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## CHARACTERISTICS OF DELAYED SECONDARY MANAGEMENT OF GUNSHOT AND SHRAPNEL WOUNDS OF THE FACE AND NECK WITH EXTENSIVE TISSUE DEFECTS

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### Summary.

*Combat-related maxillofacial injuries frequently involve extensive soft tissue loss, contamination, and complex anatomical disruption. Gunshot and shrapnel wounds of the face and neck often present with large defects communicating with the oral cavity, accompanied by fractures of the facial bones. Delayed secondary surgical wound management in such cases presents considerable technical challenges. Modified button suture techniques may offer significant advantages for the approximation of wound edges subjected to high tension.*

**Objective.** *To evaluate the efficacy of a modified button suture technique for delayed secondary closure of extensive facial and cervical soft tissue defect in a patient with combat-related gunshot trauma.*

**Materials and Methods.** *A clinical case is presented of a 42-year-old male patient with a through-and-through gunshot-shrapnel injury of the left buccal, submandibular, and cervical regions, combined with a comminuted fracture of the mandibular angle. Secondary surgical wound management was performed on post-injury day 11. Polyamide sutures (3/0) were passed through dense, fibrotic tissues using large-gauge injection needles; external fixation was achieved with 2-3 cm plastic buttons to ensure even tension distribution. The study was conducted in accordance with the ethical principles set forth in the Declaration of Helsinki, as approved by the Bioethics Commission of the M. I. Pirogov National Medical University. Written informed consent for the publication of clinical data was obtained from the patient, with confidentiality of personal information guaranteed.*

**Results.** *The modified button suture technique enabled effective approximation of wound edges without excessive tension, preventing suture cut-through. Healing proceeded by primary intention without complications. Intermaxillary fixation was discontinued at 6 weeks, with restoration of occlusion and consolidation of mandibular fragments. At 6 weeks, a dense but functionally insignificant scar was observed.*

**Conclusions.** *The modified button suture technique represents a reliable and efficacious option for delayed secondary closure of extensive soft tissue defects of the face and neck following gunshot injuries, ensuring uniform tension distribution, minimising the risk of wound dehiscence, and promoting primary wound healing. This technique is applicable to both military and civilian maxillofacial surgical practice.*

**Keywords:** *Gunshot Wounds; Button Sutures; Regeneration; Tissue Defect; Secondary Surgical Wound Debridement; Maxillofacial Region.*

### Introduction

Modern combat-related facial trauma is diverse in nature and, encompassing both ballistic and non-ballistic injuries caused by various types of weaponry. The widespread use of rocket and artillery systems has established blast wounds as a distinct category of combat surgical trauma, characterised by combined injury mechanisms. When the primary or sole component of a blast injury is shrapnel-related trauma, however, such cases are more appropriately categorised as gunshot-shrapnel wounds [1].

Gunshot and shrapnel wounds have a distinct clinical profile, as they are frequently accompanied by extensive tissue defects and contamination [1-4]. The selection of an optimal treatment strategy for such injuries remains challenging, as no standardised clinical approach has been established [7,8]. One of the most significant challenges involves delayed secondary debridement of wounds with extensive soft and hard tissue defects in the facial region, with such patients typically presenting to rear-area hospitals with purulent, deformed wounds and gaping, unhealed defects that frequently communicate with the oral cavity. In these cases, wound edge approximation is necessary but is often complicated by excessive tension, which increases the risk of suture dehiscence.

In the delayed surgical management of wounds with tissue loss, button sutures represent an effective method

for wound edge approximation that minimizes the risk of suture failure.

The first successful widespread use of button sutures for both fresh and granulating facial gunshot wounds was reported during military operations in 1939-1940. The application of early plastic reconstruction techniques employing these sutures resulted in recovery in up to 96% of patients with facial soft tissue injuries across the front lines.

Subsequent improvements in wound closure techniques are described in the literature [1-25]. A simplified method for applying button sutures to the facial region was developed, and in 1943, the purse-string button suture technique was introduced. This advancement facilitated the reduction and, in some cases, complete closure of circular wounds – for example, in cases of chin avulsion and similar injuries.

The button suture technique, while relatively simple, requires refinement in certain cases involving complex facial and cervical defects.

In wartime medicine, tension-relieving techniques such as modified button sutures may offer considerable advantages for the closure of large soft tissue defects in various anatomical regions, including those encountered in female patients. Their primary application in the present study pertains to maxillofacial injuries; however, the principles of controlled tension distribution and low-cost stabilization are potentially applicable to other

high-risk wound types, as discussed in the following sections [26-29].

