

# Evaluation of limitations of venous ulcers in legs

## Avaliação das limitações de úlceras venosas em membros inferiores

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### Abstract

**Background:** The chronic venous insufficiency (CVI) has a considerable socioeconomic impact in Western countries due to its high prevalence, research and treatment cost, and loss of workdays. The Short Form Health Survey (SF-36) questionnaire, the analysis of muscular activation and mobility of the tibiotarsal joint are instruments used for CVI evaluation. **Objective:** To assess osteomuscular limitations and changes in the quality of life of patients with venous ulcers in lower limbs. **Methods:** Ten patients with ulcers classified using CEAP (Clinical, Etiological, Anatomical, and Pathophysiological) classification were evaluated. Six of them answered the SF-36 questionnaire and the pain analogue scale, and underwent goniometry, muscular strength evaluation and electromyography. **Results:** The mean age of studied subjects was 67.4 ( $\pm 11.7$ ), and 70% of them were female. Results showed no statistically significant correlation between pain, range of motion (ROM), muscular strength, electromyography (EMG), and the lesion size. However, results showed a correlation between the psychological profile on SF-36 questionnaire and the domain of motor activities, as well as between psychological profile and social activities, and between psychological profile and perception of itself. The electromyographic evaluation of studied muscles also showed a significant difference. **Conclusion:** The presence of venous ulcers in lower limbs can generate limitations and changes in these patients' quality of life. The psychosocial aspect showed preponderance over the motor one, increasing restrictions in daily activities.

**Keywords:** quality of life; electromyography; muscular strength; evaluation; physiotherapy.

### Resumo

**Contexto:** A insuficiência venosa crônica tem um impacto socioeconômico considerável nos países ocidentais devido à alta prevalência, custo das investigações e tratamento e à perda de dias trabalhados. O questionário de qualidade de vida *Short Form Health Survey* (SF-36), bem como a análise da ativação muscular e mobilidade da articulação tibiotársica, é um instrumento utilizado para a sua mensuração. **Objetivo:** Avaliar as limitações osteomusculares e as alterações na qualidade de vida em portadores de úlcera venosa em membros inferiores. **Métodos:** Foram estudados dez pacientes com úlceras classificadas com Classificação de Doença Venosa Crônica (CEAP: Clínica, Etiologia, Anatomia e Fisiopatologia) 6, que responderam ao questionário SF36 e à escala analógica de dor e realizaram a goniometria, força muscular e eletromiografia. **Resultados:** A idade média do grupo estudado foi 67,4 ( $\pm 11,7$ ), sendo 70% dos casos do sexo feminino. Não houve correlação significativa entre dor amplitude do movimento (ADM), força muscular, eletromiografia (EMG) e o tamanho da lesão. Entretanto, houve correlação entre o perfil psicológico do SF-36 e o domínio de atividades motoras, bem como do perfil psicológico com as atividades sociais e percepção de si mesmo. Também houve diferença significativa na avaliação eletromiográfica dos músculos estudados. **Conclusão:** A presença de úlcera venosa em membros inferiores pode gerar limitações e alterações na qualidade de vida destes indivíduos. O aspecto psicossocial demonstrou-se preponderante sobre o aspecto motor, aumentando as restrições nas atividades de vida diária.

**Palavras-chave:** qualidade de vida; eletromiografia; força muscular; avaliação; fisioterapia.

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## ■ INTRODUCTION

Chronic venous insufficiency (CVI) is defined as an abnormal functioning of the venous system, caused by valvular incompetence associated or not with venous flow obstruction<sup>1,2</sup>.

CVI has a considerable socioeconomic impact in Western countries due to its high prevalence, research and treatment cost, and loss of workdays<sup>3</sup>.

The prevalence of CVI increases with advancing age, affecting 2-7% of the population, and the prevalence of its major complication, the chronic venous stasis ulcer, affects 1-3% of people<sup>2,4</sup>. The characteristic location of the stasis ulcer is the distal third of the medial face of the thighs, adjacent to the medial malleolus<sup>5</sup>.

