

Surgical treatment of pressure ulcers: an 11-year experience at the Department of Plastic and Reconstructive Surgery of Hospital of Kaunas University of Medicine

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Key words: pressure ulcers; myocutaneous flaps; fasciocutaneous flaps.

Summary. The aim of this study was to evaluate morphological characteristics of pressure ulcers, methods of surgical treatment and its effectiveness in the Clinic of Plastic and Reconstructive Surgery of Kaunas University of Medicine Hospital.

Material and methods. A retrospective data analysis of 139 patients with pressure ulcers treated in the Clinic of Plastic and Reconstructive Surgery, Kaunas University of Medicine Hospital, from January 1996 to January 2007 was performed.

Results. A total of 139 patients were surgically treated for pressure ulcers at the Clinic of Plastic and Reconstructive Surgery, Kaunas University of Medicine Hospital, from January 1996 to January 2007. Eighty-one patients were treated repeatedly (from 1 to 7 admissions; $M=1$). Pressure ulcers were healed completely in 94 patients who underwent surgery during the treatment in the hospital; in 45 patients who underwent surgical treatment, pressure ulcers were partially healed, and on discharge from hospital, only small wounds were left. Pressure ulcers most commonly occur in tuber ischii area (69 cases). The mean age of patients was 42 ± 13.65 years ($M=31$); pressure ulcers were for 8.9 ± 8.5 months on average ($M=31$). At admission to Kaunas University of Medicine Hospital, the mean size of pressure ulcers was 42.62 ± 53.27 cm² ($M=10$). The results showed that the size of pressure ulcers depends on the duration of paraplegia ($P<0.05$). In 93 cases, pressure ulcers were treated using myocutaneous flaps; 17 of them were closed with V-Y advancement technique over the sacral area, 35 were closed with m. gluteus rotation flap, and in 41 cases, V-Y advancement technique using hamstring flaps was used.

Conclusions. In patients with paraplegia, the first pressure ulcer occurs after 74.79 ± 61.34 months from the onset of the disease. Pressure ulcers most commonly occur over tuber ischii area. The most effective surgical treatment of pressure ulcers is closure of the wound using myocutaneous flaps (use of the hamstrings); fasciocutaneous flaps were the most commonly used method in patients who underwent surgery for the second time.

Introduction

Pressure ulcers are a necrosis of skin and underlying tissues, which develop due to tissue malnutrition in the body areas exposed to prolonged pressure. Bedridden, debilitated, paralyzed patients and patients with cardiovascular and neurological diseases most often develop pressure ulcers (1). According to the literature data, more than two-thirds of pressure ulcers occur in patients older than 70 years. Among neurologically impaired patients, pressure ulcers occur at a rate of 5–8%; they are the direct cause of death in 7–8% of paraplegics (1–7). At a younger age, pressure ulcers occur more frequently in men, and it is related to spinal cord injuries. On the contrary, in an older age, pressure ulcers predominate in women, and it is

associated with longer lifespan (1, 5). Anatomically, the skin overlying the hips and buttock is most often affected (67%); however, pressure ulcers may also be observed over the heel, scapula, and patella areas (25%). Pressure ulcer occurrence over the greater trochanter of the femur and the ankle is most associated with prolonged lateral decubitus positioning of a patient. Pressure ulcers can develop over the nasal, cheek, forehead, occiput, chest, and elbow areas (8%) (1, 7). Moisture, sweat, urine, or feces promote skin maceration and it becomes more sensitive to pressure. Because of this, patients incontinent of urine and feces are at higher risk of developing pressure ulcers.

The main factors of etiopathogenesis are decreased mobility and sensitivity, impaired blood supply,

Table. Stages of pressure ulcers

Stage 1 – acute inflammation of all skin layers. The ulcer presents clinically as nonblanching erythema of intact skin; this area clearly differs from intact tissues.
Stage 2 – the ulcer presents epidermis or dermis. Epidermis and dermis breakdown (abrasion, blister) with erythema surrounding skin break
Stage 3 – uneven damage to cutaneous and subcutaneous tissues
Stage 4 – the penetration of pressure ulcer into the deep fascia; necrosis of muscles, bones, joints, and surrounding tissues

malnutrition, older patient age, local pressure to tissues, edema, friction, and skin injury (1–4, 6–9). Pressure ulcers increase the rate of disability and mortality. Pressure ulcers can be complicated by sepsis, myonecrosis, osteomyelitis, necrotizing fasciitis, septic arthritis, cellulitis, dysreflexia, amyloidosis, urethral fistula, and malignant transformation of tissues.

