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Short Report Collaborative Research

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Short Report

National audit of non-melanoma skin cancer excisions performed by plastic surgery in the UK

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Introduction

Keratinocyte or non-melanoma skin cancer (NMSC) is the most common malignancy worldwide, encompassing basal cell carcinoma (BCC) and cutaneous squamous cell carcinoma (cSCC). The mainstay of treatment for NMSC is excision. The likelihood of recurrence is directly related to achieving tumour-free margins. Just 1 per cent of BCCs recur where margins are clear[1,2], compared with 31–41 per cent when margins are involved[3,4]. Equivalent data for cSCC are lacking but, given the metastatic potential (5–47 per cent)[5], complete excision is paramount. In the UK, the majority of complex and high-risk skin cancers are excised by plastic surgeons.

A systematic review was undertaken to establish the risk of incomplete excision from surgical excision[6–8]. National guidelines estimate the risk (for example 5 per cent)[9], but these were extrapolated from Mohs micrographic surgery (MMS)[10] rather than surgical excision studies. A meta-analysis[7] of 110 non-Mohs clinical studies containing 53 796 patients established an incomplete excision risk of 11.0 per cent for BCCs and 9.4 per cent for cSCCs. Subgroup analysis of excisions performed by plastic surgeons showed incomplete excision in 9.4 per cent of BCCs and 8.2 per cent of cSCCs. Using this as the audit standard[7], the primary aim of this study was to undertake a national audit of NMSC surgical excisions in UK plastic surgery units. The secondary aim was to identify risk factors for incomplete excision by plastic surgeons.

Methods

Between March and July 2020, all adult patients with a preoperative diagnosis of BCC or cSCC undergoing surgical excision were eligible for inclusion. Collaborators submitted consecutive cases. Exclusion criteria were lesions excised using MMS or operations with intraoperative frozen-section analysis, as margin assessment takes place immediately and further excision is undertaken during the same operation. Consequently, the incomplete excision rate for MMS is below 1 per cent and, although intraoperative frozen-section analysis has a high false-negative rate and is inferior[11], including either technique might have biased the results. Excisions expected to have incomplete margins (incision, shave or punch biopsies) were also excluded. The data points were broadly based on previous UK national dermatology audits of NMSC excisions[12,13] (*Table S1*).

Full details of reporting, definitions, ethics, follow-up, validation, missing data, and statistical analysis, including mixed-effects logistic regression, can be found in *supplementary material* (*Tables S1–S6*).

Results

Data on 2202 patients, undergoing 2607 excisions at 34 plastic surgery units (corresponding to 70 per cent of units nationally) were included. A total of 158 patients undergoing 186 excisions did not meet the eligibility criteria and were excluded. Of those who had a histologically confirmed BCC or cSCC, the characteristics of the cohort, location of lesions, treatments, complications, and ongoing care are outlined in *Table 1*.

Plastic surgeons typically excised suspected BCCs without a preoperative tissue diagnosis (72.5 per cent, 1000 of 1380). The incomplete excision rate for BCCs was 5.3 per cent (68 of 1281). Suspected cSCCs were biopsy-proven in 30.8 per cent (320 of 1036). The incomplete excision rate for cSCCs was 7.7 per cent (57 of 739). Lesions with a preclinical diagnosis of BCC and cSCC that transpired to be histologically different are outlined in *Table S2*.

The results of mixed-effects logistics regression are summarized in *Table 2* and *Fig. 1a*. After adjustment, the factors that increased the risk of incomplete excision were recurrent lesions/re-excision and tumours located on the head and neck. Clinical ulceration trended

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Table 1 Characteristics of the cohort, location of lesions, treatments, complications, and ongoing care

