

---

# Surgical Management of Pressure Ulcers

*Anthony Porter and Rodney Cooter*

## Introduction

Pressure ulcers are localised areas of tissue necrosis that develop when soft tissue is compressed between a bony prominence and an external surface for prolonged periods of time. They have been reported throughout history (in the *Bible*, Lazarus, Job and Isaiah, among others, are thought to have had pressure ulcers) and in Egyptian mummies<sup>1</sup>. While pressure is the main causative factor, many others – such as shear, friction, denervation, poor nutrition, age and smoking – can also contribute<sup>2</sup>. Studies suggest that the prevalence of pressure ulcers is between 3 and 14 per cent in acute hospital settings, and up to 25 per cent in nursing home settings<sup>3</sup>. In the US, around a million patients have pressure ulcers, at an annual cost of \$US1.3 billion<sup>4</sup>, while in Australia the figure is about 60,000 patients, with an annual cost of \$Aus120 million.

As recommended by the US National Pressure Ulcer Advisory Panel<sup>5</sup>, pressure ulcers can be evaluated and staged as follows.

- **Stage I:** non-blanching erythema of intact skin.
- **Stage II:** partial-thickness skin loss.
- **Stage III:** full-thickness skin loss with destruction of subcutaneous tissue, superficial to the deep fascia.
- **Stage IV:** full-thickness skin loss with destruction of tissues to the deep fascia (muscle, bone, tendon, etc.).

*Rodney Cooter MD FRACS  
Director*

*Anthony Porter MB BS(Hons)  
Plastic Surgical Registrar*

*Department of Plastic and Reconstructive Surgery  
University of Adelaide  
Royal Adelaide Hospital  
The Queen Adelaide Hospital  
Adelaide, South Australia 5000*

Stage I and II pressure ulcers do not require surgical treatment as they will heal with local therapy, improvement in pressure-area care and hygiene. While stage III ulcers are likely to heal spontaneously, they have a recurrence rate of between 32 and 77 per cent if managed conservatively<sup>6</sup>. Surgical coverage of the ulcer aims to reduce the recurrence rate due to the unstable scar, and expedite coverage<sup>6</sup>.

Stage IV ulcers almost always require surgical management, due to the large size of the defect and its complications. This paper will present an overview of the surgical management of patients with pressure ulcers.

## Indications for Surgery

Benefits of surgical closure of pressure ulcers are as follows<sup>7</sup>.

- Reduces protein loss from the wound.
- Prevents progressive osteomyelitis and sepsis.
- Improves patient hygiene and appearance.
- Reduces rehabilitation costs.
- Averts future Marjolin's ulcer and amyloidosis.

## Pre-operative Assessment

Many factors must be considered when assessing a patient's suitability for pressure ulcer surgery. They can be categorised as those related to the patient in general and those specific to the pressure ulcer. An excellent review of peri-operative management has been provided by Stal *et al*<sup>8</sup>.

## Patient Assessment

A patient's physical suitability for undergoing a large surgical procedure and lengthy post-operative rehabilitation must be determined, and any reversible factors, such as uncontrolled heart failure, renal failure and anaemia, remedied. Investigations should include a complete blood picture, biochemistry

---

(with special attention to creatinine, albumin, zinc and magnesium), iron and folate levels. A common problem is poor nutrition, for which a useful marker is the patient's albumin level, and many surgeons would not perform a reconstruction in a patient whose serum albumin was less than 30 g/L<sup>8</sup>.

Delayed cutaneous hypersensitivity, while a better marker of protein malnutrition and the likelihood of post-operative complications, is seldom used in the clinical setting. Hyperalimentation with enteric feeding may be necessary to redress this problem if the patient's intake of high protein and calories cannot be improved sufficiently<sup>9</sup>.

To be a candidate for surgery the patient must also be mentally able to endure 6 to 10 weeks of acute hospitalisation, with much of that time spent avoiding pressure on the reconstruction site. This requires considerable motivation and a thorough understanding of the problem. The likelihood of long-term compliance must also be determined, to avoid a lengthy and expensive hospitalisation preceding a rapid return to the patient's original condition. As a part of the patient's mental assessment, a careful appraisal of the factors contributing to the development of the pressure ulcer must also be made<sup>8</sup>.

