

Determination of the accuracy of juxtacapsular dissection of the breast. What is left behind?

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Abstract

Background: Resectional breast surgery has become less extensive. Dissection on plane of the superficial fascia covering the breast (juxtacapsular) is used during various procedures for retention of the appearance of the breast. The accuracy of this method and its ability to remove all glandular breast tissue has never been tested.

Methods: Twenty patients with breast cancer were studied prospectively.

Juxtacapsular dissection of the inferior flap was performed during mastectomy.

Biopsies were taken on each side of the dissection plane at 3 sites: median, medial and lateral. Several histological slides were prepared from each biopsy and examined for the presence of breast parenchymal or dispersed glandular tissue.

Results: Three hundred and forty nine histological slides were examined, 185 from the resected breast side and 164 from the subcutaneous side. Ninety four percent of the slides from the breast side contained glandular tissue. Breast glandular tissue was found outside the dissection plane in 16 of 20 cases and in 33% of slides. This was sparse and dispersed in 69% of slides.

A mean of 81% of slides from individual cases revealed glandular tissue inside and the absence of glandular tissue outside the dissection plane (“expected result”), demonstrating predominantly accurate juxtacapsular dissection.

Conclusion: This study demonstrated that accurate juxtacapsular inferior flap dissection leaves behind glandular breast tissue in a greater proportion of cases than any previous study. While this tissue is sparsely-distributed, surgeons should be aware of the occurrence of glandular breast tissue outside the juxtacapsular dissection plane in the majority of cases.

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The surgical treatment of breast cancer has changed progressively from that of mutilating procedures to eradicate a lethal growth, to the current practice of minimal resectional surgery and retention of the appearance of the breast.(1,2) This is because it has become evident that radical surgery for breast cancer achieves no better results than more conservative procedures.(3,4) The development of effective antineoplastic drugs and radiation therapy has run pari passu with that of breast-retentive surgery. These developments have allowed the maintenance of a normal or near normal appearance of the breast after surgical treatment of cancer.(5)

The ideal in breast cancer surgery is to remove the tumor and all glandular tissue, but to retain the aesthetic aspect of the breast. For this reason procedures have been developed that retain the skin of the breast as well as its defining features. Skin-sparing mastectomy and nipple-sparing mastectomy in which the whole skin envelope of the breast is retained, are prone to ischaemia of the skin and therefore to a substantial incidence of skin necrosis.(6) The ideal plane of dissection for these procedures is uncertain. One practice is to remove the glandular tissue by dissection on the capsule of the breast, ie the juxtacapsular plane. This is also recommended for retention of the inframammary fold. Conventional mastectomy which raises the inferior flap onto the rectus abdominis muscle, of necessity disrupts this fold. Much has been written about dissection on the plane of the capsule of the breast and this

method is commonly employed, but accuracy of this juxtacapsular dissection has never been formally investigated.

The aim of this study was to determine the accuracy of juxtacapsular dissection of the breast by determining histologically the presence of such tissue on either side of this plane. Secondary aims were to determine the nature as well as the location of any glandular tissue outside the dissection plane.

Patients and methods

A prospective study was performed on 20 patients who were scheduled for mastectomy for invasive breast cancer. Convenience recruitment of patients was used, based on the availability of the investigating surgeon as these procedures were performed on different surgeons' operation slates. Patients with locally advanced disease, those who had had prior chemotherapy and those whose primary tumors were close to the inframammary fold were excluded.

Written informed consent was obtained individually from each patient. Permission to perform the study was obtained from the Research Ethics Committee of the Faculty of Health Sciences of the University of Pretoria.

