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ORIGINAL PAPER

Inferior pole breast reconstruction by TDAP flap in post-burn breast contracture

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Abstract

Background Post-burn breast deformities are not an uncommon condition after severe second-degree or third-degree burn and present as severe asymmetry of the breast as compared to the opposite side, displacement of nipple-areola complex, obliteration of inframammary fold, and reduced breast projection. Based on deformities especially for lower pole breast contracture, we propose a new classification to describe breast contracture. There is no tailor-made approach described to deal such deformities. Various options are available ranging from skin graft to different flaps. We present reconstruction by TDAP flap after the release of breast contracture grades I and II. This study aimed to classify the lower pole breast contracture according to its severity and to evaluate the outcome of TDAP flap reconstruction and augmentation of the lower pole of the breast in terms of symmetry and aesthesis.

Methods This is a descriptive retrospective study of 10 patients with 15 post-burn contracted breast affecting the inferior pole of the breast and inframammary fold within a period of January 2012 to March 2016 in Kasralainy hospital, Cairo. All cases were evaluated according to flap vascularity, donor site morbidity, symmetry, and esthetic outcome.

Results All flaps survived completely. Flap dimension ranged from 18 × 10 to 22 × 12 cm. The muscle sparing design had been used in three patients due to lack of reliable perforators. Patients were evaluated for their satisfaction, and all of them were satisfied.

Conclusions It is essential to classify the grade of post-burn lower pole breast contracture according to the proposed classification. TDAP is a valuable option in case of grade I and II deformities only. For severe grade III breast contracture, more volume restoring procedure is advisable.

Level of Evidence: Level IV, therapeutic study.

Keywords TDAP flap for breast contracture · Post-burn breast deformity · TDAP flap

Introduction

Post-burn breast deformities are a common condition, especially after severe second-degree and third-degree burn involving the chest region. Breasts are an important part of the identity of a woman and absence, or deformity of the breast can be both functionally and emotionally debilitating.

Severe post-burn scarring in childhood can interfere with the healthy development of breast in later life and completely obscures the nipple areola complex.

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In mild to moderate contractures, the breast growth may be restricted only in some areas leading to distortion of shape, contour, and symmetry and can be an esthetic concern.

Scar contractures need to be released early to prevent or correct breast deformities. Several methods have been described for release and coverage such as skin grafts or flaps, but there is no consensus on the treatment of choice.

The TDAP flap is based on perforators of thoracodorsal artery and was first described by Angrigiani in 1992 as muscle (LD muscle) sparing flap [1]. Several authors have modified the technique and used it as partial or total breast reconstruction.

In mild to moderate contracture of the lower pole of the breast, the skin graft can be used, but contour may not be as good as re-contracture can occur which gives suboptimal result [2] whereas use of muscle flap gives excess bulk and may obliterate the contour of breast [3].

TDAP flap being a loco-regional flap and thus provide best color and texture match with less bulk and cause no donor site functional deficit as compared to LD or other muscle flaps.

In our study, lower pole contractures were released with, and the defect recreated. The proposed TDAP flap was marked along the vascular axis of the thoracodorsal artery, and perforator was dissected to its origin. The skin and subcutaneous tissue was harvested, islanded on perforator, and propelled to the lower pole of the breast at the defect site. The donor site was closed primarily.

This study aimed to classify the lower pole breast contracture according to its severity, volume deficiency, and position of nipple-areola complex and outcome of TDAP flap that was used for reconstruction and augmentation of the lower pole of the breast in terms of symmetry and aesthesis.

Materials and methods

This descriptive retrospective study was carried out at Kasralainy hospital, Cairo from the period of January 2012 to March 2016 in 10 patients with 15-post burn breast contracture affecting the inferior pole of the breast and inframammary fold. The flame burn was the etiology in seven patients while scald hot water burns in three patients. Patients' age ranged from 16 to 30 years at the time of presentation. The timing of the presentation was variable ranging from 4($n = 8$) to 12($n = 2$) years after the burn injury. We propose a classification for the post-burn involvement of the inferior part of the breast to categorize the patients that are indicated for this technique (Table 1; Fig. 3). We included only grades I and II in our study. In five cases, there was bilateral breast involvement, and the two sides were operated sequentially at 6 months.

