Egypt, J. Plast. Reconstr. Surg., Vol. 49, No. 1, January: 65-75, 2025

Optimizing Axillary Reconstruction with Pedicled Thoracodorsal Artery Perforator Flaps: A Versatile Solution

TAREK MOHY RAGEH, M.D.*; TAREK FOUAD KISHK, M.D.**;
AYMAN ANWAR ABD EL-WAHAB GHOZLAN, M.B.B.Ch.** and
MOHAMMED ABDALLAH EL-NAHAS, M.D.**

The Department of General & Oncological Surgery and Plastic Surgery Department**, Faculty of Medicine, Menoufia University, Shebin Elkom, Menoufia*

Abstract

Background: The TDAPF offers a pedicled approach for AX reconstruction, characterized by consistent flap thickness, minimal donor site complications, and dependable vascular anatomy with a lengthy pedicle [1].

Objective: This study examines the merits, drawbacks, and possible complications associated with using the thoracodorsal artery perforator flap (TDAPF) for axillary (AX) reconstruction.

Methods: This was a prospective cohort study performed at Menoufia University Hospital's Surgery Department from January 2022 to January 2023, involving 20 patients needing AX reconstruction due to defects. Inclusion criteria included patients aged 18 to 60 years with AX contractures, suitable for anesthesia, and lacking significant underlying health issues.

Results: Evaluation using the Constant-Murley score demonstrated a substantial enhancement in shoulder function after the procedure, approaching normal levels, particularly in terms of pain, daily activities, and range of motion. Preoperatively, abduction strength was largely unaffected, as the condition doesn't directly impact shoulder muscles or the joint itself. The average preoperative Dermatology Life Quality Index (DLQI) score was 12.3 (range: 9–15), decreasing to 2.99 (range: 2–7) one year postoperative.

Conclusion: AX reconstruction presents intricate challenges, necessitating careful selection of specific reconstructive techniques. TDAPFs have emerged as a significant option for AX reconstruction, either as standalone or combined with other methods.

Key Words: *Axilla – Axillary Reconstruction – Axillary Reconstruction – Pedicled flap – Thoracodorsal Artery Perforator Flap.*

Correspondence to: Dr. Ayman Ghozlan,
E-Mail: hanyghozlan31@gmail.com

Ethical Committee: Protocol approval from the Local Research Committee, Studies Committee, and Research Ethics Committee, Menoufia Faculty od Medicine.

Introduction

The axilla is a crucial anatomical region housing the shoulder joint, major blood vessels, and nerves extending from the thorax to the arm. Despite its vital position and contents, defects in this area are rare [1]. However, when defects do occur, careful reconstruction is essential due to the complex three-dimensional nature of the space.

Common causes of axillary (AX) defects include severe burn injuries leading to contractures that impair both aesthetic appearance and functional mobility [2]. These contractures often affect muscles and tendons, potentially resulting in joint contractures and altering optimal hand positioning, thus impacting overall hand function [3].

Hidradenitis suppurativa (HS) is another significant issue affecting the axilla, commonly involving multiple regions with apocrine sweat glands,

List of Abbreviations:

AX : Axillary.
TDAPF : Thoracodorsal Artery Perforator Flap.
LDM : Latissimus Dorsi Muscle.
DLQI : Dermatology Life Quality Index.
AWS : Axillary Web Syndrome.
HS : Hidradenitis Suppurativa.
CRP : C-Reactive Protein.
ESR : Erythrocyte Sedimentation Rate.
CBC : Complete Blood Count.
ANOVA : Analysis of Variance.
SPSS : Statistical Package for the Social Sciences.
IQR : Interquartile Range.
SD : Standard Deviation.
IRB : Institutional Review Board.

particularly affecting women and often occurring bilaterally [4].

Surgical intervention in the axillary region involves various techniques such as direct closure, secondary-intention healing, split-thickness grafting, and local flaps [5]. After contracture release, achieving adequate coverage of the exposed area remains a critical challenge [7]. Additional options for reconstruction include tissue expanders, fasciocutaneous flaps, and free flaps, which offer more extensive and versatile coverage depending on the specific needs of the patient [6].

Axillary web syndrome (AWS), also known as cording, typically develops within one to five weeks following breast cancer surgery, presenting as a visible and palpable cord beneath the skin that becomes tense and painful during shoulder movements [5].

Managing extensive soft tissue defects in the axilla resulting from conditions like post-burn contractures, chronic HS, or ectopic carcinoma poses significant challenges [6].

Surgical intervention in this uniquely shaped three-dimensional space is complex, especially after contracture release, necessitating adequate coverage of the exposed area [7].

The thoracodorsal artery perforator flap (TDAPF), originating from one or more perforators of the thoracodorsal vessel axis or its vertical branch, offers specific advantages, including a long pedicle and consistent flap thickness while maintaining the functionality of the underlying latissimus dorsi muscle (LDM) [8].

Despite these benefits, the popularity of the TDAPF is not as widespread as other perforator flaps, possibly due to the challenging dissection required because of the small diameter of the perforators and their proximity to branches of the thoracodorsal nerve [8].

Accordingly, we aimed to evaluate the benefits, drawbacks, and probable complications related to utilizing the TDAPF for AX reconstruction.

