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## Dermatosis Contributing Factors in Bilateral Lower Limb War-Amputees

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**Abstract:** This study conducted to assess the factors related to skin lesions in bilateral lower limb war-amputees. This is a clinical based, cross-sectional study of 335 bilateral amputees who injured during Iran-Iraq War. Their demographics and injuries detail, amputation, prosthesis and gait-aid characteristics, stump hygiene and skin problems, have been investigated. Through logistic regression analysis, the three factors of the shape of the stumps, the length of the stumps and excessive perspiration were recognized to have an independent association in skin lesions development, among the population studied. The results suggest that most of stump skin disorders in war-injured amputees are due to intensity of injury and awkwardness of the stump. The quality of surgical, medical and rehabilitative care, improve their quality of life by functional ambulation with prosthesis.

**Key words:** Amputee, skin lesion, related factor, war, lower extremity

### INTRODUCTION

The eight years Iran-Iraq war (1980-1988) left more than 578 individuals who have undergone bilateral lower extremity amputation because of a wound suffered during wartime (Almassi *et al.*, 2009). Getting injured in war fields under urgent situations, multiple extremities injuries, organ system damage and young active age presented a special challenge for the rehabilitation team to provide independent ambulation. Most of these amputees require multiple revisions in order to obtain a healed, painless and functional residual limb (Zargar *et al.*, 2007; Huston *et al.*, 1998).

Dermatologic problems are more common in war-amputees (Almassi *et al.*, 2009).

Huston *et al.* (1998) demonstrated that mechanical forces due to poor prosthesis and socket fitting, skin tension, scar location, scar adhesion, ischemia, poor hygiene and hypersensitivity reactions resulted in skin problems development among war-amputees. No other studies found about skin problems contributors in veterans but several determinants causing skin lesions have been suggested in general amputees. These mainly included shear and stress forces, increased humidity, poor prosthetic fitting, poor nutritional skin status, vascular insufficiency, hypersensitivity to chemical compounds, poor hygiene (Levy, 1992; Meulenbelt *et al.*, 2006, 2007)

inappropriate use of socks, prosthesis fitting, hairy/sweaty limb (Dudek *et al.*, 2006); Poor suction-socket adaptation (Sbano *et al.*, 2005; Trindade and Requena, 2009); age, activity level, socket fit, biomechanics and wearing pattern (Lake and Supon, 1997), residual limb and silicone liner washing (Hachisuka *et al.*, 2001).

In the study by Dudek *et al.* (2005), amputation level, being employed, type of walking aid and absence of peripheral vascular disease were independently associated with the presence of skin problems.

In the study by Meulenbelt *et al.* (2009), smoking, use of antibacterial soap and stump washing frequency were implicated as a provocative determinant for skin problems.

This study investigates the skin disorders contributing factors among bilateral lower limb war amputees.

### MATERIALS AND METHODS

All the 578 bilateral lower limbs amputees of the Iraq-Iran war who were members of Iranian Shahid organization and served by the same organization were invited to participate in health assessment project (2006-2007). A multidisciplinary team included physician, dermatologist, orthopedic surgeon, prosthetist, physical therapist and rehabilitation medicine specialist assessed

all participants separately. The members of research team performed reviewing of wartime medical records, updating history and physical examination as well as completion of the questionnaires.

The information was collected consisting of the amputee's age, age at time of injury, sex, education, marriage and employment status, amputation characteristics, smoking history, prosthesis/walking aid usage, stump hygiene and skin problems.

