Ablation of Apocrine Glands With the Use of a Suction-Assisted Cartilage Shaver for Treatment of Axillary Osmidrosis

An Analysis of 156 Cases

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Abstract: Axillary osmidrosis is a disturbing social problem. Topical antiperspirants are only temporary solutions. Permanent solutions always involve invasive operation. In this study, we evaluated the effectiveness and complications of a minor surgical procedure. From December 2000 to December 2006, 156 patients (130 females and 26 males) whose ages ranged from 10 to 62, with an average age of 23, were treated for axillary osmidrosis with suction-assisted cartilage shaver under local anesthesia on an outpatient basis. Patients were followed for 6 to 59 months with an average of 16 months. The total satisfaction rate was 97.4% (152/156). The patient complication rate was 7.7% (12/156) and the wound complication rate was 5.1% (16/312). There were no recurrent malodor, contracture scars, arm abduction limitation, or any nerve injury in our series. The minor procedure can be an efficient and predictable treatment choice for axillary osmidrosis.

Key Words: osmidrosis, apocrine glands, suction-assisted cartilage shaver

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Axillary osmidrosis or bromhidrosis is a common distressing social problem for many people living in the hot tropical climate. In Asian culture, people with body malodor are always considered as outcasts. Topical treatments of astringents, antiperspirants, or aluminum salt preparations are temporary.[1] Botulinum toxin local injections can control the axillary sweating and malodor temporarily by blocking cholinergic innervation of the sweating glands.[2] Permanent solutions always involve operations, which include en bloc excision of skin and subcutaneous tissue,[3,4] surgical excision of subcutaneous tissue,[5,6] sympathectomy,[7] electrodessication,[8] and ultrasonic liposuction.[9,10] Large wounds, conspicuous scars, long recovery time, and incomplete elimination are the problems of the above techniques. Therefore, they discourage the patients.

In this study, we evaluated the effectiveness and complications of a minor procedure, ablation of apocrine glands with the use of a suction-assisted cartilage shaver for treatment of axillary osmidrosis.

MATERIALS AND METHODS

From December 2000 to December 2006, 156 osmidrosis patients were treated with suction-assisted cartilage shaver under local anesthesia on an outpatient basis at the department of plastic and reconstructive surgery, Kuang Tien General Hospital, Taichung, Taiwan. The female to male ratio was 5 to 1 (130:26). The ages ranged from 10 to 62 with an average of 23. They all had the embarrassing malodor that discouraged their social activities. All patients were followed-up for 6–59 months with a mean of 16 months.

Surgical Procedures

Bilateral axillae are exposed in a supine position and arms are abducted at a 180-degree angle. Axilla hair is shaved and the hair-bearing rhomboid area is marked. Local anesthesia is prepared by 2% xylocine (5mg/kg), 0.3 mg epinephrine, and 400 mL normal saline. Serving as tumescent solution, 200 mL of local anesthesia is injected to the subcutaneous layer of each side to minimize bleeding, make dissection easier, reduce postoperation pain, and reduce ecchymosis. The tumescent solution can be injected slowly to infiltrate the subcutaneous tissue and nerve endings by pressure. It is not necessary to add another local anesthetic for the skin incision area. For example, 300 mg xylocaine with 400 mL normal saline has the same dosage as 300 mg xylocaine with 15 mL solution (2% xylocaine). The difference is the onset after the injection. At least 10 minutes are always necessary for the onset of tumescent solution.

A 0.5- to 1-cm incision is made on the central axillary crease. Dissecting scissors (Metzenbaum) passing through the incision is inserted horizontally to fully separate the subcutaneous layer of the marked area (Fig. 1). Then, the subcutaneous flap of about 0.5-cm thickness is elevated. The suction-assisted cartilage shaver (E9005 System, Livatec Corporation, Largo, FL) is used for ablation of the subcutaneous tissue containing the apocrine glands (Figs. 2 and 3). The cartilage shaver blade is made up of 2 concentric metal cannulas. The diameter of the outer cannula is 4 mm and that of the inner cannula is 3 mm. The outer cannula tip has an upward opening hub with a grid to allow the rotating inner cannula to serve as a continuous curette for the ablation procedure. The inner cannula with toothless tip was used in our series for prevention of skin rupture. The inner cannula is also set at 2500 rotations per minute (Figs. 2 and 3). A suctioning tube with a distal pump is connected to the handle of the shaver for quick removal. The shaving tip was kept upward for prevention of deep muscle or nerve injury. The shaver is drawn from the axillary edge to the central crease for the ablation of the apocrine glands (Fig. 4). The entire axilla is then treated from all angles. The end point of the shaving procedure can be made by the following:

