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Novel surgical use of electrosurgical tip cleaners in subdermal excision for axillary osmidrosis

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Background Axillary osmidrosis is a disease characterized by axillary malodor. The conventional treatment method of subdermal excision uses Metzenbaum scissors. Recently, subdermal excision using the Versajet system was introduced. However, it is an expensive surgical tool, and a recent study demonstrated a higher frequency of axillary skin necrosis with the Versajet. We propose a novel, cost-effective, and safe subdermal excision method that utilizes an electrosurgical tip cleaner (ETC).

Methods Our retrospective cohort study included 27 patients who underwent subdermal excision from June 2012 to November 2021. The patients were classified into three groups according to the surgical method: Metzenbaum scissors, Versajet, and ETC. The operation time, hospitalization cost, and postoperative complications were investigated.

Results The number of patients in the Metzenbaum scissors, Versajet, and ETC groups was seven, eleven, and nine, respectively. The mean operation time and hospitalization cost were significantly different among the three groups ($P<0.05$). The longest mean operation time was observed in the Metzenbaum scissors group (112.9±23.6 minutes), followed by the ETC and Versajet groups (76.4±27.1 and 64.2±24.8 minutes, respectively). The most expensive method was the Versajet ($2,346.1±517.7), followed by the ETC and Metzenbaum scissors ($1,391.8±317.7 and $1,279.6±287.5, respectively). No postoperative complications were observed.

Conclusions The ETC is a novel method of subdermal excision, comparable to Metzenbaum scissors or Versajet. Therefore, it is recommended for situations where it is necessary to consider both the time and cost of surgery.

Keywords Surgical procedures, operative / Axilla / Cosmetic techniques

INTRODUCTION

Axillary osmidrosis is a disease characterized by axillary malodor, which can lead to a decrease in an individual's social activity and self-confidence. Although the majority of East Asians have a faint axillary odor, patients with axillary osmidrosis feel the need to undergo treatment [1].

Numerous treatment methods, both non-surgical and surgical, have been developed to treat this issue. Surgical methods include excision of the skin area where the apocrine gland is located. An alternative and more effective option is subdermal excision of the subcutaneous tissue containing the apocrine gland with Metzenbaum scissors. In 2013, Kim et al. [2] first introduced subdermal excision using the Versajet system (Smith & Nephew), and this device has subsequently been used in many studies. The Versajet has the advantage of removing apocrine tissue faster and more evenly. However, it is an expensive surgical tool, and a recent study demonstrated that skin necrosis of the axilla occurs more frequently with its use [3]. In this study, we propose a novel, cost-effective, and safe subdermal excision method that utilizes an electrosurgical tip cleaner (ETC).

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METHODS

We conducted a retrospective cohort study, enrolling 27 patients who underwent subdermal excision for axillary osmidrosis from June 2012 to November 2021. These patients experienced unpleasant malodor in both axillae that caused them to refrain from social activities, and therefore wanted to undergo surgery. Based on electronic medical records, the patients were classified into three groups according to the subdermal excision method used: Metzenbaum scissors, Versajet, or ETC. Age, sex, anesthesia method (general or local), operation time, hospitalization cost, and postoperative complications were investigated. The duration of the operation was determined from the time of incision to when the final dressing was completed. Later, the patients answered a survey about the effectiveness of surgery, including malodor elimination, reduced hair growth, the degree of sweat elimination, and subjective satisfaction.

Statistical analysis

All analyses were performed using the open-source software SciPy version 1.7.1. One-way analysis of variance (ANOVA) and the Fisher exact test were used for comparisons among the three groups. For statistically significant data, the Bonferroni *post hoc* analysis was used to determine further significance. A probability of less than 5% was used to determine statistical significance in one-way ANOVA and the Fisher exact test, and 1.7% was used for the Bonferroni *post hoc* analysis.

