COMBINED RHOMBOID FLAP AND DOUBLE Z-PLASTY TECHNIQUE FOR RECONSTRUCTION OF POSTBURN WEB SPACE CONTRACTURES

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Submitted: 22/2/2020; Accepted: 9/6/2020; Published: 21/3/2021

ABSTRACT

Background

One of the most common deformities after the occurrence of hand burn is web space contracture which has both aesthetic and functional drawbacks. In this prospective study combined rhomboid and double Z-plasty technique is used to reconstruct web space contracture.

Objectives

Is to assess a combination of the rhomboid flap with a double Z-plasty technique for reconstruction of palmar and dorsal web space contractures to decrease shortcoming and achieve better functional and aesthetic results.

Patients and methods

18 webs of 9 patients with postburn web space contracture of palmar and dorsal type were submitted to reconstruction using combined rhomboid and double Z-plasty technique.

Results

The average age of the 9 patients included in our study was 24 years and most of them developed web space contracture as a result of a flame burn. The duration of their contracture ranged between (2-20) years. Our patients were satisfied with the results both regarding the functional and aesthetic appearance of the webspace. After using this technique for reconstruction of 18 webs which were included in our study, we didn't notice any significant complications in terms of flap necrosis, digital ischemia, wound dehiscence or infection, and recurrence of contracture.

Conclusion

The combined rhomboid flap and double Z-plasty technique is a simple and effective method for reconstruction of postburn web space contracture of the hands.

Keywords: *Webspace; Postburn contracture; Rhomboid flap; Z-plasty.*

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https://doi.org/10.17656/jsmc.10289

INTRODUCTION

Development of contracture is an ongoing process and may continue for up to 2 years after sustaining the injury. Thus, any intervention which prevents the progress of contracture should be effective in doing so within this time frame [1]. In an intact hand, the webspace goes at a 45° angle from the extensor side of the metacarpophalangeal joints to the center of the proximal phalanx in the palmar direction. This anatomy can change considerably after the occurrence of hand burn [2].

The blood supply of the web skin is from dorsal and volar branches. Through the volar aspect of the intermetacarpal spaces, there are perforating vessels that give off dorsal digital arteries. Dorsal carpal branches of ulnar and radial arteries will unite to form the dorsal carpal arch which is less consistent than that found in the volar aspect [3].

The normal interdigital web is a dynamic structure that changes its configuration with motion, when adducted it is collapsed as a fold and when abducted assumes a square shape [4].

The webspace allows for essential hand movements including finger abduction, adduction, and independent finger flexion and extension at the metacarpophalangeal joint [5, 6]. Webspace contractures are classified into three groups: [1] dorsal web contractures, [2] palmar web contractures, and [3] interdigital (syndactyly type) web contractures [5].

The first reference to the rhomboid flap was by Suzuki in 1987, in which an elliptical subcutaneous pedicle flap rotated 90° was used to reconstruct a skin defect caused by epicanthal release. In 1994, Uzanismail presented the subcutaneous pedicle rhomboid flap with its definitive geometric pattern. Ulker added Z-plasties to the end of a subcutaneous pedicle rhomboid in their patients successfully [5, 7].

This study aims to assess a combination of the rhomboid flap with a double Z-plasty technique for reconstruction of palmar and dorsal web space contractures to decrease shortcomings and achieve better functional and aesthetic results.

PATIENTS AND METHOD:

A prospective study including 9 patients with a total of 18 postburn web space contractures underwent reconstruction from January 2017 to May 2018 in Rizgary Teaching Hospital and Slemani Burn, Plastic and Reconstructive Surgery Hospital.

There were 3 males and 6 females. Their ages were ranging between (5-38) years with a mean age of 24 years. The cause of burn was flame in 6 patients and scald in 3 patients. The duration of their contracture ranged between (2-20) years, all of the patients had stable burn scar contractures at the time of reconstruction but complained of both aesthetic and functional effects of web space contractures.

Inclusion Criteria

1) Mature, stable burn scar contracture

2) Non-severe web space contracture

Exclusion Criteria

1) Immature burn scar contracture

2) Severe web space contracture

Surgical Technique

The operation can be performed under local or general anesthesia under pneumatic cuff tourniquet control. All the cases were done under 2.5X magnification with the patient in supine position and arm placed on a side table. Palmar and dorsal web space contractures with supple and mature scar tissue were included in our study.

