A quality audit of outcomes in wide local excision of non-melanoma skin cancers at Chris Hani Baragwanath Academic Hospital

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A research report in submissible article format submitted to the Department of Plastic Surgery, School of Clinical Medicine, College of Health Sciences, University of Witwatersrand, Johannesburg, in fulfilment of the academic requirements for the degree of Master of Medicine.

Declaration

I, Wei-Han Chen, declare that this research report is of my own, original, unaided work. It is being submitted for the degree of Master of Medicine (MMed) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination at this or any other University.

Wei-Han Chen

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Dedication

This study is dedicated to every patient suffering from skin cancer, acknowledging the patience you display to deal with diagnostic and treatment uncertainties, and the mental toughness you demonstrate in the face of the word “cancer”. This study is also dedicated to your families for their unwavering support, ensuring you make all your hospital appointments. We all know a diagnosis of skin cancer requires lifetime follow up.

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I want to show my appreciation to all the staff, from physicians to fellow surgeons, for their dedication to the practice in diagnosing and referring to the unit of Plastic and Reconstructive Surgery at Chris Hani Baragwanath. Your tireless efforts despite the volume of patients can be the difference between curative treatment and palliative care.

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Declaration of Interest

I have no declarations.

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Author Guidelines

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Section	Requirements	Checklist
Abstract	• 250 words. • Structured: Background, Methods, Results, and Conclusions.	250 words
Body	• 3000 words. • Double spacing.	2994 words excluding tables
References	• No limit. • American Medical Association (AMA) style.	25 references
Figures and Tables	• 20 maximum. • Numbered sequentially. • Tables must be saved in an editable file format. • Tables should not be embedded within the text of the manuscript document.*	10 tables 2 figures
Supplemental digital content	• 10 items • 8 video clips maximum	N/A

* For the purposes of ease of examination of this research report, the tables are imbedded. The word count for the tables is 541 words.

Abbreviations

AAD	American Academy of Dermatology
BAD	British Academy of Dermatology
BCC	Basal Cell Carcinoma
CHBAH	Chris Hani Baragwanath Academic Hospital
MMS	Mohs Micrographic Surgery
NCCN	National Cancer Care Network
NMSC	Non-Melanoma Skin Cancer
SCC	Squamous Cell Carcinoma
UV	Ultra-violet

Abstract

Background: Non-melanoma skin cancers (NMSC), including basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), are the most common malignancies and account for one-third of cancer diagnoses. This places a significant burden on the healthcare system, particularly when inadequately treated.

The gold standard of care for NMSC is Mohs Micrographic Surgery (MMS). When MMS is unavailable, a macroscopic marginal margin is recommended by the National Cancer Care Network (NCCN) guidelines. The primary objective of this study was to determine the cancer clearance rate of wide local excision in NMSC treatment.

Methods: This study was a single centre retrospective file review of patients who had undergone wide local excision of NMSC at Department of Plastic and Reconstructive Surgery, Chris Hani Baragwanath Academic Hospital (CHBAH) between 1st September 2021 and 31st August 2024.

Results: In all, 158 cases were reviewed (BCC=116, SCC=42). Cancer clearance was achieved in 134 patients (84.8%). Most NMSCs involve the head and neck, which also had the most incomplete excisions. Cancers with involved margins were generally smaller. In BCC and SCC, nodular subtype and moderately differentiated keratinizing were the most common respectively. SCCs had a proportionally higher margin involvement, particularly deep margins. Thicker tumours (>2mm) had a higher risk for margin involvement.

Conclusions: Most patients achieved a disease-free status. However, some may be at risk for incomplete excision. These include NMSCs involving the head and neck

region, aggressive subtypes of BCC and SCC, and tumour thickness over 2mm. MMS may be considered for improved quality of care.

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Submissible Article

A quality audit of outcomes in wide local excision of non-melanoma skin cancers at Chris Hani Baragwanath Academic Hospital

Introduction and Background

Non-melanoma skin cancers (NMSC) are the leading cancers in the world, accounting for one-third of all cancer diagnoses[1]. The United States alone encompasses an estimated 5.4 million new diagnoses annually[2]. In a 2016 study, Gordon et al. found that between 13.3 to 19.3 million USD are allocated to cutaneous malignancies diagnosis and treatment annually by the South African healthcare system[3]. Basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) are the two most common types of NMSC, and BCC diagnoses are triple the number of SCC[4]. The current mainstay of treatment for these cancers is complete excision while considering cancer-free tissue preservation[5].

Various international guidelines are described for both BCC and SCC treatment. The National Comprehensive Cancer Network (NCCN), British Academy of Dermatology (BAD) and American Academy of Dermatology (AAD) all describe risk stratification for NMSC. All these guidelines state that Mohs micrographic surgery (MMS) is the gold standard for treatment[6], especially for high-risk lesions, as MMS achieves both complete tumour eradication and disease-free tissue preservation. However, the recommendations on macroscopic surgical margins for adequate excision when MMS is unavailable are varied.

BCC is by far the most common cutaneous malignancy[7]. It derives from the pluripotential epithelial cells at the dermo-epidermal junction[8]. The most common eyelid malignancies are BCCs and account for more than 80 percent of head and neck cancers[9]. There are currently more than 26 identified subtypes with the most common occurring being nodular, while 38.5 percent are mixed cases[10]. It is a slow-growing malignancy with low metastatic potential ranging between 0.0028 and 0.55 percent[10]. Non-surgical treatment modalities do exist, such as radiotherapy and topical agents. However, they have a lower success rate in tumour eradication[11].

