

## ORIGINAL ARTICLE

# A retrospective study on flap complications after pressure ulcer surgery in spinal cord-injured patients

B Biglari<sup>1</sup>, A Büchler<sup>2</sup>, T Reitzel<sup>1</sup>, T Swing<sup>2</sup>, HJ Gerner<sup>2</sup>, T Ferbert<sup>2</sup> and A Moghaddam<sup>2</sup>**Study design:** A retrospective study reporting specific complications of certain skin flaps for treating pressure ulcers.**Objectives:** To describe the rate and type of complications after pressure ulcer surgery in patients with spinal cord injury.**Setting:** Germany, Rheinland Pfalz.**Methods:** We collected data from 352 patients treated with 421 skin flaps to determine the rate and type of complications of each skin flap used.**Results:** In this study, we analyzed the results of 421 skin flaps in 352 patients with a total of 657 pressure ulcers from January 2006 to December 2010. Our patients had ischial, pelvic, sacral, trochanteric and lower extremity ulcers. Ischial ulcers were most common, followed by sacral and trochanteric ulcers. There were 87 complications in 421 flaps, which was an overall rate of 21%. Suture line dehiscence was the most common complication with 27 cases (31%), followed by 22 cases of infection (25.2%), 17 cases of hematoma (19.5%), 12 cases of partial necrosis (13.7%) and 9 cases of total flap necrosis (10.3%).**Conclusion:** Pressure ulcers in spinal cord-injured patients are very common and difficult and expensive to treat. The high rate of complications and the associated costs suggest the importance of evaluating the efficacy of treatment options. Conservative procedures have been standardized, but there still has been limited success in establishing guidelines on how to manage complications arising from flap surgery. Our extensive documentation of flap plastics will be useful managing complications after the surgical treatment of pressure ulcers in spinal cord-injured patients.*Spinal Cord* (2014) **52**, 80–83; doi:10.1038/sc.2013.130; published online 12 November 2013**Keywords:** flaps; complications; paraplegics

## INTRODUCTION

Pressure ulcers are one of the most common secondary conditions in spinal cord-injured patients.<sup>1</sup> In Central Europe, there are 50 cases of pressure ulcers per 10 000 patients.<sup>2,3</sup> This rate is even higher in Germany where patients suffer from pressure ulcers at a rate of 10%.<sup>4</sup> Spinal cord-injured patients are especially at risk shown by a rate of pressure ulcers of 26–60%.<sup>5</sup> Treatment requires enormous resources and impacts on patients and care facilities greatly.

In general, the therapy of pressure ulcers is based on the localization, size, depth, age of the patient, previous surgical interventions, scars and history of infections. These variables influence the type, length and costs of a sufficient therapy. Conservative measures include the substitution of electrolytes as well as position changes.<sup>6,7</sup> A regular checkup is also necessary to reduce the occurrence of surface defects and the use of further resources.<sup>8</sup>

Poor management after the appearance of pressure ulcers as well as waiting too long can limit the success of conservative therapy, leading to the necessity for plastic surgery. A systematic review revealed recurrence and complication rates of 8.9 and 18.6% in musculocutaneous, fasciocutaneous and perforator-based flaps for treatment of pressure sores.<sup>9</sup> In an 8-year study, Tavakoli *et al.* showed a recurrence rate of 41.4% for ischial sores in para- and tetraplegics treated with hamstring flaps.<sup>10</sup> In the most extreme cases, such as in arterial

hemorrhaging, sepsis and deep abscesses with fever and empyema in joints, emergency care is even needed.<sup>11,12</sup> A recent study showed that improvisation in surgical techniques leads to higher success rate for pressure ulcer healing in patients with spinal cord injury.<sup>13</sup>

The purpose of this paper was to document the rate and type of complications of skin flaps for the treatment of pressure ulcers in spinal cord-injured patients performed in our care facilities. This extensive documentation of flap plastics will be useful for surgeons in managing complications and doing quality control in the treatment of pressure ulcers in spinal cord-injured patients. Our research group is dealing with professional wound care in spinal cord-injured patients and gained good experience in their treatment.<sup>14,15</sup>

