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Double Focal Compression Bandaging Technique: How Long Does a Vascular Ulcer Need to Heal?

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Abstract

Vascular ulcers in the lower extremities are a serious health issue, with a high socio-economic cost. Early detection and treatment will prevent patients from going through a painful path, resulting in reduced quality of life. Primary care physicians and nurses play an essential role in this work, and collaboration with angiology specialists will lead to positive results. The double focal compression bandage technique is based on physiological concepts such as arteriogenesis and angiogenesis, responding to lack of tissue perfusion, resulting in the formation of a vascular ulcer. All we need is bandages and gauze. The pressure obtained, by filling the wound bed with gauze padding, creates pressure gradients that stimulate arteriogenesis and angiogenesis to the affected area, leading to wound healing. This article refers to the time needed for a vascular ulcer to heal. It is based on my clinical experience, over 20 years ago, with over 200 patients with vascular ulcers. Positive results have been published on this technique, as regards infection, debridement, peripheral arterial disease, minor surgery, and heart failure. This article relates to the period of healing of a vascular ulcer, and shows that the healing time of vascular ulcers, depends on vascular impairment before treatment, therefore, some ulcers will take very little time and others a long time to heal. We need to be patient. Monitoring the clinical path is key to success. But how long does it take for a vascular ulcer to heal? We will try to clarify the matter.

Keywords: Vascular Ulcers; Time Healing; Compression Bandaging

Introduction

How much time does it take to heal a vascular ulcer? It is not easy to answer this question, as it will depend on the pathological vascular alterations of the patient. The size of venous leg ulcers significantly related to the ulcer duration, the diameter of perforating veins around the ulcers, the reflux time of common femoral veins, and the reflux time of great saphenous veins [1]. According to clinical practice guidelines for management of venous leg ulcers, a response inadequate to compression therapy along to an atypical ulcer, should induce to make a biopsy from the edge of the wound, to rule out the possibility of a malignancy or another cause for the ulceration [2]. A long time in the healing of an ulcer is considered a criterion for ordering a biopsy, especially if there is any sign of malignancy on the wound bed or its edges [3]. Most venous leg ulcers heal within 3 to 4 months with adequate compression therapy performed by a healthcare professional trained in compression therapy for leg ulcers. Some ulcers need for hospitalization, others may take longer to heal, and a very small number never heal [4]. Patients with chronic wounds have significantly impaired in their health-related quality of life [5]. From the results of my clinical experience, the recovery time will depend on the vascular abnormalities of the patient. We can heal vascular ulcers using only compression therapy, but not the underlying disease, venous hypertension, or peripheral arterial disease. It is very important to have patience in the treatment of vascular ulcers

in the legs because they can take a lot of time to heal. Even if an ulcer resolves in 3 months, compressive treatment is given for at least 3 months. All we need to do is check out the clinical course.

When should I start treating a vascular ulcer?

The answer is easy, once detected and diagnosed, because early treatment is essential for success. The patient with a vascular lower extremity ulcer should have a vascular assessment, with documentation about wound location, size, depth, drainage, and tissue type; palpation of pedal pulses; and measurement of the ankle-brachial index [6]. We must keep in mind that a large ulcer, started small. It is very important to treat them at the beginning, to avoid their progression. By way of example, we show some clinical cases of ulcers healed within a few months, and others that took years. Patience, perseverance, and monitoring of clinical course have been key to success.

Method

The double-focal compression technique is a form of compression therapy that uses two bandages to perform compression on the leg [7].

Figure 1: Double focal compression bandaging technique.

How do we apply the compressive bandaging?

- The first bandage is made with an adhesive bandage, to immobilize the 1 cm thick gauze padding, which is placed on the wound bed, and avoid its displacement with movement (Figure 2/1).
- The second is a short stretch bandage to apply gradual external compression, from the toes up to two centimeters below the knee flexion. We start the compression bandaging, from the forefoot, taking half of the heel and return to the forefoot to ascend towards the knee, with a gradual compression bandaging and a 45° tilt (Figure 2/ 2-3).
- To avoid discomfort to the patient, the compressive bandage should be kept below approximately 2 cm of popliteal fossa. We fix with adhesive tape the bandage (Figure 2/ 4).

- We fix with adhesive tape, the area of the front foot adjacent to the toes (Figure 2/ 5).
- Afterwards, we fix the bandage laterally with adhesive-tape (Figure 2/ 6-7).
- Finally. we fix the bandage with adhesive tape, in the back of the leg (Figure 2/8).

