and the traction to 5 minute intervals. Group B followed a conventional ankle stabilisation and exercise rehabilitation program comprising of manual therapy, interferention, laser and proprioception exercises conducted by an experienced physiotherapist. Both groups received the same NSAID (Non-Steroidal Anti-Inflammatory Drug) from day 3 post injury for 5 days. An ultrasound examination was done on each patient every two weeks (from Group A and Group B) to compare the amount of tissue healing in both groups. Patients were treated until they were back to full recovery (regaining full proprioception, muscle power with pain free range of motion and being back to competitive level). The time from injury to full recovery (return to competitive level of sport) was documented in both groups and compared with one another.



Picture 2: Compression of the ankle with circular wrap.



Picture 3: Traction with 13mm and 44mm JSFB.

Statistical analysis

Statistical analysis was done in collaboration with the Department of Statistics at the University of Pretoria. Descriptive statistics was used to explore the data and compared the two groups by means of statistical tests (*Mann-Whitney U-test and Fisher's exact test*). Due to the relatively small numbers of the participant, these tests were used as they produced the most accurate statistical power. The Mann-Whitney U-test was used for the analysis of the recovery time, swelling and thickness of the ligaments, while Fisher's exact test was used to analyse the appearance of the ligaments. P-values equal to or less than 0.05 were taken as significant.

Results

Table 1: Number of athletes tested per group with average BMI and age.

	Grade 1 ankle ligament injuries	Grade 2 ankle ligament injuries	Average BMI (kg/m ²)	Average Age (years)
Group A	7 (6 males and 1 female)	6 (3 males and 3 females)	25.4±3.3 (19 – 30)	20.5±1.4 (18 – 24)
Group B	6 (5 males and 1 female)	6 (5 males and 1 female)	25.5±2.8 (21 – 31)	22.7±4.2 (18 – 29)
Total	13 (11 males and 2 females)	12 (8 males and 4 females)	--	--

