VOLUME 71 | ISSUE 4 | OCTOBER - DECEMBER 2020 ORIGINAL ARTICLE

Correlation of limping during walking with pain, oedema and restriction of ankle range of motion after ankle sprains

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ABSTRACT

Purpose. The correlation of the degree of ankle sprain, pain, oedema and the restriction of the range of motion of the ankle with limping during walking after ankle sprain in the acute post-traumatic period.
Material and method. The sample consisted of 68 individuals, 18-50 years old, with 1st and 2nd degree ankle sprain. We evaluated the degree of sprain with clinical examination, the pain with VaScale, the oedema with figure of eight method as well as the restriction of the range of motion of the ankle with a digital goniometer. The limping concerning the difference in support time at each leg while walking was evaluated too.
Results. Statistically, the degree of ankle sprain was found to be significantly correlated with pain (Spearman's rho = 0.660, p = 0.000), oedema (Spearman's rho = 0.672, p = 0.000) and restriction on its range of motion (Spearman's rho = 0.564, p = 0.000). The difference in walking support time was significantly correlated with pain (Spearman's rho = 0.297, p = 0.014) and the degree of sprain (Spearman's rho = 0.362, p = 0.002) but not with oedema and restriction on the range of motion of the ankle.
Conclusion. The intensity of the pain and the ankle sprain degree can be evaluated by the degree of limping during walking. However, the swelling and the restriction on the range of the ankle motion cannot be evaluated by the degree of limping during walking after an ankle sprain.

KEY WORDS: Ankle Sprain, Pain, Oedema, Limping, Plantogram

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Figure 1: *Parameter measurements*

Introduction

A sprain is one of the most common sport injuries where there is a stretch or rupture of ligaments which stabilize a joint [1]. The ankle and the knee are the most susceptible joints in sprains although the shoulder and the hip have a greater range of motion. The most frequent mechanism of injury is a forceful ankle plantar flexion and inversion of the foot in a plantar flexion [1]. The ankle sprains are clinically classified in three degrees depending on their severity.

In the 1st degree sprains what can be observed is stretching or slight tearing of the ligament with mild tenderness, swelling and stiffness. The ankle feels stable and it is usually possible to walk with minimal pain. In the 2nd degree or moderate sprains there is an incomplete tear with moderate pain, swelling and bruising. Although the ankle at times feels stable, the damaged areas are tender to the touch and walking is painful. In 3rd degree sprains there is a complete tear of the affected ligaments with severe swelling and bruising. The ankle is unstable and walking is usually impossible because of the pain. The clinical classification of the degree of sprain is clearer because of the oedema and pain after 4-5 days [2]. Although sprains are considered to be the result of sport activities, they are also common in daily activities [1]. After a sprain there is pain, oedema and less functional ability. The functional ability is restricted because of the inability of full weight bearing, which is clinically expressed with limping during walking. The full weight bearing ability is the ability to load equally on both legs during walking.

Restriction of the weight bearing ability is related with the person's functionality. However, other factors such as reduced daily physical activity, fear of falling and reduced static balance may also prove important for weight bearing ability [3]. Partial or not full weight bearing ability refers to walking with less support on the leg, while weight bearing inability refers to walking only with the use of helpful equipment. The reason for restriction of weight bearing and limping during walk is the pain and the fear of further tissue injury. Less loading during walking results in more energy consumption of the body [4]. The weight bearing ability, age, the ankle sprain degree and the mechanism of injury are indicators of the time of rehabilitation after ankle sprains [5]. Most investigations of sprains evaluate different factors such as pain, oedema, range of motion of ankle, the functional disability and returning time to activities. There are no studies about weight bearing ability during walking after an ankle sprain. The aim of the present study is to record the levels of pain, the extent of edema, the restriction of the range of motion and weight bearing ability when walking after an ankle sprain, as well as examining the correlations between the above parameters in the acute post traumatic period.

Material – Methods

68 individuals, 18 to 50 years old, with an ankle sprain of 1st and 2nd degree participate in this study. The ankle sprain degree with medical examination, the pain during walking using the VAScale and the oedema with figure of eight method. Furthermore, the range of motion with a digital goniometer and the limping during walking by the support time with dynamic plantogram were assessed **(Fig. 1).**

The statistical analysis of the sample was performed with SPSS version 20.0 statistical package.

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TABLE 1.