Routine preoperative assessment included complete blood count and coagulation profile. All patients underwent a handheld doppler study to locate and mark the perforators of the thoracodorsal artery close to the anterior border of the latissimus dorsi muscle. Perforator mapping was done in the lateral decubitus to simulate operative position. Based on previous anatomical studies [1] (Angrigiani et al. [4], 1995 and Spinelli et al. [5], 1996), the perforators were sought out in a region 8 cm below the axillary crease (it is an axillary wrinkle which is found at the junction of the upper arm with the shoulder/back region) and within 2 cm of the anterior border of the LD muscle. The vertically oriented island TDAP flap was outlined as per defect; patients were operated upon on the lateral decubitus position first to facilitate flap harvest and then converted to supine position to facilitate insetting after the closure of the donor site. The flap was monitored daily. Hospital stay was for 24 h with regular follow-up after discharge. Patients were followed up for an average period of years (Figs. 1 and 2).

Table 1 Classsifcation of post-burn contracture of inferior pole of the breast

Grade	Deformities of breast
(I)	Mild deficiency of the inferior pole of the breast without obliteration of the inframammary fold, normally located nipple areola complex and the superior pole is having normal shape.
(II)	Moderate deficiency of the inferior pole of the breast with obliteration of the inframammary fold, with or without abnormally located nipple areola complex and the superior pole is having normal shape.
(III)	Severe deficiency of the inferior pole of the breast with obliteration of the inframammary fold, abnormally located nipple areola complex and superior pole is flattened (flattened breast that is adherent to the abdominal wall at a lower position).

Grade (I) and grade (II) were only included in this study

Grade (III) was excluded from this study

Surgical technique

A full release of the contracted inferior pole was done 2–3 cm above the scarred obliterated inframammary fold leaving a raw area on the inferior pole of the breast. A template was made for the defect to plan the length and width of vertically oriented TDAP flap. The recreated breast defect after the release of contracture was covered with saline-soaked dressing fixed with staples till completion of flap harvest. The skin incision was made along the anterior aspect of the skin island that also overlaps with the anterior border of the latissimus dorsi muscle. The thoracodorsal artery and visible septocutaneous perforators were identified (Figs. 1d, 3, and 4) and dissected, and then, skin incision along the posterior aspect of the drawn island was completed. The perforators were identified from medial to the lateral aspect of the patient; then, the dissection was continued in the subfascial plane of the latissimus dorsi muscle using sharp dissection with fine scissors under loupe magnification while securing hemostasis using bipolar electrocautery. Once a suitable visible pulsatile perforator was identified, the cleavage plane of the LD muscle in which that perforator resides was developed by spreading muscle fibers in their longitudinal integrity. The perforator was dissected from the surrounding muscle fibers where they tend to lie in a fibro-fatty layer up to the main thoracodorsal pedicle which was dissected free till the desired pedicle length is reached. When the perforator diameter is less than 0.5 mm, there is a high risk for perforator injury during dissection. A muscle-sparing technique was performed in such cases by preserving a 2–5 cm cuff of LD muscle around the Fig. 2d. The tunnel is released and the flap shares in the reconstruction of the lateral aspect of the inferior pole where it joins the vertically oriented donor site wound. The donor site was closed primarily after insertion of a suction drain. Flap inset