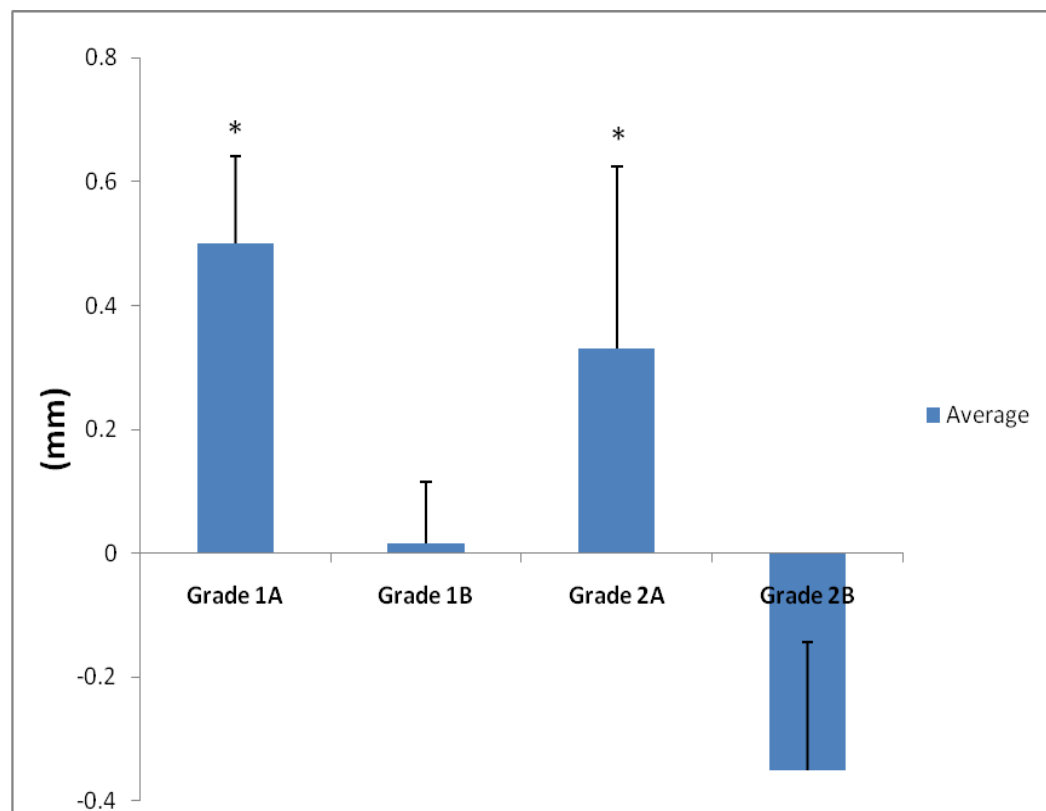


Figure 1: Change in ligament size. [* Significantly different to control group at corresponding time point (p < 0.05)]

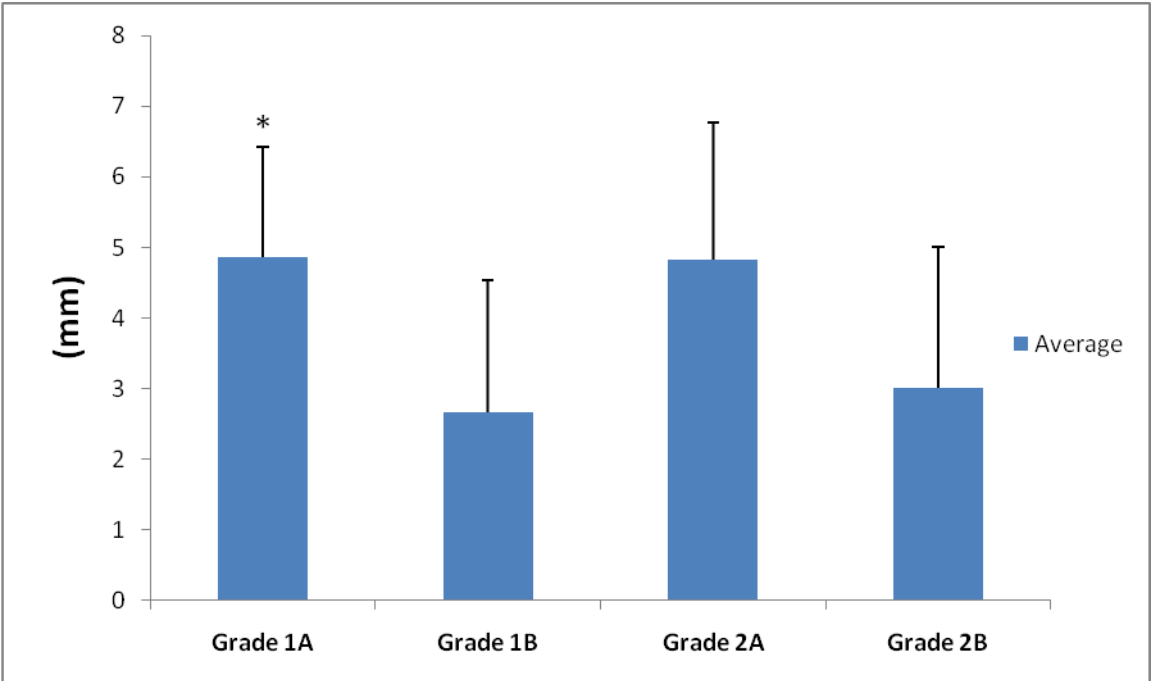


Figure 2: Decrease of fluid collection in the anterior recess. [* Significantly different to control group at corresponding time point ($p < 0.05$)]