Raising of the inferior mastectomy flap was chosen as a convenient locality for sampling in this study. All procedures were total mastectomies and all dissections were performed by one experienced breast surgeon. Standard elliptical incisions were made encompassing the nipple-areola complex and the skin over the tumor. Sharp-

toothed Lahey traction forceps were applied to the dermis of the inferior flap and retracted away from the chest wall, while firm countertraction was applied manually to the breast tissue. Dissection by minimal application of electrocautery without charring of the tissue was performed in the apparent plane of separation between parenchymal breast and subcutaneous tissue. This plane was recognised as an almost avascular layer between the dense, fibrous, whiter breast tissue, and the yellow adipose tissue under the skin. The dissection was therefore just outside the breast capsule. This dissection resulted in the thickness of the flaps varying according to the patient's bodily habitus. Division was continued down to the deep fascia on the pectoralis major muscle. Biopsies were then taken on either side of this dissection plane from the resected breast tissue and the subcutaneous tissue directly opposite (by temporarily opposing the breast tissue and the inferior flap). The biopsies were taken from the halfway position of the extent of the flap at three sites, viz directly inferior to the nipple (median) and 4 to 5cm on either side (medial and lateral) (Fig.1). This was done to determine whether accuracy would vary in different areas of dissection. The biopsy sites are depicted graphically in figure 1. The specimens were immediately placed into a fixing solution and later subjected to histological examination. Several slides were prepared from each biopsy according to technical feasibility from small biopsies, and to anticipate any technical attrition. These preparations were examined by the study histologist for the presence of glandular breast tissue.

Specimen preparation.

Tissue samples were fixed in a mixture of 2.5% gluteraldehyde and 2% formaldehyde in phosphate-buffered saline for 12-24 hours. They were thereafter dehydrated in

successively stronger ethanol solutions, cleared with xylene and then embedded in paraffin wax. Sections of 4-6µm were stained with haematoxylin and eosin, and images viewed at 10x magnification.

Definitions

Glandular breast is defined as glandular tissue embedded in a dense fibrous stroma, with or without varying amounts of fat tissue in the stroma.(7) Such tissue is assumed to be part of the intracapsular parenchymatous breast tissue and will hereinafter be referred to as aggregated breast tissue.

Loose islands of breast glandular tissue associated with or without strands of fibrous tissue and surrounded by fat tissue will hereinafter be referred to as dispersed glandular tissue. Such tissue is assumed to be unattached in relation to the breast parenchyma and to be located outside the breast capsule.

Statistical analysis

Descriptive summary statistical analysis was performed. Classical tests of hypothesis for two-sample proportions were calculated using the 12.1 version of the Stata software. Parameters compared were the type of tissue, the location in relation to the dissection plane and the site of the biopsy. Comparisons were considered to be

statistically significant when the probability (Z-standardised or t-statistics) was $(Z/t) \leq 0.05$.

Results

All the patients were female and presented with stages I or II breast cancer. Their ages ranged from 41 to 77 (mean 55) years.

There were no major surgical complications in this group of patients, and specifically no instances of skin necrosis occurred.

Intra- and extraparenchymal glandular breast tissue as defined above, was readily discernible on the histological preparations (Fig.2). Some slides revealed isolated islands of glandular tissue embedded in strands of fibrous tissue of the superficial fibrous capsule of the breast or in a field consisting of fat tissue only (Fig.3). A lesion of mild hyperplasia of the usual type was present on a single slide. No electrocautery artefact was seen in any of the specimens.

In total 349 histological slides were prepared. These comprised 2 or more from each side of the dissection plane from the three designated sites (medial, median and lateral), except in one case where only 1 satisfactory slide was available from 1 side of the dissection plane at 1 site.

Parenchymal breast biopsies

Of the 185 slides prepared from specimens taken from the parenchymal side of the dissection plane 173(94%) contained breast glandular tissue (“expected” finding). This occurred in all 20 cases, and in all of the 3 sites (medial, median and lateral) except for 2 cases which were devoid of glandular tissue in the lateral specimens. This tissue was aggregated in 164 (95%) of the slides and dispersed in 9(5%).

Extracapsular biopsies

Of the 164 slides prepared from specimens taken from the subcutaneous (extra capsular) tissues 109(66.5%) contained no glandular tissue, while 55(33%) contained breast glandular tissue (finding “not expected”) (Table 1). The glandular tissue occurred in 16 of the 20 cases (80%), but the tissue was sparsely distributed in the majority, viz 39 of 55 slides (71%) (Table1). Aggregated glandular tissue was present in 16(29%) of the slides. The specimens revealed glandular tissue in at least 1 of the 3 sites (medial, median and lateral) in 15 cases (75%).

