

## Original Article

# Dermatological findings following acute traumatic spinal cord injury

D Rubin-Asher<sup>\*1</sup>, G Zeilig<sup>1</sup>, M Klieger<sup>2</sup>, A Adunsky<sup>3</sup> and H Weingarden<sup>1</sup>

<sup>1</sup>The Department of Neurological Rehabilitation, The Chaim Sheba Medical Center, Sackler School of Medicine, Tel-Aviv University, Israel; <sup>2</sup>Dermatological Department, The Chaim Sheba Medical Center, Sackler School of Medicine, Tel-Aviv University, Israel; <sup>3</sup>Department of Geriatric Medicine and Rehabilitation, The Chaim Sheba Medical Center, Sackler School of Medicine, Tel-Aviv University, Israel

**Study design:** Prospective study.

**Objective:** To identify and define dermatological conditions following acute traumatic spinal cord injury (ATSCI) during inpatient rehabilitation.

**Setting:** Spinal Cord Injury Unit, The Department of Neurological Rehabilitation, The Chaim Sheba Medical Center, Israel.

**Methods:** During a 1-year study, all patients following ATSCI were prospectively studied for new dermatological findings during their inpatient rehabilitation. Every new dermatological finding was defined concerning its location with regard to the patient's neurological level, the time from injury to appearance and the exact dermatological diagnosis.

**Results:** During the study year, 46 ATSCI patients were hospitalized in our department, of whom were 38 (82.6%) males and eight (17.4%) females (mean age 30.2 years). A total of 21 (45.6%) patients were tetraplegic and 25 (54.3%) paraplegic. Of the patients, 28 (60.9%) had complete neurological injuries and 18 (39.1%) incomplete. In all, 14 (30.4%) patients developed a dermatological condition. There was no significant age or sex correlation to the development of these complications. There was a greater likelihood of paraplegia (48 versus 9.5%,  $P = 0.005$ ) and being neurologically complete (42.9 versus 11.1%,  $P = 0.02$ ). The dermatological findings appeared on an average of 80.3 days after the initial neurological insult. There were a total of 22 different dermatological findings: 11 (50%) were local fungal infections, two (9.1%) psoriatic lesions, two (9.1%) hyperkeratotic lesions, two (9.1%) bacterial infections (one folliculitis, one impetigo) and single cases of seborrheic dermatitis, acne, alopecia, scabies and allergic reaction. Of the findings, 14 (63.6%) were below the neurological level, including all of the fungal infections.

**Conclusions:** Dermatological findings are common during rehabilitation of ATSCI. The clinical impact of these findings is low, but nevertheless, they are troublesome to the patient. The most common dermatological disorder was a local fungal infection below the neurological level. Paraplegic patients are more susceptible to the development of this condition. Patient and staff education regarding proper skin care may reduce these infections.

*Spinal Cord* (2005) **43**, 175–178. doi:10.1038/sj.sc.3101697; Published online 30 November 2004

**Keywords:** spinal cord injury; dermatological finding; local fungal infection; tinea pedis

## Introduction

Dermatological findings appear to be common during the first months after spinal cord injury (SCI). Stover *et al*<sup>1</sup> described skin changes occurring during the chronic phase of SCI. Reed *et al*<sup>2</sup> studied dermatological disorders occurring after SCI and found a high incidence of seborrhea and seborrheic dermatitis, altered sebaceous secretion, dermatophytosis, changes in sweat

secretion and eczematous reactions. Wilson and Walshe<sup>3</sup> studied the incidence of seborrheic dermatitis in patients during the acute phase of SCI and found this condition in 65% of recently injured tetraplegics. The standard treatment of cervical spinal injury at the time the study was conducted included a prolonged period of immobilization that limited the possibility of hair washing and face cleansing. The authors state the possible accumulation of sebum and scale on inadequately scrubbed skin as the possible cause of their findings. An interesting anecdotic case report regarding dermatological changes

\*Correspondence: D Rubin-Asher, The Department of Neurological Rehabilitation, The Chaim Sheba Medical Center, Sackler School of Medicine, Tel-Aviv University, Israel

after SCI was reported by Amon and Wolff<sup>4</sup> who presented a case report regarding spontaneous healing of atopic dermatitis under the neurological level in a newly injured paraplegic boy.