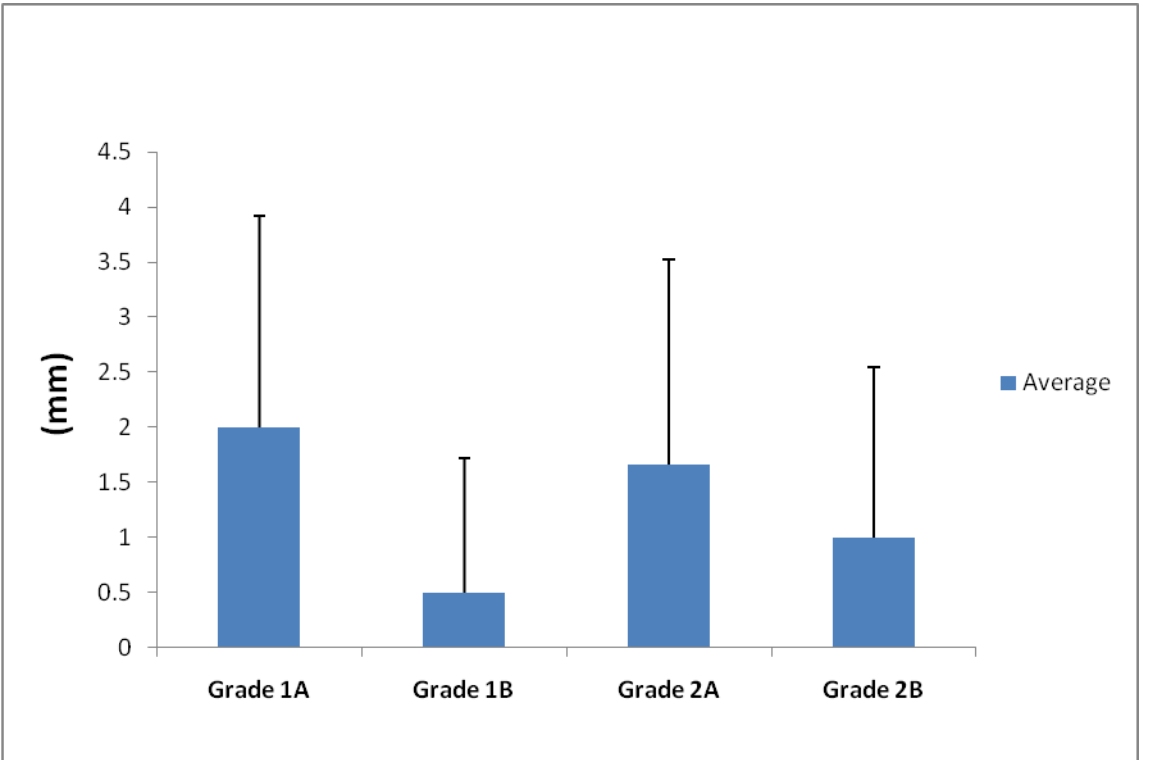


Figure 3: Decrease of fluid collection in posterior recess.

