Introduction

Australia holds the unenviable position of leading the world in new diagnoses of melanoma and non-melanoma skin cancers. In 2018 the incidence of melanoma in Australia was reported at 33.6 per 100,000 while non-melanoma skin cancer incidence was 147.5 per 100,000. Excision of skin lesions is a common procedure undertaken by a variety of practitioners both in the primary care setting and hospitals. According to the Medicare data for the 2019 financial year, malignant skin lesion excisions and melanoma excisions were billed on 894,339 separate occasions and this may underestimate non-melanoma skin cancer excisions by as much as 24 per cent. Plastic surgeons are often faced with lesions that are considered too challenging by other clinicians and must balance appropriate margins with anatomical location and reconstructive options.

The recommended margins of excision for melanoma are well established, however, for non-melanoma skin cancers there is a greater variability based on location, size and risk assessment. For low-risk basal cell carcinomas (BCCs), especially on visible regions such as the face, a suggested excision margin of 3–4 mm is accepted. This increases to 5–10 mm margins for high risk BCCs. Current international guidelines on squamous cell carcinomas (SCCs) recommend 4–6 mm margins for low risk lesions while high risk lesions require 6–10 mm margins. When it comes to melanoma, current clinical guidelines recommend melanoma in situ to be excised with 5–10 mm margins, invasive melanoma less than 0.8 mm in depth with no high-risk features excised with 10 mm margins, and those with greater depth or concerning features, with up to 20 mm margins.

While it is recommended that all margins be measured prior to excision, time pressures, lack of equipment or clinician confidence may result in margins that are estimated rather than formally measured. This increases the risk of involved margins and need for re-excision to prevent recurrence. We reviewed the estimated margins of common excisions and compared these between groups of different surgical experience. We hope to encourage the use of formally measured margins in all lesion excisions.

Our study

We conducted a study with 32 participants who were asked to draw 3 mm, 5 mm and 10 mm margins around three separate 10 mm simulated lesions without the use of a measuring device. Participants were divided equally into four groups...
consisting of eight members: consultant plastic surgeons, surgical registrars, junior medical staff and medical students. Each participant drew their lesions independently without viewing other participant’s attempts. Each margin was measured from eight different axes which were averaged and results were tabulated based on surgical experience to the nearest 0.5 mm. Acceptable margins were those within 0.5 mm of the desired measurement. Chi squared analysis was used to assess data between groups and margin size for significance ($P < 0.05$).

Surgical registrars were the most accurate overall with acceptable margins in 11 of the 24 lesions (45.8%) as demonstrated in Table 1. This was followed by plastic surgery consultants and junior medical officers with five of 24 margins acceptable (20.8%) and finally by medical students who only recorded an acceptable margin for just one of the 24 lesions (4.2%). While surgical registrars more than doubled the acceptable margin rate of plastic consultants and junior medical officers, this was not deemed significant ($P = 0.066$). Medical students were found to have the widest range of estimated margins across all margin groups (Figure 1).

When it came to margin size, 3 mm margins were estimated significantly more accurately than 10 mm margins with 13 of 32 (40.6%) estimated within 0.5 mm compared to just two of 32 (6%) ($P = 0.001$).

Margins were largely underestimated with 82 per cent of all lesions drawn smaller than the required size. Surgical registrars underestimated margin size the least with 13 of the 24 margins less than the required size. This increased to 21 of 24 for both medical students and plastics consultants and 23 of 24 for junior medical officers representing a significant difference between the groups when compared to surgical registrars ($P = 0.011$ and $P = 0.0008$ respectively). Of note, margins were significantly underestimated (defined as less than 80% of the required margin) most commonly by medical students (19 of 24 margins), followed by junior medical staff (13 of 24 margins), plastic consultants (8 of 24 margins) and finally surgical registrars (6 of 24 margins). On evaluation by

### Table 1: Acceptable* margins by surgical experience and margin size

<table>
<thead>
<tr>
<th></th>
<th>3 mm margin</th>
<th>5 mm margin</th>
<th>10 mm margin</th>
<th>Total by surgical experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical students</td>
<td>1/8</td>
<td>0/8</td>
<td>0/8</td>
<td>1/24 (4%)</td>
</tr>
<tr>
<td>Junior medical officers</td>
<td>4/8</td>
<td>1/8</td>
<td>0/8</td>
<td>5/24 (21%)</td>
</tr>
<tr>
<td>Surgical registrars</td>
<td>5/8</td>
<td>4/8</td>
<td>2/8</td>
<td>11/24 (46%)</td>
</tr>
<tr>
<td>Plastic surgery consultants</td>
<td>3/8</td>
<td>2/8</td>
<td>0/8</td>
<td>5/24 (21%)</td>
</tr>
<tr>
<td>Total by margin size</td>
<td>13/32 (41%)</td>
<td>6/32 (19%)</td>
<td>2/32 (6%)</td>
<td>19/32 (60%)</td>
</tr>
</tbody>
</table>

*Acceptable margins defined as within 0.5 mm of expected distance

Fig 1. Surgical margins by experience
margin size, significant underestimation was largely even across the groups occurring in 46.8 per cent of 3 mm margins, 43.8 per cent of 5 mm and 53.1 per cent of 10 mm margins.