## MATERIALS AND METHODS

We treated 657 pressure ulcers in 352 patients with 421 flaps from January 2006 to December 2010 in the Insurance Trauma Center Ludwigshafen, Germany. Of the 352 patients involved in the study, 67 were female (19%) and 285 male (81%). All patients were spinal cord injury patients who were paralyzed either by traumatic injury (92.05%) or by other causes, such as spina bifida, multiple sclerosis, spondylodiscitis, tumors, cavernous hemangioma, Coxsackie virus, abscess or Guillan-Barré syndrome (7.95%). Patients were either completely paralyzed (76.14%, American Spinal Injuries Association (ASIA) A) or incompletely paralyzed (23.86%, ASIA B; 3%, ASIA C; Figures 1 and 2).

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In a follow-up, we examined 280 patients (79.5%) in intervals of 6 weeks, 6 months and 1 year after discharge. Ulcers were classified according to the National Pressure Ulcer Advisory Panel (NPUAP 2007). The size of the ulcer was also calculated and the localization was identified. Treatment involved the following flaps listed according to frequency of use: rotation flap, gluteus maximus flap (GMF), tensor fasciae latae flap (TFL), biceps femoris flap (BFF), posterior thigh flap (PTF), Conway flap, Limberg flap, total thigh flap and transverse back flap (Table 1). The following complications of these skin flaps were documented after surgery: infection, hematoma, suture line dehiscence, partial necrosis or flap failure. Data on patients were gathered retrospectively from patient records and organized regarding the type of flap used. Rates of complications per type of flap were calculated accordingly (Table 2).

**RESULTS**

In this study, we analyzed the results of 421 skin flaps in 352 patients with a total of 657 pressure ulcers from January 2006 to December 2010. Our patients had ischial, pelvic, sacral, trochanteric and lower extremity ulcers. Ischial ulcers were most common, followed by sacral and trochanteric ulcers (Table 3). Most ulcers were grade IV (Table 4). Hospital stay was variable with an average of 71 days per patient. Treatment with GMFs was associated with the longest hospital stay per flap of 119 days (Table 1). Altogether, the following flaps were used: rotation flaps in 131 cases (31%); GMFs in 82 cases (19.4%); tensor fascia lata flaps (TFFs) in 77 cases (18.3%); BFFs in 55 cases (13%); PTFs in 35 cases (8.4%); Conways in 27 cases (6.4%); Limbergs in 10 cases (2.4%); transverse backs in 1 case (0.3%) and total thigh flaps in 3 cases (0.7%; Table 1).

There were 87 complications in 421 flaps, which was an overall rate of 21%. Suture line dehiscence was the most common complication with 27 cases (31%), followed by 22 cases of infection (25.2%), 17 cases of hematoma (19.5%), 12 cases of partial necrosis (13.7%) and 9 cases of total flap necrosis (10.3%; Table 5).

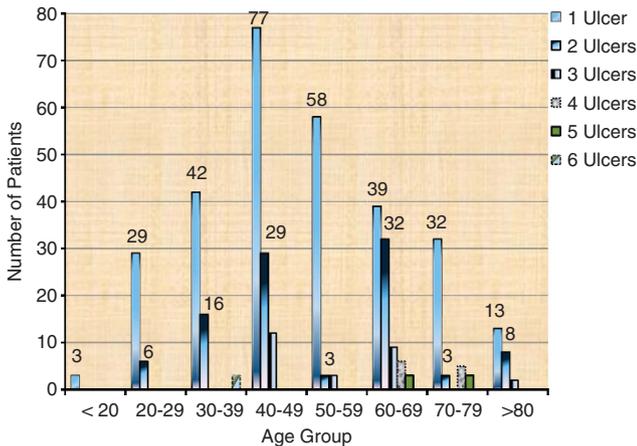
Suture line dehiscence was most common in PTFs and TFFs; hematoma in Limbergs and BFFs; infection in Conway flaps and PTFs; partial necrosis in TFFs and necrosis in BFFs, GMFs and TFFs. TFFs had the highest rate of complications (48.6%), that is, 17 complications in 35 flaps. Rotation flaps had the lowest rate of complications (11.5%), that is, 15 complications in 131 flaps (Table 5). In 21 patients with IV grade ulcer osteomyelitis with local infiltration was detected. The germ spectrum was very heterogeneous. Intra-operative debridement of the bone was implemented, smear tests were taken from the wound and bone parts were analyzed by the microbiology and pathology. Depending on the clinical report, the patients received a calculated antibiotics for 14 days. Infection parameters were determined on a regular basis. If there had been

