

SURGICAL TREATMENT OF PRESSURE ULCERS

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Abstract

Pressure sores or bedsores are injuries to the skin and underlying tissues that result from prolonged pressure on the skin. Bedsores most often develop on areas of skin that cover bony parts of the body, such as the heel, ankles, hips or buttocks. These wounds most often present themselves in immobilized or bedridden patients on parts of the body that are compressed between the skeleton and underlying surface. The treatment is often long lasting, time consuming and management is difficult process that demands enormous financial and human resources.

The aim of this paper is to present our experience with the surgical treatment of the deep pressure sores. Our study presents a cohort of 30 patients that were surgically treated at the University Clinic for Plastic and Reconstructive Surgery, in Skopje, Republic of Macedonia, during a fifteen year period from 1996 to 2010. Emphasis of the surgical treatment was placed on harvesting and transplanting Cutaneous and Myofasciocutaneous flaps in order to cover the deep soft tissue defects. Results include statistical analyses of the group, systematization of the pressure ulcers according to the regions affected, utilized operative techniques as well as the average hospitalization stay. The youngest patient is a 10 years old child with a scalp pressure ulcer following a neurosurgery operation. The oldest patient is 83 years old male with a decubitus in the sacral region. Mean hospitalization stay is 26 days. Surgical treatment of the decubital ulcers, adequate and on time applied, in combination with appropriate pre- and post-operative care, gains satisfying functional and aesthetic results. That applies especially in selected patients where primary illness as reason for pressure ulcer is prone to successful rehabilitation.

Key words: decubitus, reconstruction, flap

Introduction

Decubital ulcer, pressure sore, pressure ulcer, bed sore or simply decubitus are all synonyms that refer to wound occurring due to long-lasting excessive pressure over the tissues which are compressed between the bone prominences and external objects. These objects could be anything that creates compression over the soft tissue like beds, mattresses, wheelchairs etc. On the other hand, the bone prominences usually are sacral, ischial, trochanteric, calcaneal, spine processi, calvaria and other parts of the skeleton comprising the most affected regions. (1,2)

The term decubitus originates from the Latin word "decumbere", which means "to lay", "to lie on" inducing the fact that these wounds have been seen initially in patients lying immobile for longer time. As a medical problem, pressure ulcers seem to be as present as the civilization, as J. Thompson Rowing in 1961 has described a decubital ulcer in Egyptian mummy. Sir James Paget in 1873 was first to explain the pathophysiology of these ulcers. Namely, the main reason for decubital ulcers is the pressure exerted over the tissues which can withstand a short termed high pressure, but not prolonged. When this compression rises to level higher than the capillary filling pressure, which is approximately

32mm Hg, a process of hypoxia and ischemia occurs leading to cell death and tissue necrosis. Furthermore, uninterrupted and prolonged pressure causes thrombosis of the small arteries and veins, additionally contributing to tissue necrosis and subsequent inflammation. This common pathway initiates the magic circle towards pressure ulcer and can occur after as little as 2 hours of unrelieved overpressure. Tissue resistance to pressure and hypoxia differs among distinct cell types regarding their dissimilar oxygen needs, as muscle cells are more amenable to ischemia than the overlying skin which can bear as long as 12 hours over-pressed without appearing any signs of ischemia. This is the reason for wider and deeper necrotic areas than expected when seen on initial patient inspection. Time needed for pressure ulcer to develop also depends on patient weight, blood supply of the tissue, concomitant local infection, maceration and other contributing factors. (1-3)

Any patient with impaired mobility is prone to pressure ulcer occurrence such are comatose or sedated patient, patient with quadriplegia/ paraplegia, heavily or terminally ill patient, burned or polytraumatized patient. While immobile, they can't assist when needed in order to inhibit long-lasting over pressure thus being susceptible to pressure sores unless medical staff prevent it. Muscle

atrophy seen in prolonged immobilizations or neurological impairments, is the reason for de-bulking the bone prominences. The lack of sensibility in spinal cord injuries makes skin thinner and more vulnerable to friction and traction forces, which break down skin barrier, resulting in macerations that adhere to clothes and injure the skin additionally. Also, insensibility means painless, thus annulling the main symptom of injury, the pain. On the other hand, wound presence postpones the rehabilitation program which is of great importance for these patients.