**Statistical analysis:** Multilevel mixed-effects logistic regression model (MMLRM) was fitted for binary/binomial response skin lesion. These models contain both fixed effects and random effects. The fixed effects such as the effect of predictor variables are analogous to standard regression coefficients and are estimated directly. The distribution of the random effects is assumed to be Gaussian. The conditional distribution of the response given the random effects is assumed to be Bernoulli, with success probability determined by the logistic cumulative distribution function (optional). Exchangeable structure was considered for the random effects of right and left limb repetition, which estimate equal variances for random effects and one common pair-wise correlation (Hedeker, 2005). Based on the covariance structure, the analysis was performed by two steps: (1) In the context of the univariate or unadjusted MMLRM, the association of each predictor variable with the skin lesion was evaluated. (2) In the context of the multivariate or adjusted MMLRM, the simultaneous association of each predictor variable with the skin lesion was evaluated, adjusting for other predictor variables. All significant variables from univariate analysis were entered in this step. Odds ratios and their 95% confidence intervals were presented as the effect sizes of the association. As the estimation method, since the log likelihood for this model has no closed form, it is approximated by adaptive Gaussian quadrature (Hedeker, 2005). The p-values <0.05 set as significant. Data were analyzed by STATA 10 statistical software.

## RESULTS

Responses were received from 335/578 (58%). The mean age of the participants at the time of study was  $43.04 \pm 6.32$  years and the mean age at the time of injury was  $22.6 \pm 4.3$  years. Of the amputees, 327 (97.6%) were men, 93 (27%) were employed, 327 (97.6%) were married and 93 (31.6%) were smoker. High school diploma was the most common level of education 107 (40%). Most of the amputees 247 (73.7%) used prosthesis with the help of gait aid for ambulation.

The most common shape of limb was cylindrical, for right limb 189 (56.4%) and left limbs 184 (55%). The most common level of amputation, for both limbs, was below-knee 56.8%. The most common length of limb was standard, for right limb 207 (61.7%) and left limb 230 (68.6%).

Blast injury from grenades (n = 191, 56%), land mine (n = 111, 33%) and bombing (n = 16, 4.7%), caused most of causality. At least 1 skin problem was detected for 189 (56.4%) of the 335 amputees.

Skin problems frequency, based on each individual limb was 37.3% (126/335) for right and same amount for left limb.

Table 1 provides descriptive information for the amputees and for the residual limbs.

**Univariate analysis:** Results of Univariate or unadjusted MMLRM, considering exchangeable correlation structure for the right and left limb repetition is shown in Table 2.

As can be seen, marriage status, age, prosthesis usage, ambulation methods, stump washing frequency, stump type, stump length, amputation level and perspiration status were significantly associated with skin lesion ( $p < 0.05$ ). Based on the results:

Married subjects had about 2.86 (1/0.35) times better outcome than single subjects. With increasing one year in subjects' age, the outcome would be better about 3%.

Prosthesis users had about 2.84 times worse outcome than who not use prosthesis. Ambulation by prosthesis with gait aid and prosthesis by itself had about 2.71 and 3.18 times worse outcome than wheelchair ambulatory, respectively.

Subjects who washed the residual limb daily had about 1.48 times worse outcome than subjects who washed the residual limb 2 to 3 times a week.

Conic shape stumps had about 1.9 times worse outcome and bulbous shape had about 3.7(1/0.27) times better outcome than cylindrical stumps, respectively.

Below-knee amputation had about 1.53 times worse outcome than above-knee amputation. Long stumps had about 1.58 times worse outcome than standard stumps.

Subjects with excessive perspiration had about 3.28 times worse outcome than subjects with normal perspiration.

**Multivariate analysis:** Results of multivariate analysis or adjusted MMLRM based on significant variables in the univariate analysis and by considering exchangeable correlation structure for the right and left limb repetition is shown in Table 3.

