

# SURGICAL TREATMENT OF PRESSURE ULSERS

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## Abstract

Although a pressure ulcer is a potentially serious condition that always calls for treatment, only a small percentage of patients with pressure ulcers are candidates for surgery. The choice between conservative treatment and surgery for a pressure ulcer depends on a thorough evaluation of the ulcer, as well as the patient's physical and mental states. In general, superficial pressure ulcers (stages I and II) are likely to benefit from conservative treatment. Deep pressure ulcers (stages III and IV, often resulting from spinal cord injury) often require surgical intervention. The surgical techniques described in this essay include direct closure (which is rarely indicated), local and sensate flaps, and skin grafting. Skin transplantation and cutaneous and other thin flaps have more limited indications in pressure ulcer surgery. Thorough debridement before reconstruction, patient compliance, control of concomitant disease, professional postoperative support, and sufficient pressure relief are imperative for treatment success. © 2004 Excerpta Medica, Inc. All rights reserved.

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A pressure ulcer is a serious or potentially serious condition that always calls for active treatment. The proportion of pressure ulcers suitable for operation depends on the patient population, but normally only a low percentage are candidates for surgery. However, among selected groups of patients, such as those with spinal cord injury and deep stage III or IV pressure ulcers [1], surgery may be indicated for the majority.

Pressure ulcers are expensive to treat. Costs are estimated to be £1,000 to £20,000 (1,250 –25,000 €) per year per pressure ulcer [2–4]. Prevention is found to be cheaper than cure [5], and surgical treatment can be more expensive than conservative treatment [6].

The crucial questions are, who would benefit from surgical intervention, and how should the pressure ulcers be treated? Surgery should improve the patient's situation as a whole, and it is not always the most obvious surgical method that is the best choice for the individual patient. If the resources, including a committed and well-educated staff on all levels, are not present, then surgery is likely to fail because of insufficient care and lack of postoperative support, both of which make recurrence almost inevitable.

## Selection of patients for pressure ulcer surgery

No clear criteria for selecting patients with pressure ulcers for surgery exist, but decision guidelines have been developed [3,6–8]. Pressure ulcer surgery is for selected groups of patients. Indications should be strict, treatment protocols clear, treatment goals realistic, and there should be improvement in the patient's quality of life.

Superficial stage I and stage II pressure ulcers [1] should be treated conservatively by using optimal ulcer treatment and by eliminating the local and general conditions that interfere with healing.

Deep pressure ulcers may be candidates for surgery. Deep pressure ulcers lack large amounts of soft tissue, and if conservative healing succeeds, the resulting area will consist of stiff and scanty scar tissue. If the patient requires a tissue with high mechanical performance, there is no need to await healing, because conservatively healed tissue is often of insufficient quality.

The time factor can also be an indication for surgery. Large wounds often take many months to heal by conservative means. Healing is much quicker after surgery.

Long-standing (years) pressure ulcers can result in the development of amyloidosis or malignant degeneration of the pressure ulcer into a Marjolin ulcer, a planocellular carcinoma. These factors should also be considered in the indications for surgery.

Underlying infected bone also signals the need for surgery. Osteomyelitis in pressure ulcers is eliminated by sur-

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Table 1  
Identification of patients for surgery

1. Identify pressure ulcer patient
2. Evaluation of pressure ulcer
  - Conservative treatment?
  - Surgery?
3. Evaluation of patient's physical state
  - Concurrent medical diseases?
  - Medical treatment?
  - Fit for anesthesia and operation?
4. Evaluation of patient's mental state
  - Cooperative?
  - Informed?
  - Motivated?
  - Realistic?
  - Patient's wishes?
5. Evaluation of future
  - Outcome?
  - Rehabilitative possibilities?
  - Social network?
  - Control?

ger [9]. Debrided osteomyelitic bone must be covered with soft tissue with a good blood supply to ensure healing [1