Pressure ulcers are classified according to the grade of tissue damage. In practice, a four-stage classification is used (1–4, 7–9) (Table).

Surgical treatment of pressure ulcers is one of the main treatment methods in the presence of deep and large in size pressure ulcers. There are several methods for surgical closure of pressure ulcers: they can be closed using fasciocutaneous flaps, musculocutaneous flaps from surrounding tissues, or more complex muscle flaps for closure of the wound. Depending on the location and size of a pressure ulcer, various surgical procedures using rotation flaps are performed. In the presence of ischial pressure ulcer over bony prominences, the wound defect can be covered with *m. gluteus maximus* rotation flap and V-Y advancement rotation flap (use of the hamstrings). Sacral pressure ulcers can be closed using fasciocutaneous rotation flaps according to Griffith and Conway or myocutaneous *m. gluteus maximus* rotation flaps; the V-Y advancement technique using myocutaneous flaps can also be applied. When pressure ulcer occurs over the greater trochanter of the femur, the tensor fascia lata flaps or vastus lateralis flaps of *m. quadriceps femoris* are used (7, 10–13). No consensus exists as to which rotation flap is superior. Surgical closure using myocutaneous flaps is considered a method providing better long-term treatment results.

The aim of this study was to evaluate morphological characteristics of pressure ulcers, methods of surgical treatment, and its effectiveness in the Clinic of Plastic and Reconstructive Surgery, Hospital of Kaunas University of Medicine (HKUM).

Material and methods

A retrospective data analysis of 139 patients with pressure ulcers treated in the Clinic of Plastic and Reconstructive Surgery, HKUM, from January 1996 to January 2007 was performed.

The system of data evaluation:

1. Data on pressure ulcers were evaluated according to the following criteria: location of pressure ulcers, size of pressure ulcer (the area of pressure ulcer is assessed by the area of the injured skin in cm²), the number of pressure ulcers (pressure ulcer is considered a separate unit when it is at a different anatomical site and/or a subcutaneous segment of undamaged skin separates two neighboring pressure ulcers), the base of pressure ulcer at admission (clean with granulation, with puss, necrosis, secreting base), bacterial culture, pathohistological examination of pressure ulcer, duration of the disease (i.e. the time of occurrence of pressure ulcer treated), the cause of pressure ulcer (paralysis, trauma, burns, other), condition of pressure ulcers on discharge from HKUM (whether pressure ulcers were completely healed or were not healed).

2. Data on patient were evaluated according to the following criteria: gender, age, duration of plegia, number of admissions due to pressure ulcers (both treatment of pressure ulcers at HKUM and other medical institutions is included), whether a patient underwent surgical treatment (the number of surgeries and the technique of surgery) or was treated conservatively (conservative treatment: hydrocolloid dressing, silver sulfadiazine solution, antibiotic creams, antiseptic solutions, and other) before admission to hospital, comorbid diseases (diabetes mellitus, osteomyelitis, other, none).

3. Analysis of treatment for pressure ulcers during hospital stay was performed based on these criteria: the length of hospital stay, treatment method (surgical or conservative), pre- and postoperative period; the number of surgeries during a present stay; whether

systemic antibiotic therapy was applied and what antibiotics were administered; evaluation of clinical and biochemical parameters: complete blood count analysis, C-reactive protein (CRP) level, average temperature of a patient during a single administration.

Data analysis was performed using SPSS 10.0 program. For the comparison of the means of variables analyzed was performed using Student *t* test. Results are presented as mean $\pm$ standard deviation (mean $\pm$ SD). Frequencies of categorized variables were calculated; relationship was evaluated by using χ^2 and Fisher exact tests; correlation was assessed by using Kendall tau *b* test. The difference was statistically significant when $P < 0.05$.

Results

A total of 139 patients were surgically treated for pressure ulcers at the Clinic of Plastic and Reconstructive Surgery, HKUM, from January 1996 to January 2007. Eighty-one patients were repeatedly treated (from 1 to 7 admissions; $M=1$). Pressure ulcers were healed completely in 94 patients who underwent surgery during the treatment in the hospital; in 45 patients who underwent surgical treatment, pressure ulcers were partially healed, and on discharge from hospital, only small wounds were left. Pressure ulcers most commonly occur in tuber ischii area (69 cases) (Fig. 1). Only decubitus ulcers of 3–4 stages were operated on.

