COMBINED USE OF ACELLULAR DERMAL MATRIX AND SKIN GRAFTING IN THE TREATMENT OF POST BURN NECK CONTRACTURE

Jednoczasowe zastosowanie bezkomórkowych matryc tkankowych i przeszczepów skóry pośredniej grubości w leczeniu przykurczów bliznowatych szyi u pacjentów oparzonych

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Abstract

Abnormal scarring and scar contractures are a serious clinical problem in the treatment of burn injuries. Scar contractures involving joints can limit their motion range, compromising the quality of life in post-burn patients. Hypertrophic and hyperpigmented scars are also a major aesthetic problem for these patients. W present a case report describing the potential combined use of acellular dermal matrix with skin grafting and surgical resection of the contracting scar in the treatment of a young healthy female diagnosed with post burn neck contracture. As a result of the therapeutic approach used, increased motion range and improved scar aesthetics were achieved. In conclusion, the presented method of scar contracture treatment provides a good functional and aesthetic outcome.

Streszczenie

Nieprawidłowe bliznowacenie i powstanie przykurczu bliznowatego w wyniku leczenia ran oparzeniowych jest poważnym problemem klinicznym. Przykurcz bliznowaty obejmujący staw powoduje ograniczenie jego ruchomości, co ma znaczący wpływ na jakość życia pacjentów. Przerośnięcie i hiperpigmentacja blizny stanowi także problem natury estetycznej. Prezentowany przypadek dotyczy pacjentki, u której w wyniku leczenia oparzenia termicznego doszło do powstania przykurczu bliznowatego w obrębie szyi. W leczeniu zdecydowano się na chirurgiczne wycięcie blizny z pokryciem ubytku tkanek przy pomocy matrycy tkankowej w połączeniu z wolnym przeszczepem skóry pośredniej grubości. Dzięki zastosowaniu tej metody osiągnięto znaczną poprawę w zakresie zwiększenia zakresu ruchomości stawu i ostatecznego wyglądu nowo powstałej blizny. Prezentowany przypadek wskazuje, że zastosowanie matrycy tkankowej w połączeniu z wolnym przeszczepem skóry pośredniej grubości może być skutecznym i bezpiecznym sposobem leczenia przykurczu bliznowatego.

Keywords: burn, neck, contracture, dermal matrix, ADM

Słowa kluczowe: oparzenie, szyja, przykurcz, matryca tkankowa, ADM

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Introduction

Thermal burns affect approximately 1% of the world's population each year [1]. Burns are estimated to cause approximately 180,000 deaths annually worldwide. In Poland, about 8,500 people are hospitalised for burns each year [2]. The prognosis and duration of hospital stay among burn patients depends on the severity of burns, which is in turn determined by the extent, depth, and location of the wounds, and the co-occurrence of airway injury. Age is also an important prognostic factor. The Baux score is a tool used to estimate the risk of death depending on the patient's age and burn extent [3].

Burn treatment carries the risk of complications. The most common of these include burn wound infections,

abnormal scarring and scar contractures. These latter significantly impair patient function and pose the greatest therapeutic challenge, especially when joints are involved [3]. Early rehabilitation, splinting of areas particularly prone to scar contractures and avoidance of prolonged immobilisation are used in the prevention of scar contractures [4]. The treatment of scar contractures involves non-invasive methods such as local scar mobilisation, physiotherapy, compression garments, and silicone dressings in the firs place, and, if these fail, minimally invasive methods, such as photo resurfacing (lasers, intense pulsed light [IPL]), platelet rich plasma (PRP) injections or fat grafting, as well as microneedling, are used. Surgical management is the final stage of treatment.

Precise excision of the scar tissue including the contracture, release of tissue adhesions and then closure of the resulting tissue defects with skin grafts or transposition flaps is the treatment of choice in local reconstruction of scar contractures.

In recent years, acellular dermal matrix (ADM) has been increasingly used in the treatment of burn contractures. ADM is a type of skin substitute used for repairing skin and subcutaneous tissue defects in cases where the use of autogenous skin grafts is not possible due to exposure of vessels, nerves or tendons. In cases of extensive, deep defects, the combination of ADM and autogenous skin graft has shown promising results in reducing wound closure time, limiting contractures, as well as improving elasticity and aesthetic outcomes [5, 6].