Surgical procedure

In all three groups, patients were placed in a supine position with abduction of both arms at a 120° angle. Using a surgical marking pen, the incision line was marked along the axillary hair. Tumescent solution was injected into the axilla. Next, two parallel 3-cm incisions were made along the axillary crease. The superficial subcutaneous layer was dissected using scissors. The skin flap was ele-

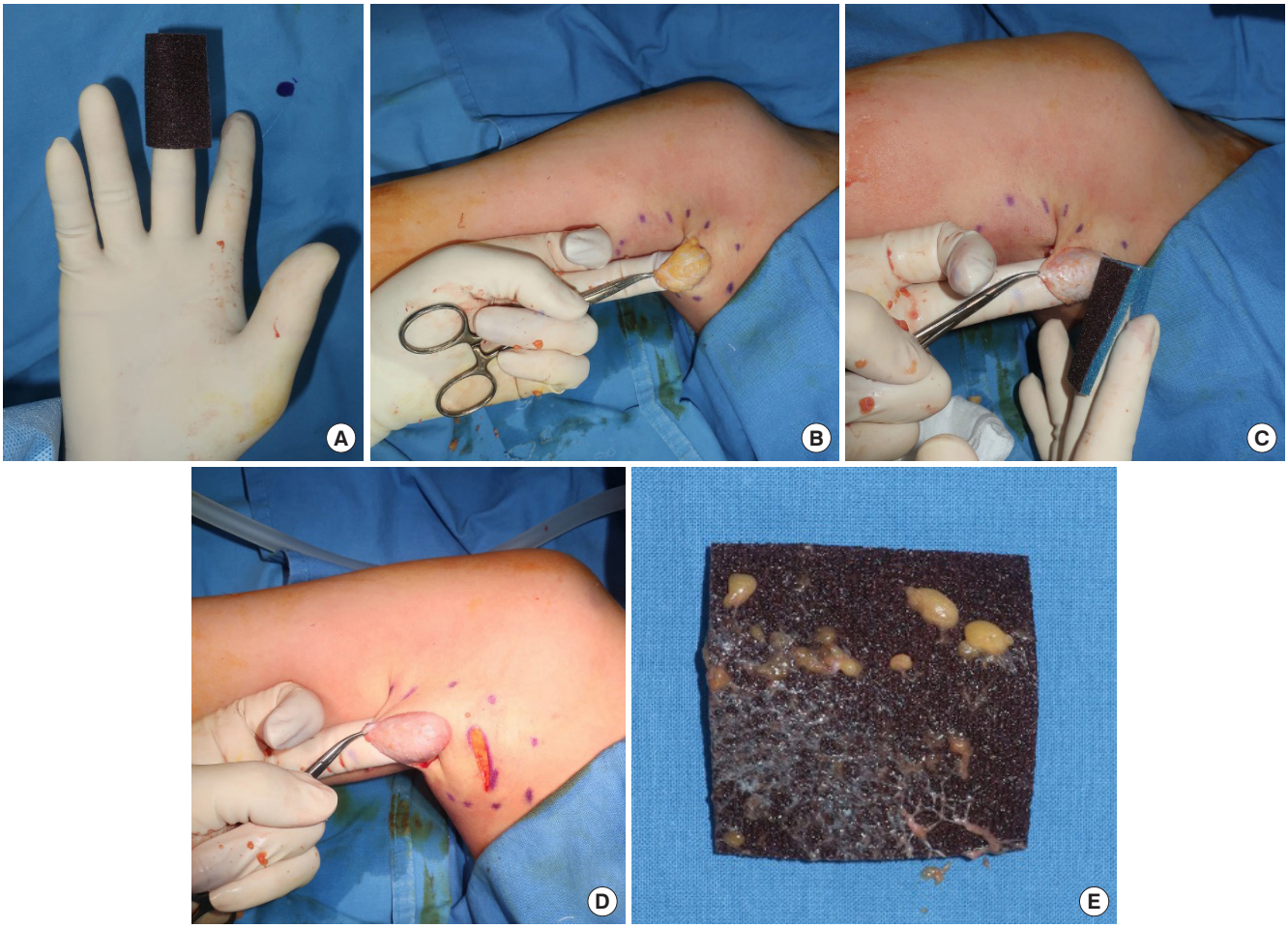

Fig. 1. Clinical images of the subdermal excision process using an electrosurgical tip cleaner (ETC). (A) Holding an ETC wrapped around the long finger and stabilized with the index and ring fingers in a half-bent position. (B) Exposing subdermal tissue by using mosquito forceps to turn over the skin flap. (C) Scratching the subdermal tissue repeatedly until the apocrine glands were removed. (D) After subdermal excision with an ETC. (E) An ETC smeared with apocrine glands within subcutaneous tissue.

vated, and the margin was held using mosquito forceps. It was then turned over to expose the subdermal layer containing the apocrine glands.