Patients and Methods

This was a prospective cohort study performed at a single center to examine patients undergoing AX reconstruction. The Ethical Committee of the Menoufia Faculty of Medicine Ethical authorized the study [IRB approval no. (insert number)]. From April 2022 to April 2023, 20 patients with AX defects requiring reconstruction were recruited from the Surgery Department of Menoufia University Hospital.

The study commenced after receiving protocol approval from the Local Research Committee, Studies Committee, and Research Ethics Committee. Informed written consent, explaining the study's objectives and procedures in simple terms, was obtained from all participants. Patients possessed their own right to decline participation without impinging on their medical treatment and had the option to discontinue their involvement in the study at any moment without facing any negative consequences. Confidentiality of all patient data and results was strictly upheld.

Inclusion criteria comprised patients aged 18 to 60 years with AX contractures suitable for anesthesia and free from significant underlying health issues. Exclusion criteria included previously operated cases of AX contractures with complications, refusal of consent for photography and publication, and patients deemed unfit for surgery.

Inclusion criteria:

Criteria	Details
Age	- 18 to 60 years
Axillary	- (AX) defects
Other indications	- Severe burn injuries leading to AX contractures, Post-burn contractures, Hidradenitis suppurativa (HS) affecting the AX region

Preoperative assessments included detailed history-taking, focusing on burn history (degree, causative agent, post-burn period), trauma history, malignancy history, history of radiotherapy and/or chemotherapy, history of diabetes mellitus, and other risk factors affecting blood supply. Clinical examination evaluated the surgical operative field preoperatively, including skin and muscle strength. Laboratory tests included CBC, CRP, ESR, creatinine, bilirubin, platelet count, blood culture, and urine culture. Clinical examination evaluated the surgical operative field preoperatively, including skin and muscle strength. This is significant as it helps determine the extent of the defect, the condition of surrounding tissues, and the overall functional status, which are crucial for planning the appropriate surgical approach. Laboratory tests included CBC, CRP, ESR, creatinine, bilirubin, platelet count, blood culture, and urine culture. These tests are significant because they help assess the patient's overall health, detect any underlying infections or inflammatory conditions, and ensure that the patient is in optimal condition for surgery.

Vital signs were monitored, and patients were assessed to tailor the needed flap, perform effective release and dissection of the skin flap with the LDM, prepare the bed for flap harvesting, and transfer the flap for AX reconstruction. Surgical challenges, operative time, complications, and procedural difficulties were documented for each patient.

All patients underwent surgery under general anesthesia, with intravenous administration of broad-spectrum antibiotics during anesthesia induction. Anesthesia was managed to maintain adequate perfusion without administering vasopressors.

The patient is positioned laterally on the operating table, with adhesive tape securing their position by passing over the waist. The ipsilateral shoulder is abducted to 90 degrees, while the elbow is flexed to 60-90 degrees, and the forearm is positioned on the side.

Preoperative perforator mapping with hand held Doppler ultrasound (8MHz) was performed to locate suitable perforators and plan the surgery effectively. The site of the incision and flap outlining were determined based on the location of the identified perforators. The incision was made at the marked site, ensuring an optimal position for the flap harvest.

Steps of the operations are illustrated in Figs. (1-3). The procedure was done under magnification using 4x magnifying loupe.

Harvesting the thoracodorsal artery perforator flap (TDAPF) involves making an incision and using monopolar diathermy to fully cut through the dermis and subcutaneous fat while ensuring haemostasis. Careful dissection through the superficial fascia covering the latissimus dorsi muscle (LDM) is performed to identify any direct or septocutaneous perforator that runs along the anterior border of the LDM and can serve as the flap pedicle. Once a perforator is found, scissors are used for dissection to prevent spasm.

It is important to identify the lateral (free) LDM border, where the posterior cutaneous branches of the lateral intercostal nerves loop around it. This is particularly significant when planning for sensory deprivation in the TDAPF. During the surgery, if an appropriate perforator was found that included an artery and two accompanying veins, and it was proven to be pulsating, regular irrigation with saline is performed to avoid vessel spasms.

Dissection and isolation of the intermuscular portion of the perforator are carried out using bipolar diathermy by carefully separating muscle fibers and fatty planes around the perforator. This step is meticulous and time-consuming, although an alternative technique may be used to expedite it, involving preserving the entire LDM except for a 2cm cuff around the perforator, which does not affect muscle function.

Continued isolation and dissection of the intramuscular portion of the perforator are performed while preserving the motor branches of the thoracodorsal nerve until the appropriate length and caliber are attained. When more length is required, the transverse branch of the thoracodorsal artery is either ligated or clipped, allowing for dissection to continue until reaching the point where the circumflex scapular arteries originate from the subscapular trunk. Capillary refill of the skin paddle is monitored continuously after complete detachment of the flap from the LDM.

The flap is transferred to the defect via a subcutaneous tunnel, ensuring that no twisting or pressure is exerted on the pedicle. The donor area is closed directly, and suction drainage is typically applied for 24-48 hours if the flap width is less than 10cm; otherwise, split-thickness skin grafting is performed.