CEAP (Clinical, Etiological Anatomical, and Pathophysiological) classification is the most widely used one for CVI. It is a more complete classification because it includes, besides clinical and anatomical criteria, etiological and pathophysiological aspects, and, by a scoring system, classifies clinical severity and incapacity for work. It is considered a more complex and more difficult approach<sup>6</sup>.

The quality of life questionnaires are useful to assess social limitations and detect changes in lifestyle often not determinable by other traditional markers. The Short Form Health Survey (SF-36) was designed to be a generic assessment questionnaire. It consists of two parts: the first one assesses the state of health (by questions related to physical mobility, pain, sleep, energy, social isolation and emotional reactions), and the second one evaluates the impact of the disease on patient's daily life<sup>7-9</sup>.

The range of motion (ROM) and the muscular strength of muscle groups adjacent to the ulceration can be affected<sup>10</sup>. Although there is no consensus on the relationship between ulcer healing and disability of calf muscles,<sup>11</sup> this muscle-joint involvement may be related to inactivity, emotional state or even physiological changes imposed by CVI, such as pain.

This study tested the hypothesis that in CVI patients there is a strong correlation between emotional aspects, functional capacity, pain, and muscular activation capacity.

This study aimed to correlate changes in the quality of life of patients with venous ulcer in lower limbs and their muscular activation capacity.

## ■ METHODS

This prospective clinical research is a case-control study in which the research subject is his own control. The studied population consisted of patients screened in the Integrated Care Unit (ICU)

in Martins neighborhood in Uberlândia (MG), all enrolled in Programa de Atenção Primária à Úlcera Venosa e Pé Diabético.

Patients and their parents were fully informed about the study and, after signing a term of informed consent, they completed a questionnaire to assess quality of life (SF-36).

The study was approved by the Research Ethics Committee of Centro Universitário do Triângulo, under Opinion nº 647.886. Inclusion criteria were: age over 40 years; signing a term of informed consent; patient enrolled in Programa de Atenção à Úlcera Venosa e Pé Diabético of the ICU in Martins neighborhood in Uberlândia (MG); and availability to contact the Electromyography Laboratory.

Exclusion criteria were: absence of definite diagnosis; patient or patient's responsible family member request for interrupting the participation; lack of proper understanding about the tests; patient or patient's responsible family member refusal in signing a term of informed consent.

Questionnaires were administered in the waiting room of the ICU's angiology office by the researchers reading of domains to be addressed. Subsequently, patients went to the EMG Laboratory, where pain assessment using the analogue scale, goniometry of the tibiotarsal joint, muscular strength evaluation, and bilateral electromyography of tibial anterior muscles and soleus muscles were performed.

### **Procedure and electromyographic data record**

For EMG data collection, five electrodes were placed on the patient. The first one was placed on the patient's right tibial anterior muscle, the second one on the right soleus muscle, the third one on the left tibial anterior muscle, the fourth one on the left soleus muscle, and the fifth one, corresponding to the ground wire, on the lateral condyle of the right femur. For the positioning of electrodes, we used the Surface Electromyography for the Non-invasive Assessment of Muscles (SENIAM) protocol from the Electromyography European Community.

Before placing the electrodes, we performed a rigorous site inspection, checking for the presence of hair, performing trichotomy when required, followed by sterilization with 70% alcohol, and then placing the electrodes, using adhesive tape (Micropore) for better grip on the skin.

Electrodes were connected both to an eight channel electromyograph (DataHominis Tecnologia Ltd.) and a computer, using MyosystemBr1 software. First we analyzed the EMG signal with the volunteer standing still for the detection and elimination of

noise or any required repositioning of electrodes. Then, patient's data, the location of the ulcer side, the dominant lower limb, and the appointment of muscles to be evaluated were recorded.

