

Outcome of Pedicled Thoracodorsal Artery Perforator Flap in the Surgical Treatment of Stage II and III Hidradenitis Suppurativa of Axilla

Hussein Elgohary, MD, Ahmed M. Nawar, MD, Ahmed Zidan, MD, Ahmed A. Shoulah, MD, Mohamed T. Younes, MD, and Ahmed M. Hamed, MD

Background: Hidradenitis suppurativa (HS) is a chronic, inflammatory disease affecting the apocrine glands of the axillary, groin, and mammary regions with significant physical and psychosocial sequelae. Surgical excision of the affected tissue is the criterion standard treatment. Advanced cases of axillary HS are associated with high rates of recurrence and require extensive surgical resection with challenging reconstruction associated with risk of postoperative complications. The most effective method for reconstruction of the axilla after excision of HS is yet to be identified.

Objectives: The aim of the study was to evaluate the results of the use of pedicled thoracodorsal artery perforator (TDAP) flap as a method of reconstruction for axillary effect result from wide surgical excision as a line of treatment for stage II and III HS of the axilla.

Patient and Methods: The study included 20 patients with stage II and III (Hurley staging system) HS of the axilla, 18 male and 2 women treated by wide local excision and reconstruction by rotational TDAP flap. At the end of follow-up, outcome is judged by complete remission of disease, comparing preoperative shoulder function (using Constant-Murley shoulder outcome score), and quality of life (using dermatology life quality index) with postoperative results after 1 year, plus durability of reconstruction, donor site morbidity, overall aesthetic outcome, and patient's satisfaction.

Results: The mean \pm SD follow-up period was 30 ± 5.2 months (range = 12–60 months). Four patients (20%) were treated for their right side, 8 patients (40%) for their left side, and 8 patients (40%) were treated bilaterally, so we perform 28 operations for 20 patients. The treated patients with stage II disease were 16 (57.14%) and with stage III disease were 12 (42.85%). The size of the defects was usually approximately 10×15 cm. By the end of follow-up period, all patient showed complete remission of the disease with improvement in both shoulder function and quality of life, whereas 1 flap (3.57%) was complicated by bleeding treated by reoperation, 2 flaps (7.14%) complicated by wound infection that was treated conservatively, 3 other flaps (10.71%) showed wide scare at insight of the flaps, and 1 flap (3.57%) developed hypertrophic scare at donor site of the flap. **Conclusions:** Surgical treatment of stage II and III HS of axilla and reconstruction by rotational TDAP flap provides good aesthetic and functional results with 100% success rate in eradicating and complete remission of the disease during follow-up period and accepted complication rate.

Key Words: hidradenitis suppurativa, axilla, surgical excision, thoracodorsal artery perforator flap, outcome

(*Ann Plast Surg* 2018;81: 688–693)

Received May 9, 2018, and accepted for publication, after revision August 20, 2018. From the Faculty of Medicine, Benha University, Benha, Egypt.

All authors contributed to the submission. H.E., A.M.N., A.Z., A.A.S., M.T.Y., and A.M.H. contributed to the operations and follow-up of cases in addition to writing the article.

Conflicts of interest and sources of funding: none declared.

Reprints: Hussein Elgohary, MD, Faculty of Medicine, Benha University, Fareed Nada St, Benha, Egypt. E-mail: dr_elgohary1996@yahoo.com.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.annalsplasticsurgery.com).