During flap insetting, the patient is initially positioned supine. This position allows the surgeon to accurately assess the symmetry of both breasts. If additional volume is required to achieve the desired breast size and shape, an implant or tissue expander is placed in the subpectoral plane (beneath the pectoralis major muscle). The flap, which is typically harvested from another part of the body (such as the abdomen), is then inset above the pectoralis muscle. After insetting the flap, the patient is repositioned to a sitting position. This change in position is crucial as it allows for a more realistic assessment of the breasts' appearance and symmetry, mimicking the effect of gravity when the patient is upright. Adjustments can then be made to ensure optimal aesthetic results.

After surgery, each flap is monitored every four hours for the first 48 hours, then every eight hours until discharge. Donor site wound dressing is changed, and wound inspection is performed after 24 hours, except for cases with skin grafts, where dressing checks occur after four days. Patients are typically discharged within 5-7 days post-surgery and followed-up at two-week intervals in the outpatient department for three months.

The evaluation of aesthetic outcome entails the assessment of factors such as color match, texture match, AX contour, and scar complications, with scores of 0–3. Scoring 10–12 is considered excellent, 7–9 good, 4–6 fair, and <4 poor.

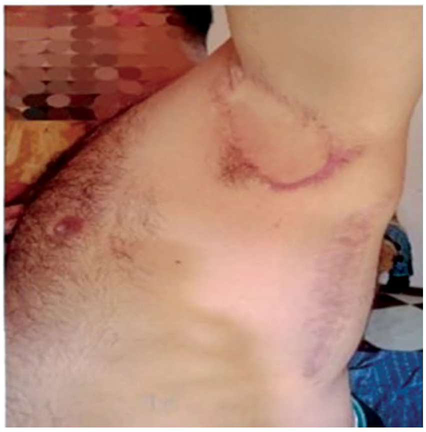
By the end of the follow-up period, the outcomes were evaluated based on complete remission of problem, comparison of preoperative shoulder function (employing the Constant-Murley shoulder outcome score), and quality of life (via the dermatology life quality index [DLQI]) with postoperative results following one year, reconstruction durability, donor site morbidity, and the level of satisfaction reported by the patient.

(A)

(B)

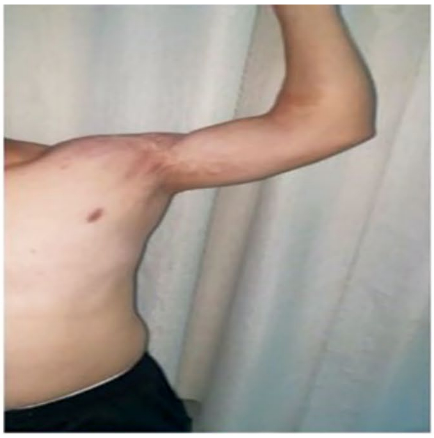
(B)

(C)

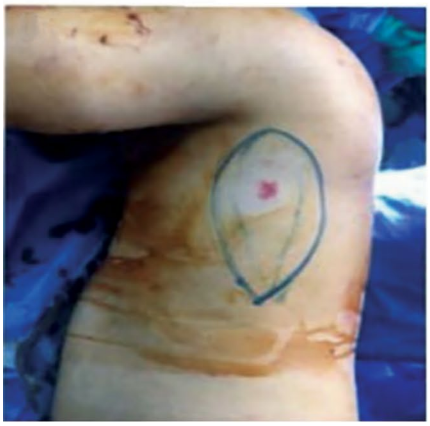


(D)

Fig. (1): Surgical Management of Left Axillary Hidradenitis Suppurativa in a 40-Year-Old Male. (A) Preoperative view showing left axillary hidradenitis suppurativa before surgical intervention. (B1) Surgical markings for the thoracodorsal artery perforator flap guided by handheld Doppler ultrasound, alongside excision of the affected pathology. (B2) Transfer of the perforator flap to the recipient site for axillary defect reconstruction. (C) Immediate postoperative outcome after closure of the donor and recipient sites. (D) Follow-up photograph depicting the surgical outcome one month postoperatively, demonstrating resolution of the hidradenitis suppurativa and satisfactory wound healing.



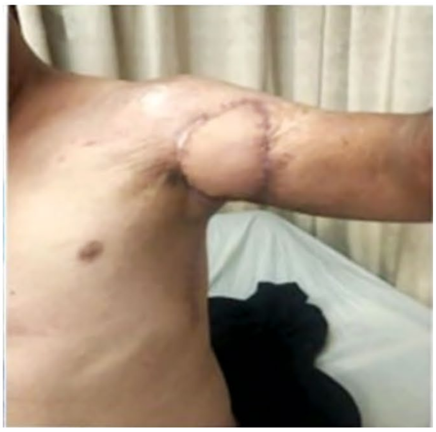
(A)



(B)

(B)

(C)



(D)

Fig. (2): Surgical Management of Left Axillary Contracture in a 25-Year-Old Male Post-Trauma. (A) Preoperative view demonstrating left axillary contracture post-trauma, significantly impacting the patient's daily activities. (B) Surgical markings for the thoracodorsal artery perforator flap guided by handheld Doppler ultrasound. (C) Release of axillary contracture during the surgical procedure. (D) Transfer of the perforator flap to the recipient site and closure of surgical wounds. One-month postoperative outcome showing resolution of axillary contracture and favorable cosmetic results.

