



**HAL**  
open science

## A two millimetre free margin from invasive cancer minimises residual disease in breast-conserving surgery

Stephen Thomas Ward, Bruce Jones, Alan Jewkes

### ► To cite this version:

Stephen Thomas Ward, Bruce Jones, Alan Jewkes. A two millimetre free margin from invasive cancer minimises residual disease in breast-conserving surgery. *International Journal of Clinical Practice*, 2010, 64 (12), pp.1675. 10.1111/j.1742-1241.2010.02508.x . hal-00585815

**HAL Id: hal-00585815**

**<https://hal.science/hal-00585815>**

Submitted on 14 Apr 2011

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



**A two millimetre free margin from invasive cancer  
minimises residual disease in breast-conserving surgery**

Journal:	<i>International Journal of Clinical Practice</i>
Manuscript ID:	IJCP-06-10-0325
Wiley - Manuscript type:	Original Paper
Date Submitted by the Author:	16-Jun-2010
Complete List of Authors:	Ward, Stephen; Department of Breast Surgery, Good Hope Hospital, Rectory Road Jones, Bruce; Department of Breast Surgery, Good Hope Hospital, Rectory Road Jewkes, Alan; Department of Breast Surgery, Good Hope Hospital, Rectory Road
Specialty area:	



## TITLE PAGE

**A TWO MILLIMETRE FREE MARGIN FROM INVASIVE CANCER MINIMISES RESIDUAL  
DISEASE IN BREAST-CONSERVING SURGERY****Ward ST, Jones BG, Jewkes AJ****CORRESPONDING AUTHOR:**

Stephen T Ward, BSc(Hons) MB BS MRCS

Good Hope Hospital, Rectory Road, Sutton Coldfield, West Midlands B75 7RR, UK

e-mail: [drsteward@yahoo.com](mailto:drsteward@yahoo.com)

Corresponding address: Department of Breast Surgery

Good Hope Hospital

Rectory Road

Sutton Coldfield

West Midlands

B75 7RR, UK

Telephone: +44 7904 216421

Fax: +44 121 42 49548

**OTHER AUTHORS:**Bruce G Jones; [bruce.jones@heartofengland.nhs.uk](mailto:bruce.jones@heartofengland.nhs.uk)Alan J Jewkes; [alan.jewkes@heartofengland.nhs.uk](mailto:alan.jewkes@heartofengland.nhs.uk)

Good Hope Hospital, Rectory Road, Sutton Coldfield, West Midlands B75 7RR, UK

**KEYWORDS:**

Surgical margins; Re-excision; Breast-conserving surgery; Breast neoplasm

**ABSTRACT****Aims**

In breast-conserving surgery, the width of free margin around a tumour to ensure adequate excision is controversial. The aim of this study was firstly to evaluate the frequency of residual disease in wider excision specimens in patients who undergo further surgery due to close margins of less than 5 millimetres. Secondly, the ability of demographic and tumour-related factors to predict the close margins was appraised.

**Patients and methods**

Three-hundred-and-three patients were included in the study. Patients undergoing wider excision were assessed for the presence of residual disease and this was tested for association with the width of the initial free margin. Various factors were studied for association with close or involved margins by univariate analysis.

**Results**

Fifty-three percent of patients were eligible for re-excision based on the need for a 5 millimetre clearance. With a free margin of 2 mm or more from invasive cancer, the probability of finding residual disease was 2.3%. The probability of residual disease was higher for DCIS and did not decline with increasing free margin width.

Tumour size, lobular cancer type, vascular invasion and nodal involvement, were associated with close margins.

**Conclusions**

We suggest that a free margin of 2 mm from invasive cancer is adequate to minimise residual disease, whereas the equivalent free margin for DCIS is unclear. Patients with large tumours and lobular cancer type should be counselled at the time of first surgery concerning the higher risk of further excision and mastectomy.

**Word count: 241**

**What is already known about this topic?**

Following breast-conserving surgery, a margin involved with tumour is associated with residual disease and an increased risk of local recurrence. The necessary width of free margin to minimise both residual disease and local recurrence is controversial. The relationship between residual disease and local recurrence is also unclear.

**What does this article add?**

Our department requested re-excision of margins if the free margin width was less than 5 millimetres. Most other units aim for less than a 5 millimetre free margin and we were thus well-positioned to study the relationship between free margin width and residual disease.

