




A skin stretch system for the immediately closing of the large skin defects of the anterior chest wall following large keloid excision

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Abstract

Large anterior chest wall skin defects following keloid resection, which are not suitable for primary closure, represent a substantial reconstructive challenge, partly due to the expected high tension closure and the considerable rate of recurrence. The TopClosure[®] Tension Relief System (TRS) is a novel skin stretching and wound closure-secure system which has been shown as a substitute for skin grafts, tissue expanders, and flaps. A 36-year-old man presented with a large keloid with ulcerations on the anterior chest wall. The patient underwent surgical resection of the keloid with immediate primary closure of the chest wall skin defect using the TRS. The surgical procedure and the postoperative period were uncomplicated. The wound was completely closed with a slightly raised scar after the 15th month follow-up. This is a rare case of immediate primary closure of a skin defect following resection of a large keloid of the anterior chest wall by the application of a skin stretching technique named as TRS. The TopClosure[®] TRS can help simplify the surgical procedures and shorten the operative time. Furthermore, the appliance can also be used for cosmetic improvements of the scar and minimize the need for future reconstructive procedures as well. Level of Evidence: Level V, therapeutic study

Keywords Skin · Stretch · Defect · Chest wall · Keloid

Introduction

The anterior chest wall is constantly subjected to skin stretching caused by the natural repeated movements and is most susceptible to developing keloids [1]. However, the resection of large anterior chest wall keloids and reconstruction of large chest wall skin defects is a challenging surgery. First and foremost, a clinical technique that is simple and safe with a short recovery period, with acceptable pain and cosmetic results with minimal morbidity, should be adopted to reconstruct soft tissues of the chest wall. There are many techniques currently available for the repair of anterior chest wall skin defects when primary closure is not feasible, such as flap transfer, skin graft, and vacuum-assisted closure [2–5]. These methods may

facilitate large anterior chest wall reconstructions by relatively complex surgical procedures, injuring the adjacent or donor healthy site, being associated with high morbidity, and increasing economic burden. In addition, they require an experienced surgeon and adequate surgical facilities to allow smooth execution of the procedure.

The TopClosure[®] Tension Relief System (TRS) and related techniques enable the employment of both mechanisms of stress—relaxation and mechanical creep for skin stretching. The system is composed of two flexible polymer attachment plates (APs) that are attached to the skin by adhesive or by the customary skin staples or sutures, over a large area of adherence [6–8]. In the present report, we aim to describe the case of a patient who had a large keloid with ulcerations on the anterior chest wall that customarily could not be primarily closed. The patient was treated by complete surgical removal of the large keloid followed by immediate primary closure of the skin defect by using a newly introduced technique using multiple TopClosure[®] TRS devices. This is the first reported case of immediate primary closure of soft tissue defect of the chest wall by the application of stress relaxation by this novel device with an aesthetically acceptable result.

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Case report

A 36-year-old male patient with congenital funnel chest underwent surgery with sternal turnover 20 years ago. During the 1-year period after surgery, a keloid formed on the anterior chest wall. Four years after the operation, the anterior chest wall scar was excised and closed primarily by tension sutures. However, the anterior chest wall scar formed again and gradually proliferated with distinct symptoms of itch. A large keloid with ulcerations and scar contracture formed on the anterior chest wall, and the patient treated these ulcers with topical mupirocin ointment, while the symptoms of the anterior chest wall lesions had no significant improvement. In physical examination prior to surgery, a large keloid lesion was observed on the patient's anterior chest wall, measuring about 19 × 14 cm involving the nipple–areolar complexes (NACs) (Fig. 1). There were discharging sinuses present in the keloid. The large area of scar contracture of the chest skin prevented the patient from extending the upper body to a fully upright posture. This significantly affected the patient's quality of life. The basic preoperative laboratory tests (electrocardiogram, chest X-ray, blood test, coagulation, and biochemical) were normal. In order to improve the patient's quality of life, we decided to perform a total resection of the large keloid on the anterior chest wall including the deformed NACs and reconstruct the chest wall immediately.

