Skin Problems of the Stump in Lower Limb Amputees

Meulenbelt, Henk E. J.; Geertzen, Jan H. B.; Jonkman, Marcel F.; Dijkstra, P.U.

Published in:
Acta dermato-venereologica

DOI:
10.2340/00015555-1023

Publication date:
2011

Acta Derm Venereol 2011; 91: 178–182

CLINICAL REPORT

Skin Problems of the Stump in Lower Limb Amputees: 2. Influence on Functioning in Daily Life

Henk E.J. MEULENBELT[1], Jan H.B. GEERTZEN[1], Marcel F. JONKMAN[2] and Pieter U. DIJKSTRAA[1,3]
Departments of [1]Rehabilitation Medicine, [2]Dermatology and [3]Oral and Maxillofacial Surgery, University Medical Center Groningen, University of Groningen, Groningen, the Netherlands

The aim of this study was to analyse the influence of stump skin problems on functioning in daily life in lower limb amputees. A cross-sectional study was performed by means of a questionnaire containing 9 questions assessing functioning in daily life. Question scores were added to give a total score (range 0 (no influence) to 27 (maximum negative influence)). Two thousand and thirty-nine people were invited to participate, with 805 participants completing a questionnaire. Of these, 507 reported one or more skin problems. Skin problems had a negative influence on ability to perform household tasks, prosthesis use, social functioning, and participation in sports. The mean total score was 5.5 ± 4.1. This correlated significantly with the number of skin complaints (r = 0.483; *p* = 0.01). In linear regression analyses, gender (β = -0.15) and number of skin problems (β = 0.25) accounted for 23% of the total score. This study confirms the influence of skin problems on functioning in daily life. *Key words: skin problems; amputation; lower limb; quality of life.*

(Accepted August 10, 2010.)

Acta Derm Venereol 2011; 91: 178–182.

Henk E.J. Meulenbelt, Department of Rehabilitation Medicine, University Medical Center Groningen, University of Groningen, Hanzeplein 1, PO Box 30.001, NL-9700 RB Groningen, The Netherlands. E-mail: H.E.J.Meulenbelt@rev.umcg.nl

Basic epidemiological data on skin problems of the stump in lower-limb amputees remain scarce (1). As an example, skin problems of the stump may affect functioning in daily life by reducing the length of time for which prostheses are worn. Clinicians treating a skin problem of the stump may instruct the amputee not to wear the prosthesis to support healing. However, such observations are anecdotal (2–5).

Several instruments have been developed and used in the field of dermatology to improve our understanding of the influence that skin problems may have on participation, perceived quality of life (QoL) and the results of treatment (6).

In the field of rehabilitation medicine there is increased interest in using QoL as an outcome in studies evaluating either the influence of a certain condition or the result of a rehabilitation program. However, it is still a challenge to properly measure QoL (7).

Based on this increased interest in the perceived QoL of amputees, it may be interesting to evaluate the influence of skin problems of the amputation stump on functioning in daily life.

To the best of our knowledge, no literature is available concerning the influence of skin problems on functioning in daily life in lower-limb amputees, although this question has been posed (8). The aim of this study was to analyse the influence of skin problems of the amputation stump on functioning in daily life, and to investigate if there is a relationship between the total number of stump skin problems and the use of prostheses.

MATERIALS AND METHODS

To assess the influence of skin problems on functioning in daily life, questions from the Dermatology Life Quality Index (DLQI) were used. The DLQI is a valid and reliable instrument for measuring the influence of skin problems on QoL (9).

Nine questions from the DLQI were adapted specifically for lower-limb amputees. Since we wanted to assess the influence of skin problems on the length of time for which prostheses could be worn by participants, we adapted one question concerning the influence of skin problems on the clothes someone wears by replacing the word "clothes" with "prosthesis". The question concerning skin sensations (how "itchy, sore, painful or stinging" the skin was) was omitted as it did not assess activities. Instead, these skin sensations were added to the list of skin problems participants could choose from. Furthermore, the DLQI's timeframe ("over the last week") was changed to "over the last month", since this was the timeframe of the questionnaire in which the questions were present. The scores for each question were added, giving a total score with a minimum value of zero (no influence on functioning) and a maximum of 27 (maximum negative influence on functioning). The questions and the response options are summarised in Appendix SI (available at http://www.medicaljournals.se/acta/content/?doi=10.2340/00015555-1023.)

