

Original Article

The application of reverse tubular medial upper arm flap in the reconstruction of ripped facial defects

Xianglin Dong¹, Juan Ma¹, Shaolin Ma¹, Hao Wen²

¹Department of Burns and Plastic Surgery, The First Affiliated Hospital of Xinjiang Medical University, Urumqi 830011, Xinjiang, P. R. China; ²State Key Laboratory Incubation Base of Xinjiang Major Diseases Research, Clinical Medical Research Institute, The First Affiliated Hospital of Xinjiang Medical University, Urumqi 830011, Xinjiang, P. R. China

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Abstract: Reverse medial upper arm flap is usually utilized in the reconstruction of defects in soft tissues of head and facial skin and is with good clinical efficacy. However, it has not been used in the reconstruction of ripped defects. In this study, we used the reverse tubular medial upper arm flap to repair the ripped facial defects. The reverse tubular skin flap from the medial upper arm was longitudinally cut into two parts. One part was used for the reconstruction of ripped facial defects. The other part was used as inner lining to repair the defects of mucosa. Using this method, 3 patients with ripped facial defects were successfully repaired. Thus the reverse tubular medial upper arm flap was successfully used in the reconstruction of ripped facial defects with little surgical trauma, simple manipulation of the operation, increased success rate of the operation and reduced incidence of complications.

Keywords: Ripped defects, flap, upper arm

Introduction

Ripped facial defects often include defects in mucosa, bone, cartilage and skin soft tissue. The reconstruction of ripped facial defects could be done using flaps, which include folded forehead flap [1], the folded trapezius flap [2], the pectoralis major muscle flap [3], the rectus abdominis free skin flap [4], the distal forearm flap, the anterolateral thigh flap [5] and the free flap [6-8], etc.

Currently, free flap transplantation is the main method for the reconstruction of ripped facial defects [6-8]. However, the operation time of this method is relatively long and furthermore the workload is relatively large. It has been reported that the ripped facial defects were repaired through a lining formed by the folded axial flap or muscle flap [3, 9]. However, due to the lack of blood supply to the far end of the flap, it was likely to form dead space between flaps, thus resulting in hematoma and difficulty in wound healing. One study used free-thickness skin graft as lining and transplant it to the chest triangular flap or radial forearm flap. The flap was then sutured *in situ*. After 2-3 weeks,

the pre-prepared axial pedicle flap with lining was then transferred for the reconstruction of composite tissue defects of face and forehead [10]. This method was safe, effective and relatively easy to manipulate. However, the free-thickness skin grafts were easy to get spasm and infection. Some studies reported that the reconstruction of full-thickness cheek defects were repaired with temporalis muscle flap (as inner lining) and flaps of face, neck and chest (as outer lining) [11]. However, the use of these flaps was limited due to their pedicle. Urken, *et al.* [4] reconstructed the severely damaged facial defects with free rectus abdominis free skin flap. However, the color, texture and flexibility of the flap did not match with that of the recipient in some patients. In addition, not all patients could adapt to such a wide range of surgery.

Clinically, the soft tissue defects of head, face and neck are commonly reconstructed with the transfer of pedicle flap of medial upper arm [12, 13]. This method is quite simple, effective and with fewer complications. The flap of medial upper arm could form skin tube during the transfer process to the head and face, thus

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Figure 1. Cartoons illustrating reconstruction surgery procedure with reverse tubular medial upper arm flap. A. Location of medial upper arm flap (as the arrow indicated) with the pedicle near the elbow, the far end of flap near the armpit and the width not affecting suture of cutting wounds; B. Formation of skin tube by reverse medial upper arm flap (phase I surgery). The far end of flap is sutured on the wounds formed under the ripped defects, the rest of flap is sutured to form the skin tube (as the arrow indicated) and the upper limbs are fixed to the head; C. Reconstruction of ripped facial defects (Phase II surgery) (as the arrows indicated). The skin tube is sectioned. And inner side of the skin is sutured with mucous defects (a), the outer surface of the skin tube is sutured with nearby soft tissue of defected skin (b), and the pedicle of skin tube is sutured on the wounds formed above the defects (c).

avoiding the exposure of flap wound. In our study, the formed skin tube was longitudinally sectioned. One side of skin was used as inner lining to repair defects in oral mucosal surface and the other side as outer lining to repair soft tissue defects in skin. This method is not only applicable in the reconstruction of ripped mid-facial defects, and also applies to ripped cheek defects, thus making it simple for the reconstruction of defects of ripped mucosal surface. In addition, such method can significantly reduce surgical trauma and the incidence of complications. From May 2010 to October 2012, we used reverse medial upper arm flap to reconstruct the ripped facial defects in 3 cases of patients and eventually achieved good effects.

