A Comparative Evaluation to Determine the Compression Levels and Static Stiffness Index Achieved in Four Velcro Wrapping Compression Devices

Natalie Lee MSc, BSc (Hons) RN.
Clinical Manager Haddenham Healthcare, Senior Trainer Lymphoedema Training Academy. Honorary Lymphoedema Nurse Specialist Wolverhampton Lymphoedema Service.

Introduction

The purpose of this comparative evaluation was to demonstrate and compare the levels of compression and static stiffness indexes achieved by four Velcro systems, on healthy subjects. Damstra and Partsch (2013) describe Velcro-wraps as compression wrapping systems that have been used previously in the management of lymphoedema during the maintenance phase of treatment. Wraps function in a similar way to short stretch bandaging as they provide graduated compression to the limb, whilst applying low resting and high working pressures. According to Wigg and Lee (2014) advantages of using Velcro-wrapping systems include being less bulky than bandages, Williams (2016) states they are suitable for self-application and are a less time consuming, safer option for treatment (Lawrance, 2008). Ehmann, *et al* (2016) suggests Velcro-wrapping devices are becoming more popular in the treatment and management of lymphoedema and venous disease. It is apparent evidence to support the use of velcro wrapping systems is lacking and although compression therapy is the mainstay of treatment (Lymphoedema Framework, 2012), many studies do not focus on this treatment modality alone, failing to mirror study designs when conducting research, which impacts on the validity of research outcomes Thomas (2014). To date no research study has been conducted to observe or compare the interface pressures, level of compression achieved when a Velcro-wrapping device is applied to the leg. Furthermore there is limited robust research that details how these perform in practice. Performance is indicated by the calculation of the static stiffness index of the velcro wrap and according to Partsch (2005) is becoming an accepted performance indicator for compression garments.

Aims

To determine the suitability of adjustable Velcro-wrapping devices based on the level of compression achieved on application and the static stiffness index.

To demonstrate if adjustable Velcro-wrapping devices achieve suitable and similar levels of compression on application and to observe if a Static Stiffness Index greater than 10 mmHg is achieved.

The secondary aim was to test a newly developed adjustable velcro wrapping system to see if it achieved similar readings to the first three wraps tested.

Methods

Testing was conducted in two stages as wrap D had not been manufactured at the time of initially conducting the evaluation. The first stage of testing formed part of a university research pilot study and was subjected to Ethics approval using wraps A,B and C. The second stage of testing repeated the data collection procedure from the first part of the study for testing of wrap D.

Data Collection Procedure

A convenience sample of twenty five participants were selected in line with the exclusion criteria and following consent and used in both stage 1 and 2. Each participant was requested to rest on a treatment couch with their legs elevated to allow for hydrostatic pressures within the body to settle. They stayed supine for 5 minutes, which was timed using a stop watch. After 5 minutes a liner was applied and a pressure sensor placed at the level of BI on the medial aspect of the leg, in line with ICC guidelines.

A pneumatic pressure sensor, Kikuhime is seen as an appropriate tool to measure pressure underneath compression (Wong, et al. 2012) and was used to obtain pressure readings for each wrapping device. Liners were used to promote infection control as each wrap was re used to reduce the costs incurred during the research. A wrap was selected based on the circumferential measurements of the ankle and calf and a length measurement to below knee, and documented as wrap A, B or C and wrap D in the second stage. To ensure correct placement of the pressure monitor each participant were asked to extend and flex the foot so that the location of B1 could be identified by palpating for where the gastrocnemius meets the Achilles tendon as (Rabe, et al. 2008) suggests, this is lateral to the tibial muscle. Once in place the pressure monitor was switched on to allow for the lying pressure to be documented. The person inputting the data confirmed the reading to be correct as the "hold" function was pressed to display the steady measurement. The participant was then asked to stand for 1 minute, again timed by stop watch, to allow for changes in hydrostatic pressure to become stable. The second reading was then documented. This was repeated, with participants attending on consecutive days, to ensure limbs were rested between applications. It was also documented which limb had been used to ensure when they came back that the same limb was not used again. To allow for equal evaluation of pressures achieved each wrap was applied a total of 30 times.

Data Analysis

Data was analysed using an excel spreadsheet with a data analysis add on, once it had been sorted and grouped by wrap number. It was decided to analyse the data as a whole prior to analysing data for each wrap to present analysis of the differences between each wrap. Descriptive data analysis was used to determine means for lying, standing and SSI and also standard deviations. As the study was conducted in 2 parts, with wrap D being tested sometime after the original study using wrap A, B and C, tests for statistical significance were not reproduced.