The questions were part of a questionnaire, which, in a previous study, had been used to identify skin problems and determinants of skin problems of the stump in lower-limb amputees (10). The questionnaire consists of a series of open and multiple-choice questions. It assesses the following parameters: demographics, characteristics of the amputation and prosthesis (whether the amputee had a liner, or used stump socks or other materials between the socket and his/her skin), activity level of the amputee, stump and prosthesis hygiene, and skin problems. The timeframe for reporting skin problems was the month prior to receiving

the questionnaire. Participants who reported one or more skin problems were asked to answer the questions concerning the influence of these skin problems on functioning in daily life.

Subjects

Lower-limb amputees who were at least 18 years of age and had received their prosthesis through the OIM (Orthopedische Instrument Makerij: an orthopaedic workshop), or were member of the National Society of Amputees (LVvG: Landelijke Vereniging van Geamputeerden), were sent a letter inviting them to participate. This group of potential participants represents approximately 25% of the Dutch population of lower-limb amputees who use a prosthesis. Persons willing to participate returned a written form with their name and address. Our questionnaire was then sent to each participant to be completed and returned to us using a pre-paid envelope. If a returned questionnaire had missing data, an effort was made to retrieve them either through telephone contact or by re-sending the questionnaire with the missing answers highlighted. Non-respondents received a reminder by telephone or, if no number was available, by post.

Data entry

Answers to the questionnaire were entered into a database. All participants were able to report the year of their amputation. If the day of the month was unknown, the fifteenth of that month was entered as the date of amputation. If the month was missing, the first of July of that year was entered as the date of amputation. These assignments were made to allow assessment of the influence of time since amputation. If a participant reported more than one reason for amputation (e.g. trauma and infection or diabetes and infection), the most logical cause based on pathophysiological evidence was chosen and entered into the database. Due to similarities in their pathophysiology, peripheral arterial disease and diabetes were entered as a single reason for amputation.

For participants who had undergone a bilateral amputation ($n = 30$), the following procedure was followed. When both lower limbs were amputated at the same level, we determined on which side the skin problems were reported and used that side in statistical analyses ($n = 6$). When a participant reported similar skin problems on both residual limbs, one side was randomly chosen for analysis ($n = 11$). If it was not reported which stump had been affected by skin problems, the available data were checked to determine whether the participant had reported the occurrence of skin problems in the month prior to filling in the questionnaire. In such cases ($n = 6$), one side was randomly chosen for analysis. When the participant's two limbs had been amputated at different levels, we verified whether the stump more affected by skin problems had been identified. If so, this side was used in the statistical analyses ($n = 7$). All data were checked for correct entry.

Data analysis

Data analysis was performed using SPSS 16.

Determinants were entered backwards stepwise in a linear regression analysis with the total score as the outcome. The determinants were selected, using clinical experience, based on the hypothesis that they might influence functioning in daily life (Table I). If a determinant was ordinal in the questionnaire it was dichotomised prior to analysis (rendering it either "present" or "absent"). The chosen determinants were tested for multicolinearity.

When conducting the linear regression analysis with total score as the outcome measure, the residuals were not normally distributed. Thus, one of the assumptions of linear regression was not met.

Table I. *Summary of the determinants analysed in the regression analysis*

Age (years)
Gender
Time since last amputation (years)
Amputation level
Reason for amputation
Bilateral amputation
Marital status
Level of education
Presence of co-morbidity
Complaint affecting the non-amputated leg
Use of a liner
Use of a walking aid
Smoking
Frequency of stump washing
Complaint of smell when doffing prosthesis
Previous use of a different prosthesis
Number of skin problems reported

As a result, we transformed the total score by taking the square root of each total score and using it as the outcome measure in the analysis. The resulting residuals followed a normal distribution. Determinants which had a statistically significant association with the total score were analysed to evaluate if the mean total score differed between the group where the determinant was present and the group where the determinant was absent. To analyse the association between number of skin problems reported and total score, a Pearson correlation coefficient was calculated. A one-way ANOVA was performed to measure the association between number of skin problems and prosthesis use.

