

Evaluation of the Donor Site Morbidity Following Harvesting of Thoracodorsal Artery Perforator Flap

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Abstract

Background: The use of thoracodorsal artery perforator (TAP) flap preserves the latissimus dorsi (LD) muscle and, hence, reduces donor site morbidity and complications.

Objective: In this study we evaluate the donor site morbidity of the TAP flap regarding aesthetic and functional aspects.

Methods: In this study we evaluated the resulting aesthetic and functional consequences of the harvest of thoracodorsal artery perforator flap. This included postoperative donor site complications. The shoulder function was evaluated 3-6 months post-operatively by the QUICKDASH scale. The donor site scar quality and related problems were assessed six months post-operatively by using three scar scoring systems (the patient scar assessment scale, observer scar assessment scale, and the Vancouver Scar Scale).

Results: Minimal donor site complications were reported with three case of wound dehiscence two of them managed conservatively, one case of wound infection and one case of seroma. We used three scar assessment scores which showed good scar quality except for the cases where skin graft was used to cover the donor site when its width exceeded 10cm. Regarding functional outcome, we found normal shoulder movements except for early limitation of abduction and forward elevation that were improved with time.

Conclusion: The use TAP flap reduces donor site complications and morbidity and should be used when feasible as an alternative to LD musculocutaneous flap.

Key Words: Thoracodorsal – Perforator – Flap – Donor.

Disclosure: The authors state that they have no financial relation to the study's subject matter, and they have no conflicts of interest.

Ethical Considerations: The Helsinki Declaration's tenets were followed while conducting this study. The Tanta University Faculty of Medicine's Ethical Committee gave its approval for this work. All patients provided written agreement after receiving full information about the surgery and the publication of their images.

Disclosure: No conflict of interest.

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Introduction

For the various reconstructive techniques to yield the best possible results, donor-site morbidity minimization is a crucial factor. This leads to the increased popularity of muscle sparing fasciocutaneous and perforator flaps over muscle or myocutaneous flaps that are associated with more complications [1].

Since its initial description by Angrigiani et al. and Spinelli et al., the thoracodorsal artery perforator (TAP) flap gained significant attention due to its unique benefits, which include the preservation of latissimus dorsi (LD) muscle function, a long donor vessel, the ability to harvest a sizable flap from a concealed donor location, homogeneous flap thickness, and the avoidance of posterior axillary fold contour deformity by preserving the LD muscle and innervation [2,3].

During TAP flap harvest, the thoracodorsal vessels are often dissected by separating the muscle fibers without compromising the muscle itself. However, the combination of the technique of flap harvest and the reduction of the muscle's blood supply may lead to muscular atrophy and a slight decline in function [4].

In this study we evaluate the donor site morbidity of the TAP flap regarding aesthetic and functional aspects.

Patients and Methods

From September 2017 to December 2021, this study was carried out at our University's Faculty of Medicine, Department of Plastic and Reconstructive Surgery. It included 20 patients operated upon by the TAP flap. Individuals who are not surgical candidates, have peripheral vascular disease, have undergone prior harvest of LD flap, or have under-

gone axillary dissection, were excluded from this study.

The skin paddle width was determined by the width of the defect and the possibility of primary closure, which was assessed by the skin-pinching test. In case of reconstruction of defects that result from release of wide scar contractures or excision of skin malignancies, the dimensions of the flap are determined after complete execution of the procedure. Since an eccentric perforator position inside the flap ensures a longer pedicle and is fairly safe, it is not necessary to center the perforator in order to safely perfuse this flap. Two designs were utilized for the skin island:

- 1- Vertical skin island, designed over the free or lateral border of the LD muscle. This design incorporates only the perforators derived from the descending branch of the thoracodorsal artery (TDA).
- 2- Transverse skin paddle, designed horizontally along the posterior back to incorporate the perforators derived from both descending and transverse branches of TDA. That design was preferred more in females in order to conceal the donor scar in the bra line posteriorly.

After wound healing, patients were followed up in the clinic monthly except for patients who developed wound related complications who were followed more frequently as needed. No scar treatment was prescribed for any of our patients during the postoperative first six months to allow for the natural scar remodeling process and to avoid study bias. The donor site scar quality and related problems were assessed six months post-operatively by the patient scar assessment scale (PSAS), observer scar assessment scale (OSAS) and the Vancouver Scar Scale (VSS) [5,6].