The 2023 NCCN guideline stratified BCCs into either high- or low-risk, based on clinical and pathological features[12]. Clinical features include size, borders, anatomical location, recurrence, immunosuppression, and previous radiation. Pathological features focus on the histology, including subtype and thickness. When a tumour is assessed as low-risk, a four-millimetre margin can be included when the tumour is excised to ensure tumour clearance. For cancers classified as high-risk, NCCN guidelines only mention a wider margin must be taken, with no specific measurement[12].

Following BCCs, the second most prevalent NMSC are SCCs[13]. SCCs are dysplasias in the basal layer of the epidermis and develop mostly in damaged skin[14]. This includes non-healing wounds, viral and bacterial infections, exposure to carcinogens, and by far the most common, ionizing and non-ionizing radiation, particularly ultraviolet (UV)[15]. SCCs are responsible for more than sixty percent of cancers involving the external ear. SCCs[16] can metastasize via lymphatics to regional lymph node basins or to solid organs haematogenously[17]. SCC is responsible for the second highest mortality rate in populations of 85 years and older[18].

According to NCCN 2023 guidelines, SCC is classified into low-risk, high-risk and very high-risk lesions[19]. Risk stratification is measured by clinical and pathological features. Clinical risk factors assess the size, location, recurrence, immunosuppression, prior radiation, growth, and neurologic symptoms. Pathological factors mention the depth of invasion, degree of differentiation, and the presence of perineural or lymph-vascular involvement. The guidelines, in the absence of MMS, recommend a four- to six-millimetre margin for low-risk lesions, while high-risk and very high-risk SCCs recommendations are merely an unspecified wider margin of excision[19].

The NCCN guidelines were developed around a landmark study performed by Zitelli and Wolf in 1987. NMSCs less than two centimetres in diameter, when excised with MMS, had a 95% cancer clearance rate with a four-millimetre margin. Lesions exceeding two centimetres required a larger margin[20].

NMSC represents a significant burden of disease globally, as it affects all populations irrespective of socioeconomic status. Internationally, medical innovations, as well as adoption of MMS as the gold standard in NMSC management, are improving outcomes. However, for South African plastic surgeons working in the public sector, where resource limitations, such as theatre time, bed availability, and the financial implications of MMS, macroscopic surgical margins as outlined by the NCCN are still the primary treatment modality. It is therefore pertinent that the guidelines used are applicable to the population and pathology treated in this centre. This will enable adequate tumour extirpation, tissue preservation, and safe reconstruction of NMSC defects. Previously, A study by Bhat et al reported a cancer clearance rate of 88% using wide local excision[21]. However, this was using the BAD guidelines.

This study's primary objective was to assess the cancer clearance rates of NMSC at Chris Hani Baragwanath Academic Hospital (CHBAH) using the macroscopic wide local excision guidelines described by the NCCN, and secondary objectives were to identify links between incomplete excision, patient factors, and tumour characteristics.

Method

This quality audit used a retrospective record review that evaluated the cancer clearance rates of NMSC by the Department of Plastic and Reconstructive Surgery at CHBAH in Soweto, Gauteng, South Africa. Ethical clearance was obtained from the University of the Witwatersrand Human Research Ethics Committee (Medical) (M250358). Permission to carry out the study was given by the CHBAH Research Committee and the study was registered on the National Health Research Database (GP 202503054).

Study Population and Data Collection

The study population included the records of adult patients aged 18 years or older who underwent excision of non-melanoma skin cancers using the NCCN guidelines at CHBAH over a four-year period from 1 September 2021 until 31 August 2024. In this study centre, the surgeons implemented departmental protocols based on NCCN, with a macroscopic excision margins of 4mm for low-risk BCC and a minimum of 5mm for high-risk BCC. Lesions confirmed as SCC were excised with a macroscopic margin of 5mm for low-risk SCC and 1cm for high-risk SCC. All incision biopsies and re-excisions of previously incomplete excisions were excluded. These patients were identified from theatre records.

Primary measures were margin involvement on a histological specimen. Secondary measures were cancer characteristics, such as types and subtypes, tumour size, depth, perineural and lymphatic invasion. Patient factors reviewed were age, sex, and tumour location. All patient data were deidentified and subsequently captured on the data capturing sheet (Appendix D).

Data Analysis

Categorical variables were reported as frequencies and percentages. Chi-square tests were used for statistical analysis. Continuous variables were described using the median and interquartile range (IQR) as data were not normally distributed. For statistical comparisons the non-parametric Mann-Whitney U-test was used. In all cases, a p-value of less than 0.05 was considered statistically significant. A Microsoft Excel spreadsheet was used for descriptive analyses while statistical analyses were carried out using JASP[22].

Results

A total of 158 files were included in this audit. They were reviewed for patient information, tumour characteristics, excision margins, and outcomes.

The primary objective was to determine the cancer clearance rate of non-melanoma skin cancers at CHBAH. The 158 records comprised 116 patients (73.4%) with BCC, and 42 patients (26.6%) with SCC. It was found that 134 of the patients (84,8%) had completely clear excisions. There were 24 (15.2%) with incomplete excisions.

The secondary objective was to determine links between incomplete tumour excision and disease characteristics, including age, gender, anatomical location, and

histological features of tumour specimens. The records of those with clear and incomplete excisions were analysed further and compared to see whether any pattern for unsuccessful treatment could be established.