Table 1: Descriptive information for amputees and for limbs

	Without skin lesions (n = 146)*	With skin lesion (n = 189)*
<b>Amputees</b>		
Age	43.41±5.6	42.61±6.8
<b>Sex</b>		
Man	144 (98.6%)	183 (96.8%)
Woman	2 (1.4%)	6 (3.2%)
<b>Marriage</b>		
Single	3 (2.1%)	4 (2.1%)
Married	143 (97.9%)	184 (97.4%)
<b>Education</b>		
Primary	37 (25.3%)	34 (18%)
Guidance	28 (19.2%)	40 (21.2%)
Diploma	47 (32.2%)	60 (31.7%)
Post Diploma	9 (6.2%)	13 (6.9%)
BS	19 (13%)	27 (14.3%)
MS and PhD	6 (4.1%)	15 (8%)
<b>Occupation</b>		
No	106 (72.6%)	136 (72%)
Yes	40 (27.3%)	53 (28%)
<b>Smoking</b>		
No	105 (72%)	124 (65.6%)
Yes	41 (28%)	65 (34.3%)
<b>Excessive perspiration</b>		
No	74 (50.7%)	41 (21.7%)
Yes	75 (49.3%)	148 (78.3%)
<b>Ambulation by</b>		
Wheelchair	30 (20.5%)	29 (15.3%)
Prosthesis	14 (9.6%)	15 (7.9%)
Prosthesis and gait aid	102 (60%)	145 (76.7%)
<b>Stump washing frequency</b>		
Every day	67 (46%)	96 (50.8%)
3-4 time/week	79 (54.1%)	93 (49.2%)
	Without skin lesions (n = 209)**	With skin lesions (n = 126)**
<b>Stump shape (right)</b>		
Conic	56 (27.1%)	56 (44.7%)
Cylindrical	124 (59.4%)	65 (52%)
Bulbous	29 (13.5%)	5 (3.3%)
<b>Stump shape (left)</b>		
Conic	66 (31.5%)	52 (41.3%)
Cylindrical	115 (55%)	69 (54.7%)
Bulbous	28 (13.4%)	5 (4%)
<b>Stump length (right)</b>		
Short<9 cm	47 (22.5%)	31 (24.6%)
Long>24 cm	26 (12.4%)	24 (19%)
Standard	136 (65.1%)	71 (56.3%)
<b>Stump length (left)</b>		
Short<9 cm	33 (15.8%)	29 (23%)
Long>24 cm	25 (12%)	18 (14.3%)
Standard	151 (72.2%)	79 (62.7%)
<b>Amputation level (right limb)</b>		
Below-knee	107 (51%)	80 (63.4%)
Above	102 (49%)	46 (36.5%)
<b>Amputation level (left limb)</b>		
Below-knee	110 (52.6%)	78 (61.1%)
Above	99 (47.4%)	49 (38.8%)
<b>Prosthesis (right limb)</b>		
No	86 (41.4%)	34 (27%)
Yes	123 (58.9%)	92 (73%)
<b>Prosthesis (left limb)</b>		
No	84 (40.2%)	30 (23.8%)
Yes	125 (59.8%)	96 (76.2%)

\*Skin problem in amputees. \*\*Skin problems in residual limbs

The results of this analysis revealed that stump shape, stump length and excessive perspiration were significantly associated with skin lesion when the other factors were accounted (p<0.05).

Table 2: Odds ratio, 95% CI and the results of univariate MMLRM model for variables

Variable	Odds ratio	95% CI lower limit	95% CI upper limit	p-value
<b>Marriage</b>				
Single	1 <sup>a</sup>	-	-	-
Married	0.35	0.13	0.98	0.046
<b>Education</b>				
Primary	1.85	0.37	9.13	0.45
Guidance	2.80	0.57	13.68	0.20
Diploma	2.49	0.52	11.99	0.26
Post Diploma	2.29	0.43	12.10	0.33
BS	2.13	0.43	10.65	0.36
MS and PhD	5.00	1.00	27.96	0.05
<b>Occupation</b>				
No	1 <sup>a</sup>	-	-	-
Yes	0.91	0.63	1.30	0.59
<b>Smoking</b>				
No	1 <sup>a</sup>	-	-	-
Yes	1.21	0.86	1.69	0.27
age	0.97	.95	0.995	<0.021
<b>Prosthesis</b>				
No	1 <sup>a</sup>	-	-	-
Yes	2.84	1.84	4.40	<0.0001
<b>Ambulation by</b>				
Wheelchair	1 <sup>a</sup>	-	-	-
Prosthesis with gait aid	2.71	1.67	4.39	<0.0001
Prosthesis by itself	3.18	1.61	6.31	<0.001
<b>Stump washing frequency</b>				
3-4 times/week	1 <sup>a</sup>	-	-	-
Every day	1.48	1.08	2.02	<0.014
<b>Stump shape</b>				
Cylindrical	1 <sup>a</sup>	-	-	-
Bulbous	0.27	0.09	0.81	<0.02
Conic	1.9	1.2	3.04	<0.009
<b>Stump length</b>				
Standard	1 <sup>a</sup>	-	-	-
Long	1.58	1.001	2.48	<0.049
Short	1.44	0.97	2.12	0.07
<b>Amputation level</b>				
Above	1 <sup>a</sup>	-	-	-
Below	1.53	1.11	2.11	<0.009
<b>Excessive perspiration</b>				
No	1 <sup>a</sup>	-	-	-
Yes	3.28	2.34	4.62	<0.0001

