Bloodless de-epithelialization in reduction mammoplasty with hydrodissection using a digital automatic anesthesia injector: case series

INTRODUCTION

Reduction mammoplasty, a common procedure for treating macromastia, is very safe and effective [1]. Vertical scar breast reduction using a superomedial pedicle is performed increasingly often due to its excellent functional and aesthetic outcomes [2]. De-epithelialization, an early step in reduction mammoplasty that removes excess skin and changes the nipple-areolar complex, helps save the subdermal plexus, including the vascular structures that provide oxygen and nutrients to cells. However, de-epithelialization of the pedicle is the most tedious and time-consuming step in breast reduction surgery. To save time in this step, various de-epithelialization techniques have been introduced, but there is no standard technique. The introduction of the local anesthetic intradermal infiltration technique by Bennett and Gilman [3], which has improved hemostasis and allowed hydrodissection at the epidermal-dermal junction, could help reduce the time spent on de-epithelialization. However, the conventional infiltration technique using a syringe may not deliver local anesthetics at a consistent volume, and the operator could experience fatigue. We present a series of cases where a digital automatic injector was used. The digital injector was used to perform even local infiltration of a mixture of 2% lidocaine and 1:100,000 epinephrine (0.018 mg/1.8 mL) into the junction of the dermis and epidermis, and to reduce the total amount of the injected mixture.

CASE REPORT

Methods

Before surgery, we measured the width, height, distance from the suprasternal notch to the nipple, distance from the nipple to the inframammary fold, and the breast volume of each patient scheduled for reduction mammoplasty using a superomedial pedicle...
with the vertical short scar technique. Preoperative markings were drawn on the patient’s breast in the standing position. Under general anesthesia, along the marked line, a mixture of 2% lidocaine and 1:100,000 epinephrine (Huons) was injected beneath the epidermis using an i-JECT digital injector (Medihub) mounted on a 30-gauge needle (Fig. 1, Supplementary Video 1). The digital injector has four modes for adjusting the injection rate of the lidocaine and epinephrine mixture with the press of a button. We injected the mixture using mode 2 to reduce the injection time. To confirm whether local anesthetic had been injected correctly at the epidermal-dermal junction, we checked for the formation of wheals on the patient’s skin. De-epithelialization was carried out with a no. 10 blade using the traditional method. A simple experiment was conducted to compare the conventional injection method by a dental anesthetic syringe and the machine injection method. The mixture was injected by the same operator onto the same area of 5 × 10 cm pieces of EasyFoam (CGBio) using the conventional method and the machine injection method. Both the quantity of the mixture used for injection and the extent of its diffusion were evaluated.

### Cases

We present seven cases of reduction mammoplasty using a superomedial pedicle with the vertical short scar technique, in which we used a digital automatic injector to administer an infiltration mixture of 2% lidocaine and 1:100,000 epinephrine (Table 1). Cases 1 and 7 underwent reduction mammoplasty on both breasts, and case 6 underwent mastopexy on both breasts. The surgical approach for cases 2, 3, 4, and 5 consisted of an implant-based breast reconstruction procedure after skin-sparing mastectomy was performed to treat breast cancer. Subsequently, reduction mammoplasty was carried out on the contralateral breast. The de-epithelialization area was approximately 50 cm² in four cases and 70 cm² in the other three cases. The amount of mixture used per 1 cm² was approximately 0.04 mL in all cases except for case 1. The injection time was about 130 seconds except in case 1, and the de-epithelialization time was under 10 minutes. There were no complications such as skin necrosis, hematoma, or wound infection. This technique of de-epithelialization with the digital automatic injector was faster and caused less bleeding than the technique without the digital automatic injector (Figs. 2, 3).

![Fig. 1. Intraoperative mixture of lidocaine and epinephrine infiltration with digital automatic injector. It is possible to confirm that the mixture has been injected into the epidermal-dermal junction by checking for wheal formation on the patient’s skin (Supplementary Video 1).](image1)

![Fig. 2. De-epithelialized breast pedicle, showing minimal bleeding after de-epithelialization.](image2)

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (yr)</th>
<th>Location</th>
<th>Preoperative volume (mL)</th>
<th>Reduction mass (g)</th>
<th>De-epithelialization area (cm²)</th>
<th>Amount of mixture (mL)</th>
<th>Injection time (sec)</th>
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Table 1. Summary of case series
DISCUSSION

Symptomatic macromastia can be treated by performing breast reduction mammoplasty, which is possible to perform in several different ways [4]. Irrespective of the type of procedure, excess breast tissue and skin should be removed, and the nipple-areolar complex should be appropriately located. The deskinning method, removing both the epidermis and dermis, consumes less time than de-epithelialization, which removes only the epidermis [5]. However, deskinning could increase the risk of nipple-areolar complex necrosis because the subdermal plexus, which contains many vascular structures that deliver blood to the nipple-areolar complex, is resected during the procedure. De-epithelialization of the pedicle involves preserving the pedicle while removing the epithelium, but it is time-consuming and tedious.