Patient demographic information

Age

The median age of the patients with clear margins was 61.5 years (IQR = 52 to 70 years), and the median age of the patients with a residual tumour was 69.5 (IQR = 55.5 to 72.3 years). However, the age difference was not statistically significant (p=0.323). The majority of the patients overall (81,5%) were over the age of 50 years. There was a peak in those aged over 70 years with half (50%) making up the group with residual margins (Table 1).

Gender

There were 94 male patients (59,5%), and 64 female patients (40,5%) overall, with both those with clear margins and those with residual tumours having more males than females. There was no association between gender and margin clearance (p=0.437).

Table 1: Patient age and gender vs margin clearance

	Clear margins (n=134)		**Residual tumour (n=24)**		**Total (n=158)**		
	n	**%**	**n**	**%**	**n**	**%**	**p-value**
Age							
Under 40 years	9	6.7	1	4.2	10	6.3	0.323
40 to 49 years	15	11.2	4	16.7	19	12.0	
50 to 59 years	37	27.6	4	16.7	41	25.9	
60 to 69 years	38	28.4	3	12.5	41	25.9	

70 to 79 years	29	21.6	11	45.8	40	25.3	
80 years and over	6	4.5	1	4.2	7	4.4	
Gender							
Female	56	41.8	8	33.3	64	40.5	0.437
Male	78	58.2	16	66.7	94	59.5	

n=number

Tumour information

Tumour information included location, size and depth, and BCC subtype and SCC differentiation.

Location

Overall it can be seen that 93 tumours (58.9%) were in the head and neck areas. This was made up of 73 tumours (54.5%) for those with clear margins, and 20 tumours (83.3%) for those with a residual tumour. The other areas (upper and lower limbs and trunk) had far fewer tumours. The borderline statistical significance (p=0.052) may be taken to indicate that most were in the head and neck areas (Table 2).

Table 2: Tumour location vs margin clearance

	Clear margins (n=134)		**Residual tumour (n=24)**		**Total (n=158)**		
	n	**%**	**n**	**%**	**n**	**%**	**p-value**
Head and neck	73	54.5	20	83.3	93	58.9	0.052
Upper limb	18	13.4	0	0.0	18	11.4	
Lower limb	12	9.0	1	4.2	13	8.2	
Trunk	31	23.1	3	12.5	34	21.5	

n=number

Size and depth

The median size of the tumours in those with clear margins was 150.0 mm^2 (IQR = 56.0 to 399.00 mm^2), compared to a smaller size of 100.0 mm^2 (IQR = 28.8 to 204.0

mm^2) in those with a residual tumour. This difference approached statistical significance (p=0.056). The median depth of the tumours in those with clear margins was 3.0 mm (IQR = 1.8 to 4.5 mm), compared to a much greater depth of 4.6 mm (IQR = 3.8 to 6.0 mm) in those with a residual tumour. This difference was statistically significant (p=0.009) (Table 3).

Table 3: Tumour size and depth vs Margin clearance

	Clear margins (n=134)		**Residual tumour (n=24)**		
	Median	**IQR**	**Median**	**IQR**	**p-value**
Tumour size (mm^2)	150.0	56.0 to 399.0	100.0	28.8 to 204.0	0.056
Tumour depth (mm)	3.0	1.8 to 4.5	4.6	3.8 to 6.0	0.009

n=number
IQR=interquartile Range

The tumour depth with respect to margins was plotted a boxplot and may be seen in Figure 1. Visual inspection would suggest that if a patient had a tumour more than 3.75mm thick, there was an increased likelihood of a residual margin.