## INTRODUCTION

Breast-conserving surgery (BCT) followed by adjuvant radiotherapy has been validated as an alternative to mastectomy over 20 years follow-up in selected patients [1,2]. These studies have demonstrated similar survival in both groups although there is an increased rate of local recurrence in patients undergoing BCT. Local recurrence has a detrimental effect on survival with nearly 50% patients with local recurrence having coincident distant disease [3,4].

There are no defined anatomical compartments in the breast and surgeons therefore rely on a rim of normal tissue around the tumour known as the *free margin* as evidence of complete removal. The most important factor determining local recurrence is the status of the free margin of the excised specimen [5]. Local recurrence occurs more frequently when there is no margin of normal tissue around the tumour despite adjuvant radiotherapy [6]. The width of free margin necessary to conclude that the tumour has been adequately excised is controversial and may differ for invasive cancer and ductal carcinoma in-situ (DCIS) [5,7].

A survey of two hundred breast surgeons from the United Kingdom revealed a wide variation in what is considered to be an adequate margin with 24% wanting a clear margin of 1 mm and 65% wanting a margin of 2 mm or more [8]. This study highlights a disparity in practice across different units and the need for evidence-based guidelines.

Marginal involvement is an indication for further surgery in the form of either wider excision or mastectomy and is frequently associated with residual disease in the further surgical specimen [6]. Further surgery when margins are not involved has been undertaken in order to gain a free margin clearance of 1, 2 or 5 mm [8]. Further surgery is obviously desirable if it leads to a risk reduction of local recurrence but negatively impacts on cosmesis as well as patient psychology and hospital resources. The relationship between residual disease and local recurrence is unclear [6].

1  
2  
3 With a policy in place to undertake further surgery when required to gain a free margin of certain width,  
4 pre-operative factors that could predict the likelihood of inadequate margins in BCT specimens could be  
5 useful in both patient counselling and the selection of patients for more extensive primary surgery or  
6 routine cavity shaving. Previous studies have found inconsistent associations of a wide range of factors  
7 available pre-operatively with the presence of involved margins and residual disease [6,9].  
8  
9  
10  
11  
12

13  
14  
15 During the study period, our unit aimed for a free margin of 5 mm in patients undergoing breast-conserving  
16 surgery for both invasive cancer and DCIS. The association between the width of free margin and residual  
17 disease in wider excision specimens was evaluated to guide local policy. Various demographic and  
18 tumour-related factors were also studied for an association with inadequate margins in order to establish  
19 how these factors could influence the nature or extent of surgery.  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## PATIENTS AND METHODS

The Good Hope Hospital Breast Cancer Database (GHHBCD) identified 310 patients who underwent breast-conserving surgery for breast cancer between 1<sup>st</sup> October 2002 and 22<sup>nd</sup> October 2008. These patients all had a pre-operative histological diagnosis of probable invasive cancer or DCIS, but seven patients were excluded due to absent or benign disease following excision, leaving a total of 303 patients in the study population.

The BCT specimens were oriented by the surgeon using sutures and in some instances, accompanied by one or more cavity shaves before submission for histopathological analysis. For ease of discussion, cavity shave specimens taken at the initial operation will be referred to as *primary cavity shaves*.

Surgical specimens were immediately placed in 10% neutral buffered formalin and transported to the pathology department. The specimens were left in formalin for a minimum period of 24 hours. BCT specimens were sliced at 5 mm intervals usually in the direction of the shortest axis. Every radial and deep margin of BCT specimens were analysed, taking at least three blocks of tumour from the closest macroscopic margins. Most or all of the tissue from cavity shave specimens were embedded for microscopic examination.

The distance between the tumour and the margin on microscopic assessment was noted for the following margins: medial, lateral, superior and inferior by analysis of pathology reports. A free margin width of less than 5 mm for either invasive cancer or DCIS was deemed to be inadequate in our unit, prompting either a wider excision or mastectomy. Anterior (superficial) and deep margins were not assessed in this study because generally wider excision was not performed if the anterior or deep free margin was less than 5 mm. The ability to perform a wider excision of the anterior and deep margins is frequently limited by the location of the tumour and there is evidence that most recurrences in relation to breast tissue occur along radial margins [10].