After determining the contracture line (which is either palmar or dorsal web space contracture), a subcutaneous pedicle rhomboid flap was designed along its long axis in the webspace with its length equal to the whole length of the contracture line. The two 120° inner angles of the rhomboid were located on the tension line of the web space contracture and the two 60° angles were placed perpendicular to the tension line (Figure 1 A), then two relaxation incisions were added to the rhomboid flap (Figure 1 B).

After preoperative planning, the rhomboid flap was incised down to the healthy subcutaneous tissue maintaining its subcutaneous pedicle. Here, some releases in the contracture line can be seen.

The donor area of the relaxation incisions was advanced from the Y to the V shape and the donor area resulting from the advancement of the subcutaneous pedicle rhomboid flap was sutured from the V to the Y shape (Figure 1 C). After that, to avoid recurrence of contracture as a result of the longitudinal scar in

the donor area of the rhomboid flap, two traditional Z plasties were designed on both sides along the long axis of the contracture line (Figure 1 D and E). The tourniquet was removed completely and hemostasis was achieved using bipolar cauterization.

At the end of the operation, the skin was sutured using 5/0 non-absorbable (polypropylene) suture for the rhomboid flap and 6/0 non-absorbable (polypropylene) suture for the Z –plasties (Figure 1 F). The dressing was performed using Iodine-impregnated gauze on the wounds and multiple dry gauzes were applied in the webspace to maintain it in abduction.