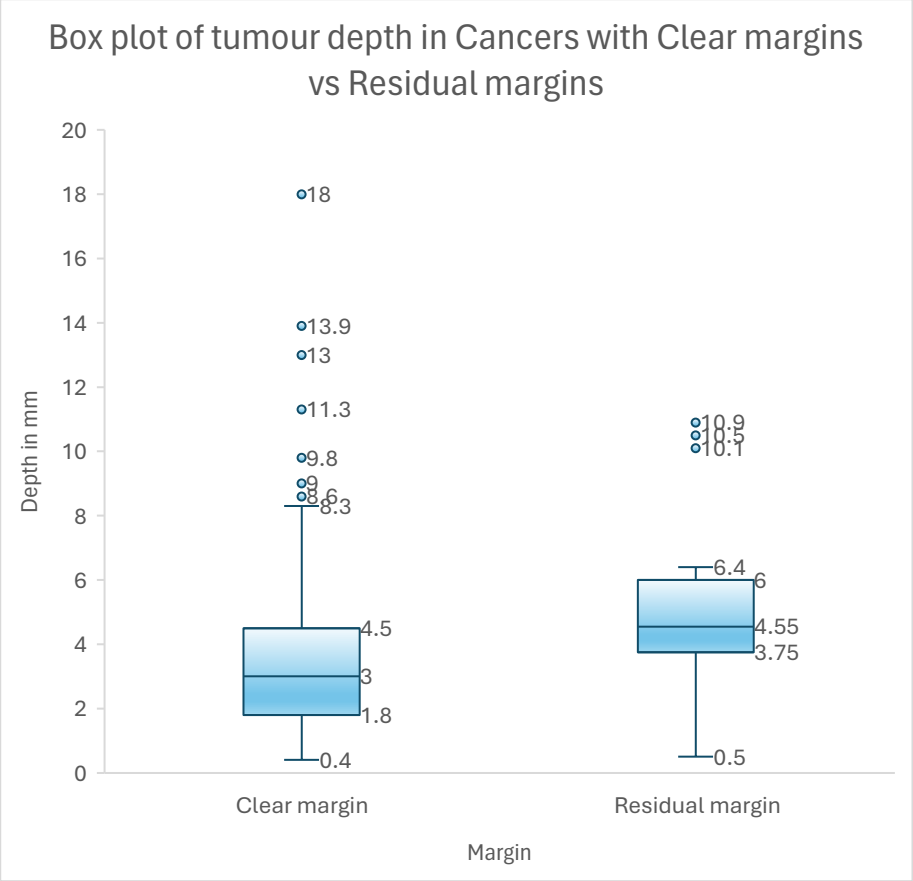


Figure 1: Boxplot of margin vs tumour thickness

BCC subtype and SCC differentiation

The BCC analysis showed that 55 tumours (47.4%) were heterogenous in nature and exhibited multiple subtype features on the same specimen. The most frequently occurring subtype was nodular, which had the most residual tumours after surgical excision (n=6). The second most common subtype was infiltrating, which had the second most involved margins (n=4). Superficial (13.8%), adenoid (12.9%) and micronodular (11.2%) came next, and each had a single involved margin (Table 4).

Table 4: BCC subtypes vs margin clearance

	Clear margins (n=103)		Residual tumour (n=13)		Total (n=116)	
	n	%	n	%	n	%
Nodular	34	33.0	6	46.2	40	34.5
Superficial	15	14.6	1	7.7	16	13.8
Micronodular	12	11.7	1	7.7	13	11.2
Adenoid	14	13.6	1	7.7	15	12.9
Infiltrating	20	19.4	4	30.8	24	20.7
Morpheaform	4	3.9	0	0.0	4	3.4
Baso-squamous	3	2.9	0	0.0	3	2.6
Pleomorphic / Other	1	1.0	0	0.0	1	0.9

n=number

In the SCC group, 37 cases were moderately differentiated (91.1%), four (9.5%) cases were poorly differentiated, and there was only a single well differentiated case (2.4%). Ten cases (90.9%) with a residual tumour were moderately differentiated (Table 5).

Table 5: SCC differentiation vs margin clearance

	Clear margins (n=31)		Residual tumour (n=11)		Total (n=42)	
	n	%	n	%	n	%
Moderate keratinising	23	74.2	9	81.8	32	76.2
Moderate non-keratinising	4	12.9	1	9.1	5	11.9
Poor Differentiation	3	9.7	1	9.1	4	9.5
Well-differentiated	1	3.2	0	0.0	1	2.4

Margins

Clear margins are described, followed by tumour types and margins, and tumour size and margins.

Clear margins

Those with clear margins had peripheral margins with a median of 3.5 mm and deep margins with a median of 2.8 mm. This was despite a minimum macroscopic margin of 4mm peripherally as per the NCCN guidelines.

Table 6: Clear margins (n=134)

	Median	**IQR**
Closest peripheral margin (mm)	3.5	2.5 to 5.3
Deep margin (mm)	2.8	1.4 to 4.9

IQR=Interquartile Range

Tumour types and margins

The tumour types were cross-tabulated with clearance outcomes. (Table 7). This result was statistically significant (p=0.020), indicating that the majority of 103 (76.9%) patients with clear margins had BCC.

In all, there were 24 incomplete excisions, representing 15.2% of the entire sample. There were 13 patients with BCC, making up 11.2% of the BCC sample, and 12 patients with SCC, making up 26.2% of the SCC sample.

Table 7: BCC and SCC and margin involvement

	Clear margins (n=134)		Residual tumour (n=24)		Total (n=158)		
	n	**%**	**n**	**%**	**n**	**%**	**p-value**
BCC	103	76.9	13	54.2	116	73.4	0.020
SCC	31	23.1	11	45.8	42	26.6	

