Surgical treatment of basal cell carcinoma: a case series on factors influencing the risk of an incomplete primary excision

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Abstract

Background Basal cell carcinoma (BCC) is the most common skin cancer form, and one first-line treatment is surgical excision. Complete excision is vital to minimize risk of recurrence. Studies on occurrence of incomplete excisions have given diverse results and seldom include large populations from a dermatological setting.

Objectives The rate of positive surgical margins in primary surgery of BCC at a tertiary dermatology clinic is studied. Factors associated with an incomplete primary excision are analysed.

Methods Patients scheduled for standard excision, without perioperative margin control, of BCC during the years 2008–2015 were prospectively enrolled in the study. Tumour-specific factors, including histopathologic subtype, as well as postoperative outcome were registered. Incomplete excisions were analysed in relation to patient- and tumour-related factors.

Results In total, 4.6% of 3911 BCC tumours were incompletely excised. The rate of incomplete excisions was higher for facial tumours and among tumours with an aggressive histological subtype. Morpheiform BCC on the nose or ear had the highest rate of an incomplete excision, 61.5% and 50%, respectively.

Conclusions Most BCCs, irrespective of subtype, were completely excised during the primary excision. Tumour sites nose and ears were associated with the highest rate of positive primary surgical margins, especially for infiltrative or morpheiform BCCs. Surgery with perioperative examination of margins is strongly recommended for these tumours.

Introduction

Skin cancer is an increasing health problem in fair-skinned populations and is among the cancers with the most rapidly increasing incidence.1–3 The three most common skin cancers are basal cell carcinoma (BCC), squamous cell carcinoma and melanoma. Out of these, BCC is by far the most common cancer form and in Sweden, the tumour-based age-standardized incidence rate in 2008 was 430/100 000 person years for males and 352.6/100 000 person years for females.4 Person-based incidence in other parts of Europe varies from 77–158/100 000 person years (European standardized incidence rate).5 Together, the different skin cancer forms create a significant and increasing health problem in Sweden and Europe.

Since 2004, all histologically examined BCC tumours in Sweden are registered in the national Swedish basal cell carcinoma registry.4 The diagnosing pathologist reports the cases, and registration of histological subtype is mandatory. Due to a long national tradition, all BCC tumours in Sweden are histopathologically classified according to Jernbeck et al.6; where Glas-type IIA corresponds to nodular BCC, type IB corresponds to superficial BCC and type III corresponds to morpheiform BCC. Glas-type II is defined as an infiltrative subtype with an intermediately aggressive growth pattern between type I and type III. BCC Glas-type I through III thus indicates an increasingly aggressive growth pattern. In this article, BCC subtype will henceforth be
categorized as nodular, superficial, infiltrating or morpheiform BCC for clarity.

For many BCC subtypes, the gold standard treatment is surgical excision. For low aggressive BCC, alternative treatments such as cryosurgery, curettage and cryosurgery, photodynamic therapy (PDT) and topical Imiquimod can be used.7 Regarding highly aggressive tumours, such as morpheiform BCC, wide surgical excision or surgery with perioperative examination of margins [as in Mohs Micrographic surgery (MMS)] is recommended.8,9 Due to limited accessibility to Mohs surgery, most primary excisions of BCCs in Scandinavian countries are not executed in Mohs surgical centres.

Since 2001, a protocol for referral of skin tumours from general practitioners has been implemented in our hospital admission area (160 000 inhabitants). This results in all skin tumour referrals being directed to the tertiary dermatology department, Helsingborg General hospital, where the diagnosis is made. Out of these, the majority of tumour treatments, including excisions, are made by dermatologists/dermatological surgeons.10

When surgically excising BCC, complete removal of the tumour is crucial to minimize recurrence risk. In previous studies, data on rate of incomplete primary excisions vary widely and numbers ranging from 6% to 18% regarding BCC have been reported.11–17 The studies are mainly based on excisions performed by physicians from non-dermatological specialties and larger studies from a dermatological setting are sparse.

The aims of this study were to analyse the overall rate of incomplete excisions of BCC at a tertiary dermatology clinic as well as whether tumour subtype or tumour localization influences the risk of an incomplete primary excision.

