

Changes in the parameters of gait after a mechanical debridement of a plantar callosities

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Abstract Introduction: Plantar callosities are a common cause of pain in the fore-foot and also a cause of alterations in plantar pressure. Mechanical debridement with a scalpel can relieve pain and increase functional capacity.

Objective: The aim of the study was to analyse if debridement of plantar callosities and corns modify walking.

Methods: Thirty four patients with plantar foot pain due to callosities and corns, and up to 5 in the visual analogical scale (VAS) of pain, (20 women, age 29 ± 11.57 years) were analysed by taking into account the changes of their gait. The outcome measurement was the VAS scale and the Win-track system, cycle of the gait(milliseconds), angle(degrees), cadence(number/minutes) and step(centimetres) were measured, 24 h before and after the debridement with a scalpel.

Results: There were significant differences in foot pain (mean 67.7, $p < 0.001$) but there were no significant differences in measures of gait variables before the debridement of the callosities, and 24 h after the procedure, being all those above 0.05.

Conclusions: Our study shows that the debridement with scalpel does not change the variables of the gait 24 h after the procedure.

KEYWORDS

Corns; Plantar callosities; Gait cycle; Change; Chiropody; Gait angle

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Introduction

Plantar callosities are a common cause of foot pain [1]. While the causes of plantar callosities are numerous, the most common form is that which

results from a mechanical loading of the skin [2]. It is thought that repeated micro trauma of the skin secondary to abnormal foot mechanics, such as pronated or high-arched feet, unusual foot morphologies, such as bunion or deviations of toes and external pressures such as footwear [2e4] are the most common cause of painful plantar callosities. Callosities are a natural defense mechanism of the skin in order to compensate prolonged pressure, friction or any other way of local irritation, producing an increase on skin thickness [5]. However, it becomes pathological when the increase of keratin is enough to cause pain [6]: furthermore, it is thought that the presence of painful callosities have an effect on static posture [7]. The most common treatment of painful plantar callosities is mechanical debridement of the thickened skin with a scalpel blade. Previous research has demonstrated that while mechanical debridement results in a small reduction in pain [1], the effect of this treatment on gait remains unclear, with research only looking at measures of static balance [7], patient reported functional changes [8,1,7] or changes in plantar pressures in a diabetes population [9].

The aim therefore of this study was to explore the effect of mechanical debridement of plantar callosities on temporal and spatial aspects of gait.

Methods and materials

Study design

This study was conducted as a single arm, non-blinded proof of concept study.

Participants

Participants were recruited from the Podiatry Care Unit of University of Malaga: in order to avoid bias selection on behalf of the investigators, every third sequential patient who attended the clinic for treatment of painful plantar callosities were invited to participate. The exclusion criteria included patients who had lower limb surgery in the last 12 months; significant systemic comorbidities such as rheumatoid arthritis, Parkinson's disease or diabetes; painful cutaneous conditions such as plantar warts; an inability to complete the questionnaires; or a history of sharp scalpel debridement of callosities in the previous 6 months.

The study protocol was in accordance with standard ethical and human research principles.

Written informed consent for participation and publication was given of each patient, including the publication of photographs. The ethical approval was granted from CEUMA 2013-0012-H. University of Malaga. All patients received an informed consent form that explained the study that was to be held, and that they returned signed.

Intervention

The treatment was sharp scalpel debridement of painful forefoot plantar callosities. The sharp scalpel debridement protocol received by the patients consisted of the removal of the plantar callosities [10], including corns, with a scalpel blade by a podiatrist with 20 years of experience (IGP). The callosities were reduced using a number 3 scalpel handle with a number 10 or 15 scalpel blade and in accordance with standard practice for infection control [3,11].

Data collection

Patient Reported Outcomes: Prior to treatment, sociodemographic data (age, gender) and anthropometric data (Body Mass Index and shoe size) were collected (Table 1). Foot pain was assessed using a visual Analogic Scale (VAS). A common assessment of intensity of pain associated with their plantar callosities where a 100 mm line anchored by two extremes of pain, with 0 representing no pain and 100 as pain as worse as it could be. VAS is quick to administer [12] and demonstrates good validity and reliability [13,14] and has been used for measuring patient's perception on relief foot pain in podiatry treatment [15]. The VAS was administered prior to treatment and then when they came back 24 h later.