Copyright © 2018 Wolters Kluwer Health, Inc. All rights reserved. ISSN: 0148-7043/18/8106-0688

DOI: 10.1097/SAP.0000000000001658

Hidradenitis suppurativa (HS) is a skin disease characterized by chronic exacerbation and remission of clusters of abscesses that affect the apocrine or sweat glands leading to the formation of subcutaneous such as infections, sinuses, fistulae, and significant scarring of the affected area. The most commonly affected areas are axilla, groin, under the surface of the breast, inner thigh, and perianal region.¹

Onset is most commonly between the ages of 20 and 40 years, and it does not occur before puberty. Women are 3 times more likely than men, but severe lesions are seen more in men.²

The exact cause is unknown, the onset is insidious, and some scientists believe that it is caused by the formation of keratin plugs in the follicles or by blockage of the apocrine gland. In both cases, the plugged gland or follicle becomes larger, ruptures, and infected. The HS flare is painful and sometimes progress to form open wounds leading to marked scarring, persistent lesions may lead to sinus tract and connecting abscesses, and at this stage, complete healing is not possible. The disease is not contagious.³

It is predisposed by genetic factors, as an autosomal dominant inheritance is proposed, and hormonal factors such as sex hormones, especially excess androgens. Though exacerbating, factors may be obesity because it causes mechanical irritation, occlusion, and maceration. Other factors are hot humid climates, oral contraceptive pills, nonbreathable tight clothes, and emotional and erotic stress. Diagnosis is clinical and does not need tissue biopsy. Triad of typical lesions, characteristic distribution, and recurrence are enough for diagnosis.⁴

Stages:

Hurley staging system is the first staging system and still in use depending on the subjective extent of the diseased tissue:

Stage I: solitary or multiple isolated abscess formation without scarring or sinus tract.

Stage II: recurrent abscesses single or multiple widely separated lesions with sinus tract formation.

Stage III: diffuse or broad involvement across a regional area with multiple interconnected sinus tracts and abscesses.⁵

The Hurley staging classification is a useful tool to guide management. For small, localized cases, antibiotics may have a role in disease control. However, all conservative therapies do not prevent recurrence. The only definitive form of treatment is surgical excision, especially in stage II and stage III, not only to remove the affected area that leads to disease recurrence but also to use the treatment of choice, which is called wide local excision, where the lesions and surrounding normal tissue are surgically excised leaving wide defect that must be reconstructed. Multiple methods of resection and wound closure have been described, but there is no consensus as to which one has the best outcome.^{6,7}

The current study aimed to evaluate the results of the use of pedicled thoracodorsal artery perforator (TDAP) flap as a method of reconstruction for axillary defect resulting from wide surgical excision as a line of treatment for stage II and III HS of the axilla.

PATIENT AND METHODS

The current prospective clinical cohort study was conducted at the General Surgery Department, Benha University Hospital, after

obtaining approval from the local ethical committee and after fully informed written consent was signed by the patient. This study was carried out on 20 consecutive adult patients with stage II and stage III HS of the axilla from January 2013 to January 2018. Of the 20 patients, 8 were treated bilaterally and 12 were treated unilaterally, so 28 operations had been carried out.

All patients underwent clinical examination including a collection of demographic data and medical history and obstetric history for women.

Inclusion criteria are stage II and stage III HS of axilla (according to Hurley staging system).

Exclusion criteria are stage I of the disease, patients who receive other lines of treatment except for antibiotics, previous surgery to the back-affecting donor area, previous radiotherapy to the axilla, and generally unfit patient for major surgery.

The operation was performed during the period of a remission of disease. If there were discharging sinuses, antibiotics were taken for 1-week preoperative until there was no discharge.

SURGICAL PROCEDURE

The patient was in supine position, and the arm was abducted to 120-degree angle. After sterilization, excision of all hairy area of skin of axilla was performed, and this included the diseased part and all hairy

area around, plus the underlying sinuses and fistulae, leading to complete clearance of axilla of all diseased tissue. The resulting defect was measured in centimeter in both long axis and transverse axis (Fig. 1).