RESULTS

A total of 2,039 persons were invited to participate. The initial number was 2,142, but we discovered that some people had received two invitations as a result of their satisfying both the OIM and LVvG inclusion criteria. Of the 1,082 respondents, 872 agreed to participate. Eight-hundred and sixteen questionnaires (40%) were eventually returned of which 805 were suitable for statistical analysis.

A total of 507 participants (63%) reported one or more skin problems in the month prior to receiving the questionnaire. Their characteristics are summarised in Table II.

Most amputations were either transtibial (49%; $n = 249$) or transfemoral (32%; $n = 163$). The most common reasons for amputation were trauma (44%; $n = 225$) and peripheral arterial disease/diabetes (23%; $n = 117$). One-hundred and seventy participants (34%) had a paid job. Sixty-one percent ($n = 310$) walked less than 500 m/day. Fifty percent used a liner.

The reported symptoms are listed in Table III. The most frequently reported skin problems were profuse sweating (50%; 95% CI: 46–55), redness of the skin persisting for more than one minute after doffing of the prosthesis (46%; 95% CI: 42–51), and sensitive skin (36%; 95% CI: 32–40). Of the participants who reported one or more skin problems, 25% (95% CI: 21–29) were forced to wear their prosthesis less frequently as a result of the skin problem.

Table II. *Characteristics of the participants who reported skin problems (*n = *507)*

Characteristics	
Age, years, mean (SD)	58 (15)
Time since last amputation, years, mean (SD)	20 (18)
Gender, *n* (%)	
Male	298 (59)
Female	209 (41)
Amputation level, *n* (%)	
Transtibial	249 (49)
Knee-exarticulation	54 (11)
Transfemoral	163 (32)
Hip/pelvis	11 (2)
Bilateral	30 (6)
Reason for amputation, *n* (%)	
Peripheral arterial disease/diabetes	117 (23)
Trauma	225 (44)
Oncology	75 (15)
Congenital	22 (4)
Infection	27 (6)
Other	41 (8)
Presence of co-morbidity, *n* (%)	240 (47)
Smoking, *n* (%)	141 (28)
Paid job, *n* (%)	170 (34)
Use of a walking aid, *n* (%)	303 (60)
Walking distance (m/day), *n* (%)	
0–99	131 (26)
100–199	88 (17)
200–499	91 (18)
500–1000	86 (17)
>1000	111 (22)
Use of a liner, *n* (%)	252 (50)
Participation in sport, *n* (%)	179 (35)
Participation in sport with prosthesis, *n* (%)	118 (23)
Frequency of stump washing , *n* (%)	
0–4 times/week	115 (23)
>4 times/week	392 (77)
Use of prosthesis indoors, *n* (%)	
0–49 %	119 (23)
50–100%	388 (77)
Prosthesis use (h/day), *n* (%)	
0–8	79 (16)
>8 h/day	428 (84)
Skin problem(s)[a], *n* (%)	476 (94)

[a]>1 month prior to filling in the questionnaire. SD: standard deviation.

Table III. *Skin problems in the month prior to filling in the questionnaire*

Skin problem	*n* (%)[a]
Itching[b]	144 (28)
Sensitive skin[b]	183 (36)
Prickly skin[b]	77 (15)
Painful skin[b]	124 (24)
Profuse sweating	256 (50)
Cold skin	65 (13)
Warm skin	66 (13)
Skin redness persisting for >1 min after prosthesis doffing	235 (46)
White/blue skin	77 (15)
Swelling	78 (15)
Pimples	139 (27)
Blisters	150 (30)
Crusts	41 (8)
Corn/callus	117 (23)
Abrasion	120 (24)
Existing wound	39 (8)
Infection	10 (2)
Mechanical problems	30 (6)
Other	29 (6)

[a]Many participants reported multiple skin problems; percentages represent the proportion of participants reporting particular skin problems.
[b]These problems were assessed using a 4-point scale ("none", "light", "moderate", "severe"), and the results dichotomised (none/light = "absent", moderate/severe = "present").

On average, 2.9 ± 1.7 skin problems per participant were reported in the month prior to receiving the questionnaire (Fig. 1).