Spatial and temporal aspects of gait

Prior to treatment and twenty-four hours later, participants completed a quantitative gait assessment: this time period was considered important in order to avoid any short term tenderness sometimes

Table 1 Anthropometrical data.

N (34)	Means (SD)	C.I. 95%
Age	29.00 (11.57)	24.42e33.58
Body Mass Index	23.32 (3.39)	21.98e24.66
Shoe size	39.67 (2.85)	38.54e40.80
Gender (male/female)	14e20	

SD: Standard Deviation; C.I. Confidence Interval.

Table 2 Changes in the foot pain before/after the treatment.

	Baseline		Post		Post treatment difference		p Value
	Mean(SD)	C.I. 95%	Mean(SD)	C.I. 95%	Mean(SD)	C.I. 95%	
Pain	77.0(9.9)	73.3e80.7	9.3(7.8)	6.3e12.6	67.7	64.2e71.3	<0.001

SD: Standard Deviation; C.I. Confidence Interval.

reported by patients following debridement. Gait variables were measured using the Win-Track system (MEDICAPTEURS Technology, France), a pressure platform which captures temporal and spatial aspects of gait [16]. Variable collected included the following: time in single stance (ms), Cadence (steps/min), step duration for both limbs (ms), gait cycle duration (ms), double-stance duration (ms), swing duration for both limbs (ms), Stride duration (ms, right), stride length of both limbs (cm), step length for both limbs (cm), Gait cycle length (cm, right), angle of progression both feet (degrees) [16]. A member of the research team not involved with the treatment collected the gait data (ABOA).

Sample size

As an exploratory study investigating the effect of mechanical debridement on gait, sample size calculations were not performed [17]. We assumed a 10% loss during follow-up, so that a final total of 34 subjects were recruited.

Data analysis

Our strategy for gait analysis included the following: first, all data were explored for the normality of data frequency distribution using the KolmogoroveSmirnov statistic with a Lilliefors significance level. Once we determined that the data was normally distributed, a student's T-test was used as inferential proof for related samples. The statistic criterion level of significance was $p < 0.05$. SPSS v. 19.0 (SPSS Inc., USA) was used to perform the statistical calculations.

Results

Thirty four patients (20 women) were recruited with painful forefoot plantar callosities, with an average age of 29 years. Participant characteristics are included in Table 1. All participants completed the study. The mean VAS pain rating before treatment was 77 mm (SD ¼ 9.9, 95% CI 73.3e80.7). Pre and post treatment values for pain are presented in Table 2 and for gait characteristics in Table 3.

While there was a significant reduction in pain measurement of 67.7 mm twenty four hours following the mechanical debridement ($p < 0.001$, 95 CI ¼ 64.2e71.3), there were no differences in any of the gait parameters pre and post treatment.

Discussion

This is a single arm, non-blinded proof of concept study, designed to explore the effect of mechanical debridement of plantar callosities of the feet in modifying the temporal and spatial parameters of gait. Our results suggest that while the treatment had an effect in reducing pain, there were no changes on gait parameters, such as gait angle, step cadence or step duration.

The study was carried out by using healthy patients, between 18 and 50 years old, who only presented with painful plantar calluses.

While our study demonstrated no effect on gait parameters, it is consistent with other studies investigating pain. Balanowski et al. show the effectiveness of the mechanical debridement of plantar keratosis [7], observing that pain decreases significantly and increased in patient reported functional capacity, they also found no changes are detected on static balance after removing calluses with a scalpel. While Menz's study on patient reported functional capacity and static balance [18], show that the presence of other foot problems, particularly pain, decreases balance and functional capacity. As the aim of mechanical debridement is to reduce pain, it has the potential to increase mobility and the independence of the elderly. This is directly related to our data, in which we do not observe a relation between gait parameters and a mechanical debridement of calluses, although those authors only observe functionality.

