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Early rehabilitation treatment of ankle sprains in athletes

ABSTRACT: A TOTAL OF 24 VOLLEYBALL PLAYERS WITH 2ND DEGREE ANKLE SPRAIN INJURIES WERE TREATED WITH A FUNCTIONAL BANDAGE FOR 7 DAYS, CRYOULTRASOUND THERAPY DURING THE FIRST 12 HOURS AND SUBSEQUENTLY WITH ACTIVE MOBILISATION USING *MEDISLIPPER* FROM DAY FIVE. AN ISOMETRIC, ELECTROMYOGRAPHIC, STABILOMETRIC AND FORCE PLATFORM TEST WERE PERFORMED AT THE START AND END OF TREATMENT WITH *MEDISLIPPER*. THE COMPARISON BETWEEN THE RESULTS OBTAINED INDICATED A SIGNIFICANT INCREASE IN MUSCLE STRENGTH (+ 37%, P = 0.021), MOTOR UNIT RECRUITMENT (+ 34.6%, P = 0.039), PROPRIOCEPTIVE CONTROL WITH CLOSED EYES (+ 31.86%, P = 0.029) AND JUMP CAPACITY (+ 42%, P = 0.027). TREATED PATIENTS RETURNED TO COMPETITIVE SPORTS IN AN AVERAGE OF 18.6 DAYS WITHOUT REQUIRING USE OF A BRACE OR FUNCTIONAL BANDAGE.A *FOLLOW-UP* VISIT 6 MONTHS FROM THE END OF TREATMENT REVEALED AN ABSENCE OF RELAPSE.

A sprained ankle is one of the most common musculoskeletal problems in young sportsmen and - women, with an incidence of between 10-40% of all injuries (*Scott & Renstrom, 1999*). It is estimated that there are approximately 5,000 new cases every day in Great Britain (*De Bie et al., 1997*) and about 2 million every year in the USA (*Beynnon et al., 2001; Woods et al., 2003; Bahr, 2002*). Lateral sprains are by far the most frequent type of sprained ankles, and are favoured both by the tibiotarsal joint's anatomical predisposition to inversion as a consequence of the lateral malleolus being longer than the tibial malleolus and of certain determining

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- JOINT RECOVERY
- MUSCLE STRENGTHENING
- PROPRIOCEPTION

anatomical factors such as, for example, the lateral malleolus being positioned behind the tibial mortise or a poorer fit between the trochlea and the ankle mortise (*Di Giovanni*, 2004). Sprains can be classified from an anatomic and pathological point of view into four grades according to the severity of the anatomical injury:

• grade 0 – no clinically detectable tearing or instability;
• grade I (mild) – stretching of the anterior talofibular ligament, with no macroscopic damage, modest swelling, tenderness when loaded and little functional limitation;
• grade II (moderate) – partial tearing of the anterior talofibular and calcaneofibular ligaments, significant swelling and tenderness, mild or modest instability and partial functional limitation;
• grade III (severe) – complete tear of the lateral ligamentous complex and, in some cases, also of the interosseous ligament, with tenderness and functional impotence, effusion and severe instability.

One recent review found that full recovery of the ankle was only achieved in 36 to 85% of patients with sprain injuries (*Van Rijn et al.*, 2008), demonstrating that inadequate treatment can lead to chronic problems such as a reduction in the range of movement, local pain and articular instability with potential for relapse (*Wolfe et al.*, 2001). The prevalence of sprained ankles has been reported in various sports such as basketball, football, volleyball, tennis and rugby, where the foot is subject to considerable stress due to jumps, sprints, and sudden changes of direction (*Garrick & Requa*, 1988; *Simpson et al.*, 1999; *Ekstrand*, 1983).

Little evidence is available concerning risk factors in ankle sprains (*De Bie et al.*, 1997): one prospective study on basketball players showed that prior sprain episodes can make a subject prone to subsequent injuries of the same type, as can unsuitable footwear and inadequate warming up (*McKay et al.*, 2001). Whereas limited dorsiflexion in children increases the risk of ankle sprains (*Tabrizi et al.*, 2000), the role of other parameters such as height, weight, dominant limbs, ligament laxity and postural instability is unknown (*Garrick & Requa*, 1988).

There is no evidence as to what the best treatment for sprained ankles might be (*Cooke et al.*, 2003; *Lamb et al.*, 2005; *Boyce et al.*, 2005; *Beynnon et al.*, 2006) although, regardless of the degree of injury, the first objective is to reduce local swelling. The PRICE (Protection, Rest, Ice, Compression, Elevation) rule is undoubtedly appropriate as it indicates the steps required for treatment in the acute phase and accelerates the repair processes (*Hettinga*, 1985; *Sims*, 1986).