BCC=Basal Cell Carcinoma
SCC= Squamous Cell Carcinoma
n=number

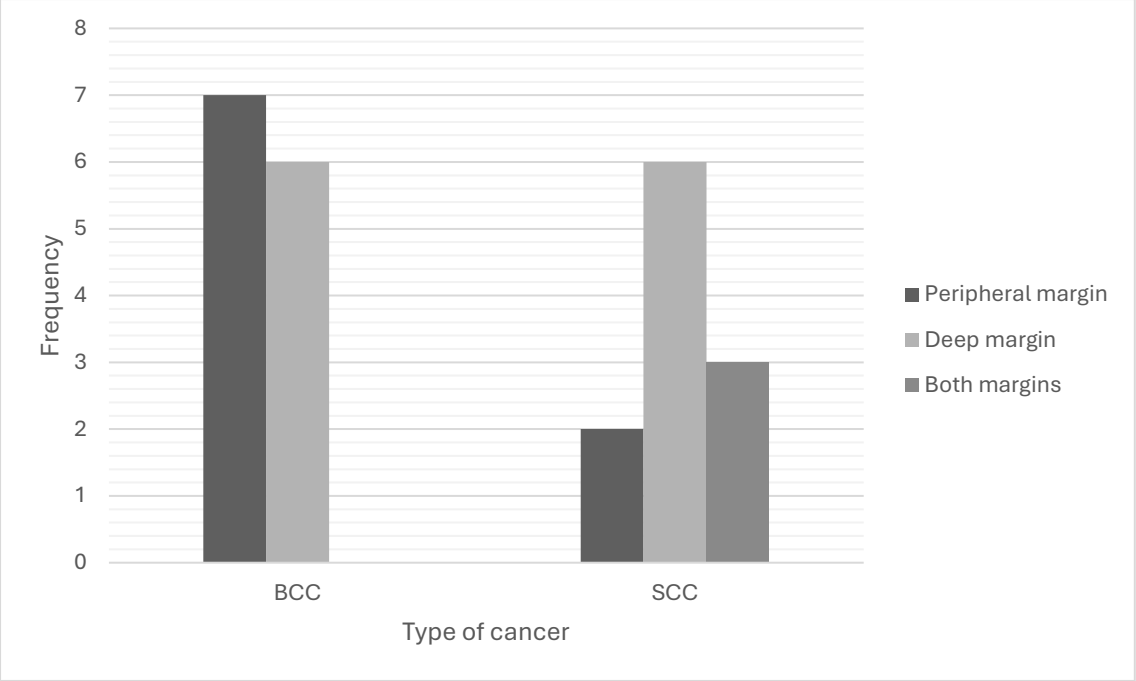
In the residual tumour was located only at the deep margin in 12 (50%) of the cases. A residual tumour at the peripheral margin only was less common, affecting seven (29.2%) patients. A residual tumour at both deep and peripheral margins was the least common, affecting five (20.8%) patients.

To explore this further, the frequencies of the implicated margins were cross-tabulated (Table 8).

Table 8: Implicated margins of BCC vs SCC

	BCC	SCC
Peripheral	7	2
Deep	6	6
Both	0	3

BCC=Basal Cell Carcinoma
SCC= Squamous Cell Carcinoma



BCC=Basal Cell Carcinoma
SCC= Squamous Cell Carcinoma

Figure 2: Implicated margins of BCC vs SCC

Those with BCC had seven peripheral and six deep margins implicated, while those with SCC had two peripheral and six deep margins implicated. While those with BCC had no occurrences implicating both margins, those with SCC had three such occurrences.

Tumour size in mm^2 and margins

Tumours were classified for their size as large (>400mm^2), medium (100 to 400mm^2), or small (<100mm^2) and compared for margin involvement (Table 9).

Table 9: Tumour size (in mm^2) and margins

	Large >400mm^2 (n=37)		Medium 100 to 400mm^2 (n=60)		Small <100mm^2 (n=61)		Total (n=158)		
	n	%	n	%	n	%	n	%	p-value

Clear margin	34	91.9	50	83.3	50	82.0	134	84.8	0.382
Residual tumour	3	8.1	10	16.7	11	18.0	24	15.2	

n=number

From Table 9 it can be seen that 11 (18%) small tumours had involved margins, followed by 10 (16.7%) medium tumours with involved margins, and only 3 (8.1%) large tumours had involved margins.

Tumour depth (thickness in mm) and margins

Using the NCCN guidelines, the tumours were classified as thinner if less than 2mm, and thicker if more than 2mm (Table 10).

Table 10: Tumour depth (thickness in mm) and margins

	Thinner (<2mm) (n=38)		**Thicker (>2mm) (n=119)**		**Total (n=157)***		
	n	**%**	**n**	**%**	**n**	**%**	**p-value**
Clear margin	36	94.7	97	81.5	133	84.7	0.049
Residual margin	2	5.3	22	18.5	24	15.3	
Total	38	100.0	119	100.0	157	100.0	

** One patient file did not record thickness*

From Table 10, it can be seen that if a tumour was less than 2mm the chance of an involved margin was 2 out of 38 (5.3%). If it was greater than 2mm, the risk of involved margin was 22 out of 119 (18.5%). Therefore the odds ratio of thicker tumours (>2mm) having involved margins compared to thin tumours (<2mm) was 3.5.

Discussion

This audit evaluated the outcomes of patients who have undergone primary surgical excision of NMSC at CHBAH and provides an understanding of the status of cancer clearance in this setting. In the three years studied, the cancer clearance rate of NMSC in this centre was 84.8 percent, lower than the 95 percent clearance rate described by the NCCN[12] but consistent with previous literature on wide local excisions of NMSC in 2022[21]. This lower rate may be attributed to the severity of disease upon presentation, and poor differentiation of macroscopic tumour borders, particularly with underlying solar keratosis and dysplasia.

The study population trended towards advanced age, which is in keeping with other studies[23]. This can be explained by the natural history of the disease, such as cumulative UV radiation exposure and immunosenescence. The gender disparity with a larger male sample may potentially be attributed to social and occupational factors, including health-seeking behaviour, attentiveness to skincare routines, and occupational exposures. However, these factors were not investigated in this study.

Histologically, the BCC prevalence was almost triple that of SCC, confirming that BCC is the most common type of NMSC. Of the 26 BCC subtypes described in previous studies[24], only eight were identified, with the nodular subtype being the most common, followed by infiltrating, then superficial spreading. Approximately half of the BCC specimens were mixed subtypes, higher than the 38.5 percent previously reported[25].

Nodular subtypes accounted for the highest number of margin involvements, while infiltrating subtypes demonstrated a higher proportion of incomplete excision of tumour when considering sample size. This difference may be due to the growth pattern of

infiltrative subtypes being more aggressive, having poorly demarcated margins, and having tumour cords that are narrow and invade deeply into the underlying tissue[26]. These factors make them difficult to visualize macroscopically and remove with wide local excision.