1. Flap palpation. When the subcutaneous flap was shaved to be a cutaneous flap, it meant the end point. Preserving adequate dermis thickness is necessary for prevention of skin necrosis,
2. Direct visualization. By 2 retractors, the small incision wound can be used as a window to check any residual apocrine glands located at the undersurface of the flap or on the floor of the pocket (Fig. 5), and
3. Endoscope confirmation. It is useful for a beginner in a learning curve. Flap palpation can be trained by endoscope confirmation.

A penrose drain is inserted and removed on the first postoperative day in the outpatient clinic (Fig. 6). The wound is closed with

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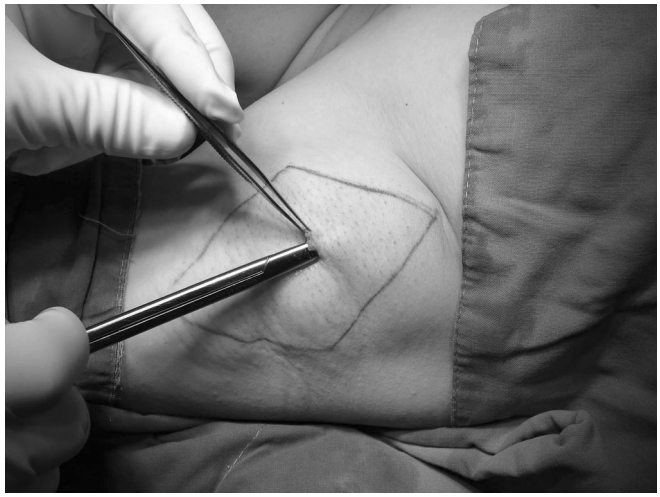

FIGURE 1. A 0.5-cm incision was made on the central skin crease. A 0.5-cm thickness subcutaneous flap elevation and pocket formation were done with Metzenbaum scissors.

FIGURE 2. Suction-assisted cartilage shaver with toothless tip inner cannula.

FIGURE 3. The inner cannula was set at 2500 rotations per minute.

FIGURE 4. The shaver is drawn from the axillary edge to the central crease for ablation of the apocrine glands.

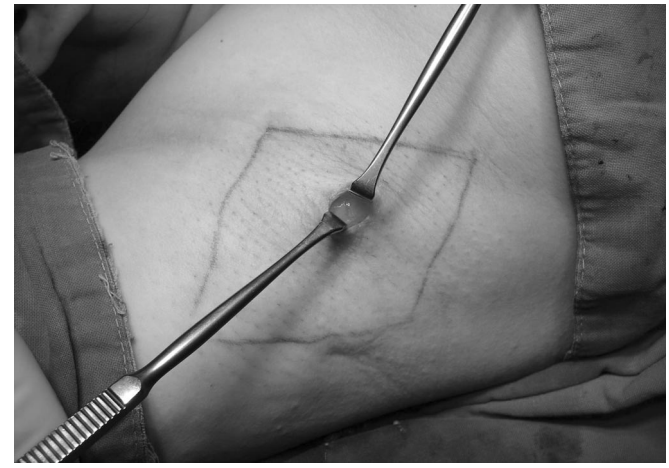

FIGURE 5. Checking bleeders by the small wound with 2 baby retractors.