The mean age of patients was 42 ± 13.65 years ($M=31$); in patients, the pressure ulcers had been present for an average of 8.9 ± 8.5 months ($M=3$). The sample comprised 19 women and 120 men. The youngest patient was 13 years old and the oldest 67 years old. Women and men were similar in mean age.

At admission to HKUM, the mean size of pressure

ulcers was 42.62 ± 53.27 cm² ($M=10$). The results showed that the size of pressure ulcers depends on the duration of paraplegia ($P < 0.05$). However, there was no statistically significant association between the duration of pressure ulcer formation and the size of pressure ulcer ($P > 0.05$). In 89 patients, the base of the wound was clear with granulations, 13 patients had pressure ulcers with pus, 18 – with necrotic material, 19 – had pressure ulcers with extensive fluid-secreting base. No statistically significant association between the character of pressure ulcer base and complete healing of pressure ulcer at discharge was found ($P > 0.05$).

Pathohistological examination of the ulcer was performed in 56 patients. In 60.7% of patients examined, lesions characteristic of active chronic inflammation were found; in 28.4% of patients, lesions with pseudosarcomatous epithelial hyperplasia, characteristic of active chronic inflammation; in 4.4% of patients, fibroblastic lesions of a pressure ulcer; in 4.5% of patients, pressure ulcer and in 2% of patients, atypical desmoplasia of pressure ulcer was present.

After surgery, the wound was drained with 2–3 drains of vacuum drainage system. During the first postoperative day, 145.85 ± 86.27 mL ($M=105$) of serohemorrhagic fluid were removed. Drains were removed after 8.44 ± 3.13 days ($M=6$). No statistically significant relationship was demonstrated between the size of pressure ulcer and serohemorrhagic fluid secretion within the first postoperative day. We compared the extent of fluid secretion after surgical closure with myocutaneous and fasciocutaneous flaps. After surgical closure with myocutaneous flap, the fluid secretion was statistically significantly lower ($P < 0.05$) (Fig. 2).