The presence of contractures, spasticity and reflex spasms should be determined and minimised by physiotherapy, drug treatments and, occasionally, neurosurgery<sup>8</sup>. Intractable spasms may preclude reconstructive surgery because of the risk of such involuntary movements leading to bleeding, haematomas and wound dehiscence. Non-surgical measures such as vacuum-assisted wound closure may be appropriate in such cases.

Patients who are not candidates for major reconstructive operations due to poor medical condition are best managed by debridement of any necrotic tissue from the pressure ulcer, followed by a prolonged course of dressings, possibly supplemented by vacuum-assisted closure. In these patients, development of the pressure ulcer may well be a pre-terminal event and debridement can often be performed without any anaesthesia.

## Wound Assessment

Before being suitable for reconstruction, a pressure ulcer should meet several criteria. It should be free of necrotic tissue, with healthy granulation tissue present, and be showing a healing tendency. Most pressure ulcers fail to meet any of these objectives on initial presentation and require a period of wound management to remove the infected and necrotic tissue that is almost invariably present. The first choice for dressing the initial pressure ulcer wound is usually silver sulphadiazine, as it has

been shown to rapidly reduce bacterial concentration and assist in autolytic debridement<sup>10</sup>. Long-term use, however, should be avoided, due to overgrowth with opportunistic organisms. Judicious sharp surgical debridement is performed until bleeding tissue is reached, and it needs to be repeated until the wound is free of necrotic tissue. After the initial phase of surgical debridement and silver sulphadiazine dressings, a period of dressings with non-antiseptic agents such as hydrogels or alginates is commenced<sup>3</sup>. Vacuum-assisted wound closure may be performed in order to accelerate reduction of the volume of the pressure ulcer – the negative pressure generated at the wound-foam interface seems to reduce oedema and promote production of granulation tissue in the base of the pressure ulcer<sup>11</sup>. Further studies are required, to investigate more fully the role of this technique in managing pressure ulcers.

Intravenous antibiotics are often used as an adjunct to reducing the bacterial load of a pressure ulcer, despite evidence of reduced effect due to their poor delivery to chronic pressure wounds. If there is evidence of sepsis, cellulitis or deep infection of the pressure ulcer, a course of intravenous antibiotics should be given, as directed by proven microbiology<sup>3</sup>. Quantitative bacteriology counts may be performed, as they provide a useful measure of the degree of bacterial colonisation of a wound.

It has been shown that the concentration of bacteria in a wound needs to be less than  $10^5$  organisms per gram of tissue, and less than  $10^2$  Streptococci, for a wound to be healthy enough to close spontaneously or heal after reconstruction<sup>12</sup>.

Radiology of a pressure ulcer is useful in determining the magnitude of the problem. The extent of the ulcer and the presence of any fistulae can often be demonstrated by way of a sinogram or fistulagram<sup>8</sup>, while the presence of osteomyelitis may be diagnosed by performing a plain radiograph in combination with a white cell count and erythrocyte sedimentation rate. In addition, some groups advocate a bone biopsy if osteomyelitis is strongly suspected, as it is a sensitive and specific test. Bone scans and CT scans are sometimes performed, although their results seldom influence treatment<sup>13</sup>. If osteomyelitis is present, prolonged antibiotic treatment does not seem to affect the outcome of the disease and has not been shown to be associated with delayed healing or recurrence<sup>14</sup>. Adequate debridement of bone – performed until healthy, bleeding bone is reached – and a short course of antibiotics appear to be satisfactory treatment of osteomyelitis in a pressure ulcer.

---

## Surgical Principles

The basic tenets of surgical treatment of pressure ulcers were proposed by Conway and Griffith in 1956<sup>6</sup> and remain valid today.

- All of the pressure ulcer, including the surrounding scar, underlying bursa and any other soft-tissue calcification, should be excised as a 'pseudotumour'. This reduces the chance of wound breakdown and infection.
- The underlying bone should be removed as a recontouring osteotomy, to increase the surface area of the weight-bearing region.
- Either muscle or subcutaneous fat with fascia should be used to pad the bony stump and fill the dead space. This reduces the risk of recurrence and deep wound infection.
- The area of pressure should be resurfaced with a large flap of healthy skin that does not leave a donor defect in a weight-bearing area requiring skin grafting.
- The flap should be:
  - as large as possible, with the suture line lying away from the area of direct pressure, and
  - designed so that it does not interfere with the design of other local flaps that may be needed if the wound breaks down or recurs.