The Patient Scar Assessment Scale (PSAS) is a six-item subjective rating that includes color, thickness, irregularity, stiffness, itching, and pain associated with the scar. The patient assigns a score to each item, where 1 denotes normal skin and 10 denotes the worst possible scar. Poorer results are correlated with higher scores.

The Observer Scar Assessment Scale (OSAS) is an objective scale evaluated by the surgeon and includes 6 items: vascularity (pale to purple skin), thickness, pigmentation, relief (extent of surface irregularities), surface area (none to >4cm) and pliability (supple to stiff). Each item is rated by the observing surgeon, in comparison with normal skin, with a maximum score of 10 points. A higher score means a poorer scar quality.

The Vancouver Scar Scale includes evaluation of 4 variables: Skin pigmentation (on a score of 0 to 2), skin thickness (0 to 3, suggesting the possibility of hypertrophic scarring), color (indicating the degree of inflammation and hypervascularization, 0 to 3), and pliability (0 to 5). A score of 0/13 indicates normal skin.

The shoulder function was evaluated 3-6 months post-operatively by the QUICKDASH scale [7].

Results

The patients' ages (mean 31.8 ± 13.45 SD) ranged from 9 to 55 years. There were fifteen men (75%) and five women (25%) in total. Thirteen patients (65%) had soft tissue defects in the lower limb, and seven patients (35%) in the upper limb and axilla. Four patients (20%) had pedicled flap reconstructions, and the remaining sixteen patients (80%) had free flap reconstructions.

The flap dimensions ranged from 12 x 7 cm (84 cm²) to 26 x 11 cm (286 cm²). A single perforator served as the flap base in all patients. The mean length of the thoracodorsal pedicles was 16.8, with a range of 14 to 23cm. In 16 patients (80%, flap widths <10cm), primary donor site closure was performed, and in four patients (20%, flap widths >10cm), skin grafting was done.

The donor site morbidity of the TDAP flaps utilized in this study was evaluated in three aspects: post-operative donor site complications, scar related problems and functional impairment.

A- Post-operative donor site complications developed in 5 cases (25%) Three of these patients had wound dehiscence (two of them were minor and successfully treated by repeated dressing, while the third patient needed surgical closure). Wound infection developed in one patient and was successfully treated by local wound care. Seroma developed in one patient and was treated by repeated aspiration. (Fig. 1).

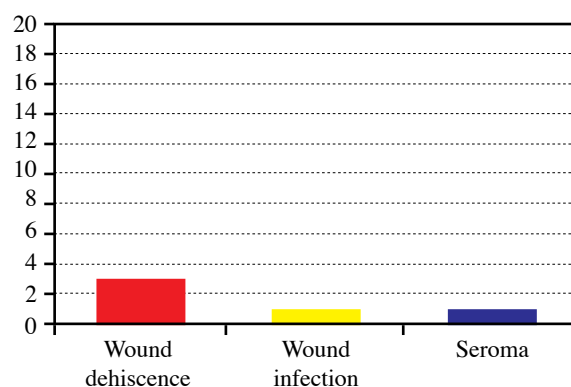


Fig. (1): Post-operative donor site complications.

B- Scar related problems (Figs. 2,3): These developed in six patients (30%); two cases of hypertrophic scars (10%) and four cases of scar widening (20%). Scar related complications

developed in all patients, in whom split thickness skin graft was employed to cover the donor site because of flap size more than 10cm. These cases showed the worst scores on the 3 scales.



Fig. (2): TDAP flap donor site hypertrophic scar.



Fig. (3): TDAP flap donor site widened scar due to coverage with split thickness graft (STSG).

The mean score of the patient scar assessment scale (PSAS) (minimum 6, maximum 60) was 16.2, the observer scar assessment scale (OSAS) (minimum 6, maximum 60) was 15.15 and for the Vancouver scar scale (VSS) (minimum 0, maximum 13) was 4.5 (Figs. 4-6).

C- Functional impairment: The shoulder function was evaluated 3-6 months post-operatively by the QUICKDASH scale. The shoulder movements related to the action of the LD muscle (shoulder extension, adduction, and medial rota-

tion of the arm) were found to be normal without any disability. There was only early limitation in the shoulder's forward elevation and abduction (passive and active) that was improved over time. This early limitation was manifested in the QUICKDASH scale by difficulty performing actions like hammering and washing the back, as these actions require shoulder abduction and/or forward elevation. The mean score was 7.2 which means minimal disability (QUICKDASH score ranges from 0 that means no disability to 100 that means marked disability).

