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Clinical Efficacy and Safety Analysis of Reversed Flap Turnover Layered Minimally Invasive Surgery for the Treatment of Bromhidrosis

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Abstract: *Objective*: To explore the clinical efficacy and safety of reverse skin flap turnover and stratified minimally invasive surgery for the treatment of bromidrosis, and compare it with traditional bromidrosis excision surgery, providing a reference for optimizing clinical surgical plans for bromidrosis. *Methods*: A total of 100 patients with bromidrosis admitted to the Vascular Surgery Department of our hospital from January 2024 to December 2025 were selected as the study subjects. They were randomly divided into an observation group and a control group using a random number table method, with 50 cases in each group. The control group was treated with traditional fusiform excision surgery, while the observation group was treated with reverse skin flap turnover and stratified minimally invasive surgery. Surgical-related indicators, the overall clinical treatment response rate, the incidence of postoperative complications, scar scores at 6 months postoperatively, and recurrence rates were compared between the two groups. Patient postoperative satisfaction was also recorded. *Results*: The observation group showed significantly better results than the control group in terms of operative time, intraoperative blood loss, and incision healing time (all $p < 0.001$). The overall response rate in the observation group was significantly higher than that in the control group ($\chi^2 = 5.005$, $p = 0.025 < 0.05$). The overall incidence of complications in the observation group was significantly lower than that in the control group ($\chi^2 = 6.353$, $p = 0.012 < 0.05$). At 6 months postoperatively, the Vancouver Scar Scale (VSS) scores and recurrence rates in the observation group were significantly lower than those in the control group, while overall patient satisfaction was significantly higher in the observation group (all $p < 0.05$). *Conclusion*: Reverse skin flap turnover and stratified minimally invasive surgery is effective for the treatment of bromidrosis. Compared with traditional surgical methods, it offers advantages such as less trauma, reduced bleeding, faster healing, a lower incidence of complications, minimal scarring, and a lower recurrence rate. It is safer and more acceptable to patients, making it suitable for clinical promotion and application.

Keywords: Bromidrosis; Reverse skin flap turnover and stratified minimally invasive surgery; Traditional fusiform excision surgery; Clinical efficacy; Safety

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1. Introduction

Bromidrosis, also known as fox odor or axillary osmidrosis, is a common clinical dermatological accessory disease primarily caused by abnormal secretion from the apocrine glands in the axillary region. The secretions are decomposed by bacteria on the skin surface, producing unsaturated fatty acids and ammonia, resulting in a distinctive pungent odor. It is more prevalent among young adults, particularly women [1]. Although bromidrosis does not cause organic damage to internal organs, it significantly affects patients' daily social interactions, mental health, and quality of life. Some patients may even develop psychological issues such as low self-esteem, anxiety, and social avoidance, making it necessary to actively pursue effective treatment methods. Currently, surgical treatment is the primary approach for bromidrosis, with the core principle being the complete removal of the axillary apocrine glands to block the source of the odor [2]. Traditional fusiform excision surgery was commonly used in clinical practice in the past. Although it can partially remove the sweat glands, it has drawbacks such as large incisions, significant trauma, obvious postoperative scarring, restricted upper limb movement due to traction, a relatively high incidence of complications, and poor controllability of recurrence rates, making it difficult to meet patients' demands for aesthetics and postoperative comfort [3]. With the development of minimally invasive surgical techniques, various minimally invasive surgical methods for bromidrosis have gradually replaced traditional methods. Reverse skin flap turnover and stratified minimally invasive surgery, through precise positioning, small incision design, and stratified dissection and turnover of skin flaps, allows for the complete removal of apocrine glands under direct vision while maximally preserving normal skin tissue, balancing efficacy and aesthetics. This study selected 100 patients with bromidrosis and conducted a grouped comparative analysis of the clinical efficacy, safety, and prognosis of reverse skin flap turnover and stratified minimally invasive surgery versus traditional surgical methods, aiming to provide objective data support for selecting the optimal surgical plan for bromidrosis in clinical practice. The report is as follows.