Assessment of microflora showed the following

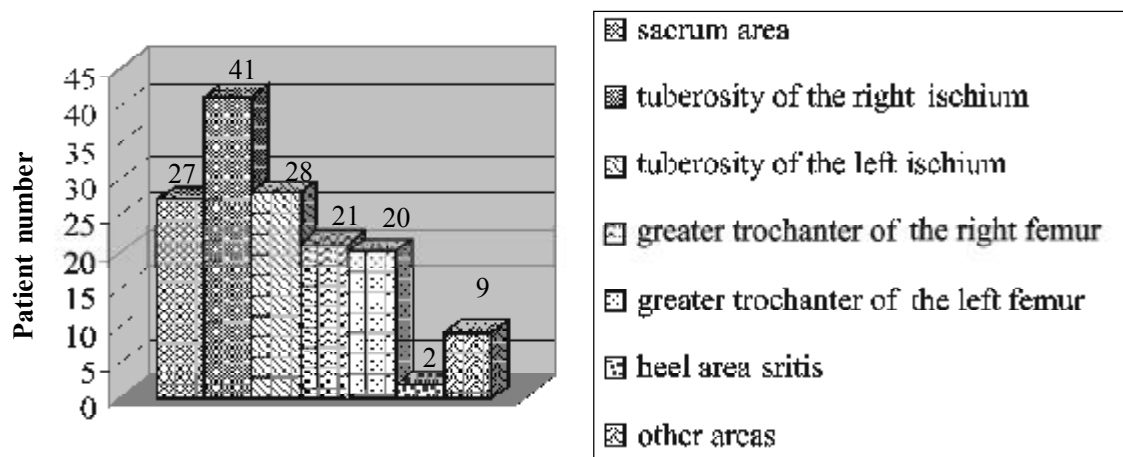


Fig. 1. Location of pressure ulcers

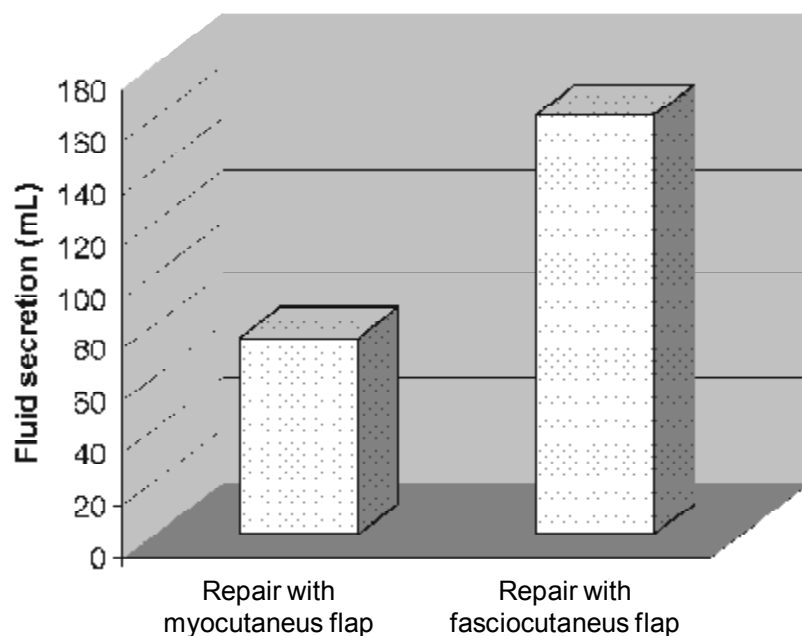


Fig. 2. Fluid secretion during an early postoperative period ($P<0.05$)

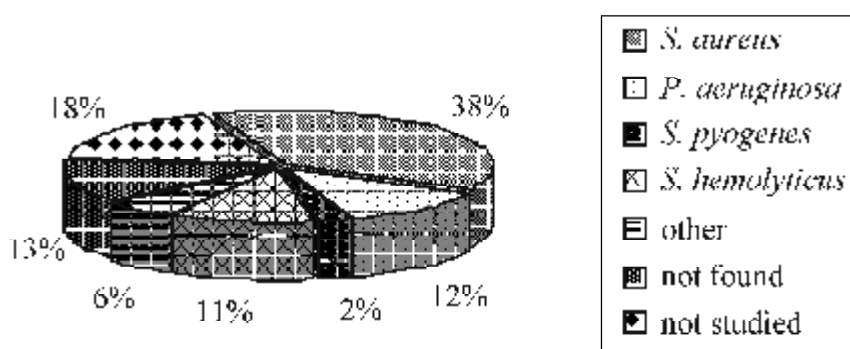


Fig. 3. Pathogens isolated from pressure ulcers

pathogens cultured from pressure ulcers: in 65 cases *Staphylococcus aureus* was present; in 18, *Pseudomonas aeruginosa*; in 4, *Streptococcus pyogenes*; and in 16, *Streptococcus haemolyticus*. No pathogens were cultured in 18 cases, and 23 patients were not examined (Fig. 3). There were no cases of suppuration of pressure ulcers operated.

In the majority of patients (82.7%), the most common cause of pressure ulcer occurrence is spinal cord injuries, resulting in paraplegia. In paraplegic patients, the first pressure ulcer occurs after 74.79 ± 61.34 months from the onset of the disease.

The length of hospital stay at the Department of Plastic and Reconstructive Surgery was 21 ± 15.64 days on average ($M=14$). Before surgery, the patient spent 3 ± 3.71 days ($M=1$) on average, after surgery – 16.2 ± 10.92 days ($M=13$).

At the time of follow-up, 67 patients had previously undergone surgery for pressure ulcers (23 were treated with myocutaneous flaps, 44 with fasciocutaneous flaps); the remaining 65 patients had been treated conservatively (19 patients with hydrocolloid dressings, 4 with antiseptic solutions, 1 with silver sulfadiazine solution, 2 with antibiotic solutions, and 39 with other means).

During a single hospitalization at HKUM, on an average 1.09 ± 0.42 surgeries were performed ($M=1$). Various flaps may be designed to cover the wound. In 93 cases, pressure ulcers were treated using myocutaneous flaps; 17 of them were closed with V-Y advancement technique over the sacral area, 35 were closed with *m. gluteus* rotation flap, and in 41 cases, V-Y advancement technique using hamstrings was applied. In 27 cases, fasciocutaneous flaps were used,

in 8 cases preparative necrectomies were performed, and 4 patients underwent excision of the pressure ulcer and dermatoautoplasty.

