

Application of Lando® Artificial Dermal Regeneration Matrix in Treatment of Challenging Scar Contracture Release of a Severely Deformed Wrist: A Case Report

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Abstract

Background: Here we present a case of a 36-year-old woman who suffered from severe (118°) flexion deformity of the right wrist joint because of heavily burn scar contracture of the right hand wrist.

Methods: After scar excision, the wrist external fixator was applied and adjusted regularly to extent the wrist and to obtain normal range of motion of the wrist joint. Skin reconstruction was performed with a dermal regeneration matrix and eventually with a split-thickness skin graft.

Results: No complications were detected associated with the treatment of the dermal regeneration matrix. Take-rate of the artificial dermal matrix and split-thickness skin graft were 100%. The wrist flexion deformity was corrected from 118° to 33° and was basically restored to its normal anatomical position. Follow-up at 6 months, the cosmetic and function results were satisfactory.

Conclusion: This study demonstrates that the dermal regeneration matrix provides a potential alternative for reconstruction of complex contracture wounds.

Keywords: Artificial Dermal Regeneration Matrix; Scar Contracture; Dermal Reconstruction

Introduction

Contracted scars, along with hypertrophic scars at the anatomical sites such as the hand/wrist, neck and axilla, may lead to disability and deformity with loss of function. The surgical treatment is essential to improve functional and aesthetic appearance of the injured sites and to help the patient re-integration into social and professional life [1,2]. The artificial dermal regeneration matrix is a considerable technique used in the reconstruction surgery of contracted scars, hypertrophic scars, and keloids. The artificial dermal regeneration matrix could guide dermis reconstruction, reduce scar/contracture formation, and give the same good functional and cosmetic results as a full-thickness skin graft [3]. Lando[®] artificial dermis (Shenzhen Tsingcare Medical Co. Ltd., Shenzhen, China) is a bilayer artificial dermal matrix with favorable biocompatibility and low immunogenicity for dermal reconstruction [4]. One layer is made of a silicon semi-permeable membrane as the temporary epidermal substitute to prevent water loss and infection. The other layer is made of made of 3-dimensinal porous matrix of collagen I and chondriotin-6-sulphate composite to promote cell growth and angiogenesis. As native cells migrate into the collagen layer, the matrix is slowly degraded and replaced by neodermis tissue. Once the dermal scaffold is adequately vascularized in 2-3 weeks post grafting, the silicone layer can be removed and replaced by a split-thickness autograft to complete wound closure. In addition, different from natural acellular dermal matrix such as allogeneic skin or allogeneic, Lando[®] artificial dermis, similar to Integra dermal regeneration template, belongs to synthetic dermal substitute.

In this study, we describe a complicated contracture case surgery using Lando[®] artificial dermis.

Case presentation

A 36-year-old woman was present with heavy contracture of the right hand wrist post-burn. The patient suffered from thermal burn injury on her right forearm more than 30 years ago. According to the patient herself, she received regional treatment of surgery in 1984 and surgical release of adhesion between the middle finger, ring finger and forearm in 1997. Scars continued to form on her right upper limb after wound healing, and resulted in flexion contracture of the elbow joint and wrist.