The patient was in the lateral position. A point was marked at 8 cm below the posterior axillary fold and 2 cm posterior to the lateral border of latissimus dorsi ms, which was marked preoperative, and this point represents the hilus for thoracodorsal neurovascular bundle into the muscle. The design of flap was centered around this point with the longitudinal axis of the defect, which was from cephalic to caudal direction, and transverse axis of the defect, which was from medial to lateral. Anterior border of the flap was incised first down to serratus fascia, and then, medial dissection of the flap was performed toward the lateral border of latissimus dorsi ms. The thoracodorsal bundle was under the lateral border of latissimus dorsi ms, as the start of bundle dissection to detect the cutaneous perforator; once reached, the cuff of 3 cm of ms was taken around to avoid perforator injury. The posterior border of the flap was incised, and the flap was separated completely and now only attached to the vascular pedicle. The thoracodorsal vessel was ligated distal to the perforator, and then, the following branches were ligated from distal to proximal, lateral branch of thoracodorsal, then the medial branch of thoracodorsal, and then the circumflex scapular artery. At all dissection, thoracodorsal nerve was intact. The flap was passed under the skin bridge between the donor site and axillary



FIGURE 1. A, Stage II disease and preoperative marking. B, Wide local excision. C, First postoperative day. D, Four-year postoperative.



FIGURE 2. A, Stage III disease during an attack of inflammation. B, Preoperative marking. C, Immediate postoperative results. D, Three-year postoperative.

defect, with caution not to twist its blood supply during rotation. The patient returned supine and the flap was sutured to the edge of the defect in 2 layers. The donor site was closed in 2 layers over suction drain (Fig. 2).

All patients were discharged after 5 days. Patients were instructed to limit their arm mobility for 15 days until complete wound healing occurred. Recovery time was usually approximately 3 weeks. In cases treated bilaterally, there was a 3-month interval at least before the second operation.

Study Outcome

Surgical Outcome

The intraoperative (IO) collected data included operative time, IO blood loss, and frequency of IO complications, and the postoperative (PO) data included PO hospital stay and frequency of PO complication.

Functional Outcome

At the end of follow-up, outcome was assessed by complete remission of disease, comparing preoperative shoulder function (using Constant-Murley shoulder outcome score), and quality of life (using dermatology life quality index [DLQI]) with postoperative results after 1 year, plus durability of reconstruction, donor site morbidity, and patients' satisfaction.

The DLQI is a questionnaire that measures how much the patient skin problem affects his life. It has 10 questions with the following scores (0:3) for each question: 0 to 1, no effect at all on patients life; 2 to 5, small effect on patient life; 6 to 10, moderate effect on patient life; 11 to 20, very large effect on patient life; and 21 to 30, extremely large effect on patient life, so the higher the score the more the quality of life is impaired.

The Constant-Murley score is a 100-point scale, used to determine the functionality of the shoulder after treatment. The test is divided into the following 4 subscales: pain (15 points), activities of daily living

TABLE 1. Detailed Characteristics of the Studied Group

	n	%
Concomitant disease		
None	17	85
Hypertension	1	5
Diabetes mellitus	1	5
Viral hepatitis C	1	5
Stage of disease		
Stage II	16	57.14
Stage III	12	42.85

TABLE 2. Operative and Postoperative Data

Op time, min	210 ± 25
Op blood loss, mL	250 ± 40
Need for blood transfusion	—
Intensive care unit admission	—
Hospital stay, d	6 ± 3
Intraoperative complication	Injury of medial cutaneous nerve of arm (1 case)

(20 points), strength (25 points), and range of motion (forward elevation, external and internal rotation, and abduction of shoulder) (40 points). The higher the score the higher the quality of function.

Aesthetic Outcome

Evaluation of aesthetic outcome depends on assessment of certain parameters such as color match, texture match, contour of axilla, and scar complications. Each item takes score 0 to 3.

Score 10 to 12 is considered excellent, 7 to 9 good, 4 to 6 considered fair, and less than 4 poor (Supplemental Digital Content 1 and 2, <http://links.lww.com/SAP/A312>, <http://links.lww.com/SAP/A313>).

Statistical Analysis

Obtained data were presented as mean ± SD, median, interquartile range, numbers, and percentages. Results were analyzed using Man-Whitney and Wilcoxon tests. Statistical analysis was conducted using the SPSS (Version 20, 2006) for Windows statistical package. The *P* value of less than 0.05 was considered statistically significant.