### Objective

To describe the clinical management and outcomes of an extensive facial and cervical soft tissue defect in a patient with combat-related gunshot trauma treated with a modified button suture technique.

### Materials and Methods

This study presents a clinical case of delayed secondary surgical wound management in a patient with an extensive gunshot-induced defect of the face and neck, treated at the Department of Maxillofacial Surgery of the Vinnytsia Regional Pirogov Memorial Clinical Hospital. A modified button suture technique was developed and employed. Given the extensive area of tissue loss and the need for wound edge approximation under significant tension, standard needle ligature techniques were not feasible. Large-gauge injection needles were used as guides, with nylon (polyamide) sutures (3/0) threaded through the beveled opening and passed through the tissue via the needle channel. Standard metallic suture plates being unavailable, conventional buttons (2-3 cm in diameter, with 2-4 holes) were used for external suture fixation. This technique enabled effective approximation of wound margins, reduced tissue tension, and contributed to improved wound healing and aesthetic outcomes.

The study was conducted in accordance with the ethical principles set forth in the Declaration of Helsinki, as approved by the Bioethics Commission of the M. I. Pirogov National Medical University. Written informed consent for

the publication of clinical data was obtained from the patient, with confidentiality of personal information guaranteed.

### Results and discussion

A patient with an extensive facial and cervical defect was treated in the late post-injury period, 11 days after the injury. Patient R., a 42-year-old male, was admitted to the Department of Maxillofacial Surgery of the Vinnytsia Regional Pirogov Memorial Clinical Hospital with the following diagnosis: blast-shrapnel trauma; through-and-through gunshot wound of the left buccal and submandibular regions and the lateral surface of the upper and middle thirds of the neck on the left, accompanied by an extensive soft tissue defect communicating with the oral cavity; comminuted fracture of the left mandibular angle.

The patient was transferred to the maxillofacial surgery department 7 days after the injury. At the initial stage of treatment, primary surgical wound debridement, hemostasis, and dressing application were performed, along with antibiotic therapy. Mandibular fixation and wound closure were not performed.

On clinical examination, notable facial asymmetry secondary to swelling of the left hemiface was observed, along with malocclusion and an extensive wound in the left submandibular and cervical regions. The wound measured approximately 10 × 17 cm, extended deeply to the cervical neurovascular bundle, and exhibited significant soft tissue loss with retracted edges; it was gaping and communicated with the oral cavity in the retromolar region (Figure 1). The wound surface was contaminated and covered with fibrinopurulent exudate, with a fetid odour and dense, contracted margins.



**Figure 1.** Patient R., 42 years old. Diagnosis: blast-shrapnel injury; through-and-through gunshot wound with infection of the left buccal and submandibular regions and the lateral surface of the neck on the left, with a soft tissue defect communicating with the oral cavity; comminuted fracture of the left mandibular angle.

The mandible was displaced toward the left, in the direction of the defect, with salivary leakage into the wound and consistent saturation of the dressings with saliva. Crossbite was present, and a bony defect was palpable in the region of the left mandibular angle. Orthopantomography and computed tomography (CT) demonstrated a comminuted fracture of the mandibular angle, body, and ramus on the left, with loss of bone continuity.

On the day of admission, intermaxillary fixation was performed using a bimaxillary arch bar with eyelet hooks and elastic traction under local anaesthesia, with restoration of occlusion. The mucosal defect in the left retromolar area was simultaneously sutured, thereby isolating the cervical wound from the oral cavity. Salivary leakage into the cervical wound ceased by postoperative day 4. The wound in the submandibular and cervical regions was managed conservatively for several days with Betadine®-impregnated dressings.

Delayed surgical wound management with local flap closure was performed under general anaesthesia on postoperative day 4 (day 11 post-injury), following confirmed complete wound bed decontamination.

A flap of the anterior cervical triangle was elevated to the level of the superficial lamina of the deep cervical fascia, incorporating the fascial sheath of the cervical neurovascular bundle and the sternocleidomastoid muscle. Stay sutures were applied to approximate the widely separated wound edges, and button sutures were placed to prevent suture cut-through in the soft tissues. Polyamide sutures were passed through the dense, fibrotic tissues using large-gauge injection needles (0.8 × 40 mm).