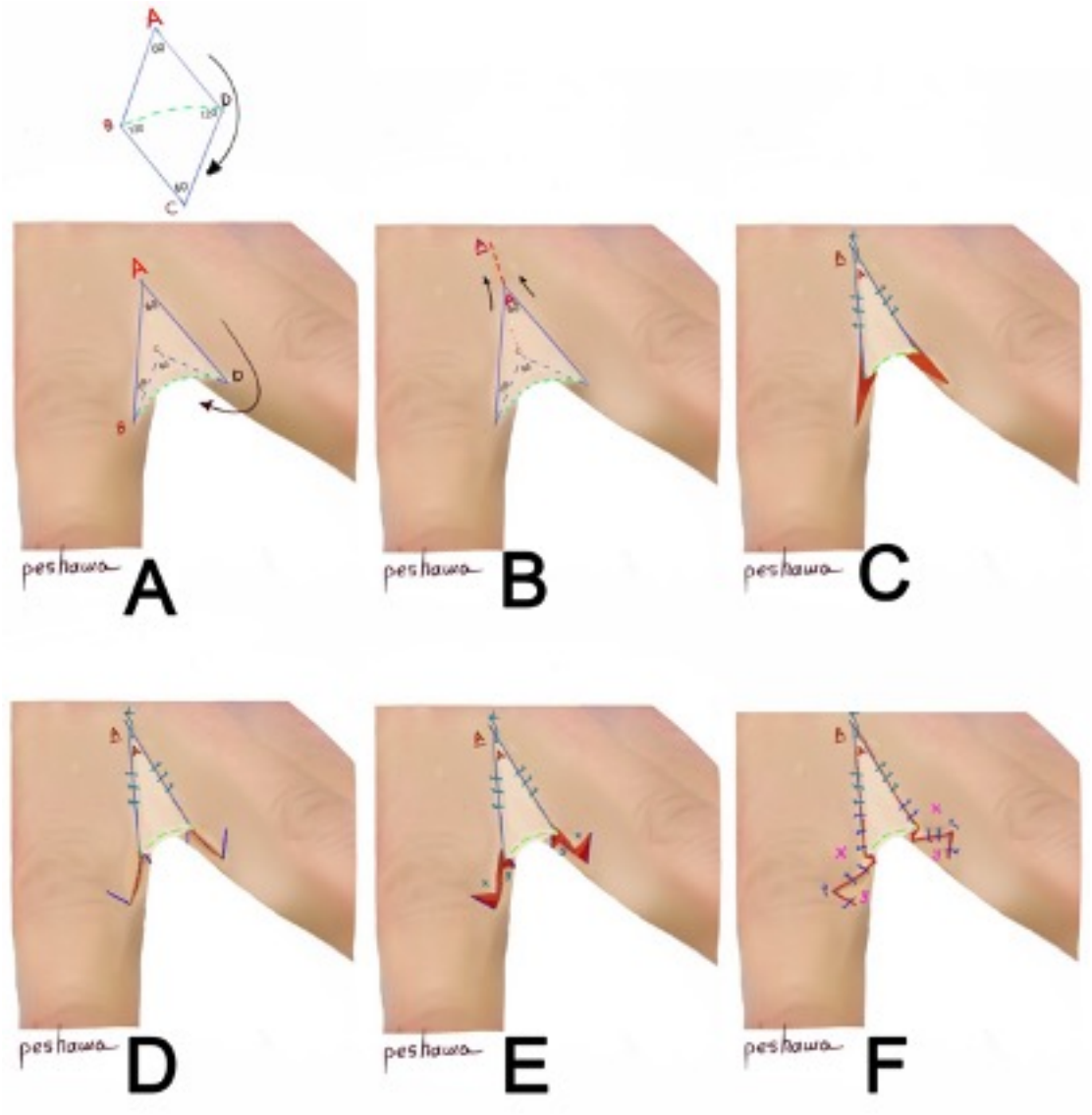

Figure 1. The drawings of the rhomboid flap and double Z-plasty technique in web space reconstruction: (A) preoperative marking of the rhomboid flap with 60° and 120° inner angles, (B) markings of relaxation incisions and direction of advancement of rhomboid flap shown, (C) advancement of the rhomboid flap, (D) double Z-plasty added to the donor area of the rhomboid flap, (E) Z-plasties incised and elevated, (F) the final result after suturing of the rhomboid flap and double Z-plasties.

RESULTS

During follow up period, all of our patients showed a significant improvement in the degree of digital abduction in comparison with the preoperative angle, Table 1 below.

All of our patients were quite satisfied with the postoperative results regarding their digit movement and they were able to do independent digit flexion, extension, and abduction. Regarding the aesthetic appearance of the web spaces postoperatively, all the web spaces were pleasing in their appearance and looked quite normal.

Table 1. Pre and postoperative abduction angles.

Patient No.	Web involved	Preoperative angle	Postoperative angle	Angle increase
1	Right 1st	42	49	7
	Left 1st	45.5	56	10.5
2	Left 2nd	14	21	7
	Left 4th	28	31.8	3.5
3	Right 2nd	35	38.5	3.5
	Right 4th	31.5	38.5	7
4	Left 3rd	21	24.5	3.5
5	Right 1st	50	65	15
	Right 2nd	27	30	3
	Right 3rd	20	22	2
6	Left 1st	57	67	10
7	Left 2nd	23	35	12
	Left 3rd	20	29	9
	Left 4th	26	33	7
8	Right 2nd	20	25	5
	Right 3rd	20	22	2
9	Left 3rd	25	35	10
	Left 4th	34	46	12
Mean ± SD (Range)		29.9 ± 11.9 (14 to 57)	37.1 ± 14.2 (21 to 67)	7.2 ± 3.9 (2 to 15)