Patients were seated on a bench with their feet fixed on the floor. The seat height was adjusted according to each patient's height. Each patient was instructed to perform maximal voluntary isometric contraction (MVIC) toward the dorsiflexion position (for tibial anterior muscle assessment) and, subsequently, plantar flexion position (for soleus muscle assessment), symmetrically and bilaterally. The same researcher conducted all assessments. EMG collection time during MVIC was five seconds.

Subsequently to data collection, patients were analyzed at the interval between two and three seconds, at which the maximum EMG activity was achieved.

Values of Root Mean Square (RMS) and Integral of Envelopment were used for statistical analysis. The Wilcoxon test was used to analyze EMG, comparing differences between muscle groups. The Spearman's rank correlation coefficient was used to correlate SF-36 questionnaire and the other variables. The significance level was set at 0.05.

## RESULTS

Ten patients participated of the study, and 70% of them were female. Patients mean age was of 67.4 ( $\pm 11.7$ ) years. According to ethnicity, the incidence percentage was 50% Caucasian and 50% Black. Considering all studied subjects, the mean income was less than five minimum wages.

Regarding the dominance of lower limbs, 100% were right-handed. In 70% of cases the ulcer was located on the left side and 30% on the right side.

All subjects had hypertension, and 20% of them concomitant diabetes. Smoking was not a habit of this population, but alcoholism was present in 20% of cases, in males only.

Using the Spearman's rank correlation coefficient, no correlation between variables range of motion (ROM), muscular strength, lesion size, EMG and SF-36 questionnaire ( $p > 0.05$ ) was observed.

On the other hand, when we considered the domains of the SF-36 questionnaire, correlations between variables were observed. There was also a correlation between motor activities and psychological state, shown in Table 1, and between psychological profile and social activity (Table 2). Analyzing the domains perception of itself and current health status, we obtained  $r = 0.773$  ( $p = 0.009$ )

and  $r = 0.634$  ( $p = 0.049$ ) for health status a year ago, respectively.

For statistical analysis of EMG (Table 3), using RMS values and Integral of Envelopment, we excluded three patients with ulcers on the dominant side. Thus, we totaled seven right-handed individuals with ulcers on the contralateral side. The Wilcoxon test, applied to RMS values, showed differences between the right and left tibial anterior muscle ( $p = 0.028$ ), whereas the highest RMS values and Integral of Envelopment were obtained on the right one. There was also a difference between the right

**Table 1.** Values regarding subjects psychological profile  $\times$  answers regarding moderate and vigorous intensity motor activities.

Analyzed variables	Values rs	Probabilities
Depressed $\times$ moderate-intensity activities	0.783	0.007*
Downhearted $\times$ moderate-intensity activities	0.807	0.005*
Exhausted $\times$ moderate-intensity activities	0.843	0.002*
Tired $\times$ moderate-intensity activities	0.807	0.005*
Depressed $\times$ carrying groceries	0.671	0.034*
Downhearted $\times$ carrying groceries	0.709	0.022*
Exhausted $\times$ carrying groceries	0.764	0.010*
Tired $\times$ carrying groceries	0.667	0.035*
Depressed $\times$ walking several blocks	0.671	0.034*

\* $p < 0.05$ , rs = Spearman's correlation.

**Table 2.** Psychological profile  $\times$  social activities: physical health and emotional problems interfering in social life.

Analyzed variables	Values rs	Probabilities
Depressed $\times$ physical and emotional aspects or domains*	0.684	0.026**
Exhausted $\times$ physical and emotional aspects or domains*	0.663	0.037**
Depressed $\times$ physical and emotional aspects or domains***	0.694	0.028**

\* $p < 0.05$ . \*\*Answers regarding question n° 6. \*\*\*Answers regarding question n° 10. rs = Spearman' correlation.

**Table 3.** Root Mean Square (RMS) values and Integral of Envelopment from right and left tibial anterior muscle and right and left soleus muscle.

