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**ТИББИЁТДА ЯНГИ КУН
НОВЫЙ ДЕНЬ В МЕДИЦИНЕ
NEW DAY IN MEDICINE**

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LONG - TERM RESULTS OF PLASTIC SURGERIES IN SPINAL CORD INJURED PATIENTS

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✓ Resume

Recent studies on spinal cord injury patients commonly define pressure ulcers as neurotrophic disorders resulting from spinal cord trauma. Pressure sores, as reported by various authors, are observed in 28 to 90% of spinal cord injury patients and are considered one of the primary obstacles to the implementation of effective rehabilitation measures.

The aim: The aim of this study was to investigate the long-term outcomes of plastic surgeries in patients with spinal cord injuries.

Materials and Methods of the Study: This study analyzed the long-term outcomes of inpatient treatment in 12 patients with neurotrophic ulcers caused by post-traumatic spinal cord and vertebral injuries, who had previously undergone unsuccessful conservative and surgical treatments at other healthcare facilities. These patients received inpatient care in the department of purulent surgery and surgical complications of diabetes at the multidisciplinary clinic of Tashkent Medical Academy from 2020 to 2024. In 7 (58.3%) patients, the ulcers were localized in the gluteal area, in 2 (16.7%) in the sacral region, and in 3 (25.0%) cases in the proximal part of the lateral thigh (hip joint area). Bone tissue destruction was observed in 5 cases (41.7%) out of 12, in patients with neurotrophic changes in the gluteal region. Almost all patients had lower paraplegia with complete loss of all types of sensation by the conduction type. Results: As a result, it was possible to close the pressure ulcers with well-perfused tissue without tension. Additionally, adherence to specific conditions during the postoperative period played a significant role in the successful outcomes

Key words: spinal cord, neurotrophic disorders, plastic surgeries

Relevance

Recent studies on spinal cord injury patients commonly define pressure ulcers as neurotrophic disorders resulting from spinal cord trauma. This classification underscores the absence of innervation at the site of injury, coupled with the low tissue resistance and their limited capacity for reparative regeneration (Baskov A.B., 2000; Nikitin G.D., Kartashev I.P., 2001; Mikheev E.V., 1998). However, other researchers highlight additional factors such as pressure, shear forces, and friction. These forces, acting on the tissues between the bones of the skeleton and the surface of the bed, lead to ischemia of the soft tissues. With prolonged exposure, this ischemia progresses to tissue necrosis, followed by secondary infection, which, in conjunction with unfavorable conditions, can result in severe septic complications (Mikheev E.V., 1998; Elizarov P.M., 1994; Mitish V.A., 1999; Warbanov K., Krause-Bergmann F., Brenner P., 1997) [6]. Pressure sores, as reported by various authors, are observed in 28% to 90% of spinal cord injury patients and are considered one of the primary obstacles to the implementation of effective rehabilitation measures. Additionally, pressure sore sepsis remains one of the leading causes of mortality in patients with spinal cord injuries in the long-term [9]. It has been established that key factors contributing to the development of ulcerative defects include shear forces, friction, and moisture in anatomical regions of the body [5]. Extensive wound defects significantly impact the general health of patients, increasing the incidence of infectious complications (including anaerobic putrefactive processes) and contributing to fatal outcomes. Furthermore, trophic ulcers result in higher treatment costs due to prolonged hospital stays, additional care expenses, and the increased workload of medical and support staff [7].

A practicing surgeon treating patients with neurotrophic tissue changes following spinal cord injury must consider numerous factors, including the degree of tissue damage, as this plays a significant role in determining the surgical treatment approach.

Classification of Pressure Ulcers:

- **Stage 1:** Persistent erythema of the skin, which does not resolve after pressure is relieved; the skin remains intact.
- **Stage 2:** Persistent erythema of the skin, epidermal detachment, superficial (shallow) loss of skin integrity (necrosis) extending to the subcutaneous tissue.
- **Stage 3:** Destruction (necrosis) of the skin, extending to the muscle layer with muscle involvement; may present with serous discharge from the wound.
- **Stage 4:** Necrosis of all soft tissues, with the presence of a cavity where tendons and/or bone structures are visible.

Pressure ulcers progress through the following stages: 1) necrosis, 2) granulation of the tissue after necrosis has cleared, 3) epithelialization, and 4) scarring or formation of a trophic ulcer [9].