Correlation of sprain degree with other parameters

		Sprain Degree
pain	Spearman's rho	0.660
	Sig (2-tailed)	**0.000***
	N	68
oedema	Spearman's rho	0.672
	Sig (2-tailed)	**0.000***
	N	68
range of motion	Spearman's rho	0.564
	Sig (2-tailed)	**0.000***
	N	68

The Paired Sample t-test was applied as there was regularity in the distribution of data after the coding, but also the Spearman's rho correlation coefficient, because there was no regularity in the data distribution. The significance level was set as 5% and bilateral.

Results

The degree of ankle sprain was found to be statistically associated with pain (Spearman's rho=0.660, p=0,000), oedema (Spearman's rho=0.672, p=0,000) and range of motion of joint (Spearman's rho=0.564, p=0,000) **(Table 1).** More specifically, the correlation was positive, because the higher the degree of sprain, the more intense the pain was. The swelling and the limitation in the range of motion increased as well.

The difference of the support time during walking between the two legs, namely limping is significantly associated with pain (Spearman's rho = 0.297, p = 0.014), sprain degree (Spearman's rho = 0.362, p = 0.002), oedema (Spearman's rho = 0.166, p = 0.176) and restriction of the ankle's range of motion (Spearman's rho = 0.232, p = 0.057) **(Table 2).** The difference in weight bearing ability between the two legs during walking was greater in the second degree of sprains and the pain was more intense.

Discussion

Ankle sprains are frequent injuries and are usually due to an ankle inversion injury. Male gender and participation in high-level sport activities are risk factors for ankle joint injuries [6]. The main symptoms that characterize a sprain are pain, oedema, the restriction of ankle range of motion and the inability to full leg weight bearing ability. The main goal of the ankle sprains treatment is to reduce pain and oedema and protect the ligaments from further injury.

Striding is the basic unit of measurement in walking and running analysis [7]. On the other hand, stepping is part of the stride and is defined by the contact of one leg with the ground until contact of the opposite one [7]. The walking cycle is divided into the support phase where the tread is in contact with the ground and the suspension phase [8]. In a normal walk there is symmetry of the phases between the two legs.

The assessment of pain in this study was done as in other studies with the VAScale or otherwise a

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TABLE 2.

Correlation of difference in support time with other parameters

		Difference in support time with other parameters
pain	Spearman's rho	0.297
	Sig (2-tailed)	**0.014***
	N	68
oedema	Spearman's rho	0.166
	Sig (2-tailed)	**0.176**
	N	68
restriction of the ankle range of motion	Spearman's rho	0.232
	Sig (2-tailed)	**0.057**
	N	**68**
ankle sprain degree	Spearman's rho	0.362
	Sig (2-tailed)	**0.002***
	N	68

visual analogue scale for pain. The levels of pain after a sprain vary depending on the degree of sprain. A further factor is that the perception of pain may vary among patients, but the validity and reliability of pain assessment is ensured by scientific studies that evaluate the method of diseases of the musculoskeletal system [9]. Analgesics and NSAIDs can be used for the reduction of pain after sprains with good efficacy [10,11]. The ankle pain was found to correlate statistically significantly with the restriction in the range of motion, swelling and degree of sprain. Greater correlation was found to exist with the degree of sprain. The greater the pain is, the greater the degree of the sprain is, and there is more restriction to the range of motion of the ankle movement. Also, with regard to the degree of sprain, the higher it is, the higher is the level of the pain, the oedema increases and the reduction in the range of motion as reported in the literature and confirmed by the measurements in the present study [12].

Oedema is one of the clinical features of the sprain. The figure-of-eight method used in this study is a valid and reliable method, as it is described in other scientific studies [13]. In bibliographic reports the volume of oedema was not found to be associated with functional disability after an ankle sprain [14]. In our study the ankle oedema was related to the degree of sprain, but not to limp during walking.

The restriction of the ankle range of motion may be due to oedema or pain. Local pain during pressure with fingers helps us locate injured structures which typically involve the joint, while the pain during active or against resistance movement usually involves muscles, tendons or ligaments [15]. In many studies, only ankle flexion is evaluated [16]. Moselay and Adam (1991) used photography to measure the angle of ankle [17]. The restriction of ankle motion was found to correlate with pain rather than ankle swell-

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ing after sprains. Most studies concerned the assessment of people with chronic anxiety disorder [18].

Weight bearing for a shorter time in one leg during walking is clinically manifested by lameness. Limiting the loading capacity is due to the fear that excessive loading on an injured or surgical arm will lead to a deterioration of the condition or failure of the operation [19]. A plantogram is a measurement of plantar pressures and walking time support. It can be performed with plantografs, which are expensive devices and are usually found in medical centers [20]. It is a reliable way of assessing the charging capacity and body balance without any attachment of cables or reflectors. As consequence, no individual preparation is needed and there is no difficulty in doing it [3]. Nevertheless, because of the cost, it is difficult to use it in everyday clinical practice.