The results of our study suggest that increased surgical experience does correlate with increased accuracy of margin excision with medical students performing significantly worse than surgical registrars and plastic consultants. Of interest, surgical registrars tended towards increased accuracy when compared to plastic consultants although this was not found to be significant. This may relate to the fact that lesion and margin marking is a role often designated to registrars. This suggests volume and frequency of margin marking may increase the accuracy of estimated margins, however this is purely an extrapolation.

Another trend noted by this study is that increasing margin size resulted in reduced accuracy. Whereas 41 per cent of 3 mm margins were within 0.5 mm of the desired margin, only six per cent of 10 mm margins were considered adequate. This trend was replicated in each group and can be demonstrated in Figure 1. While this is an expected finding with larger distances in general more difficult to estimate, it is concerning when considering that larger margins are used for lesions with more malignant potential and hence margin accuracy is of greater importance. In melanomas less than 1 mm Breslow depth, Mackenzie and colleagues demonstrated in a case control study of 11,290 patients that a histological margin less than 8 mm resulted in higher rates of local recurrence.6 In a similar analysis by the Melanoma Institute of Australia, of 2131 patients with melanomas 1–2 mm Breslow depth, significantly higher rates of recurrence were found in histological margins less than 8 mm although this did not correspond with melanoma specific survival rates.7 In our study, 17 of the 32 10 mm margins were estimated as less than 8 mm which would result in increased risk of local recurrence if used as the surgical margin.

When it comes to well circumscribed BCCs, 3 mm margins have been shown to result in clear margins in 85–94.7 per cent of margins in recent literature.8–10 In a case series on 134 well circumscribed facial BCCs excised with narrow margins, Kimyai-Asadi and colleagues found a positive margin in 16 per cent of lesions with 1 mm margins, 24 per cent of lesions with 2 mm margins and 13 per cent of lesions with 3 mm margins.11 Although this study did not find a significant difference between positive excision margins due to the small number of included cases, this study suggests higher positive margins with narrow excision when compared to the recommended 3 mm margin. While nodular BCCs with positive radial margins are occasionally managed with surveillance rather than re-excision, this results in further clinic appointments and patient anxiety again showing the greater burden placed on both the patient and the healthcare system with positive margins.

Another point of concern is that this study demonstrated the notable tendency towards underestimating margins with 82 per cent (79 of 96 lesions) of all margins smaller than the recommended margin size and 48 per cent (46 of 96 lesions) of total lesions less than 80 per cent of the recommended margin size. In contrast, just two lesions, both performed by medical students, were greater than 120 per cent the recommended lesion size. One explanation for this finding is that surgeons are regularly in the position of balancing appropriate margin size with lesion location and are compelled to avoid inappropriate removal of healthy tissue. This is especially true on the face where small changes in margin size may be the difference between primary closure and local or regional flap reconstruction. While patients may be initially dismayed by the proposed reconstructive incisions, this must be balanced by the risk of positive margins and the need for a secondary procedure.

This study focused on simulated lesions rather than real excisions and as such the relationship between surgical margin and pathological margin cannot be assessed. While pathological margins are of the greatest relevance to recurrence risk, concurrent pathological margins at the time of lesion excision (such as used in Mohs surgery or frozen section) is both costly and time consuming and generally reserved for high-risk lesions or challenging locations. Hence, surgical margins act as the best surrogate for pathological margins and, in many circumstances, are the only guide a surgeon has at the time of excision to minimise risk of recurrence. It is because of this that accurate surgical margins are of importance and should not be dismissed as irrelevant until histological margins can be assessed at the time of excision for every lesion in a cost effective and timely fashion.
Conclusion

Senior surgical staff were more accurate across all margin sizes compared to junior medical staff and medical students. Surgical registrars were most accurate at estimating margins while smaller margins were estimated more accurately regardless of surgical experience. Of note, margins were largely underestimated across all levels of surgical experience. This study acts as a timely reminder to surgeons of all levels to measure margins for every lesion to avoid the risk of positive margins and need for re-excision.

Conflict of interest

The authors have no conflicts of interest to disclose.

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References