The responses to questions concerning the influence of skin problems on functioning in daily life are summarised in Table IV. Notably, ability to perform household tasks, prosthesis use, social functioning, and participation in sport were negatively affected by the presence of skin problems.

A total of 498 participants reported that the question relating to the influence of skin problems on prosthesis use was applicable. Subdivision of these participants by their response gave the following results: "not at all" (2.2 ± 1.7 skin problems), $n = 172$; "a little" (2.9 ± 1.4 skin problems), $n = 201$); "a lot" (3.6 ± 2.0 skin problems), $n = 88$; and "very much" (4.1 ± 1.7 skin problems), $n = 37$).

One-way ANOVA revealed the existence of statistically significant inter-group differences ($F_{3,494} = 25.50$; $p < 0.01$). The median (IQR) total score was 5 (2 to 8). The Pearson correlation between number of skin problems and total score was 0.48 ($p = 0.01$). The results of the linear regression analyses are summarised in Table V.

Determinants with statistically significant associations with total score were gender and number of reported skin problems. Males (5.2 ± 4.0) had a significantly lower mean total score than females (6.0 ± 4.3) ($p = 0.03$; Mann-Whitney U test). The interaction between these two determinants was tested, but it did not contribute significantly to the model. To

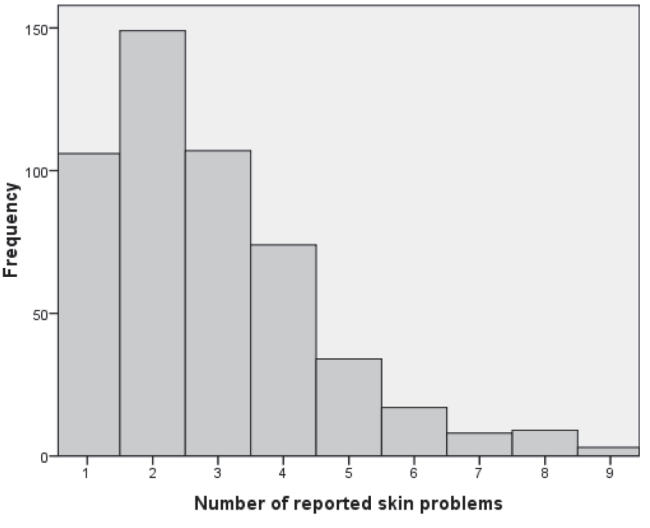

Fig. 1. Frequency of reported skin problems in participants reporting at least one skin problem.

Table IV. *Responses to questions concerning the influence of skin problems on functioning in daily life*

Parameter[a] (*n*[b])	% (*n*)[c]
Household tasks (454)	28 (172)
Use of prosthesis (498)	25 (125)
Social functioning (473)	21 (99)
Participation in sport (230)	15 (35)
Labour (277)	9 (25)
Treatment (377)	9 (34)
Embarrassment (507)	3 (15)
Relationships (458)	3 (14)
Sex (375)	3 (11)

[a]Each parameter was investigated using a 4-point scale ("none", "light", "moderate", "severe"), with the additional option of reporting that it was not applicable.
[b]Number of respondents for whom the parameter was applicable.
[c]Percentage and number of participants who reported that their skin problems were of moderate or severe influence on a specific parameter.

analyse possible cumulative effects of multiple skin problems, the square of the number of skin problems was also entered in the analysis. It did not contribute significantly to the regression analysis. Gender and number of reported skin problems accounted for 23% of the variance of the total score.

On the basis of the results of the regression analyses, the average total score can be estimated. For example, a female reporting four skin problems has a regression score of 2.53 ($1.53 + (0 \times -0.15) + (4 \times 0.25)$). Since the square root of the total score was used as the outcome measure, this outcome must be multiplied by itself to obtain the total score. The estimated average total score for a person with these characteristics would therefore be 6.4 (2.53×2.53), meaning that her present skin problems have a minor to moderate effect on her functioning in daily life (11).