SCC, despite a smaller population size, portrayed an interesting picture regarding histological differentiation. The majority of specimens showed features of moderate differentiation, particularly the keratinizing subtype. While poor differentiation was noted in less than ten percent of the SCCs studied, there was only one case demonstrating well differentiated SCC. This finding was contrary to the traditional understanding that well differentiated SCCs are the most common[27]. This may be attributed to a delay in patient presentation, secondary to patient and systemic factors, including avoidance, patient level of education, and access to the healthcare facility.

After surgical excision of tumours using the NCCN guidelines, BCCs had a higher number of incompletely excised tumours compared to SCCs, but with a much smaller sample size the SCCs still accounted for almost half of the margin involvements in this study. This demonstrates a relatively higher risk for incomplete excision. Margin involvements were similarly distributed for BCC excisions, while SCC excisions had a higher propensity for a residual tumour to be present at the deep margin. The higher number of deep margin involvements is in keeping with the vertically destructive nature of SCC.

NMSCs were more likely to develop in the head and neck region compared to other locations. Head and neck tumours were also more likely to be incompletely excised using wide local excision. This shows that despite the cost and poor availability, there

is still a potential need for MMS, particularly when treating head and neck BCC and SCC.

This study compared the tumour thickness and size of NMSCs that were completely excised and those with residual tumour at the margins. Tumours with a thickness of more than 2mm had 3.5 times higher risk of incomplete surgical excision compared to tumours with a thickness of less than 2mm, and this finding was significant. Size varied widely for both completely and incompletely excised tumours. Interestingly, the median size of NMSCs with involved margins was smaller than that of those completely excised. This finding may be due to a potential link between incomplete excision and tumour location, rather than the total surface area of the tumour.

NMSCs that were completely excised had a median microscopic clearance of 3.5mm at the closest peripheral margin, while the deep margin was 2.8mm. This shows that, in most cases, operators potentially excised beyond the recommendations of the NCCN macroscopic peripheral margin guidelines resulted in a median 0.5mm loss of healthy tissue.

There were various limitations to this study. Firstly, as a retrospective record review, there was potential for recall bias, as only patients who presented for their surgery were included, therefore, the sample may not have been representative of all NMSC patients who have presented to the hospital. Secondly, a small study size (n=158) from a single centre may also not be extrapolated to the entire population, especially when studying the patients with margins involved (n=24). The number of patients included in a 3-year period was also less than expected, this may have potentially been affected by the coronavirus pandemic or populations treated at CHBAH. Thirdly, despite the guidelines stipulated by NCCN guidelines for macroscopic wide local

excisions, surgeon experience was not accounted for, therefore the macroscopic borders may be incorrectly measured by the presence of premalignant lesions such as solar keratosis, therefore macroscopic measurements may not align with the actual edge of tumour. Finally, the patient risk factors such as patient phenotype, genotype, and disease comorbidities have not been included in this study. Future studies should include a larger population group involving multiple centres, identifying patient histories that may increase the risk for NMSC development.

In conclusion, this study has shown that the outcomes of primary wide local excision of NMSC at CHBAH has been favourable for the majority of patients, with most patients experiencing disease-free status post-operatively. However, certain factors have been identified to predict incomplete excision. These include SCC, aggressive subtypes of BCC, tumours with a thickness of more than 2mm, and tumours located in the head and neck region. Improvement in care can be achieved by identifying those patients who are at risk for incomplete excision, as well as incorporating MMS to help achieve better service delivery, while acknowledging the financial implications and resource limitations in the CHBAH setting.

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Appendix A: Approved Research Protocol

Title

A quality audit of outcomes in wide local excision of non-melanoma skin cancers at Chris Hani Baragwanath Academic Hospital.

Name: Wei-Han Chen (Student Number 2527855)

Degree: MMed (Wits)

Supervisors: 1) Professor E. Ndobe, FC Plast Surg (SA), MMed (UCT)
Department Head of Plastic and Reconstructive Surgery
Division of Plastic and Reconstructive Surgery
Department of Surgery
University of Witwatersrand
Johannesburg
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2) Dr L.B.A. Monaisa, FC Plast Surg (SA), MMed (Wits)
Consultant Plastic Surgeon
Division of Plastic and Reconstructive Surgery
Department of Surgery
University of Witwatersrand
Johannesburg
South Africa

3) Prof E.E. Nweke, BSc (Hons), PGDipHE, MSc, PhD
Senior Lecturer
Department of Surgery
Wits School of Clinical Medicine

Literature Review

Non-melanoma skin cancers (NMSC) are one of the leading causes of cancers in the world, and account for a third of cancer diagnoses[1]. In the United States alone, an estimated 5.4 million new diagnoses are made annually[2]. Gordon et al found in 2016, that the South African healthcare system allocates between 13.3 to 19.3 million USD to diagnose and treat skin cancers annually[3]. The 2 most common types of nonmelanoma skin cancers are Basal Cell Carcinoma (BCC) and Squamous Cell Carcinoma (SCC), with BCC more common than SCC[4]. The current mainstay of treatment for these cancers is complete excision, however, taking into account cancerfree tissue preservation[5].