**Table 1 Executed flap operations and hospital stay**

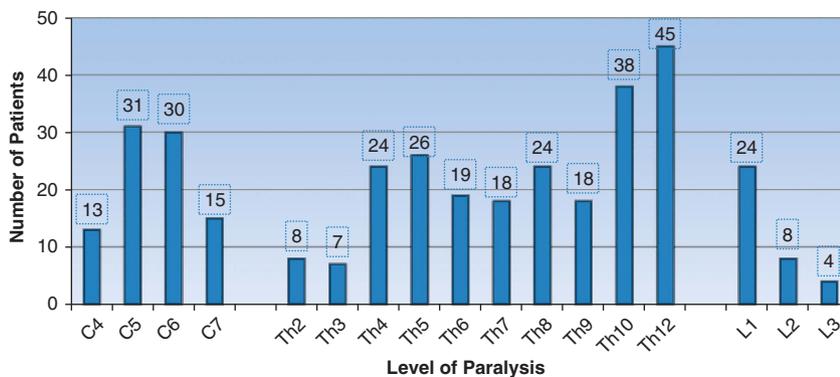
Type of skin flap	Number	Percentage (%)	Average hospital stay (days)
Rotation flap	131	31.12	45.78
Gluteus maximus flap	82	19.48	119
Tensor fascia lata flap	77	18.29	46.81
Biceps femoris flap	55	13.06	46.25
Posterior thigh flap	35	8.31	37
Conway flap	27	6.41	49
Limberg flap	10	2.38	34.3
Total thigh flap	3	0.71	
Transverse back flap	1	0.24	
Total	421	100	

**Table 2 Localization vs type of flap**

Localization	Type of flap
Ischium	PTF/biceps fem.
Sacrum	Gluteus max. flap Limberg rotation flap/total thigh flap
Trochanter	TFL/Conway/rotation flap



**Figure 1** Distribution of ulcers according to age group.



**Figure 2** Localization of spinal cord injuries in 352 patients.

**Table 3 Localization of pressure ulcers**

Ischium	289	43.99%
Sacrum	143	21.77%
Trochanter	124	18.87%
Heel	38	5.78%
Ankle	24	3.65%
Upper/lower leg/knee	16	2.44%
Perineum/scrotal region/tail bone	12	1.83%
Forefoot/side of foot/midfoot	11	1.67%
Total number of ulcers	657	(100%)

**Table 4 Distribution of pressure ulcer grade (NUPAP) according to localization**

Grade	I	II	III	IV	Total
Ischium	22	69	100	98	289
Sacrum	13	38	68	24	143
Trochanter	18	8	64	34	124
Heel	5	14	15	4	38
Ankle	6	4	7	7	24
Upper/lower leg/knee	8	8			16
Perineum/scrotal region/tail bone	6	6			12
Forefoot/side of foot/midfoot	6	5			11
Total ulcers	84	152	254	167	657

suspected osteomyelitis, a magnetic resonance imaging was applied. The trochanter was affected in 6 cases and the ischium in 15 cases. The wound status before closure was satisfying.