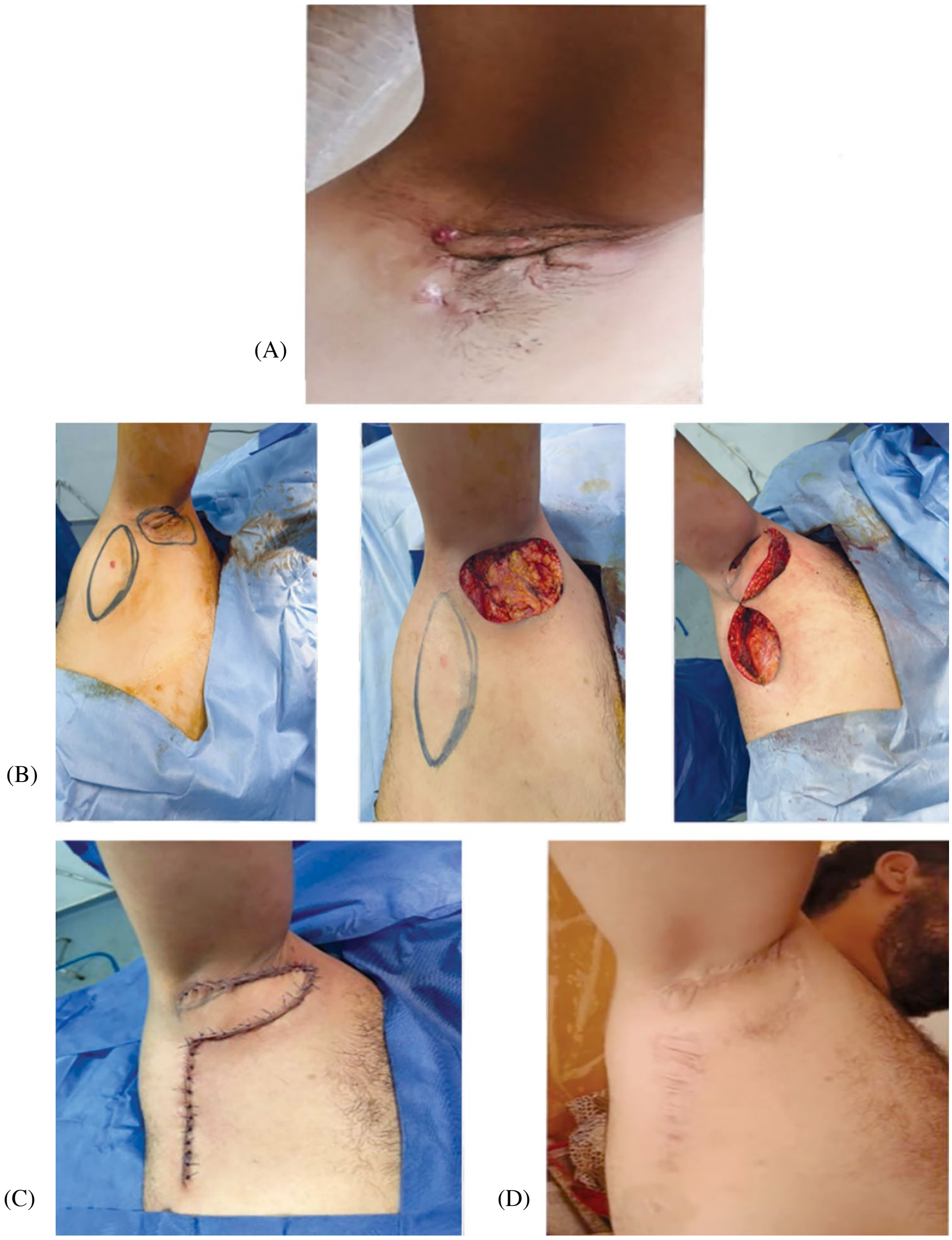


Fig. (3): Surgical Management of Right Axillary Hidradenitis Suppurativa in a 38-Year-Old Man. (A) Preoperative view illustrating right axillary hidradenitis suppurativa before surgical intervention. (B1) Surgical markings for the thoracodorsal artery perforator flap guided by handheld Doppler ultrasound. (B2) Excision of the hidradenitis suppurativa pathology. B3. Transfer of the perforator flap to the recipient site for reconstruction. (C) Closure of the donor and recipient sites following flap transfer. (D) One-month postoperative outcome demonstrating resolution of hidradenitis suppurativa and aesthetic improvement.

Statistical analysis:

The distribution normality for quantitative variables was evaluated through the Kolmogorov-Smirnov test ($p>0.10$). The Chi-square test, Fisher's exact test, or McNemar test were utilized to analyze categorical variables. The comparison of continuous variables between two groups was conducted using either Student's *t*-test or Mann-Whitney U test, depending on the normal data distribution. To compare three or more patient groups, we deployed the one-way analysis of variance (ANOVA), subsequently followed by the Student–Newmann–Keuls technique as a post hoc test when needed. Normally distributed data are typically represented as mean ± SD while reporting the non-normally distributed data as median [25^{th} –75^{th} IQR]. Statistical analyses were conducted through SPSS 19.0 software (IBM SPSS, USA), considering two-tailed $p<0.05$ a statistically significant.