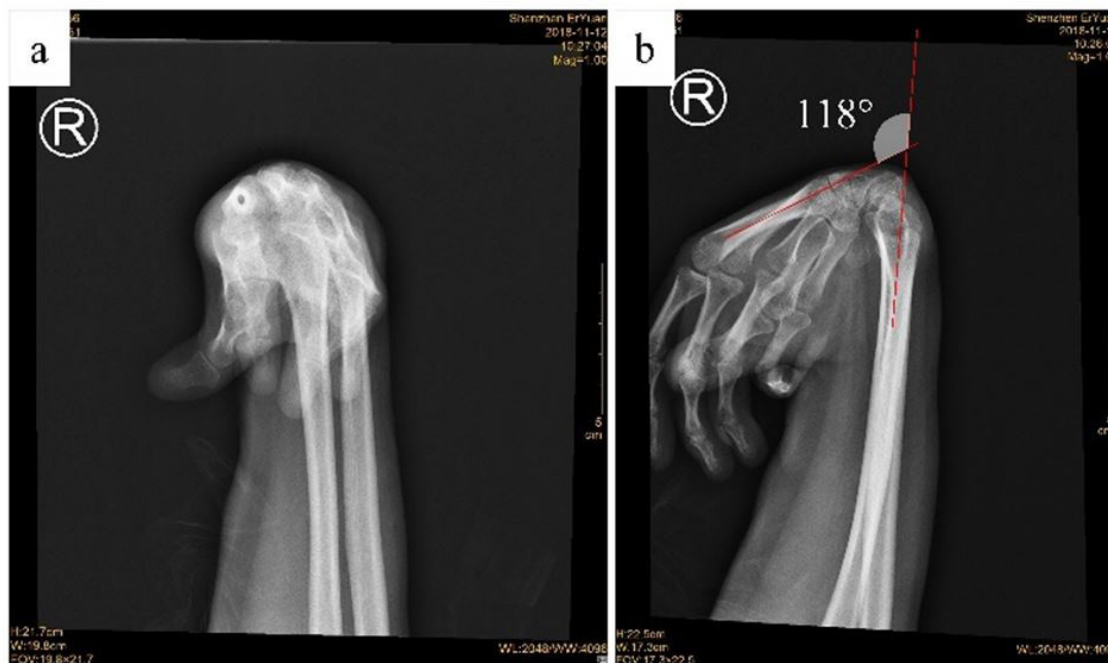


Figure 1: X-ray films before surgery. Radiologic aspect of the right wrist joint anteroposterior (a) and lateral side; (b) demonstrate severe (118°) flexion deformity of the wrist joint

The patient was earlier treated at our clinic center for the elbow joint flexion contracture release in October 2017, and achieved a good outcome with elbow flexion and extension range from 90° to 160°. The patient came again for the contracture release of the right hand wrist in November 2018. The patient had extensive burn scars on her right upper limb and linear scar contracture of the palmar wrist. Active range of motion was measured using a goniometer pre-therapeutic. The wrist joint suffered from severe flexion deformity (118°) without dorsal extension function (Figure 1). Phalangeal bones of each figure were significantly smaller than normal ones because of growth restriction.



Figure 2: Reconstruction surgery of the contracted scars; (a) Post-burn contracture scar. The flexion deformity of wrist joint angle was 118°; (b) The scar tissue was debrided to vascularized wound bed. The metacarpophalangeal joints of each finger were fully released to 160°, fixed with Kirschner wires; (c) Wrist external fixator was performed on the lateral side; (d, e) Anterior, lateral, and posterior side views after Lando[®] artificial dermis application. The artificial dermis was fixed with staples and bound properly; (f) 54 days later after first stage surgery, the silicone layer was removed. The dermal substitute was well integrated and vascularized. The wrist external fixator was removed and the wrist was basically restored to its normal anatomic position, followed by a split-thickness skin grafting

All procedures were performed under general anesthetic. First, all the scar tissue was excised down to a depth that ensured a non-scarred and vascularized wound bed. The obviously contracted palmaris longus was cut off, and the metacarpophalangeal joints of each finger were fully released to 160°. Each finger was fixed at the functional position with Kirschner wires. The contracture of the wrist joint was fully released, on condition that avoiding exposure of blood vessels, nerves and tendons. The wrist flexed

roughly 150°. Wrist external fixator was performed on the lateral side. Meanwhile, Lando' artificial dermis was applied to the wrist and the right hand palm wound defects and attached to the edge according to the manufacturer's introductions (Figure 2d and e). Finally, petrolatum gauze were applied over the artificial dermis and sterile gauze were used for bandaging. After the operation, the wrist external fixator was adjusted forward about 2 circles every one or two days to extent the wrist joint and to obtain normal range of motion. During the process, the wrist external fixator should be tightened and loosened appropriately to prevent tissue damage, especially nerve tissue damage. Continuous wound care and regularly dressings are essential for the success of this procedure. The next day after operation, the wound was inspected to look for any hematoma or serous collection. The dressings were changed every three to four days. The wound, the blood supply and sensation of the fingers were inspected regularly by capillary refilling times of each finger nail bed and patient pain-sense evaluation.

The second procedure was performed 54 days later. The wrist external fixator was removed and the wrist was basically restored to its normal anatomic position. The silicon layer was gently peeled away and replaced with a split-thickness skin graft obtained from the right thigh. Dressings were changed every 3 days thereafter. On postoperative day 9 (Figure 3a), the wound was completely healed. Strengthen exercise and rehabilitation treatments were required. Right upper limb system function exercise and rehabilitation after wound healing were conducted for more than 6 months though active activity and passive activity.