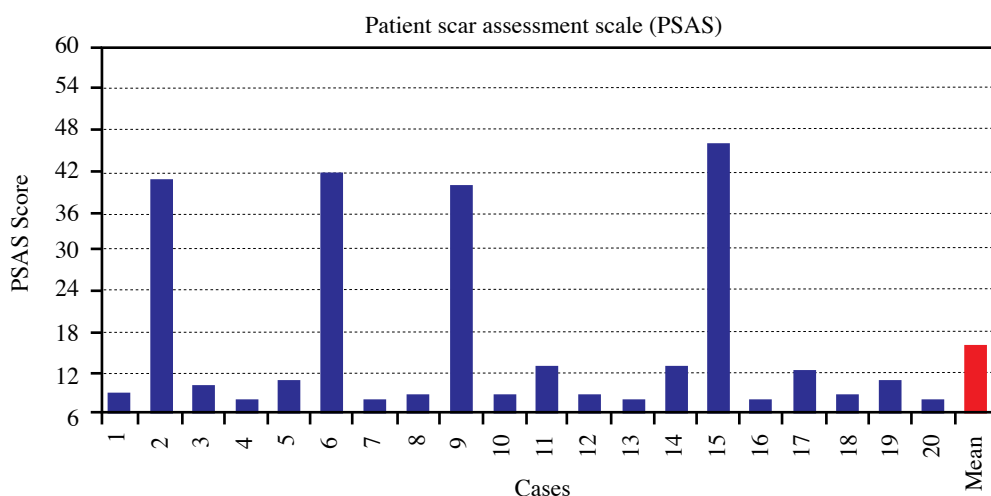


Fig. (4): Donor site scar problems as assessed by the patient scar assessment scale (PSAS), the worst scores (Cases No. 2, 6, 9, 15) where the donor site was covered by STSG. The mean score was 16.2.

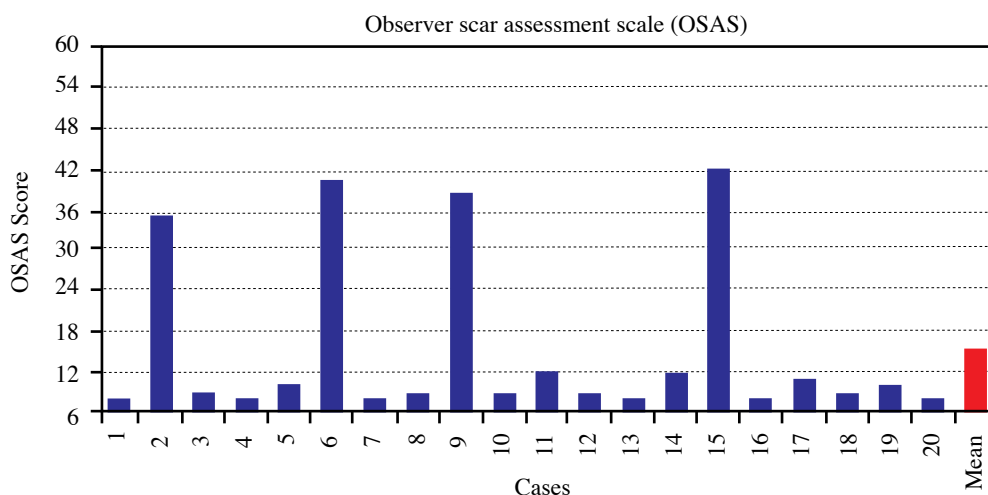


Fig. (5): Donor site scar problems as assessed by the observer scar assessment scale (OSAS), the worst scores (Cases No. 2, 6, 9, 15) where the donor site was covered by STSG. The mean score was 15/15.