Results

The operative time, closure type, flap dimensions, thoracodorsal pedicle length, number of perforators and their types are shown in Table (1). The majority of the operative time was dedicated to the intramuscular dissection of perforators. We collected flaps of different lengths based on the anticipated deficiencies following the excision of cicatrizing tissue (Table 1).

This prospective cohort study was conducted at a single center to investigate patients undergoing axillary (AX) reconstruction. From April 2022 to April 2023, 20 patients with AX defects requiring reconstruction were recruited from the surgery department of Menoufia University Hospital. Inclusion criteria included patients aged 18 to 60 years with AX contractures suitable for anaesthesia and free from significant underlying health issues.

The average duration of the surgical procedure for the pedicled flaps was 186 minutes, with a range of 170–210 minutes. The majority of the time was dedicated to the intramuscular dissection of perforators. The average duration of the surgical procedure for the pedicled flaps was 186 minutes, with a range of 170–210 minutes. The majority of the time was dedicated to the intramuscular dissection of perforators. The primary site was primarily closed in 18 cases (90%), whereas split skin grafting was performed for closure of the secondary site in 2 patients (10%).

We collected flaps of different lengths based on the anticipated deficiencies following the excision of cicatrizing tissue. The range of flap length varied from 13cm and 22cm. The average length was 17 cm, with a standard variation of 1.92. The collected flaps varied in width, ranging from a minimum of 7cm to a maximum of 10cm. The average width was 7.89cm, with a standard deviation of 1.41. The range of flap pedicle lengths was between 13cm and 21cm, with a mean length of 16cm (Table 1).

These early complications occurred: Dehiscence in 3 cases (15%), hematoma in 1 case (5%), post-operative flab venous congestion in 1 case (5%), and wound infection in 1 case (5%). The following late complications occurred: Widened scar in 3 cases (15%), flap bulkiness in 2 cases (10%), and wound infection in 1 case (5%). In this study, the term "donor site" refers to the area from which tissue, typically skin or muscle, is surgically harvested to reconstruct or repair another part of the body. Conversely, the "recipient site" denotes the location where this tissue flap or graft is transferred and surgically reattached to address a defect or injury. Hematomas, characterized by localized collections of blood outside blood vessels, represent potential complications that may arise at either the donor or recipient site postoperatively but more common in recipient. Effective management of hematomas is critical to mitigate risks such as infection or impaired wound healing, thereby optimizing the outcomes of reconstructive procedures Wound infection complication in surgical contexts, typically occurring days to weeks after the initial procedure. It is characterized by the invasion of pathogenic microorganisms into the surgical wound, leading to localized inflammation and impaired wound healing. Factors contributing to wound infection may include compromised immune function, inadequate surgical wound care, bacterial colonization of the wound site, or contamination during the procedure. Management involves prompt identification through clinical signs such as increased pain, swelling, redness, or purulent discharge from the wound. Treatment often includes antimicrobial therapy tailored to the identified pathogens and may necessitate surgical debridement in severe cases to control infection and promote wound healing (Table 2).

Debulking was conducted in two patients, accounting for 10% of the total, whereas evacuation was conducted in one patient, representing 5% of the total. Moreover, 85% of the flaps resulted in an accepted aesthetic outcome, with 90% of the patients expressing satisfaction with the appearance. The patient satisfaction after completion of the procedures at the end of the follow up period is shown in Table (5). The primary factor contributing to low satisfaction was the discrepancy between the two sides in patients with bilateral disease. Secondary procedures were performed in two patients, involving flap debulking approximately one month after the initial operation. Additionally, evacuation procedures were conducted to address seroma formation, with interventions occurring one month post-operation (Table 3).

Utilizing the Constant-Murley score, significant enhancement in shoulder function was observed following treatment, approaching a state close to normalcy, particularly in terms of discomfort, daily activities, and range of motion. Preoperatively, the strength of abduction remains mostly unaffected as the disease does not impact the muscles of the shoulder or the joint itself. The average preoperative DLQI score for patients was 12.3 (9:15), while the one-year postoperative was 2.99 (2:7) (Table 4).

In our study, AX reconstruction using the TDAPF was performed on 20 patients with a mean age of 38 years (range: 20-55 years). The majority of patients were male (75%). The most prevalent causes of soft tissue defects in our cohort included axillary web syndrome (AWS) (35%) and hidradenitis suppurativa (HS) (35%), followed by post-burn contractures (30%).

Table (1): Operative time distribution and Flap characteristics among the included group of patients.

Variables	Cases (N=20)
Operative time:*	
Median (range) [in years]	186 (170-210)
Closure Type:*	
Primary	18 (90%)
Skin grafted	2 (10%)
Flaps' length (cm)	17 (13-22)
Flaps' width (cm)	7.89±1.41
Thoracodorsal Pedicle Length (cm)	17±2.5
Number of perforators:	
1	14 (70%)
2	4 (20%)
3	2 (10%)
Type#:	
Musculocutaneous	17 (85%)
Septo-cutaneous	3 (15%)

Table (2): Early and late complications among the included group of patients.