Results

Table 1 Overall pressure on application

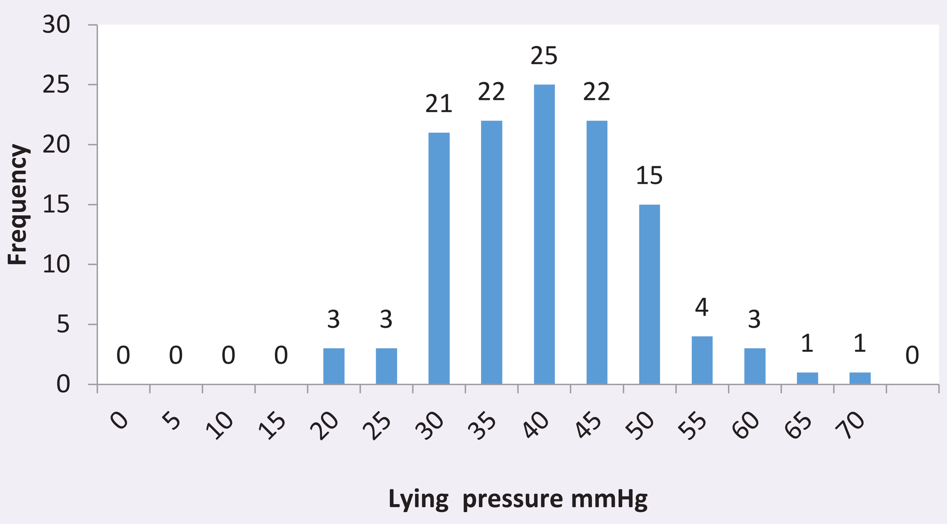

Table 1 details the overall pressures achieved on application of the wraps. Overall 68 wraps achieved a pressure of between 30-40 mmHg. However, average lying pressure was 37.8 mmHg with a standard deviation of 9.38, when calculating how many applications were within the average +/- 9.38, 93 wraps fall within range, with 27 pressure readings across all wraps falling outside of this range.

Table 2 Overall increase in pressure on standing

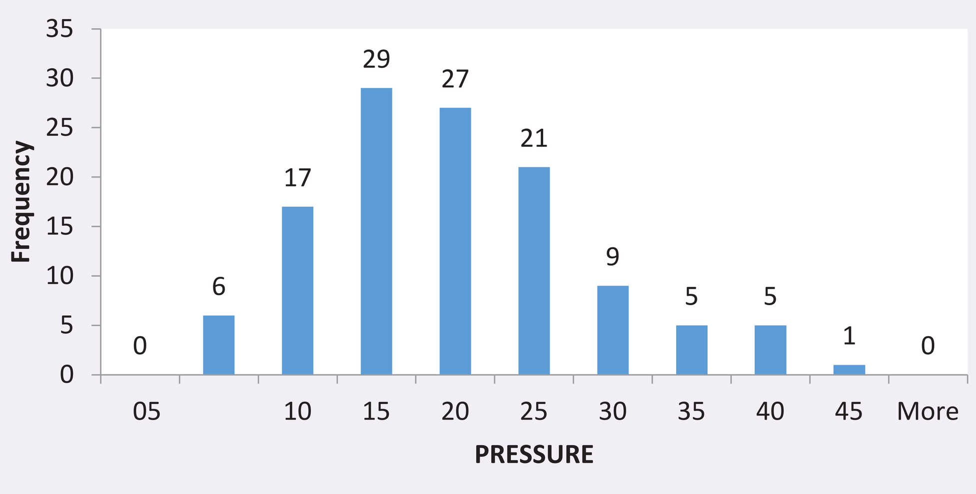

Table 2 shows the frequency of SSI overall. The mean SSI was 17.98 with a standard deviation of 8.63. In this instance the mean pressure may not be relevant as the purpose of the evaluation was to see how many wraps achieved a pressure greater than 10mmHg difference from lying to standing. In total 114 wraps achieved a pressure greater than 10mmHg, 6 wraps achieved an SSI of less than 10mmHg.