Materials and methods

Material

Patients who underwent a primary surgical excision of a skin tumour at the Department of Dermatology, Helsingborg Hospital in southern Sweden, from March 2008 to September 2015 were prospectively enrolled in the case series. In 2017, a retrospective study of the prospectively registered and consecutively operated patients with the outcome of BCC was performed. All non-BCC tumours were excluded as well as all wide/secondary surgical procedures (re-excisions) and shaves. Tumours were included regardless of prior histological evaluation/biopsy. All cases were treated with standard excision, without the use of perioperative margin control. Excisions were made in accordance with the current Swedish national recommendations, where small (<2 cm) low aggressive BCC tumours should be excised with 3–4 mm clinical margin. Highly aggressive tumours, where perioperative margin control is not applied, should be excised with at least 5 mm clinical margin.18 The majority of excisions were made by specialists and residents in dermatology. Selected tumours in the head and neck area were excised by specialists and residents in otolaryngology (ENT physicians), who during the study period were working at the dermatology department. All excisions were made at the dermatology department, and experienced dermatology specialists were available for perioperative consultation regarding tumour margins. Overall, a minority of primary BCC cases were referred to other clinics for treatment. Tumour samples were histologically evaluated, using traditional serial cross-sectioning. Incomplete excision was defined as an excision with a histologically verified positive surgical margin, whereas complete excision was defined as an excision with free margins. Specific information regarding whether incomplete excisions involved lateral or deep margins was not registered in this study.

Surgical quality registry

At the department of dermatology in Helsingborg, all surgical excisions of skin tumours are registered through the computerized patients file system (Journalsystem Melior®, Siemens AB, Upplands Väsby, Sweden). Multiple fixed questions are used in order to register data regarding preoperative parameters such as sex, age, tumour size and tumour localization. Histopathological diagnosis and tumour clearance (yes/no), as described by the pathology report, are registered postoperatively by a registered nurse. Histopathological diagnosis and subtype retrieved from the pathology report are consistent with the Glas-classification used in the national Swedish basal cell carcinoma registry.4 Regarding BCC tumours with a histologically mixed growth pattern, the most aggressive growth pattern is registered. In this study, outcome was defined as tumour clearance (yes/no). Outcome was related to independent variables, including tumour subtype and localization.

The surgical quality registry includes all dermatosurgical excisions made at the dermatology department. The current study focused only on excisions of BCC. For the first part of the study period, 2008–2011, all excised BCCs were registered according to histopathological subtype as morpheiform or non-morpheiform. As of 1 January 2012, until the end of the study period, all non-morpheiform BCCs were further subclassified in the quality registry into nodular, superficial and infiltrating BCC. For practical and statistical reasons, data regarding rate of incomplete excisions in relation to tumour subtype in the present study were based on numbers regarding the dichotomous variable morpheiform or non-morpheiform growth pattern. A supplementary subgroup analysis was made, studying data regarding nodular, superficial, infiltrating and morpheiform BCC type during the later study period 2012–2015, Figure 1.

Statistics

Data from the quality registry were extracted using the software program Qlik View® (QlikTech International AB, Lund, Sweden) and exported to Excel® (Microsoft corporation, Redmond,
WA, USA). Statistical analyses were performed using the software R (R Core Team\(^{19}\)) version 3.6.0. Population characteristics were presented using descriptive methods. An odds ratio (OR) was calculated, displaying the association regarding a certain tumour characteristic and an incomplete excision. Comparisons were made in relation to a defined reference group. Comparisons of the binary outcome were made using the exact Fisher’s test for \(2 \times 2\) tables and its generalization for \(2 \times k\) tables \((k > 2)\). For multiple comparisons for \(k > 2\), a logistic model was used with multiple comparisons using the multcomp package\(^{20}\) version 1.4.10 in R, adjusting for the family-wise error (using Holm or the single-step method).\(^{21}\) A multiple logistic regression was made with subtype, localization and size of the tumour as well as age and sex of the patient as predictors. Analyses were made using R version 3.6.1.\(^{19}\) A two-sided \(P\)-value of <0.05 was considered significant. Where appropriate, a 95% Clopper–Pearson confidence interval was used for proportions. Cases with missing data regarding tumour clearance or relevant predictors were excluded from calculation of significance. Number of missing cases is presented, when existent.