Results



Figure 3: Short-term follow-up images; (a, b) 9 days and 14 days after the second stage operation, the split-thickness skin graft taken rate was 100%; (c, d) One month after the second stage operation. The cosmetic appearance was satisfied despite of hyperpigmentation on the palm. The motion of wrist and metacarpophalangeal joints was acceptable

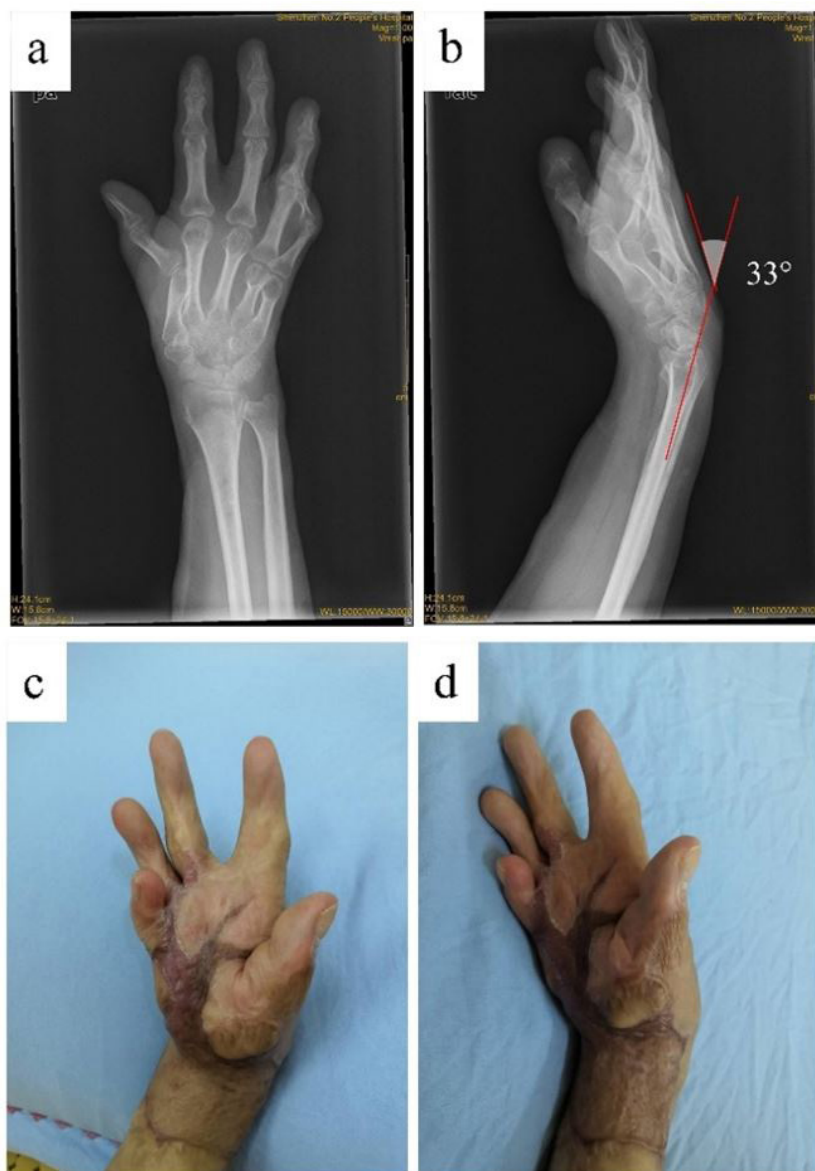


Figure 4: X-ray films four months after surgery and six months follow-up images; (a,b) Four months follow-up: Radiologic aspect of the right wrist joint anteroposterior and lateral side showed a significant improve of the wrist joint function (flexion deformity was corrected from 118° to 33°); (c, d) Six months follow-up. The cosmetic appearance was favorable with slight scar and reduced hyperpigmentation on the palm

On postoperative day 22, the patient was discharged with 100% taken graft and acceptable motion of wrist and metacarpophalangeal joints as long as a satisfactory cosmetic appearance despite of hyperpigmentation on the palm. The dermal substitute was well integrated and vascularized (Figure 2f) and the take-rate of the split-thickness skin graft was 100% (Figure 3a). No infections or other complications were found during the wound healing process. Duration of hospital stay was 82 days. One month and six months follow-up showed an acceptable cosmetic appearance and wrist function after the second stage operation (Figure 3c and d Figure 4c and d). The range of wrist motion improved significantly (flexion deformity was corrected from 118° to 33°) (Figure 4), metacarpophalangeal joint forward flexion 90° and dorsal extension 0° (measured by protractor) postoperative.