RESULTS

The mean ± SD follow-up period was 30 ± 5.2 months (range = 12–60 months). The study included 20 patients: 18 men and 2 women with a mean ± SD age of 29.3 ± 8.4 years (range = 21–38 years). The mean ± SD body mass index was 29.5 ± 2.6 kg/m². The patients with stage II disease were 16, and the patients with stage III disease were 12 (some patients had stage II at one side and stage III at the contralateral side). The size of the defect ranged from 8 × 12 to 12 × 17 cm, and the mean ± SD depth of the lesion after excision was 10 ± 3 mm (Table 1).

After 28 operations for 20 patients undergo wide local excision with TDAP flap coverage of the defect the mean ± SD operative time was 210 ± 25 minutes, this is due to rechanging position and

TABLE 3. Shows Postoperative Complication

Complication	
Shoulder and arm pain (transient)	20 (100)
Diminished sensation in flap	20 (100)
Parasthesia in medial aspect of upper arm	1 (3.57)
Wound infection	2 (7.14)
Seroma	1 (3.57)
Bleeding	1 (3.57)
Lymphedema of the flap	2 (7.14)
Redundant flap skin	1 (3.57)
Wide scare at insight of the flap	3 (10.71)
Donor site morbidity	
Hypertrophic scare	1 (3.57)
Seroma	2 (7.14)

TABLE 4. Dermatology Life Quality Index Score

	Mean ± SD Preoperative Results	Mean ± SD 1-y Postoperative Results	Paired <i>t</i> Test	<i>P</i>
Stage II	11.6 ± 2.82 (8:14)	3.25 ± 1.77 (1:6)	11.33	<0.001*
Stage III	21.5 ± 3.32 (18:25)	2.9 ± 1.65 (1:5)	24.97	<0.001*

*Significant at <0.05.

resterilization between different steps of the operation and mean ± SD blood loss 250 ± 40 mL with no need for blood transfusion or intensive care unit admission and mean ± SD hospital stay approximately 6 ± 3 day. There is only 1 case (3.57%) that has an injury to the medial cutaneous nerve of the arm that occurs during excision of complex sinus in the case with stage III disease (Table 2).

After the operation, all patients (100%) show complete success with no cases of total or partial flap loss and complete success in eradicating the disease with no disease recurrence in the treated side during the period of follow-up; in addition, all cases (100%) show shoulder and upper arm pain, which is transient, can be controlled by non-steroidal anti-inflammatory drugs, relived usually after 15 ± 5 days, and diminished flap sensation, which is partially recovered by the 6-month postoperative. Parasthesia occurs in the medial aspect of the upper arm in 1 case (3.57%) also partially improved by use of neurotonics. Minor wound infection occurs in 2 cases (7.14%) and treated conservatively. Seroma occurs in 1 case (3.57%) because of early drain removal, treated by repeated aspiration. Reactionary hemorrhage occurs in 1 case (3.57%) treated by reoperation, and opening donor site, it is found because of slipped ligature from the circumflex scapular branch and proper hemostasis was performed. Lymphedema of flaps occurs in 2 cases (7.14%) improved partially by antiedematous drugs. Redundant flap skin occurs in 1 case that needs refashioning, but the patient refuses further intervention. Wide scare at flap margin occurs in 3 cases (10.71%) because of relatively smaller flap size than the defect, and the problem appears usually by fourth-month postoperative and usually needs no treatment. Donor site problems were that hypertrophic scare occurs in 1 case (3.57%) treated by silicone containing gel and seroma occurs in 2 cases (7.14%) treated by repeated aspiration (Table 3).

One year after the operation, we evaluate both patient's quality of life and shoulder function using DLQI and Constant-Murley shoulder outcome score and comparing the results with the patient results recorded preoperative during an attack of inflammation.