DISCUSSION

Number of skin problems and gender were significantly associated with the influence of skin problems on functioning in daily life in lower-limb amputees. Determinants considered to be of potential influence prior to the study (see Table I), such as level of amputation, co-morbidity and age, which have all been found to influence the rehabilitation process (12), did not contribute significantly to the regression equation. To avoid obvious interactions between the model and the total score, we did not include determinants that were assessed by the nine questions, such as employment status and participation in sport (see Appendix SI).

Table V. *Linear regression model for predicting total score (*$R^2 = 0.23$*)*

Determinant (and coding)	beta	SE	*p*
Gender (male=1, female=0)	–0.15	0.07	0.03
Number of skin complaints reported	0.25	0.02	<0.001
Constant	1.53	0.08	<0.001

SE: standard error.

Concerning gender, the mean total score was significantly higher in female participants than in males, suggesting that skin problems of the stump have a greater influence on functioning in daily life in the former. This might be explained by the results of a previous study, which assessed self-reported skin problems. In that study, female gender was found to increase the risk of skin problems (10). This result should be interpreted with caution, as self-reported skin problems correlate poorly with observed skin problems (13). Nevertheless, an explanation for the increased risk of skin problems may be that females tend to give more attention to medical problems (14).

In the linear regression model, only 23% of the variance in the total score could be accounted for. This low percentage indicates the likely existence of other determinants that were not assessed in this study. Perhaps in future studies determinants that were not assessed in this study, e.g. characteristics of the prosthesis or other characteristics of the activity level of the amputee, should be assessed more specifically.

The clinical implication of the total score of the regression model has yet to be established. A previously published guideline for the DLQI (11) may be of some assistance in enhancing conversion of the total score to a score that can be used in clinical practice. However, this guideline is based on the scores of the original DLQI from which our questionnaire was adapted. Thus, direct comparison is not possible. Nevertheless, it provides an indication of the impact of skin problems affecting the amputation stump on functioning in daily life. Measuring changes in total score over time may give an indication of the success of skin treatments.

A significant relationship was found between the number of skin problems reported and the reported influence of skin problems on the use of prostheses. The magnitude of this influence may differ between lower-limb amputees, dependent on their need to use of their prostheses while performing certain activities. Research has shown that lower-limb amputees who usually perform recreational activities using a prosthesis are also able to perform these activities without a prosthesis, but with decreased ability (15). Thus, the influence of skin problems on functioning in daily life will vary depending on the activities undertaken and the need for a prosthesis to perform those activities. Most of the questions use a 5-point Likert scale ("very much"/"a lot"/"a little"/"not at all"/"not relevant"), and it is therefore possible to assess the impact of skin problems using an ordinal scale. However, it cannot establish whether the influence of a skin problem on a particular activity is primarily caused by the skin problem or the fact that the prosthesis cannot be worn. The initial activity level of an amputee may also influence

the extent to which his/her skin problems affect his/her functioning in daily life. Finally, the use of a total score may be inadequate to assess specific problems, only giving a general impression of the influence of skin problems of the stump on functioning in daily life. It is known that loss of mobility, problems with prostheses, and participation in social activities (which may be negatively influenced by skin problems, as reported by 25% of participants (see Table IV)) are predictors of perceived QoL (16). A qualitative study incorporating a semi-structured interview may provide further information regarding the influence of skin problems on functioning in daily life. Such a study could seek to assess the activity levels of amputees prior to the development of skin problems.

Several methodological factors may have influenced the results of this study, including several types of bias. A postal questionnaire may lead to information bias if participants do not answer the questions adequately. Selection bias may have occurred, as not all potential participants were willing to participate. As we have no descriptive data for the non-participants, we are unable to compare the characteristics of the participants and non-participants. There may be recall bias as a result of participants reporting the presence of previous skin problems. The one-month timeframe was specifically chosen to minimise this potential bias.

To the best of our knowledge there is no existing Dutch questionnaire to assess the influence of skin problems on functioning in daily life. The DLQI was chosen as it provides a valid and reliable scale for evaluating the influence of skin problems on QoL (9). We adapted certain questions to make the questionnaire more suitable for lower-limb amputees. These adaptations were made because we found no suitable questions in the literature, and because the questions in the DLQI were, in our opinion, the most suitable available. To facilitate replication in future studies, we present the questions used as an appendix (Appendix SI). As this is the first time this set of questions has been used to assess this problem, validity and reliability cannot be established. In future studies, a question concerning the influence of skin problems on the time for which prostheses can be worn should be included to the original version of DLQI.