The proportions of extracapsular, aggregated and dispersed glandular tissue for the median, medial and lateral sites is also shown in Table 1 (last column). While there was a trend for more extracapsular glandular tissue to occur at the median site than the other 2 sites, the comparisons did not reach statistical significance: median (24/55 slides, 43%) vs medial (14/55 slides, 25%) $p = 0.07$ and median (43%) vs lateral (17/55 slides, 31%) $p=0.2$.

Accuracy of dissection in the juxtacapsular plane is depicted in Figure 4. This shows results for the total number of slides in the study (first 2 panels), as well as slides from individual cases (third panel). The difference between the proportions of 81% of slides in individual cases from the breast side with glandular tissue (confidence interval 64-98), and 19% of slides from the subcutaneous side without glandular tissue (confidence interval 2-36) is highly significant, z score 3.92, $p < 0.001$ (unpaired Student's t-test). This is the "expected result" and indicates that dissection was done predominantly at the interface of breast and subcutaneous tissue, and was therefore mainly accurate. Apparent intraparenchymal dissection in this study, as evidenced by the presence of aggregated glandular tissue outside the dissection plane, was uncommon. It occurred in only one site in 82% of cases which demonstrated extracapsular breast tissue, and on only 1 slide in 73% of these cases.

Discussion

The demonstration of accuracy of dissection in intended total removal of glandular breast tissue has never been published before. This was determined in the present study by statistical analysis of the presence of breast tissue on either side of the juxtacapsular dissection plane, and for the designations of "expected" and "unexpected" results. This analysis showed that dissection had, in the main, been accurate.

Studies have been published addressing the completeness of glandular tissue removal in skin-sparing procedures. Cao et al (8) examined additional tissue superficial to the resection plane of the tumor in 168 patients undergoing skin-sparing mastectomy for breast cancer. They found breast tissue outside the resection margin in 38% of cases. Of these, 20% demonstrated residual carcinoma. Torresan et al (9) excised the skin flaps that would remain after skin-sparing mastectomy in 42 breast cancer patients undergoing mastectomy. They found glandular breast tissue in the skin flaps in 59.5% of cases. The prevalence of this tissue was associated with skin flap thickness greater than 5mm. A similar study by Ho et al found involvement of the skin by cancer in 20% of cases of skin-sparing mastectomy.(10) Beer et al (11) described islands of breast tissue in the superficial fascia in 42% of 62 breast reduction specimens. They, however, demonstrated absence of the superficial layer of the superficial fascia of the breast in 44% of cases.

Similar studies have been performed in patients undergoing modified radical mastectomy for cancer, as in the present study. Carlson et al (12) removed tissue outside the fascial capsule of the breast in the region of the inframammary fold in 24 mastectomy specimens. Representative specimens from this tissue were examined and breast tissue was demonstrated in 13 cases (54%). The calculated percentage of total breast tissue that would have been left behind was small. Gui et al (13) used a similar method in studying the inframammary fold . Twenty percent of specimens taken from the resected inframammary fold contained breast tissue. The tissue under the skin flaps in Patey mastectomies was examined by Tewari et al.(14) They found residual breast tissue in 8 of 37 cases (21.6%), and in 3 cases tumor tissue was also found. The thickness of the flaps is not stated. Prophylactic total glandular

mastectomy and modified radical mastectomy were compared by Barton et al (15) for residual breast tissue. Biopsies were taken from the anterior chest wall after mastectomy. Glandular tissue was identified in 5% of biopsies regardless of the type of mastectomy. The proposition that no mastectomy is ever complete is based on this study.(12,16) In all these studies significant amounts of breast tissue were demonstrated outside supposed complete glandular resection margins. Using our method which purposively sampled on either side of a resection margin, breast tissue was demonstrated outside the resection plane in 55 (33%) of histological slides and in 16/20 (80%) of cases.

