Original Article

Significant reduction of hypertrophic scarring by lateral vertical incision in skin-sparing and nipple-sparing mastectomy

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**Background:** Some kinds of incisions have been reported in skin- or nipple-sparing mastectomy, but few reports have described the advantages and disadvantages of each incision. This study was conducted to compare the lateral horizontal incision with the lateral vertical incision in both mastectomies, in terms of hypertrophic scarring, breast envelope necrosis, nipple-areola necrosis.

**Material and Methods:** We performed a retrospective analysis of patients who underwent skin- or nipple-sparing mastectomy using lateral horizontal or lateral vertical incisions with immediate breast reconstruction. All data were obtained retrospectively from databases, operation records and postoperative pictures. We compared the frequency of hypertrophic scarring and breast envelope necrosis between lateral horizontal and lateral vertical incision groups by using Pearson’s chi-square test. For nipple-sparing mastectomy, we also investigated nipple-areola necrosis.

**Results and Conclusions:** One hundred fifty cases were analyzed and identified as 89 lateral horizontal incision cases and 61 lateral vertical incision cases. Mastectomy comprised SSM in 49 cases and NSM in 101 cases. Hypertrophic scarring was significantly less frequent with lateral vertical incisions (1.6%) than with lateral horizontal incisions (14.6%) (P=0.007). No significant differences were seen in terms of breast envelope necrosis, nipple-areolar necrosis.

**Key words:** skin-sparing mastectomy; nipple-sparing mastectomy; incision; hypertrophic scar

**Introduction**

Skin-sparing mastectomy (SSM) was first described by Toth and Lappert ¹ in 1991, representing complete removal of breast tissue while preserving as much of the overlying breast skin envelope as possible to prepare the patient for immediate breast reconstruction (IBR). SSM involves excision of the nipple-areola complex, biopsy scar and skin immediately above the tumor. This minimal excision preserves much of the breast skin envelope and inframammary fold. The technique has been widely adopted for IBR due to the better esthetic results without severely impacting local recurrence and survival rates compared to modified radical mastectomy ².

Nipple-sparing total mastectomy ³ and nipple-sparing mastectomy (NSM) ⁴ emphasize leaving only the skin envelope in comparison with "subcutaneous mastectomy", and were reported in 1998 and 2001, respectively. These procedures have recently become more frequently used for small, peripherally located tumors ⁵, although some surgeons have raised concerns about possible cancer involvement in the nipple region.

Various kinds of incisions have been reported with these mastectomies. Toth and Lappert ¹ first reported a reduction-pattern mastectomy, and later reported periareolar incision with submammary incision and tennis racquet incision, which signifies a periareolar incision with a lateral extension to facilitate access to the axilla ⁶. These three incisions and elliptical incision are most commonly reported, and the periareolar incision is most common in the United Kingdom ⁷. Conversely, lateral vertical incision is sometimes reported in Japan ⁸, ⁹.

The incisions used in mastectomy vary among institu-
tions and few reports\textsuperscript{10,11} have described the advantages and disadvantages of each incision. This is the first comparative study of the lateral horizontal incision and the lateral vertical incision in SSM and NSM, in terms of hypertrophic scarring, breast envelope necrosis, nipple-areola necrosis.

Materials and Methods

Retrospective analysis was performed for all patients who underwent SSM or NSM using lateral horizontal or lateral vertical incisions (Fig. 1) with IBR between May 1999 and June 2008 in our institute. Lateral horizontal incisions were used mainly before July 2005 and later- al vertical incisions were used mainly after July 2005. A periareolar incision was added in all cases until 2001. After that, a periareolar incision was added when dissection of the nipple-areolar region proved difficult. After 1999, one of the authors (M.H.) or several surgeons under his direction carried out reconstructive procedures. All data were obtained retrospectively from databases, operation records and postoperative pictures. Of these, 8 patients were excluded because of the lack of follow-up period or no data about hypertrophic scarring or breast envelope necrosis. The follow-up period was defined as the period between the day of IBR and the day on which all data were collected. We excluded cases in which follow-up period was <6 or >24 months.

