

## Role of Compression and Physical Therapy in the Treatment of Chronic Venous Insufficiency

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### 1. Abstract

Chronic venous insufficiency (CVI) is a common peripheral vascular condition characterized by the retrograde blood flow in the lower extremity/-ies and its consequences; such are oedema and other complications. Clinical severity of CVI is assessed according to the CEAP (Clinical, Etiological, Anatomic and Physiopathologic) classification which recognizes seven grades of increasing clinical severity (C<sub>0</sub>-C<sub>6</sub>). The compression therapy aims to accelerate vein, lymph and microcirculation flow and therefore reduces chronic nonbacterial inflammation and oedema of the extremity. According to the elasticity and stiffness, compression bandages and garments are divided in short and long-stretch compression materials. Compression therapy is applicable in all stages of CVI. Moreover, compression therapy in conjunction with physical therapy and lifestyle modifications is more effective in reducing oedema, prevention of venous distension, and reduction of venous wall tension with improvement of calf muscle pump function. Physical therapy combines everyday lifestyle modifications, physical activity, medical exercise, sports activity, hydrotherapy and electrotherapy in the CVI treatment. Therefore, physical therapy is used either for prevention or either for therapeutic purposes in CVI. For grades CEAP C<sub>0</sub>-C<sub>2</sub> preventive measures are consisted of education and counselling, medical exercise and general fitness,

and sports and physical activities. Whereas, for therapy in grades CEAP C<sub>3</sub>-C<sub>6</sub>: medical exercise and specific rehabilitation program, manual lymphatic drainage and massage, balneotherapy and electrotherapy.

### 2. Introduction

The aims of compression therapy are to accelerate vein, lymph and microcirculation flow and therefore to reduce chronic nonbacterial inflammation and oedema of the extremity. Compression is the main symptomatic therapy for chronic venous insufficiency (CVI) of the lower extremities and the lymph oedema with relive of symptoms and improving of clinical picture. If this is not the case the compression is not appropriate or the diagnosis must be re-evaluated. Varicose veins develop as a consequence of elevated venous pressure that does not decline to normal levels during walking despite the action of the calf muscle pump. The most frequent cause is improper functioning of venous valves, resulting in retrograde flow of blood (reflux). Less frequently varicose veins occur as a result of proximal venous obstruction. Primary varicose veins develop due to undefined causes, whereas secondary varicose veins are mostly caused by deep venous thrombosis (DVT). Congenital varicose veins develop as a result of congenital anomalies of the venous system [1,2]. According to literature data, 20 to 38 per cent of venous leg ulcers occur as a consequence

of post-thrombotic syndrome following DVT [3,4]. If chronic venous insufficiency is not detected and treated at an early stage, lesions of the skin and subcutaneous tissue progress, leading to the development of stasis dermatitis, *atrophie blanche*, lipodermatosclerosis and finally venous ulceration (Figure 1). CEAP (Clinical,

*Etiological Anatomic and Physiopathologic*) classification of CVI is described in Table 1. Untreated lymphoedema develops fibrosis, papillomatosis, nonbacterial erythema, ulcerations and elephantiasis. Rare very dangerous complication is lymphangiosarcoma.

**Table 1:** Assesment Of Cvi Clinical Severity by Using The Ceap Classification.

Grade	Clinical signs & symptoms of assessed limbs (A/S)
C <sub>0</sub>	Without clinical sign of CVI
C <sub>1</sub>	Telangiectases in reticular varicose veins
C <sub>2</sub>	Varicose veins
C <sub>3</sub>	Oedema
C <sub>4a</sub>	Hiperpigmentation, hypostatic dermatitis
C <sub>4b</sub>	Lipodermatosclerosis, atrophie blanche
C <sub>5</sub>	Same as C <sub>4</sub> with healed ulcer
C <sub>6</sub>	Same as C <sub>4</sub> or C <sub>5</sub> with open ulcer

CVI – chronic venous insufficiency, C - clinical classification, CEAP - Clinical, Etiological, Anatomic and Physiopathologic, A – asymptomatic, S – symptomatic.