The mean preoperative DLQI score for patients with stage II disease is 11.6 (8:14), whereas 1-year postoperative is 3.25 (1:6). The mean preoperative score for patients with stage III disease is 21.5 (18:25), whereas 1-year postoperative is 2.91 (1:5). All patients show improved quality of life after the operation especially patient with stage III disease (Table 4).

Using the Constant-Murley score, there is marked improvement in the quality of shoulder function after treatment reaching near normal especially regarding pain, daily activity, and range of movement. The strength of abduction is not markedly affected preoperatively because the disease does not affect muscles of shoulder or joint itself (Table 5).

The aesthetic outcome is accepted in 85% of flaps with 18 patients (90%) who were satisfied with the aesthetic appearance (Table 6). The main cause of poor satisfaction was the disparity between 2 sides in the patients with bilateral disease.

DISCUSSION

The pathophysiology of the disease involves the obstruction of the apocrine glands, resulting in glandular dilatation, bacterial infection

TABLE 5. Constant-Murley Shoulder Outcome Score

	Preoperative Results	1-y Postoperative* Results	Paired <i>t</i> Test	<i>P</i>
Pain (15 point)				
Stage II	4.5 ± 2.12	13.1 ± 1.11	33.66	<0.001*
Stage III	3.7 ± 2.96	2.3 ± 3.1	76.52	<0.001*
Activity of daily living (20 point)				
Stage II	14.0 ± 2.15	17.7 ± 2.15	6.75	<0.001*
Stage III	8.1 ± 2.17	16.1 ± 2.13	14.12	<0.001*
Range of motion (40 point)				
Stage II	28.0 ± 4.18	38.0 ± 2.15	19.49	<0.001*
Stage III	22.0 ± 6.21	36.0 ± 4.15	26.26	<0.001*
Strength of abduction (25 point)				
Stage II	20.95 ± 2.19	23.1 ± 2.13	3.27	0.004*
Stage III	19.4 ± 4.13	20.0 ± 3.15	0.51	0.62
Total score (100 point)				
Stage II	68.1 ± 10.15	92.0 ± 7.71	15.96	<0.001*
Stage III	1.8 ± 15.42	84.0 ± 12.41	39.6	<0.001*

*Significant at <0.05.

with abscess formation and consequent rupture, tissue injury, fistula formation, fibrosis, and retractable scars.⁸

Treatment of HS remains a challenge to surgeons and frustration to the patient. Conservative and surgical treatments can be used to resolve HS. However, conservative treatment in cases of relapse has proven to be mostly ineffective, increasing relapse rates. Similarly, frequent local drainage can generate unaesthetic and cicatricial retraction with movement limitations.⁹

Surgical techniques used to reconstruct axillary defects include direct closure, healing by secondary intention, split thickness grafting, and local flaps. Wide local excision is the criterion standard treatment for advanced cases of the disease, because limited excision is usually followed by recurrence.¹⁰

The problem with wide local excision is how to close the defect? The Pollok method of closure has been advocated by Tasche et al¹¹ and involves wide excision of the HS followed by an edge-to-edge closure with minimal undermining; no skin grafting is involved, thus reducing hospital stay.

Leaving wound open to granulate, followed by split thickness graft, also leads to scarring, liability to ulcerate, and the extreme color mismatch between reconstructed area and surrounding normal tissue. Watson¹² preferred to excise HS and close the defect with a split-skin graft. In a series of 72 patients, he found a reoperation rate of 13% after split-skin grafting, compared with 19% when a flap was used, and 54% when the defect was closed directly. The total number of patients undergoing flap reconstruction was much smaller than those having skin grafting.¹²

In our study, primary closure with TDAP flap was not followed by reoperation because there was no total or partial flap loss or even wound dehiscence.

Local flaps can be random or fasciocutaneous. Lipshutz¹³ described closure using subcutaneous bilateral double V-Y advancement flaps after total excision of the hair-bearing axillary skin. This required the patients to have their arms fixed by their side for 2 weeks.¹³

In our study, there was no need for arm fixation as the patients were advised to limit their arm mobility until ensuring complete wound healing.