### Identification of patients for surgery

All patients with a stage III or stage IV pressure ulcer should be evaluated for surgical treatment. However, patients with pressure ulcers always have other diseases, making treatment of the whole patient (and not only the pressure ulcer) extremely important. The patient's ability to tolerate an operation and participate in postoperative rehabilitation must be evaluated. Concurrent diseases must be corrected preoperatively. The risk of anesthesia and surgery must be weighed against the benefit of elimination of the pressure ulcer. It is possible that some patients may be drug addicts or have daily habits or social circumstances that should be changed before surgery can be recommended. An uncooperative patient is at overwhelming risk of recurrence. If the rehabilitative outcome cannot be anticipated, surgery should be postponed until the circumstances are under control. Setting the indication for surgery should always be a careful and individually based estimation (Table 1). The indication for surgery can be more or less absolute, as in sepsis emanating from a decubital focus.

In debilitated patients, debridement without subsequent reconstruction may be the optimal treatment. Patients prone to general recovery can also benefit from an isolated debridement, because a clean cavity can heal after the patient is mobilized and the region relieved of pressure.

Spinal cord-injured patients cannot be expected to regain sensation. They cannot detect pain caused by pressure and ischemia, and cannot relieve pressure because of paralysis. These patients need tissue of a sufficient magnitude and quality to withstand unphysiological pressure. Reconstruction of deep pressure ulcers with myocutaneous flaps will

usually be indicated for these patients. In other groups, such as patients with sclerosis disseminata in advanced stages, the intellect and frame of mind of the patients must be assessed in order to evaluate future compliance.

Informed consent of the patient is an obvious prerequisite and is of the utmost importance because of the high rates of complications and recurrences associated with surgery [1,8,10-12].

Preoperative treatment with muscle-releasing casts or intraoperative tenotomy can be used to release muscle spasms [13]. If there is a risk of postoperative contamination with urine or feces, an indwelling urine catheter and lower bowel emptying are indicated before surgery [14].

Bone underlying deep pressure ulcers should always be investigated preoperatively with conventional x-ray for osteomyelitis, although the images are seldom diagnostic. Clinical appearance, laboratory tests, and bone cultures are usually necessary for diagnosis. Scanning and scintigraphic investigations are used only in selected cases [15].

### Debridement

After debridement, bone should be left with a smooth nonprominent surface to reduce local pressure on the reconstructed area [7]. In cases of osteomyelitis in the ischial tuberosities, only the affected part should be debrided. Prophylactic total ischiectomy is never indicated because urethral fistulas and perineal ulcerations can develop [1,7].

During debridement, specimens for diagnosis of bacterial growth are procured. A tissue biopsy is preferable to a swab culture [1,9,16]. If the pressure ulcer extends to the bone, a biopsy of the bone involved should be obtained [1,15]. Many experts prefer noninvasive diagnosis of osteomyelitis if operative debridement is not planned. However, noninvasive methods, such as aspiration of fluid from the ulcer, are considered less satisfactory [1,15]. If clinical osteomyelitis is present, the authors' preference is bone biopsy. Osteomyelitis can be expected in the majority of deep pressure ulcers [9]. Increasing the number of bone biopsies raises the probability of obtaining a correct microbiological diagnosis.

Debridement reduces the bacterial counts in an ulcer. Treatment with antibiotics is indicated only if infection is present, or if sepsis is a risk after debridement. If reconstruction is performed immediately after the debridement, antibiotics are compulsory. In cases with active osteomyelitis or sepsis, antibiotics are initiated preoperatively [1].

Hemostasis must be obtained carefully after debridement. Because of the hyperemia in the sound tissue surrounding an ulcer, patients with pressure ulcers have a significant risk of developing hematomas postoperatively. Bleeding from minor vessels should be controlled with a dry gauze dressing loosely applied in the cavity until the next change of dressing after 8 to 24 hours.