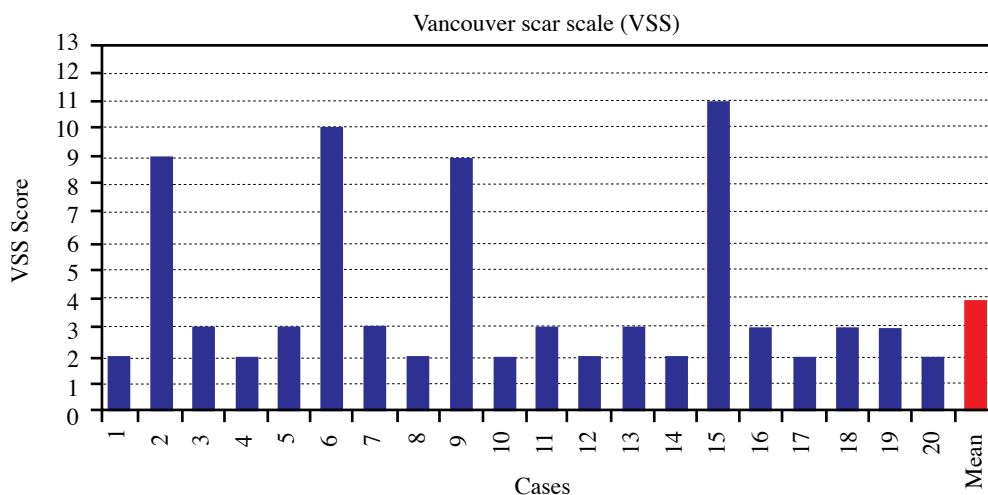


Fig. (6): Donor site scar problems as assessed by the Vancouver scar scale (VSS). The cases, in which the donor site was closed by STSG, showed the worst scores (Cases 2, 6, 9, 15), the mean score was 3.95.

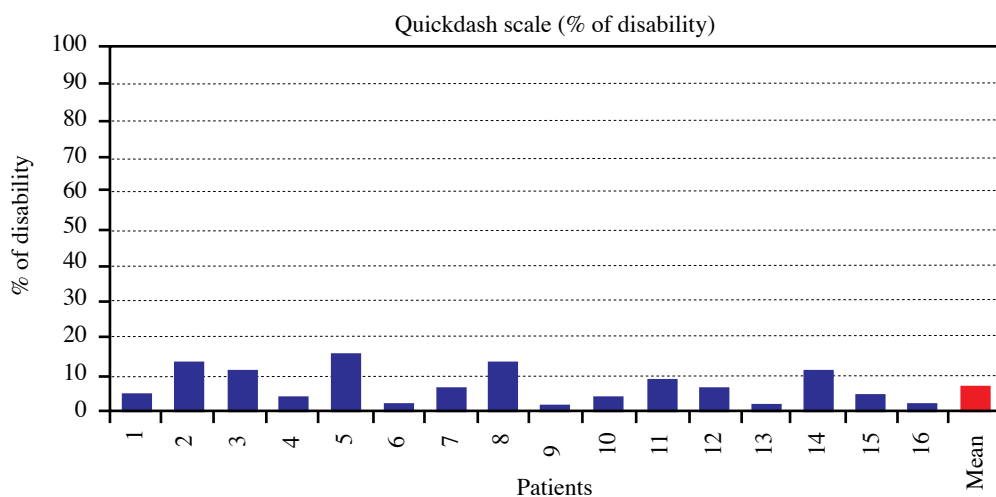


Fig. (7): QUICKDASH scale evaluating the shoulder function post harvesting of free TDAP flap, the mean score was 7.2.

Discussion

The LD musculocutaneous flap is one of the workhorse flaps of soft tissue reconstruction with common donor site complications especially seroma (reported incidence 5-80%) and prolonged wound drainage which are linked to lengthier hospital stays and higher expenses [8,9]. The primary reason for post-operative seroma, in cases of extended flaps, is the sacrifice of the muscle as well as the lumbar fat [10].

By sparing the LD muscle, the TAP flap decreases postoperative wound drainage and lowers the risk of formation of seroma [11,12]. This was confirmed in our study, where one patient (5%) developed post-operative seroma. This resulted in reduced hospital stay, fewer hospital visits, and reduced cost.

It was important to evaluate the donor site morbidity after TAP flap harvest for two reasons. First, it was not addressed as the main issue in previous studies. In addition, the functional outcome in the donor site after harvesting free TAP flap was reported by small number of authors [11]. Second, when compared to conventional latissimus dorsi musculocutaneous flap, TAP flap dissection necessitates special skills, may be challenged by the lack of a large enough perforator and is prone to result in partial flap necrosis [13].

The donor site scar assessment was performed about 6 months postoperative (to allow for a reasonable time of wound healing and scar maturation) using three scales; PSAS, OSAS and VSS. These scales include both subjective and objective items evaluated by the patient himself and the surgeons. The mean score of (PSAS), (OSAS), (VSS) was 16.2, 15.15 and 4.5 respectively. Bach et al reported TAP flap donor site scar assessment with PSAS, OSAS and VSS were 25.8, 21.5 and 8 respectively [14].