<sup>a</sup>Reference category

Table 3: Odds ratio, 95% CI and the results of final multivariate analysis or adjusted MMLRM model for variables

Variable	Odds ratio	95% CI Lower limit	95% CI Upper limit	p-value
<b>Stump's shape</b>				
Cylindrical	1 <sup>a</sup>	-	-	-
Bulbous	0.4	0.12	1.29	0.12
Conic	2.25	1.25	9.63	<0.003
<b>Stump's length</b>				
Standard	1 <sup>a</sup>	-	-	-
Long	1.51	0.92	2.47	0.15
Short	1.55	1.02	2.36	<0.04
<b>Excessive perspiration</b>				
No	1 <sup>a</sup>	-	-	-
Yes	2.89	1.85	4.53	<0.0001

<sup>a</sup>Reference category

Conic shape stumps had about 2.25 times worse outcome than cylindrical shape stumps. Short stumps had about 1.55 times worse outcome than standard stumps

and subjects with excessive perspiration had about 2.89 times worse outcome than subjects with normal perspiration.

## DISCUSSION

Skin lesions have been frequently reported in stumps of amputees. Recognition of their contributing factors has a paramount role in prevention of the lesions and successful treatment of any existing ones.

Through logistic regression analysis, the three factors of the shape of the stump, the length of the stump and excessive perspiration were recognized to have an independent association in skin lesions development, among the population studied.

As compared to cylindrical stumps, cone-shaped stumps had an increased risk of developing a skin lesion. This observation may be explained by low volume of the cone-shaped stumps; namely atrophy of the limb. The prominent points of the bones are predisposed to a higher degree of pressure during ambulation, which increased the potential for skin problems.

Short stumps were at a greater risk for skin lesion development compared with standard stumps. This is mainly because of the fact the length of the stump has a significant role in fitness of prosthesis (Pohjolainen, 1991); any disruption in fitness of the prosthesis will predispose the amputated limb to skin lesions (Levy, 1992).

Excessive perspiration compared with normal perspiration increased the risk of a skin problem. Warmth and moisture from perspiration promote maceration of the skin with in the socket and encountered bacterial folliculitis, furuncles, boils and cellulites. Previous studies confirm this results (Levy, 1992; Lake and Supon, 1997).

Lower age, unmarried, no gait aid, daily washing of the stump and below-knee amputation were recognized to be a risk factor of a skin lesion initially, but in multivariate analysis such associations were not observed.

Most of these factors were suggested as a determinant of skin lesion in previous studies (Dudek *et al.*, 2005; Meulenbelt *et al.*, 2009) by the fact, this study found the skin lesions developed secondary to no ideal residual limbs for shape and length in our population.

These findings suggest the bilateral war-amputees poses more challenges to the rehabilitation team than civilians amputees. The victims experience multiple extremities and organ systems damages, extended and contaminated wounds, muscle crash, fracture and burns in a violent environment. As a result, many war amputees suffered from residual limbs problem and require multiple

surgical revisions to obtain a comfortable and functional limb. The poor condition of a war-injured limb may not yield an ideal stump, which leads to skin problems one way or another.

The quality of surgical, medical and rehabilitative care improves their quality of life by decreasing their disability.

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