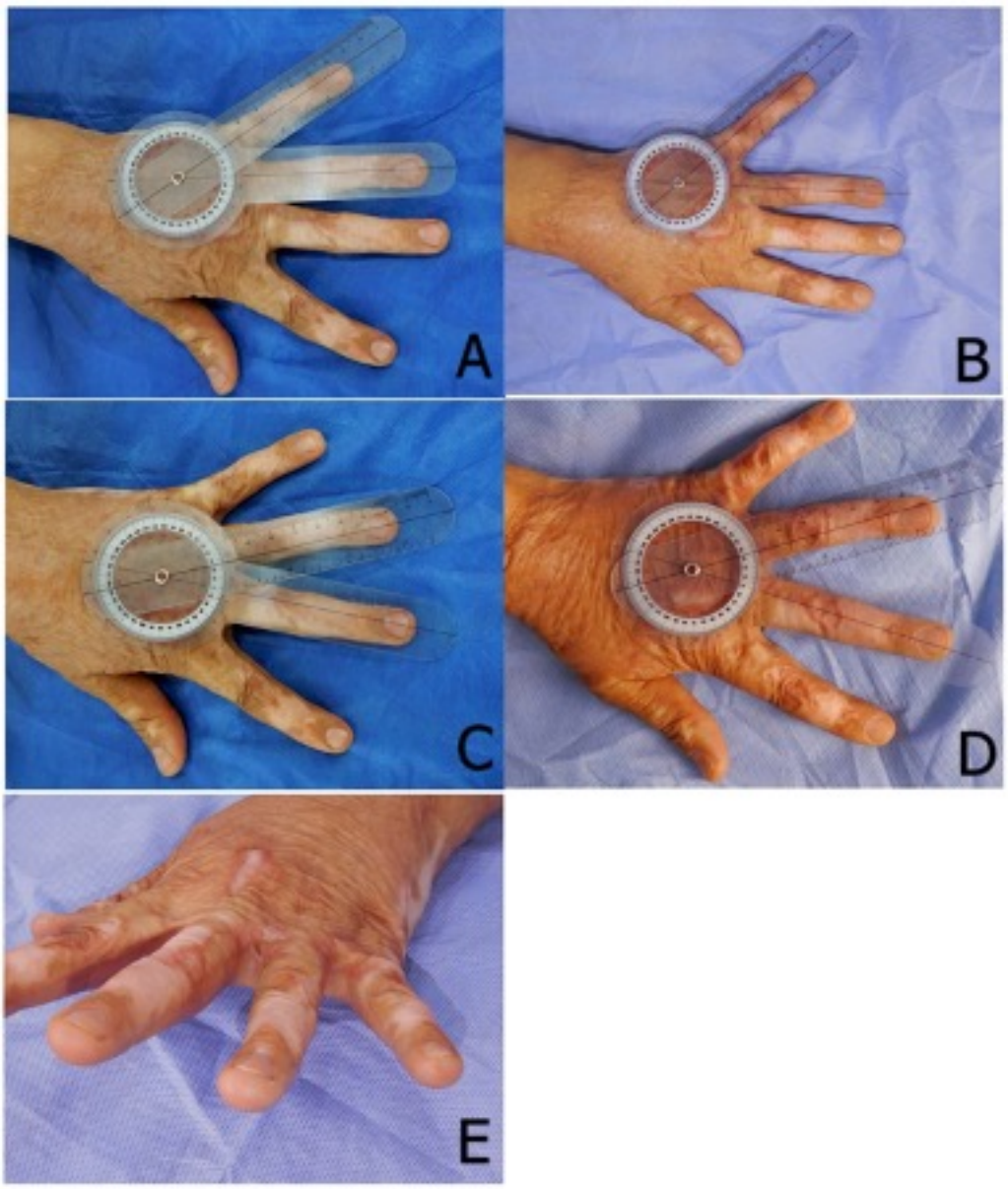

Figure 2. A 21-year-old lady with third and fourth web space contracture as a result of the flame burn. (A) preoperative view of fourth webspace, (B) two months postoperative view of fourth webspace (12° gain in angle), (C) preoperative view of third webspace, (D) two months postoperative view of third webspace (9° gain in angle), (E) postoperative webspace view.