To apply this technique safely. it is necessary to follow a simple methodology consisting of three steps:

- The first step is to perform a differential diagnosis, with ulcers appearing in other diseases.
- The second step consists in making a clinical diagnosis of the signs and symptoms of chronic venous insufficiency (CEAP classification).
- The third step consists in excluding a severe arterial disease by calculating the ankle/brachial index.

Figure 2: Applying the compression bandaging.

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The pathophysiological basis for this technique is the stimulation of arteriogenesis and angiogenesis, due to the pressure generated by the padding-gauze placed on the wound bed and the bandaging, which increases the speed of blood flow to the vessels in the affected area.

Material and diagnostic tools

What is the pressure, when using this bandage? We need pressure, to direct the blood flow from the legs to the right atrium, to counteract the adverse effects of vein. We can achieve it, using only bandages and a pad-gauzes. Stasis dermatitis is one of the complications caused by venous hypertension resulting from retrograde flow due to incompetent venous valves, valve destruction, or obstruction of the venous system [8]. Pressure improves the ochre dermatitis.

The pressure is obtained by the application of a compression bandage on the leg. Two types of bandages are available, shortstretch and large-stretch (Figure 3). in pressure between the rest pressure of the bandage, and that exerted during standing. As a rule of thumb, regarding the material used, inelasticity is defined as an increase greater than 10 mm Hg of pressure, when going from rest to standing, whereas if it is less than 10 mm Hg, then, we speak of elasticity [10,11].

When I started treating the vascular ulcers, I used an elastic bandage that was very effective. The explanation can be seen in the pressure graph obtained by measuring with the Pico-press device. The elastic bandage behaves like an inelastic, by placing a pad-gauzes of 1 cm thick, on the wound bed (Figure 5). If the padding thickness is increased by 2 cm, the resultant pressure is lower (Figure 6), and we have to apply the bandage harder, to get the same pressure. The patient would not tolerate the bandage and remove it. Sometime later, I would use an inelastic bandage, because the pressure increases with movement and decreases with rest, more physiological behaviour and better tolerance (Figure 4).



This will assist us in understanding the physical characteristics, and functioning of these bandages:

- Working pressure: It is the pressure exerted by the compression bandage, when moving the legs.
- **Resting pressure:** This is the pressure exerted by the compression bandage when the patient is at rest.
- Stiffness is defined as the increase in sub-bandage pressure per centimeter increase in the circumference of the leg [9].
 Static Stiffness Index: This is quantified by the difference

Figure 4: Pressure readings by Pico press device (short-stretch and large-stretch). Graphic of book. UIP CONSENSUS DOCUMENTS, Boston 2013, E. Rabe (Ed.).

As a practical guide, when the patient moves from the supine to the standing position a pressure increase of more than 10 mm Hg, defines inelasticity, whereas an increase of less than 10 mm Hg marks elasticity [12].

What diagnostic tools are required?

These diagnostic tools are relatively simple and cost-efficient: A/Gauzes for padding and doing focal compression on wound bed. B/ Adhesive bandage for attaching focal compression. C/ Inelastic bandage (10x10 cm; short stretch) for external compression bandage. D/ A saline physiological solution for cleansing the ulcer

Figure 5: Pressures obtained using an elastic bandage, without pad and with 1 cm pad. Courtesy of Prof. Hugo Partchs.

Figure 5: Pressures obtained using an elastic bandage, without pad and with 1 cm pad. Courtesy of Prof. Hugo Partchs.

surface. E/ Adhesive tape for fixing the bandages. F/ Hand-Doppler for checking peripheral pulses, and a device for calculating the ankle/arm index. G/ A weight-control scale.

I have published several papers, based on the clinical findings of more than 200 patients, with vascular ulcers treated with this technique, and the benefits regarding infection, debridement, peripheral artery disease, surgical injurie, and failure cardiac I will briefly describe the relevant some aspects of this clinical experience.

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Regarding infection in vascular ulcers, focused pressure on the wound bed prevents infection, by stimulating arteriogenesis in

the affected area, increasing blood circulation and promotion of monocyte antibacterial, antifungal, and antiviral activity [13,14] (Figure 7).



To prove this, I ordered cell cultures at various stages of the clinical course, and despite a positive culture and corresponding antibiogram, I did not use antibiotics without obvious signs or symptoms of infection. We just need to do a daily follow-up, in the first few weeks, to detect them, in which case, if they were prescribed. But in my experience, that hasn't happened [17].