For those patients who underwent wider excision following BCT, the presence of residual disease was determined. Residual disease was defined as the presence of either invasive cancer or DCIS. Those

1  
2  
3 patients who underwent completion mastectomy or who were treated with chemoradiotherapy between the  
4 primary and further operations were excluded from the analysis. Some patients underwent wider excision  
5 of two or more margins sent as separate specimens, enabling the histopathological assessment of each  
6 margin and its wider excision to contribute separately to the analysis.  
7  
8  
9

10  
11  
12  
13 In the second part to the study, patients were classified into two groups: *Close margins* (one or more free  
14 margins of less than 2 mm at BCT) and *clear margins* (all free margins 2 mm or more). The two groups  
15 were compared for differences in demographic factors (age at diagnosis, tumour laterality), pathological  
16 factors (tumour grade, tumour type, presence of vascular invasion, use of a primary cavity shave) and  
17 radiological factors (ultrasound-determined tumour size). Ultrasound-determined measurements were  
18 chosen because they were thought to be more objective than clinical measurements and were more  
19 frequently performed than mammographic measurements.  
20  
21  
22  
23  
24  
25  
26  
27

28  
29 The experimental protocol was approved by the Good Hope Hospital Research and Ethics Committee. All  
30 breast cancer database data, pathology report data and radiology report data were tabulated using Microsoft  
31 Excel 2007 and statistical analysis was performed using StatView (v5.0, SAS Inst. Inc.). The Mann-  
32 Whitney U-test was used to test for statistical significant differences in age, and tumour size while Chi-  
33 squared analysis was used to test for statistical significant differences in tumour grade and type and the  
34 presence of vascular invasion.  $\chi^2$  and P-values were calculated to three significant figures.  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## RESULTS

Of the 303 patients in the study population, 93 (31%) patients underwent a wider excision and 39 (13%) a completion mastectomy. This left 171 (56%) patients who did not proceed to further surgery. Eleven patients in the wider excision group progressed to a third operation, all mastectomies.

Based on the criteria for free radial margins of 5 mm, 161 (53%) patients were eligible for further surgery although only 132 (44%) actually proceeded to this.

Of the 93 patients undergoing a wider excision, 140 wider excision specimens (88 for invasive cancer and 52 for DCIS) were analysed, a mean of 1.5 wider margins per patient.

### Width of free margin and residual disease in wider excision specimens

The percentage of wider excision specimens found to contain residual disease declined with increasing width of the free margin from invasive cancer at first surgery (see table 1). With a free margin of 2 mm or more, the probability of finding residual disease was 2.3%.

Regarding the relationship between the width of the free margin from DCIS and the percentage of wider excision specimens with residual disease, the overall probability of residual disease was higher for DCIS than for invasive cancer and this probability did not appear to decline as rapidly with an increasing width of free margin.

### Demographic and tumour-related factors

Comparison between the *close* and *clear* patient groups revealed a statistically significant association between tumour size, the presence of vascular invasion and nodal involvement with close margins (see table 2). Despite no overall association between the various tumour types and close margins, there was a statistically significant association when comparing the frequency of only ductal and lobular invasive carcinomas. Of the above factors, tumour size (as determined by ultrasound) and tumour type would be available to the surgeon pre-operatively.

## DISCUSSION

Our results clearly show a relationship between the width of the free margin and the likelihood of finding residual disease at further surgery. In order to minimise the risk of residual disease, we would recommend aiming for a free margin from invasive cancer of 2 mm. A free margin of 2 mm from DCIS was associated with a higher probability of residual disease but this analysis was based on fewer numbers.

From a logical standpoint, adequate excision should only demand a margin that is not directly involved with disease. However, the methodology employed to pathologically assess margin status is imprecise [5,7]. A single haematoxylin and eosin slide of a 2-3 mm block from a BCT specimen visualizes less than a thousandth of its surface area and therefore evaluation of margins is made by random and not complete examination of the surface [11]. A width of free margin is thus simply a marker of increased probability of adequate local excision of the tumour. A study of mastectomy specimens found that if hypothetical BCT surgery had been performed with free margins as great as 20 mm, foci of invasive tumour would remain in the breast in 14% cases [12]. This is because breast cancer is a disease of multifocality, multicentricity and discontinuous spread.