Despite the availability of modern, high-tech dressings for conservative treatment, the issue of radical closure of neurotrophic ulcers remains a challenge to this day. In global medical practice, a vast number of methods and techniques have been developed for closing neurotrophic ulcers, including free split-thickness and full-thickness autografts, local transposed flaps on a temporary pedicle, and both free and non-free tissue complex transplants [1, 2, 3, 4, 8].

All of the above highlights the necessity of selecting optimal surgical and conservative treatment strategies for neurotrophic ulcers in patients with spinal cord injury. The location of the neurotrophic ulcers must be considered, as it may directly impact the duration of rehabilitation and the healing process of the wound defect. The aim of this study was to investigate the long-term outcomes of plastic surgeries in patients with spinal cord injuries.

Materials and methods

This study analyzed the long-term outcomes of inpatient treatment in 12 patients with neurotrophic ulcers caused by post-traumatic spinal cord and vertebral injuries, who had previously undergone unsuccessful conservative and surgical treatments at other healthcare facilities. These patients received inpatient care in the department of purulent surgery and surgical complications of diabetes at the multidisciplinary clinic of Tashkent Medical Academy from 2020 to 2024. Upon admission, all patients underwent general clinical and instrumental examinations, including MRI of the spine in the area of the wound defect and radiological assessment to rule out osteomyelitis. Along with antibacterial therapy, the patients also received infusion therapy. Among the included patients, 4 (33.3%) were men, and 8 (66.7%) were women.

The majority of patients were between 20 and 40 years old, representing the most socially active age group. The pressure sores, ranging in size from several centimeters to 10-15 cm in diameter, appeared as chronic skin ulcers with rough, calloused edges, covered with granulations and, in most cases, with necrotized tissue. In 7 (58.3%) patients, the ulcers were localized in the gluteal area, in 2 (16.7%) in the sacral region, and in 3 (25.0%) cases in the proximal part of the lateral thigh (hip joint area). Bone tissue destruction was observed in 5 cases (41.7%) out of 12, in patients with neurotrophic changes in the gluteal region. Almost all patients had lower paraplegia with complete loss of all types of sensation by the conduction type.

Surgical intervention was performed after preoperative preparation, which included rational antibiotic therapy following bacteriological examination of the wound flora and determining its sensitivity to antimicrobial agents, restoration of the body's electrolyte, water, and protein balance, detoxification, and wound debridement (staged necrosectomies, sanitation with various antiseptics, and the use of polyethylene glycol-based ointments). The main criteria for the readiness of the ulcer for surgery were the presence of granulation tissue across the entire surface, the absence of necrotic tissue, and the lack of clinical signs of wound intoxication.

In cases of large pressure ulcers in the gluteal area, local tissue plastic surgery was performed. In one case, due to the large size of the defect and pronounced scarring, myoplasty was performed using the *m. gracilis* muscle. For ulcers located in the sacral area and the hip joint region, "hammer-shaped" and "P-

shaped" plastic surgeries were carried out with a transposed skin-muscle flap. For smaller pressure sores, excision was followed by plastic reconstruction of the wound surface using surrounding tissues.

In order to improve postoperative care, prevent recurrence, and enhance long-term outcomes for patients with neurotrophic defects in the anatomical areas affected by post-traumatic spinal injuries, who require reconstructive surgery, a structured collaboration was established in 2002 between the surgical department (Department of Reconstructive Plastic Surgery, Karolinska University Hospital) and the rehabilitation center (Stockholm Rehabilitation Station) in the Stockholm region, Sweden. A treatment program was introduced, regulating preoperative assessment and preparation, surgical procedures, as well as postoperative care and rehabilitation (Table 1).