Furthermore, other local factors and comorbidities do contribute. Local factors comprise bad hygiene, urinary or fecal incontinence, moist and wet environment, lack of effective dressings, infections. Comorbidities like anemia and malnutrition are of great importance, due to the fact that both decelerate wound healing and aggravate catabolism. Vascular abnormalities as seen in diabetics stress out the probability for sore appearance.(3, 4, 5)

Out of many staging classifications, the one of Shea modified by National Pressure Ulcer Advisory Panel is widely used. Comprising 4 stages of ulceration, this system describes the depth of the sore. First stage is presented as non-bleachable erythema, induration, pale color, but still an intact skin. Second stage presents a partial thickness skin loss that involves epidermis and possibly dermis, usually seen as blister or superficial ulcer. Stage III refers to a full thickness skin loss and sub dermal tissue necrosis with an unaffected fascia. Stage IV represents the deepest ulcer involving fascia, muscle, tendons, joint capsule and probably bone. At this stage, osteomyelitis is often seen as well as deep undermining sinus tracts that destroys the tissue in the vicinity. A practical staging system divides pressure ulcers in shallow ulcers (stage I and II), deep ulcers (stage III and IV) and ulcers where the depth cannot be evaluate at the moment of inspection due to present necrosis that need to be debrided. (6)

The complex treatment of pressure ulcers is time consuming, demanding and slow going process that employs lot of resources and efforts. Modern approach of the treatment comprises adequate handling of the primary illness, prevention with all means especially usage of anti-decubital beds and mattresses that eliminates overpressure, correction of comorbidities like anemia and hypoproteinemia, employing optimal wound healing environment and finally, surgical treatment. Shallow ulcers are treated conservatively whereas deep ulcers conservatively or/and surgically.

Interest of this paper is the surgical treatment of deep pressure ulcers i.e. pressure ulcers of stage III and IV. Surgical treatment is applied when the general condition

of the patients allows operation. By using various reconstruction methods the intention is to close the ulcer as soon as possible, but as well to shorten the hospital stay and accelerate the rehabilitation process. Pressure ulcer surgery includes following basic principles when utilized: ulcer and surrounding scar excision, removing of the underlying pressure point bone (ostectomy) which is seldom infected and lastly, reconstruction of the defect, covering dead space, restoring contour with similar and stable tissue by using various flap transfers. Prior reconstruction, radical necrectomy is a must and includes removing not only of the dead tissue, but also the surrounding scar and even the granulations out from the wound bed. The resulting defect is thus far larger and primary closure is practically impossible to conduct. Sutures have to be placed without any tension, on contrary the wound will dehiscence and the reconstruction is doomed to fail. Inclusively, usage of flaps, local or distant, is obligatory concerning the fact that primary closure is infeasible, expect maybe in few cases with smaller and narrow sores. (2, 7)

Patients where good result with minor recurrence risk is expected are enrolled for surgery. This means patients with good general condition preoperatively assessed, patients with complimentary social resources (social support, anti-decubital beds, adequate home medical care, wheelchair mattresses etc.), compliant attitude and knowledge to prevent recurrence. To minimize operative risk, as well as to enhance the success rate, all comorbidities should be corrected, especially anemia, hypoproteinemia (obtaining serum albumin level $> 35\text{g/l}$), glycemic level in diabetics. Good overall health and mental states, younger age, sufficient nutritional status, negative smoking history and absence of urinary or/and fecal incontinence indicate satisfying outcome. Postoperative infection is minimized if bacterial load is less than $10^6/\text{g}$ tissue from decubital site. To accelerate wound cleansing and to promote healing after necrectomy, modern dressing technologies (impregnated alginates, hydrocolloids, autolytic gels, adhesive barriers etc.) are used more frequently as they absorb much discharge, provide adequate moisture environment, stimulate necrolysis but also decrease odor often present in combination of daily whirlpool and high pressure saline irrigation as well as vacuum assisted closure. Yet another modus in treatment is hyperbaric oxygen therapy which stimulates granulation tissue growth by obtaining optimal local oxygen level. (3, 7, 8)

Material and Methods

The study comprises all operatively treated patients on the University Clinic for Plastic and