2. Materials and methods

2.1. General information

A total of 100 patients with bromidrosis admitted to the Vascular Surgery Department of our hospital from January 2024 to December 2025 were selected as the study subjects.

2.1.1. Inclusion criteria

(1) Met the clinical diagnostic criteria for bromidrosis, with moderate to severe odor and poor response to conservative treatment;
(2) Aged 18–45 years, with unilateral or bilateral bromidrosis, and voluntarily accepted surgical treatment;
(3) No surgical contraindications, normal coagulation function, no local skin infection, ulceration, or scar-prone constitution;
(4) Patients and their families provided informed consent, signed the surgical informed consent form, and cooperated with postoperative follow-up.

2.1.2. Exclusion criteria

(1) Severe dysfunction of the heart, liver, kidneys, or other organs;

(2) Pregnant or lactating women;
(3) Previous history of axillary surgery or local injection therapy;
(4) Patients with mental illness or cognitive impairment unable to cooperate with treatment;
(5) Patients lost to follow-up or with incomplete data postoperatively.

2.1.3. Study design

Patients were randomly divided into an observation group and a control group using a random number table method, with 50 cases in each group. Observation group: 18 males and 32 females; aged 19–43 years, with an average age of (26.58 ± 4.26) years; disease duration of 1–12 years, with an average of (5.32 ± 2.14) years; 46 cases with bilateral bromidrosis and 4 cases with unilateral bromidrosis. Control group: 20 males and 30 females; aged 18-45 years, with an average age of (27.12 ± 4.53) years; disease duration of 1-11 years, with an average of (5.18 ± 2.07) years; 45 cases with bilateral bromidrosis and 5 cases with recurrent bromidrosis. There were no statistically significant differences in general information such as gender, age, disease duration, and side of bromidrosis between the two groups ($p > 0.05$), indicating comparability.

2.2. Surgical methods

The control group underwent traditional fusiform excision surgery. Patients were placed in a supine position with their upper limbs abducted at 90 °. The axillary skin was routinely disinfected with iodophor, and a sterile surgical drape was placed. Local infiltration anesthesia was administered. A fusiform incision was designed along the distribution area of axillary hair. The skin and subcutaneous tissue were incised, and the skin and subcutaneous adipose tissue containing the apocrine glands in the axillary region were completely excised. After thorough hemostasis, the subcutaneous tissue and skin were sutured layer by layer. Postoperatively, gauze compression bandaging was applied, and routine anti-infective treatment was given for 3 days. Sutures were removed 10–12 days postoperatively.

The observation group underwent reverse skin flap turnover and stratified minimally invasive surgery, performed by the same group of senior vascular surgeons according to a standardized protocol to ensure uniformity of operations.

(1) Preoperative positioning

Before surgery, with the patient's upper limb abducted, the axillary hair area was positioned using a sterile marking pen, extending 0.5–1 cm beyond the boundary of the axillary hair to completely cover the apocrine glands and reduce the possibility of recurrence.

(2) Incision design

A 1.0–1.5 cm arc-shaped incision was made along the axillary sulcus, avoiding major skin lines and balancing operational space with minimally invasive aesthetics.

(3) Anesthesia protocol

Local tumescent anesthesia was administered using 0.5% lidocaine with 1:200,000 epinephrine to reduce bleeding and prolong the analgesic effect.

(4) Skin flap dissection and turnover

After anesthesia, the skin was incised to the superficial fascia layer. A reverse skin flap was bluntly dissected and turned over, clearly exposing and stratified dissecting the sweat glands and fat while avoiding damage to deep blood vessels and nerves.

(5) Hemostasis and drainage

Intraoperative electrocoagulation hemostasis was performed, with the single-point action time not exceeding 0.5 seconds. Negative pressure drainage or fenestrated drainage was placed according to the degree of bleeding.

(6) Suture and bandaging

After confirming no bleeding, the subcutaneous tissue was sutured with absorbable sutures, and the skin was sutured with cosmetic sutures. Postoperatively, an "8-figure" bandage was applied for moderate compression bandaging for 72 hours to prevent hematoma and scar hyperplasia.