2 4-0 nylon stitches, which are anchored to the base subcutaneous tissue. There are no further fixation sutures needed for the axilla defatted skin flap and the deep tissue to prevent subdermal plexus impairment, which may increase the possibility of skin edge necrosis. Bulky dressings with elastic bandages are used for external compression. The total operation time is 50 minutes including the anesthesia procedures. Patients are asked not to abduct arms exceeding a 45-degree angle in daily activity for 21 days. Abrupt exercise may delay wound healing. The wound stitches are removed after 10–14 days. The techniques mentioned above have some differences from the published papers.[11–13]

RESULTS

All patients were followed-up for 6–59 months, with the mean of 16 months. They were asked to complete a questionnaire to check for satisfaction levels of malodor. Recovery time, contracture scar, and limitation of arm abduction were checked objectively. Complications such as hematomas and incision wound edges necro-

FIGURE 6. The wound was closed with 2 stitches, which were anchored to the subcutaneous base. Penrose drain was inserted.

sis were all checked by doctors as well. The results for the 156 followed-up patients were divided into 3 groups based on the papers published before[14] (Table 1). In group I, the results were considered good (completely satisfied): 1) malodor was not remarkable (neither the patient nor persons nearby were conscious of it), and 2) scarring was inconspicuous. There were 144 patients (144/156, 92.3%) in this group. In group II, the results were considered fair (partially satisfied): 1) malodor was much improved but sometimes accompanied by mild sweating noticeable only to the patient, and 2) scarring was acceptable to the patient. Eight patients (8/156, 5.1%) were included in this group. In group III, the results were considered poor: 1) malodor was not improved or clothes were stained by sweat postoperation, 2) unacceptable ugly scars were found, and 3) severe complications such as hematomas needing further operations or big wound edge necrosis more than 2 × 2 cm in size needing more than 35 days for secondary wound healing. Four patients were included in this group. Two of these 4 patients had 2 hematomas that needed further debridement. The hematomas were both on the right side. The other 2 patients suffered from 3 big wounds edge necrosis (3 × 3 cm, 3 × 2 cm, 2.5 × 2 cm) that required secondary wound healing for more than 35 days. In this group, no one was included for nonimproved malodor, stained clothes, or esthetically unacceptable scar. In group II, no one asked for a second operation. Group I and group II were included in the total satisfaction rate. The patient complication rate was 7.7% (12/156). The wound complication rate was 5.1% (16/312) (Table 2). Two patients (2/12) had 2 hematomas. Ten patients (10/12) had 14 wounds edge necrosis (9 wounds on the right side, 5 wounds on the left side). Three of them (3/14) were more than 2 × 2 cm in size. The average operation time was 50 minutes including the local anesthesia procedure. The average wound healing time was 21 days. There were no cases of partial wound disruption, skin necrosis needing full thickness skin graft, local infection, contracture scars, arm abduction limitation, or any nerve injury (Fig. 7). There was also no recurrent malodor in our series during the follow-up period. Histology revealed the apocrine glands before and after shaving (Figs. 8–10).

TABLE 2. Complications

Complication	No. Patients	No. Wounds
Hematoma	2	2
Wound edge necrosis	10	14
Local infection	0	0
Wound disruption	0	0
Skin necrosis needing FTSG	0	0
Contracture scar	0	0
Arm abduction limitation	0	0
Nerve injury	0	0
Total	12	16
Complication rate	7.7% (12/156)	5.1% (16/312)

FTSG indicates full thickness skin graft.
Average follow-up, 16 months.

TABLE 1. Comparison of Different Surgical Methods for Axillary Osmidrosis

Author	Surgical Method	No. Patients	Result, %			Operative Complications, %	Wound Healing
			Good	Fair Wound	Poor		
Inaba et al,[24] 1978	Subcutaneous shaving	220	91.8	4.5	0.9	—	—
Yoshikata et al,[5] 1990	1 or 2 transverse incisions	21	42.3	38.5	19.2	19.2 (of patients)	1 month
Endo & Nakayama,[27] 1993	4 transverse incisions	26	66.7	23.8	9.5	9.5 (of patients)	—
Wu et al,[14] 1994	Rhomboid skin excision	102	44.1	47.1	8.8	11.1 (of patient) 6.7 (of wound)	1 month
Tung & Wei,[6] 1997	2 transverse incisions	46	89.1	9.8	1.1	6.5 (of patients) 4.4 (of wounds)	9.2 days
Park et al,[25] 1997	1 transverse incision & CO_2 laser	20	80	20	0	15 (of patients)	1 month
Park et al,[17] 1998	1 transverse incision, manual excision	48	44.8	47.9	7.3	8.6 (of patients) 7.3 (of wounds)	—
Kunachak et al,[26] 2000	Noninvasive laser	32	81.2	12.5	6.2	0	—
Tung,[11] 2001	1-cm incision, cartilage shaver	64	91.4	6.3	2.3	3.9 (of wounds)	5 days
Lee et al,[12] 2005	Two 1-cm incisions, cartilage shaver	89	92.1	7.9	0	1.1 (of patients) 0.6 (of wounds)	21 days
Current study, 2007 (Wu)	0.5–1.0-cm incision, cartilage shaver	156	92.3	5.1	2.6	7.7 (of patients) 5.1 (of wounds)	21 days