The apocrine glands contained in the superficial subcutaneous fat were resected, while the subdermal plexus was preserved. There were notable differences among the three groups in terms of resection methods. The Metzenbaum scissors group underwent a manual resection using Metzenbaum scissors, whereas the Versajet group used a hydrosurgery technique to trim the subdermal layer. For the ETC group, the apocrine glands were removed using the rough surface of the ETC, like sandpaper. The ETC was wrapped around the long finger and stabilized with the index and ring fingers in a half-bent position. Next, the subdermal layer was scratched repeatedly until the apocrine glands were removed in the subdermal plexus (Fig. 1). We used two to three ETCs per axilla. If an aspect of the rough surface became fully smeared with apocrine gland embedded in subcutaneous tissue, as in Fig. 1E, the ETC was replaced.

After eradication of the superficial fat tissue and the apocrine glands, the skin flap was turned back and bleeding was controlled. Copious irrigation was done to make sure there were no foreign body substances left. To prevent hematoma, the skin flap and superficial fascia were sutured with Vicryl sutures at approximately 2 to 4 points. Next, a drain was inserted into the subcutaneous layer. The subcuticular suture and skin closure were done. A compressive dressing was applied to avoid skin flap necrosis, hematoma, and seroma. The drain was removed 1 to 2 days postoperatively if the patient was tolerating the pain. The patients were discharged 3 to 5 days after surgery.

RESULTS

A total of 27 patients were enrolled, with a mean age of 23.3 ± 13.2 years. The clinical and demographic characteristics of the patients according to the surgical method used are shown in Table 1. The number of patients in the Metzenbaum scissors, Versajet, and ETC groups was 7, 11, and 9, respectively. There were no significant differences in age, sex ratio, method of anesthesia, length of hospitalization, or follow-up time among the groups. The mean operation time was significantly different among the three groups (P = 0.002). The longest mean operation time was observed in the Metzenbaum scissors group (112.9 ± 23.6 minutes), followed by the ETC and Versajet groups (76.4 ± 27.1 and 64.2 ± 24.8 minutes, respectively). In addition, there was a statistically significant difference in the average cost of hospitalization among the three groups (P < 0.001). The most expensive method was the Versajet ($2,346.1 ± 517.7), followed by the ETC and Metzenbaum scissors $1,391.8 ± 317.7 and $1,279.6 ± 287.5, respectively).

Bonferroni *post hoc* analysis was performed on the statistically significant differences observed in operation time and total cost of hospitalization among the three groups. The results are presented in a box plot graph (Figs. 2, 3). The mean operation time for the Metzenbaum scissors group was compared with that required for the Versajet and ETC groups (P = 0.001 and P = 0.014, respectively). While a significantly longer operation time was seen for the Metzenbaum scissors group (Fig. 2), there was no significant difference between the Versajet and ETC groups (P = 0.305). The mean total cost of hospitalization for the Versajet group compared to that for the Metzenbaum scissors and ETC groups (Fig. 3), was significantly higher (P < 0.001). However, no significant differences were ob-

Table 1. Clinical and demographic characteristics of patients according to the surgical method

Characteristic	Surgical method			P-value
	Metzenbaum scissors	Versajet	Electrosurgical tip cleaner	
No. of patients	7	11	9	
Age (yr)	26.6 ± 16.7	26.1 ± 15.3	20.4 ± 6.6	0.576[a]
Sex				0.999[b]
Male	3	6	5	
Female	4	5	4	
Anesthesia				0.122[b]
General	6	7	3	
Local	1	4	6	
Operation time (min)	112.9 ± 23.6	64.2 ± 24.8	76.4 ± 27.1	0.002[a]
Length of hospitalization (day)	6.4 ± 2.0	6.2 ± 2.2	7.0 ± 1.0	0.671[a]
Total cost of hospitalization (Dollar, $)	1,279.6 ± 287.5	2,346.1 ± 517.7	1,391.8 ± 317.7	< 0.001[a]
Follow-up time (mo)	5.6 ± 1.5	6 ± 1.4	6.6 ± 2.1	0.538[a]

Values are presented as number or mean ± SD.
[a]One-way analysis of variance; [b]Fisher exact test.