Case report

The procedure was performed in a 46-year-old clinically healthy patient diagnosed with a neck scar contracture resulting from a mixed-degree (II/III) thermal burn with a total body surface area (TBSA) of 40% according to the Lund and Browder (LB) chart, involving the neck, shoulder girdle, chest, back, both upper limbs and perineum. The primary treatment of the burn included three necrectomies, with coverage of the resulting tissue defects with free intermediate split-thickness skin grafts (STSGs). The STSG achieved 95% healing. Pressure garment therapy (PGT) and intensive rehabilitation were recommended during outpatient treatment. Despite preventive measures, the patient was diagnosed with a neck scar contracture, significantly limiting her functioning (fig. 1). For this reason, the woman was qualified for urgent surgical treatment. On admission, the scar received a Vancouver Scar Scale (VSS) score of 11 [7]. Restricted range of cervical spine motion in flexion, extension and left-right rotation was noted. The boundaries of the scar were considered to be the region of the cervical notch of the sternum on the lower side, the bony margin of the mandible on the upper side and the region of the mastoid processes of both temporal bones laterally to 60% of the anterior circumference of the neck. The surgical procedure involved a suprafascial excision of scar tissue, sparing all relevant anatomical structures to the extent that full mobility could be restored in the cervical spine. The resulting tissue defect was covered entirely with MatriDerm® matrix, cut to fit the size of the defect. The matrix was covered with STSG meshed at 1:1.5 and fixed to the wound edges using skin staplers. The dressing was made of Bactigras® mesh and sterile gauze soaked in Microdacyn®. Temporary immobilisation of the cervical spine in maximum flexion was also applied. A rigid orthopaedic collar (Camp) was used for this purpose. The immobilisation made it possible to dispense with negative pressure wound therapy (NPWT) dressing typically used for simultaneous ADM and STSG healing. Due to the significant risk of perioperative graft and matrix damage, it was decided to keep the patient under analgosedation for the next 48 hours, until the first dressing change. The dressing was changed every 48 hours.

The following changes in the surgical site and general condition were observed during the healing process:

- transient whitening of the grafts, which was thought to be related to the presence of tissue matrix under the grafts (fig. 2), on postoperative days 2 and 4;
- a short-term increase in laboratory inflammatory markers accompanied by a rise in body temperature to 37.5°C, observed on postoperative day 4;
- spots of graft lysis in the mid-part of the wound, at the site of greatest tissue tension, spontaneously healed by granulation (fig. 3);
- completely integrated ADM and healed STSG - confirmed on postoperative day 29 (fig. 4);
- residual wounds representing <10% of the surface area of the repaired tissue defect.

Perioperative fluoroquinolone antibiotic therapy at typical doses was administered during hospital stay. The patient did not require transfusion of blood products. Inpatient treatment was concluded on postoperative day 9, and full local wound healing was achieved on day 30. Immobilisation with a cervical collar was maintained throughout local treatment. Healing of 85% of the surface area of the applied skin grafts was achieved. The newly formed scar received a VSS score of 3, which was an improvement of 8 over the original scar. Increased range of motion in the cervical spine in flexion, extension, right and left lateral flexion and right-left rotation was achieved.

The patient was referred for further treatment at the Day Rehabilitation Unit at the Burns Centre.

Figures 5 and 6 show the final appearance of the scar 7 months postoperatively.

Discussion

In the case presented here, a therapeutic approach using ADM and STSG was chosen due to the good long-term outcomes in patients with similar contractures reported in the literature. The primary goal of treatment in this case was to achieve the greatest possible range of motion in the cervical spine and to prevent re-contraction of the resulting scar.

The literature provides sufficient evidence for the efficacy of this method in avoiding abnormal wound scarring. In 2011, Cervelli et al. demonstrated the superiority of MatriDerm® combined with STSG over STSG alone in the treatment of traumatic wounds.