FIGURE 7. An inconspicuous scar (arrow) was noted on the left central axilla of a 24-year-old female 13 months postoperation.

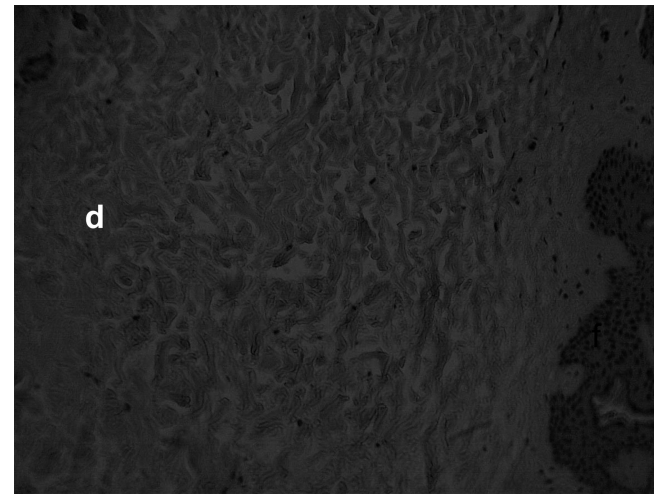

FIGURE 9. Skin biopsy after shaving revealed that apocrine glands were eliminated (hematoxylin-eosin stain; ×200); d, deep dermis (subcutaneous layer was shaved); ep, epidermis.

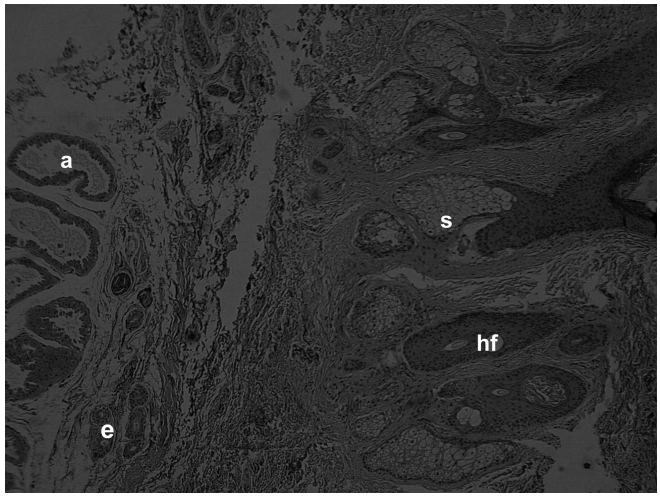

FIGURE 8. Skin biopsy before operation revealed apocrine glands in subcutaneous layer (hematoxylin-eosin stain; ×200); a, apocrine gland; e, eccrine gland; s, sebaceous gland; hf, hair follicle.

