

ANKLE SIZE MEASUREMENTS WITH THE FOOT IN A FREE HANGING POSITION

Reliability of the Figure-of-Eight Tape Method

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ABSTRACT: Ankle swelling is a commonly encountered condition in physiotherapy practice. Reliable and easy methods of quantification are required to record progress in treatment. The aim of this study was to establish the inter- and intra-reliability of the figure-of-eight tape measure for measuring ankle size. Thirty-six healthy subjects were measured in long-sitting position with the foot hanging free over the edge of a plinth. Three testers performed four measurements each for a total of 12 measurements per subject. The intra-class correlation coefficient was 0.96 for inter-tester reliability and 0.94 for intra-tester reliability. The results agree with previous reliability studies using the figure-of-eight tape method on healthy subjects. The figure-of-eight tape method is easily learned and applied. It is a reliable method for measuring ankle size. Further research is needed to demonstrate the reliability and validity of the technique in a clinical setting.

KEY WORDS: RELIABILITY, POSITIONING, ANKLE SIZE MEASUREMENTS

INTRODUCTION

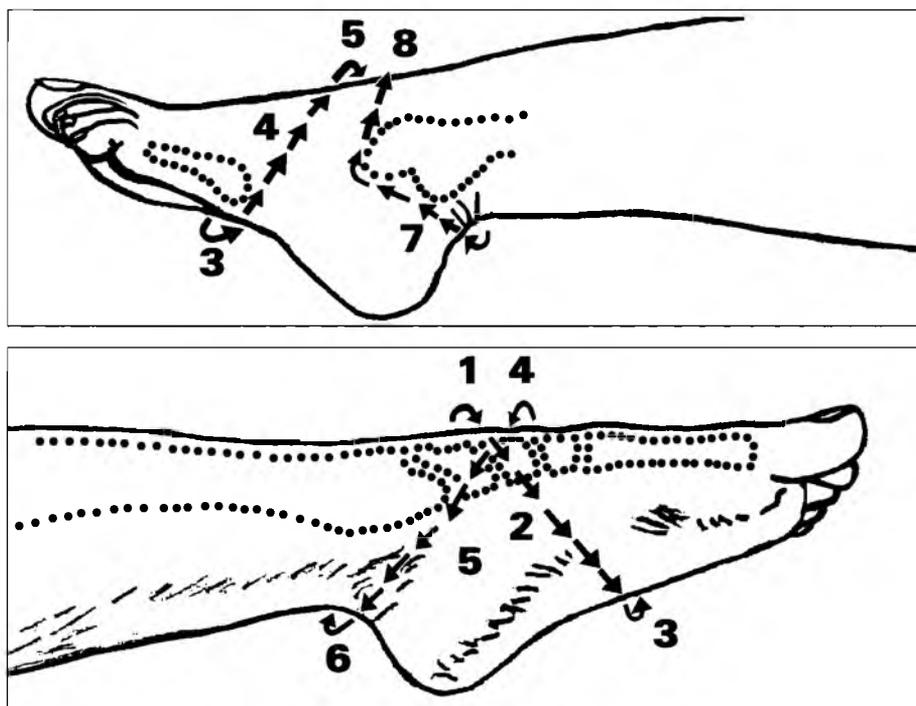
Post-traumatic ankle swelling is a common condition encountered by physiotherapists in daily clinical practice. Sportsmen are especially prone to these kind of injuries although protective devices and taping play an important preventive role (Peterson & Renstrom, 1986). In addition, ankle swelling can often occur as a complication after cast immobilisation for trauma of the lower legs (Airaksinen *et al.*, 1991). The aetiology of swelling is probably multifactorial, including increased capillary filtration and reduced lymphatic drainage resulting from soft tissue trauma to lymphatic vessels (Stranden & Myhre, 1981).

Swelling is one of the cardinal signs of acute inflammation and is mostly associated with haemorrhage, heat and pain. Of these signs, swelling is the major cause of functional disability following the injury (Nilsson, 1981). Regular measurement of joint swelling is required to provide the therapist with objective recordings with which to plan or alter the rehabilitation program. In clinical practice ankle swelling is often evaluated by volumetry, or water plethysmography.