Regarding debridement in vascular ulcers, we just need a physiological solution to clean the wound bed. The formation of necrotic foci on the surface of the ulcers, responds to a deficit of tissue perfusion, however, the effect of arteriogenesis increases blood flow to the affected area and causes monocytes, converted into macrophages, to carry out autolytic debridement [15]. When performing the technique of double focal compression bandage, involves doing two types of debridement: A/ Autolytic (by macrophages) and B/ Mechanical (when changing the padding) (Figure 8).

Figure 8: The necrosis was resolved within one month, after a focused pressure was applied to the wound bed. Double focal compression bandaging technique.

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Regarding peripheral artery disease in patients suffering from vascular ulcers and oedema, compression therapy is not a contraindication for reducing oedema. It is possible to reduce oedema and heal ulcers, in a patient suffering from occlusive artery disease, using this simple technique [16]. Amputation of the left fifth toe (Figure 9).

Figure 9: Reduced oedema after compressive therapy.

Regarding the surgical wound (minor surgery), focused pressure on the surgical suture improves the aesthetic outcome [17]. By way of example, we show the aesthetic result, having applied pressure on the surgical suture (Figure 10, 11).

Regarding the patients with failure cardiac and vascular ulcers, compression bandaging in the legs is contraindicated in patients with NYAH class IV: "Patients with heart disease resulting in the



Figure 11: A/ I sutured the patient, applying pressure on the surgical suture, B/ Another patient stitched without putting pressure on the surgical suture.

inability to move on any physical activity without discomfort. Symptoms of Cardiac failure or the anginal syndrome may be present even at rest. If any physical activity is undertaken, discomfort is improved" (NYAH classification) [18]. Compression in the lower limbs, in patients suffering from oedema, increases cardiac preloading, by excessive volume of blood in the heart chambers. This has an adverse effect on patients with heart failure (class NYAH IV), however, it can have a positive effect on the other classes (I, II, III)? My experience with these patients is that it has a positive effect [19]. This increase in cardiac preload causes an increase in pressure in the walls of the heart chambers, producing natriuretic peptides as a mechanism of physiological compensation. Natriuretic peptides (NPs) are hormones which are mainly secreted from heart and have important natriuretic and kaliuretic properties. There are four different groups NPs identified till date [atrial natriuretic peptide (ANP), B-type natriuretic peptide (BNP), C-type natriuretic peptide (CNP) and dendroaspis natriuretic peptide, a D-type natriuretic peptide (DNP)], each with its own characteristic functions. The N-terminal part of the prohormone of BNP, NT-proBNP, is secreted alongside BNP and has been documented to have important diagnostic value in heart failure [20]. Apart from blood pressure lowering properties, natriuretic, diuretic, and/or kaliuretic properties of the NP originating from the ANP prohormone and from BNP, inhibition of the renin-angiotensin system, sympathetic outflow, and vascular smooth muscle and endothelial cell proliferation have been attributed to NP [21]. C-type natriuretic peptide (CNP) are potent stimulators of endochondral bone growth [22]. B-type natriuretic peptide (BNP) linked to cardiac failure. This is an example of a compression bandaging tolerance for an 85-yearold woman, diagnosed with ischemic cardiomyopathy, left bundle branch block and moderate aortic stenosis with heart failure II/ III. She was hospitalized for acute decompensated heart failure (02-10-2015), was diagnosed with severe aortic stenosis and underwent aortic valve replacement surgery (Figure 12). In May (05-06-2019) he came to our office because of a trauma to his left leg, fifteen days ago, with a wound that hasn't healed, despite the treatment. Peripheral arterial disease was ruled out, and we started treating her with double focal compression bandaging, making a daily follow-up of heart signs/symptoms, in the first few weeks, to detect cardiac decompensation (Figure 12). There was no cardiac decompensation, and her quality of life improved, supporting the compression bandage without problems.



Figure 12: Chest x-ray before aortic valve replacement surgery, and after applying compression therapy to the legs.

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The following image (Figure 13), show the clinical evolution of the ulcer until its healing.

Figure 13: Ulcer healed 5 months after treatment by double focal compression bandaging.

Regarding the healing time of the vascular ulcer, we show some examples of patients healed in very little time, and conversely, others who took years.

Case Report 1

(Figure 14): A 61-year-old woman underwent varicose veins surgery, 19 years ago, using the CHIVA procedure. She came to our office (16-06-2015) for having, for a month, a bluish lump on the back of his right leg. Peripheral arterial disease was excluded by measurement of ankle/brachial index (ABI = 0.98). We started treating her, using "double focal compression bandaging", with an excellent result Figure 14). Two weeks later there is a significant reduction in varicose vein size.

