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Phantom limb pain after amputation in diabetic patients does not differ from that after amputation in nondiabetic patients

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ABSTRACT

There is a commonly held belief that diabetic amputees experience less phantom limb pain than nondiabetic amputees because of the effects of diabetic peripheral neuropathy; however, evidence to verify this claim is scarce. In this study, a customised postal questionnaire was used to examine the effects of diabetes on the prevalence, characteristics, and intensity of phantom limb pain (PLP) and phantom sensations (PS) in a representative group of lower-limb amputees. Participants were divided into those who had self-reported diabetes (DM group) and those who did not (ND group). Participants with diabetes were further divided into those with long-duration diabetes (>10 years) and those with short-duration diabetes. Two hundred questionnaires were sent, from which 102 responses were received. The overall prevalence of PLP was 85.6% and there was no significant difference between the DM group (82.0%) and the ND group (89.4%) ($P = 0.391$). There was also no difference in the prevalence of PS: DM group (66.0%), ND group (70.2%) ($P = 0.665$). The characteristics of the pain were very similar in both groups, with sharp/stabbing pain being most common. Using a 0–10 visual analogue scale, the average intensity of PLP was 3.89 (±0.40) for the DM group and 4.38 (±0.41) for the ND group, which was not a statistically significant difference ($P = 0.402$). Length of time since diagnosis of diabetes showed no correlation with average PLP intensity. Our findings suggest that there is no large difference in the prevalence, characteristics, or intensity of PLP when comparing diabetic and nondiabetic amputees, though a larger adjusted comparison would be valuable.

1. Introduction

Phantom limb pain (PLP), the sensation of pain originating from an area of body tissue that is not physically present, is a common phenomenon, which affects around 80% of lower-limb amputees [3,4,8]. Often, amputees also describe an awareness of nonpainful phantom sensations (PS) such as itching or pins and needles originating from the phantom limb; studies have shown that these nonpainful sensations are almost as prevalent as PLP [3].

Traditionally, amputees with diabetes are thought to experience less PLP [1,2]. Longstanding peripheral neuropathy reduces all sensations perceived from the lower limbs and, as such, patients with diabetes and associated neuropathy are believed to perceive less pain from the phantom limb after an amputation. While large studies have shown that the incidence of PLP is independent of age, gender, and level of amputation [4,8], data on what effect the presence of diabetes or peripheral neuropathy may have are notably scarce.

PLP can be experienced in many different forms. Literature describes a sharp/stabbing sensation as the most common type of pain, with aches and shooting pain also being highly prevalent [3]. There are, however, no data suggesting how a preexisting neuropathy might affect the characteristics of pain perceived from a phantom limb.

To address the lack of detailed information on the effects of diabetic neuropathy on PLP and PS, we designed a customized postal questionnaire, which was sent by post to 200 recent lower-limb amputees receiving mobility rehabilitation. The main outcome measures were the prevalence of PLP and PS, the most common characteristics of PLP, and the average intensity of PLP measured using a 0–10 visual analogue scale (VAS).

For the comparisons in this study, the experiences of diabetic ("DM") and nondiabetic ("ND") cohorts were examined. Though

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neuropathy was not formally assessed, it is assumed that the diabetic cohort have, on average, more marked peripheral neuropathy than the nondiabetic cohort.

2. Methods

2.1. Study population

The Specialist Mobility Rehabilitation Centre (SMRC) is a facility that provides specialist wheelchair, artificial limb, and orthotic services for the population of Lancashire and South Lakeland. After ethical approval was gained through an institutional review board (Lancashire Teaching Hospitals), the patient database from the SMRC was used to generate a list of patients who had recently had a lower-limb amputation. These patients were identified to receive a postal questionnaire.

Subjects selected for inclusion in the study were those who had had one or more lower-limb amputations in the preceding 3 years. Those who had had an amputation <3 months preceding the start of the study (June 2010) were excluded under the rationale that their wound may not yet be completely healed. Stump pain has a close relationship with PLP [6,8], therefore it was undesirable to include patients whose level of stump pain had not yet plateaued due to a recent surgical wound. Participants who indicated that they had recently suffered trauma to their amputation stump were excluded on the same basis. Those under the age of 18 years and whose amputation was of digits only were also excluded from the study. Amputees known to have had an amputation on both lower limbs were sent an additional copy of the questionnaire and were asked to fill out the questions regarding PLP for each limb.