Nilsson (1981) stated that volumetry is a valid method for evaluation of swelling in the ankle and foot. However, no reliability studies have been found in the literature. Furthermore, volumetry proves to be an impractical method and alternate less cumbersome methods are required in clinical practice. Other methods of measuring swelling regularly used in the clinic include circumferential measurements obtained through the use of standard tape measure, or using callipers across the malleoli (Esterson, 1979). Measurements across the malleoli have the disadvantage that they do not usually measure swelling resulting from ankle sprains because the

measuring device does not cross the injured structure. The figure-of-eight tape method is another commonly used procedure. It is easily reproduced by using bony landmarks around the ankle. This tape method used measurements across several common sites of ankle sprains and proved to be more valid than other circumferential measurements. The method proved to be both reliable and practical (Tatro-Adams *et al.*, 1995). In the above study, measurements were obtained at joint ankles of neutral dorsiflexion as described by Esterson (1979). In this position the dorsiflexor muscles are in a shortened position and tendons

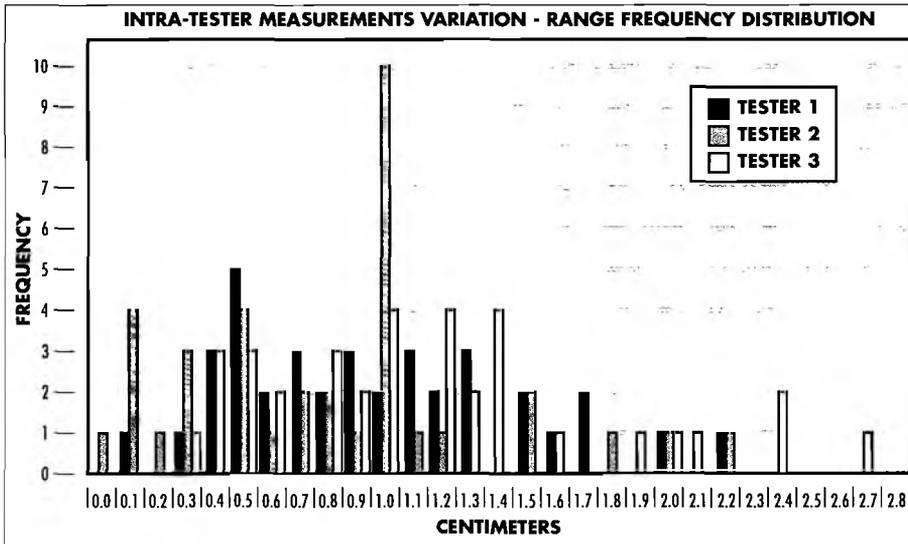
Figure 1: The figure-of-eight method of ankle measurement



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become more prominent around the ankle. These factors could affect the circumference of the ankle and influence the measurement. Recommendations were made by Tatro-Adams et al. (1995) for further studies to establish the reliability of the figure-of-eight method obtained at joint angles other than neutral dorsiflexion.

The purpose of this study was to test the intra-tester and inter-tester reliability of the figure-of-eight tape method of ankle measurement with the foot hanging free from a long-sitting position.

METHOD

Thirty-six male subjects from the faculty of Allied Health Sciences (Kuwait University) were recruited for this study. None of the subjects had sustained an ankle injury in the two months prior to testing. The testing protocol was described to each subject and each was asked to sign a consent form prior to the beginning of the study. A retractable plastic tape measure was used to measure the left or right ankle of each subject (dominant side). The subject was seated in a long sitting position with both feet beyond the end of the plinth to the level of the mid-calf. The ankle girth was measured with the foot hanging free, without any active muscle contraction occurring.

The protocol used by Esterson (1979) was followed for all measurements. After marking the landmarks with a skin pencil the tape measure was wrapped around the ankle in the following way (see Figure 1). 1. The beginning of the tape was placed on the tibialis anterior tendon at the level of the lateral malleolus. 2. The tape was drawn medially and placed just distal to the tuberosity of the navicular. 3. The tape was pulled across the arch and up just proximal to the base of the fifth metatarsal. 4. The tape was pulled across the tibialis anterior tendon. 5. The tape was continued around the ankle joint just distal to the distal tip of the medial malleolus. 6. The tape was pulled across the Achilles tendon. 7. The tape was placed just distal to the distal tip of the lateral malleolus. 8. The measurement was finished at the point at which it crosses the start of the tape.