I would like to emphasize the importance of early treatment to achieve a good result. Despite these advances, the patient should use compression stockings, throughout his life, to reduce the adverse effects of venous hypertension. Figure 14: Two weeks after compression bandaging.

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Case Report 2

(Figure 15,16): A 82-years-old male with ischaemic heart disease and comorbidity. He suffered a wound in the back of his left leg, three weeks ago, which that did not heal despite treatment. For a week now, he has suffered pain with oedema in his left leg. Peripheral artery disease was excluded by measurement of ankle/ brachial index (ABI = 0.90). Due to severe oedema, low molecular weight heparin was used for two weeks, to prevent thrombosis. We started treat him (04-29-2016) with double focal compression bandaging, and the ulcer healed within a month (Figure 15,16).



A very superficial wound can be seen, which would not attract attention if there was no swelling in the leg. The 12-day response to treatment is positive, with resolution of oedema. The highlight in this case is the rapid recovery of the wound, and the resolution of the oedema. We stress the importance of early treatment.

Case Report 3

(Figure 17): A 59-year-old man with varicose veins suffered mild trauma, to the back of his left leg, two weeks ago. He came to

Figure 16: Decreased oedema after compression treatment.

our medical office because the wound wasn't recovering (09-28-2017). Peripheral artery disease was excluded by measurement of the ankle/arm index (ABI = 0.92). We started treat him, using only "double focal compression bandaging". The ulcer healed one month and a few days later (Figure 17). The patient underwent varicose venous surgery, a year later. We emphasize the need for early treatment, immediately upon detection and diagnosis of the ulcer.

Figure 17: Ulcer healed after compressive therapy, one month later.

The next three clinical cases show vascular ulcers, which took a long time to recover.

Case Report 4

(Figure 18): An 85-year-old woman with an ulcer on her left leg and a bad progression for years, who hasn't responded to the prescribed treatments. She had been treated by hospital angiologists without a positive outcome. She came to our clinic (01-06-2011) and was diagnosed with vascular ulcer, excluding peripheral artery disease by measure of ankle/brachial index

(ABI = 0.92). We started to treat her, using only "double focal compression bandaging". One month after starting treatment, we observed an infection with pseudomonas, which was not treated pharmacologically because there were no symptoms or signs of infection [12]. In the first few weeks, we follow the patient every day, and then weekly. We taught the patient's daughter the compression bandage technique because the patient could not come to the clinic as often as we asked. Perhaps, that was one of the reasons why the ulcer took so long to heal. The bandaging was not performed by qualified personnel. At 38 months from the beginning of treatment, we decided to make the compression bandaging ourselves, and the patient came to the doctor's office, as often as we told her. The ulcer healed, four months later (Figure 18).

Another notable clinical event was the appearance, in several stages of clinical evolution, of necrotic zones that did not require debridement. An autolytic debridement took place due to the effect the arteriogenesis. This technique enables autolytic debridement, since the pressure focused on the wound stimulates arteriogenesis. The resulting increased adhesion of monocytes and their transformation into macrophages are required for the growth of these vessels, as these cells produce numerous cytokines and growth factors involved in arteriogenesis [18]. Macrophages play an essential role during inflammation in normal wound healing. They promote the recruitment and proliferation of fibroblasts and express some of the key growth factors that stimulate angiogenesis [23]. This graphic scheme helps to explain the process.

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30-2018), using only "double focal compression bandage", and the ulcer healed 4 months later. The ulcer that we treated seven years ago hasn't reappeared. A new ulcer arose, but in a different place, we applied the same treatment, obtaining the same result, the healing of the ulcer.

Figure 18: The ulcer healed three and a half years later, using only compression therapy.

On the other hand, when changing the bandage and removing the filling, we do a mechanical debridement. Despite the long recovery period, the biopsy was not necessary, as the ulcer showed no signs of malignancy in the wound bed or on its edges. Due to the impossibility of showing the entire photographic sequence of the clinical evolution of the ulcer, in these 3.5 years, we showed a monthly exposure until its healing (Figure 18).

The patient came back to our practice five years later, with another ulcer on the outer malleolus of the left foot (Figure 19). She was treated with a variety of treatments, including antibiotics, without any positive results. On this date we began to treat it (04-

Figure 19: Ulcer healed, four months later.