After surgery, 124 patients left hospital for further outpatient treatment; the remaining 15 patients continued their treatment in a rehabilitation clinic or other hospital.

Antibiotic therapy was administered to 92 patients. Thirty patients received penicillin treatment, 39 patients were treated with first-generation cephalosporin cefazolin, 14 patients were given gentamicin, and 8 – a reserve antibiotic, vancomycin. Antibacterial treatment was administered after bacterial culturing and after evaluating the bacterial count and sensitivity to antibiotics (according to antibiogram).

In a patient, pressure ulcers can lead to a series of systemic reactions of the organism. Analysis of biochemical and clinical testing findings revealed that CRP level was 94.21 ± 70.19 mg/L, and blood leukocyte count was $11.03 \pm 8.13 \times 10^9$ /L, although the temperature was normal ($36.7 \pm 0.39^\circ\text{C}$). In addition, we found that blood leukocyte count was significantly associated with the size of pressure ulcer ($P < 0.05$); however, no significant association between the size of pressure ulcer and CRP level was observed ($P > 0.05$).

Discussion

The mean age of patients treated for pressure ulcers at the Clinic of Plastic and Reconstructive Surgery during 1996–2007 was similar (41 years on average) as compared to other reports (1–3, 6), and spinal cord injury-induced paraplegia was the main cause of pressure ulcer development. Pressure ulcers most often were treated repeatedly ($M=1$). These findings confirm that the treatment of pressure ulcers is a time-consuming and very expensive process (2, 3, 6). According to the worldwide data, pressure ulcers recur most frequently in paraplegic patients, with recurrence rates being 80% (1, 7). Relapse of decubitus ulcer is conditioned by inadequate tendance of a patient (1).

Men were more likely to develop pressure ulcers than women (120 versus 19), and this is consistent with worldwide trends. Spinal cord injury occurs more frequently in men than women; therefore, men are found to have a higher probability of developing pressure ulcer.

Pressure ulcers most commonly occur over bony prominences of the ischium (1, 5, 9). Ischial pressure ulcers are common to the wheelchair-bound seated patients as they are paralyzed and had to spend the majority of the time in the seated position. Therefore,

frequent patient repositioning is a cornerstone in treatment and prevention of pressure ulcers, aiming to reduce the negative effect of interface pressure (1, 3, 8, 9, 14–19). Turning and repositioning the patient every 2 hours is the most effective.

In the treatment of pressure ulcers, it is important to evaluate bacterial contamination. In our study, *Staphylococcus aureus* and *Pseudomonas aeruginosa* were the most frequently found bacteria in pressure ulcers, which is consistent with other reports by foreign scientists (1, 8, 9, 18, 20). Wound necrectomy is the main procedure for treatment and prophylaxis of bacterial contamination. Antibiotics are recommended when the wound is colonized with a high bacterial count ($>100,000/\text{g}$ in a culture grown) in order to prevent systemic infectious complications (sepsis, osteomyelitis). Antibiotics are administered according to antibiogram findings. Penicillin, cefazolin, and gentamicin were the most commonly administered antibiotics. The similar antimicrobial treatment is described in other reports. In the treatment of pressure ulcers, antiseptic solutions and silver sulfadiazine may be used. It is necessary to administer antibiotics when are osteomyelitis, cellulitis, or sepsis. In the case of development of one of these complications, it is necessary to administer broad-spectrum antibiotics, which are effective against a wide range of bacteria, both gram-positive and gram-negative, and anaerobic. Clindamycin and gentamycin penetrate to tissues surrounding pressure ulcer and affect the vast majority of microorganisms (1, 8, 9, 18, 20).