Reconstructive surgery, Medical faculty in Skopje, Macedonia, in the period of last fifteen years, from 1996 to 2010. Out from 30 patients, 21 were males (70%). The average age is 58.6 years (range 10 – 83). The youngest patient is a 10 years old boy presented with an occipital pressure sore, due to previous brain surgery and prolonged comatose state. The oldest patient is an 83 years old male with a decubital ulcer on sacral region due to a lasting immobility. Inclusion criteria are pressure ulcer stage III and IV, conscious patients, good general health status, adequate social support with expected sufficient rehabilitation and postoperative prevention of decubital recurrence, serum albumin level $> 35\text{g/l}$, wound bacterial contamination less than 10^6 CFU/gr. wound tissue, absence of anemia. Exclusion criteria are pressure ulcer stage I and II (where conservative treatment is treatment of choice), infections, hyperpyrexia, sepsis, concomitant injuries and severe diseases of other nature, quadriplegia as well as patient without social support and affected mental status wherein no postoperative rehabilitation process could be followed and recurrence is expected. Age is not criteria, but younger patients are advanced.

Etiologically, most of the patients were spinal cord injured with paraplegia, comprising 24 patients (80%). Three patients (10%) had the ulcer as a result of prolonged unconsciousness after neurosurgery. Two (6.66%) had the ulcer due to hospitalization in the intensive care unit for longer time. One patient (3.34%) was immobile for few months at home after hip replacement surgery and that's our oldest patient.

According to pressure ulcer localization, patients are classified into regions as following: sacral region pressure ulcer in 15 patients (50%), trochanteric region in 7 patients (23%), occipital region in 4 patients (13%) and

other regions affected in 4 patients (13%). On inspection, prior operation, sores are measured and staged, using the Shea decubitus staging system (modification by National Pressure Ulcer Advisory Panel). Stage III is present in 19 patients (63%), whereas stage IV in 11 patients (37%). Majority of the cases emphasizes decubital ulcer with dimension ranged from 5cm^2 to 10cm^2 . Data relating decubitus distribution in the group according to etiology, localization, stage and dimension is summarized in Table 1.

Good nutritional status is obtained by hypercaloric, rich in protein diet, for optimizing albumin blood level more than 35g/l . Occasionally, parenteral or enteral nutritional solutions are administrated prior surgery. Preoperative blood samples are taken in order to reveal any abnormalities. Correction of anemia is also imperative. Additional supplements, vitamins and minerals are used as well. While preparing for surgery, it is necessary to clean and dress the wound bed in order to reduce bacterial load which is measured by frequent tissue biopsy or/and microbiology swabs. Necrectomies, dressings and saline irrigations are done ambulatory, thus preparing the wound bed as soon as possible. By using hydro gels that speed up local autolytic processes and high-absorbent pads, like alginates, silver alginates and hydrocolloid barrier dressings, we enhance cleaning faster than by using the traditional gauze dressings.

Operation in general anesthesia is planned at the most appropriate time for the patient, when general health parameters and local wound characteristic allow aggressive treatment. Operative technique includes radical excision of whole necrotic tissue with the surrounding scar and granulations, thus reaching the bone prominence. When necessary, bone prominence is ablated after which

Table 1. Distribution of pressure ulcers in the group according to etiology, localization, stage and dimension

Localization	Etiology	Stage	Dimension
Sacral region	Spinal cord injury with paraplegia	III stage –	$>10\text{cm}^2$
15 50%	24 80%	19 63%	7 33%
Trochanteric region	Brain injury and comatose patients	IV stage –	$< 10\text{cm}^2$
7 23%	3 10%	11 37%	23 77%
Occipital region	Prolonged intensive care unit admittance		
4 13%	2 6.66%		
Others (ischialic, heels)	Immobilization		
4 13%	1 3.34%		

This table shows that sacral region is most affected, whereas patients with spinal cord injury are most frequent. Decubitus with III stage is in predominance as well as pressure ulcer smaller than 10cm^2 in surface area.

Table 2. Distribution of flap types used in reconstruction of pressure ulcers

Myocutaneous flaps	m.tensor fasciae lata flap		m.gluteus maximus flap			
Total:30 (100%)	1 (12.5%)		7 (87.5%)		8 (27%)	
Cutaneous flaps	Transposition flap	Unilateral rotation flap	Bilateral rotation flap	Bipedicular flap		Total:30 (100%)
Total: 22 (100%)	10 (45%)	8 (36%)	2 (9.5%)	2 (9.5%)	22 (73%)	

This table shows the frequency of the flaps we've utilized in our group and it points out that cutaneous flaps, out of which transposition flap as subtype, are the most used.