The wound edges were mobilised and approximated, with sutures tied over four buttons to ensure even tension distribution (Figure 2). Approximation of the retracted cervical flap edges enabled secondary wound closure without excessive tension. The surgical site was drained with tubular drains, which were used for irrigation during the early postoperative period.

The wound healed by primary intention without complications, with sutures removed gradually between postoperative days 10 and 14 (Figure 3).

Intermaxillary fixation was removed 6 weeks postoperatively, with fracture fragment consolidation observed and occlusion restored.

Following wound healing, a retracted, dense scar was observed, which did not result in functional impairment (Figure 4). An additional surgical procedure is planned to improve the aesthetic appearance of the postoperative area.

Delayed secondary surgical management of gunshot and shrapnel wounds presents specific challenges in cases involving deformed, retracted flaps of irregular shape with associated tissue defects. Increased curvature of the wound edge is associated with a proportionally greater tendency toward flap retraction, the extent of which is determined by the depth of involvement of the underlying structures, including the superficial and deep cervical fascia and muscles.

In delayed secondary wound management, such flaps require additional fixation of the entire tissue mass to enable tension-free skin closure. Button sutures facilitate layered closure of both the skin and subcutaneous tissues, thereby preventing wound dehiscence and frequently eliminating the need for additional reconstructive surgery.



**Figure 2.** Same patient following delayed secondary surgical wound management with local tissue flap reconstruction and button suture application.



**Figure 3. Same patient on postoperative day 14 following suture removal.**



**Figure 4. Same patient 6 weeks postoperatively.**

In modern military conflicts, extensive soft tissue defects subjected to high tension are encountered in the maxillofacial region, the trunk, the perineum, and the extremities. Tension-relieving and retention suturing techniques employing external bolsters or buttons on the suture loops distribute mechanical load over a broader skin surface, reduce local pressure on wound edges, and thereby decrease the risk of tissue cut-through and wound dehiscence. Clinical reports describe successful use of button or button-like bolsters for closure of decubitus ulcers, high-risk abdominal incisions, and other extensive soft tissue wounds, where they provided additional security during the early phase of healing and improved primary intention closure in compromised patients. Ordinary

plastic buttons and similar devices can be sterilised and reused, which makes this technique particularly valuable in wartime settings with limited resources and mass casualties, where simple, inexpensive, and rapidly applicable methods are required for reliable closure of contaminated, high-tension wounds [26].

Historical gynaecological and urogynecological literature indicates that button sutures can be safely applied in female pelvic surgery. In the 19th century, Bozeman and other authors popularised the button suture for closure of vesicovaginal fistulas, achieving reliable approximation of friable vaginal tissues around the fistulous tract and demonstrating the feasibility of controlled tension distribution in this region [27,28]. More recent work has described the

use of single button sutures to join the walls of the cervical canal during procedures for complete occlusion of the cervical canal and external os, with the button serving as a simple external support to control suture tension [29]. Contemporary urogynecological protocols also describe single button sutures as one of the plication options in anterior colporrhaphy; however, a limited number of isolated button sutures may be insufficient for long-term support if used alone. These data suggest that modified button sutures may be considered a low-cost, rapidly deployable option for temporary or definitive closure of extensive perineal, vulvar, or lower abdominal soft tissue defects in female patients during wartime, particularly when complex flap reconstruction or specialised fixation devices are unavailable. Careful patient selection, protection of underlying hollow organs, and multidisciplinary collaboration with gynaecologists and urologists are essential, as high-quality comparative clinical data for these indications remain limited.

The application of button sutures significantly improves the quality of delayed surgical management of gunshot wounds and optimises wound healing through primary tension closure with local tissue advancement, without additional incisions.

Button sutures may be widely employed in the management of facial gunshot wounds, both as primary guiding and approximating sutures for flap wounds and for secondary closure of granulating wounds. Applied in this manner, button sutures enable effective full-depth approximation of wound edges, obviate the need for additional relaxing incisions in comparable clinical situations, and substantially reduce tissue tension along the primary suture line, thereby preventing suture cut-through and wound dehiscence.

### Conclusions

1. Button sutures enable effective full-depth approximation of wound edges along the entire length of the defect and substantially reduce tissue tension along the primary suture line, thereby preventing suture cut-through and wound dehiscence.

2. Standard long injection needles may be used as guides for passing fixation sutures through dense wound margins, and conventional plastic buttons may be employed for external anchoring of the suture loops.