**Results**

In total, 11,151 dermatosurgical excisions were performed between March 2008 and September 2015. After exclusions, 3,911 registered primary excisions of BCC were included in the study, Figure 2. Out of these, 85.2% were performed by dermatologists and 14.8% by visiting ENT physicians. The median patient age was 72 years (range 18–98). Among treated patients, 51% were female and 49% male. The mean tumour diameter was 11.1 mm. The overall rate of incomplete excisions was 4.6%.

**Tumour localization**

For tumours located on the sites ‘face’, ‘nose’ and ‘ear’, there was a higher rate of incomplete primary excisions in relation to other body sites. Regarding tumours located on the nose, the rate of incomplete excisions was 20.3% and the corresponding number for the ear was 23.7%. This was significantly higher in relation to excisions made in other parts of the face, where 6.5% of excisions were incomplete, Table 1. When further analysing excisions made in the face, there was no significant difference in proportion of incomplete excisions between the different facial areas, other than regarding ear or nose, data not shown.

![Figure 1](image1.png)

**Figure 1** Overview of the study period. Due to registration reasons, outcome was presented in two groups; excisions made during the whole study period\(^a\) and excisions made during the years 2012–2015\(^b\). In the latter group, all four histological subtypes of BCC used in Swedish nomenclature (nodular, superficial, infiltrating and morpheiform) were presented.

![Figure 2](image2.png)

**Figure 2** Mode of inclusion.
OR is related to the rate of incomplete excisions among non-morpheiform (Table 2a) and nodular BCC (Table 2b), which were de-
t†
significant difference in rate of incomplete excisions dependent on tumour localization. When further classifying the non-morpheiform BCC tumours during the years 2012–2015, infiltrating BCC had a significantly higher rate of incomplete excisions in comparison to non-morpheiform BCC tumours were incompletely excised, Table 2a. For the site ‘face’ (‘ear’ and ‘nose’ excluded), the rate of incomplete primary excisions of morphoeform BCC tumours was 50% and 61.5%, respectively, Table 3. In the latter study period, when further subclassifying all non-morpheiform BCC, the infiltrating subtype also showed a high occurrence of incomplete excisions among morpheiform BCC in comparison to non-morpheiform BCC. In total, 30.6% of morpheiform and 3.8% of non-morpheiform BCC tumours were incompletely excised, Table 2a. Histological diagnosis/BCC subtype There was a significantly higher rate of incomplete excisions among non-morpheiform BCC (in total) divided by tumour localization. Histological diagnosis/BCC subtype Table 1 Rates of incomplete excisions during the years 2008–2015, divided by tumour localization 

| Tumour localization | Number of excisions (% of all excisions) | Proportion of incomplete excisions, % (95% CI)† | OR (95% CI);‡ | P-value¶ |
|---------------------|-----------------------------------------|-----------------------------------------------|----------------|--------|
| Torso               | 1173 (30)                               | 1.2 (0.7–2.0)                                 | 0.2 (0.1–0.3)  | <0.001*|
| Leg                 | 493 (12.6)                              | 1.6 (0.7–3.2)                                 | 0.2 (0.1–0.5)  | 0.003* |
| Arm                 | 225 (5.8)                               | 1.8 (0.5–4.5)                                 | 0.3 (0.1–0.7)  | 0.14   |
| Neck                | 183 (4.7)                               | 4.4 (1.9–8.4)                                 | 0.7 (0.3–1.4)  | 0.95   |
| Scalp               | 158 (4)                                 | 5.1 (2.2–9.7)                                 | 0.8 (0.4–1.6)  | >0.99  |
| Face (ear and nose excluded) | 1424 (36.4) | 6.5 (5.2–7.9)                                 | 1.0 (ref)      |        |
| Nose                | 158 (4)                                 | 20.3 (14.3–27.4)                              | 3.7 (2.4–5.7)  | <0.001*|
| Ear                 | 59 (1.5)                                | 23.7 (13.6–36.6)                              | 4.5 (2.4–8.5)  | <0.001*|
| Missing data        | 38 (1.0)                                | —                                             | —              |        |
| BCC (in total)      | 3911                                    | 4.6 (4.0–5.4)                                 | 0.004**         |        |