Many guidelines exist internationally regarding the management of both BCC and SCC. The National Comprehensive Cancer Network (NCCN), American Academy of Dermatology (AAD) and British Academy of Dermatology (BAD) all provide details on risk stratification for NMSC, the common denominator in the aforementioned guidelines is that Mohs micrographic surgery (MMS) is the gold standard for treatment[6], particularly high-risk lesions, as this provides both complete tumour eradication as well as healthy tissue preservation. However, they differ in opinion on recommendations particularly around macroscopic surgical margins for adequate excision in the absence of Mohs.

The most common cutaneous malignancy is the BCC[7]. It derives from the pluripotential epithelial cells at the dermo-epidermal junction[8]. It is the most common cause of eyelid malignancies as well as accounting for more than 80% of head and neck cancers[9]. There are currently more than 26 identified subtypes, the most common being nodular, while 38.5% are mixed cases[10]. It is a slow-growing

malignancy with low metastatic potential ranging between 0.0028-0.55%[10]. Nonsurgical treatment modalities do exist, such as radiotherapy and topical agents, however with a lower success rate in eradication of tumour[11].

The 2023 NCCN guideline stratifies BCCs into two groups, either low or high-risk, based on clinical and pathological features. Clinically would entail location, borders, recurrence, immunosuppression, and previous radiation. Pathologically, would refer to subtype and presence of perineural invasion. If a lesion is deemed low-risk, it can be safely excised with a 4mm margin, whereas for lesions demonstrating high-risk features, the recommendation is that an excision with a non-specified wider margin should be taken[12].

SCCs are the second most common skin cancer after BCC[13]. The tumour originates from the basal layer of the epidermis and rarely occurs in undamaged skin[14], including chronic wounds, viral infections, exposure to ultraviolet (UV) carcinogens and radiation[15]. More than 60% of cancers involving the external ear are confirmed to be SCCs. SCCs metastasize either lymphatically to the regional lymph node basin or haematogenous to solid organs[16]. It ranks second only to malignant melanoma for fatality rates in the population group aged over 85 years old [17].

As per the 2023 NCCN guidelines, SCC risk stratification is classified into low-risk, high-risk and very high-risk lesions[18]. These are determined by clinical and pathological features, clinical risk factors take into account location, size, extent, recurrence, immunosuppression, prior radiation, growth, and neurologic symptoms.

Pathological risk factors investigate the degree of differentiation, histologic features, tumour depth, perineural and lymph-vascular involvement. The guidelines

recommend a 4-6mm macroscopic margin for low-risk lesions, whereas high-risk and very high risk SCCs are once again given an unspecified wider margin of excision[18].

The NCCN guidelines are based on a single study performed by Zitelli and Wolf in 1987 which showed that tumours less than 2cm in diameter had a 95% complete excision rate with a 4mm margin, as demonstrated by MMS. Whereas lesions larger than 2cm required a larger margin[19].

NMSC affect populations in both low and high-income countries, representing a significant burden of disease globally. Despite the advances in medicine and the use of MMS as the gold standard in the treatment of both BCCs and SCCs internationally, the focus for the South African plastic Surgeon working in the public sector should still be macroscopic excision margins. The reasons for the aforementioned are due to limited theatre time, bed pressures and the financial cost of training and equipment for MMS. It is therefore pertinent that the macroscopic guidelines are representative of the population and pathology in this institution to allow complete tumour excision, tissue preservation and safe reconstruction of NMSC defects.

Study Objectives

The primary objective is:

To determine the cancer clearance rate of non-melanoma skin cancers at Chris Hani

Baragwanath Academic Hospital, Johannesburg, South Africa.

The secondary objective is:

To determine relationships between incomplete tumour excision and disease characteristics, including age, gender, anatomical location, and histological features of tumour specimen.

Methodology

A retrospective study will be performed, participants include all day cases undergoing excision of non-melanoma skin cancers as per the NCCN guidelines at Chris Hani Baragwanath Academic Hospital from 1 September 2021 until 31 August 2024. In this study centre, the surgeons implement macroscopic excision margins of 4mm for low risk BCC, and a minimum of 5mm for high-risk BCC. Lesions confirmed as SCC are excised with a macroscopic margin of 5mm and 1cm for low risk and high risk respectively. All incision biopsies and re-excisions will be excluded. These participants will be identified from theatre records. Primary outcome will be margin involvement on histological specimen. Secondary outcomes include cancer types and subtypes, cancer diameter, age and sex. Other patient demographics, as well clinical presentation will not be considered in this study. This study would want to achieve a minimum sample size of 150 patients.

See data capturing sheet attached.

The data will be collected using a data capturing sheet (addendum 1). No patient identifying data will be captured on the sheet, instead a unique study number will be assigned to the participants. Captured data will then be transcribed to REDCAP.

Data Analysis

Categorical variables, such as margin involvement, will be reported as frequencies and percentages. Continuous variables, like tumour thickness, will be described using the mean with standard deviation (SD) for normally distributed data, and the median with interquartile range (IQR) for non-normally distributed data.

To analyze the predictors associated with margin involvement among categorical variables, Chi-square or Fisher's exact tests will be employed. For continuous variables, a t-test or Mann-Whitney test will be utilized to compare means or medians, accompanied by p-values.

Binary logistic regression will be conducted to identify factors related to margin involvement, with factors showing a p-value of less than 0.05 considered statistically significant. All statistical analyses will be carried out using Stata Version 18 or higher, and the data analysis will be subject to verification by supervisors.