Operative details

Under general anesthesia, almost the entire scar tissue including the deformed NACs of patient were resected, resulting in an about 24 × 16-cm soft tissue defect (Fig. 2(A)). The TopClosure[®] TRS (IVT Medical Ltd., Ra'anana, Israel), which was previously described in detail by M. Topaz and associates [6–8], was applied for wound closure. Six pairs of



Fig. 1 A large keloid with ulcerations on the anterior chest wall

APs (TopClosure[®], 8-mm sets) were attached by adhesive to the skin 2 cm away from the wound edges on average and secured to the skin by skin staples (Weck Visistat[®] 35 W, 6.5 × 4.7 mm, Teleflex Medical, NC, USA). A pair of tension sutures (Ethicon 0, MO–2 PDS[®] II, 40 mm 1/2C, Johnson & Johnson International) was inserted for each TRS set, first through one AP, then deep into the subcutaneous tissue across the tissue gap, and then out through the contralateral AP on the other side of the skin defect. The suture was then passed through the designated holes in the front part of the APs and over to the first plate. There was cyclical intermittent stress–relaxation forces applied across the wound with these devices, with the highest tension being applied at the center of the wound (pull and tension for 30 s, and relaxation for 40–80 s). The sequence of application of each cycle was also varied amongst the various TRS sets during the closure process. Intermittent absorbable subcutaneous sutures (Ethicon 3–0, VICRYL[®] Plus Antibacterial, 22 mm 1/2C, Johnson & Johnson International) were applied and were locked in stages following locking the tension sutures to tightly obliterate dead space. Wound margins were sutured by silk braided non-absorbable suture (Ethicon MERSILK[®] 4–0, Johnson & Johnson International). The skin edges were gradually approximated without undermining until complete primary closure (Fig. 2(B)). The high-vacuum wound drainage system (Redon bottle 400 ml, pfm medical ad, Germany) was placed in the wound. The entire surgical procedure lasted for about 3 h, the blood loss was estimated at less than 80 cm³, and the vital signs of the patient were stable during the uneventful surgery.

Results

Although on both sides of the skin wound the patient had mild pain using the TRS device, there was no obvious ischemia or necrosis of the wound edges. The TRS was kept applied for 16 days after the surgery to support the wound closure. Three days later, the high-vacuum wound drainage system was pulled out. After 20 days, all stitches were removed. The patient tolerated the procedure well. At 15 months of follow-up, the healed scar, although raised, was thought to be esthetically acceptable (Fig. 3).

Discussion

Repaired wounds of the anterior chest wall are exposed to high skin tension, predisposing it to abnormal scar formation on healing [1]. Chest wall skin defects resulting from removal of an abnormal scar are not uncommon. In this case, the removal of a keloid created a large chest wall skin defect. Although many traditional techniques are currently available,

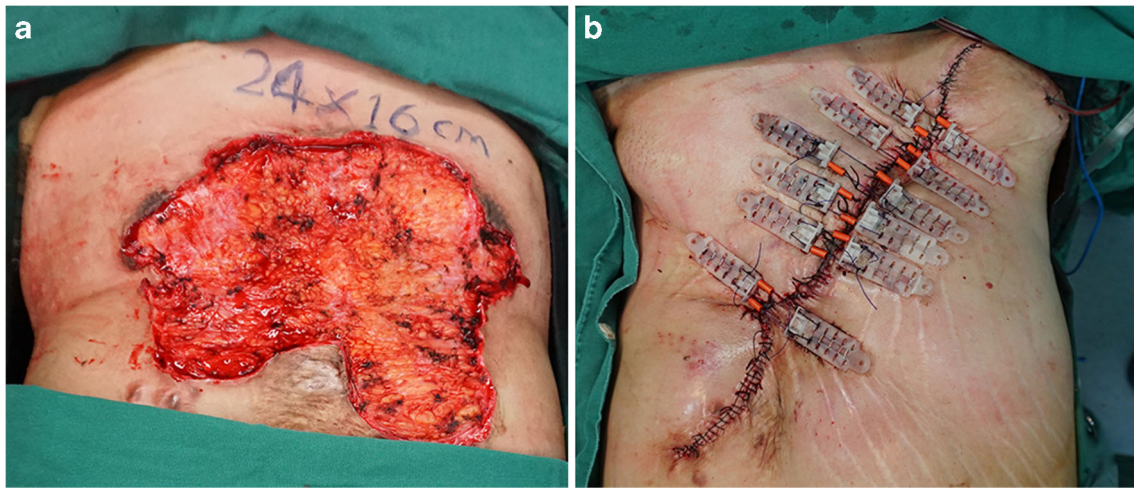


Fig. 2 (A) The entire keloid of the chest wall was resected, resulting in an about 24 × 16-cm soft tissue defect. (B) The vast chest wall skin defect was immediate primary closure using six TopClosure[®] sets