The Limberg flap has been used by O'Brien et al¹⁴ to reconstruct axillary defects resulting from the excision of HS. Nine patients were described, with flaps raised at the axillary fascia. Complications included superficial epidermal necrosis at the tips of the flaps. This technique leaves scars in the posterior axillary fold or in the inframammary crease. A similar technique was described by Harrison¹⁵ as a transposition flap. These local advancement flaps cannot cover the large defects created by wide local excision of HS.^{14,15}

Other methods of reconstructing the axilla include the use of a pedicled pectoralis major flap and other myocutaneous flaps. However, these can leave large donor site defects that require skin grafting or can be problematic with the inconstant anatomy of the cutaneous perforator.¹⁶⁻¹⁸

In our study, there were no recorded cases of epidermal necrosis as the thoracodorsal bundle is robust; all donor sites are closed primarily with no need for skin graft, but there is scar in the posterior axillary fold (donor area), which is annoying for some patients and insignificant for the others. With TDAP flap not like the local advancement flaps, it can cover large defects (up to 12 × 17 cm in our study).

Yii et al¹⁹ have described 2 techniques, the lateral perforator-based V-Y advancement flap and the double opposing V-Y advancement flap based on the posterior arm and the lateral chest wall perforators. However, the narrow vascular pedicle and the inconsistent course of these perforators make them unreliable. Schwabegger et al⁹ have been used the similar V-Y advancement flap but based on random perforators.

The TDAP flap procedure has a number of advantages over other surgical procedures. First, it is a 1-stage procedure. Second, the texture, color, and thinness of the skin used for reconstruction are very similar to those of the axilla because it is nonhair-bearing skin in most cases. Third, the possible dimensions of the TDAP flap allow extensive resection of the axillary area without long-term retractions and with the maintenance of the axilla's diamond shape. Fourth, it presents advantages in terms of pliability to the defect. Finally, the donor site morbidity is minimal, apart from the resultant scar, and well tolerated in most cases.²⁰

Despite many advantages mentioned previously, there are also some disadvantages of TDAP flap. The meticulous planning and preoperative perforator mapping are required not to place the flap outside the area of the perforators, and this takes surgical experience. The identification of these skin perforators may be performed using some anatomic landmarks and handheld Doppler. Patient positioning and dissection of the perforator may increase operative time because of variations of the perforator anatomy. For this reason, the surgeon should be fully aware of perforator topographic variations. The other disadvantage of the TDAP flap is scar widening or hypertrophic scar of the donor site in some of patients with relatively large flap dimensions. Although our study demonstrated a low incidence of flap complications, care must be taken in high-risk patients such as smokers and patients with associated comorbid diseases to decrease the risk of flap failure.²¹

CONCLUSIONS

The previous study shows the difficulties in reconstructing the axilla. The axilla is a complex region in terms of skin type, shape, and contour. The TDAP flap can be used successfully as another method of reconstruction in this difficult area. The TDAP flap is

TABLE 6. Patients Satisfaction and Aesthetic Outcome

Patients Satisfaction	Very		Poorly	
	Satisfied	Satisfied	Satisfied	Unsatisfied
No. patients (20)	12 (60%)	6 (30%)	2 (10%)	—
Aesthetic outcome	Excellent	Good	Fair	Poor
No. flaps (28)	18 (64.28%)	6 (21.42%)	2 (7.14%)	2 (7.14%)

reliable, and its thoracodorsal arterial system is robust and predictable. Subfascial dissection preserves the fascial plexus, thus allowing a length to width ratio of 3:1 allowing closing large defects. There is no need to immobilize the shoulder; the scar is hidden in the posterior axillary fold. Furthermore, it provides excellent contour, color, and texture match, preserving the axillary fold, free range of mobility of upper limb, long-term durability with no tendency for early necrosis or late ulceration, and with an acceptable aesthetic outcome. We recommend it to be used in the clinical practice.