After surgery, both groups of patients received routine anti-infective, anti-swelling, and analgesic treatment. Patients were instructed to avoid strenuous upper limb activities, raising their arms, or lifting heavy objects within 1 week postoperatively, keep the local skin clean and dry, change dressings regularly, and were followed up for 6 months postoperatively.

2.3. Observation indicators

(1) Surgical-related indicators

The operative time, intraoperative blood loss, and incision healing time were recorded for both groups, with measurement data retained to two decimal places.

(2) Clinical efficacy determination

Patients were followed up at 6 months postoperatively, and efficacy was determined based on the elimination of axillary odor. Cure: Complete disappearance of axillary odor, with no odor at close range; Marked response: Significant reduction in odor, with only slight odor at close range that does not affect social interactions; Effective: Reduction in odor, but still present to some extent, requiring daily masking; Ineffective: No improvement or worsening of odor. The overall response rate = (number of cured + markedly responsive + effective cases) / total number of cases × 100.00%.

(3) Postoperative complications

The occurrence of postoperative complications such as subcutaneous hematoma, skin necrosis, incision infection, scar hyperplasia, and upper limb traction discomfort was statistically analyzed in both groups, and the overall incidence of complications was calculated.

(4) Scar score

At 6 months postoperatively, the Vancouver Scar Scale (VSS) was used to assess scar conditions, with a total score ranging from 0 to 15. A lower score indicates a milder scar and more aesthetically pleasing appearance [4].

(5) Recurrence rate and satisfaction

The number of bromidrosis recurrence cases was statistically analyzed at 6 months postoperatively, and the recurrence rate was calculated. A self-made satisfaction questionnaire was used to assess patient postoperative satisfaction, which was divided into very satisfied, satisfied, and dissatisfied. The overall satisfaction rate = (number of very satisfied + satisfied cases) / total number of cases × 100.00%.

2.4. Statistical methods

Data analysis was performed using SPSS 22.0 statistical software. Measurement data were expressed as ($\bar{x} \pm s$), and comparisons between groups were made using independent sample t-tests. Count data were expressed as [n (%)], and comparisons between groups were made using χ^2 tests. $p < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of surgical-related indicators between the two groups

The observation group showed significantly better results than the control group in terms of operative time, intraoperative blood loss, and incision healing time (all $p < 0.001$). See **Table 1**.

Table 1. Comparison of surgical-related indicators between the two groups

Group	Operation time (min)	Intraoperative blood loss (mL)	Wound healing time (d)
Observation group (n = 50)	42.36 ± 5.28	8.25 ± 1.36	7.12 ± 1.05
Control group (n = 50)	58.74 ± 6.35	22.68 ± 3.42	11.36 ± 1.82
t	14.037	35.395	14.255
p	< 0.001	< 0.001	< 0.001

3.2. Comparison of clinical efficacy between the two groups

The overall response rate in the observation group was significantly higher than that in the control group ($\chi^2 = 5.005$, $p = 0.025 < 0.05$), as shown in **Table 2**.

Table 2. Comparison of clinical efficacy between the two groups of patients

Group	Cured	Markedly effective	Effective	Ineffective	Total effective rate (%)
Observation group (n = 50)	36	9	3	2	48 (96%)
Control group (n = 50)	22	11	8	9	41 (82%)
χ^2					5.005
p					0.025

3.3. Comparison of the incidence of postoperative complications between the two groups

The overall incidence of complications in the observation group was significantly lower than that in the control group ($\chi^2 = 6.353$, $p = 0.012 < 0.05$), as shown in **Table 3**.

Table 3. Comparison of the incidence of postoperative complications between the two groups

Group	Subcutaneous hematoma	Scar hyperplasia	Incisional infection	Skin necrosis	Upper limb discomfort from traction	Overall incidence rate (%)
Observation group (n = 50)	1	1	1	-	-	3 (6%)
Control group (n = 50)	4	2	2	2	2	12 (24%)
χ^2						6.353
p						0.012

3.4. Comparison of postoperative scar scores, recurrence rates, and satisfaction between the two groups

At 6 months postoperatively, the VSS scores and recurrence rates in the observation group were significantly lower than those in the control group, while the overall patient satisfaction was significantly higher in the observation group (all $p < 0.05$). See **Table 4**.

