



## Efficacy of Four Layer Bandage in Treatment of Venous Ulcer.

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### ABSTRACT

*Introduction: Four layer bandaging is easy to perform and less time consuming method used in treatment of chronic venous ulcer.*

*Objectives: 1. To study the efficacy of four layer bandage in venous ulcer healing. 2. To study the reduction in venous ulcer area with the use of four layer bandage. Material & Methods: The study was conducted at Smt. Kashibai Navale Medical College & General Hospital, Pune. Total 15 patients were included in study.*

*Results: The average ulcer area was  $6.5 \pm 2.98$  cm<sup>2</sup>. The change in ulcer area was significant. After two weeks of treatment the ulcer area decreased on average by 1.4 cm<sup>2</sup>/per week, after four weeks by 1.0 cm<sup>2</sup>/per week and after eight weeks by 0.7 cm<sup>2</sup>/per week and 0.63 cm<sup>2</sup>/week after 12 weeks. The average loss of area during the whole 12-week observation period was 0.63 cm<sup>2</sup>/per week.*

*Conclusion: Four layer bandaging is a good alternative for treatment of chronic venous ulcers as it doesn't require hospitalization.*

### KEYWORDS :

#### INTRODUCTION:

The Chronic Venous Insufficiency (CVI) of the extremities is a progressive disease and the most severe form of the disease is class 6 (according to the CEAP classification system), where active ulceration is formed. The venous ulcerations are located most often above the medial malleolus, are extremely hard to heal and are with distinct pain syndrome<sup>1</sup>. When the disease is not adequately treated, the patients may obtain various degrees of disability. The complex approach combining medical and local treatment, limb elevation and elastic compression is the only method that has proven its effect in solving the problem because the presence of an active ulcer is a contra-indication against surgical intervention<sup>2</sup>. Below the knee, graduated compression from toe (highest) to knee (lowest), in the form of bandaging or stockings, is viewed as a key component of treatment when venous leg ulceration occurs in the absence of relevant arterial disease<sup>3</sup>.

Venous ulcers are a common problem associated with venous incompetence, chronic venous hypertension and venous stasis, leading to oedema, skin necrosis and ulceration. Compression therapy has been found to be the most efficient means of treatment but remains expensive due to the chronic nature of this problem.

Graduated compression bandaging from the ankle to the calf is the most effective treatment for those with confirmed venous leg ulceration. A compression bandage should fulfil the following criteria (Fentem 1990)

- Provide a safe, reproducible and effective compression
- Maintain the compression
- Provide compression in the presence of necessary dressings
- Be capable of providing graduated compression
- Remain unaffected by humidity or by discharge from the ulcer
- Be comfortable and permit the wearing of outdoor shoes
- Be liked by the patient making compliance therapy more likely

Four-layer bandaging was developed by a clinical group in Charing Cross Hospital, London, to meet the needs for an effective compression system<sup>4</sup>.

system<sup>4</sup>.

The concept underpinning the bandage development was the need for sustained compression. The group used Stemmer's theoretical framework, which suggested that an external pressure of the order of 40mm Hg at the ankle was required to achieve ulcer healing in chronic venous insufficiency, with lower levels of compression required for patients with varicose veins and higher pressures in those with venous/lymphatic disorders<sup>5</sup>. The development of the bandage system also took account of the considerable clinical problems experienced, such as high levels of exudate, and disproportionate limb sizes and shapes<sup>6</sup>. Reducing the number of clinical visits was also considered ideal. The aim was to develop a system that required only weekly application in the majority of patients. This feature of 4-layer bandaging has contributed to the cost effectiveness of the system through major reductions in nursing time<sup>7</sup>.

**LAYER 1 – ORTHOPAEDIC WOOL.** The 10 cm bandage is applied without tension in a loose spiral from base of toes to knee joint with 50% overlap.

• **LAYER 2 – LIGHT SUPPORT BANDAGE.** The 10 cm bandage is applied in spiral toe to knee with 50% overlap with 50% overlap.

• **LAYER 3 – LIGHT COMPRESSION BANDAGE.** The 10 cm elastic conformable compression bandage is applied at mid stretch (50%) in a figure of eight from toe to knee, with a 50% overlap. This layer provides 17 mm Hg pressure at the ankle.

• **LAYER 4 – COHESIVE EXTENSIBLE BANDAGE.** The 10 cm lightweight, elastic, cohesive bandage is applied at mid stretch (50%) in a spiral with a 50 % overlap from toe to knee. This layer provides 23 mm Hg pressure at the ankle.

This study was planned to evaluate the efficacy of four layer bandage system in treatment of venous ulcers.

#### OBJECTIVES:

To study the efficacy of four layer bandage in venous ulcer healing.

To study the reduction in venous ulcer area with the use of four layer bandage.

## Material and Methods

**Study Design** -- A prospective non randomized clinical trial was carried out on patients with venous ulcers. Patients from in patient and outpatient clinic of Smt. KashibaiNavale Medical College & General hospital, Pune were included in the study. Prior approval of Institutional Ethics Committee was taken. Written informed consent was taken from all the patients, after giving them information about the study (the characters of the study, benefits and possible side effects).

**Study Subjects** --This study was carried out during March - Dec 2015. The study included 15 adult patients with a diagnosis venous ulcer classified as C6 according to the clinical classification of CEAP classification.