Complications related to the donor location developed in six patients (30%); two cases of hypertrophic scars (10%) and four cases of scar widening (20%). Scar related complications developed in all patients, in whom split thickness skin graft was employed to cover the donor site because of flap size more than 10cm. These cases showed the worst scores on the 3 scales.

Repair of the TDAP flap donor location with excess tension will lead to increased incidence of hypertrophic and widened scars [13]. We noticed also that primary closure of the TDAP flap donor site was more easily performed in the transversely oriented

flaps than for the traditional vertically oriented flaps of the same width. This can be explained by:

- The relaxed skin tension lines (RSTL) in the upper back run transversely so facilitating the closure of the transversely oriented TDAP flaps and hence lowering the incidence of hypertrophic and widened scars [12,15].
- There is preferential longitudinal orientation of elasticity of the back skin. Donor site closure of the longitudinally oriented flap is limited due to poor elastic reserve in the direction of chest circumference. This explains also the frequent hypertrophic scarring and/or scar widening at the donor sites of large longitudinally oriented TAP flaps [8,13].

The transversely oriented TAP flaps are more advantageous in females as the resulting donor site scars are well concealed in the brassiere lines, moreover the primary closure of the vertically oriented flaps might displace the breast mound laterally [16].

The shoulder function after harvesting of the free TAP flaps was evaluated by the QUICKDASH scale (3-6 months post-operative). The shoulder movements related to the action of the LD muscle (shoulder extension, adduction, and medial rotation of the arm) were found to show very little disability. The mean score was 7.2 which means minimal disability (QUICKDASH score ranges from 0 that means no disability to 100 that means marked disability).

We found only early limitation in the shoulder's forward elevation and abduction (passive and active) that was improved over time. This early limitation was manifested in the QUICKDASH scale by difficulty performing actions like hammering, washing the back, as these actions require shoulder abduction and/or forward elevation. But neither movement; forward elevation or abduction, has a direct connection to the activity of the LD muscles. These deficiencies could be attributed to the tightness produced by the scar tissue [17].

There are many studies in literature documenting the shoulder disability and complications following the harvest of LD muscle flap. These could be summarized as follow:

- 1- Isokinetic assessments of shoulder function were employed in some studies. Variable shoulder function decline was noted in as many as 73% of the patients [18,19].
- 2- Shoulder strength decreased, according to other authors, and was estimated to be between 13 and 68% [20,21].

- 3- Reduced shoulder mobility, instability and weakness were reported by goniometers and isokinetic tests [22].
- 4- The biomechanical outcomes of reconstruction using an LD musculocutaneous flap have been reported by Martino et al. Approximately two-thirds of the patients had shoulder mobility impairment, according to their assessment. Clinical examination revealed that up to 20% of patients had an element of shoulder joint microdislocation [23].
- 5- The literature from 2005 to 2013 was examined meta-analytically, and the results demonstrated that there are demonstrable losses in shoulder joint stability, range of motion, strength, and overall functionality as a result of LD muscle transfer. But for the great majority of patients, these impairments resolved in 6 to 12 months [24].

Harvesting the TDAP flap preserves the LD muscle intact with its TD nerve supply therefore decreasing the donor site morbidity and preserving the shoulder function [12].

Rindom et al., 2018 found that patients who underwent TAP flap reconstruction have lower probability to experience postoperative pain or limitation in the range of motion and mostly will not need ongoing training and/or physiotherapy compared to LD musculocutaneous flap patients [24].

Hamdi et al., reported the use of 32 TAP flaps with LD muscle strength preserved after surgery. Although shoulder mobility was equivalent in all movements following surgery, there was a substantial decline in both passive abduction and active and passive forward elevation. The harvest of TAP flaps did not impact the thickness of the LD muscle. None of the donor sites had any seroma development [17].

Similar results were reported by Schwabegger et al who found no donor-site issues or seromas, possibly as a result of the routine application of tacking sutures following flap harvesting. Except in two instances, where the TAP flaps were harvested together with the complete LD muscle in a chimeric form, there was no discernible muscular deficiency of the LD muscle or considerable contour deformity at the donor location [25].

Conclusion:

The use TAP flap reduces donor site complications and morbidity and should be used when feasible as an alternative to LD musculocutaneous flap. the major drawback is the unaccepted aesthetic outcome when skin graft is employed to cover the donor site when flap width exceeds 10cm.

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