**Figure 1A:** Increasing clinical severity of chronic venous iinsufficiency. a) Telangiectases, b) Reticular varicose veins, c) Varicose veins, d) Hypostatic dermatitis with hiperpigmentation (dark area) and atrophie blanche (central white discoloration) and e) Ulcus cruris hypostasicum.



**Figure B**



**Figure C:**



**Figure D.**



**Figure E.**

### 3. Compression Therapy

According to elasticity and stiffness we divide compression bandages and garments in short and long-stretch compression materials. Long-stretch compression bandages are appropriate for decongestion phase of suprafascial oedema of the extremity and for maintain compression therapy for CVI. Round netted garments are appropriate for immediate compression therapy for early stages of CVI, where there is no oedema of the leg and also for maintain compression therapy for all stages of CVI. According to the degree of extensibility (ability of the bandage or garments to stretch when force is applied), short-stretch (extensibility 10% to 100%) and long-stretch (extensibility >100%) compression materials are distinguished. The force needed to stretch an elastic material to a certain length and produce a certain amount of pressure depends on the strength of the material. By elasticity of the material we describe its ability to resume its original length when tension is reduced [1,3]. We suggest compression therapy in all stages of

chronic venous insufficiency. It is used to reduce oedema, prevent venous distension, and reduce venous wall tension with improvement of calf muscle pump function [2]. Conditions for good compression are normal peripheral arterial flow, good ejection fraction of the heart, good calf muscle pump, normal sensibility of the extremity and good mobility of the patient. Absolute contraindications for compression therapy are peripheral arterial disease (PAD) with critical ischemia (*arterial blood pressure index* – ABPI below 0.5), bacterial skin infection (cellulitis, erysipelas), trophic skin changes in diabetic food, decompensate heart failure, contact allergic dermatitis for compression materials, malignant tumors and malignant lymphoedema of the extremity. Relative contraindications are sensibility disturbances of the extremity, immobile patients and PAD with ABPI between 0.6 and 0.8. Low compression class stockings or high stiffness compression systems or intermittent compressive pump (ICP) with intermittent compression are recommended [1]. If there is no oedema on the leg, we can treat CVI with round netted compression stockings immediately. Otherwise we have to reduce the leg oedema and improve the skin changes with compression bandages first. For the reduction of suprafascial oedema in CVI, we can advise short or long stretch bandages. The maintain phase of compression therapy is usually proceeded with long stretch compression bandages or round netted compression stockings [4-6]. Indications for round netted stockings compression class I are CVI with varicose veins without oedema and pregnant women with varicose veins without leg oedema. Indications for stockings compression class II or are all other stages of CVI, pregnancy with leg oedema and after surgery and /or endovenous varicose vein treatment (laser, radio frequency, sclerotherapy). We decided for stockings compression class III if huge lipodermatosclerosis is presented. It is very important that doctor, who prescribes type of garments, level of compression and height of compression stockings, is well educated. He/she must establish diagnosis first and know all about indications and contraindications for compression therapy [1,3]. Compression therapy is indicated in all stages of CVI and lymphoedema. Long-stretch compression bandages and stockings are recommended for beginning phase of CVI and maintain therapy.