Complications	Number of patients	Percentage (%)
Early complication:		
Wound Dehiscence	3	15
Hematoma	1	5
Post-operative flap venous congestion	1	5
Wound infection	1	5
Late complications:		
Widened scar at follow-up	3	3
Flap bulkiness	2	10
Wound infection	1	5

Table (3): Reoperation and Aesthetic assessment among the included group of patients.

Levels	Counts	% of Total
Debulking	2	10%
Evacuation	1	5%
Satisfaction level:		
Unsatisfied	1	5.0%
Low satisfied	4	20.0%
Very satisfied	15	75.0%

Table (4): Satisfaction level.

Levels	Counts	% of Total
Satisfaction level:		
Unsatisfied	1	5.0%
Low satisfied	4	20.0%
Very satisfied	15	75.0%

Table (5): Functional assessment among the included group of patients Using Constant-Murley.

Variables	Preoperative Results	1-year Postoperative	*p*-value
Pain (15 Points)	3.8±2.37	12.1±2.2	<0.001*
Activity of daily living (20 Points)	13.9±2.86	16.8±3.12	<0.001*
Range of motion (40 Point)	28±5.8	39±2.7	<0.001*
Strength of abduction (25 Point)	21±1.9	23±2.5	<0.001*
Total score (100 Points)	69±10.13	90.65±8.1	<0.001*

Table (6): DLQI.

Variable	Preoperative Results	1-year Postoperative	*p*-value
DLQI	12.3±3.74 (9:15)	2.99±1.88 (2:7)	<0.001

Discussion

Patients with AX contractures often present significant movement limitations and associated deformities, posing a unique challenge for reconstructive surgeons compared to other anatomical regions. In our investigation, AX reconstruction using the TDAPF was performed on 20 patients. Patient ages ranged from 20 to 55 years, with males comprising the majority (75%), consistent with findings by Hawas et al. [9] and Marchesi et al., [10] where a higher proportion of male patients were observed, possibly due to increased susceptibility to traumatic events among males [11,12]. The most prevalent causes of soft tissue defects in our study were axillary web syndrome (AWS) (35%) and hidradenitis suppurativa (HS) (35%), followed by post-burn contractures (30%). This contrasts with the study by Ndiaye et al., [11] where all AX reconstruction instances stemmed from post-burn complications, but closely resembles the findings of Hawas et al., [9] which encompassed HS, burn scar contractures, and traumatic AX defects.

The prevalence of soft tissue defects in our study cohort was delineated as follows: Axillary web syndrome (AWS) and hidradenitis suppurativa (HS) each accounted for 35% of cases, with post-burn contractures comprising 30% of the total. Based on our study of 20 patients, this distribution translates to 7 patients affected by AWS, 7 patients by HS, and 6 patients by post-burn contractures. We acknowledge that the predominance of males in our research cohort may influence the categorization of traumatic axillary contractures within the

AWS group or separately, contingent on specific study criteria. Idiopathic or non traumatic axillary web syndrome is very rare about 0.6 of patients mainly in athletics due to lymphatic damage at axillary site and need physiotherapy.

This contrasts with the study by Ndiaye et al., [11] where all AX reconstruction instances stemmed from post-burn complications, but closely resembles the findings of Hawas et al., which encompassed HS, burn scar contractures, and traumatic AX defects [9,11]. The considerable length of the TDAPF pedicle, potentially extending up to 25cm, presents a notable advantage whether utilized as a free or pedicled flap. The eccentric positioning of perforators relative to the skin paddle enables effective pedicle elongation, consistent with our observations [12]. The flap dimensions were modified to match the dimensions of the defect after releasing the AX contracture. Skin paddles measuring up to 23×10 cm were found to be feasible, allowing for the immediate closure of the donor site [11,13]. Our study recorded an average operative time of 186 minutes, akin to Elgohary et al.'s findings of 210±25 minutes, attributed to procedural steps requiring position changes and resterilization. However, Hawas et al., reported an initial mean operative time of 111 minutes, which decreased to 80 minutes with enhanced procedural efficiency [9,13].

Regarding donor site closure in our study, we achieved primary closure in the majority of cases (70%). This finding contrasts with Roswell et al.'s experience with pedicled pectoralis major and other myocutaneous flaps, where extensive donor site defects often required skin grafting. It's important to note that our study did not aim to compare different flaps, including those mentioned by Roswell et al.

Conversely, Hawas et al., achieved primary closure in all donor sites, even with the largest defect measuring 18×13 cm [9]. Herein, we identified complications related to the TDAPF in 6 patients (30%): Two instances of partial distal necrosis did not surpass a length of 2cm. Additionally, there were two cases of venous congestion caused by a hematoma under the flap. These issues were treated conservatively by releasing stitches and cleaning beneath the flap. Balázs et al., in their study on AX reconstruction with the TDAPF, documented a 23.3% complication rate among 15 patients, with venous congestion occurring in 25% and total flap loss in one patient (6.9%).