In our clinical practice, we have observed the onset of various dermatological conditions during the acute rehabilitation period following acute traumatic SCI (ATSCI). To better identify and define these findings we performed a prospective study in which we tracked and categorized new dermatological disorders, including the etiology, the location in regard to the patient's neurological level and the time of appearance post-injury.

## Patients and methods

The study was conducted in a neurological rehabilitation department of a university-affiliated medical center. In a 1-year prospective study, all patients undergoing inpatient rehabilitation following ATSCI were observed for dermatological changes until their discharge. Of the entire group, 24 patients completed the entire rehabilitation hospitalization from admission to discharge during the course of the study year. The nursing staff regularly inspected the patient's skin for dermatological abnormalities, in addition to the standard skin care. A dermatological change was defined as any observed new skin condition excluding ingrown nails, pressure ulcers and burns. Previous dermatological conditions were not included in the study. All dermatological findings were further evaluated by a board-certified dermatologist and characterized in regard to diagnosis and etiology. The time from trauma to appearance of the disorder and the location in regard to the neurological level were also recorded by one of the authors (DA). Statistical analysis was performed using the  $\chi^2$  test and Fisher exact test, with  $P \leq 0.05$  as statistically significant.

## Results

In all 46 ATSCI patients were hospitalized in our department, of whom 38 (82.6%) were males and eight (17.4%) females (mean age 30.2 ( $\pm 11.1$ ) years). A total of 21 (45.6%) patients were tetraplegic and 25 (54.3%) paraplegic. Of the patients, 28 (60.9%) had complete neurological injuries (American Spinal Injury Association (ASIA)<sup>5</sup> A) and 18 (39.1%) incomplete (ASIA B-E) (Table 1). Of the patients, 14 (30.4%) developed a dermatological condition. There was no significant age or sex correlation to the development of these complications. There was, however, a statistically significant correlation to paraplegia *versus* tetraplegia (48 *versus* 9.5%,  $P = 0.005$ ) and to complete injury *versus* incomplete injury (42.9 *versus* 11.1%,  $P = 0.02$ ) (Table 2). The dermatological finding appeared on an average of 80.3 days ( $\pm 45.7$ ) after the initial neurological insult. There were a total of 22 different dermatological findings: 11 (50%) were skin and nail local fungal infections, two (9.1%) psoriatic lesions, two (9.1%) hyperkeratotic

**Table 1** Study population

	<i>n</i>	%
Total number	46	100
Male	38	82.6
Female	8	17.4
Age	30.2 $\pm$ 11.1	
Tetraplegia	21	45.6
Paraplegia	25	54.3
Neurologically complete	28	60.9
Neurologically incomplete	18	39.1

**Table 2** Characteristics of patients with dermatological findings

	<i>Dermatological Finding</i>		
	<i>n</i>	%	<i>P</i>
Number	14	30.4	
Male	11	28.9	
Female	3	37.5	NS
Age	29.6 $\pm$ 10.2		
Tetraplegia	2	9.5	
Paraplegia	12	48.0	
Neurologically complete	12	42.9	0.005
Neurologically incomplete	2	11.1	0.02

lesions, two (9.1%) bacterial infections (one folliculitis, one impetigo) and single cases of seborrheic dermatitis, acne, alopecia, scabies and allergic reaction. Of these findings, 14 (63.6%) were below the neurological level, including all of the fungal infections (Table 3). Similar results were found in the subgroup of those patients who had completed the entire rehabilitation course during the study year. Of the 24 patients in this group, 18 were paraplegics, and nine of them developed pedal fungal infections. Of the six tetraplegics in this group, none developed fungal infections ( $P = 0.05$ ).

## Discussion

The lack of a control group eliminates the possibility of comparing the dermatological findings in our SCI patients and the general population. We included in our analysis only new onset dermatological findings, so that in a way, each patient before injury can be considered his/her own control.

The most frequent dermatological finding (incidence of 50%), was local skin and nail fungal infections all occurring below the neurological level of injury. Many different physiological, immune, local, and behavioral changes following ATSCI may be factors in the pathophysiology leading to the development of this finding.