Studies have demonstrated an association between the width of the free margin and the probability of residual disease following wider excision [7,9,13,14]. A study of 211 patients treated by BCT showed residual disease in 44% cases with involved margins, 24% cases with free margins of less than 3 mm and in no cases where the free margin was greater than 3 mm [13]. In contrast to our findings, one study demonstrated residual disease in 45% patients with a free margin between 2 and 5 mm [9]. This may be due to the free margin of 2-5 mm surrounding in-situ as opposed to invasive disease.

Rationally, residual disease ought to be avoided but its importance in relation to local recurrence is unclear. The importance of the free margin width in terms of local recurrence has been corroborated by studies showing that re-excision to achieve clear margin status results in a low rate of local recurrence, equivalent to if the margins were clear initially [15]. There is also evidence that local recurrence rates are generally higher with free margins of less than 2 mm [5]. The use of routine cavity shaving in patients all treated by

1  
2  
3 the same surgeon, has demonstrated a higher rate of local recurrence and lower overall survival in those  
4 with positive primary cavity shaves [16] after 10 years of follow-up. This difference was however only  
5 statistically significant in the patient group with node negative disease.  
6  
7  
8

9  
10  
11 With regard to DCIS, the full extent of disease is often non-palpable and is underestimated by  
12 mammography [7] making adequate surgical margins more difficult to obtain. Our data was not able to  
13 determine a free margin width associated with minimal residual DCIS due to our policy of not re-excising  
14 free margins of more than 5 mm. The difficulty in obtaining a free margin around DCIS has led some  
15 investigators to suggest a free margin of 10 mm to minimise local recurrence [17], although a recent meta-  
16 analysis has reported no benefit from a free margin of more than 2 mm when combined with radiotherapy  
17 [18].  
18  
19  
20  
21  
22  
23  
24

25  
26  
27 It is accepted that the most important factor leading to local recurrence after BCT and adjuvant  
28 radiotherapy, and the only factor under surgical control, is the presence of involved margins, and that these  
29 require re-excision [6]. The controversy over the width of free margin required to avoid re-excision has  
30 been caused by conflicting results from the literature. This has probably arisen from a wide variation in  
31 patient characteristics, selection criteria leading to BCT over mastectomy, inclusion of patients undergoing  
32 diagnostic excisions, surgical technique, the use of radiotherapy including the use of radiotherapy boosts  
33 and differences in radiological and pathological evaluation. For this reason, it is wise for every breast unit  
34 to evaluate their individual rates of residual disease from wider excisions and local recurrence rates.  
35  
36  
37  
38  
39  
40  
41  
42  
43

44 We have shown a statistical association between tumour size and close margins. One study found  
45 associations between positive margins and a variety of factors, but interestingly, only tumour size was  
46 found to uphold a significant association after multivariate analysis [19]. A proportion of operations in this  
47 study were diagnostic excisions as opposed to wide local clearances. However, tumour size appears to  
48 consistently be associated with close or involved margins after adjusting for confounding factors [6,19,20].  
49 There is also published support for the association between involved lymph nodes and vascular invasion  
50 with involved margins [20], consistent with our results. A similarly-conducted study to ours [9] showed an  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 association between close margins and pathological tumour size, an extensive intraductal component to the  
4  
5 tumour, referral from a symptomatic rather than population-based screening program and the absence of  
6  
7 pre-operative diagnosis. We did not assess all of these factors in our study and there is some evidence that  
8  
9 an extensive intraductal tumour component is associated with residual disease after adjusting for  
10  
11 confounding factors [21]. Other factors which may be important are the operating surgeon, tumour  
12  
13 multcentricity and palpability but these were not analysed in our study. In agreement with our results  
14  
15 regarding tumour type, there is evidence that lobular cancers are associated with higher rates of margin  
16  
17 involvement [22,23].  
18  
19

20  
21 Pre-operative factors such as tumour size and type could be used to counsel patients about the increased  
22  
23 risk following BCT of wider excision or mastectomy to obtain clear margins. It is possible that routine  
24  
25 cavity shaving, used selectively in patients with large tumours, may prove a useful adjunct to increase the  
26  
27 proportion of patients with clear margins.  
28  
29