Nonetheless, a study by Mohos et al. [14] show cased those 6 patients experienced flap complications, including 2 cases of venous congestion, 2 wound infections, and 2 instances of flap bulkiness (9.1%). In our current research, we observed similar complications among our patient cohort." [14]. Donor site complications occurred in 6 cases (30%), primarily consisting of wound dehiscence managed conservatively. Scar widening at the donor site was observed in 3 cases (15%), possibly due to closure without anchoring sutures. These results are consistent with Marchesi et al.'s study reported scar-related issues at the donor site in 20% of cases as hypertrophic scars and in 30% as widened scars due to closure without anchoring sutures. Overall, they reported donor site complications in 50% of the included group [10]. Our study found that preserving the thoracodorsal nerve during surgery helped retain the contours of the back, reduced pain after the operation, and minimized the formation of seromas. This was in comparison to using the typical LD flap technique, and no irregularities in contour or seromas were observed postoperatively. Hamdi et al. [15] found similar results while assessing shoulder function after TDAPF harvesting for breast reconstruction. They found that shoulder mobility on the operated side was comparable to the non-operated side. Still, there was a decrease in both active and passive forward elevations postoperatively, which aligns with our own findings. This decrease may be attributed to postoperative factors such as scar tissue formation, muscle tightness, or pain, rather than preoperative conditions [15]. Assessment of function using the Constant-Murley score demonstrated a significant enhancement in shoulder function post-treatment, approaching near-normal levels, particularly in terms of pain, daily activity, and range of motion, consistent with Elgohary et al., who also utilized this scoring system [13]. Regarding aesthetic outcomes, 75% of our patients reported being very satisfied, 20% moderately satisfied, and one patient (5%) dissatisfied. Conversely, in Elgohary et al.'s study, 90% of patients expressed satisfaction with the aesthetic appearance. Hawas et al., reported 60% of patients being very satisfied, with concerns primarily focused on donor site scars for some individuals. Mahfouz's study indicated overall patient satisfaction, with a few expressing dissatisfactions with back scars and AX flap bulkiness [9,13,16]. Wide local excision is preferred for advanced cases, as limited excision often results in recurrence. Closure with split-skin grafts post-HS excision has shown a lower reoperation rate compared to flap reconstruction or direct closure. The Limberg flap has been utilized for AX defect reconstruction, albeit with reported complications such as superficial epidermal necrosis [17]. In contrast to alternative techniques mentioned, such as direct closure and split-thickness grafting, the TDAPF procedure provides several notable benefits. Its ability to preserve muscle function while effectively covering defects in the axillary region ensures functional and aesthetic outcomes, as observed in our study cohort. Furthermore, the TDAPF's reliance on perforator flaps minimizes donor site complications, aligning with recent advancements in reconstructive surgery aimed at optimizing patient outcomes and quality of life.

Firstly, it is a one-stage procedure. Secondly, the skin utilized for reconstruction closely resembles the axilla texture, color, and thinness, typically being nonhair-bearing skin. Thirdly, the potential TDAPF dimensions allow for extensive AX area resection while maintaining the diamond shape of the axilla and minimizing long-term retractions. Fourthly, it provides excellent pliability to the defect. Lastly, the morbidity at the donor site is negligible, preserved for the formation of scar tissue, and is generally well tolerated **[13]**. Several studies have examined the use of thoracodorsal artery perforator flaps (TDAPFs) in reconstructing soft tissues in extremities. These studies have highlighted several advantages of TDAPFs, including their thickness comparable to that of extremities, which allows for a two-team approach during surgery. They also noted a decreased risk of pedicle involvement by atherosclerotic changes, suitable length (up to 23cm) and diameter (up to 2mm) for use as pedicles, minimal negative effects on the donor site, stable coverage with acceptable aesthetic appearance, and the ability to close the donor site directly for flaps up to 10cm wide. Additionally, TDAPFs can hide donor scars under clothing, potentially have sensation, be used in combination with muscle or bone flaps, offer flexibility in orienting the skin paddle, and remove excess fat to leave 2cm of subcutaneous tissue to cover shallow defects.

However, there are several drawbacks associated with the TDAP flap **[18,19]**. Thorough planning and mapping of the perforators before surgery are essential to prevent inserting the flap in an incorrect location, which would necessitate the skills of an experienced surgeon. Identifying these skin perforators may involve utilizing anatomical landmarks and handheld Doppler. Patient positioning and perforator dissection can extend operative times due to variations in perforator anatomy, necessitating surgeon familiarity with topographic variations. Another constraint is the possibility of scar expansion or hypertrophic scarring at the donor site in patients with particularly large flap dimensions. While our study showed a low occurrence of flap complications, it is important to be cautious when dealing with high-risk patients, such as smokers and those having comorbid diseases, in order to reduce flap failure risk **[20]**. Validation of our findings necessitates multicentric investigations with larger sample sizes, while longer-term follow-up is essential for evaluating the occurrence of long-term complications and recurrence rates.

Conclusion:

The axilla remains a challenging region for reconstructive surgery, requiring careful consideration of specific reconstructive techniques. TDAP flaps have emerged as a notable option for AX reconstruction when utilized alone or in combination with other techniques.

Conflict of interest: The authors reported no conflict of interest.

Funding: No funding.

Acknowledgement: No acknowledgement.

References

1- Schmidt-Hansen M., Bromham N., Hasler E. and Reed M.W.: Axillary surgery in women with sentinel node-positive operable breast cancer: A systematic review with meta-analyses. Springer Plus, 5: p. 1-13, 2016.