	BCC	cSCC
Demographics		
No. of patients	1091	691
No. of lesions excised	1281	739
Age (years), median (i.q.r.)	73 (64–81)	80 (73–86)
Sex ratio (M : F)	680 : 411	484 : 207
Anaesthetic*		
Local	1223 (97.9)	668 (95.0)
General	24 (1.9)	31 (4.4)
Regional	2 (0.2)	4 (0.6)
Unknown	32	36
Lesion location		
Head and neck	950 (74.2)	498 (67.3)
Leg	105 (8.2)	98 (13.3)
Trunk	167 (13.0)	40 (5.4)
Arm	46 (3.6)	42 (5.7)
Hand	5 (0.4)	56 (7.6)
Foot	8 (0.6)	3 (0.4)
Genitalia, perineum	0 (0)	2 (0.3)
Reconstruction		
Direct closure	741 (58.2)	291 (39.6)
Skin graft	299 (23.5)	316 (43.0)
Open, delayed	27 (2.1)	44 (6.0)
Flap	204 (16.0)	83 (11.3)
Other	2 (0.2)	1 (0.1)
Unknown	8	4
Mean tumour diameter (mm)	12.96	19.04
High-risk lesions†	949 (74.1)	308 (41.7)
Very high-risk lesions‡	n.a.	289 (39.1)
All margins		
Clear	1213 (94.7)	682 (92.3)
Involved	68 (5.3)	57 (7.7)
Deep margins		
Clear	1256 (98.0)	694 (93.9)
Involved	25 (2.0)	45 (6.1)
Peripheral margins		
Clear	1230 (96.0)	718 (97.2)
Involved	51 (4.0)	21 (2.8)
Both peripheral and deep margins		
Involved	8 (0.6)	9 (1.2)
Complications		
Uncomplicated	900 (93.7)	566 (90.1)
Infection	22 (2.3)	20 (3.2)
Bleeding	13 (1.4)	12 (1.9)
Graft/flap failure	7 (0.5)	14 (2.2)
Other	19 (2.0)	16 (2.5)
No follow-up/unknown	320	111
Ongoing care§		
No further treatment	1015 (78.8)	303 (41.2)
Surveillance	236 (18.3)	444 (60.5)
Re-excision	32 (2.5)	45 (6.3)
Radiotherapy	5 (0.4)	36 (5.1)

Values are *n* (%) with respect to lesions unless otherwise indicated; **n* (%) with respect to patients. †British Association of Dermatologists guidelines for the management of basal cell carcinoma (BCC) criteria for high risk: tumour size over 2 cm; tumour site central face around eyes, nose, lips, and ears; histological subtype morpheic, infiltrative, micronodular, and basosquamous; recurrent lesions; perineural invasion. British Association of Dermatologists guideline for the management of people with cutaneous squamous cell carcinoma (cSCC) criteria for high risk: tumour diameter 2–4 cm; perineural invasion; poorly differentiated; lymphovascular invasion; ear or lip. ‡Very high-risk criteria for cSCC: tumour diameter over 4 cm; bone invasion; perineural invasion; high-grade subtype. §Some lesions were managed using more than one modality.

towards significance. The results of sensitivity analysis are shown in *Tables S3, S4*, and *Fig. S1a, b*.

Incompletely excised NMSCs were mostly managed by re-excision (57, 39 per cent), surveillance (40, 27 per cent) or radiotherapy (17, 12 per cent). For incompletely excised lesions, re-excision was more common for cSCCs than BCCs (*Fig. 1b* and *Table S5*). No other factors were clearly associated with re-excision.

Table 2 Results of mixed-effects logistic regression analysis to identify risk factors for incomplete excision

	Crude risk ratio	Adjusted risk ratio
Age (per year)	1.01 (1.00, 1.02)	1 00 (0.99, 1.02)
Male sex	0.87 (0.62, 1.23)	0.74 (0.51, 1.09)
Clinical diagnosis of BCC	1.29 (0.92, 1.81)	1.33 (0.91, 1.93)
Clinically ulcerated	1.89 (1.27, 2.83)	1.76 (1.14, 2.71)
Site of lesion		
Trunk	1.00 (reference)	1.00 (reference)
Head and neck	3.22 (1.41, 7.39)	3.29 (1.37, 7.94)
Limbs	1.12 (0.42, 2.99)	0.93 (0.33, 2.64)
Recurrent lesion/re-excision	2.10 (1.25, 3.55)	2.07 (1.18, 3.61)
Tumour diameter (per mm)	1.01 (1.00, 1.02)	1.02 (1.00, 1.03)
Planned peripheral margin (per mm)	0.99 (0.93, 1.05)	0.97 (0.86, 1.10)
Depth of excision		
Subcutaneous fat	1.00 (reference)	1.00 (reference)
Including fascia	0.76 (0.44, 1.31)	0.66 (0.36, 1.22)
Deep to fascia	1.30 (0.80, 2.10)	0.91 (0.52, 1.58)
Reconstruction		
Direct closure	0.68 (0.32, 1.45)	0.83 (0.36, 1.93)
Flap or graft	0.84 (0.39, 1.81)	0.84 (0.36, 1.92)

Values in parentheses are 95 per cent confidence intervals. Risk is used in place of odds, given that the event is rare. BCC, basal cell carcinoma.