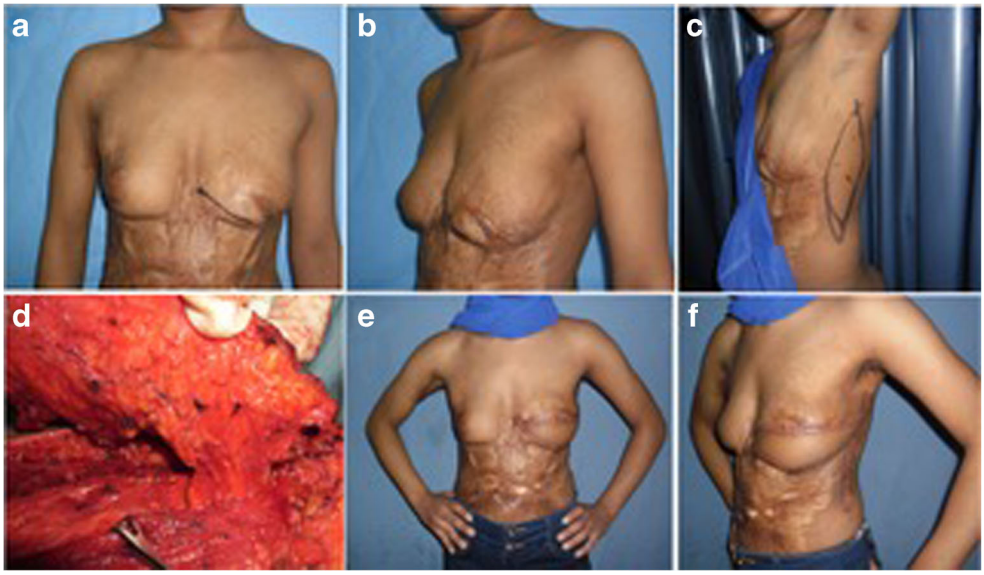

Figure 1 Patient 1. **a** Pre-operative: post-burn inferior pole contracture left breast, front view. **b** Pre-operative: post-burn inferior pole contracture left breast, left lateral view, Grade II deformity left side. **c** Pre-operative marking for TDAP skin paddle. **d** Intraoperative picture showing septocutenous perforators. **e** Post-operative after 1 year, front view. **f** Post-operative picture after 1 year, lateral view

was done after insertion of suction drain underneath. This was made easier by turning patient to the supine position.

Results

Release and reconstruction of the inferior pole of the breast were performed in all patients utilizing vertically oriented thoracodorsal artery perforator (TDAP) flap. The muscle sparing design had been used in three patients due to lack of reliable perforators. The timing of the presentation was variable ranging from 4 ($n = 8$) to 12 ($n = 2$) years after the burn accident. Flap dimensions ranged from 18 × 10 to 22 × 12 cm. All flaps had survived totally without complication. Only one case had minor wound dehiscence at the medial aspect of the breast but healed on its own capacity. Donor site vertical scar developed hypertrophic scar 1 month postoperatively in three cases that had recovered with topical polysiloxane application. Table 2 summarizes the patient data and techniques used and their satisfaction using a short scale from 0 to 4) where 4 = very satisfied, 3 = satisfied, 2 = neither satisfied nor dissatisfied, 1 = dissatisfied, and 0 = very dissatisfied.

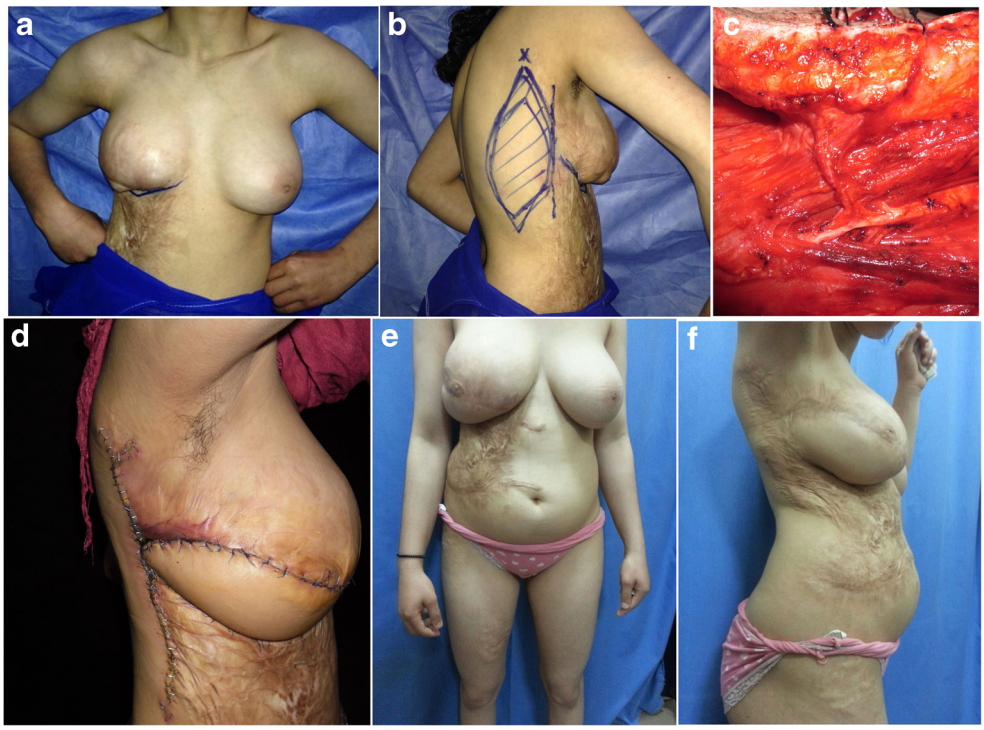

Fig. 2 Patient 2. **a** Post-burn inferior pole contracture Grade II right breast. **b** Flap design and preoperative marking. **c** Intraoperative musculocutenous perforator. **d** Post-operative after a week, lateral view. **e** Post-operative after 1 year, front view. **f** Post-operative after 1 year, right lateral