#### 4. Physical Therapy and Lifestyle Modifications

##### 4.1. Preventive Measures

The several risk factors for developing CVI are described. The influence of some factors is still unknown, since they are interacting to each other [7]. Moreover, the influence of some factors could be reduced and they are named changeable risk factors. These changeable factors are: sedentary lifestyle, low physical activity, higher body mass index (BMI), smoking, history of lower extremity injury, occupation (prolong periods of standing and/or sitting) and flat foot deformities [7,8]. The last one is controversial. Therefore, for the prevention and progression of CVI in the early stages (CEAP C<sub>0</sub>-C<sub>2</sub>), the following measures could modify the

influence of changeable risk factors. Education and counselling. The cessation of sedentary lifestyle and practicing routine moderate physical activity three times per week for at least 30 minutes positively influence to variety of body functions and is scientifically proofed [9]. In general, it is beneficial for cardiovascular system and prevention of metabolic diseases, reduces the fat tissue and increases the muscular tissue mass. Regular physical activity builds bone strength and lowers the risk for fall. As well, the decrease incidence of psychoorganic syndrome and better intellectual skills are investigated. Studies showed that routine exercise in period of just 3 months, even in non-trained elderly population, still brings positive effects. Hence, regardless the age status all individuals with risk for CVI should start to exercise regularly by previously designed exercise program [9]. Smoking is risk factor for amelioration and development of diabetes and polyneuropathy complications, medical conditions with high prevalence in elderly. Additionally, sustain of smoking is advisable due to the risk for systemic and peripheral arterial insufficiency [10]. Vocation counseling is aimed to target more ambulatory professions than those consisted of long period of sitting or standing, such are catering or desk service [10]. Prevention measures include alternation of standing and sitting positions after 30 to 40 minutes. This measure is suitable also for prevention of common low back pain. Emphasis is on walking, and choosing whenever is possible. Individuals with risk for CVI should practice frequent daily rest and elevate legs for 20 minutes period in 30 degrees inclination to stimulate drainage [7]. Susceptibility for trauma and trauma history of lower extremity raise risk for CVI. The rehabilitation plan is to achieve full range of motion in ankle joint (especially in upper talocrural joint), activate calf muscle pump, reduce lymphedema and start decongestion [10]. There is no data available for positive effect of shoe insoles in prevention of CVI. However, recommendation is to strength longitudinal and transverse arch of foot with specific exercises that include activation of muscle pump as well [11]. Medical exercise and general fitness. Medical exercise includes program of few simple exercise that target: promotion of full range of motion (ROM) in large lower limb joints (emphasis on subtalar and talocrural joints), strength training of calf muscle pump and induction of decongestion. It is important to pace the breathing rhythm with muscle contraction, and to contract muscles when exhaling. Exercise program should be repeated twice per day (in the morning and afternoon) in set of 10 repetitions for 3-5 seconds muscle contractions<sup>14,15</sup>. For instance, Brunner and Fleischlin created special exercise training program for CVI [12]. Sports and physical activities. In spite that sports activity modifies risk for CVI, when choosing the type of sports preference should be made for those decreasing the venous pressure and increasing venous flow. This is made by activation of ankle muscle pump (triceps surae muscle, small muscles of foot), activation of respiratory muscles (diaphragm, intercostal muscles) and accessory respiratory muscles (sternocleidomastoid muscle, scalene muscles,

serratus anterior muscle, pectoral muscles and trunk extensors) and dynamic muscle contraction which resists gravity and change the muscle length in movement. Walking is superior to jogging in lowering venous pressure and is recommendable for persons with high venous pressure [13,15]. Hydrotherapy, exercise in neutral hydro medium (bit cold/ lukewarm, temperature  $\leq 28-30^{\circ}\text{C}$ ) or hydrogymnastics works by: dynamic exercise which is focus on ankle range of motion and muscle pump activation, physical characteristic of water such are hydrostatic pressure increases surface vein decongestion, double effects of movement rhythmic surface turbulence (massage or drainage) and autonomic vasoconstriction [14]. Exercise in water medium is weight bearing free for joint and blood vessels and is opposite to running when we are exposed to high repetitive joints loads and stress. Thereafter running is best to practice on softer surfaces with absorbing footwear. Recommended sports and physical activities for CVI are described in Table 2. Some sports have negative effect on CVD and ameliorate condition. These sports involve long periods of lifting and squats which raise the intra-abdominal pressure and compress the valves, or blocking the ankle muscle pump by footwear immobilization. Sports with high risk for lower limb injury are not favourable (for instance: rollerblading, heavy lifting, shooting, sailing, alpine skiing, tennis). Practicing before mention sports is not absolutely contraindicated, but special care and individual assessment of risk factors according the classification (CEAP  $C_4-C_5$ ) have to be considered (for example, application of adaptive compression stocking).