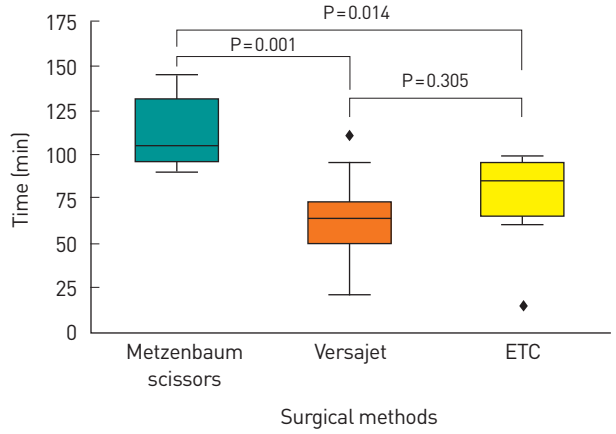

Fig. 2. Operation time according to the surgical method. The data show a statistically significant difference between Metzenbaum scissors and the Versajet and between Metzenbaum scissors and the electrosurgical tip cleaner (ETC). However, there was no significant difference between the Versajet and the ETC.

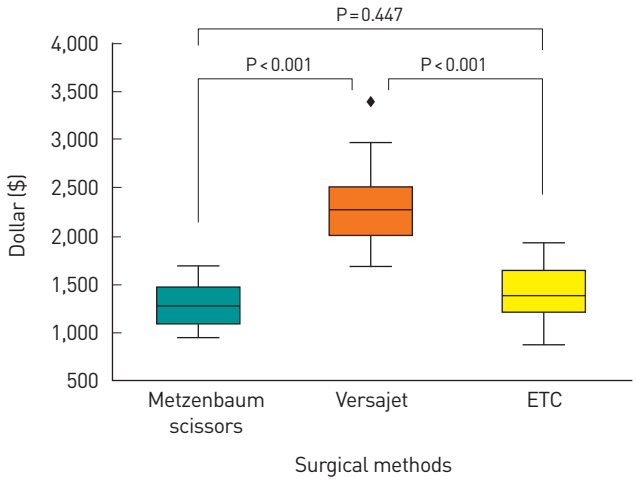

Fig. 3. Total hospitalization cost according to the surgical method. The data shows a significant statistical difference between Metzenbaum scissors and the Versajet and between the Versajet and the electrosurgical tip cleaner (ETC). However, no significant difference was observed between Metzenbaum scissors and the ETC.

served between the Metzenbaum scissors and ETC groups (P=0.447).

During the follow-up period, no postoperative complications such as hematoma, seroma, wound infection/dehiscence, skin necrosis, pigmentation, or inflammation due to a foreign body reaction were reported. Finally, no significant differences were observed in effectiveness for the surgical treatment groups, as was evaluated using four parameters, each measured on a 3-point scale (Table 2).

DISCUSSION

Axillary osmidrosis is a subjective disease that is characterized by axillary malodor. Bacteria decompose apocrine secretions in the axilla to produce ammonia and short-chain fatty acids. These by-products cause malodor [4], which can negatively impact an individual's mental health and can lead to an impoverished social life.

The treatment of axillary osmidrosis can be non-surgical or surgical. Non-surgical treatment includes application of deodorant, injection of botulinum toxin, and subcutaneous ethanol injections into the axillary area. Surgical treatment includes en bloc resection, liposuction, laser, and subdermal excision of the hair-bearing skin of the axilla, of which subdermal excision is the most effective. It is less aggressive and results in reduced scaring compared to en bloc resection. Furthermore, it has a lower recurrence rate than both liposuction and laser treatment [1,5,6].

Surgical treatment of axillary osmidrosis exposes the apocrine gland buried in the fibrotic dermis of the subdermal tissue. To achieve this, the conventional subdermal excision method involves manual removal of the subcutaneous tissue, including the apocrine gland, with Metzenbaum scissors. This step is performed after making a linear incision in the axilla [7]. In 2013, Kim et al. [2] first proposed subdermal excision using the Versajet, which is a hydrosurgery method. Since their study was published, various follow-up studies have been conducted.