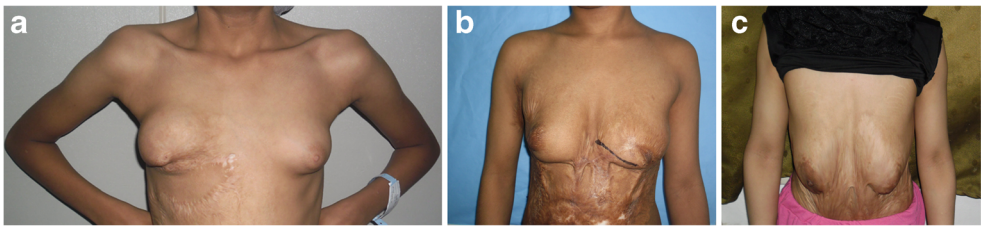

Fig. 3 Various types of breast deformities. **a** Grade I breast contracture. **a** Grade II breast contracture. **b** Grade III breast contracture

Discussion

Post-burn contracture and deformities of the breast are one of the most difficult challenges for the reconstructive surgeon as the breast is a vital organ not only for lactation but defines feminity in a woman. The burn of the chest area and abdomen in the childhood affects the development of breast and causes severe deformity of the breast like asymmetry, displacement of nipple-areola complex, superior or inferior pole contracture with or without infra-mammary fold obliteration. Based on such deformities, we propose a new classification to describe the breast deformities and uses of T-DAP flap for lower pole contracture in grade I and II breast contracture (Table 1) However, there are few Fig. 4 to describe such deformity and treatment options available [2].

Ozgur et al. have classified post-burn breast deformities as either mild or severe. For milder contracture, treatment choices are the release of contracture and skin graft or Z plasty or local flap [6].

The common etiologies of post-burn breast contracture include flame burn which accounts for 70% and scald burns that account for 30%. The ratio being may be reversed as described by G.Y.Ozgenel that depends on local culture and customs of a country [7].

Conventionally lower pole contracture of the breast is reconstructed by contracture release and skin graft which is an effective method, but there is always a risk of secondary contracture and recurrence of the deformity. Also, graft becomes hypertrophied and hyperpigmented with secondary contracture which results in a poor esthetic outcome (Mueller, 2002) [8].

In mild to moderate contractures associated with volume deficit, use of flaps or expanders is recommended (Reema Dina Jarjis, 2016) [9], or in another word, a skin graft may not be a good option. Also, skin graft in the upper half of breast usually offers better prognosis than the lower half and the infra-mammary groove, which nearly always develop re-contracture as advocated by El-Otiefy and Darwish [2].

Although various authors have given the excellent result (Reema Dina Jarjis, 2016) [9] in their few case reports using thick split-thickness skin graft where the donor area had to undergo resurfacing by thin SSG, this increases the donor site morbidity comparison to TDAP flap which is closed primarily, and the donor area is well hidden.

Secondarily, use of FTSG needs large donor area to be closed primarily which may be a limitation of using FTSG in thin patients where donor area skin may not be too lax to be closed primarily (Mueller 2000) [8]. With so many disadvantages of skin graft either partial thickness or full thickness, newer techniques kept evolving or use of local flaps became popularized [3, 6] . Integra is another option which can be used with skin graft in breast contracture which was recommended by Tsoutos et al., but it is not feasible in the low socioeconomic country due to its high