As a proof of concept study, our study had several limitations. First, we had no control group: any changes before or after treatment may be associated with a placebo effect. While we did demonstrate that VAS for pain did detect change, the gait parameters did not. We used temporal and spatial gait parameters, which to our knowledge from review of the literature has never been used

Table 3 Changes in the step before/after the treatment.

	Baseline means(SD)	Baseline CI 95%	Post treatment means(SD)	Post treatment CI 95%	Pre and post treatment difference(mean, 95% CI)	p Value
Cadence(number/min)	150.73(173.71)	(67e234.46)	145.76(174.77)	(61.53e230)	4.96 (-14.48 to 12.74)	0.896
Step duration (ms; left)	678.78(467.56)	(453.42e904.14)	652.11(263.08)	(525.30e778.91)	26.67 (-188.26 to 209.25)	0.914
Step duration (ms; right)	616.68(358.09)	(444.08e789.27)	603.16(272.47)	(471.83e734.49)	13.52 (-433.74 to 1203.50)	0.182
Gait cycle(ms)	1387.37(446.02)	(1172.39e1602.34)	1187.63(331.42)	(1027.89e1347.37)	199.74 (-143.27 to 429.04)	0.314
Double-stance duration(ms; right)	284.47(127.81)	(222.87e346.08)	388.16(452.95)	(169.84e606.48)	-103.69 (-387.09 to 155.55)	0.388
Swing duration(ms; left)	1370.79(449.28)	(1154.24e1587.34)	1341.58(422.60)	(1137.89e1545.27)	29.21 (-310.88 to 326.19)	0.961
Swing duration(ms; right)	1446.84(278.56)	(1312.58e1581.11)	1289.21(518.84)	(1039.14e1539.28)	157.63 (-74.82 to 431.74)	0.709
Stride duration(ms; right)	1426.58(910.53)	(987.71e1865.44)	1662.89(762.91)	(1295.18e2030.61)	-236.31 (702.08e1504.51)	0.709
Stride length(cm; right)	521.43(957.52)	(59.92e982.94)	71.11(217.83)	(-33.87 to 176.10)	450.31 (-181.36 to 651.21)	0.256
Step length(cm; left)	500.68(79.94)	(462.15e539.22)	555.26(126.39)	(494.34e616.18)	-54.58 (-138.19 to 66.96)	0.481
Step length(cm; right)	502.05(83.05)	(462.02e542.08)	544.89(206.74)	(445.25e644.54)	-42.84 (-85.02 to 75.87)	0.908
Gait cycle length(cm; left)	903.42(347.81)	(735.78e1071.06)	964.68(262.06)	(838.37e1091.00)	-61.26 (-250.71 to 177.94)	0.73
Gait cycle length(cm; right)	918.16(346.10)	(751.34e1084.98)	946.95(351.40)	(777.58e1116.32)	-28.79 (-143.78 to 113.70)	0.812
Angle(degrees; left)	4.97(3.875)	(3.11e6.84)	5.61(3.72)	(3.82e7.41)	-0.63 (-2.056 to 1.056)	0.514
Angle(degrees; right)	5.37(6.51)	(2.18e8.46)	6.77(4.70)	(4.10e8.75)	-0.90 (-2.35 to 3.42)	0.705

SD: Standard Deviation; C.I. Confidence Interval.

before. Lack of change may be associated several issues including lack of sensitivity to change or too small sample size. Given the importance of the question, (i.e. does reduction in plantar pain associated with mechanical debridement of painful plantar callosities result in changed gait), further research is needed. More complex gait quantification is recommended, including dynamic plantar pressures or 3D kinematic measures of gait in addition to other methodological issues, such as increasing the sample and to use a control group.

Conclusions

Our study suggests that patient with painful plantar callosities experience an improvement in pain following mechanical debridement. There is no evidence that the parameters of gait investigated in this study using Win-Track platform change following debridement of plantar callosities.

Conflict of interest

All the authors declare that they have no conflict of interest derived from the outcomes of this study.

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