Table 3 Comparison of lying and standing accross all wraps

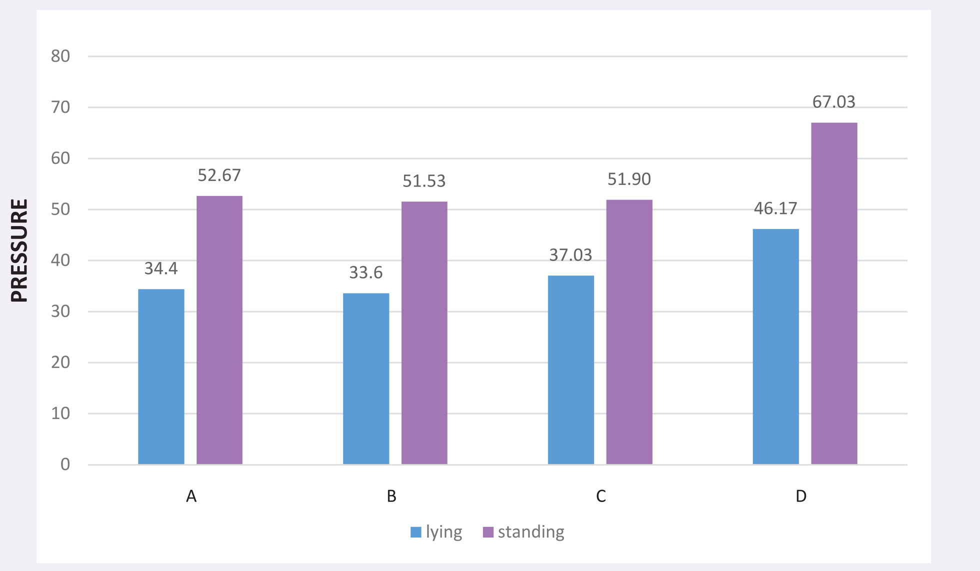

Table 3 demonstrates the overall pressures achieved on application of each wrap and the increase in pressure when standing. Showing that although all wraps achieve an increase in pressure when standing, wrap D achieved the greatest mean pressure on application as well as the higher mean standing pressures.

Conclusion & Recommnedations

The results of the evaluation can conclude that velcro wraps do achieve the recommended interface pressure of between 30-40 mmHg with a SSI greater than 10 mmHg. These results contribute to the understanding of the pressures achieved initially on application and the SSI achieved in four velcro wrapping systems. Further studies should be conducted in the form of randomised controlled trials, on groups of patients with lymphoedema to ascertain how they perform in practice. Special attention should be given to how appropriate the wraps are for reducing limb volume and improving tissue changes in the lymphoedematous limb. Other objectives within studies should compare how the wraps conform to different limb shapes and data should be gathered on how they impact on patients' movement and quality of life (Hardy, 2012).

References

Damstra, R.J., Partsch, H.(2013)Prospective, randomised, controlled trial comparing the effectiveness of adjustable compression velcro wraps versus inelastic multicomponent compression bandages in the initial treatment of leg lymphoedema. J Vascular Surgery: Venous and lymphatic disorders. 1(1)13-18

Ehmann,S. Whitaker, J,C. Hampton, S. Collarte,A. (2016) Multinational, pilot audit of a Velcro adjustable compression wrap system for venous and lymphatic conditions. JWC: 25, 9, 613-620

Hardy D. (2012)Reducing the risk of lower limb lymphoedema.Primary Health Care;22(6):16-21

Lawrance, S. (2008) Use of a Velcro Wrap system in the management of lower limb lymphoedema/chronic oedema. Journal of Lymphoedema. 3: 2, 65–70

Lymphoedema Framework (2012). Best Practice for the management of lymphoedema. 2nd Ed. Compression Therapy: a position document on compression bandaging. Imprimerie Reboul. France

Partsch, H. (2005). The static stiffness index: A simple method to assess the elastic property of compression material in vivo. Dermatologic Surgery, 31, 625-630.

Rabe, E., Partsch, H., Junger, M., Abel, M., Achhammer, I., Becker, F., et al. (2008). Guidelines for clinical studies with compression devices in patients with venous disorders of the lower limb. European Journal of Vascular and Endovascular Surgery, 35, 494-500.

Thomas, S. (2014). Practical limitations of two devices used for the measurement of sub-bandage pressure: Implications for clinical practice. Journal of Wound Care, 23(6), 300-313Weller, et al. (2010)

Wigg J, Lee N. (2014) Redefining essential care in lymphoedema. Br J Community Nurs 19(4 suppl): S20–27

Williams, A.(2016) A review of the evidence for adjustable compression wrap devices. J Wound Care 25: 5, 242–247.

Wong, I. K. Y., Man, M. B. L., Chan, O. S. H., & Abel, M. A. A. (2012). Comparison of the interface pressure and stiffness of four types of compression systems. Journal of Wound Care, 21(4), 161-167