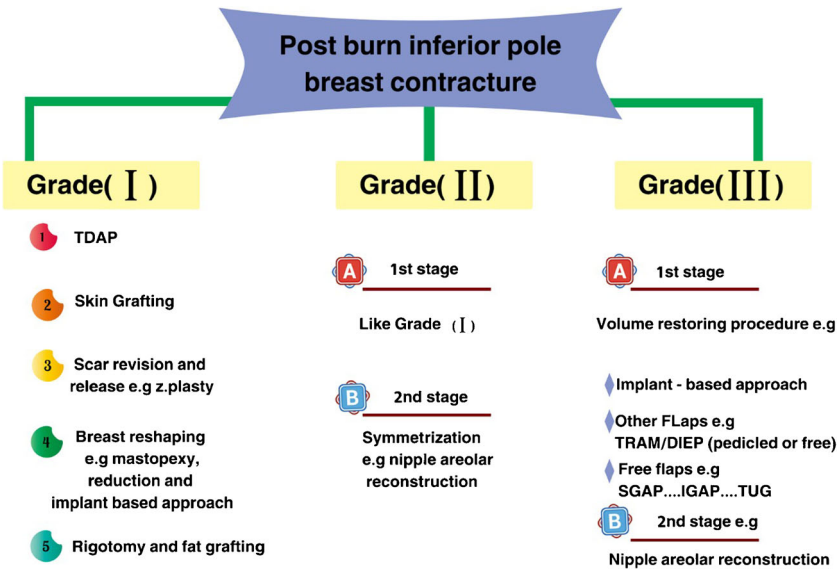

Fig. 4 Algorithm showing management of inferior pole breast contracture

Table 2 Patient's demography, techniques used, and final result

Patient	Age	Burn type	Burn time (Y)	Breast(s) affected	Degree of breast deformity	Doppler perforator mapping	Defect size (cm)	Flap(s) size (cm)	Flap Type	Patient Satisfaction
1	17	flame	13	Bilateral	Grade 1 on both sides	14 cm from posterior axillary fold, 2 cm medial to anterior border of latissmus. On both sides	14 × 8	18 × 11	Propeller Vertically-oriented TDAP (bil)	Very satisfied
2	24	flame	12	Right side	Grade 1	12 cm from posterior axillary fold, 3 cm medial to anterior border of the latissmus	16 × 8	19 × 11	Propeller Vertically-oriented TDAP	Very satisfied
3	16	flame	12	Left side	Grade 2	14 cm from posterior axillary fold, 2 cm medial to anterior border of latissmus.	18 × 10	22 × 12	MS-Vertically oriented TDAP	Very satisfied
4	30	flame	18	Right side	Grade 2	11 cm from posterior axillary fold, 3 cm medial to anterior border of latissmus	18 × 10	22 × 12	MS-Vertically oriented TDAP	Very satisfied
5	20	scald	16	Left side	Grade 2	12 cm from posterior axillary fold, 3 cm medial to anterior border of the latissmus	18 × 10	22 × 12	Propeller Vertically-oriented TDAP	satisfied
6	22	flame	18	Bilateral	Grade 1 on both sides	10 cm(rt) and 12 cm(lt) from posterior axillary fold,3 cm medial to anterior border of the latissmus on both sides	14 × 8	18 × 10	Propeller Vertically-oriented TDAP (on both the sides)	Very satisfied
7	26	scald	22	Right side	Grade 2	12 cm from posterior axillary fold, 3 cm medial to anterior border of the latissmus	16 × 10	18 × 12	Propeller Vertically-oriented TDAP	Very satisfied
8	27	scald	23	Bilateral	Grade 1 on both sides	14 cm (rt) and12cm (lt) from posterior axillary fold2cm medial to anterior border of latissmus on both sides.	15x8c	18 × 10	Propeller Vertically-oriented TDAP (on both the sides)	Very satisfied
9	18	flame	14	Bilateral	Grade2 on both sides	10 cm from posterior axillary fold, 3 cm medial to anterior border of the latissmus	19 × 10	22 × 12	Rt side: MS-Vertically oriented TDAP Lt side: Propeller Vertically-oriented TDAP	Satisfied
10	29	flame	25	Bilateral	Grade 2 on both sides	12 cm from posterior axillary fold,3 cm medial to anterior border of the latissmus (on both the sides)	18 × 10	22 × 12	Propeller Vertically-oriented TDAP (on both the sides)	Satisfied

cost and availability [10]. Integra being a dermal regeneration template needs to be skin grafted which in turn leaves some sort of donor site morbidity.