## DISCUSSION

We were able to show in our results that certain skin flaps are associated with particular complications. This is due to a number of different factors involved in the surgical preparation and implantation of skin flaps. The scientific literature points to specific factors in flap surgery that cause complications such as the separation of the flap from primary blood sources, temporary reduction in circulation and expansion of wound areas during surgery.<sup>10,16-19</sup>

The localization of pressure ulcers influences the appearance of complications, probably due to positioning and care of the ulcer following surgery. Researchers have documented the rate of complications according to pressure ulcer reconstruction localizations, and show varying results. In one of the more comprehensive studies over the last years, Schryvers *et al.* reported on the rate of complications of 421 flaps in 168 patients over 20 years. Authors showed that trochanteric reconstructions had the highest rate of complications (35%), followed by sacral (30%) and ischial (30%).<sup>18</sup> However, Foster *et al.* reported different findings in an earlier study showing that ischial reconstructions had the highest rate of complications (42%), followed by sacral (20%) and trochanteric (15%).<sup>19</sup>

We chose not to report on the rate of complications according to reconstruction localization, because the focus of our study was on the type of flap used; however, we did show results on the occurrence of pressure ulcer localizations. We had a similar distribution of ulcer localizations in patients as Schryvers *et al.*, who reported that 43% of patients had ischial ulcers, 20% sacral and 19.4% trochanteric.<sup>18</sup> Our patients had 44% ischial ulcers, 22% sacral and 19% trochanteric.

Schryvers *et al.* grouped flaps not according to complexity, rather according to tissue type, that is, cutaneous and myocutaneous flaps.<sup>18</sup>

This made comparison with our results difficult, but we were able to confirm in our study that the most common complication was suture line dehiscence. Schryvers *et al.* had a total rate of complications of 31%, which was significantly higher than our rate of 21%. Forester *et al.* also found suture line dehiscence to be the most common complication and had a higher rate of complications of 28% in 280 skin flaps than in our study.<sup>19</sup>

Overall, the rate of complications in studies varied heavily. Alhuwalia *et al.* published a complication rate of 16% in 104 skin flaps.<sup>17</sup> Another study from Srivastava *et al.* observed a rate of complications of 16.6% in 25 patients with 39 pressure ulcers.<sup>20</sup> Authors had a much lower number of cases treated than we did, and did not describe how they defined complications.

The rate of complications is reflected in the length of hospital stays.<sup>21</sup> The total hospital stay in our study was more than three times shorter as in Schryvers *et al.*, that is, 25 104 days for 352 patients (71.3 days per patient) compared with 41 559 days for 168 patients (247.4 days per patient).<sup>18</sup> Shorter hospital stays suggest greater efficacy of treatment and lower ensuing costs.<sup>21</sup>

There is currently no mention in the scientific literature of complications according to specific flaps. As mentioned above in relation to Schryvers *et al.*, authors grouped complications according to type of tissue, but failed to divide these groups into specific flaps. For example, Wong *et al.* described the difference in complications between 18 gluteal fasciocutaneous rotational and 20 myocutaneous flaps.<sup>22</sup> The 12-month follow-up investigation revealed that complications in the first group was 17% and in the second group 15%.<sup>22</sup> Findings were not presented in a useful manner, because the grouping of flaps was too general. It does not account for all factors affecting the appearance of complications as discussed above. The use of specific flaps involves specific surgical procedures, which are associated with differing rates of complications. The current grouping of flaps in the presentation of complications does not provide surgeons with the necessary information for doing quality control after using a specific flap.

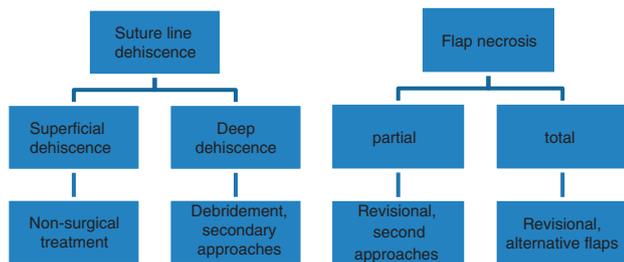
In order to improve on the presentation of complications, we grouped specific complications according to certain flaps. This allowed us to show that suture line dehiscence was most common in PTFs and TFFs; hematoma in Limburgs and BFFs; infection in Conway flaps and PTFs; partial necrosis in TFFs and necrosis in BFFs, GMFs and TFFs. We also gave an overall evaluation of the rate of complications for each flap, showing that TFFs had the highest rate of complications (48.6%) and rotation flaps the lowest rate of complications (11.5%; Table 5). In addition, we showed hospital stay according to flap (Table 1). The gluteus maximus flap had the longest hospital stay. Limburg and PTFs were associated with shorter stays. This form of presentation allows surgeons managing complications or doing quality control after flap surgery to compare their results easily with ours.