including skin grafting, pedicle muscle transposition, free muscle flaps, tissue expansion, and negative-pressure wound therapy, the reconstruction of anterior chest wall skin defect is challenging. As far as we know, this report presents for the first time a technique for reconstructing a large anterior chest wall skin defect by using the TRS technique.

The traditional techniques mentioned above have been used to close wounds on the chest wall with successful outcomes [2–5, 9]. However, these operating techniques achieve skin closure of the chest with the potential risk of greater morbidity. The expertise required by surgeons in order to perform these procedures has greatly advanced, creating even greater challenges in the treatment of such defects. The

TopClosure[®] TRS, serving as a tension-relief platform, has enabled the surgeon to stretch the skin using the viscoelastic properties of skin for closing large skin defects or huge skin gaps primarily with a period of delay if required without inflicting ischemia, necrosis, and wound failure [6–8, 10]. The TopClosure[®] TRS device is a simple, economical, and practical solution with a relatively low complication profile [7, 8]. In this case, the large anterior chest wall skin defect was closed, following the application of device-assisted intraoperative force to stretch the adjacent normal skin on either side of the wound, immediately closing it with direct skin advancement. The whole process was associated with a shorter hospital stay with minimal morbidity and a relatively short operating and postoperative healing time when compared to what may be expected from more complex traditional methods of closure. To our knowledge, this is the first time that such a large anterior chest wall skin defect has been successfully closed by immediate primary closure by advancing lateral skin with mild pain.

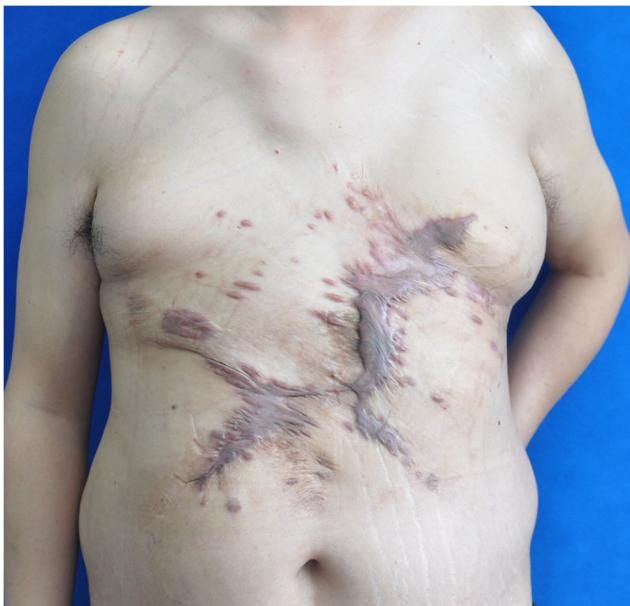


Fig. 3 Fifteen months after surgery, the wound was completely closed, with an esthetically acceptable, slightly raised scar

Conclusion

This case reports the clinical potential of TRS as a new wound closure concept in harnessing skin ductility for primary closing large skin wounds. Further clinical trials are warranted in order to better study the viscoelastic properties of the skin and substantiate the application of TopClosure[®] TRS.

Compliance with ethical standards

Conflict of interest Zhanyong Zhu, Yueqiang Zhao and Mosheng Yu declare they have no conflict of interest to disclose. Moris Topaz is one of the inventors of TopClosure[®] TRS ad CEO of IVT Medical Ltd. manufacturer of the device.

Ethical approval An ethical committee approval for the above reported procedure was waived by the Medical Ethics Committee of the Renmin Hospital of Wuhan University Review Board.

Informed consent Following a detailed review of the intended surgical procedure, the patient consented for the publication of this case report and the use medical information for the purposes of the study.

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