One study with metanalysis showed that functional therapy is the best approach to treating a sprained ankle (*Kerkhoffs et al.*, 2002; *Kerkhoffs et al.*, 2002; *Kerkhoffs et al.*, 2002; *Jones et al.*, 2007) and should involve early mobilisation and articular loading in addition to cryotherapy, the use of compressive bandages, braces and therapeutic exercises (*Bleakley et al.*, 2008; *Van Rijn et al.*, 2008).

The aim of the rehabilitation programme should be to increase muscle strength and recover the entire range of movement and proprioceptive control (*Perron M et al.*, 2007; *Delahunt et al.*, 2006; *Delahunt et al.*, 2006; *Hall et al.*, 1999). The purpose of this paper is to evaluate the efficacy of early active articular mobilisation with *medislipper* in athletes with grade 2 ankle sprains.

Materials and methods

We treated a total of 24 athletes, all volleyball players belonging to sports clubs in the province of Parma, aged between 16 and 25 years (16 males with a mean age of 23.3 years and 8 females with a mean age of 22.4 years), who had grade 2 ankle sprain injuries, as documented by ultrasound or MRI. Patients were treated with a functional bandage for 7 days and started early cryoultrasound treatment within the first 12 hours. From the fifth day post-injury they started joint and proprioceptive recovery with active mobilisation (*medislipper*, **figure 1**).

The cryoultrasound treatment was administered in twelve 20-minute sessions, in continuous mode, with a power of 2.0 watt/cm^2 and a temperature of - 2° C (**figure 2**). The programme with the *medislipper* involved 12 daily sessions with the patient seated, under monopodalic load and with the knee flexed 90°.

Figure 1
Medislipper

Figure 2
Application of cryoultrasound therapy

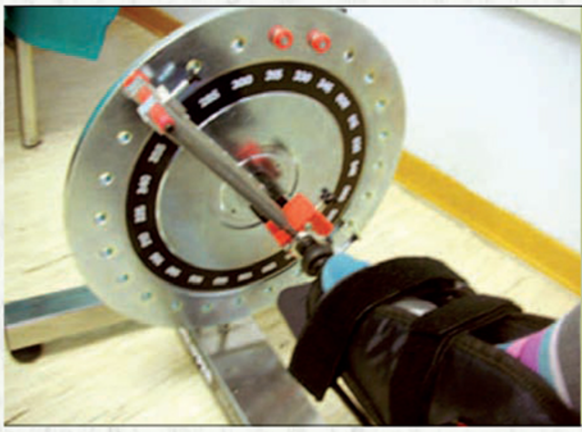


Figure 3
Active mobilisation against resistance with *medislipper*

Figure 4
Upwards jump with no counter-movement

Each session consisted in 6 series lasting 5 minutes with a 1 minute pause between sets, without resistance to movement initially, medium resistance after the first 6 sessions and then gradually increasing (**figure 3**).
Before and at the end of treatment with *medislipper* we performed:
• an isometric test to evaluate the strength of the plantar and dorsal muscles and the inverter and everter muscles of the tibiotarsal joint;
• an electromyographic test to evaluate the fibular, anterior and posterior tibial, gemellus and triceps surae muscles;
• a stabilometric test to evaluate maintenance of the centre of gravity and swaying under monopodalic load with closed eyes;
• a force platform test to evaluate the athlete's jump capacity (upwards jump without counter-movement – **figure 4**).

Results

The results obtained in pre- and post-treatment evaluations underwent statistical evaluation with Student's T-test for paired data, considering a value of $p < 0.05$ to be significant.
The comparison between the results obtained before and after the rehabilitation protocol showed a significant increase in muscle strength (+ 37%, p = 0.021, **figures 5 and 6**), motor unit recruitment (+ 34.6%, p = 0.039 – **figures 7 and 8**), proprioceptive control with closed eyes (+ 31.86%, p = 0.029 – **figure 9**) and jump capacity (+ 42%, p = 0.027). Treated patients returned to competitive sports in a mean of 18.6 days without requiring a brace or functional bandage. Maintenance of the results obtained was evaluated by means of a follow-up visit six months from the end of rehabilitation treatment and did not reveal any relapse.