### 30 31 **CONCLUSION**

32  
33 This study has demonstrated that in patients undergoing BCT, a free margin of 2 mm from invasive cancer  
34  
35 is associated with a low risk of residual disease. A free margin of up to 5 mm from DCIS is associated with  
36  
37 residual disease in one third of patients. Large tumour size, as determined pre-operatively by ultrasound,  
38  
39 and lobular cancer type are associated with close margins and these patients should be counselled at the  
40  
41 time of first surgery concerning the higher risk of further excision and mastectomy.  
42  
43

44  
45 **Word count: 2394 (excluding abstract)**  
46  
47

### 48 49 **Acknowledgements:**

50  
51 The authors would like to acknowledge Dr T Salim for informing us of the processes involved in  
52  
53 histopathological assessment of the specimens.  
54  
55  
56  
57  
58  
59  
60

## REFERENCES

1. Fisher B, Anderson S, Bryant J et al. Twenty-year follow-up of a randomized trial comparing total mastectomy, lumpectomy, and lumpectomy plus irradiation for the treatment of invasive breast cancer. *N Engl J Med* 2002; 347: 1233-41
2. Veronesi U, Cascinelli N, Mariani L et al. Twenty-year follow-up of a randomized study comparing breast-conserving surgery with radical mastectomy for early breast cancer. *N Engl J Med* 2002; 347: 1227-1232
3. Veronesi U, Marubini E, Del Vecchio M et al. Local recurrence and distant metastases after conservative breast cancer treatments: partly independent events. *J Natl Cancer Inst* 1995; 87: 19-27
4. Clarke M, Collins R, Darby S et al. Effects of radiotherapy and the differences in the extent of surgery for early breast cancer on local recurrence and 15-year survival: An overview of the randomized trials. *Lancet* 2005; 366: 2087-2106
5. Luini A, Rososchansky J, Gatti G et al. The surgical margin status after breast-conserving surgery: discussion of an open issue. *Breast Cancer Res Treat* 2009; 113: 397-402
6. Singletary SE. Surgical margins in patients with early-stage breast cancer treated with breast conservation therapy. *Am J Surg* 2002; 184: 383-393
7. von Smitten K. Margin status after breast-conserving treatment of breast cancer: How much free margin is enough? *J Surg Oncol* 2008; 98: 585-587
8. Young OE, Valassiadou K, Dixon M. A review of current practices in breast conservation surgery in the UK. *Surg Oncol* 2007; 89: 118-123
9. Dillon MF, Hill ADK, Quinn CM et al. A pathologic assessment of adequate margin status in breast-conserving therapy. *Annals Surg Oncol* 2006; 13: 333-339
10. Dixon JM, Norman B, Dillon P. Breast incisions for conservation surgery [Comment, Letter]. *Ann R Coll Surg Engl* 1997; 79: 387-388
11. McCready DR. Keeping abreast of marginal controversies. *Annals Surg Oncol* 2004; 11: 885-887
12. Holland R, Vellig S, Mravunac M et al. Histologic multifocality of Tis, T 1-2 breast carcinomas: Implications for clinical trials of breast conserving surgery. *Cancer* 1985; 56: 979-990