†A 95% confidence interval (CI) is presented. †Odds ratio (OR) for an incomplete excision in relation to tumour localization is presented, together with a 95% CI. OR is related to the rate of incomplete excisions among tumours located on the face (ear and nose excluded), which was defined as reference group. ‡P-value is calculated by Fisher’s exact test. Significance level: P < 0.05. P-values are adjusted according to Bonferroni–Holm. *Significant result. This signifies a significant difference in rate of incomplete excisions in comparison to the reference group. **There was a significant overall difference in rate of incomplete excision dependent on tumour localization.

Histological diagnosis/BCC subtype There was a significantly higher rate of incomplete excisions among non-morpheiform BCC (in total) divided by dichotomous histological diagnoses morpheiform or non-morpheiform. (b) Rates of incomplete excisions during the years 2012–2015, divided by histological diagnosis. Non-morpheiform subtypes further subclassified

| (a) | Histological diagnosis | Total number of excisions (% of all excisions) | Proportion of incomplete excisions, % (95% CI)† | OR (95% CI);‡ | P-value¶ |
|-----|------------------------|-----------------------------------------------|-----------------------------------------------|----------------|--------|
| Non-morpheiform BCC | 3789 (96.9) | 3.8 (3.2–4.4) | | | |
| Morpheiform BCC | 121 (3.1) | 30.6 (22.5–39.6) | 11.2 (7.1–17.4) | <0.001* | |
| Missing data | 1 | — | — | — | |
| BCC (in total) | 3911 | 4.6 (4.0–5.3) | | | |

(b) | Histological diagnosis | Total number of excisions (% of all excisions) | Proportion of incomplete excisions, % (95% CI)† | OR (95% CI);‡ | P-value¶ |
|-----|------------------------|-----------------------------------------------|-----------------------------------------------|----------------|--------|
| Nodular BCC | 975 (45.8) | 1.1 (0.6–1.9) | 1.0 (ref) | | |
| Superficial BCC | 381 (17.9) | 2.1 (1.0–3.9) | 1.9 (0.8–4.7) | 0.20 | |
| Infiltrating BCC | 690 (32.4) | 7.5 (5.7–9.7) | 7.1 (3.7–13.8) | <0.001* | |
| Morpheiform BCC | 83 (3.9) | 26.5 (17.8–36.6) | 31.6 (14.7–68.2) | <0.001* | |
| Missing data | 1 | — | — | — | |
| BCC (in total) | 2130 | 4.4 (3.5–5.3) | | <0.001** | |

†A 95% confidence interval (CI) is presented. †Odds ratio (OR) for an incomplete excision in relation to tumour subtype is presented, together with a 95% CI. OR is related to the rate of incomplete excisions among non-morpheiform (Table 2a) and nodular BCC (Table 2b), which were defined as reference groups. ‡P-value calculated by Fisher’s exact test. Significance level: P < 0.05. P-values are adjusted according to Bonferroni–Holm. *Significant result. This signifies a significant difference in rate of incomplete excisions in comparison to the reference group. **There was a significant overall difference in rate of incomplete excision dependent on tumour subtype.
Table 3 Rates of incomplete excisions during the whole study period, 2008-2015, divided by tumour localization and histological diagnosis