2.2. Questionnaire

Questionnaires were sent by post along with an explanatory letter including contact details for questions and a prepaid envelope for their return. There was no suitable standardised questionnaire available, thus a customized questionnaire had to be created (see Appendix 1: questionnaire). Questionnaires were not made anonymous so that patients could be contacted for further information if needed. Results were anonymised once the data set for each patient was complete.

2.3. Statistical methods

Diabetic and nondiabetic groups were compared. Continuous variables such as "age" and "PLP intensity" are presented as the arithmetic mean ± 1 SE. For "age," the Mann–Whitney *U* test was used to calculate statistical significance when comparing groups; for other continuous variables, unpaired *t*-tests were used. Binary data such as "sex" and "experience phantom limb sensations – yes/no" are presented as the total number and percentage; for these data, Fisher's exact test was used to determine statistical significance when comparing groups. The Pearson correlation coefficient was used to measure correlation between variables (such as age and PLP intensity on VAS). We did not consider data statistically significant unless $P \leqslant 0.05$.

3. Results

3.1. Response rate

Of the 200 patients who received a questionnaire, 114 (57%) responded within 3 weeks. Ninety of the returned questionnaires were complete and in a useful condition initially, and after telephoning to gather missing data, the final number of responses suitable for analysis was 102 (51%). The remainder of the forms were not usable because they were incomplete and the participant could not be contacted by telephone. Of the 102 complete replies, 11 were from bilateral amputees. Therefore, the total number of accounts of PLP was 113.

3.2. Stump trauma

Participants were asked to state if they had recently suffered any trauma to their stump. Limbs with recent stump trauma produced significantly higher average PLP scores (5.69 ± 0.59 out of 10 on VAS), compared to limbs with no recent stump trauma (4.13 ± 0.29) ($P = 0.0416$). In order to prevent this variable from skewing later data analysis, respondents who had indicated that they had recently suffered trauma to their stump were excluded from the remainder of the study. After exclusion of amputees with stump pain, the total number of accounts of PLP was 97. This represents the data from 79 unilateral amputees and 9 bilateral amputees.

3.3. Demographics

The average age of the respondents was 69 years, and there was no significant difference in the average age of the respondents with diabetes (70.5 ± 1.45) and without diabetes (67.9 ± 1.45) ($P = 0.61$). Similarly, there was no difference in the proportion of males to females when comparing the DM group (73% male) and ND group (also 73% male) (Table 1).

Demographics had no effect on average PLP intensity. Men experienced an average PLP intensity of 4.13 ± 0.34 on the VAS, while women experienced an average PLP intensity of 4.12 ± 0.68 ($P > 0.99$). Using the Pearson correlation coefficient, we also determined that there was no relationship between PLP and age (Pearson coefficient $[r] = -0.106$, $r^2 = 0.0113$, $P = 0.299$).

There was a small numerical difference when comparing the average PLP intensity between transtibial and transfemoral amputees (3.89 ± 0.39 and 4.59 ± 0.59, respectively), however, this was not statistically significant ($P = 0.26$).

3.4. Phantom limb pain in diabetic and nondiabetic groups

Table 2 shows the respondents reported experiences of PLP and PS. Subjects were said to "experience PLP" if they stated that they experienced one or more types of PLP (e.g., burning) or if they rated

Table 1
Demographics and amputation characteristics of study group.

	Total (n = 88)	Diabetic group (n = 44)	Nondiabetic group (n = 44)	P value
Age (years)				
Mean ± SEM	69.2 ± 1.27	70.5 ± 1.45	67.9 ± 1.45	0.61
Range	28–95	45–95	28–92	–
Male	64 (72.7%)	32 (72.7%)	32 (72.7%)	>0.99
Female	24 (27.3%)	12 (27.3%)	12 (27.3%)	>0.99
Amputation level	Total (n = 97)	Diabetic group (n = 50)	Nondiabetic group (n = 47)	
Hip disarticulation	1 (1%)	0 (0%)	1 (2%)	–
Transfemoral	34 (35%)	11 (22%)	23 (49%)	0.0063
Knee disarticulation	1 (1%)	0 (0%)	1 (2%)	–
Transtibial	60 (62%)	39 (78%)	21 (45%)	0.001
Partial foot	1 (1%)	0 (0%)	1 (2%)	–
Mean time since amputation (years)	1.63 ± 0.20	1.56 ± 0.22	1.70 ± 0.34	0.725