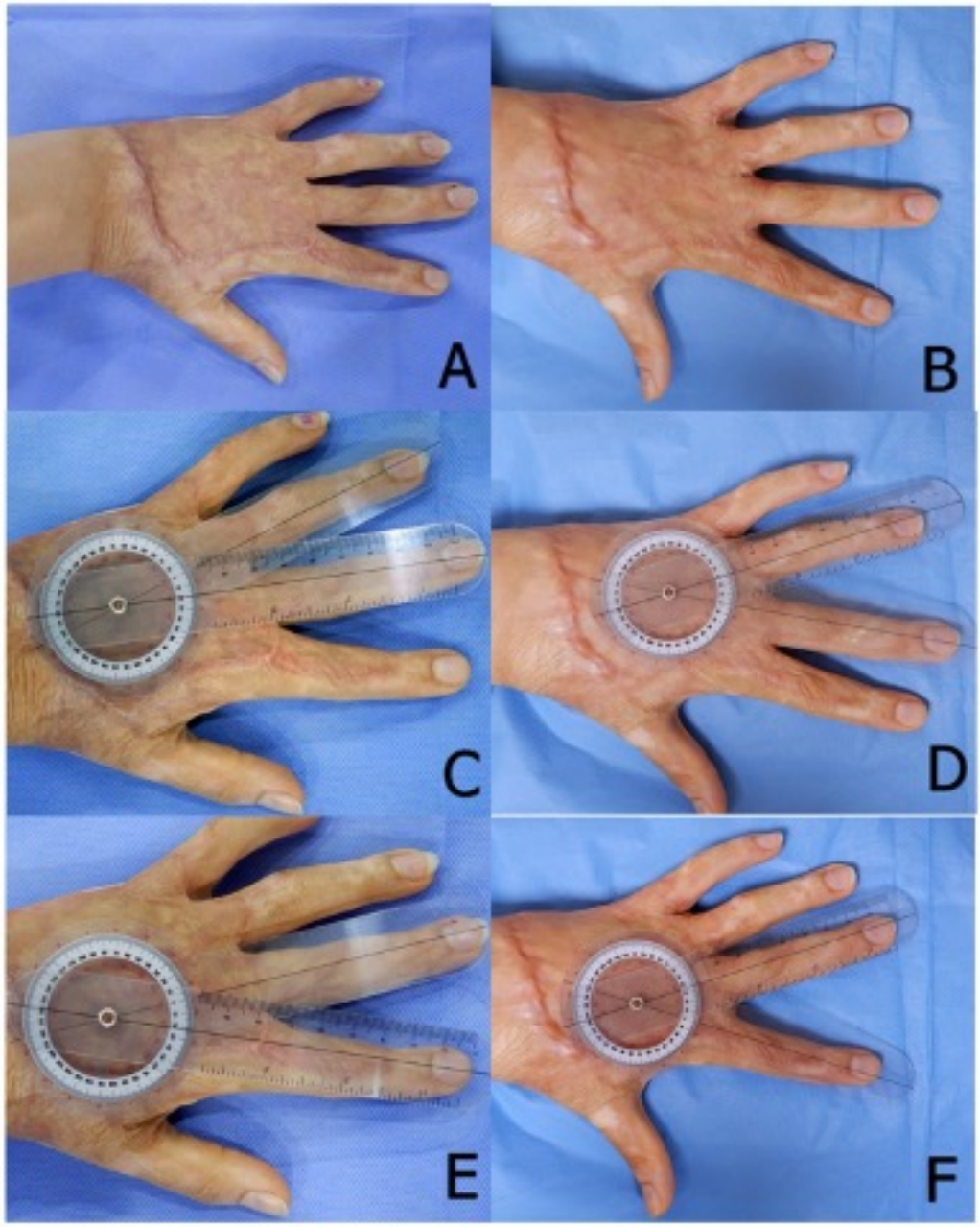

Figure 3: A 38-year-old lady with second and third web space contracture as a result of the flame burn. (A) preoperative view, (B) six months postoperative view (C) preoperative view of third webspace, (D) six months postoperative view of third webspace (9° gain in angle), (E) preoperative view of second webspace, (F) six months postoperative view of second webspace (12° gain in angle).

DISCUSSION

Given humans' innate action to shield the body from the burning agent or to extinguish the effects elsewhere on the body, hands are the most commonly burnt body part with an incidence of more than 50% of all burns and greater than 80% of severe burns [8, 9].

Although the overall surface area of each hand is less than 3% of the total surface area of the body and generally does not play a major role in the survival of the patient. However, its function and aesthetic appearance are important for reintegration into society and professional life [2, 10, 11]. Postburn deformities can be due to deficient or altered anatomy and are the most common cause of contractures occurring in the hands despite all advances in the management of burn injuries [12-14].

Many surgical procedures were used to correct postburn web contractures. These include simple vertical incision with transverse closure, release and skin grafting, simple Z plasty, complex Z plasty, V-Y plasty, and various rotational flaps with or without grafting [15].

All our flaps completely survived with no flap necrosis or wound dehiscence. They were taken with adequate thickness and dissected down to the healthy subcutaneous tissue without undermining, but with maintaining a broad subcutaneous pedicle. The reliable thickness and blood supply of the flaps together with minimal undermining accounted for the high rate of flap survival in this study with no reported cases of flap necrosis. Also, no cases of digital ischemia were reported since meticulous dissection was carried out with the aid of loupe magnification. Regarding the aesthetic aspect of using this technique, our results showed a nice aesthetic appearance of the web spaces with a nearly normal rectangular shape and an angle of inclination nearly comparable to normal. However, 3 webs developed a small linear scar on the dorsal aspect, which was not significant and was corrected under local anesthesia afterward.

Our study is consistent with Elif San et al. who used a rhomboid flap and double Z-plasty for the treatment of 11 postburn web space contractures in 8 patients. Their results showed that both hand function and aesthetic appearance of the web spaces were quite satisfying postoperatively [5].

The procedure does not include flap rotation thus local tissue is rarely displaced and it provides excellent color and texture match without hair growth within the webspace. The proposed method places incisions outside the web space so it prevents new scar formation and possible recurrence of contracture. [5, 16]

In conclusion, the combined rhomboid flap and double Z-plasty technique showed to be a simple and predictable method for postburn web space reconstruction. It has good functional and aesthetic results with an acceptable scar and thus it is recommended to be used for postburn web space contracture release. However, it is better to apply the technique for a larger sample and longer period to achieve a better evaluation of the technique.

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