It is clear from published studies that no type of mastectomy removes all glandular tissue.(15,17) This inability is demonstrated in the present study for juxtacapsular dissection. It is also clear that there is concern about the completeness of lesser resectional procedures on the breast.(8,18,19) These considerations are important in the management of invasive breast cancer as well as in patients subjected to prophylactic procedures for genetic abnormalities predisposing to cancer.(20)

Conversely, there is a desire to retain the defining cosmetic aspects of the breast after cancer surgery. These are specifically the breast mound, the nipple-areola complex and the inframammary fold. The ideal is to remove all mammary glandular tissue but to retain these aesthetic features.

In skin-sparing mastectomy and nipple-areola sparing mastectomy glandular excision is performed through limited skin access. Various methods of defining the plane of dissection in these procedures are recommended. These include limiting the thickness

of the skin flaps, ranging from 2mm up to 1cm (21,22,23), and dissection on the plane of the breast capsule.(22) The latter plane is used by some surgeons also during total or modified radical mastectomy.

The breast is surrounded by an anterior and a posterior layer of the superficial fascia covering the anterior chest wall.(22,24) This is conventionally referred to as the breast capsule. Juxtacapsular dissection is performed on the plane of the anterior layer of the superficial fascia covering the breast parenchyma.

In the present study an attempt was made to determine the accuracy of total breast glandular excision by juxtacapsular dissection of the inferior mastectomy flap. The differentiation of aggregated and dispersed breast tissue was made to distinguish between possible erroneous intraparenchymal juxtacapsular dissection, and the natural occurrence of breast tissue outside the breast parenchyma. This latter phenomenon may be the explanation for the findings of other investigators. Indeed, the glandular tissue demonstrated outside the breast capsule in the present study was mainly sparse and scattered (dispersed). While there is scant description of the precise histological appearance of such tissue in published studies, it seems to be similar to that seen in the present study. Beer et al (11), who examined vertical sections of skin and subcutaneous tissue of breast reduction specimens also demonstrated “islands of breast tissue”. The description of such tissue by Barton et al is that of “glandular tissue ... that did not form a discernible pattern”. Gui et al (13) categorised the presence of breast tissue as absent, focally present or abundant. This is similar to the categories of aggregated and dispersed breast tissue used in the present study.

It is possible that the occurrence of much of the apparently extracapsular glandular tissue in these cases was due to the breast capsule being incomplete or absent, as postulated by Beer et al.(11) The vast majority of instances of extracapsular breast tissue in this study consisted of sparse, unattached islands of glandular tissue on single slides from single sites.

The acceptable plane of dissection for skin-sparing mastectomy and nipple-sparing mastectomy is uncertain. The thinner the skin flaps the more likely is skin necrosis. (6, 21) Dissection on the breast capsule (superficial fascial layer) would usually obviate necrosis, as in the present study, but apparently at the price of leaving behind some breast tissue in the majority of cases. Juxtacapsular dissection is also relevant to retaining the inframammary fold. Conventional mastectomy of necessity disrupts the fold thus destroying an important defining feature of the breast.

Local recurrence rates after breast cancer surgery have declined progressively. This is largely due to the widespread use of adjuvant therapy.(5) This begs the question of the significance of breast tissue probably left behind by modern less radical procedures. With regard to breast cancer, it has been shown that local recurrence is more related to the biological behaviour and local characteristics of the tumor, than to the type of surgery.(25) However, residual breast tissue is clearly of concern in patients in whom adjuvant therapy is not contemplated, such as procedures for cosmesis, non-invasive carcinoma and cancer prophylaxis.

The present study was performed on the inferior mastectomy flap and is therefore especially relevant to maintenance of the inframammary fold. This structure is an important defining feature of the female breast. Many methods have been described to reconstruct the fold after mastectomy, using own tissue or foreign material.(26, 27, 28) Few, however, can restore the fold to its completely natural appearance.

Dissection on the anterior breast capsule has been recommended for retention of the fold.(8, 22) This maintains the natural appearance but it would appear that some breast tissue is left in situ.

Conclusions

This study demonstrates that juxtacapsular resection of the parenchymal breast can be performed accurately and will remove most, but not all, glandular tissue. By employing a precise and directed sampling technique, accurate juxtacapsular dissection is shown in this study to leave behind mainly sparsely-distributed glandular tissue in the majority of cases.

This study concurs with previous publications that glandular tissue occurs beyond the parenchymal breast. This tissue is mostly dispersed and of low volume.