Lower-limb amputees were invited by letter to participate in a study concerning skin problems of the stump. The response rate for the 2,039 invitees was 40%. Although it was clearly stated that lower-limb amputees without skin problems were also welcome to participate, they were potentially less likely to respond. The design of this study, a survey based on a postal questionnaire, may have contributed to the low response rate (17).

This low response rate may mean that the results of our study do not fully reflect the true extent of the observed problems. It is not possible to verify any such deviation as no literature addressing the influence of skin problems of the stump on functioning in daily life exists. We performed an explorative study and the questions used may have omitted situations or activities that are problematic for lower-limb amputees who are unable to wear the prosthesis due to skin problems of the stump.

REFERENCES

1. Meulenbelt HE, Dijkstra PU, Jonkman MF, Geertzen JH. Skin problems in lower limb amputees: a systematic review. Disabil Rehabil 2006; 28: 603–608.
2. Hoaglund FT, Jergesen HE, Wilson L, Lamoreux LW, Roberts R. Evaluation of problems and needs of veteran lower-limb amputees in the San Francisco Bay Area during the period 1977-1980. J Rehabil Res Dev 1983; 20: 57–71.
3. Livingston DH, Keenan D, Kim D, Elcavage J, Malangoni MA. Extent of disability following traumatic extremity amputation. J Trauma 1994; 37: 495–499.
4. Otter N, Postema K, Rijken RA, van Limbeek J. An open socket technique for through-knee amputations in relation to skin problems of the stump: an explorative study. Clin Rehabil 1999; 13: 34–43.
5. Koc E, Tunca M, Akar A, Erbil AH, Demiralp B, Arca E. Skin problems in amputees: a descriptive study. Int J Dermatol 2008; 47: 463–466.
6. Finlay AY. Quality of life measurement in dermatology: a practical guide. Br J Dermatol 1997; 136: 305–314.
7. Gallagher P, Desmond D. Measuring quality of life in prosthetic practice: benefits and challenges. Prosthet Orthot Int 2007; 31: 167–176.
8. Dudek NL, Marks MB, Marshall SC, Chardon JP. Dermatologic conditions associated with use of a lower-extremity prosthesis. Arch Phys Med Rehabil 2005; 86: 659–663.
9. Lewis V, Finlay AY. 10 years experience of the Dermatology Life Quality Index (DLQI). J Investig Dermatol Symp Proc 2004; 9: 169–180.
10. Meulenbelt HE, Geertzen JH, Jonkman MF, Dijkstra PU. Determinants of skin problems of the stump in lower-limb amputees. Arch Phys Med Rehabil 2009; 90: 74–81.
11. Hongbo Y, Thomas CL, Harrison MA, Salek MS, Finlay AY. Translating the science of quality of life into practice: What do dermatology life quality index scores mean? J Invest Dermatol 2005; 125: 659–664.
12. Geertzen JH, Martina JD, Rietman HS. Lower limb amputation. Part 2: Rehabilitation – a 10 year literature review. Prosthet Orthot Int 2001; 25: 14–20.
13. Jagou M, Bastuji-Garin S, Bourdon-Lanoy E, Penso-Assathiany D, Roujeau JC. Poor agreement between self-reported and dermatologists' diagnoses for five common dermatoses. Br J Dermatol 2006; 155: 1006–1012.
14. Koopmans GT, Lamers LM. Gender and health care utilization: the role of mental distress and help-seeking propensity. Soc Sci Med 2007; 64: 1216–1230.
15. Legro MW, Reiber GE, Czerniecki JM, Sangeorzan BJ. Recreational activities of lower-limb amputees with prostheses. J Rehabil Res Dev 2001; 38: 319–325.
16. Asano M, Rushton P, Miller WC, Deathe BA. Predictors of quality of life among individuals who have a lower limb amputation. Prosthet Orthot Int 2008; 32: 231–243.
17. Asch DA, Jedrziewski MK, Christakis NA. Response rates to mail surveys published in medical journals. J Clin Epidemiol 1997; 50: 1129–1136.