Several methods—electrocautery, laser, dermatome, hydrosurgery systems, and intradermal infiltration of local anesthetic—aimed at helping this process have been suggested [3,6,7]. Electrocautery delivers a strong electrical current to tissues to exert its desired effect, which may cause increased tissue damage, disturb wound healing by causing thermal injury or skin necrosis, and predispose the patient to infection [8]. Although the use of a laser in de-epithelialization could save time, it could delay wound healing and cause the formation of cysts. Furthermore, it costs more and requires expert skills. Pedicle de-epithelialization could be accomplished using a dermatome or a hydrosurgery system, which could reduce the operative time; however, these methods may result in incomplete de-epithelialization and sometimes require a second step to complete the process [9]. Additionally, the consumables used with the machines are very expensive.

Considering the disadvantages of these methods, we saved time during de-epithelialization by using a no. 10 blade and a digital injector to inject the mixture of 2% lidocaine and 1:100,000 epinephrine. The digital injector can control the injection rate through four modes. The operator could change the anesthetic injection rate by pressing a button (P mode: 1.8 mL/465 sec, mode 1: 1.8 mL/202 sec, mode 2: 1.8 mL/125 sec, mode 3: 1.8 mL/47 sec) (Supplementary Video 2). In case 1, we used mode 1, and the injection stage took more than 6 minutes. However, after the operation of the machine became familiar, the amount of injection was about 2 mL and could be injected with mode 2. The total time required for injection in cases 2 to 7 was approximately 2 minutes each.

The hydrodissection technique we used in these cases involved the injection of local anesthesia into the epidermal-dermal junction to separate the epidermis from the dermis and reduce bleeding. The success of the dissection was confirmed by wheal formation. This technique is similar to hydrodissection in nipple- and skin-sparing mastectomy, where a separation occurs between the subcutaneous plane and the prepectoral plane [10]. In hydrodissection performed with injection of a mixture, the surgeon can perform de-epithelialization more rapidly and accurately. Iwuagwu and Drew [5] reported that de-epithelialization using electrocautery without anesthetic injection took an average of 15.5 minutes. In our cases, when the time for digital injection and the time for de-epithelialization were combined, the procedure was estimated to take approximately 10 to 12 minutes. This can reduce the duration of the patient’s hospital stay, operation time, and treatment costs.

Computer-controlled local anesthetic delivery is utilized in den-
tal surgery to minimize patient pain during local anesthesia [11]. A digital automatic injector, as opposed to a traditional syringe, offers consistent volume and rate delivery, regardless of tissue resistance or density [12]. This results in easier hydrodissection and more accurate dissection of the epidermis. In our polyurethane foam experiment, injection was uniform in both groups on the front side, which had a non-permeable film layer. However, the mixture spread to the back side of the polyurethane foam only in the conventional injection group (Fig. 4). This indicates that the injection of the mixture was more uniform and accurate in the machine injection group than in the conventional injection group. The difference in uniformity and accuracy between conventional and machine injections is expected to be more significant in the human body due to the firm attachment of the fibrous component to the epidermal-dermal junction. Epinephrine has the potential to cause skin necrosis and even cardiomyopathy [13], while lidocaine can result in serious side effects, such as arrhythmia and shock. To mitigate these risks, reducing the total amount of the lidocaine and epinephrine mixture is recommended. In our experiment, the amount of mixture used was two ampoules in the conventional injection group, compared to only one ampoule in the machine injection group. The digital injector helped us use fewer ampoules of local anesthetic, and it includes a safety feature to check for proper needle insertion before injection occurs.

In conclusion, using a digital injector makes de-epithelialization easier and reduces bleeding, since it allows for precise injection of anesthetic into the epidermal-dermal junction without wasting time or increasing operator fatigue. Moreover, this technique improves the safety of the procedure by minimizing the potential over-delivery of epinephrine and lidocaine to the dermal layer through the use of precise injection into the epidermal-dermal junction, as well as by reducing the overall amount of the mixture administered. Subsequent investigations are necessary to measure the overall injection and de-epithelialization time associated with the use of intradermal infiltration, compared to the time required for de-epithelialization without this technique.

NOTES

Conflict of interest
No potential conflict of interest relevant to this article was reported.

Ethical approval
The study was approved by the Institutional Review Board of Gachon University Gil Medical Center (GDIRB 2023-278).

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

REFERENCES