designing and rising the flap for covering the defect follows. Local flapping is the most appropriate type for reconstruction dealing with the depth and location of these defects. Concerning the different region and magnitude of the defect to be reconstructed as well as the quality of the nearby skin, which is often damaged, it is impossible to use one uniform flap pattern in each defect. Thus, designing the flap is of great importance for successful operation whereto we pay great attention. Whether adjacent muscle is to be included in flap design or not, depends mostly on wound depth and necessity for optimal bone padding. If bone is ablated and wound is not that deep, cutaneous flap is rather used. Vice versa, if bone is not affected, (ulcer stage III), not ablated, in thin patients with deep wounds, than musculocutaneous flap is rather utilized. That is why we apply variety of flap patterns. Cutaneous flaps are used in 22 patients (73%), whereas myocutaneous in 8 (27%). In one trochanteric decubitus, m.tensor fasciae lata myofasciocutaneous flap is designed whereas in 1 trochanteric, 1 ischiadic and 5 sacral pressure ulcers, myocutaneous m.gluteus maximus flap with different pivotal point is conducted. When cutaneous flaps are used, various transfer methods regarding directions of tissue movement are patterned. These comprise transposition flaps (used in 10 patients), unilateral rotation flaps (used in 8 patients), bilateral rotation flaps (in 2 patients) and bipedicular flaps (in 2 patients). Transposition is a kind of pivotal flap where pedicle with the donor site flap is transposed in order to cover the adjacent defect. When a rotation flap is planned, we raise flap from the surroundings and bring it by means of rotation directly in the defect. Bipedicular flap has two pedicles, large enough to reconstruct defect. At the end of operation, loose dressing is applied over the base where blood supply comes from and on contrary, compressive dressing over the flap body in order to prevent any hematoma formation that will compromise flap viability. Vacuum drainage is employed compulsory in each case. First redressing follows on the ward after 3-5 days when the drain tube is taken out. Sutures are pulled out after 10-16 days. Patient has to avoid pressure over

operative field while lie on bed for at least 4-6 weeks postoperatively; frequent patient repositioning and anti-decubital mattresses are conducted on regular base. Subcutaneous low-weight heparin (enoxiparin) administration follows for to prevent any vascular compromitation of flap blood supply.

In one patient, two decubital ulcers on distinct sites are present. While the one on sacral region is to be treated with flap, the other on the trochanteric region is sutured directly after the usual preoperative ulcer preparation. Although not advisable, in selected cases when dealing with small but deep ulcers, with good adjacent skin quality and appropriate local environment, direct closure can be utilized safely. Otherwise, among other due to suture tension, suture line will dehiscence and reconstruction is doomed to failure.

Follow up after hospital discharge is advised on weekly basis first month, than monthly first half year and gradually increasing the interval. Written advices for prevention of recurrences are issued on discharge day. Flaps used in reconstruction of decubital ulcer are summarized in Table 2.

Results

Operations underwent satisfactory and each patient took it well. When performing this surgery, it is anticipated complications to occur. These can be divided into early and late complications seen on follow ups. Early complications occur on the ward in first two - four weeks after surgery and these include:

- hematoma formation due to suction failure of the drainage system in 5 patients (16.7%);
- infection in operative site in 3 patients (10%), all in cases with hematoma;
- partial dehiscence in 5 cases (16.7%), three in cases with postoperative hematoma;
- marginal flap necrosis in 4 cases (13.3%).

These complication are overlapping in same patients and all in all occurred in totally 9 patients (30%), out of which 6 were reconstructed with myocutaneous flaps. This rate, although as high as nearly one third of

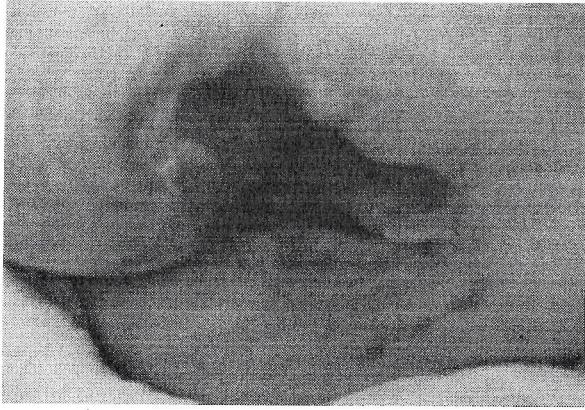


Fig. 1. Deep pressure ulcer, stage IV with dimension over 10cm², in sacral region, in paraplegic 39 old female, with concomitant diabetes mellitus, with clean wound bed without any necrosis and infection, ready for operation