**Table 2:** Recommended Sports And Physical Activities For Patients With Cvi.

Walking/ stroll / brisk walking/ race walking
Nordic walking / climbing
Jogging / marathon
Cross-country skiing
Cycling (indoor & outdoor)
Dance (ballroom / modern)
Triathlon (combination of swimming, running & cycling)
Swimming / diving / fin swimming*
Deep-water walking*
Aqua aerobic*

CVI - chronic venous insufficiency, \*neutral hydro medium up to temperature  $\leq 28-30^{\circ}\text{C}$ .

## 4.2. Therapeutic Modalities

Treatment of more progressive stages of CVI (CEAP  $C_3-C_6$ ) incorporates physical therapy in combination with compression therapy and other treatment modalities, like drugs, assistive technology and similar. Before starting any physical therapy, detail check-up for contraindications and associated musculoskeletal comorbidities have to be made. Individual approach in creating suitable rehabilitation program is crucial for the optimum result. Medical exercise and rehabilitation program. Medical exercise for therapeutic purposes is more complex and differs from preventive one, whereas the limited body function is present and also a need for medical environment. That why, the physiatrist and physiotherapist are involved. Exercise is run under the physiotherapist supervision. He/she is monitoring breathing rhythm, movement coordination and side effect. In case of some changes, the physiatrist is consulted and rehabilitation plan will be modified. Manual lymphatic drainage and massage. There is no evidence that classical massage influence the CVI, expect that gives momentary relaxation and general well-being. Manual lymphatic drainage in combination with compression therapy induces collateral lymphatic network, mobilizes oedema, reduces fibrosis and stimulates transport through lymphatic vessels. Good results are shown in reductions of lymphedema and postoperative in varicose veins [8].

**4.2.2. Balneotherapy:** The term balneotherapy stands for medical use of different spa therapeutic modalities, usually referring to the thermo-mineral water [17]. Early signs of CVI (CEAP  $C_0-C_2$ ) are suitable for balneotherapy as well as more progressive – like varicose veins that are not the contraindication. Here is the effect of hydrotherapy additionally enrich with spa therapeutic modalities. In Europe, balneology is very common and recently great progress has been made in scientific studies. French randomize study showed long-term positive effect on skin changes and quality of life, in patients with CEAP  $C_4-C_5$  [16]. During 3 week period they underwent specific balneology and educational programs. Balneology program consisted of deep-water walking, water massage, whirlpool, Kneipp’s baths and ROM exercises. For brief period of 15 minutes they were exposed even to higher temperature  $34-36^{\circ}\text{C}$  (indifferent/warm) with no side effects. It is interesting, that known thermal reaction has been not recognized in patient from control group. This is normal reaction to spa treatment and is occurring 3rd to 6th day of exposure. Balneotherapy is method of choice in elderly, because is beneficial to lower limb osteoarthritis [18]. Method in not harmful, when exposure period, treatment duration and contraindication are taking considered. Electrotherapy. Electrostimulation is frequently applied method and widely in use. Low frequency alternating current between 18 to 36 Hz is used for muscle stimulation [7]. It induces involuntary muscle contraction. Lower frequencies have more antiedemic effect, while higher build the muscle as it is in hypotrophy due to inactivity. Electrostimulation can follow the other treatment modalities such is sclerotherapy. In