Table 4. Comparison of postoperative scar scores, recurrence rates, and satisfaction between the two groups

Group	VSS score (points)	Recurrence rate [n (%)]	Overall satisfaction rate [n (%)]
Observation group (n = 50)	2.15 ± 0.42	1 (2.00)	47 (94.00)
Control group (n = 50)	6.84 ± 1.26	7 (14.00)	40 (80.00)
t/χ^2	25.023	4.891	4.332
p	< 0.001	0.027	0.037

4. Discussion

The core pathogenesis of bromhidrosis lies in the excessive secretion of apocrine sweat glands in the axillary region. The key to surgical treatment is the complete removal of apocrine sweat glands while minimizing surgical trauma, reducing the risk of complications, and ensuring postoperative aesthetic appeal [5]. Traditional fusiform excision involves directly removing skin tissue containing sweat glands, which is a simple procedure but results in significant trauma. It is challenging to precisely control the excision range, often leading to residual sweat glands or excessive removal of normal tissue. Postoperatively, patients not only exhibit wide and prominent scars that affect the appearance of the axillary region but may also experience discomfort due to skin defects that restrict upper limb movement. Additionally, the incidence of complications such as subcutaneous hematoma and skin necrosis is relatively high, and the recurrence rate remains elevated, making it difficult to meet the modern patient's demands for minimally invasive, aesthetically pleasing, and comfortable treatment [6,7].

Reversed skin flap turnover and stratified minimally invasive surgery is a minimally invasive technique optimized based on the anatomical structure of bromhidrosis. In this study, this technique achieved precise, minimally invasive, and efficient therapeutic effects through standardized preoperative localization, incision design, anesthesia, and hemostatic drainage procedures. Expanding the preoperative marking of the boundary of axillary hair distribution ensures comprehensive coverage of potential areas where apocrine sweat glands may be located, preventing postoperative residue and recurrence. Designing a 1.0–1.5 cm arc-shaped small incision along the axillary fold avoids major skin lines, ensuring sufficient surgical space while minimizing postoperative scar formation, aligning with cosmetic surgery principles. Local tumescent anesthesia combined with epinephrine effectively constricts local blood vessels, significantly reducing intraoperative blood loss. In this study, the intraoperative blood loss in the observation group was significantly lower than that in the control group. Additionally, tumescent anesthesia separates tissue spaces, facilitating skin flap dissection and reducing the risk of tissue damage.

During surgery, the reversed skin flap turnover allows for stratified removal of apocrine sweat glands under direct visualization, ensuring more thorough removal compared to the blind excision in traditional techniques, thereby effectively improving the treatment efficiency [8]. Strict control of electrocoagulation hemostasis time, combined with microporous negative pressure drainage or small fenestration drainage, and standardized postoperative "8-figure" bandage compression can effectively prevent complications such as subcutaneous hematoma and skin necrosis [9]. In this study, the overall complication rate in the observation group was significantly lower than that in the control group, highlighting the safety advantages of this technique. Furthermore, the minimally invasive small incision combined with cosmetic suturing results in minimal postoperative scarring, with a VSS score significantly lower than that of traditional techniques. Patients experience no significant discomfort or restriction in upper limb movement, leading to a marked improvement in quality of life. The recurrence rate was only 2.00%, and patient satisfaction reached 94.00%, significantly superior to traditional techniques.

The results of this study indicate that reversed skin flap turnover and stratified minimally invasive surgery significantly outperforms traditional fusiform excision in terms of surgical trauma, treatment efficiency, complication control, scar aesthetics, recurrence rate, and patient satisfaction, aligning with conclusions from domestic studies on related minimally invasive bromhidrosis techniques. The core advantages of this technique are as follows: first, it is minimally invasive, with small incisions, minimal trauma, and reduced blood loss, leading to faster postoperative healing; second, it is precise, allowing for stratified operation under direct visualization, thorough removal of sweat glands, and reduced recurrence risk; third, it is aesthetically pleasing, with concealed incisions and minimal scarring, meeting patients' cosmetic needs; fourth, it is safe, with standardized hemostasis and drainage, a low complication rate, and smooth postoperative recovery.