| Tumour localization | Histological diagnosis          | Number of excisions | Proportion of incomplete excisions, % (95 % CI)† | OR (95% CI)‡ | P-value§ |
|---------------------|--------------------------------|---------------------|-------------------------------------------------|-------------|---------|
| **Face (ear and nose excluded)** | BCC, non-morpheiform | 1369                | 5.6 (4.4–6.8)                                    | 1.0 (ref)   | -0.001* |
| P < 0.001**          | BCC, morpheiform          | 55                  | 29.1 (18.2–41.9)                                 | 7.0 (3.7–13.1) | -0.001* |
| Nose                | BCC, non-morpheiform       | 145                | 16.6 (11.1–23.2)                                 | 3.4 (2.1–5.5) | -0.001* |
| P = 0.001**          | BCC, morpheiform          | 13                 | 61.5 (34.8–84.1)                                 | 27.2 (8.7–85.2) | -0.001* |
| Ear                 | BCC, non-morpheiform       | 53                 | 20.8 (11.4–32.9)                                 | 4.5 (2.2–9.0) | -0.001* |
| P = 0.14            | BCC, morpheiform          | 6                  | 50 (15.6–84.4)                                   | 17.0 (3.4–85.7) | 0.03*  |
| Scalp               | BCC, non-morpheiform       | 156                | 5.1 (2.4–9.3)                                    | 0.9 (0.4–1.9) | -0.99   |
| P = 0.99            | BCC, morpheiform          | 2                  | 0 (NA)                                           | 0           | -0.99   |
| Neck                | BCC, non-morpheiform       | 176                | 4.0 (1.7–7.5)                                    | 0.7 (0.3–1.6) | -0.99   |
| P = 0.27            | BCC, morpheiform          | 7                  | 14.3 (0.9–49.4)                                  | 2.8 (0.3–23.9) | -0.99   |
| Torso               | BCC, non-morpheiform       | 1147               | 0.5 (0.2–1.1)                                    | 0.1 (0.04–0.2) | -0.001* |
| P = 0.001**         | BCC, morpheiform          | 26                 | 30.8 (15.4–69.7)                                 | 7.6 (3.2–17.9) | -0.001* |
| Extremities         | BCC, non-morpheiform       | 706                | 1.6 (0.8–2.8)                                    | 0.3 (0.1–0.5) | -0.001* |
| P = 0.18            | BCC, morpheiform          | 12                 | 8.3 (0.2–38.5)                                   | 1.5 (0.2–12.1) | 0.5     |
| Missing data        |                                | 38                 |                                                 |             |         |
| **BCC (in total)**  |                                | 3911               | 4.6 (4.0–5.4)                                    |             |         |

† A 95% confidence interval (CI) is presented. ‡ Odds ratio (OR) for an incomplete excision in relation to tumour subtype and localization is presented, together with a 95% CI. OR is related to the rate of incomplete excisions among non-morpheiform BCC located on the face (ear and nose excluded), which was defined as reference group. § P-value calculated by Fisher’s exact test. *Significant result. This signifies a significant difference in rate of incomplete excisions in comparison to the reference group. **There was a significant overall difference in rate of incomplete excision dependent on tumour subtype on this localization. Significance level: P < 0.05. P-values are adjusted according to Bonferroni-Holm.

Multiple logistic regression analysis

We performed a multiple logistic regression on patient- and tumour-specific factors and their effect on the odds of an incomplete excision. Odds ratio (OR) was correlated with the reference group located in the intercept. This included female sex, an age of 70 years, a tumour size of 1 cm, tumour subtype IA and facial tumour localization (nose and ear excluded). The analysis confirmed a significantly greater odds of an incomplete excision regarding BCC subtypes II and III as well as regarding tumour localizations nose and ear. There was a significantly greater odds of an incomplete excision among larger tumours. The odds also increased in relation to increasing patient age, Table 4.

Discussion

In the present case series on surgically excised BCC in a dermatology department, without accessibility to perioperative margin assessment, we found high rates of incomplete primary excisions for BCC located on nose and ear. The rates were highest for tumours with an aggressive histopathologic growth pattern (infiltrating and morpheiform BCC). These findings were confirmed in a multiple regression analysis. Overall, the rate of incomplete excisions was low in comparison to earlier studies.11–17 Our study stands out, investigating occurrences of incomplete excisions in a dermatological setting. It is one of few studies presenting data on positive surgical margins among different BCC tumour subtypes in relation to tumour site. A unique strength is that our study presents specified data regarding highly aggressive BCC subtypes excised on the nose or ear.