Table 1

WEEK 1 - BED REST IN THE HOSPITAL
During the first week after surgery, the patient remains in a special Clinitron bed with heating, which minimizes pressure.
WEEK 2 - BED REST IN THE REHABILITATION UNIT
The second week is spent in bed on an inflatable mattress that reduces pressure. Showering, as well as emptying the bladder and bowels, should be done in bed. During meals, the patient may sit at a 60-degree angle with bent legs. The patient's position in bed should be changed regularly. The surgical area is inspected and documented three times a day.
WEEK 3 - BEGINNING SITTING IN A WHEELCHAIR
The stitches are removed, and the patient can sit in a wheelchair with a high-profile air cushion for 30 minutes, three times a day. Assistance is required for movement and dressing, and leaning forward is not allowed. The surgical area will be checked before and after sitting. The wheelchair and cushion are adjusted by the therapist during the first sitting. The sitting time is gradually increased to a maximum of two hours.
WEEK 4 - BEGINNING SITTING WITH STRAIGHT LEGS
The patient is allowed to sit in bed with straight legs, bending the hips at a 90-degree angle, but without leaning forward. Sitting on a toilet seat or shower chair is permitted, using a pressure-relieving cushion. A physiotherapist to optimize sitting posture and cushion positioning conducts pressure mapping in the wheelchair. Strength and endurance training begins cautiously, without straining the operated area. The patient must be thoroughly informed about pressure ulcers.
WEEK 5 - LIMITATIONS
At the end of the fifth week, the patient is hospitalized. Limitations for 6 months: a maximum of 2 hours of sitting time, using the same pressure-relieving devices as during rehabilitation. Lifetime limitations: regularly change position in the wheelchair or in bed using pressure-relieving cushions/mattresses. The choice of which to use will be determined at the 6-month check-up. Pressure relief in bed should be done 1-2 times a day, and the body checked as needed, with corrective actions taken to address any issues. No high-intensity training is allowed for the first 6 months.

Results and discussions

The analysis of the obtained data showed that the postoperative period proceeded smoothly for all patients, and the wounds healed by primary intention. This outcome can be attributed to the technique we employed, which involves excising the calloused edges of the pressure ulcer, ensuring meticulous hemostasis, and transposing a skin-muscle flap on a broad vascular pedicle, taking into account the vascular architecture. As a result, it was possible to close the pressure ulcers with well-perfused tissue without tension. Additionally, adherence to specific conditions during the postoperative period played a significant role in the successful outcomes.

Patient D.N., born in 1990, medical record No. 28402/13348/270. In 2020, the patient fell from a height at home and sustained a fracture of the body of the L1 vertebra, resulting in immediate paralysis of the legs. In April 2023, pressure ulcers developed in the left gluteal region. She received treatment

both in inpatient and outpatient settings at her place of residence and underwent several surgical interventions.

Due to the non-healing neurotrophic ulcer, the patient was hospitalized in the Department of Purulent Surgery and Surgical Complications of Diabetes at the Multidisciplinary Clinic of Tashkent Medical Academy for surgical treatment. She presented with complaints of general weakness, pressure ulcers in the left gluteal area, and the absence of movement and sensation in the lower extremities.

Neurological status: Spastic paresis of the lower limbs, anesthesia following the conduction type at the level of L1.

Local status: In the left gluteal region, there is a pressure ulcer measuring 6.0 x 3.0 cm, covered with pale, sluggish granulations and serous discharge. The depth of the wound defect is 8.0 cm.

Diagnosis: Spinal cord injury (SCI) due to compression fracture of L1 (2020) with subsequent reconstruction of the lumbar spine and plastic surgery of the wound defect. Deep pressure ulcer in the left gluteal region. Late recovery period after compression fracture of L1 (2020). Sensory loss following the conduction type from the level of L1 bilaterally. Pelvic organ dysfunction.

Blood tests: Hemoglobin (Hb) – 114 g/l, Red blood cells (RBC) – $3.8 \times 10^{12}/L$, Leukocytes (WBC) – $8.7 \times 10^9/L$, Erythrocyte sedimentation rate (ESR) – 42 mm/h, Bilirubin – 7.4 mmol/l, Alanine aminotransferase (ALT) – 17.5 U/L, Aspartate aminotransferase (AST) – 16.6 U/L



Fig. 1. Condition of the pressure ulcer in the left gluteal region upon admission

The patient underwent surgery: excision of the pressure ulcer in the left gluteal region and plastic reconstruction of the wound defect using local tissues. A distinctive feature of this procedure was the destruction of the ischial bone, which was resected prior to performing the plastic surgery. The main requirement of this operation is the thorough removal of tissues in contact with the wound defect.