The procedure was repeated four times by three testers giving a total of twelve trials per subject. The subject sequence was determined by random assignment. The recorder of each trial measurement was blind to the previous measurement. SPSS software was used to calculate the

TABLE 1: INTRA-TESTER VARIATION

Tester	Greatest Measurement Variation Within a Subject Over 4 Trials (cm)	Least Measurement Variation Within a Subject Over 4 Trials (cm)	Average Range of Variation (cm) 36 subjects
1	2.00	0.10	0.93
2	2.20	0.00	0.81
3	2.70	0.30	1.19
			Mean: 0.98

TABLE 2: INTRA-TESTER CORRELATION - CORRELATION MATRIX

Tester 1	Measurement 1	Measurement 2	Measurement 3
Measurement 2	0.95		
Measurement 3	0.95	0.97	
Measurement 4	0.94	0.96	0.98
Tester 2	Measurement 1	Measurement 2	Measurement 3
Measurement 2	0.96		
Measurement 3	0.96	0.96	
Measurement 4	0.95	0.96	0.97
Tester 3	Measurement 1	Measurement 2	Measurement 3
Measurement 2	0.95		
Measurement 3	0.92	0.91	
Measurement 4	0.92	0.93	0.92

**TABLE 3
INTER-TESTER CORRELATIONS**

Tester	Correlation Coefficient (r)
1 and 2	0.96
1 and 3	0.96
2 and 3	0.96

Intraclass Correlation Coefficients (ICCs) to assess the degree of reliability of the intra-tester and inter-tester measurements.

RESULTS

The findings of this study indicated that intra-tester measurement variations within a subject over four trials ranged from 0.0 cm to 2.7 cm (Figure 2). Figure 2 illustrates that 64% showed a variation of less than 1cm. The average range of the variation for each of the three testers was 0.93 cm, 0.81 cm and 1.19 cm, with a mean range for all three testers of 0.98 cm (Table 1). The intra-tester correlation coefficient ranged between 0.91 and 0.98 (Table 2). The correlation coefficient between testers was 0.96 (Table 3).

DISCUSSION

This study is based on the recommendations made by Tatro-Adams *et al.* (1995) in a previous reliability study of the figure-of-eight tape method of ankle size assessment. The methodology in this study was largely based on that used by these authors. However, particular care was taken to obtain the measurements with the foot in a relaxed position so that no muscle contraction would occur, i.e. the foot was hanging free over the edge of the plinth with the person in long sitting. This was in contrast to the above mentioned study where the foot was held in neutral dorsiflexion. The results of this study agree with the figures obtained by Tatro-Adams *et al.* (1995). However, our reliability scores are slightly different (0.96 versus 0.98) to the ones obtained by them. These results still indicate a very good intra- and inter-tester reliability. A possi-

ble explanation for this difference might be that the testers we used, although practising physiotherapists, had no previous experience with this technique. A minimal instruction session (one hour) was provided before the study took place. The use of more experienced testers could probably increase the reliability further. Once the bony landmarks are indicated the technique is easy to perform in a time-efficient way. As indicated by Esterson (1979) and Tatro-Adams *et al.* (1995) the figure-of-eight technique has a higher validity than other circumference measures. In the figure-of-eight measuring method the tape crosses the injured structures, i.e. around the malleoli and ventral side of the foot. However, the method can not differentiate between effusion and oedema (intra- and extra-capsular swelling) where more complicated measures are required. Measurements with the foot in dorsiflexion at ninety degrees are not always possible due to pain and limitations in range of motion. Also, muscle contractions and tendon tension could hamper accurate measurements. It is therefore recommended that measurements of ankle size should preferably be done with the foot hanging free over the plinth's end. Our results indicate that the figure-of-eight tape method is a highly reliable method of measuring ankle size in healthy subjects. Further research should concentrate on reliability studies in a clinical setting. Also, validity studies and comparative trials with other existing circumferential methods are required to confirm the value of this technique as a clinical tool.

CONCLUSION

This study strongly supports the use of the figure-of-eight tape method as a reliable tool for the assessment of ankle size. It is recommended to obtain ankle measurements in a relaxed hanging position to avoid muscle contraction and tendon movements. This method is easily learnt and has a potential as a tool for clinical assessment and treatment planning and progress. Further research should be carried out to confirm the reliability of the measurement tool in a clinical setting.

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