## Surgical Options

A range of options for closing a chronic wound is available to the surgeon. The simplest reconstruction is direct closure, although this is not always appropriate as it often requires tension for closure and leaves a scar across the original pressure zone, leading to a high dehiscence rate. A split-skin graft is also simple but is rarely, if ever, performed for a pressure ulcer as it does not replace subcutaneous tissue and so does not provide padding of bony prominences; also, such a graft has low shear resistance, almost inevitably leading to recurrence<sup>6</sup>.

Local flaps, the most common reconstructions performed for pressure ulcers, involve transfer of well-vascularised skin with underlying structures such as subcutaneous tissue, fascia and muscle. The flap can be classified, according to its components, as simple cutaneous (skin and subcutaneous tissue only), fasciocutaneous (skin, subcutaneous tissue, fascia) and myocutaneous, which includes all soft tissue layers from skin to muscle<sup>7</sup>.

Most flaps used are either fasciocutaneous or myocutaneous, with indications for including muscle in a flap much debated<sup>15</sup>. Indeed, there are several disadvantages to doing so. Muscle is more susceptible to pressure necrosis than either skin or subcutaneous tissue and has a higher metabolic rate. This may be the reason why muscle is seldom, if ever, interposed between bone and skin at the site of normal, weight-bearing bony prominences. On the other hand, muscle-containing flaps are well vascularised, which makes them reliable and improves their ability to coapt to local tissue and overcome infection. They fill in deep holes well, eliminating dead space and helping to prevent seroma or haematoma formation. They also provide a larger pad with which to disperse pressure temporarily, although they tend to undergo muscle atrophy with time<sup>16</sup>.

Although several papers report the successful use of free flaps to treat pressure ulcers, they are seldom necessary. Tissue expansion has also been used to provide additional skin in difficult reconstructive cases, with some success. This is despite concerns about placing a foreign body near an infected wound and using pressure to stretch skin in a patient with an ulcer caused by pressure<sup>17</sup>.

Another technique for treating pressure ulcers is that of using a carbon dioxide laser to perform debridement. It is reported to improve haemostasis, decrease blood loss and reduce the incidence of infection. However, operating times for laser surgery are two to six times longer than for conventional surgery, and this has tempered enthusiasm for the technique<sup>18</sup>.

## Specific Areas

A comprehensive review of the details of all flaps used to close pressure sores in all regions is beyond the scope of this article. Rather, a brief description of the more commonly used options for reconstruction in the three commonest areas of pressure ulcer – ischial, sacral and trochanteric – will be provided. The amount of skin loss and depth of the defect, plus a knowledge of previous flaps raised in the region and ambulatory status, will affect the reconstruction performed.

### Ischial

Such pressure ulcers are usually extensive and deep, although, often, there is only a small skin deficit. The most common reconstructions are the gluteal thigh flap<sup>19</sup>, a fasciocutaneous flap based on the descending branch of the inferior gluteal artery, and the inferior gluteus maximus myocutaneous flap<sup>20</sup>.

---

The biceps femoris V-Y myocutaneous flap can be used to fill large defects but not in ambulatory patients, as the origins and insertions of the muscles are severed to allow the flap to move. It is based on (that is, its blood supply comes from) segmental perforators from the profundus femoris vessels, most of which enter the muscle in its distal half.

### Sacral

Sacral pressure ulcers usually leave a large skin defect but are not very deep. Often, they require reconstruction with large random fasciocutaneous flaps, such as inferiorly-based buttock rotation flaps<sup>6</sup>, rhombic flaps or, if small, Z-plasty-shaped transposition flaps. Gluteus maximus myocutaneous flaps, based on the superior and/or inferior gluteal arteries, as either V-Y or island flaps, are useful for deeper defects that require muscle-filling<sup>21</sup>.