Previous studies have demonstrated changes in the function of sweat and pilosebaceous glands appearing after SCI. Yaggie *et al*<sup>6</sup> have recently published their

**Table 3** Dermatological findings

Patient data			Dermatological finding	
Age	Gender	ASIA	Diagnosis	Location
26	M	A, T5	Tinea pedis	BNL
24	M	A, T6	Folliculitis	ANL
41	M	A, T11	Seborrheic dermatitis	ANL
			Psoriatic nail	ANL
			Tinea pedis	BNL
20	M	B, C5	Psoriasis	BNL
37	M	CES	Tinea pedis	BNL
37	F	A, T11	Hyperkeratosis	BNL
			Tinea corporis	BNL
19	M	A, T5	Tinea pedis	BNL
21	M	A, T6	Inflammatory tinea pedis	BNL
33	M	CES	Onychomycosis	BNL
22	F	A, T5	Telogen effusion acne	ANL
48	M	CCS	Keratoderma	ANL
			Tinea pedis	BNL
20	M	A, T12	Tinea pedis	BNL
22	M	CES	Onychomycosis	BNL
			Tinea pedis with secondary infection	BNL
45	F	A, T4	Scabies	ANL + BNL
			Allergic dermatitis	ANL + BNL
			Impetigo	BNL

M = male; F = female; BNL = below neurological level; ANL = above neurological level; CCS = central cord syndrome; CES = cauda equina syndrome

study comparing sweat production in able-bodied individuals and SCI patients (athletes and untrained individuals). They demonstrated that in SCI patients, there is a decreased sweat production below the injury level. There have been a number of different observations regarding sebaceous gland function. Thomas *et al*<sup>7</sup> found an increased sebum excretion rate below the level of injury in paraplegic patients. Others have demonstrated the contrary.<sup>1</sup> Changes in skin humidity and greasiness have been shown to affect susceptibility to local fungal infections.<sup>8</sup>

Alternations of immune function have also been found to increase the appearance of local fungal infections.<sup>9</sup> Immunological changes including an overall decreased immune function have been found in SCI individuals. These changes have been found to start soon after injury and to continue thereafter.<sup>10,11</sup> Natural-killer cell function is decreased,<sup>11</sup> T-cell function and activation are decreased<sup>11</sup> and macrophage phagocytosis is altered.<sup>11</sup> SCI patients have also been found to have reduced levels and function of cellular adhesion molecules<sup>9,10</sup> and reduced levels of surface markers on both lymphocytes and granulocytes.<sup>12</sup> Levels of IL-2, IL-6 and IL-2R receptors have also been found to be altered.<sup>10,13</sup> Other studies<sup>14</sup> suggest that some of these immunological changes occur only in patients with a cervical injury level. This latter finding may well be related to damage to the sympathetic nervous system, a known modulator of immune functions.

Some local skin changes have been demonstrated to follow SCI. Stover *et al*<sup>1</sup> found a high incidence of skin thickening and nail hypertrophy in SCI patients, occurring more frequently in high SCI. Dermatohistopathological studies<sup>15</sup> of skin biopsies from patients with skin thickening revealed perivascular inflammatory infiltrates in the skin and dermal fibrosis starting within 2 months of SCI and continuing thereafter. In chronic patients, dermal fibrosis was found more frequently in tetraplegic patients. Lotta *et al*<sup>16</sup> examined skin biopsies of two SCI patients with heterotopic ossification and found capillary and small vessel endothelial hyperactivity, basement membrane thickening and reduplication, changes of the perivascular connective tissue and microcalcifications in the subcutaneous fat.

Factors such as a reduced ability to properly dry the skin and less skin airing may also predispose SCI patients to local fungal infections.

Previous studies<sup>1-3</sup> have demonstrated a high incidence of seborrheic dermatitis following SCI (58–65%), and acne is well known to be very common in clinical practice. Nevertheless, in our study only one case of seborrheic dermatitis and one of acne were reported. This discrepancy is most likely due to exclusion of pre-existing skin disorders as well as a possible bias toward under-reporting of these common abnormalities.

All of the fungal infections observed in our study occurred in the paraplegic population. This finding appears to be counterintuitive in view of the depressed

immune function and dermal fibrosis, which are expected to be more marked in tetraplegic individuals. The most likely explanation is that the paraplegic patients were expected by the staff to perform ADL activities with relatively low levels of assistance. The tetraplegics received full assistance, which included daily professional monitoring of the skin, even for areas not usually at risk for pressure sores. Thus, the two groups had differing levels of skin care, with the paraplegics not necessarily meeting the full standard for hygienic skin care.