resistance to shearing and friction forces make them prone to easy damaging, no matter how thick they are.(2) On the other hand, flaps comprise health, thick tissue with their own blood supply and innervation, thus resistance to injury is as high as the normal tissue, promoting them as best solution for defect reconstruction in decubitus patients. Flaps might content different tissue types, with or without muscle included and their bulkiness is what we need when treat patient with pressure sore. The same effect can be achieved by ablation of bone prominence. Regarding the tissue composition, flaps can be fasciocutaneous and musculocutaneous. Type of the flap to be used, depends on the region, the gross of the defect and its depth. In the sacral region, flaps to be considered as an option are unilateral or bilateral rotation fasciocutaneous, musculocutaneous of m. gluteus maximus or transversal lumbo-sacral flaps. Musculocutaneous flaps with m.gluteus maximus, m.

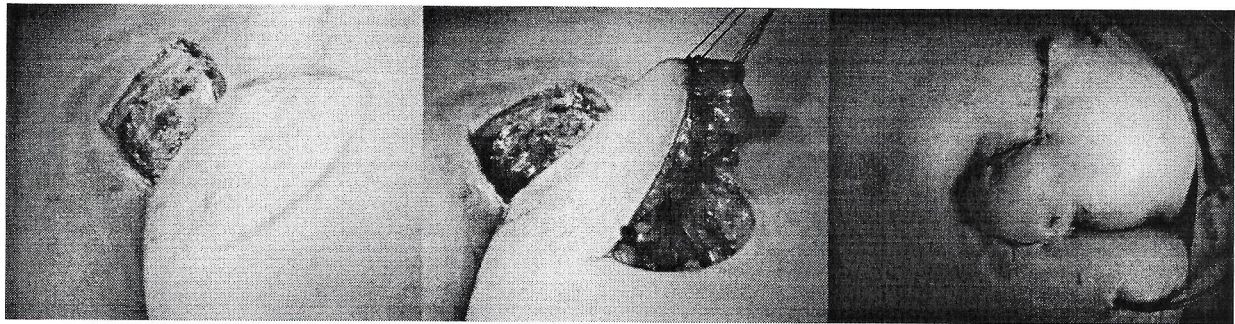


Fig 2. Transposition flap used for covering sacral post-excision pressure ulcer defect

the cases, is reasonable, bearing in mind the sensitivity and fragility of the patients treated. Hematoma was drained properly through suture line holes. Infection resolved by antibiotics, locally and systematically administrated, as well as by evacuation. Partial dehiscence and marginal flap necrosis were let to sanate by second intention for a period and delayed suture applied. Wounds in uncomplicated cases healed regularly in 14-18 days. Average hospitalization stay was 26 days (range 15 – 58 days) and more the complications occurred, longer the hospital admittance.

Discussion

Operative treatment of decubital ulcer is needed in order to achieve good functional and aesthetic results in patients, to improve patients' quality of life and gain fast wound healing in those who demand rehabilitation process. Flap surgery is the mainstream for reconstruction (9). Skin grafting can be used just as a temporary coverage on clean granulated wound bed. Grafts' lacking of

semitendinosus, m. semimembranosus or m. biceps femoris or just fasciocutaneous flaps might be used when reconstruction of ischiadic pressure ulcer is planned. In trochanteric region, m.fascia lata musculocutaneous flaps as a rotation flap could be in mind, but also random vascularisation rotational or transposition cutaneous flaps. Free skin grafts are usually applied for covering donor site defects (10). Comparing to musculocutaneous, local fasciocutaneous flaps as less aggressive reconstruction method, seem to be more feasible in these patients considering their often present malnutrition and anemia thus less affecting their overall health condition. Ablation of bone prominence is advised in order surgically to prevent recurrence after reconstruction if bulky flap is not to be used. Bulky flap should always include muscle. If myocutaneous flap and bone ablation are combined, the chances for postoperative ulcer recurrence are by far decreased. This two tools cannot be always combined. In patients with pressure sores, that are often critically ill, with limiting primary illness, operative risk higher that

others and present comorbidities, less aggressive and shorter surgery is warranted. In that case, bone ablation with an usage of local cutaneous flaps insures adequate and satisfying results still more that myocutanous flaps are burdened with higher complication rate as seen in our study. When utilized cutaneous flap, corrective bone ablation of the site of ulcer is compulsory. When closing the donor site, directly or with skin grafts, must be paid attention to bone ablation of the donor site if present. For instance, when using transposition flap, flap base has to be over the tuber ischii cause that is the bulkiest part, or if not, tuber ischii has to be ablated. On contrary, we form iatrogenic locus resistens minoris for subsequent sciatic ulcer development. (2, 10, 11, 12)