A particular problem is debridement of spinal cord—

injured patients with spinal lesions above the fifth thoracic segment. In these patients, debridement or other manipulation of the pressure ulcer can provoke autonomic hyperreflexia. This is a potentially dangerous condition with critical elevation of blood pressure as the most hazardous symptom. If autonomic hyperreflexia occurs, manipulation of the patient has to be stopped immediately and the blood pressure decreased by acute reduction of vascular tone.

When reconstruction is considered, it must be decided whether debridement and reconstruction can be performed in 1 or 2 sessions. If treatment is split into 2 separate operations, there can be enough time to achieve a microbiological diagnosis. Sealing the pressure ulcer defect with a flap can conceal the development of hematoma or infection beneath the reconstructed tissue. This risk may be reduced, because these complications will develop before the reconstruction is accomplished. The great advantage of a single-session procedure is the reduction of time and resources. The current trend seems to favor a single-session procedure [8,17]. The authors, however, prefer a 2-session procedure in pressure ulcers with major bacterial presence.

## Surgical repair

Always choose the least demanding procedure available for the goals decided upon for the individual patient (Table .2)

### *Direct closure*

Direct closure is a simple, yet rarely indicated method in pressure ulcer surgery [1]. It is the process of forcing the edges of the pressure ulcer surface together where tissue has vanished. However, this will lead to increased tension in the superficial tissue and a deep cavity, factors participating in the development of pressure ulcers and dehiscence [1,17]. In some cases where the lack of tissue is not too great, direct suture might occasionally be possible and is then advisable. In the authors' experience very few pressure ulcers are suitable for direct closure.

### *Skin grafting*

Skin grafting is effective for elimination of a defect. A relatively simple procedure, it nonetheless requires a well-vascularized bed and immobilization during healing. The graft usually heals in about 10 days, but the patient should abstain from mechanical loading of the graft for about 3 weeks. A split-thickness skin graft is thin and unpliant and therefore erodes easily when subjected to pressure and friction. Split-thickness skin grafting is indicated in large, shallow, and well-granulating pressure ulcers, and in cases where nonphysiological high mechanical strain is not a factor. A full-thickness skin graft has better mechanical properties than a split-thickness skin graft but imposes more

demands on the recipient bed. It is more susceptible to mechanical strain than a local flap, which is why a flap is often preferred to a graft.

### *Local flaps*

Flaps can be categorized according to the type of vascular supply or the types of tissue in the flaps (ie, skin, fascia, and muscle). Random flaps have no specific blood supply. Because of the lack of well-defined vessels supplying blood throughout the flaps, they are of limited dimensions and consist of a single or a few tissue layers (skin, subcutis, fascia). Flaps carrying well-defined vessels (axial flaps) have a much wider range of reconstructive abilities with regard to size, versatility, and tissue constituents [14,18]

Fasciocutaneous flaps have a better blood supply than most random cutaneous flaps. The extra padding supplied by the fascia is of limited significance from the view of pressure distribution. The subcutaneous tissue between the skin and fascia will all be integrated in the fasciocutaneous flaps, but subcutaneous tissue is of limited value in pressure ulcer treatment because of its low resistance to pressure and tear and its modest blood supply. Fasciocutaneous flaps are suitable for the reconstruction of selected stage III or IV pressure ulcers without underlying osteomyelitis and without nonphysiological loading. Scrotal flaps have been used to cover perineal pressure sores. In theory, it should be advantageous that the skin is able to slide on a multitude of fascias, but we have not found this type of flap satisfactory.

Myocutaneous flaps are the treatment of choice in reconstructive procedures for deep pressure ulcers [1,8,12,13,17]. The myocutaneous flap offers the best opportunity for supplying the pressure ulcer cavity with sufficient bulk containing both excellent blood supply (muscle) and normal integumental cover (full-thickness skin). However, it must be noted that muscle has a low tolerance for ischemic injury. From an anatomical point of view, there is no reason for transposition of muscle into a pressure ulcer cavity, because these pressure point areas do not, under normal circumstances, contain muscle. Yet experiments indicate that muscle beneath pressure-loaded skin is beneficial [19]. The flap should be designed to be large enough for reuse in case of recurrence. The donor site can usually be closed directly, which is preferable to skin transplantation or secondary flaps.