### Trochanteric

The tensor fascia lata myocutaneous flap is most commonly used for this defect<sup>22</sup>. It may be raised either as a transposition flap, V-Y advancement or island flap based on a branch of the lateral femoral circumflex artery. Rectus femoris or vastus lateralis myocutaneous flaps, which are also based on branches of the lateral femoral circumflex arteries, are other, less frequently used reconstructions for this region.

## Post-operative Care

The patient's general state must be closely observed in the immediate post-operative period, with monitoring of haemoglobin levels, urine output and markers of infection. Drains are generally left in for at least 7 days, as seroma and haematoma are common complications<sup>6</sup>. Patients are generally nursed on a pressure-reducing bed, such as an air-fluidised or low-air-loss bed, which has been shown to reduce skin-surface pressure dramatically. The benefits of these beds in the non-operative management of pressure ulcers are well accepted<sup>23</sup> and their use post-operatively is highly recommended.

Timing and degree of post-operative mobilisation varies according to different units' protocols<sup>6, 8</sup>. Many avoid any pressure whatsoever on the operative site for 6 weeks, and during this period careful pressure-area care is performed to prevent pressure ulcers appearing at other sites. After 6 weeks the wound is assessed, with a graduated mobilisation program and sitting regimen implemented if it seems healthy.

The sitting regimen usually begins with 30 minutes twice a day, increased by 15 minutes twice a day if inspection of the re-constructed area reveals no sign of erythema or impending breakdown.

This period of incrementally increased sitting lasts 2 weeks. In some units a faster remobilisation program is implemented, with mobilisation and sitting initiated at 4 weeks<sup>24</sup>.

In addition to avoiding pressure on the wound, continual improvement in the patient's nutritional status is vital in promoting wound repair and remodelling. It is crucial that, post-operatively, every effort be made to modify the factors that contributed to the development of the pressure ulceration in the first place, and to educate the patient in terms of pressure awareness to minimise the risk of recurrence<sup>8</sup>.

## Complications

Complications are common following surgery for pressure ulcers and significantly increase the risk of recurrence.

The most common complications related to the procedure are haematoma, wound infection, flap necrosis and seroma, all of which contribute to the risk of wound dehiscence.

The recurrence rate of pressure ulcers varies between 40 and 60 per cent in different studies, with most ulcers recurring in the first 6 years post-operatively<sup>6, 8, 25</sup>. This suggests that long-term follow-up by a member of the treating team is required, to minimise the risk of recurrence by identifying early signs of complications. Results of these large reviews suggest higher recurrence rates in non-ambulant rather than ambulant patients, and that those with spinal-cord lesions have an especially high recurrence rate. However, studies have not revealed any difference in recurrence rates between patients with myocutaneous rather than random cutaneous flaps<sup>25</sup>.

## Summary

There are many prerequisites for a successful outcome following surgery for pressure ulcers. A thorough pre-operative assessment helps to identify the factors leading to pressure ulcer development that must be remedied. A thorough understanding of the principles and options of surgery allows the optimal procedure to be performed. However, even with optimal pre-operative and intra-operative management, many pressure ulcers do recur, due to problems early or late in the post-operative period.