Surgical treatment of pressure ulcer is complimentary with other options for medical treatment although its place is usually a final event. As already mentioned, this treatment bears lot of efforts, engage huge resources, it is complex, time-consuming and often unpredictable with the results. It affects not only the patient, but his/her family as well and has health, social and ethical impact. Once occurred, it resolves slowly, despite all measures employed, has high recurrence rate and incidence constantly increasing with unfavorable cost-effectiveness. Ulcer recurrence as late complication is most devastating incident that could happen. Usually it occurs after few months after operation. Bearing in mind the complexity of treatment, all measures that will prevent recurrence following successful closure are combined starting immediately after transferring the patient from the operating table to bed. Specialized support surfaces, weight bearing devices, frequent self- hand lifting and repositioning at least every 2 hours by medical staff, daily skin care and usage of skin protecting barrier ointments, soft underneath pads etc. are some of them. Advices for patient is of great importance and they have to be trained to deal with preventive methods as well as to inspect skin on daily basis for any impending necrosis. (9, 10) Ulcer recurrence occurred in 4 patients (13%). When present, it is harder to reconstruct; health tissue already used and lacking donor site for new flap. As luck would have it, our recurrences were superficial ulcers that cured conservatively although very slowly.

It is estimated that just in USA, total medical care treatment costs are about \$11 billion, cardinal reason being that decubitus is one of the most underrated medical problem. Still, hospitalized patients have unreasonable high development risk, among which the intensive care units patients the highest. In many countries, hospital - acquired stage III/IV decubitus is declared as adverse patients safety event, and if not presented prior hospital admittance, its treatment is not a subject to reimbursement.

That is why, much more attention is payed on prevention of pressure ulcers with a lot of comprehensive prevention programs being implemented. First step is to determinate who has over the average risk thus needing greater support. Braden and Bergstrom designed the widely used Braden scale which outflanks risk factors such are sensory perception, mobility, activity, nutrition, moisture and friction/shear (13). According to risk, this scoring system, divides patients into 4 groups: patients with mild, moderate, high and very high risk. Many will agree that this system is not comprehensive enough and doesn't asses other predictive factors, such are advanced age, hypoproteinemia, prolonged intensive care unit stay, severity of illness, low arteriolar pressure, diabetes mellitus, sepsis, vascular abnormalities and other comorbid conditions. Prevention continues with implementing many other medical measures and devices that will reduce or eliminate the main cause, overpressure on the surface. These includes specialized support surfaces (antidecubital air-flowed mattresses), repositioning of the patient every 2 hours despite usage of specialized beds, daily skin care by keeping skin clean and free of urine/ feces, application of barrier skin ointments, frequent skin quality evaluation, sufficient protein intake and good nutritional status with diet supplements added, optimized wound dressing if necessary. Unfortunately, despite all measured utilized, pressure ulcer do develop. While stage I/II ulcer, in general, heal spontaneously with adequate non-surgical medical methods, stage III/IV ulcer do need surgery and consultation with plastic surgery, who perform pressure sore reconstruction, is necessary. (4, 9, 13)

Conclusion

Holistic and multidisciplinary approach includes involvement of variety specializations, like surgeons (general surgeons, neurosurgeons, plastic surgeons, urologists), rehabilitation medicine specialists, social workers, psychologists and psychiatrists as well as geriatricians and internists, all in order to improve patients' general health, to prevent and treat pressure sores and to support progress and attitude as much as possible. If unnoticed and untreated, complications as infection, sepsis, malnutrition, amyloidosis, malign degeneration and squamous cell carcinoma (Marjolin ulceration) can follow and finally, decubitus can lead to death.

Surgical treatment of the decubital ulcers, adequate and on time applied, in combination with appropriate pre- and post- operative care, gains satisfying functional and aesthetic results. That applies especially in selected patients where primary illness as reason for pressure ulcer is prone to successful rehabilitation.

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