The flaps are usually elevated (ie, freed from their surroundings) until they are attached only by their vascular pedicles, making the flap very pliable. Raising a myocutaneous flap affects or eliminates the function of the muscle, providing a balance between optimal coverage and normal muscular function. Some muscles, such as the tensor fasciae lata muscle, are expendable in all patients. Others, such as the gluteus maximus muscle, are essential and should not be used in patients expected to be ambulatory postoperatively. In some instances, for example, the gluteus maximus mus-

cle and the quadriceps [14,18,20], the muscle can be split to both preserve function and obliterate a pressure ulcer cavity.

Reconstruction with myocutaneous flaps is major surgery, and selection of suitable patients is important to avoid causing harm. Spinal cord–injured patients can usually be offered reconstruction with otherwise expendable muscles because of the lack of voluntary function of the muscle in question [1,14,18,21]. In other situations, the importance of eliminating a pressure ulcer cavity will have a higher priority than the muscle function: osteomyelitis will be most effectively treated by using highly vascularized muscle tissue. Approximately 80% of our patients with pressure ulcers receiving reconstructive procedures are treated with myocutaneous flaps.

### Advanced and unconventional procedures

Sensate flaps (ie, flaps containing intact sensory nerves) have been used in spinal cord–injured patients to provide skin cover with sensation [2,12] to the otherwise anesthetized skin. Recurrence rates might be reduced with the use of sensate flaps [1,2], but new sensation can have the form of unpleasant dysesthesias. This makes the patients move any loading to just outside the sensate part of the flap, to an insensitive area, and a new pressure ulcer can develop [2]. An accessible flap can be raised from areas with intact sensation, such as the tensor fascia lata flap to the pelvic region [1,2].

Free flaps are muscle or myocutaneous flaps totally freed from the donor site and connected to vessels at the recipient site by microsurgical techniques. Free flaps in pressure ulcer surgery are only rarely described in the literature [22]. Free flaps involve time-consuming and resource-demanding procedures and probably should be limited to use as a last recourse.

Tissue expansion has been introduced in the treatment of pressure ulcers as skin expansion [23] or expansion of several tissue layers [1,24]. Expanding the tissue surrounding a pressure ulcer by gradually inflating expanders beneath the tissue in question increases the availability of local tissue. However, experience in this field is limited.

Reinforcing the tissue covering former or threatening pressure ulcer areas has been attempted using carbon fiber pads. Minns et al [25] found the method encouraging, with a success rate of .68%

### Flap selection

The anatomical site of the pressure ulcer naturally has a pronounced influence on the selection of flaps. A certain consensus exists about the selection of flaps for different pressure ulcer locations [7] (Table 3).

Sacral pressure ulcers neighboring the edges of the gluteus maximus muscles make the gluteus maximus myocu-

Table 2  
Choosing the least demanding procedure

1. Identify pressure ulcers
2. Evaluate each pressure ulcer according to
  - Location
  - Stage
  - Size
  - Tissue viability
  - Infection
3. Treatment options for each pressure ulcer
  - Pressure relief
    - Patient
    - Support surface
  - Wound cleansing options
    - Dressing
    - Technique
    - Debridement
    - Antibiotics
  - Debridement options
    - At bedside
    - In the theatre
    - 1 < session
  - Reconstruction options:
    - Direct suture
    - Skin grafting
    - Cutaneous flap
    - Myocutaneous flap
    - Conventional procedures
    - Other alternatives

Table 3  
Pressure ulcer location and surgical alternatives for reconstruction: authors' suggestions for repair