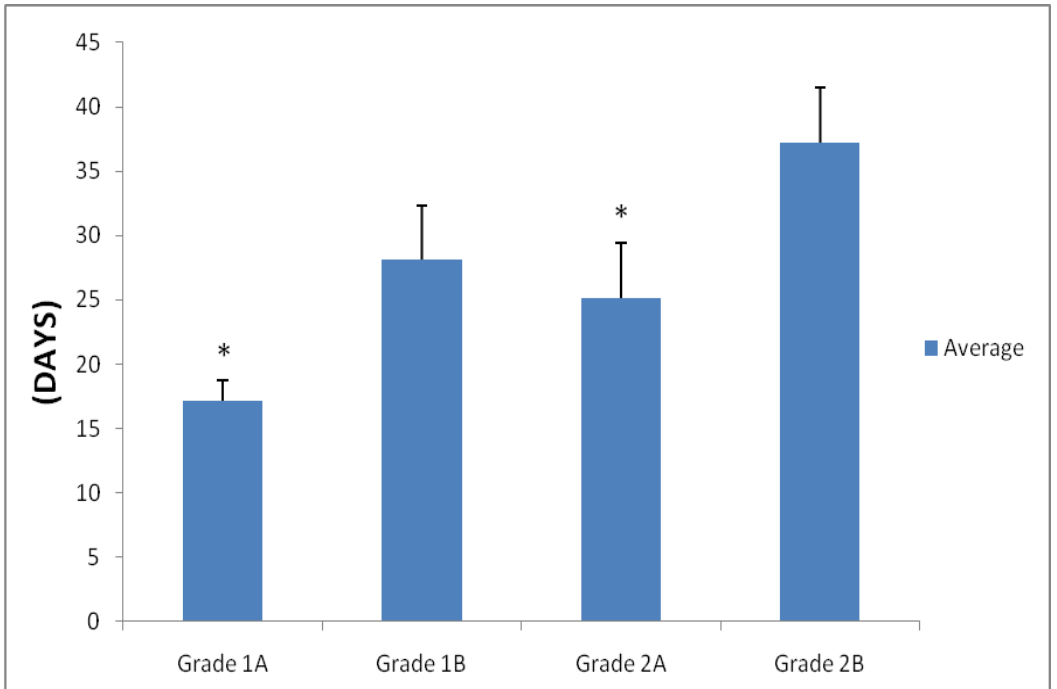


Figure 4: Time to return to competitive level of sport. [* Significantly different to control group at corresponding time point ($p < 0.05$)]

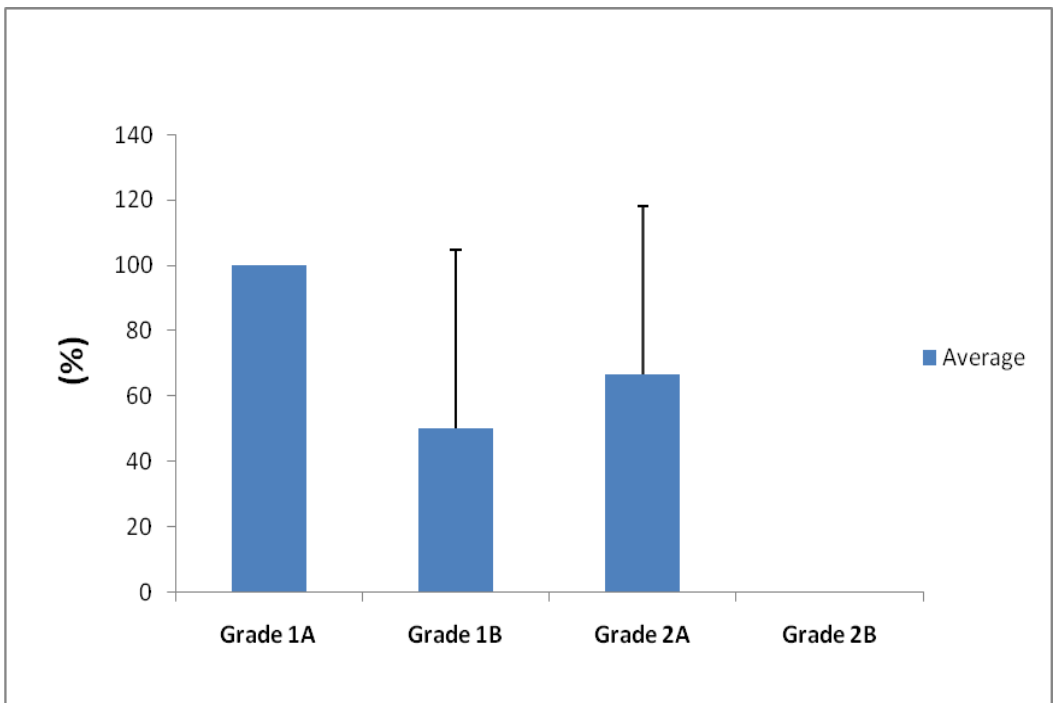


Figure 5: Percentage of ligament appearances back to normal 2 weeks post start of rehabilitation.