stages CEAP C<sub>5</sub>-C<sub>6</sub> physical modalities are used for analgesia, healing stimulation and bactericide activity [19]. For electroanalgesia TENS (transcutaneous electrical neurostimulation) is used. This is high frequency stimulation which is applied to the segment above ulcer and blocks transmission of painful impulses at the spine level. Several modalities are used for healing stimulation. One study used therapeutic ultrasound in water medium (30 kHz, 0.1W/cm<sup>2</sup>) [7]. Ultrasound waves radiate in the sterile bucket and work by reflection. Other, such are high voltage current and phototherapy like infrared radiation and laser therapy stimulate surrounding microcirculation, but no solid evidence. Recently, some studies published promising data with hyperbaric oxygen therapy, ESWT (Extracorporeal shockwave therapy) and electrostimulation. More obsolete is use for bactericide activity with 250 V high voltages current under the cathode for 2 hours [19].

## 5. Conclusion

Compression and physical therapy are applicable in all stages of CVI, respecting the contraindications and the treatment goals. Optimal compression shows an influence on pathophysiological processes, joins pressures while maintaining high pressures in active and low in resting condition and is reusable. Moreover, optimal physical therapy and rehabilitation demands individual approach depending on the clinical severity of CVI and associated musculoskeletal comorbidities. Therefore, compression and physical therapy are advised to be integrated in the complex treatment of CVI.

## References

1. Moffat Cj, Partsch H, Clark M, Franks Pj, Marston W, Understanding Compression Therapy. European Wound Management Association position document. 2003.
2. McCOLLUM C, BMJ. 1992: 520.
3. PARTSCH H. Dermatol Surg. 2005: 625.
4. Partsch H, Clark M, Mosti G, Steinlechner E, Schuren J, Abel M, et al. Dermatol Surg. 2008: 600.
5. Kecelj Leskovec N. Pressure and Stiffness with elastic and inelastic compression materials. In: Proceedings (Joint meeting ETRS/ EWMA/DGfW, Stuttgart. 2005.
6. Planinsek Rucigaj T, Kecelj Leskovec N, Bolezni ven spodnjih okoncin. In: Kinsky A, Miljković J (Eds) Kožne in spolne bolezni (Združenje slovenskih dermatovenerologov. Ljubljana. 2009.
7. Ramelet Aa, Perrin M, Kern P, Bounameaux H, Hafner J. Phlebology (Elsevier Masson, Issy-les-Moulineaux Cedex. 2008.
8. Ramelet Aa, Kern P, Perrin M. Varicose veins and telangiectasias. Elsevier Masson. Paris. 2004.
9. Chodzko-Zajko Wj, Proctor Dn, Fiatarone Singh Ma, Minson Ct, Nigg Cr, Salem Gj, et al. American College of Sports Medicine, Med Sci Sports Exerc. 2009: 1510.
10. Spires Mc, Henke Pk. Lower Limb Peripheral Vascular Disease. In: Braddom Rl (Eds) Physical medicine and Rehabilitation (Saunders Elsevier, Philadelphia. 2007.
11. Barr Kp, Harrast Ma, Low Back Pain. In: Braddom Rl. (Eds) Physical medicine and Rehabilitation (Saunders Elsevier, Philadelphia. 2007.
12. Brunner U, Fleichlin C. Vasa.1992: 469.
13. Stick C, Jaeger H, Witzleb E. J Appl Physio. 1992: 2063.
14. Roaldsen Ks, Biguet G, Elfving B, Clin Rehabil. 2011: 275.
15. Carpentier Ph, Satger B, J Vasc Surg. 2009; 163.
16. Ivanisevic G, Pojmovnik hrvatskog balneoloskog nazivlja. 2006.
17. Fioravanti A, Iacopono F, Bellisai B, Cantarini L, Galeazzi M, Am J Phys Med Rehabil. 2010; 125.
18. Goldman R, Popescu A, Thomas Hess C, Salcido R. Prevention and Management of Chronic Wounds, In: BRADDOM RL, (Eds) Physical medicine and Rehabilitation. Saunders Elsevier, Philadelphia. 2007.