Pressure Ulcer	First Choice	Second Choice
Sacral	Gluteus maximus*	Gluteus maximus*
Ischial	Hamstrings	Gluteus maximus*
Trochanteric	Tensor fasciae latae	Gluteus maximus*

\*None of the versatility of the gluteus maximus muscle as a flap for reconstruction of sacral pressure ulcers.

taneous flap the first choice. The muscles, although expendable for normal gait, can be used in spinal cord–injured patients and others without ambulatory function, but should at least be partly preserved in walking patients. Muscle and myocutaneous flaps consisting of only half the muscle can be created [14]. A distally based flap is also a possibility. This type of flap has the advantage of being free of suture lines in the area used for sitting [14]. A large number of flaps based on the gluteus maximus have been developed [13,14,26]. Flaps based on gluteus maximus are safe, but the dissection is often bloody. In patients with old spinal cord injury, the atrophy of the muscle may be pronounced, making identification difficult [1]. If the flap is planned correctly, the donor site often can be closed directly. The potential size of the gluteus maximus flap and its symmetrical location usually make these flaps usable as a secondary option. Alternatives such as a thoracolumbar flap or more distant flaps are available [1,14].

Table 4  
Pressure ulcers in paraplegia and tetraplegia patients (spinal cord injury)

Study	Surgery	Follow-up Time (mo)	Complications (%)	Recurrence (%)
Disa et al, 1992 [[41	Mixed	21	31	61
Kirkby and Holck, 1982 [[40	Myocutaneous	10	13	25
Løntoft and Kjeldsen, 1986 [[39	Mixed	35	35	41
Mandrekas and Mastorakos, 1992 [[38	Myocutaneous	24	7	13
Pers et al, 1986 [[37	Mixed	?	38	16
Relander and Palmer, 1988 [[36	Mixed	144–24	18	56
Sørensen, 1994 [[35	Myocutaneous	60	13	40
Tavakoli et al, 1999 [[34	Myocutaneous	62	62	48

Ischial pressure ulcers are among the most frequent types of pressure ulcer on the pelvis (Fig. 1). Several suitable flaps are available [7,8,14,21,27]. Our primary choice is a flap based on the hamstrings. This is a versatile and safe flap that can be readvanced a few times [21], which is why it should always be raised primarily in its full length. The proximal part of the flap can be deepithelialized and swept around the ischial tuberosity as extra padding. By modifying the muscle content, the flap can be used in spinal cord-injured patients who use muscle spasms to ease movement and in ambulant patients. Our second choice (but for several authors, the primary choice) for isolated ischial pressure ulcers is a myocutaneous gluteus maximus flap [7]. The tensor fascia lata flap can easily cover an ischial ulcer, and in patients with sensory loss below the third lumbar level, this flap can bring sensibility to the ischial area [7]. We usually use this flap for closure of an ischial pressure ulcer only if it is concomitant with a trochanteric ulcer, and both can be closed with the same flap. This method has the disadvantage that much of the flap closure is in the area used in sitting, and thus the donor site often needs a split-thickness skin graft for closure. A gracilis myocutaneous flap is also accessible, but only for small or moderate-sized ischial defects. Some authors [8] have found a significantly greater rate of success with the inferior gluteus maximus island flap and the inferior gluteal thigh flap compared with the hamstring flap and the tensor fascia lata flap.

Trochanteric pressure ulcers can primarily be closed with a tensor fascia lata flap [1,28,29]. The flap is safe with a good blood supply, the muscle is expendable, and when used for the present purpose, the donor defect can usually be closed directly. Otherwise, the donor site is closed with a split-thickness skin graft. The second choice is the vastus lateralis flap, the rectus femoris flap, or the inferior-based gluteus maximus flap [7,14].

Pressure ulcers on the heel are common but should usually be treated conservatively. When necessary, heel ulcers can be covered with a suralis fasciocutaneous flap or local muscle flaps [14].