3. Button sutures may be widely adopted in the management of facial gunshot wounds, both as primary

guiding and approximating sutures for flap injuries and as secondary closure sutures for granulating wounds.

### Prospects for further research

Future research should focus on in-depth evaluation of the potential of modified button suture techniques in the management of extensive facial and cervical soft tissue defects resulting from gunshot and shrapnel injuries, with prospective clinical studies involving larger patient cohorts needed to assess the efficacy of this technique across different clinical scenarios and varying degrees of tissue loss.

Further investigation is required to optimise the selection of suture materials, fixation elements, and instruments for suture placement, as these factors may contribute to reducing tissue cut-through and improving wound healing outcomes. The development of individualised fixation devices using three-dimensional printing technology represents a promising direction, as it would enable more precise tension distribution along the wound margins based on individual anatomical features.

Long-term functional and aesthetic outcomes warrant comprehensive study, encompassing scar quality assessment, restoration of muscular function, and the potential to obviate extensive reconstructive procedures. Future studies should aim to establish standardised clinical protocols for delayed secondary closure of extensive soft tissue defects, which would improve the overall efficacy of treatment in both military and civilian maxillofacial surgery.

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**Conflict of interest.** The authors declare no real or potential conflicts of interest that could influence the results of the presented study.

### Use of Artificial Intelligence

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## ОСОБЛИВОСТІ ПІЗНЬОЇ ВТОРИННОЇ ОБРОБКИ ВОГНЕПАЛЬНО-ОСКОЛКОВИХ РАН ОБЛИЧЧЯ ТА ШІЙ З ОБШИРНИМИ ДЕФЕКТАМИ ТКАНИН

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### Резюме.

Бойові ураження щелепно-лицевої ділянки характеризуються значною травматичністю, великими дефектами тканин та високим ризиком інфікування. Вогнепальні й осколкові поранення обличчя та ший часто призводять до складних дефектів, що сполучаються з порожниною рота та супроводжуються переломами кісткових структур. Відтермінована вторинна хірургічна

обробка таких ран є одним із найскладніших етапів лікування. Одним із дієвих методів є застосування модифікованих пластиночних (button) швів, що дозволяють зменшити натяг країв рани та забезпечити надійну їхню адаптацію.

**Мета.** Оцінити ефективність модифікованої техніки пластиночних швів при відтермінованому вторинному закритті великого дефекту м'яких тканин обличчя та шиї у пацієнта з бойовою вогнепальною травмою.

**Матеріали і методи.** Продемонстровано клінічний випадок лікування пацієнта 42 років із наскрізним вогнепально-осколковим пораненням лівої щічної, піднижньощелепної та шийної ділянок, великим дефектом м'яких тканин та багатоуламковим переломом кута нижньої щелепи. Вторинне хірургічне втручання виконано на 11-ту добу після травми після підготовки рани та стабілізації стану. Поліамідні нитки 3/0 проводили крізь товсті фіброзні тканини за допомогою ін'єкційних голок великого діаметра. Зовнішню фіксацію здійснили за допомогою пластикових гудзиків (2-3 см), що забезпечило рівномірний розподіл натягу.

Дослідження проведено із дотриманням принципів Етичного кодексу Всесвітньої медичної асоціації (Гельсінська декларація), що підтверджено висновком Комісії з питань біоетики ВНМУ ім. М. І. Пирогова. Від пацієнта отримано погодження для публікації даних за умов збереження конфіденційної інформації.

**Результати.** Пластиночні шви дозволили зблизити краї рани без надмірного натягу та уникнути прорізування тканин. Загоєння проходило первинним натягом, без ускладнень. Міжщелепну фіксацію зняли через 1,5 місяця, відзначено добру консолидацію фрагментів нижньої щелепи та відновлення оклюзії. Через 1,5 місяця після лікування сформувався щільний, але функціонально незначущий рубець.

**Висновки.** Модифікована техніка пластиночних швів є ефективною методикою для вторинного відтермінованого закриття великих дефектів м'яких тканин обличчя та шиї при вогнепальних пораненнях. Застосування гудзиків забезпечує рівномірний розподіл навантаження, зменшує ризик прорізування швів та сприяє загоєнню первинним натягом. Метод може широко використовуватись у практиці військової та цивільної щелепно-лицевої хірургії.

**Ключові слова:** вогнепальні поранення; пластиночні шви; регенерація; дефект тканин; вторинна хірургічна обробка рани; щелепно-лицева ділянка.

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