Frequencies of hypertrophic scarring and breast envelope necrosis were compared between lateral horizontal and lateral vertical incisions by using Pearson’s chi-square test. Hypertrophic scarring was defined as a scar that raised above the surrounding skin. Breast envelope necrosis was defined as skin loss (except in the nipple-areola region) that required debridement and local wound care. Data indicating hypertrophic scarring and breast necrosis were retrieved from the databases as a simply present vs. absent binary variable. For NSM, we added investigations of nipple-areola necrosis. For nipple-areola necrosis, lateral horizontal and lateral vertical incisions were further subdivided according to use of a periareolar incision (+PI) or not (-PI). Cases with no data about hypertrophic scarring or breast envelope necrosis were excluded. Between two groups (lateral horizontal and lateral vertical incisions) and two subgroups (+PI and -PI), there are no significant differences in age, BMI (body mass index) and follow-up period (Table 1.2).

JMP version 5.0.1J software (SAS Institute, Cary, NC, USA) was used to perform statistical analyses. The institutional review board at Tokyo Medical and Dental University Hospital, Tokyo, approved all study protocols.

![Figure 1](image1.png)

**Figure 1**: A) Lateral horizontal incision. B) Lateral vertical incision. Periareolar incision is shown as a dotted line. In SSM, the nipple-areola complex is removed.
Results

A total of 158 patients underwent SSM or NSM with IBR using lateral horizontal or lateral vertical incisions between May 1999 and June 2008 in our institute. Most patients were operated on or supervised by the corresponding author. One hundred fifty cases were analyzed and identified as 89 lateral horizontal incision cases and 61 lateral vertical incision cases. Mastectomy comprised SSM in 49 cases and NSM in 101 cases. Reconstruction involved a deep inferior epigastric artery perforator flap in 1 case, transverse rectus abdominis musculocutaneous flaps in 25 cases, vertical rectus abdominis musculocutaneous flaps in 6 cases, latissimus dorsi flaps in 36 cases, expander-implants in 81 cases and implant in 1 case. Frequency of hypertrophic scarring was 14.6% with lateral horizontal incision and 1.6% with lateral vertical incision. Hypertrophic scarring was thus significantly less frequent with lateral vertical incision (Fig. 3) (P=0.007; Pearson’s chi-square test). Frequency of breast envelope necrosis was 13.5% for lateral horizontal incision and 16.4% for lateral vertical incision, with no significant difference apparent between groups (P=0.621; Pearson’s chi-square test) (Table 3).

Nipple-areola necrosis was analyzed in the 101 NSM cases, comprising 66 lateral horizontal incision cases (-PI, n=39; +PI, n=27) and 35 lateral vertical incision cases (-PI, n=11; +PI, n=24). Frequency of nipple-areola necrosis was 10.3% in lateral horizontal incision -PI, 25.9% in lateral horizontal incision +PI, 18.2% in lateral vertical incision -PI, and 33.3% in lateral vertical incision +PI. Both incision groups tended to show higher necrosis rates in the +PI group, although no significant differences were identified (P=0.161; Pearson’s chi-square test) (Table 4).

Discussion

The lateral horizontal incision in SSM is like the tennis racquet incision and offers the advantage of a wide operative field. The lateral vertical incision was originally developed as the incision for breast-conservative therapy, and has often been used for SSM and NSM in Japan. In our institute, the vertical line does not extend beyond the inframammary fold. This incision can hide the scar from a frontal view, but narrows the operative field and occasionally requires use of a headlight.

We started using lateral horizontal incisions in 1999, based on the opinion of our breast surgeon. We then shifted to lateral vertical incisions in 2005 to improve esthetic appearance. The present study was undertaken to clarify the advantages and disadvantages of both incisions.

Hypertrophic scarring

When we think about the incision line, we consider skin tension lines like Kraissl lines or Borges’s relaxed skin tension lines (RSTL). Borges advocates the use of Kraissl’s line for the torso and extremities. A lateral horizontal incision on the breast follows the Kraissl line, whereas a vertical incision does not. We were therefore initially concerned about increased hypertrophic scarring with a lateral vertical incision. However, lateral horizontal incisions were found to cause more hypertrophic scarring despite similar breast envelope necrosis rates between these incisions. The Kraissl line is generally at right angles to muscle fibers, but the line runs parallel to muscle fibers in the region of the serratus anterior muscle and the scar also runs parallel...
to muscle fibers. This may be one reason underlying the increased hypertrophic scarring seen with lateral horizontal incisions and modifications of the Kraissl line may thus be required.