However, when applying this technique clinically, the following points should be noted: precise preoperative marking to avoid inadequate coverage leading to residual sweat glands; gentle intraoperative manipulation and strict control of electrocoagulation intensity and duration to prevent skin burns and necrosis; uniform postoperative compression bandaging, close observation of local blood supply, and guidance for patients in postoperative care to avoid strenuous upper limb activity and reduce complication incidence [10]. Additionally, this technique requires a certain level of proficiency from the surgeon and should be performed after standardized training to ensure surgical effectiveness and safety.

5. Conclusion

In conclusion, reversed skin flap turnover and stratified minimally invasive surgery demonstrates significant clinical efficacy in treating bromhidrosis. Compared to traditional fusiform excision, it offers multiple advantages, including shorter surgical time, minimal trauma, reduced blood loss, faster incision healing, a low complication rate, minimal postoperative scarring, a low recurrence rate, and high patient satisfaction. It is safe and balances therapeutic effects with aesthetic needs, effectively improving patients' bromhidrosis symptoms and mental health while enhancing their quality of life. This technique is the preferred option for treating bromhidrosis and warrants promotion in vascular surgery clinics. Future studies could further expand the sample size, extend follow-up periods, and delve into the long-term efficacy and refined criteria for suitable patient populations to provide more comprehensive clinical references.

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Disclosure statement

The authors declare no conflict of interest.

References

[1] Hong S, Zhang J, Hong F, 2016, Analysis of the Efficacy of a Comprehensive Minimally Invasive Surgical Method for Treating Bromhidrosis. Chinese Journal of Aesthetic Medicine, 25(10): 27–30.

[2] Tian X, Zhou R, Gao F, et al., 2023, Overview of Surgical Treatment for Bromhidrosis. Journal of Clinical Dermatology, 52(10): 633–637.

[3] Yao X, Wu X, Ding Y, et al., 2016, Comparative Analysis of Complications Between Two Incision Types for Apocrine Sweat Gland Trimming in Bromhidrosis Treatment. Journal of Practical Dermatology, 9(1): 53–55.

[4] He Q, Wang J, Sun L, et al., 2026, Advances in the Application of External Traditional Chinese Medicine Therapy for Early Intervention in Hypertrophic Scars After Burns. Chinese Journal of Aesthetic Medicine, 35(3): 168–173.

[5] Zhang L, Wang X, Xi W, 2023, Specialized Precise Comprehensive Nursing During the Perioperative Period of Endoscopic Microdynamic Radical Surgery for Bromhidrosis. China Medical Aesthetics, 13(12): 66–70.

[6] Dou S, Yang Y, Miao X, et al., 2021, Network Meta-analysis of the Efficacy of Different Methods for Treating Bromhidrosis. Chinese Journal of Aesthetic Medicine, 30(6): 17–22.

[7] Cao R, 2024, Analysis of the Cosmetic Effects and Safety of Modified Low Lateral Thoracic Wall Fenestration Drainage Versus Traditional Drainage in Small-incision Bromhidrosis Excision. Life Science Instruments, 22(1): 102–104 + 107.

[8] Qin Q, Wang X, Zhang J, et al., 2024, Comparative Efficacy of Axillary Fold Incision Thin Skin Flap Method and Small-incision Full-thickness Skin Graft Method for Bromhidrosis Treatment. Chinese Journal of Aesthetic Medicine, 33(1): 14–17.

[9] Lin X, Lu Y, Wang T, 2021, Observation of the Efficacy of Minimally Invasive Keyhole Negative Pressure Suction for Bromhidrosis Treatment and Analysis of Factors Influencing Postoperative Complications. Journal of Tissue Engineering and Reconstructive Surgery, 17(4): 335–338.

[10] Mou Y, Yu J, Yang P, et al., 2020, Nursing Experience With 72 Cases of Bromhidrosis Surgery Using Self-adhesive Elastic Bandages for “8-figure” Bandaging. China Medical Aesthetics, 10(6): 108–111.

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