Materials and methods

Clinical data

There were 2 males and 1 female, aged 35-60 years old, who had ripped facial defects caused by car accidents. The most serious one was with ripped defect of upper face, with the defect border upper to the eyebrows, both sides to the inner canthus, and the lower to the lower part of the nose and with part of nasal defect.

Prior written and informed consent was obtained from every patient and the study was approved by the ethics review board of Xinjiang Medical University.

Phase I surgery

Cutting range of flap: The site at 5 cm from the elbow stripes in medial upper arm was chosen as flap pedicle. The far end of flap was set close to the outside area of armpit. The width of flap was based on elasticity of the skin of each person and there was no specific requirement for the width of flap as long as both sides of wounds could be sutured together after the cut of flap (**Figure 1A**). The maximum area of medial upper arm flap could reach to 8 cm×15 cm. The length of flap was about 20% longer than that of ripped defect. The incision line was tagged with a blue draw. The superficial fascia was then cut open along the tag line after local anesthesia. The flap was peeled off from superficial fascia. The cut wounds of flap were then sutured. After local anesthesia, a facial wound with the same width as the facial defect was made below the facial defect. The far end of the medial upper arm flap was sutured with the facial wound, and part of skin soft tissue in the flap was sutured with the mucosal layer of the lower end of the facial defect. The rest part of flap was sutured to form skin tube (**Figure 1B**). The upper limbs were fixed to the head with a bandage to avoid the avulsion of the flap. To avoid the blood circulation disorders of skin tube, the suture tension should not to be too high during the suture of skin tube. And to avoid the formation of hematoma in the skin tube, bleeding during the suture of skin tube should be completely sto-

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Figure 2. A typical case of ripped facial defect reconstruction with reverse tubular medial upper arm flap. This female patient was enrolled in hospital with mid-facial ripped defect caused by a car accident for one month. A. Facial appearance before operation: the area of nasal root showed ripped defects and oral mucosa was exposed; B. Facial appearance after phase I surgery. The skin tube formed by medial upper arm flap was transferred to the face and the upper limbs were fixed to the head; C. Facial appearance after phase II surgery. At 6 months after operation, ripped defects were repaired and the patient did not have any obvious discomfort.

pped. Vaseline gauze was then covered on the incision area. Rubber band holding a small gauze pad splint was used to block blood supply of the upper end of the skin tube after two weeks of the operation. The rubber band was clamped to block the blood supply for 10 minutes at the first time. If there was no color change of the skin tube, the clamping time could gradually extend. And the clamping could be performed 3-4 times each day. When the clamping time lasted more than 1 hour and the tube skin showed no swelling or pale and no obvious temperature change, the promotion of blood circulation was considered successful.

Phase II surgery

The pedicle of skin tube was cut off and skin tube was longitudinally sectioned (along the axis of the skin tube) from both sides with width of 1 cm. The defect of mucosa was repaired with the inner side of the skin tube, while the defect of skin surface was repaired with the outer side of the skin tube. The wound formed on the normal skin above the upper end of the ripped defect was repaired by the pedicle flap. The upper end of mucosal layer was reconstructed with part of skin soft tissue (**Figure 1C**).

Results

The three cases of patients involved in the study were all survived, and their ripped facial

defects were all repaired and were with smaller scars left by the donated flap. The 6-month follow-up was carried out after the operation. The facial organ displacement or contracture was well corrected after the operation. There were no abnormalities in muscle strength and sensory of upper limbs. The facial scars were small and the texture of pedicle was quite close to the facial texture. The treatment of ripped facial defects with reverse medial upper arm flap was effective.

Typical case

A female patient, aged 50 years old, was enrolled in hospital with “mid-facial ripped defect caused by a car accident for one month”. Examination showed that both eye balls and upper nasal were missed, oral mucosa was exposed, and the granulation tissue at the wound edge was fresh (**Figure 2A**). Phase I surgery was carried out to form skin tube with the reverse flap of medial upper arm. The far end of the flap was sutured at the wound formed on normal skin tissue below the lower end of defects. The rest of flap formed skin tube and the upper limbs were then fixed to the head to avoid the avulsion of the flap (**Figure 2B**). The clamping of skin tube pedicle was carried out after two weeks of the surgery to promote the blood circulation of far end of the skin tube. Phase II surgery was carried out when the blood

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circulation of far end of the skin tube was smooth after clamping training. The flap pedicle was cut off, sectioned and then sutured with the wound which was formed on normal skin above the upper end of the ripped defect. The skin tube was sectioned. The closure of defected mucous membrane was done by the use of inner side of the skin, while the outer side of the skin was used for the closure of defected facial skin. The follow-up was carried out for 6 months after the surgery and the reconstruction results were effective (**Figure 2C**).