Data from this study are compared with those from previous national audits by UK dermatologists in *Table S7*.

Discussion

This study has described the first UK national audit of NMSC by plastic surgeons. The incomplete excision rate was 5.3 per cent for BCC and 7.7 per cent for cSCC. These are both below the level expected from the authors' systematic review[11].

Previous national audits[12,13] of NMSC excisions by UK dermatologists reported incomplete excision rates of 2.1–2.6 per cent for BCCs and 4.0–4.9 per cent for cSCCs. Reasons for the higher rates identified in the present study are likely to be multifactorial, and in keeping with those observed in a systematic review[7]. The operative caseload of plastic surgeons and dermatologists is different, and comparison of the present data with those from previous national dermatology audits showed marked differences in lesion location, tumour size, re-excisions/recurrent lesions, and patients requiring reconstruction with skin grafts and flaps.

Data from this study showed that lesions on the head and neck confer a higher risk of incomplete excision and a similar correlation was identified in a systematic review. Plastic surgeons excised 92.7 per cent of head and neck lesions, compared with 84.7 per cent by dermatologists, and, although these percentages are likely higher than those in real practice owing to the inclusion/exclusion criteria applied by the individual studies, they do show a trend. Additionally, the prevalent use of MMS by dermatologists means that they typically excise a greater volume of smaller, lower-risk lesions, evidenced by the low percentage of lesions requiring reconstruction with skin grafts and flaps (8.6–11.1 per cent) (*Table S7*). Complex lesions are referred (27–52 per cent[6–9]) meaning that plastic surgeons typically excise larger lesions, more aggressive subtypes, and lesions with indistinct macroscopic borders, all of which may confer a higher risk of incomplete excision. Future work including individual-patient data meta-analysis may provide more insight into these