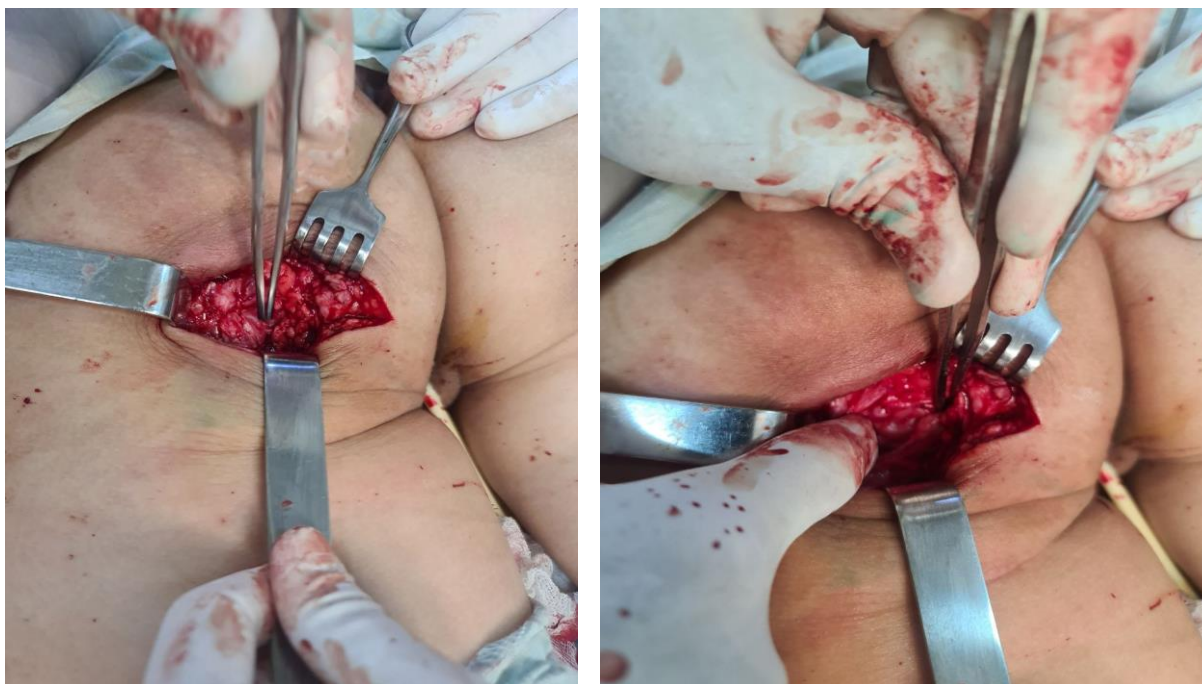


Fig. 2. Total excision of the fistulous defect and plastic reconstruction of the pressure ulcer

Another important aspect is the creation of a dense zone at the bottom of the defect using the periosteum and muscle. This step is crucial for preventing postoperative complications and recurrences.



Fig. 3. Postoperative long-term period (after 6 months)

In this clinical case, the postoperative course was smooth, with a favorable outcome in the long-term follow-up.

Pressure ulcers in the gluteal and sacral regions are large and serve as a primary source of infection in spinal cord injury patients. Vascularization in these areas is typically not problematic, as the etiology involves localized, sustained pressure on the tissues, leading to the formation of necrotic zones. After excising necrotic soft tissues and cleaning the ulcer, any protruding parts of the sacrum and coccyx should be removed. When closing wound defects, the preferred method is plastic surgery using a transposed skin-fascial flap. Underneath the skin defect, extensive cavities are revealed, associated with damage to significant volumes of subcutaneous fat, connective tissue spaces, and muscles. Surgical treatment poses challenges due to the proximity of blood vessels and nerves. Therefore, it is crucial to consider the angiosomal structure of the local tissue and, consequently, preserve the feeding vessel of the mobilized flap.

Conclusion

1. The priority approach in the treatment of chronic wound defects in patients with lower paraplegia is reconstructive and restorative surgery, which, when a proper strategy is chosen, yields good results.
2. An individually tailored treatment program based on the localization of the wound defect in spinal patients is highly effective in preventing postoperative complications and recurrences. In this regard, "hammer-shaped" and "P-shaped" plastic surgeries for the sacral and hip regions are considered optimal.
3. The primary goal of rehabilitation medicine today is to relieve patients from chronic wound defects, and all surgical interventions aimed at eliminating the pathological focus undoubtedly improve the quality of life for spinal cord injury patients.

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