Standard treatment for many BCC subtypes is surgical excision. A complete excision is important to prevent recurrence and thereby decrease risk of patient morbidity as well as minimizing health economic costs. The recurrence risk of BCC after a histologically described complete excision has been reported to be 3%–6%11,12 However, after an incomplete excision, the rate of recurrence has been reported to be 26%–38%.11,12,22,23 Furthermore, previously recurrent tumours have been correlated with a higher recurrence risk.11,24,25 These results underline that primary excision with clear histological margins is a main goal in BCC surgical treatment.

Studies have shown presence of extensive subclinical tumour spread to be frequent in tumours eligible for Mohs surgery, and especially regarding aggressive BCC tumour subtypes.26,27 It is reasonable to suggest that simple excision of these tumours would result in an incomplete excision. Regarding studies on rate of incomplete primary excisions of BCC, data vary widely and numbers ranging from 6% to 18% have been reported.11–17 Studies have shown localization and histological subtype of BCC to be factors influencing the risk of an incomplete
These studies are primarily performed in non-dermatologic surgical specialities. International recommendations define risk assessment of BCC tumours after size, histological growth pattern and localization. In these recommendations, tumours located in the ‘H-zone’ are defined as high-risk tumours. The ‘H-zone’ includes sites such as the nose, ear, chin and temple. In our study, we found a significantly higher proportion of incomplete excisions when operating on the nose or ear. When further analysing tumours located in the head and neck area, we could not see the same tendency regarding facial areas other than the nose or ears. Regarding histopathological subtype, we found that infiltrating and morpheiform BCC in a significantly higher proportion resulted in incomplete excisions. When these subtypes were located on the nose or ear, this proportion grew even larger, thus, raising the question of alternative surgical treatment modalities in these cases.

For highly aggressive BCC, Mohs micrographic surgery has long been recommended, to minimize the risk of incomplete excisions. The perioperative histological evaluation of the surgical specimen in Mohs surgery enables the surgeon to achieve a complete excision of the tumour during a prolonged surgical session. Furthermore, the histological evaluation of the entire surgical margin decreases the risk of false-negative surgical margins occurring in traditional serial cross-sectioning. These factors together decrease the risk of tumour recurrences. In a study by Kuiper et al., the overall recurrence risk after Mohs surgery was 3.3%. Sweden is an area underserved with Mohs surgery due to the costs and the laboratory requirements of the procedure. The limited access to this method results in very strict recurrences.

Table 4 Rates of incomplete excisions during the later study period, 2012–2015, divided by tumour localization and histological diagnosis

| Tumour localization | Histological diagnosis | Number of excisions | Proportion of incomplete excisions, % (95% CI)† |
|---------------------|------------------------|---------------------|-----------------------------------------------|
| Face (ear and nose excluded) | Nodular BCC | 356 | 1.7 (0.6–3.6) |
| | Superficial BCC | 51 | 5.9 (1.2–16.2) |
| | Infiltrating BCC | 322 | 6.8 (4.3–10.2) |
| | Morpheiform BCC | 40 | 27.5 (14.6–43.9) |
| Nose | Nodular BCC | 39 | 10.3 (2.9–24.2) |
| | Superficial BCC | 1 | 0 (NA) |
| | Infiltrating BCC | 37 | 21.6 (9.8–38.2) |
| | Morpheiform BCC | 7 | 71.4 (29.0–96.3) |
| Ear | Nodular BCC | 12 | 0 (NA) |
| | Superficial BCC | 0 | 0 (NA) |
| | Infiltrating BCC | 14 | 35.7 (12.8–64.9) |
| | Morpheiform BCC | 4 | 50 (6.8–93.2) |
| Scalp | Nodular BCC | 39 | 0 (NA) |
| | Superficial BCC | 4 | 0 (NA) |
| | Infiltrating BCC | 30 | 20 (7.7–38.6) |
| | Morpheiform BCC | 1 | 0 (NA) |
| Neck | Nodular BCC | 44 | 2.3 (0.1–12.0) |
| | Superficial BCC | 19 | 5.3 (0.1–26.0) |
| | Infiltrating BCC | 41 | 12.2 (4.1–26.2) |
| | Morpheiform BCC | 5 | 0 (NA) |
| Torso | Nodular BCC | 323 | 0 (NA) |
| | Superficial BCC | 174 | 0.6 (0.0–3.2) |
| | Infiltrating BCC | 152 | 0 (NA) |
| | Morpheiform BCC | 17 | 17.6 (3.8–43.4) |
| Extremities | Nodular BCC | 152 | 0 (NA) |
| | Superficial BCC | 131 | 2.3 (0.5–6.5) |
| | Infiltrating BCC | 88 | 6.8 (2.5–14.3) |
| | Morpheiform BCC | 9 | 11.1 (0.3–48.2) |
| Missing data | 18 | | |
| BCC (in total) | 2130 | 4.4 (3.6–5.4) |