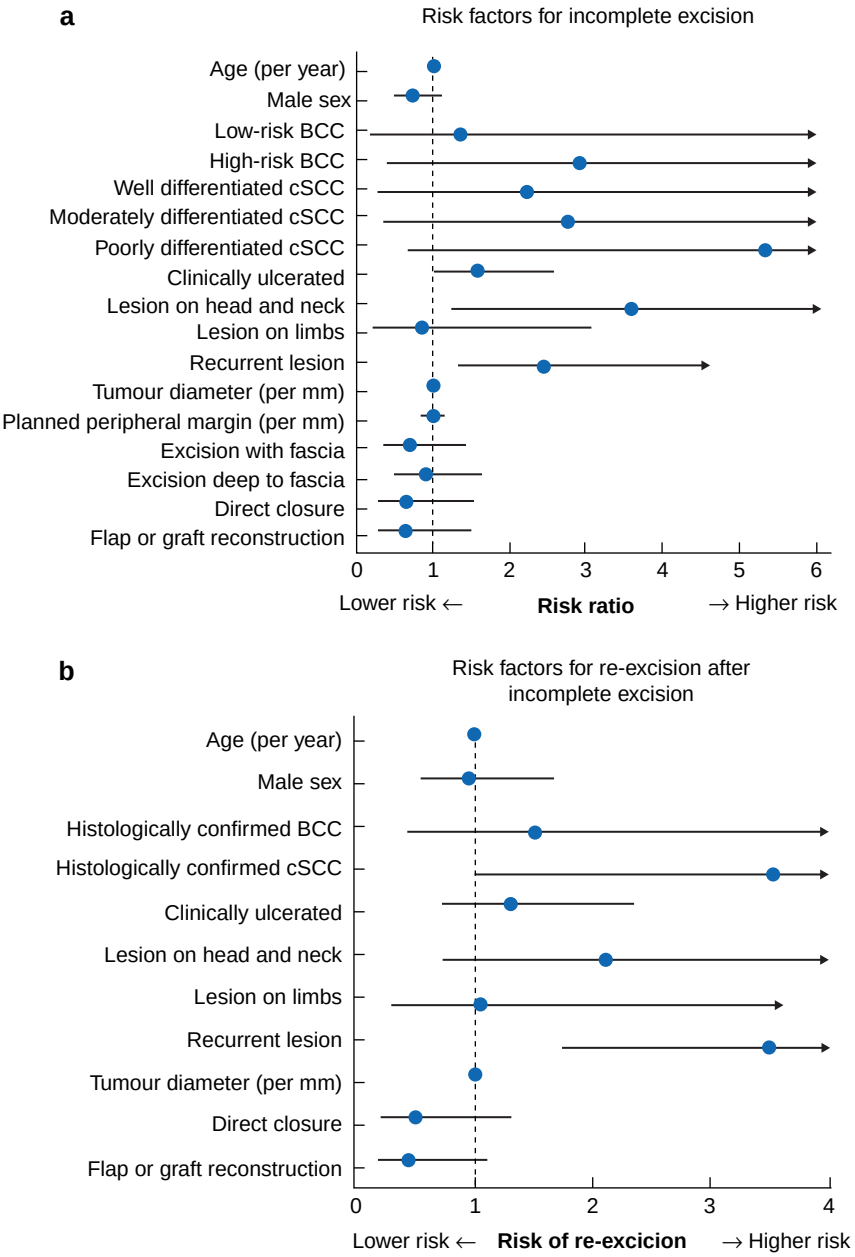

Fig. 1 Results of mixed-effects logistic regression analysis for risk factors for incomplete excision and re-excision after incomplete excision

Risk factors for **a** incomplete excision and **b** re-excision after incomplete excision. Risk is used in place of odds, given that the event is rare. Risk ratios are shown with 95 per cent confidence intervals. BCC, basal cell carcinoma; cSCC, cutaneous squamous cell carcinoma.

observations. The primary analyses were based on imputed data, and complete-case analyses (*supplementary material*) showed only head and neck location as a significant predictor of incomplete excision, so this may be a false-positive finding. Previous systematic reviews of cSCC excisions have, however, identified head and neck location as a risk factor for incomplete excision[10].

Currently, UK skin cancer guidelines are generic. Previous studies by these authors have shown differences between operators in terms of caseload and outcomes, meaning that the statistics quoted in guidelines are unsubstantiated[7]. There is likely to be merit in creating specialty-specific guidelines that address the challenges faced by different practitioners with their cohort of patients with NMSC.

The expansion of MMS services is another potential avenue for improvement in NMSC outcomes. Data from this study showed that Whiston Hospital, Merseyside, which has a plastic surgery-led MMS service, had a lower proportion of incompletely excised NMSCs than other units (1.6 per cent BCC and 4.3 per cent cSCC). The development of MMS services in other plastic surgery units or the expansion of existing dermatology-led MMS services may increase oncological clearance by removing the hardest lesions from the caseload. This is unlikely to represent a short-term solution because of the scale of training and funding required. Plastic surgeons should also show increased vigilance for head and neck lesions.

The present study was undertaken through the first wave of the COVID-19 pandemic, and this may have affected the validity of the findings, relative to normal practice[14]. Additionally, no formal power calculation was undertaken, so there is a potential for false-negative findings. However, the prospective nature and

consecutive inclusion of patients should have reduced bias, and the large number of centres and collaborators can increase confidence in these estimates of incomplete excision. In addition, given the prospective nature of the study, there is a risk that the results may even be better than in those in real life as surgeons were aware that they were being audited.

Local audits of incomplete excision are crucial for all who excise NMSC, and this study acts as an updated standard for future comparisons. This study has shown that high levels of oncological clearance are currently being achieved. It has highlighted factors associated with incomplete excision that should make plastic surgeons reconsider planned excision margins and the role of MMS in plastic surgery units. Development of specialty-specific guidelines before further cycles of this audit could help reduce NMSC incomplete excision rates further.

Collaborators

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Supplementary material

Supplementary material is available at *BJS* online.

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