During the study, all patients with pressure ulcers were surgically treated ($n=139$). Surgical treatment is recommended for patients with stage 3 and 4 pressure ulcers (10, 11, 20). Surgical treatment of pressure ulcers was based on three principles: 1) necrectomy of the wound, 2) if bone damage is present, partial or total ostectomy is performed, and 3) coverage of the wound with surrounding tissues (7, 10, 11): excision of the ulcer and coverage with surrounding tissues – skin flap, muscle flap, and fascial skin flap. The decision to use a particular flap depends not only on location, depth, and size of the ulcer but also it is important that tension on the suture line and the risk of wound dehiscence would be minimal. It was noted that after surgical closure with fasciocutaneous flaps, the patients were operated on for the second time due to the same pressure ulcer more frequently than after surgical closure with myocutaneous flaps (44 cases vs 23 cases, $P < 0.05$). Similar to other reports, surgical closure with myocutaneous flaps was the most common operative technique for pressure ulcers, perform-

ed in our patients (93 cases); 17 of them were closed with V-Y advancement technique over the sacral area, and in 41 cases, V-Y advancement technique using hamstring flaps was used. The results revealed that the lowest complication (less blood loss, less cases of seroma formation) and recurrence rates were after surgical closure using hamstring flaps.

Conclusions

In patients with paraplegia, the first pressure ulcer occurs after 74.79 ± 61.34 months from the onset of the disease.

1. Pressure ulcers most commonly occur over tuber ischii area.
2. The most effective surgical procedure for the treatment of pressure ulcers is closure of the wound using myocutaneous flaps (the use of hamstrings); fasciocutaneous flaps were the most commonly method used in patients who underwent surgery for the second time.
3. Using hamstring flaps for the closure of pressure ulcers, the lowest complication (less blood loss, less cases of seroma formation) and recurrence rates were observed.

Chirurginis pragulų gydymas (11-kos metų patirtis Kauno medicinos universiteto klinikų Plastinės ir rekonstrukcinės chirurgijos klinikoje)

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Raktažodžiai: pragulos, miokutaninė pragulos plastika, faciokutaninė pragulos plastika.

Santrauka. *Išvadas.* Pragulos – tai odos ir gilesnių audinių nekrozė, kuri susidaro sutrikus mitybai spaudžiamosiose kūno paviršiaus vietose. Literatūros duomenimis, daugiau kaip du trečdaliai pragulų randasi vyresniems nei 70 metų ligoniams. Neurologiniams ligoniams pragulų randasi 5–8 proc., pragulos kaip mirties priežastis nustatyta 7–8 proc. paralyžuotų ligonių.

Metodai. Atlikta retrospektyvioji 139 sergančiųjų, kuriems randasi pragulų, duomenų analizė, šie sergantieji nuo 1996 m. sausio mėn. iki 2007 m. sausio mėn. gydyti Kauno medicinos universiteto klinikų Plastinės ir rekonstrukcinės chirurgijos klinikoje.

Rezultatai. Kauno medicinos universiteto klinikų Plastinės ir rekonstrukcinės chirurgijos klinikoje nuo 1996 m. sausio mėn. iki 2007 m. sausio mėn. dėl pragulų operuoti 139 ligoniai ($n=139$). 81 iš jų stacionare gydyti pakartotinai (nuo vieno iki septynių kartų; $M=1$). 94 operuotiems ligoniams gydymo stacionare metu pragulos visiškai užgijo. 45 operuotiems ligoniams pragulos ne visiškai užgijo ir išvykstant iš stacionaro liko nedidelės žaizdelės. Dažniausiai pragulos formuojasi tuber ischii srityje (69 ligoniams). Pacientų amžiaus vidurkis – $42 \pm 13,65$ metų ($M=31$), kuriems pragulos buvo atsivėrusios vidutiniškai $8,9 \pm 8,5$ mėn. ($M=3$). Hospitalizavimo į KMUK metu pragulų dydis buvo $42,62 \pm 53,27$ cm² ($M=10$). Nustatyta, kad pragulos dydis statistiškai reikšmingai priklauso nuo paraplegijos trukmės ($p<0,05$). Dažniausiai buvo atliekama miokutaninė pragulos plastika – 93 atvejais, iš jų 17 atvejų atlikta V-Y plastika kryžmens srityje, 35 atvejais defektas dengiamas sukamuoju *m. gluteus* lopu, 41 V-Y plastika pagal Harmstring.

Išvados. Paralyžuotiems ligoniams pirmoji pragula randasi po $74,79 \pm 61,34$ mėn. nuo paralyžiaus pradžios. Pragulų dažniausiai randasi ties sėdynkaulio sėdmeniniu gumburu. Efektyviausia operacija praguloms gydyti yra miokutaninė pragulos plastika (Harmstring lopu), antrą kartą operuotiems ligoniams anksčiau buvo atliekama fasciokutaninė pragulos plastika.

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