Discussions

Surgical options for burn contractures primarily include flap and full-thickness skin grafting. Flap grafting is a complex process and often leaves scars in donor site. Some bulky flaps may remain with necessity for plastic surgery. Large full-thickness skin is not easily available and also brings secondary damage and pain to the patient. For severe deformity with contracture of the tendons,

muscles, blood vessels and nerves caused by contracted scars or hypertrophic scars as in this report, a two-stage procedure is a suitable and low-risk option. The most important goal of treatment is to recover the function of wrist joint. Based on above considerations, the use of artificial dermal regeneration matrix and the wrist external fixator may optimize the outcomes in this case.

The artificial dermal regeneration matrix has been broadly reported to be applied to complex wounds with exposed tendon, joint or bone and could prevent postoperative scar and contracture formation [5,6]. Scar in healing skin wounds is a tissue characterized by high alignment of collagen fibers in the plane of the wound. Studies demonstrated that artificial dermal matrix abolishes the orientation of collagen fibers, and thus eliminates the scar morphology [7]. The artificial dermal matrix modifies the normal wound healing process, converting it from wound closure by contraction and scar formation to regeneration [7,8]. In addition, dermal matrix acts as a scaffold for fibroblasts, endothelial cells and capillaries growth and is gradually vascularized on the wound bed after 2-4 weeks. Scar revision usually presents a clean, well-debrided wound bed with adequate blood supply. Therefore, the dermal matrix could be vascularized more quickly on this kind of wound than that with exposed tendon or bone.

To obtain a functional wrist and improved prognosis as possible as we can, a second-stage solution that using wrist external fixator and artificial dermis followed by the split-thickness skin graft was chosen. Wrist external fixator was gradually adjusted to fix the deformity. Sustained traction of external fixation extended the tendons, muscles, blood vessels and nerves that pass through the wrist, making wrist extension possible. During the traction process, Lando® artificial dermis was employed to cover and protect the exposed tendons, muscles, blood vessels and nerves as well as repair and reconstruct the skin tissue defects. The wrist joint gradually restored to its normal anatomic position to a great extent by stretching the tissue attached to it, in the meantime, the artificial dermis was gradually vascularized on the wound bed, providing a good condition for skin grafting. We consider that the application of Lando® artificial dermis in combination with the external fixator to repair the severe scar malformation is an optimal surgical approach.

It was reported that dermal matrix combined with negative pressure therapy could improve wound healing process, shorten the length of stay and simplify wound care [9,10]. However, other studies also indicate negative pressure doesn't accelerate vascularization within dermal matrix and shorten the duration between the first and second stage operation, and suggest that skin grafts should rely on general recommendations and clinical signs [11,12]. In this case, on account of the well-vascularized wound bed, negative pressure therapy wasn't used. While in the case of wound defects which are less vascularized or have a large amount of drainage, according to our clinical experience, the combination uses of dermal matrix that meshed or manual fenestrated by a surgical blade and negative pressure therapy is recommended.

Hyperpigmentation was observed during the follow-up time in this case. The reason of hyperpigmentation after the use of the artificial dermis is still inconclusive. Some researcher considers the development of hyperpigmentation is less relevant with the artificial dermis and hyperpigmentation might be caused because of post-inflammatory hyperpigmentation combined with extravasation of erythrocyte [13]. Sun exposure and RBC extravasation induced by the inflammatory response might also increase the risk of hyperpigmentation [14]. Hyperpigmentation could be treated with intense pulsed light therapy if it is necessary.

The success of this case provides new ideas for the treatment of similar patients, especially for patients who are unwilling to accept flap graft or full thickness skin graft. But more systematic clinical evidence is needed to evaluate long-term effects of this method.

Conclusions

On base of this clinical case, the artificial dermal regeneration matrix provides satisfactory clinical results in complex scar reconstruction with minimum donor site morbidity. Long-term follow-up study is necessary to determine the stability of this approach. We need to carry out many more cases and perhaps a randomized study comparing with other surgical alternatives to assess its degree of effectiveness.

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Not applicable.

Authors' contributions

FW, KF and WS analyzed and interpreted the patient data and wrote the manuscript. YS was a major contributor in writing and revising the manuscript. All authors read and approved the final manuscript.

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Conflict of interest

The authors declare that they have no competing interests.

Ethics approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the Ethics Committee of Shenzhen Second People's and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to participate

The patient has consented to the submission of the case report for submission to the journal.

Consent for publication

The participant has consented to the submission of the case report to the journal.

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