Discussion

For the patients with smaller facial skin soft tissue defects, the defects could be repaired with flap near the defects [14], whereas the patients with relatively large defects would need distant flap, or free flap, or muscle flap to repair the defects. In addition, large defects require sufficient capacity of flap to reconstruct defects. The maximum area of the medial upper arm flap could reach to 8 cm×15 cm [15], which could supply sufficient tissue capacity to reconstruct ripped facial defects.

Good lining is the key to the successful operation of defects. If large defects of whole layer composite tissue existed and no nearby tissues could be utilized to form the inner lining, the reconstruction of defects could be done through the folding of lining flap and muscle flap or pre-prepared free-thickness skin graft [1, 3, 10]. However, repair methods with these flaps had some drawbacks. For example, insufficient blood supply was found in the distant end of folded flap. Furthermore, dead space was easily formed between the flap, resulting in hematoma and eventually leading to unhealed wounds. The free-thickness skin grafts could easily lead to the contraction of the skin grafts and contraction of transplanted tissues, thus resulting in poor appearance of repair. Besides, free-thickness skin grafts were less resistance to infection. Using the inner skin as lining, repair method with the medial upper arm flap could overcome the above mentioned drawbacks. In this method, skin tube was formed by the medial upper arm flap. Then the skin tube was sectioned and the inner skin was used as the lining to repair the defects of soft tissue of mucous membrane.

To avoid wound infection is a guarantee to the operation success. The defected area was connected with oral cavity and a large number of

bacteria existed in there. Therefore, the postoperative infection was often caused by the insufficient blood supply of the flap, the exposure of the wounds and poor care of oral cavity after the operation. The flap of medial upper arm could provide good blood supply. In addition, one side of the skin tube was used for the repair of defected mucous membrane so that the flap wound was hardly exposed to the oral cavity, thus reducing the chance of infection.

The position of head and neck is also very important during the grafting of reverse tubular medial upper arm flap. In order to reduce tension and twist of flap and to promote the wound healing, the head and cheek should be tilted slightly to the side with the flap. The skin texture and color of medial upper arm were close to those of the facial skin. In addition, the flap was soft, delicate, elastic and without hair. Many studies have reported the reconstruction of soft tissue defects in head, face [16, 17], elbow [15] and other parts of the skin by utilizing reverse medial upper arm flap. However, the reconstruction of ripped facial defects with skin tube formed by medial upper arm flap has not been reported. In this study, the skin tube was formed by medial upper arm flap and both sides of skin tube were then sectioned. One side of the skin tube was used as the lining to repair the defects of soft tissue of mucous membrane; the other side of skin tube was used for the repair of the facial defects. This method not only applies to the reconstruction of mid-facial defects, but also applies to the reconstruction of the whole-layer defects of face and cheeks. Furthermore, such surgical method reduces the surgical trauma and the surgical risk, making the repair simple, safe and reliable. In addition, the good blood supply of flap was easily achieved by using such method. The reverse pedicle was located at the far end of the flap and nearly paralleled with the defected area after cutting off from the flap. Thus the flap was not easily twisted and stretched. Furthermore, it could not be avulsed after bandage fixation. Therefore, the blood circulation and survival of skin flap were not affected.

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Disclosure of conflict of interest

None.

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Address correspondence to: Hao Wen, State Key Laboratory Incubation Base of Xinjiang Major Diseases Research, Clinical Medical Research Institute, The First Affiliated Hospital of Xinjiang Medical University, No. 137, Liyushan South Road, Urumqi 830-011, Xinjiang, P. R. China. Tel: +8609914366180; Fax: +8609914362701; E-mail: dongxl8@163.com; Shaolin Ma, Department of Burns and Plastic Surgery, The First Affiliated Hospital of Xinjiang Medical University, No. 137, Liyushan South Road, Urumqi 830011, Xinjiang, P. R. China. Tel: +86099143-61251; Fax: +8609914362701; E-mail: mashao-lin9@163.com

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