- 1  
2  
3 13. Pittinger TP, Maronian NC, Poulter CA et al. Importance of margin status in outcome of breast-  
4  
5 conserving surgery for carcinoma. *Surgery* 1994; 116: 605-609
- 6  
7 14. Papa M, Zippel D, Koller M et al. Positive margins of breast biopsy: Is reexcision always necessary?  
8  
9 *Surg Oncol* 1999; 70: 167-171
- 10  
11 15. Freedman G, Fowble B, Hanlon A et al. Patients with early stage invasive cancer with close or  
12  
13 positive margins treated with conservative surgery and radiation have an increased risk of breast  
14  
15 recurrence that is delayed by adjuvant systemic therapy. *Int J Radiat Oncol Biol Phys* 1999; 44: 1005-  
16  
17 1015
- 18  
19 16. Besana-Ciani I, Greenall MJ. The importance of margins status after breast conservative surgery and  
20  
21 radiotherapy in node positive patients: a follow-up of 10-15 years. *Int Sem Surg Oncol* 2008; 5: 13
- 22  
23 17. Silverstein M, Lagios M, Groshen S et al. The influence of margin width on local control of ductal  
24  
25 carcinoma in situ of the breast. *NEJM* 1999; 340: 1455-1461
- 26  
27 18. Dunne C, Burke JP, Morrow M et al. Effect of Margin Status on Local Recurrence After Breast  
28  
29 Conservation and Radiation Therapy for Ductal Carcinoma In Situ. *J Clin Oncol* 2009; 27(10): 1615-  
30  
31 1620
- 32  
33 19. Tartter PI, Kaplan J, Bleiweiss I et al. Lumpectomy margins, reexcision, and local recurrence of breast  
34  
35 cancer. *Am J Surg* 2000; 179: 81-85
- 36  
37 20. Park CC, Mitsumori M, Nixon A et al. Outcome at 8 years after breast-conserving surgery and  
38  
39 radiation therapy for invasive breast cancer: Influence of margin status and systemic therapy on local  
40  
41 recurrence. *J Clin Oncol* 2000; 18: 1668-1675
- 42  
43 21. Wazer DE, Schmidt-Ullrich RK, Ruthazer R et al. The influence of age and extensive intraductal  
44  
45 component histology upon breast lumpectomy margin assessment as a predictor of residual tumor. *Int*  
46  
47 *J Radiat Oncol Biol Phys* 1999; 45: 885
- 48  
49 22. Moore MM, Borossa G, Imbrie JZ et al. Association of infiltrating lobular carcinoma with positive  
50  
51 surgical margins after breast-conservation therapy. *Annals Surg* 2000; 231: 877-882
- 52  
53 23. Dillon MF, Hill AD, Fleming FJ et al. Identifying patients at risk of compromised margins following  
54  
55 breast conservation for lobular carcinoma. *Am J Surg* 2006; 191: 201-205
- 56  
57  
58  
59  
60

TABLE 1

The percentage of wider excision specimens containing residual disease by width of free margin from the tumour at first surgery

INVASIVE CANCER				
Free margin (mm)	Residual disease	No residual disease (clear)	Total	% Residual disease
Involved	6	11	17	35.3
0.1 to 0.9	2	4	6	33.3
1.0 to 1.9	2	17	19	10.5
2.0 to 4.9	1	40	41	2.4
> 5.0	0	4	4	0.0
Total	11	76	87	
DCIS				
Free margin (mm)	Residual disease	No residual disease (clear)	Total	% Residual disease
Involved	8	10	18	44.4
0.1 to 0.9	4	3	7	57.1
1.0 to 1.9	3	6	9	33.3
2.0 to 4.9	6	11	17	35.3
> 5.0	0	1	1	0.0
Total	21	31	52	

TABLE 2

Univariate analysis of various factors between patients with clear margins of 2 mm or more against those with at least one close margin less than 2 mm. \* P-values considered to be statistically significant.

Factor	CLEAR MARGINS All margins $\geq$ 2 mm (n=202)		CLOSE MARGINS One or more margins < 2 mm (n=101)		P value
Mean age (years)	59.3		57.0		P=0.166
Laterality					P=0.685
Left	101	(50%)	53	(53%)	
Right	101	(50%)	48	(47%)	
Tumour type:					P=0.134  (P=0.0214 * Ductal vs Lobular only)
Ductal	166	(82%)	78	(77%)	
Lobular	8	(4%)	11	(11%)	
DCIS only	11	(6%)	5	(5%)	
Other	17	(8%)	7	(7%)	
Grade					P=0.431
1	49	(24%)	18	(18%)	
2	67	(33%)	36	(36%)	
3	85	(42%)	47	(46%)	
Unknown	1	(1%)	0	(0%)	
Mean size (mm)	16.2		18.2		P=0.0097 *
Lymphovascular invasion					P=0.034 *
Yes	80	(40%)	53	(52%)	
No	119	(59%)	47	(47%)	
Unknown	3	(1%)	1	(1%)	
Nodal involvement					P=0.0079 *
Yes	66	(33%)	48	(48%)	
No	136	(67%)	51	(51%)	
Unknown	0	(0%)	2	(1%)	
Use of primary shave					P=0.721
Yes	58	(29%)	31	(31%)	
No	144	(71%)	70	(69%)	
Unknown	0	(0%)	0	(0%)	