Ethical Considerations

This study will need ethics approval and permission from both the University of Witwatersrand Human Research Ethics Committee and the CEO of Chris Hani Baragwanath Academic Hospital. The study will also be registered in the National Health Research Database.

Timeline

	2024			2025								
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Protocol												
Protocol submission												
Ethics application												
Data collection												
Data analysis												
Compilation												

Funding

The cost of the research includes personnel (the registrar) to travel to Chris Hani Baragwanath, and capture data on a personal computer, which amounts to less than R1000. This will be by the Principal investigator.

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Appendix B: Ethical Clearance

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG	HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

Office of the Deputy Vice-Chancellor (Research and Innovation)

TO:	Dr W-H Chen
SCHOOL:	School of Clinical Medicine Department of Surgery Division of Plastic and Reconstructive Surgery Faculty of Health Sciences
	E-mail: Weihan.davey.chen@gmail.com
CC:	Supervisor: Professors E Ndobe and E Nweke; Dr L Monaisa <Elias.Ndobe@gmail.com> and <HREC-Medical Research Office@wits.ac.za>
FROM:	Mr Iain Burns Human Research Ethics Committee (Medical) Tel: 011 717 1252
	E-mail: Iain.Burns@wits.ac.za
DATE:	2025/04/24
REF:	R14/49
PROTOCOL NO:	**M250358** (This is your ethics application reference number. Please quote it in all enquiries, oral or written, relating to this study.)
PROJECT TITLE:	*A quality audit of outcomes in wide local excision of non-melanoma skin cancers at Chris Hani Baragwanath Hospital*

Please find attached the Clearance Certificate for the above project. I hope it goes well and that an article in a recognized publication comes out of it. This will reflect well on your professional standing and contribute to Government funding of the University.

MSWorks2000/Iain0007/Clearscan.wps

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R49 Dr W-H Chen

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M250358

NAME: (Principal Investigator)	Dr W-H Chen **DEGREE:** M Med (PR Surg)
SCHOOL:	School of Clinical Medicine Department of Surgery Division of Plastic and Reconstructive Surgery Faculty of Health Sciences
PROJECT TITLE:	*A quality audit of outcomes in wide local excision of non-melanoma skin cancers at Chris Hani Baragwanath Hospital*
DATE CONSIDERED:	Ad hoc
DECISION:	Approved unconditionally
CONDITIONS:	Retrospective record review
NOTE:	For permission to use or contact student study participants, please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za>
SUPERVISORS:	Professors E Ndobe and E Nweke; Dr L Monaisa
APPROVED BY:	Professor P Ruff, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2025/04/24 **EXPIRY DATE:** 2030/04/23

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report** in the format available at https://wits.ac.za/research/researcher-support/research-ethics/ethics-committees/. This report is due annually, for the duration of the Clearance Certificate, beginning on the first anniversary of Date of Approval above. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator _____ Date _____

Appendix C: Gatekeeper Permission

GAUTENG PROVINCE
REPUBLIC OF SOUTH AFRICA

CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL
RESEARCH COMMITTEE
Inquiries: Ms Patience Daza
Email: patience.daza@gauteng.gov.za
Tel: 011 933 0807

DATE: 15 April 2025

PERMISSION TO CONDUCT RESEARCH
(Subject to approval by the relevant Human Research Ethics Committee)

TITLE OF PROJECT: A quality audit of outcomes in wide local excision of non-melanoma skin cancers at Chris Hani Baragwanath Academic Hospital.

DETAILS OF THE INVESTIGATOR

UNIVERSITY	University of the Witwatersrand
DEPARTMENT AT CHBAH	Plastic and Reconstruction Surgery
PRINCIPAL INVESTIGATOR	Dr. Wei-Han Chen
SUPERVISOR	Professor Ndobe, Professor Nweke & Dr. Monaisa
NHRD NUMBER	GP 202503 054

The Chris Hani Baragwanath Academic Hospital Research Committee recommends that the said research be conducted at Chris Hani Baragwanath Academic Hospital (CHBAH). The Chief Executive Officer (CEO) of CHBAH is accordingly informed, and gives permission for the study to be conducted subject to the following: -

1. Permission has been granted by the Human Research Ethics Committee of the University of the Witwatersrand.
2. The Hospital will not be incurring extra costs as a result of the research being conducted on its patients within the hospital.
3. Permission being granted for the duration of the Ethics Committee Approval.
4. The results of the study being shared with the CHBAH department where the study will be conducted.

Recommended
Dr Mvuyiso Talatala
Chairperson of the CHBAH Research Committee
Date: 15/04/2025

Approved / Not Approved
Dr Nthabiseng Makgana
Chief Executive Officer
Date: 16/4/2025

Appendix D: Data Collection Sheet

Non-Melanoma Skin Cancer Data recording Sheet

Study No:				
Age				
Sex	M		F	
Cancer type	BCC		SCC	
Differentiation (If SCC)	Well	Moderate	Poor	
Subtype (if BCC)				
Cancer Location	Head and neck	Trunk	Upper limb	Lower limb
Size of Tumour (mm)				
Tumour thickness (mm)				
Perineural Invasion	Absent	Present		
Lymphovascular Invasion	Absent	Present		
Closest Peripheral Margin (mm)				
Deep Margin (mm)				

Appendix E: Turnitin Report

A quality audit of outcomes in wide local excision of non.docx

ORIGINALITY REPORT

15%	6%	5%	9%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

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