In a case report by Muller [8], even if the patient undergoes skin graft or Z plasty, there is further need of revision surgery. Z plasty requires normal adjacent tissue and cannot be used in diffuse contracture as we found in our series. In severe obliteration of IMF, the full release of contracture and even overcorrection is advisable to give a good shape, symmetry, and recreation of IMF. In those cases, Z plasty is not preferred, and skin graft will give a sub-optimal result.

Also, in the series of Mehadi et al., out of nine patients, five patients had undergone contracture release and skin grafting or Z plasty. However, they were not satisfied, so came for subsequent and definitive reconstruction by the flap which they reconstructed with LD musculocutaneous flap [11].

Based on the above reports, it is evident that for breast contracture grade I and II especially lower pole contracture full thickness tissue with moderate volume or flap is required to reconstruct the defect recreated following contracture release.

TDAP is a locoregional flap that has a good tissue match and minimal donor site morbidity. However, it requires meticulous intramuscular dissection as described by Angrigiani, but several studies show that TDAP flap is a reliable and safe option and gives superior result in breast reconstruction [1].

Using TDAP flap for IMF creation in the burned breast is not described in the literature as per our knowledge and search. The advantage of TDAP flap is that a significant dimension of the flap can be taken. In our series, the dimension ranges from 18 × 10 cm to 22 × 12 cm. Angrigiani also extended the flap design to include superior and inferior fat compartments which mean a large area of the flap can be taken without any problem [12] which support our flap dimension.

Simultaneously, when there is volume deficit in the lower pole, TDAP flap offers an excellent option to augment breast projection along with correction of inward contracture of the lower pole of the breast. In the comparative study by Angrigiani et al. in post-mastectomy patients, tissular volume achievement was enough to achieve symmetry of the contralateral breast when dealing with cup size A or B cup [12] which is comparatively equal to our result.

LD muscle used to be workhorse flap for breast reconstruction. However, it has disadvantages of donor site morbidity, scar over the back, hematomas, and seroma which are frequent when

using large muscle [13]. However, in our series, there was no complication concerning seroma, hematoma, or wound dehiscence as the donor area was closed primarily without tension and there was no dead space left behind. We kept the drain for a minimal period of 5–6 days.

Abdominal tissue in terms of TRAM/DIEP flap is another option that can be used for reconstructing the lower pole. Comparison with TDAP flap causes more donor site morbidity due to loss of muscle (partially or totally as in TRAM flap) and associated increased risk of hernia formation. Also in deep burns, there is a probability of injury to superior pedicle or associated burns over the abdomen which may not be suitable for cover over the breast. In case of thin patients, one may not find a suitable donor area to be closed primarily.

The patients were followed up for a minimum period of 6 months to 2 years and were evaluated by a simple satisfaction score. Out of ten patients, we found that seven patients were very satisfied whereas three patients were satisfied which favors the use of TDAP flap.

However, expanders and implants are associated with risk of expander exposure, capsular contracture which are absent in TDAP flap reconstruction.

When patients have severe asymmetry of the breast in terms of severe deficiency of lower pole, severely displaced nipple areola complex, or loss of superior pole projection, they will require additional procedure like implants or expander, mastopexy or other flaps along with fat grafting as per the algorithm proposed by A. Gheita et al. [14]. The authors suggest that in grade III post-burn deformity of the breast, TDAP alone is not sufficient to achieve symmetry that was excluded from our study. Also in severe scarring involving the lateral thoracic wall, TDAP flap will not be feasible.

The authors suggest TDAP flap being the first option in grade I and II breast contracture.

Limitation of study

It may require a case-control study to compare with other options available or a larger case series to authenticate our procedures over other conventional methods of breast reconstruction, that may be the limitation of our study. Although, in our classification, we have tried to include all deformities present in breast contracture and it will be useful to make an approach for reconstruction, it requires larger series to include other variations too.

Conclusion

Post-burn breast deformities are a difficult task for reconstructive surgeon. TDAP flap provides loco-regional tissue giving the best color and texture match and restores symmetry, breast volume, and nipple areola position. However, before choosing TDAP for post-burn breast reconstruction, it is useful to classify breast contracture according to the proposed classification as TDAP is a valuable option in grade I and II deformities only. For severe grade III breast contracture, more volume restoring procedure is advisable.

Compliance with ethical standards

Conflict of interest Ahmed Ali Ebrahiem and Raj Kumar Manas declare that they have no conflict of interest.

Ethical approval Not required.

Patient consent Patients provided written consent for the use of their images.

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