Multiple studies on subdermal excision for axillary osmidrosis using the Versajet showed that 66.67% to 100% of patients were

Table 2. Comparison of effectiveness by surgical method

3-Point scale	Surgical method			P-value[a]
	Metzenbaum scissors (n=7)	Versajet (n=11)	Electro-surgical tip cleaner (n=9)	
Malodor elimination				0.665
1. Good	71.4 (5)	90.9 (10)	88.9 (8)	
2. Fair	28.6 (2)	9.1 (1)	11.1 (1)	
3. Poor	0	0	0	
Reduced hair growth				0.499
1. Much	85.7 (6)	100 (11)	88.9 (8)	
2. Moderate	14.3 (1)	0	11.1 (1)	
3. Little	0	0	0	
Sweating elimination				0.665
1. Significant	71.4 (5)	90.9 (10)	88.9 (8)	
2. Improved	28.6 (2)	9.1 (1)	11.1 (1)	
3. No change	0	0	0	
Subjective satisfaction				0.665
1. Very satisfied	71.4 (5)	90.9 (10)	88.9 (8)	
2. Satisfactory	28.6 (2)	9.1 (1)	11.1 (1)	
3. Fair	0	0	0	

Values are presented as percent (number).
[a]Fisher exact test.

satisfied [3,8-11]. However, 2.7% to 62.5% of patients experienced complications such as seroma/hematoma, epidermal erosions, pigmentation, scar contracture, wound necrosis, or recurrence. In a study by Moon and Kim [3], skin necrosis was significantly more frequent in the Versajet group than in the conventional group (P = 0.036). This could be considered as an emerging drawback of the Versajet method. In addition, the Versajet is expensive, costing approximately $390.

The ETC (Medwin) used in this study was composed of four layers: sandpaper, polyurethane foam, adhesive tape, and release liner. The sandpaper and polyurethane foam layers were flexible while bent. The original purpose of the ETC was to remove ashes from Bovie electrocautery after use, which can be done by rubbing against the rough sandpaper surface. Case reports have been published on using the surface of the ETC (an easily available tool) to provide friction for purposes other than its intended use. The ETC has been used for mild dermabrasion of rhinophyma, which helps in the eventual contour [12]. In a study by Choong et al. [13], the ETC was used for debridement of granulation tissue in wound bed preparation. Lee et al. [14] attached the ETC to the contact surface of a breast retractor so that the tissue and the retractor did not slip during breast surgery.

In this study, subdermal excision was performed using an ETC for the first time. No statistically significant differences in effectiveness or complications were observed when compared to other methods (Table 2). The absence of postoperative complications (e.g., hematoma or skin necrosis) in the ETC group may have been the result of the low pressure applied while rubbing. In contrast, the Versajet possesses a speed of up to 1,078 km/hr [3] with the pressure of the skin flap maintained by the surgeon's free hand. Like the Metzenbaum scissors, only the desired tissue was removed and subdermal vascularity was preserved using the ETC.

The operation time of the ETC group was 1.8 minutes longer than that of the Versajet group. The difference was not statistically significant (Fig. 2), which suggests that the ETC method was comparable to the Versajet in terms of operation time.

To the best of our knowledge, no studies have investigated the total cost of surgical treatment for axillary osmidrosis. The total cost of surgery in the Metzenbaum scissors group and the ETC group was similar, while the Versajet group was significantly more expensive (Fig. 3). Surgery using the Versajet costs approximately $390; whereas Metzenbaum scissors do not incur added cost because they can be sterilized and reused. The ETC method cost approximately $2 to 3. The ETC can therefore be considered as a cost-effective alternative method for patients who cannot afford expensive surgery.

The limitations of this study included a relatively small number of patients and a relatively short follow-up time. Larger studies with longer follow-up periods are recommended in the future to more accurately evaluate this new surgical method.

In this study, an ETC was used as part of a new method of subdermal excision for axillary osmidrosis. This method was comparable in terms of surgical effectiveness to both Metzenbaum scissors and the Versajet. Furthermore, it took less time than Metzenbaum scissors and was less expensive than using the Versajet. The ETC was not found to be medically inferior to existing methods; therefore, it is recommended for situations in which it is necessary to consider both the time and cost of surgery.

NOTES

Conflict of interest

Sung-No Jung is an editorial board member of the journal but was not involved in the peer reviewer selection, evaluation, or decision process of this article. No other potential conflicts of interest relevant to this article were reported.

Ethical approval

The study was approved by the Institutional Review Board of the Catholic Medical Center (IRB No. UC22RASI0086) and performed in accordance with the principles of the Declaration of Helsinki.

Patient consent

The patient provided written informed consent for the publication and use of his images.

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