Conclusions

A systematic review of 21 studies showed functional treatment to be superior, as regards efficacy, to immobilisation (*Kerkhoffs et al., 2001*). Literature reports a significant increase in the functional parameters of the tibiotarsal joint in patients treated with an accelerated rehabilitation protocol combined with therapeutic exercises in the first week after a sprain (*Bleakley et al., 2008; Bleakley et al., 2010*).
In our study, thanks to the early start of the rehabilitation programme, all the athletes treated achieved excellent results. Researchers have described various proprioceptive rehabilitation exercises administered in addition to functional treatment to promote joint recovery and stability.

It has also been shown that a sprained ankle alters balance (*Perron M et al., 2007*), kinematics (*Delahunt et al., 2006*), the neuromuscular pattern (*Delahunt et al., 2006*), muscular activation (*Hall et al., 1999*) and the sense of joint position (*Konradsen et al., 1998*). *Holme et coll.* found that proprioceptive training and joint recovery commenced in the first week after the injury reduces pain and prevents relapse (*Holme et al., 1999*).

In our study, starting the rehabilitation programme early allowed all the athletes treated to achieve excellent results as the cryoultrasound exerted its anti-inflammatory, analgesic, anti-swelling and muscle relaxing effects thanks to the increase in the mechanical effect with greater collagen fibre and proteoglycan production by the connective and muscular tissue cells and the considerable reduction in the heat effect.

Training with continuous active mobilisation of the tibiotarsal joint, performed with *medislipper*, promoted the recovery of joint mobility and an improvement in proprioceptivity, thereby inducing an active, and at the same time, reflex muscle contraction with a consequent increase in activation and neuromuscular response.

The muscle strengthening obtained was possible thanks to the application of different resistances used with the *medislipper* and contributed to the recovery of strength and muscle power shown by the improvement in jump test performance.

Figure 5

Initial isometric muscle test

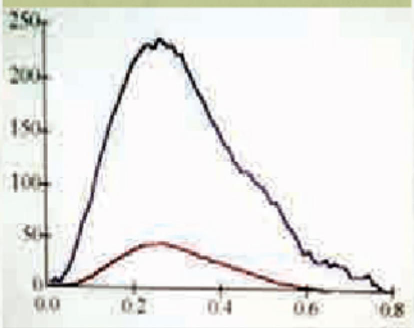


Figure 6

Final isometric muscle test

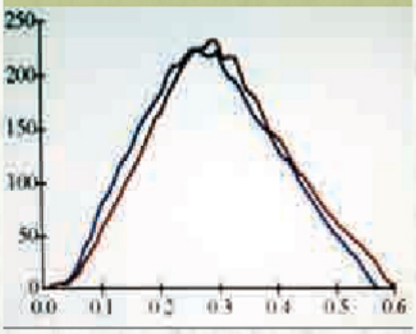


Figure 7

Initial EMG performed on the fibular muscles

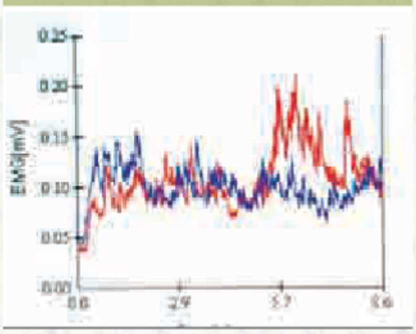
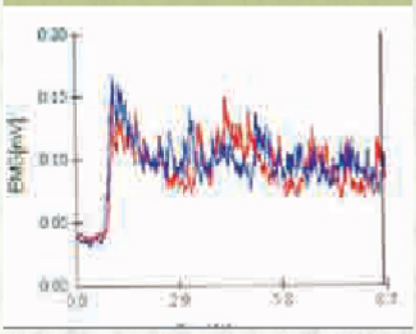


Figure 8

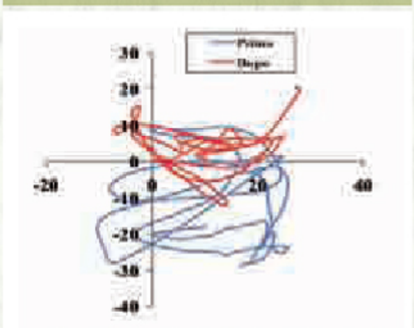
Final EMG performed on the fibular muscles



These results made it possible to obtain an accelerated recovery of parameters such as muscle strength, proprioceptivity, and jump capacity, which represent the objectives to be achieved with rehabilitation treatment, particularly in patients who practise sports on a competitive level and who need to recover performance in the shortest possible time by achieving a high-level athletic performance.

Figure 9

Initial and final stabilometry tests with closed eyes



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