Case Report 5

(Figure 20): A 89-year-old woman suffering from t He was diagnosed with chronic venous disease and underwent CHIVA surgery in 2003. he following underlying illnesses: Arterial hypertension, heart disease with severe bi-auricular dilation and atrial fibrillation, diverticulosis, arthrosis. She takes anticoagulant drug. She was diagnosed with chronic venous disease and underwent CHIVA surgery in 2003. The patient came to our office (15-07-2015), because he had two ulcers, one in the right leg and one in the left. They had been treated with different treatments, including antibiotics, without positive results. We began to treat her, using only "double focal compression bandage", achieving the healing of both ulcers, 6 and 7 months later (Figure 20). The clinical relevance lies in its previous pathology, chronic venous insufficiency, and heart disease. We can heal ulcers, but not the underlying disease, for this reason, the patients should understand that compression should be maintained over time, otherwise, clinical manifestations will reappear. The compressive bandage should be removed at night, at bedtime, because the greatest benefit is achieved with exercise. It is also advisable, to remove the bandage

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in extreme weather conditions (very hot days). We thought that the patient, due to his heart disease, would have difficulty tolerating the compressive bandage, but it was not so. Once the ulcers were healed, the patient wore compression stockings and continued to wear them.

Figure 20: Clinical course of the left leg.

The following images show a radiological sequence and how the legs look before and after the compressive bandaging. The improvement is evident, with a significant decrease in oedema, that has persisted over time. During this time, she did not suffer from cardiac decompensation. We were alert that in case it happened; we would remove her the compression bandaging. It shows a radiological sequence in these years. Keep in mind, that the treatment with compressive bandage, began in 2015 (Figure 21). Figure 21: Chest x-rays/radiological sequence. Decreased oedema that remained over time. Healed ulcers.

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Case Report 6

(Figure 22,23,24,25): A 88-year-old woman with dilated cardiomyopathy and comorbidity, with right leg ulcer. The patient went to our medical consultation (07-22-2011), because the ulcer did not heal, despite having received several treatments. Severe peripheral artery disease was excluded, by measurement of the ankle/brachial index (ABI=0.89), and we began to treat her, using just "Double focal compression bandaging". Apart from the long healing period (3.5 years), this case presents some features to highlight.

The patient had a pre-tibial ulcer in her right leg, which was not healing with different therapies. A month after applying compression therapy, another ulcer develops close to the first. Just with compression therapy, the ulcers healed ten months later (Figure 22).

Another notable feature is the appearance of new ulcers in the same leg, which means that compression therapy shows no apparent lesions. We apply the same treatment (compression therapy), and achieve the same result, healing ulcers.

Figure 22: After a month of treatment, another ulcer appears. The ulcers healed in ten months.

Figure 24: Ulcer on the outer side of the left leg.

Figure 23: Ulcers healed 10 months later compression therapy.

Eight months after starting treatment (March 2012), another ulcer appears on the outer side, in the middle third of the right leg. Other ulcers can occur at different locations in the treated leg, even to the other leg (Figure 24).

A final important point, is to emphasize the fact of treating a patient with cardiomyopathy who tolerated compressive bandaging, improving their quality of life. The improvement and appearance of the legs is obvious (Figure 25).

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Figure 25: A/ Ulcers on the right leg; B/ Ulcers on the left leg, six months after treatment.

Discussion and Conclusion

According to this clinical experience, and as regards this article, it may be concluded that: "The healing time of a vascular ulcer will depend upon the structural vascular change prior to treatment". We should be patient, when we heal a vascular ulcer because the healing times are different, depending on vascular damage, some will heal sooner, others later and some ulcers never heal. We estimate, in three months, the minimum time the patient should use "Double focal compression bandaging" even if the ulcer heals earlier. We inform the patient that once the ulcer has healed, he/ she should wear strong compression stockings, if he/she does not



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want ulcers to recur, removing them at night when he/she goes to bed. However, he/she might not be using them, for short periods of time. I would like to close this article by referring to the advantages of this compression technique (that only uses bandages and gauze) as regards:

- Focused pressure on the wound bed prevents infection. In treated patients, there was no evidence or symptom of infection, all we have to do is keep track of the patient to detect them, in which case, if we would prescribe antibiotics [13,14].
- We do not use any debridement. The use of this technique involves the performance of two types of debridement, one autolytic, because of arteriogenesis stimulation on the affected area, and another mechanic, when removing the padding [15].
- This technique can be applied to patients with peripheral arterial disease and arterial ulcers, we just need to rule out severe peripheral artery disease, by measuring the ankle/ brachial index [16].
- Compression therapy in the legs, can be used in patients who have heart failure (class NYAH I, II; III) and vascular ulcers. We feared that compression, by reducing oedema, could increase cardiac preload, and worsen symptoms, but this did not happen. We thought they wouldn't tolerate the compressive bandage, but they tolerated, and their quality of life has improved [19]. Cardiac decompensation did not occur in all treated cardiac patients.

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