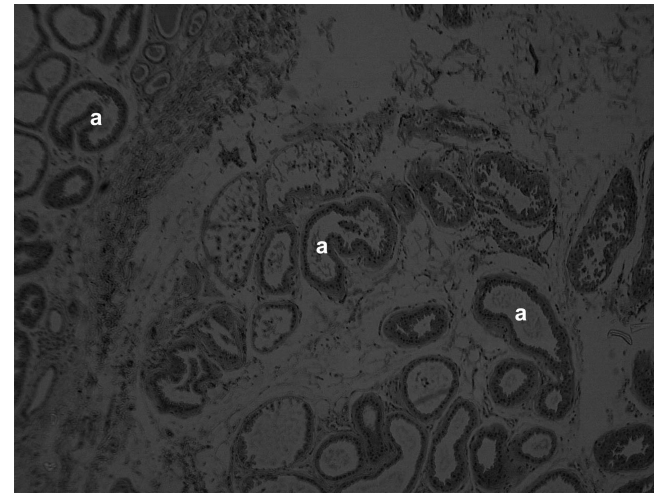

FIGURE 10. The eliminated apocrine glands (hematoxylin-eosin stain; ×200); a, apocrine gland.

DISCUSSION

There are 2 types of sweat glands: the apocrine glands and the eccrine glands. The apocrine glands are found in connection with hair follicles not only in the axilla but also in the breast areolar tissue and perineum. They excrete an odorless, milky fluid that can be decomposed by bacteria into pungent fatty acid. The glands are innervated by adrenergic fibers of the sympathetic nerve system and respond to stress by an increase in production. They are responsible for the malodor and staining of clothes. The eccrine glands are found all over the skin. They excrete an odorless, clear, salty fluid. They are innervated mainly by cholinergic fibers from the thoracolumbar sympathetic nerve system. The eccrine glands also have some connections with the adrenergic fibers and are influenced by stress. They are responsible for the hyperhidrosis.[14] In a study by Bang et al,[15] osmidrosis patients have increased apocrine glands not only in quantity but also in size compared with the control group. Therefore, surgical removal of the apocrine glands would serve as a reasonable and long-term solution for this disorder.

Various surgical techniques have been published and used for treating osmidrosis since Skoog and Thyresson[16] introduced surgical treatment for axillary hyperhidrosis in 1962[8,11,17] (Table 1). However, en bloc excision of skin and subcutaneous tissue may lead to large wounds, long recovery periods, and ugly scars. Surgical removal of subcutaneous tissue without skin excision by multiple incisions may increase wound edge necrosis. The mixed method[14] involving partial removal of skin and cellular tissue en bloc as well as removing the adjacent-area subcutaneous cellular tissue also had higher incidence of ugly scars that minimized the complete satisfaction rate.[14]

Liposuction had the advantages of small wounds, short recovery periods, low complication rates, and invisible scars. But Grazer,[18] in 1992, reported 30% recurrence. Part of the glands that are tightly bound to the dermis are difficult to remove completely with this kind of procedure.[18,19]

Ultrasonic liposuction[10,20–22] had the same advantages as liposuction. This method also had better results in ablation of apocrine glands, which were the causes of malodor. Ultrasound energy liquefies fat and sweat glands via cavitation, but minimally affects blood vessels and nerves at the same energy level. The reports for ultrasonic liposuction were summarized in the following. Chung et al,[10] in 2000, reported a 96.5% (84/87, by patient) satisfaction rate, 3.5% (3/87, by patient) recurrence rate, and 0% complication rate. Park,[20] in 2000, reported a 95.2% (20/21, by patient) satisfaction rate, 4.76% (1/21, by patient) recurrence rate, and 0% complication rate. Park et al,[21] in 2001, reported a 86.36% (19/22, by patient) satisfaction rate, 13.6% (3/22, by patient) recurrence rate, and 6.8% (3/44, by wound) complication rate. Niiyama et al,[22] in 2006, reported one case with complete satisfaction without recurrence or complication. Totally, ultrasonic liposuction was reported to have a satisfaction rate ranging from 86.36% to 96.5% (by patient), the recurrence rate ranged from 3.5% to 13.6% (by patient), and the complication rate ranged from 0% to 6.8% (by wound). By comparing ultrasonic liposuction with the suction-assisted cartilage shaver method in my series, the ultrasonic liposuction had a very minor wound complications (no skin necrosis versus some skin necrosis) rate (Table 2) and a higher recurrence rate (3.5%–13.6% versus 0%).[10,20–22] The case numbers treated with ultrasonic liposuction in the published literature were not all large enough (21, 22, 87, and 1 in the 4 articles). Herein, further study and follow-up are necessary. It was found that more invasive procedures got better effects but more complications. Less invasive procedures got less complications but less effects for ablation of apocrine glands. Therefore, only adequate methods with adequate learning curves can get the best results.