In several implant cases with lateral horizontal incision, we found backward-oriented hypertrophic scarring differing from that seen in autologous cases in which hypertrophic scarring was present for the full extent of the incision. In implant cases, the scar is susceptible to the direction of muscle fibers because the implant is set under the pectoris major and serratus anterior muscles and breast skin lies near the muscle. We think that backward scars lie on the serratus anterior muscle in parallel with muscle fibers, which tends to result in hypertrophic scarring.

**Table 3. Hypertrophic scarring and breast envelope necrosis**

<table>
<thead>
<tr>
<th></th>
<th>Lateral horizontal incision (n=89)</th>
<th>Lateral vertical incision (n=61)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophic scarring n (%)</td>
<td>13 (14.6)</td>
<td>1 (1.6)</td>
<td>0.007*</td>
</tr>
<tr>
<td>Breast envelope necrosis</td>
<td>12 (13.5)</td>
<td>10 (16.4)</td>
<td>0.621*</td>
</tr>
</tbody>
</table>

Note: *Pearson’s chi-square test.
I, implant cases; A, autologous cases.

**Table 4. Nipple-areola necrosis**

<table>
<thead>
<tr>
<th></th>
<th>Lateral horizontal incision (n=66)</th>
<th>Lateral vertical incision (n=35)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Periareolar incision</td>
<td>11 (16.7)</td>
<td>10 (28.6)</td>
<td>0.161*</td>
</tr>
<tr>
<td>No Periareolar incision</td>
<td>4 (10.3)</td>
<td>7 (25.9)</td>
<td>0.145*</td>
</tr>
</tbody>
</table>

Note: *Pearson’s chi-square test.

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**Figure 2**: Postoperative appearance after lateral vertical incision with periareolar incision and TRAM flap reconstruction. The patient showed limited breast envelope necrosis and nipple-areola necrosis. The lateral vertical scar is not conspicuous.

**Figure 3**: Postoperative appearance after lateral horizontal incision and expander-implant reconstruction. The lateral horizontal scar shows backward-oriented hypertrophy.
Breast envelope necrosis

The breast is nourished by the internal and lateral thoracic arteries, thoracoacromial artery (perforating branches of pectoris major) and so on, and breast envelope necrosis often occurs after mastectomy. Skin necrosis is partially associated with skin and subcutaneous resection thickness. In SSM or NSM, this event may complicate wound healing and even threaten the success of the reconstruction. SSM flap complication rates have been reported as 10.7-24.3% [10,16,18]. Some reports have compared incisions. Proano and Perbeck [11] compared submammary incisions with horizontal incisions, finding that skin circulation 2 cm below the nipple-areola complex was lower in the submammary incision group than in the horizontal incision group. Meretoja et al. [10] reported that tennis-racquet-type incision was associated with a higher frequency of complications like necrosis compared to a round periareolar-type incision. In our study, complication rates for both incisions were in no way inferior to past reports and showed no significant differences between incisions, so we could not reach any definitive conclusion as to which incision is better.

Nipple-areola complex necrosis

The nipple-areola complex tends to receive inadequate blood flow following mastectomy, as the main sources of nourishment are the internal and lateral thoracic arteries [10], which are cut off. We initially used lateral horizontal incision with a periareolar incision, but then ceased using the periareolar incision because too many cases of nipple-areola complex necrosis were encountered [20]. In this study, the periareolar incision group tended to display a higher necrosis rate, but no significant differences were seen between groups with or without periareolar incision. This may be attributable to the limited number of cases examined. Lateral vertical incisions tended to be associated with a higher necrosis rate. Decreased blood flow from the lateral thoracic artery may affect necrosis. Most necrosis we encountered involved epidermolysis or marginal necrosis, so few cases displayed flattening of the nipple.

According to the results described above, lateral vertical incision rarely caused hypertrophic scarring and no significant differences existed between lateral horizontal and lateral vertical incisions for other items. Lateral vertical incision was thus considered to represent a very useful incision. Particularly in NSM without periareolar incision, lateral vertical incision may represent a superior alternative because no scar is visible from the frontal view.

References