A total number of 25 active sport patients were recruited and divided into different groups according to the nature of their injuries (Table 1). Figures 1 to 4 illustrate changes from the first ultrasound (first 72 hours post injury) to the last ultrasound (before return to sport) while Figure 5 illustrates changes 2 weeks post start to rehabilitation. The Anterior Talo-Fibular Ligament (ATFL) of both grades 1 and 2 increased in size for all individuals within Group A ($p = 0.0025$ for grade 1; $p = 0.0038$ for grade 2) as seen in Figure 1. Although the fluid in the anterior recess of the ankle decreased in both groups, the fluid in the anterior recess decreased significantly more with Group A than Group B ($p = 0.0426$) for grade 1 injuries (Figure 2). The results for grade 2 injuries showed more or less the same effect for both groups. Both groups showed a decrease in fluid collection from the anterior recess with Group B decreasing more than that of Group A (Figure 2). Fluid from the posterior recess tended to decrease more for both grade 1 and 2 injuries within Group A (Figure 3). Rehabilitation started 6 days earlier for Group A and therefore the return to sport for grade 1 ankle injuries rehabilitated in Group A were on average 11 days shorter than grade 1 ankle injuries rehabilitated in Group B ($p = 0.0026$). Similar results were found with grade 2 ankle injuries (Figure 4). The return to sport for grade 2 ankle injuries in Group A were on average 12 days shorter than that of grade 2 ankle injuries in Group B ($p = 0.0081$). In general there was a tendency for the appearance of the ATFL to have changed from abnormal to normal (Figure 5) 2 weeks post the start of rehabilitation in group A for both grade 1 and 2 injuries. None of the appearances of the ligaments from Group B for grade 2 injuries appeared to have returned back to normal 2 weeks post the start of rehabilitation. This finding could be due to the fact that grade 2 ligament injuries in general take longer to heal and return back to normal post injury (Zoch, Fialka-Moser & Quittan, 2003) than grade 1 injuries. However this was based on the subjective opinion of the researcher.

Discussion

The study illustrated that JSFB can help in the management of acute grade 1 and 2 lateral ankle ligament injuries. With a six (6) day head start to rehabilitation the return to sport was on average 11 days shorter in grade 1 and 12 days shorter in grade 2 lateral ankle ligament injuries. This could be beneficial for all sporting codes especially in the professional sport environment where the time factor is vital for athlete, coach and spectator.

The fluid from the anterior and posterior recess also tended to decrease more with the JSFB programme. JSFB can therefore be helpful in managing the swelling of the ankle joint and could become a reliable tool in the management of acute grade 1 and 2 lateral ankle ligament injuries.

Group B tended to have an average age older than that of Group A; however this should not have had a remarkable change in the results as it was not a huge difference and Group B had 2 patients with an age of 28 and 29 years of age. Group A for grade 2 injuries had 3 males and 3 females while Group B for grade 2 injuries had 5 males and 1 female (Table 1). This could have had a slight difference in tissue healing, but unfortunately there were no statistics done on either gender or age.

Grade 2 injuries in Group B showed a decrease in ligament size while grade 1 injuries in Group B showed slight changes (Figure 1). Both grade 1 and 2 injuries in Group A however showed a significant increase in ligament size. The implication of ligaments increasing in size might be due to the isotonic exercises done with the JSFB - The more you exercise a muscle the stronger it becomes. This finding might implicate stronger ligaments in Group A. Grade 2 ligament injuries from Group B decreased in size as the ligaments recovered with conventional rehabilitation programmes.

A limitation to this study was that although the ultrasonographer was qualified in ultrasound examinations, it still remained the ultrasonographer's subjective opinion on ligament appearances and the placement of the ultrasound probe on the ankle joint. This could be improved in future studies by doing MRI scans on patients. However this would raise the costs of the study remarkably (Torriani & Kattapuram, 2003). Another limitation to this study is that there is very little research up to date on JSFB and its effects on rehabilitation. JSFB is becoming more and more popular and readily available in the rehabilitation setting. This opens the door for any future research on JSFB.

Future research investigating grade 3 ankle ligament injuries rehabilitated with the JSFB programme compared with surgical modalities would be beneficial. Although re-injuries to the same ankle post rehabilitation were not documented in this study, it could also form part of future research projects.

Conclusion

JSFB are used more and more often for the rehabilitation of different types of sporting injuries (shoulder, knee, and ankle injuries). This study illustrated that there is beneficial uses for JSFB in the rehabilitation of acute grade 1 and 2 lateral ankle ligament injuries. Sports men and women could benefit from the rehabilitation with JSFB and this could be a treatment modality for acute lateral ankle ligament injuries.

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