In 1977, Inaba et al[23,24] invented a tissue shaver for removal of the subcutaneous cellular tissue. This technique had a short operation time with effective results (good, 91.8%). The disadvantage of the procedure is that we had to buy a new instrument and practice with it. An electric cartilage shaver is always readily found in an orthopedic department for arthroscopic procedures. Now the instrument can play another role.

A good method for treating osmidrosis should include an outpatient operation with local anesthesia, short operation time, rapid recovery, low complication rate, inconspicuous scar, and durable results.[11,12,17,21,25–28] The suction-assisted cartilage shaver procedure fulfills all these requirements. Malodor can be easily minimized by the shaver but hematomas and wound edge necrosis may occur. We had 2 right axillae hematomas and 14 wounds edge necrosis (9 right side, 5 left side). Most of the people were predominantly right armed. Therefore, the right axilla has more daily activities. Potential bleeders should be checked diligently especially for the right side. Subdermal plexus preservation is also important for minimizing incision wound edge necrosis. The key points to prevent skin necrosis include the following: 1) inner cannula with toothless tip is better for prevention of skin rupture or edge necrosis, 2) outer cannula tip with a grid can reduce dermis injury, 3) evaluation of the dermis thickness by palpation during all the shaving procedures can prevent dermis injury,[13] 4) keep the shaver tip moving during all the procedures is important to prevent subdermal plexus injury, skin rupture, or incision wound edge necrosis, and 5) keeping arms abduction in a less than 45-degree angle in the postoperation period (21 days) can reduce the flap tension, which is also the cause of poor subdermal plexus circulation or edge necrosis. The 10 patients with 14 wounds edges necrosis presented in my early cases. With the above 5 key points, I did not have patients with skin edge necrosis for years. We had 4 small perforations of the axilla skin (4/312) in the early cases. Since the peripheral skin was durable and the wounds were very small, their healing was not delayed. Two of them were sutured by only one stitch for each. The other 2 small wounds were used as drain outlets. Wound examination is very important if severe pain or swelling occurs within the first 48 hours after the operation. Hematomas may lead to skin necrosis, poor wound healing, and ugly scars. We were careful to prevent any complications. In our series, 2 hematomas were treated in time without any sequelae. Always keeping the shaver tip upward is necessary for prevention of deep vessels or nerve injury. Five patients (5/156) with 6 wounds (6/312) had complained about transient paresthesia. But the symptoms disappeared after 3 months. There were no brachial plexus injuries in our series. No patient needed reoperation for recurrent malodor in this series. If it happens, the surgeon just needs repeat the procedures for removing the possible residual apocrine glands. If no further apocrine glands could be found in the pocket, the flap just needs to be repositioned. By blocking the nerve endings, recurrent malodor will be improved. I had 2 reoperations for debridement of the 2 axillae hematomas. In time, debridement can minimize the disaster.

My previous method[14] involved partially removing skin and cellular tissue en bloc as well as removing the adjacent-area subcutaneous cellular tissue, which had a higher incidence of conspicuous scar that minimized the complete satisfaction rate (group I) to 44.12% (45/102). The present technique with the merits of rapid recovery, low complication rate, inconspicuous scar, and permanent results elevated the complete satisfaction rate (group I) from 44.12% to 92.3% by mainly reducing the partial satisfaction rate (group II) from 47.1% to 5.1%. The patient complication rate is reduced from 11.1% to 7.7%. The wound complication rate is minimized from 6.7% to 5.1%. The incidence of skin necrosis needing full thickness skin graft is reduced from 0.44% (3 wounds/685 wounds) to 0% (0 wounds/312 wounds). The average wound-healing period is improved from 30 days to 21 days.

CONCLUSION

Ablation of apocrine glands with the use of a suction-assisted cartilage shaver for treatment of axillary osmidrosis is proved to be a reliable treatment with advantages of small wounds, rapid procedure, inconspicuous scars, and speedy recovery for returning to normal daily activities.

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