Juxtacapsular dissection is employed during various procedures on the breast. These include those for malignancy, cancer prophylaxis and cosmesis. Surgeons should be aware that glandular tissue occurs adjacent to this dissection plane outside the parenchymal breast.

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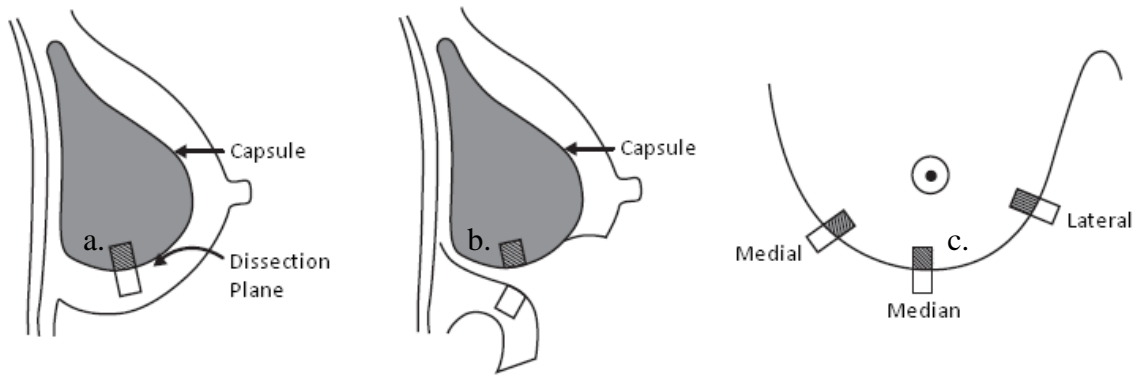


Figure 1. Biopsies were taken from either side of the dissection plane (a and b) and from three sites (c). The shaded area represents parenchymal breast tissue deep to the breast capsule. The hatched rectangles depict the parenchymal breast biopsies, and the clear rectangles the biopsies directly adjacent, from the inferior flaps.

Figure 2 VOL Karusseit

Top (x10)

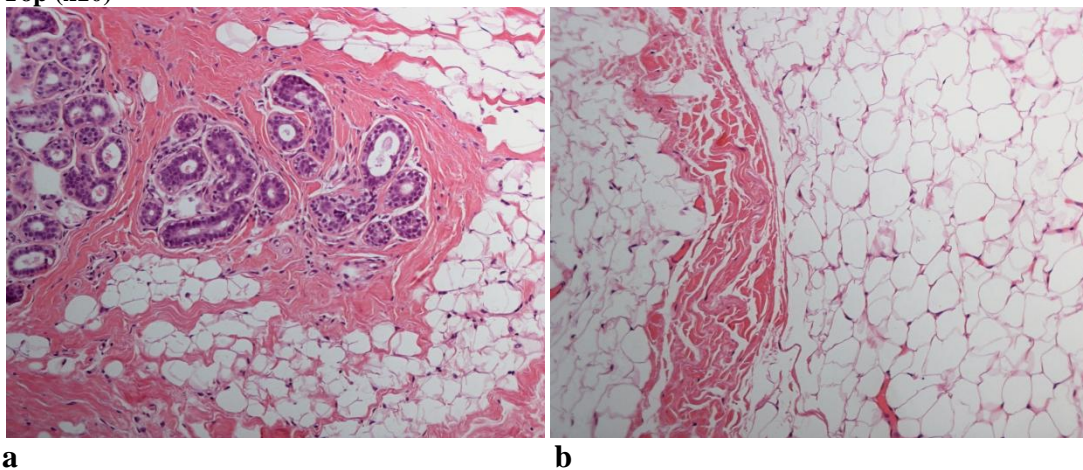


Figure 2. The histological slides depicted were prepared from biopsies taken from breast and subcutaneous tissue directly opposite each other in the same patient. Panel **a** shows normal breast tissue. Panel **b** shows a fibrous band in normal fatty tissue, and no glandular tissue.