**Inclusion Criteria** -- Patient more than 18 years of age, both sex, one or more venous ulcers larger than 1 cm<sup>2</sup> in area, no evidence of arterial disease of the legs clinically and on arterial Doppler and patient not currently receiving any other form of treatment or dressing for the ulcer.

**Exclusion Criteria** -- We excluded the patients with ulcers which are infected, patients with arterial disease, uncontrolled diabetes and diabetic sensory neuropathy, cellulitis, vasculitis or collagen vascular disease and any concomitant illnesses. Patients taking any medication that may affect wound healing, including corticosteroids and chemotherapy and patients who had active or suspected carcinoma were also excluded.

**Methodology** --All patients subjected to a clinical sheet to collect data for clinical evaluation. All patients were subjected to X-ray of leg and feet and arterial and venous Doppler ultrasound of both legs. All patients treated by compression therapy. The calculation of the area of the ulcer was done by using the graph papers to document the ulcer's perpendicular linear dimensions (typically in centimetres using graph paper); the maximum distance is length and perpendicular distance is width. The progress of healing was measured every week. And records of the percentage of healing area and area of healing dynamics in cm<sup>2</sup>/week was recorded. The study included 10 male and 5 female patients.

Compression (bandaging) technique:- Multi-layer graduated high compression elastic system (four layer bandage) was used in our study. This four layer bandage is an example of a multi-component elastic system and is designed to apply a sustained sub-bandage pressure of 35 - 40 mmHg at the ankle for patients with an ankle circumference of 18 - 25 cm in order to reverse chronic venous hypertension; this is achieved through the Laplace's law. The pressure generated by a bandage immediately following application is determined by tension in the fabric, number of layers applied and is inversely proportional to the circumference of the limb. Therefore, Limb circumference affects the sub-bandage pressure as the thinner the leg, the more pressure will be exerted. And the more layers/overlaps are applied, the greater pressure. Application of bandaging: a) Bandages were applied by a spiral technique with 50% overlapping and run from the base of the toes to just below the tibial tuberosity. The bandage was changed every week to avoid decrease of the applied pressure. b) The bandage was applied starting at the base of the toes so that there is less chance of the bandage trapping interstitial fluid produced by normal systemic hydrostatic and osmotic pressure. In short, if the bandages started further up the foot or at the ankle there would be considerable swelling of the toes and forefoot. Application of the bandages up to the knee, just below the tibial tuberosity, ensures that the calf muscles are assisted in their pumping action, reducing superficial capillary and venous hydrostatic pressure by increasing the velocity of venous blood returning to the heart.

## RESULTS:

15 patients satisfying the inclusion criteria were included in the study.

Out of 15 patients 10 were males and 5 were females. The average age of presentation was 55 ± 9.24 years. The average ulcer area was 6.5±2.98 cm<sup>2</sup>. The change in ulcer area was significant. After two weeks of treatment the ulcer area decreased on average by 1.4 cm<sup>2</sup>/per week, after four weeks by 1.0cm<sup>2</sup>/per week and after eight weeks by 0.7 cm<sup>2</sup>/per week and 0.63cm<sup>2</sup>/week after 12 weeks. The average

loss of area during the whole 12-week observation period was 0.63 cm<sup>2</sup>/per week. The percentage of total area loss after two weeks was 43.3%, after four weeks was 72.4%, after eight weeks was 83.7% and after twelve weeks was 93.9%. 9 (60%) ulcerations treated with the four-layer compression system healed completely at the end of 12 weeks, and all ulcers healed at the end of 18 weeks of bandaging. We also observed that there was significant reduction in pedal oedema with use of the four layer bandage. At the end of 8 weeks, the oedema subsided in all 15 cases. No special care of the patient or hospitalization was needed for any of the patients during the treatment. All patients were completely ambulatory during the course of treatment. They were also able to perform their daily activities.



**Image 1: At start of the treatment**



**Image 2: After 6 Weeks of treatment**



**Image 3 : After 10 weeks of treatment**



**Image 4: After 12 weeks of treatment**

#### **DISCUSSION:**

A systematic review of the literature demonstrates that various types of correctly applied compression systems significantly improve healing of venous ulceration.<sup>9</sup>

Fletcher A et al concluded that multi-layered high compression system with adequate padding should be the first line of treatment for uncomplicated venous leg ulcers with ABPI  $\geq 0.8$  in all settings<sup>10</sup> Callam et al<sup>11</sup> who assessed the effectiveness of elastic and inelastic compression of patients with ulceration of similar average initial area, reported the superiority of four layer elastic compression bandaging over non-elastic compression.

In our study the healing rate was 60% at the end of 12 weeks and 100% at the end of 18 weeks. The overall healing rates in our study were similar to those reported in previous studies by Moffatt et al.<sup>12</sup> They demonstrated that healing rates of 60% or more can be achieved in specialist clinics using multilayer bandaging systems.

Blair et al<sup>8</sup> in one of the first studies of four-layer compression bandage effectiveness achieved 74% healing of large ulcerations after 12 weeks (the initial average area was 15.4 cm<sup>2</sup>).

#### **CONCLUSION:**

Sustained compression of around 40 mm Hg achieved with a four layer bandage results in rapid healing of chronic venous ulcers that have failed to heal in many months with more conventional bandages. Compression therapy is a highly effective treatment for venous leg ulcers. Care should be taken while administering this therapeutic modality in case of mixed-arteriovenous ulcers. Four layer bandaging is a good alternative for treatment of chronic venous ulcers as it doesn't require hospitalization. So it is also cost effective.

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