REFERENCES

- Jemec GB. Clinical practice: hidradenitis suppurativa. *N Engl J Med*. 2012;366:158–164.
- Alikhan A, Lynch PJ, Eisen DB. Hidradenitis suppurativa: a comprehensive review. *J Am Acad Dermatol*. 2009;60:539–561.
- Dessinioti C, Katsambas A, Antoniou C. Hidradenitis suppurativa (acne inversa) as a systemic disease. *Clin Dermatol*. 2014;32:397–408.
- Medline Plus (2012). Hidradenitis suppurativa. U.S. National Library of Medicine. 2012.
- Hurley HJ. Axillary hyperhidrosis, apocrine bromhidrosis, hidradenitis suppurativa, and familial benign pemphigus: a surgical approach. In: Roenigk RK, Roenigk HH, eds. *Dermatologic Surgery*. New York: Marcel Dekker; 1989:729–739.
- Scheinfeld N. Hidradenitis suppurativa: a practical review of possible medical treatments based on over 350 hidradenitis patients. *Dermatol Online J*. 2013;19:1.
- Scott L, Stephen J, David M. The skin and subcutaneous tissue. In: *Schwartz's Principles of Surgery*; 8th ed. New York: McGraw-Hill Professional; 2005;15:439–485.
- Tanaka A, Hatoko M, Tada H, et al. Experience with surgical treatment of hidradenitis suppurativa. *Ann Plast Surg*. 2001;47:636–642.
- Schwabegger AH, Herczeg E, Piza H. The lateral thoracic fasciocutaneous island flap for treatment of recurrent hidradenitis axillaris suppurativa and other axillary skin defects. *Br J Plast Surg*. 2000;53:676–678.
- Farrell AM, Randall VA, Vafae T, et al. Finasteride as a therapy for hidradenitis suppurativa. *Br J Dermatol*. 1999;141:1138–1139.
- Tasche C, Angelats J, Jayaram B. Surgical treatment of hidradenitis suppurativa of the axilla. *Plast Reconstr Surg*. 1975;55:559–562.
- Watson JD. Hidradenitis suppurativa - a clinical review. *Br J Plast Surg*. 1985;38:567–569.
- Lipshutz H. Closure of axillary hidradenitis defects with local triangular flaps. *Plast Reconstr Surg*. 1974;53:677–679.
- O'Brien J, Wysocki J, Anastasi G. Limberg flap coverage for axillary defects resulting from excision of hidradenitis suppurativa. *Plast Reconstr Surg*. 1976;58:354–358.
- Harrison SH. Axillary hidradenitis. *Br J Plast Surg*. 1964;17:95–98.
- Freedlander E, Lee K, Vandervord JG. Reconstruction of the axilla with a pectoralis major myocutaneous island flap. *Br J Plast Surg*. 1982;35:144–146.
- Baudet J, Guimberteau JC, Nascimento E. Successful clinical transfer of two free thoraco-dorsal axillary flaps. *Plast Reconstr Surg*. 1976;58:680–688.
- Rowell AR, Davies DM, Eisenberg N, et al. The anatomy of the subscapular-thoracodorsal arterial system: study of 100 cadaver dissections. *Br J Plast Surg*. 1984;37:574–576.
- Yii NW, Niranjan NS. Metastatic basal cell carcinoma of the axilla: report of a case and reconstruction with an island lateral pectoral flap. *Ann Plast Surg*. 2000;45:78–82.
- Amarante J, Reis J, Santa Comba A, et al. A new approach in axillary hidradenitis treatment: the scapular island flap. *Aesthetic Plast Surg*. 1996;20:443–446.
- Kulahci Y, Sever C, Uygur F, et al. Pre-expanded pedicled thoracodorsal artery perforator flap for postburn axillary contracture reconstruction. *Microsurgery*. 2011;31:26–31.