2- Khan A.H., Ambedkar V. and Maurya R.K.: Comparing different modalities of managing postburn axillary contracture. Indian Journal of Burns, 28 (1): p. 63-68, 2020.

3- Karki D. and Ahuja R.B.: A review and critical appraisal of central axis flaps in axillary and elbow contractures. Burns & Trauma, 5, 2017.

4- Ching D.L., Mughal M., Papas A. and Soldin M.: Axillary reconstruction for hidradenitis suppurativa with an inner-arm transposition flap creating a brachioplasty effect. Archives of Plastic Surgery, 44 (03): p. 228-233, 2017.

5- Elan, Y., Xiongwei L. and Xiao L.: Diagnosis and treatment of axillary web syndrome: An overview. Chinese Journal of Plastic and Reconstructive Surgery, 2 (2): p. 128-136, 2020.

6- Cha J.A. and Yoon S.H.: Axillary Reconstruction Using a Pedicled Thoracodorsal Artery Perforator Flap Including Latissimus Dorsi Muscle Strip. Journal of Wound Management and Research, 16 (1): p. 43-48, 2020.

7- Kumaran S., Nambi G., Beck B., Paul M.K., Gupta A.K. and Dhanraj P.: A clinical study of post burn contracture of axilla & its management. Official publication of the National Academy of Burns-India, 2008.

8- Awad M.S.: Versatility of the Pedicled Thoracodorsal Artery Perforator Flap (TDAP) Anatomic Basis and Clinical Application in breast reconstruction. Zagazig University Medical Journal, 27 (2): p. 228-237, 2021.

9- Hawas E.M., Elboraey M.A., El Naggar A.N.M., Abdel Baset M.S., Ibrahim M.F. and Abdel Azeem K.M.: Reconstruction of the axilla by perforator-based propeller flap. The Egyptian Journal of Plastic and Reconstructive Surgery, 46 (2): p. 115-120, 2022.

10- Marchesi A., Marcelli S., Zingaretti N., Parodi P.C. and Vaienti L.: Pedicled thoracodorsal artery perforator and muscle-sparing latissimus dorsi flaps in the axillary reconstruction after hidradenitis suppurativa excision: Functional and aesthetic issues. Annals of plastic surgery, 81 (6): p. 694-701, 2018.

11- Ndiaye L., Sankale A., Ndiaye A., Foba M. and Coulibaly N.: Management of axillary burn contracture: A summary of 67 cases a Department of Plastic and Reconstructive Surgery. Aristide Le Dantec Hospital, Senegal Department of Orthopedic and Traumatology, Aristide Le Dantec Hospital, Senegal, 2018.

12- Hantash S., Ayad W., Hendy A.A. and Sadaka M.S.: Clinical applications of the thoracodorsal artery perforator flap in extremity soft tissue reconstruction. The Egyptian Journal of Plastic and Reconstructive Surgery, 44 (2): p. 353-359, 2020.

13- Elgohary H., Nawar A.M., Zidan A., Shoulah A.A., Younes M.T. and Hamed A.M.: Outcome of pedicled thoracodorsal artery perforator flap in the surgical treatment of stage II and III hidradenitis suppurativa of axilla. Annals of Plastic Surgery, 81 (6): p. 688-693, 2018.

14- Mohos B., Sándor G., Bognár G., Csucska M. and Lóderer Z.: Az arteria thoracodorsalis perforátor fasciocutan lebeny a krónikus axillaris hidradenitis suppurativa kezelésében. Magyar Sebészet (Hungarian Journal of Surgery), 70 (4): p. 303-306, 2017.

15- Hamdi M., Decorte T., Demuynck M., Defrene B., Fredrickx A., Van Maele G., et al.: Shoulder function after harvesting a thoracodorsal artery perforator flap. Plastic and Reconstructive Surgery, 122 (4): p. 1111-1117, 2008.

16- Mahfouz A.: Prascapular flap for reconstruction of sever axillary contracture. Plastic Surgery Unit, Surgery Department, Zagazig University Hospital, Zagazig, Egypt, 2013.

17- O'Brien, J., Wysocki J. and Anastasi G.: Limberg flap coverage for axillary defects resulting from excision of hidradenitis suppurativa. Plast. Reconstr. Surg., 58 (3): p. 354-8, 1976.

18- Chen S.L., Chen T. and Wang H.-J.: Free thoracodorsal artery perforator flap in extremity reconstruction: 12 cases. British Journal of Plastic Surgery, 57 (6): p. 525-530, 2004.

19- Kim K.N., Hong J.P., Park C.R. and Yoon C.S.: Modification of the elevation plane and defatting technique to create a thin thoracodorsal artery perforator flap. Journal of Reconstructive Microsurgery, 32 (02): p. 142-146, 2016.

20- Kulahci Y., Sever C., Uygur F., Oksuz S., Sahin C. and Duman H.: Pre-expanded pedicled thoracodorsal artery perforator flap for postburn axillary contracture reconstruction. Microsurgery, 31 (1): p. 26-31, 2011.

21- Sever C., Uygur F., Kulahci Y., Karagoz H. and Sahin C.: Thoracodorsal artery perforator fasciocutaneous flap: A versatile alternative for coverage of various soft tissue defects. Indian Journal of Plastic Surgery, 45 (03): p. 478-484, 2012.