Analyzed variables	Probabilities
Right tibial anterior $\times$ Left tibial anterior	0.028*
Right soleus $\times$ Left soleus	0.310
Right tibial anterior $\times$ Right soleus	0.028*
Left tibial anterior $\times$ Right soleus	0.612

\* $p < 0.05$ .

tibial anterior muscle and the right soleus muscle ( $p=0.028$ ), and the highest values were obtained on the first one, representing the muscle of highest activation in these patients. In other comparisons, statistical analysis showed no significant difference ( $p>0.05$ ).

## ■ DISCUSSION

CVI of lower limbs, besides being a cause of disability and embarrassment for the CVI bearer, it also represents an important socioeconomic problem in contemporary civilization. In its more severe forms, such as venous stasis ulcer, the ultimate expression of this disease, it can lead to disability and be a cause of high costs to public coffers. Comprehensive evaluation and therapeutic management of these patients are less than expected<sup>12-15</sup>.

The tibiotarsal joint mobility combined with venous valvular competence, working simultaneously, is the engine that drives the return of venous blood to the heart via anatomical relations between nerves, muscles, tendons, joint capsules, ligaments and cartilages<sup>16</sup>.

We observed that the reduction of ROM is an aggravating factor for CVI of lower limbs, because total and permanent ankle ankylosis makes patients incurable by limiting, or even annulling, the most important action of the pulse-aspiration pump of lower limbs, which is the calf muscle<sup>17</sup>.

Results of this study showed that there is a significant decrease of the soleus muscle activation on both lower limbs, but especially on the left one. This is precisely due to the calf muscle, the so-called peripheral muscle pump, that is affected by valvular incompetence, associated or not with an obstruction<sup>1</sup>. It corroborates findings of the study conducted by Davies et al.,<sup>18</sup> which were successful in reducing pain and increasing ROM through a program of stretching and strengthening exercises of calf muscles in patients with venous ulcers. Furthermore, it is important to remember that, in the elderly, muscular strength, particularly of lower limbs, is considered an important limiting factor for maintaining an autonomous lifestyle<sup>19-22</sup>.

On the non-dominant lower limb there was an apparent decrease in muscular strength and ROM. However, on the dominant lower limb this reduction was qualitatively lower, perhaps because it is the most requested support to promote stability during walking. At this stage, CVI patients use less from the muscular boost phase, at which there is a greater soleus muscle activation,<sup>23</sup> leaving it increasingly

weak, and the muscular pump more debilitated, according to results found in this study.

Patients who had ulcers on the left side showed greater reduction in muscular strength, activation and ROM comparing with the three patients who had ulcers on the right side. No other quotations with that same purpose were found. Therefore, this is a pioneering study, performing comparative EMG of lower limbs muscles in patients with chronic venous ulcers.

Pain is a common symptom and with variable intensity, not influenced by the ulcer size, since small lesions can be very painful, while large ones can be virtually painless. In general, when it occurs, the pain worsens at the end of the day in the standing position and improves with the elevation of the limb<sup>3</sup>.

According to domains of SF-36 questionnaire – it was possible to find the expected answers concerning the type of lesion and all disorders caused by it – patients become frustrated because they could no longer perform the same tasks they performed some time ago. Moreover, they could no longer work to support their family, and they no longer have the same willingness to go out for visiting friends or to attend in their community. This was compounded by the fact that the entire studied population had a very low per capita income, and none of individuals had their own means of transport, precluding the use of public transportation. All these factors contributed to the emotional state of patients, making them depressed, nervous and unhappy.

The presence of active ulceration may affect the individual's productivity at work, leading to retirement for disability, as well as restricting activities of daily living (ADL) and leisure. For many patients, venous disease means pain, loss of functional mobility and decline in the quality of life<sup>11,18</sup>.

In conclusion, the presence of venous ulcers in lower limbs can generate limitations and changes in the individuals' quality of life. The psychosocial aspect showed preponderance over the motor one, increasing ADL restrictions.

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