Our overall shorter hospital stays suggest that our treatment of complications was particularly effective in handling complications and limiting costs. We believe this can be attributed to the algorithms that we developed to treat complications of skin flaps (Figure 3). We targeted each complication with specific measures. Hematoma was drained, cleaned, samples were taken for the laboratory and then the site was closed. Necrosis was removed and later closed, but necrotic flaps were never closed directly following debridement. In cases of wound margin dehiscence, surfaces were treated conservatively and deeper defects were managed with debridement and secondary suture. Other complications such as partial flap necrosis involved necrosis removal and conservative procedures (negative pressure wound therapy). If total necrosis of the flap occurred, we removed all necrotic areas and used an alternative flap to close the wound. We

**Table 5** Frequency of complications of skin flaps

Complication	Rotation (% of 131 flaps)	GMF (% of 82 flaps)	BFF (% of 55 flaps)	TFF (% of 35 flaps)	PTF (% of 27 flaps)	Conway (% of 10 flaps)	Limberg (% of 10 flaps)	Total complications (% of 87 complications)
Hematoma	3 (2.3%)	4 (4.9%)	5 (9.1%)	2 (5.7%)	2 (7.4%)	0 (0.0%)	1 (10.0%)	17 (19.5%)
Infection	3 (2.3%)	5 (6.1%)	5 (9.1%)	3 (8.6%)	3 (11.1%)	2 (20.0%)	1 (10.0%)	22 (25.3%)
Suture line dehiscence	8 (6.1%)	4 (4.9%)	4 (7.3%)	5 (14.3%)	4 (14.8%)	1 (10.0%)	1 (10.0%)	27 (31.0%)
Necrosis	0 (0.0%)	3 (3.7%)	3 (5.5%)	3 (8.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	9 (10.3%)
Partial necrosis	1 (0.8%)	2 (2.4%)	3 (5.5%)	4 (11.4%)	1 (3.7%)	0 (0.0%)	1 (10.0%)	12 (13.8%)
Total	15 (11.5%)	18 (22.0%)	20 (36.4%)	17(48.6%)	10 (37.0%)	3 (30%)	4 (40%)	87 (99.9%)

Abbreviations: BFF, biceps femoris flap; GMF, gluteus maximus flap ; PTF, posterior thigh flap; TFF, tensor fascia lata flap.



**Figure 3** Therapy algorithms.

have found that treatment algorithms minimize complications, improve the management of complications and overall make therapy easier, more successful and cost effective. We suggest that surgeons working with skin flaps adopt or develop consequential, standardized procedures before treating patients.

**CONCLUSION**

Because of the high rate of complications and costs of treating pressure ulcers, it is important that surgeons move forward in establishing guidelines for managing complications after flap surgery. Our evaluation of the success of specific skin flaps for treating pressure ulcers will help advance knowledge on this subject. We found that some flaps showed higher rates of overall complications than others. In addition, certain complications arose more frequently than others and were associated with certain types of flaps. The low rates of complications in comparison to other studies lead us to include our treatment algorithms as suggested therapy options. The extensive documentation of flap plastics in this study will help surgeons manage complications and do quality control after the treatment of pressure ulcers in spinal cord-injured patients.

**DATA ARCHIVING**

There were no data to deposit.

**CONFLICT OF INTEREST**

The authors declare no conflict of interest.

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