*There was a significant overall difference in rate of incomplete excision dependent on tumour subtype on this localization. P-value calculated by Fisher’s exact test. Significance level: P < 0.05.
†A 95% confidence interval (CI) is presented.
This study presents data on occurrence of incomplete excisions in a dermatological setting. In our healthcare region, dermatologists perform a significant part of skin cancer excisions. In our study, an incomplete excision was defined by the presence of a positive surgical margin. A method also used in earlier studies. The extension of clear margins was not taken into account as this information often is lacking in the pathological reports for BCC. Furthermore, it was not registered whether the lateral or deep margins were involved.

Moreover, as gold standard method, the histopathologic specimens were sectioned using traditional serial cross-sectioning. Using this technique, there is an inherent risk of false-negative surgical margins since only part of the margins are examined. In a later study, several dermoscopic criteria for diagnosing BCC and discriminating subtypes have been developed. Studies have shown usage of dermoscopy and education regarding dermoscopic criteria to further enhance dermatologist’s ability to correctly diagnose BCC and to preoperatively assess BCC subtype. However, dermoscopic criteria for discriminating aggressive from non-aggressive BCCs are still lacking.

The results in the present study underline the importance of discriminating BCC tumour subtype in order to offer a correct primary treatment modality. Regarding non-nodular BCCs located on the nose or ear, liberal use of preoperative punch biopsies might today be the best alternative to confirm subtype until more dermoscopy studies on aggressive BCC subtypes are presented.

### Strengths
The present study evaluates surgical excision of BCC tumours in a large number of prospectively enrolled patients, treated at a dermatology department during the years 2008–2015. Our quality registry has a near complete coverage of performed surgeries. The clinic performs surgical excisions of all different BCC tumour subtypes on virtually all tumour localizations. Thus, the registry has a representative coverage of BCC tumours treated in the area during this period of time, decreasing the risk of selection bias. A majority of excisions were made by dermatologists, and excisions made by ENT physicians were made with the possibility of preoperative dermoscopic evaluation of the tumour by an experienced dermatology specialist. This makes our study one of few, analysing surgical margins in a dermatological setting. Furthermore, this study presents detailed data regarding surgical margins in relation to histological subtype and tumour site.

### Weaknesses
In our registry, tumours were categorized according to subtype and tumour localization primarily. Some subtype categories contained a small number of excisions, potentially decreasing power of statistical analyses.

In our study, an incomplete excision was defined by the presence of a positive surgical margin. A method also used in earlier studies. The extension of clear margins was not taken into account as this information often is lacking in the pathological reports for BCC. Furthermore, it was not registered whether the lateral or deep margins were involved.