Deep pressure ulcers on toes with osteomyelitis are usually best treated with amputation of the toe. The healing potential must be assessed before surgery is commenced.

In addition to the locations already mentioned, less com-

monly pressure ulcers can develop over any bony prominence on the extremities. The malleolus, the knee, and the elbow are often affected. Depending on the involvement of bone, local cutaneous, myocutaneous, or possibly pure muscle flaps are available [14,18].

In the head, an abundance of flaps are available, but pressure ulcers in this location are not frequent and usually have a short history with intact deep structures. The rich blood supply in the region almost obviates the need for flap reconstruction.

Several locations on the upper trunk are prone to develop pressure ulcers in at-risk patients. Local cutaneous or fasciocutaneous flaps are usually sufficient treatment, but myocutaneous flaps are also available if needed [14,18].

### Extensive, multiple, and recurrent pressure ulcers

Extensive pressure ulcers are defined as pressure ulcers too large to heal secondarily or to be treated surgically by a single flap. Of these patients, 30% to 70% have >1 pressure ulcer at admission [10,30].

When extensive pressure ulcers are located in the pelvic region, reconstruction becomes an option. Large amounts of tissue are needed. A total thigh flap gives good soft tissue covering and can be folded to cover large defects on the ipsilateral pelvis, making wheelchair ambulation possible [31]. Because a hip disarticulation is necessary, only the presence of major pressure lesions justify the thigh flap. Modifications can be performed without amputation of the entire, or part of, the extremity [32]. A rectus abdominis myocutaneous flap is also a possibility [33]. Spinal cord-injured patients are the most common target group. To prevent spasms from tearing the flap, external fixation may be indicated for a few weeks. Ablative surgery with elimination of the whole region containing the pressure lesion sometimes may be indicated as the only possibility of controlling the extensive ulcer.

Multiple pressure ulcers should be treated in as few sessions as possible [13]. To treat a single or a few pressure ulcers at separate sessions prolongs the course. Postoperatively, multiple flaps may call for special regimens and beds, because positioning will often be a problem.





Fig. 1. Right stage IV ischial pressure ulcer. Note the small skin defect. The skin could be closed without tension, but tissue is missing in the depth. (Reprinted with permission from The Prevention and Treatment of Pressure Ulcers [42]



Fig. 2. Right ischial pressure ulcer after debridement (same patient as Fig. 1). (Reprinted with permission from The Prevention and Treatment of Pressure Ulcers [42]



Fig. 3. Right myocutaneous hamstring flap. Note mobilization of the flap across the ischial pressure ulcer defect (same patient as Figs. 1 and 2). (Reprinted with permission from The Prevention and Treatment of Pressure Ulcers [42]

Recurrence is a special and all too common challenge with rates of 5% to 56% or even higher in special risk groups [11-13,26,34-41] (Table 4). The lack of tissue is pronounced in a recurrent ulcer where the reconstructed or adjacent tissue has broken down.

There is no major difference in the treatment of primary and recurrent pressure ulcers. The design of the flap should preferably avoid hampering alternative local flaps, that is, by cutting important blood vessels or scarifying future flaps. (A pressure ulcer can also recur after a second repair.) If a patient repeatedly develops pressure ulcers, the indication for continued surgery and the rehabilitation possibilities must be carefully considered.

The general technique for raising a myocutaneous flap is as follows:

1. After thorough debridement (Fig. 2), the borders of the flap are drawn on the skin with the patient in a position that gives good access to the region. The skin and subcutaneous tissue are incised in sweeping cuts to the deep fascia.
2. The fascia is opened and sutured to the skin and underlying muscle with a few sutures to prevent the skin island from being torn off the muscle.
3. The muscle is released from the surroundings, usually leaving only the vascular pedicle untouched (Fig. 3). Sometimes the muscle just needs to be partially released, and then the vessels do not need to be visualized.
4. The flap is now transpositioned into the pressure ulcer cavity, and suturing is commenced (Fig. 4). Most