Conclusion

The difference in support time between legs during walking was found to be related to the sprain degree and the pain after an ankle sprain. Consequently, we can evaluate the severity of an ankle sprain with the regard of the degree of sprain and the intensity of the pain by the support time during walking. A

Conflict of interest

The authors declare no conflicts of interest.

REFERENCES

1. Solomon L, Warwick D, Nayagam S. Apley's system of orthopaedics and fractures (8 th ed.) Great Britain: Arnold, 2001
2. Van Dijk C N, Lim L S L, Bossuyt P M M. et al Physical examination is sufficient for the diagnosis of sprained ankles. J Bone Joint Surg [Br] 1996
3. Eng JJ, Chu KS. Reliability and comparison of weight-bearing ability during standing tasks for individuals with chronic stroke. Arch Phys Med Rehabil. 2002; 83:1138–44.
4. Westerman RW, Hull P, Hendry RG, et al. the physiological cost of restricted weight bearing. Injury 2008;39: 725-7.
5. O'Connor S, Bleakley C, Tully M, McDonough S. Predicting Functional Recovery after Acute Ankle Sprain PLoS One. 2013; 8(8): e72124
6. Waterman BR1, Belmont PJ Jr, Cameron KL, Svoboda SJ, Alitz CJ, Owens BD. Risk factors for syndesmotic and medial ankle sprain: role of sex, sport, and level of competition. Am J Sports Med. 2011 May;39(5):992-8.
7. Gage, J.R., Gait analysis in cerebral palsy.1991, New York, NY: Mac Keith Press.
8. Perry J. 1992 Normal and Pathological function.
9. Boonstra AM, Schiphorst Preuper HR, Reneman MF, Posthumus JB, Stewart RE. Reliability and validity of the visual analogue scale for disability in patients with chronic musculoskeletal pain. Int J Rehabil Res. 2008 Jun;31(2):165-9.
10. Lyrtzis C, Natsis K, Papadopoulos C, Noussios G, Papathanasiou E. Efficacy of paracetamol versus diclofenac for Grade II ankle sprains. Foot Ankle Int. 2011 Jun;32(6):571-5.
11. Nadarajah A, Abrahan L, Lau FL, Hwang LJ, Fakir-Bolte C Efficacy and tolerability of celecoxib compared with diclofenac slow release in the treatment of acute ankle sprain in an Asian population. Singapore Med J. 2006 Jun;47(6):534-42
12. Wolfe MW, Uhl TL, Mattacola CG, McCluskey LC. Management of ankle sprains. Am Fam Physician 2001; 63:93-104.
13. Brodovicz KG, McNaughton K, Uemura N, Meininger G, Girman CJ, Yale SH. Reliability and feasibility of methods to quantitatively assess peripheral edema. Clin Med Res. 2009 Jun;7(1-2):21-31
14. Kaminski, T. W., Hertel, J., Amendola, N., Docherty, C. L., Dolan, M. G., Hopkins, J. T.Richie, D. (2013). National Athletic Trainers' Association Position Statement: Conservative Management and Prevention of Ankle Sprains in Athletes. Journal of Athletic Training, 48(4), 528-545.

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15. Tiemestra, J. D. (2012). Update on Acute Ankle Sprains. American Family Physician, 85(12), 1170-1176.
16. Fryer GA1, Mudge JM, McLaughlin PA. The effect of talocrural joint manipulation on range of motion at the ankle. J Manipulative PhysiolTher. 2002 Jul-Aug;25(6):384-90.
17. Moseley A, Adams R. Measurement of passive ankle dorsiflexion: Procedure and reliability. Aust J Physiother. 1991;37(3):175-81.
18. Brown C. Foot clearance in walking and running in individuals with ankle instability. Am J Sports Med. 2011;39(8):1769–1776
19. Distasio AJI, Jaggears FR, Depasquale LV, Frassica FJ, Turen CH. Protected early motion versus cast immobilization in postoperative management of ankle fractures. ContempOrthop. 1994;29(4):273-7.
20. Chen B, Bates BT. Comparison of F-Scan insole and AMTI force plate system in measuring vertical ground reaction force during gait. Physiotherapy Theory and Practice. 2000;16(1):43-53

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Lyrtzis C, Kellis E, Mariorakis C, Anastasopoulos N, Natsis K. Correlation of limping during walking with pain, oedema and restriction of ankle range of motion after ankle sprains. *Acta Orthop Trauma Hell* 2020; 71(4): 181-186.