Moreover, as gold standard method, the histopathologic specimens were sectioned using traditional serial cross-sectioning. Using this technique, there is an inherent risk of false-negative surgical margins since only part of the margins are examined. In a study by Kimyai-Asadi et al., serial transverse cross-sectioning

### Table 5

| Variable              | Odds (95% CI) OR (95% CI) | P-value*  |
|-----------------------|---------------------------|-----------|
| Reference group       |                           |           |
| Male sex              | 0.02 (0.01-0.04)          | -0.001**  |
| Age                   | 1.03 (1.004-1.05)         | 0.02**    |
| Tumour subtype        |                           |           |
| Superficial BCC       | 2.9 (1.04–7.8)            | 0.04**    |
| Infiltrating BCC       | 4.2 (2.1-8.3)             | -0.001**  |
| Morpheiform BCC       | 18.2 (8.0–41.6)           | -0.001**  |
| Tumour localization   |                           |           |
| Extremities           | 0.4 (0.2–0.9)             | 0.02**    |
| Torso                 | 0.1 (0.02-0.2)            | -0.001**  |
| Neck                  | 1.1 (0.4-2.5)             | 0.90      |
| Scapul                | 1.5 (0.6-3.9)             | 0.42      |
| Nose                  | 4.9 (2.4–10.1)            | -0.001**  |
| Ear                   | 4.0 (1.4–11.1)            | 0.01**    |
| Ln (Tumour size in cm) | 2.4 (1.5–4.1)**          | 0.001**   |

*Significance is presented as P-values. Significance level: P < 0.05. **Significant P-value.

† Odds ratio (OR) for an incomplete excision in relation to the reference group (intercept) is presented, together with a 95% confidence interval (CI). † Reference group includes female sex, age 70 years, tumour size 1 cm, nodular tumour subtype and facial localization. †OR for incomplete excision related to age showed an increased odds for an incomplete excision for every year of increased age. †This corresponds to the log of the tumour size in cm. ††OR for incomplete excision related to tumour size showed an increased likelihood for an incomplete excision for every log-cm of increased size.

indicators for Mohs surgery in Sweden. It is of great importance to evaluate standard surgical methods in order to optimize patient care and, if necessary, enable allocation of resources to increase the use of more suitable and evidence-based surgical methods. Furthermore, it is vital to specify patient and tumour characteristics indicating the need of Mohs surgery. The present study shows that infiltrating and morpheiform BCC as well as tumours located on the nose or ear would benefit from surgery with perioperative histological evaluation, such as Mohs surgery or equivalent diagnostic techniques, in order to decrease risk of incomplete excision. Meanwhile, the low proportion of incomplete excisions regarding low aggressive nodular BCC, located on the face (nose and ear excluded), indicates that simple excision might be sufficient in these cases. Prioritizing aggressive tumours and difficult tumour localizations to Mohs surgery, or similar methods, and choosing simple excision when treating low aggressive tumours in uncomplicated localizations are vital to economize on healthcare costs.

This study presents data on occurrence of incomplete excisions in a dermatological setting. In our healthcare region, dermatologists perform a significant part of skin cancer excisions. In a large study by Ramdas et al., the rate of incomplete excision was higher among plastic surgeons and general practitioners in comparison to dermatologists. Dermatologists are specially trained for diagnosing skin cancers, and dermoscopy is widely used for preoperative skin cancer diagnosis and to define tumour margins. In later years, several dermoscopic criteria for diagnosing BCC and discriminating subtypes have been developed. Studies have shown usage of dermoscopy and education regarding dermoscopic criteria to further enhance dermatologist’s ability to correctly diagnose BCC and to preoperatively assess BCC subtype. However, dermoscopic criteria for discriminating aggressive from non-aggressive BCCs are still lacking.

The results in the present study underline the importance of discriminating BCC tumour subtype in order to offer a correct primary treatment modality. Regarding non-nodular BCCs located on the nose or ear, liberal use of preoperative punch biopsies might today be the best alternative to confirm subtype until more dermoscopy studies on aggressive BCC subtypes are presented.
only had a 44% sensitivity in detecting tumour residues at the sample margin. Thus, the true number of incomplete excisions in our study might be higher than presented.

**Conclusion**

In the present study on primary excisions of BCC, an overall low percentage of incomplete excisions was found. The rate of incompletely excised nodular (low aggressive) BCC on the face (ear and nose excluded) was low, indicating that simple excision could be sufficient for the majority of those cases. However, for morpheiform or infiltrating BCC as well as for tumours located on the ear or nose, a high percentage was incompletely excised. This underlines the importance of considering the use of perioperative margin assessment in these cases.

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