Figure 1. Postoperative range of cervical mobility in a patient with neck scar contracture

The study showed faster re-establishment of the epidermal layer, reduced contracture scar formation, and greater flexibility of the resulting scar tissue in matrix-treated wounds [8]. Similar observations were made by Puchała et al., who used a different type of matrix (Integra®) for post-traumatic skin defects [9]. In 2023, early vascularisation of grafts achieved already within the first 2 weeks of healing and full re-establishment of epidermis within 2 months of MatriDerm® application were demonstrated in reconstructive surgery in thermal burn patients [10]. In the same year, a study was also published comparing the use of STSG in combination with MatriDerm® vs. alone in the treatment of tissue defects of the lower extremity. This

Figure 2. Local status of the operated area on day 4 postoperatively

Figure 3. Spots of impaired healing in the operated area

Figure 4. Complete integration of tissue matrix and skin grafts in the operated site on postoperative day 29

time, it was shown that ADM combined with STSG can be successfully used to cover deep tissue defects, without negatively affecting the final cosmetic outcome [5]. Promising results were also obtained in a study by Ryssel et al., who compared the healing outcomes for STSG combined with ADM in the treatment of burn wounds subject to early necrectomy. The study found no effect of ADM on poor skin autograft survival and showed significantly higher tissue elasticity, as assessed with VSS, in patients treated with ADM [11].

Bearing in mind that, according to the literature, proper healing of a graft on a tissue matrix ranges from 35–96% and has an increased risk of complications in the form of haematoma and infection [11, 12], it was essential to ensure optimal conditions for proper healing, especially during change of wound dressing, in the presented case. To this end, emphasis was placed on maintaining adequate intraoperative haemostasis and absolute aseptic and antiseptic rigour was used when changing wound dressing. Additional immobilisation of the body part covered with STSG for a period of several days is recommended in the literature and was also used in the presented case [13].

Appropriate management of the healing scar is an important aspect of post-operative care for STSG-treated patients. There are three key elements in the prevention of abnormal skin scarring: minimising skin tension in the wound area, ensuring adequate hydration and scar occlusion, and using scar compression therapy (PGT) [14]. In the presented case, skin tension in the wound area was negligible and did not increase as a result of the chosen method of tissue defect repair.

In further postoperative care, moisturisers in the form of a gel or silicone dressing, which, according to literature, reduce discomfort such as pruritus, pain, and hypersensitivity [14, 15], and promote the restoration of the stratum corneum water barrier through hydration and occlusion [16], were used once the wound was fully healed. It has been repeatedly demonstrated in the literature that ultraviolet radiation has a negative effect on pigmentation and scar structure [17, 18] and, therefore, patients are educated on the need for daily use of cosmetics with a high degree of UV protection (SPF50), with a preference for mineral over chemical filters.

Figure 5. Total range of motion of the operated site after 7 months - side view

Figure 6. Total range of motion of the operated site after 7 months - front view

All of the above-mentioned elements of perioperative management produced a favourable effect on the final outcome of postoperative wound healing, and the treatment resulted in a soft, elastic scar with normal colour and appearance acceptable for the patient, which did not restrict the range of cervical movement.

Conclusion

Contracture scars resulting from the treatment of burn wounds represent a major clinical challenge. The use of tissue matrices in combination with STSG in the surgical treatment of contracture scars yields very good functional and aesthetic outcomes, even in difficult body regions such as the joint area, as evidenced by the presented case.

The discussed approach involving a simultaneous application of ADM and STSG makes it possible to speed up graft revascularisation and, consequently, shorten hospital stay and accelerate rehabilitation, which may reduce both treatment costs for hospital burn units and the percentage of surgical interventions due to recurrence of contracture scars in patients with extensive tissue defects.

The use of an orthopaedic collar to stabilise the matrix and grafts in maximum cervical spine flexion in the first postoperative days minimises the risk of inadvertent damage to the skin grafts during cervical movement and prevents early contractures, which has a beneficial effect on the healing process. This technique may be a good alternative to the negative pressure wound therapy (NPWT) typically used in cases of simultaneous ADM and STSG healing, especially in defects involving problematic body regions, such as the joint area or the cervical spine.

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