A number of therapeutic and preventive measures can be recommended in order to eliminate these local fungal infections.<sup>17,18</sup>

The patient should wash his/her feet, interdigital spaces and groin thoroughly with soap and water, it is recommended that an antiseptic soap be used. The patient should properly dry his/her feet and interdigital spaces using disposable paper towels or a different towel for each foot and for each side of the groin. The use of an antifungal cream or ointment and powder in the interdigital spaces and in the groin is recommended. The patient should keep his/her feet, interdigital spaces and groin dry and aired most of the time. This is true especially in a hot and humid environment. Staff supervision would be appropriate until the patient is able to demonstrate good quality and complete independence in performing this task.

In conclusion, the most frequently found dermatological changes during the acute phase of SCI are relatively simple skin and nail local fungal infections. They are usually of little clinical importance but are troublesome to the patients. It seems that good patient and staff education regarding the importance of proper skin care may help eliminate these infections.

## References

- 1 Stover SL, Hale AM, Buell AB. Skin complications other than pressure ulcers following spinal cord injury. *Arch Phys Med Rehab* 1994; **75**: 987–993.
- 2 Reed WB, Pidgeon J, Becker SW. Patients with spinal cord injury, clinical cutaneous studies. *Arch Dermatol* 1961; **83**: 379–385.
- 3 Wilson CL, Walshe M. Incidence of seborrheic dermatitis in spinal injury patients. *Br J Dermatol* 1988; **119**(33 Suppl): 48.
- 4 Amon U, Wolff HH. Healing of chronic atopic dermatitis lesions in skin areas of paraplegia after trauma. *J Dermatol* 1994; **21**: 982–983.
- 5 Maynard FM *et al*. International standards for neurological and functional classification of spinal cord injury. *Spinal Cord* 1997; **35**: 266–274.
- 6 Yaggie JA, Niemi TG, Buono MJ. Adaptive sweat gland response after spinal cord injury. *Arch Phys Med Rehab* 2002; **83**: 802–805.
- 7 Thomas SE, Conway J, Ebling FJG, Harrington CI. Measurement of sebum excretion rate and skin temperature above and below the neurological lesion in paraplegic patients. *Br J Dermatol* 1985; **112**: 569–573.
- 8 Strauss JS, Kligman AM. An experimental study of tinea pedis and onychomycosis of the foot. *Arch Dermatol* 1957; **76**: 70–79.
- 9 Dahl MV. Dermatophytosis and the immune response. *J Am Acad Dermatol* 1994; **31**(3 Part 2): S34–S41.
- 10 Nash MS. Known and plausible modulators of depressed immune functions following spinal cord injuries. *J Spinal Cord Med* 2000; **23**: 111–120.
- 11 Cruse JM *et al*. Facilitation of immune function, healing of pressure ulcers and nutritional status in spinal cord injury patients. *Exp Mol Pathol* 2000; **68**: 38–54.
- 12 Cruse JM *et al*. Review of immune function healing of pressure ulcers and nutritional status in spinal cord injury. *J Spinal Cord Med* 2000; **23**: 129–135.
- 13 Segal JL, Gonzales E, Yousefi S, Jamshidipour L, Brunnemann SR. Circulating levels of IL-2R, ICAM-1 and IL-6 in spinal cord injuries. *Arch Phys Med Rehab* 1997; **78**: 44–47.
- 14 Campagnolo DI, Bartlett JA, Keller SE. Influence of neurological level on immune function following spinal cord injury: a review. *J Spinal Cord Med* 2000; **23**: 121–128.
- 15 Stover SL, Omura EF, Buell AB. Clinical skin thickening following spinal cord injury studied by histopathology. *J Am Paraplegia Soc* 1994; **17**: 44–49.
- 16 Lotta S, Scelsi L, Scelsi R. Microvascular changes in the lower extremities of paraplegics with heterotopic ossification. *Spinal Cord* 2001; **39**: 595–598.
- 17 Ernst E. Tinea cruris, tinea pedis and patient instruction sheets P 121-4, in common skin disorders, 5th edn, WB Saunders 2001.
- 18 Richard BO *et al*. Diseases resulting from fungi and yeasts P 370-378, Andrews' Diseases of the Skin: Clinical Dermatology. 9th edn, WB Saunders 2000.