Fig. 4. Right myocutaneous V-Y hamstring flap covering a right ischial pressure ulcer (same patient as Figs. 1, 2, and 3). (Reprinted with permission from *The Prevention and Treatment of Pressure Ulcers* [(42

frequently, myocutaneous flaps are needed in the pelvic region. Our preferences are shown in Table 3

Closure of the surgical wound should be performed in layers to approximate the different tissue layers, keeping the whole area of sufficient and uniform thickness. Pull-out sutures can be used advantageously to place the deep muscle and to obliterate dead space around bone. The number of sutures is a compromise between effective closure and a minimal amount of foreign material in the wound. Sutures should be removed when the wound is strong enough, usually after 2 to 3 weeks.

Drains are indispensable in flap surgery for reducing the risk of complications from hematoma. Suction drainage should be used. The drains should be left until drainage is

limited to 10 to 20 mL. It has been suggested that suction prevents the formation of cavities beneath the flaps. If this effect is desired, drainage should be left for 2 weeks [26]. However, the suction tube is a foreign body and a template for a tunnel from the surface to the obliterated space beneath the flap. If the tube is left for too long, it can be a possible entrance for infective organisms. Foreign bodies also increase the risk of infection in a contaminated wound. The authors remove the drains from the former pressure ulcer cavity after 2 weeks and after a few days in the donor site.

In our experience, a thin permeable bandage (eg, a single layer of paper plaster) is found sufficient for covering the suture lines.



Antibiotics should always be administered in major reconstructive procedures for pressure ulcers [10]. In a wound without necrosis or infection, a prophylactic dose given preoperatively is sufficient. If the operation is prolonged, the dose can be repeated, depending on the antibiotic used. If there has been bone involvement or if the risk of infection is increased, administration of relevant antibiotics should be continued. In order to prevent postoperative infection, it is recommended that antibiotics be used for 5 or 7 days [10,14]. Antibiotics against anaerobic organisms should be included for pressure ulcers in the pelvic region [10]. Because no consensus exists and no scientific proof has been published, both the length of the therapy and the choice of antibiotics vary. If no specific bacteria have been identified, the authors use a second-generation cephalosporin. This treatment can be given with metronidazole and possibly an aminoglycoside with increased risk of infection.

Prolonged administration of antibiotics is indicated in the treatment of osteomyelitis. Although no unequivocal recommendation exists, 2 weeks to 3 months are advocated [9,17,30]. We prefer treatment in the duration of 3 months, but there is no evidence that extended antibiotic therapy reduces the risk of complications or recurrence [30]. The antibiotics should be stopped only after the leukocyte counts and the erythrocyte sedimentation rate have been normalized. Initially, antibiotics are administered intravenously; after 2 weeks, oral administration is commenced. Longer parenteral administration is often used [9]. Local administration of antibiotics is, in our opinion, not indicated in reconstructive procedures.

Postoperatively, a continuous relief of pressure, observation of flap necrosis, and infection control have to be performed to avoid recurrence [42].

## Conclusion

The pressure ulcer patient's way through the system depends on the local organization. In general, pressure ulcer patients are treated locally. Debridement can be performed by the local surgeons. Only in cases where interventions other than standard treatment are expected will the patient be examined by specialists. If surgical treatment is expected, the plastic surgeons who will perform the reconstructive procedures should be involved.

In our area, obstinate pressure ulcers are evaluated by the Copenhagen Wound Healing Center [43] and the Odense Wound Healing Center. If reconstructive or similar procedures are expected, the departments of plastic and reconstructive surgery are involved. The surgical treatment of pressure ulcers is a multidisciplinary task. Professional demands are high, courses complicated, and problems frequent. Future progress is to be expected primarily in improved assessment, prophylaxis organization, and, to a lesser degree, in technical developments in surgery.

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