## References

1. Thompson Rowling J. Pathological changes in mummies. *Proc R Soc Med* 1961; **51**:409-15.
2. Reuler J & Cooney T. The pressure sore: pathophysiology and principles of management. *Ann Intern Med* 1981; **94**:661-66.
3. Leigh I & Bennett G. Pressure ulcers: prevalence, etiology and treatment modalities. *Am J Surg* 1994; **167**:255-30S.
4. Altersecu V. The financial costs of inpatient pressure ulcers to an acute care facility. *Decubitus* 1989; **2**:14-23.
5. Linder R & Morris D. The surgical management of pressure ulcers: a systematic approach based on staging. *Decubitus* 1990; **3**:32-38.
6. Conway H & Griffith B. Plastic surgery for closure of decubitus ulcers in patients with paraplegia, based on experience with 1000 cases. *Am J Surg* 1956; **91**:946-75.
7. Burns A & Orenstein H. Pressure sores. *Selected Readings in Plastic Surg* 1990; **5**:9.
8. Stal S, Serure A, Donovan W & Spira W. The peri-operative management of the patient with pressure sores. *Ann Plast Surg* 1983; **11**:347-56.
9. Breslow R, Hallfrisch J, Guy D *et al.* The importance of dietary protein in healing pressure sores. *J Am Geriatr Soc* 1993; **41**:357-62.
10. Kucan J, Robson M, Heggers J & Ko F. Comparison of silver sulphadiazine, povidone-iodine and physiological saline in the treatment of chronic pressure sores. *J Am Geriatr Soc* 1981; **29**:232-35.
11. Mullner T, Mrkonjic L, Kwasny O & Vecsei V. The use of negative pressure to promote the healing of tissue defects: a clinical trial using the vacuum sealing technique. *Br J Plast Surg* 1997; **50**:194-99.
12. Robson M & Heggers J. Bacterial quantification of open wounds. *Military Med* 1969; **134**:19-24.
13. Lewis Jr. M, Bailey M, Pulawski G, Kind G, Bashioum R & Hendrix R. The diagnosis of osteomyelitis in patients with pressure sores. *Plast Reconstr Surg* 1988; **81**:229-32.
14. Thornhill-Joynes M. Osteomyelitis associated with pressure sores. *Arc Phys Med Rehab* 1986; **67**:314-18.
15. Daniel R & Faibisoff B. Muscle coverage of pressure sores - the role of myocutaneous flaps. *Ann Plast Surg* 1982; **8**:446-52.
16. Ger R & Levine S. The management of pressure ulcers by muscle transposition: an 8-year review. *Plast Reconstr Surg* 1976; **58**:417-28.
17. Yuan R. The use of tissue expansion in lower extremity wounds in paraplegic patients. *Plast Reconstr Surg* 1989; **83**:892-95.
18. El-Torai I, Glantz G & Montroy R. The use of the carbon dioxide laser beam in the surgery of pressure sores. *Intern Surg* 1988; **73**:54-56.
19. Hurwitz D, Swartz W & Mathes S. The gluteal thigh flap: a reliable sensate flap for the closure of buttock and perineal wounds. *Plast Reconstr Surg* 1981; **68**:521-30.
20. Rajacic N. Treatment of ischial pressure sores with an inferior gluteus maximus musculocutaneous island flap: an analysis of 31 flaps. *Br J Plast Surg* 1994; **47**:431-34.
21. Stevenson T, Pollock R, Rohrich R & van der Kolk C. The gluteus maximus musculocutaneous island flap: refinements in design and application. *Plast Reconstr Surg* 1987; **79**:761-68.
22. Nahai F, Silverton J, Hill H & Vasconez L. The tensor fascia lata musculocutaneous flap. *Ann Plast Surg* 1978; **1**:372-79.
23. Ferrell B, Osterweil D & Christenson P. A randomised trial of low-air-loss beds for treatment of pressure sores. *JAMA* 1993; **269**:494-97.
24. Hentz VR. Management of pressure sores in a specialty center: a reappraisal. *Plast Reconstr Surg* 1979; **64**:683-91.
25. Relander M & Palmer B. Recurrence of surgically treated pressure sores. *Scand J Plast Reconstr Surg* 1988; **22**:89-92. ■

## An Ounce of Prevention...?

# ACTION<sup>®</sup> FLOTATION PADS

for Patient Pressure Protection in  
• THEATRE • RECOVERY • ICU • WARDS • A & E



ACTION Pads are in use throughout Australia for the primary prevention of pressure sores and nerve and tissue damage caused by pressure. They are UNIQUE - no other pad is made from AKTON dry viscoelastic polymer. AKTON's unusual properties provide the best in skin shear and pressure protection; they are easily cleaned with disinfectant, won't leak or deflate, and are repairable.

ACTION Pads are made in over 60 different sizes and shapes and include pads for operating tables, A & E trolleys, beds, chairs, wheelchairs, heel/ankle protectors, head pads, patient positioners, etc.

Call us for more information, your catalogue, or name of nearest distributor.

Distributed by:



**EDWARDS**  
MEDICAL SUPPLIES

15 Bellingham Street  
(PO Box 3085)  
Narellan NSW 2567

**Telephone: (02) 9820 2122**  
**Toll Free: 1800 024 407**