Figure 3 VOL Karusseit

Top (x10)

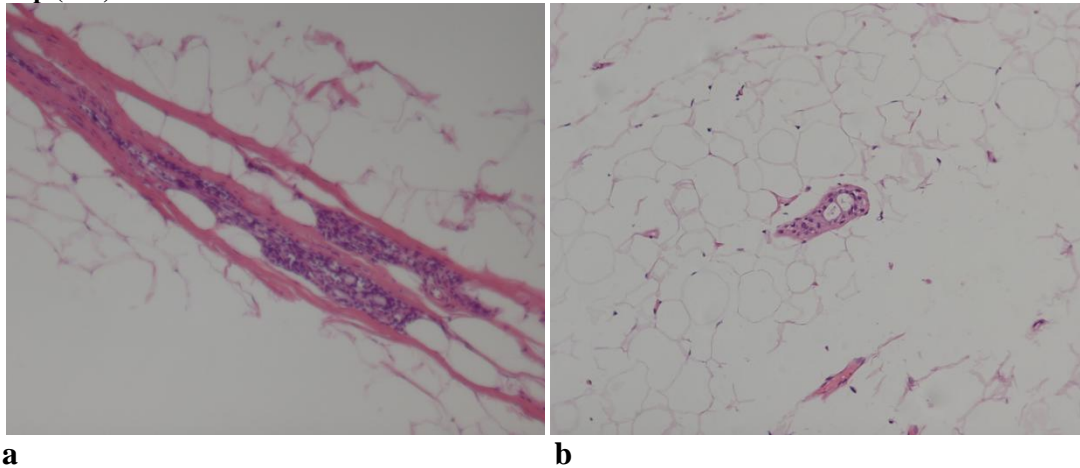


Figure 3. Examples of dispersed glandular breast tissue from extracapsular biopsies. **a** A fibrous band containing sparse glandular tissue embedded in fatty tissue. **b** A completely isolated island of glandular tissue in extracapsular fat.

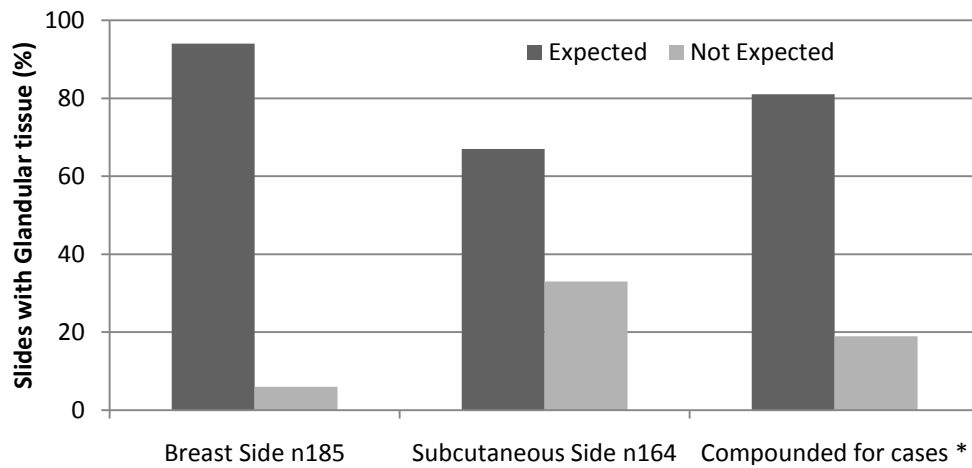


Figure 4. Proportion (%) of 349 slides containing breast glandular tissue, according to the origin of the specimens in relation to the dissection plane (the first 2 sets) and whether the result was expected or not (glandular tissue in the breast and absent in the subcutaneous tissue, or vice versa). The results were extracted for each of the 20 cases and compounded in the third set.

* $p < 0.001$ (Students t-test)

Table 1. Extracapsular slides with glandular tissue by site. n55

Site	Aggregated n(%)*	Dispersed n(%)	Total n(%)
Medial	2 (4)	12 (22)	14 (25)
Median	10 (18)	14 (25)	24 (44)
Lateral	4 (7)	13 (24)	17 (31)
Total	16 (29)	39 (71)	55 (100)

* Aggregated breast tissue occurred in 11 of the 20 cases (55%).