# Basal Cell Carcinoma of Scalp in Patients With History of Childhood Therapeutic Radiation

## *A Retrospective Study and Comparison to Nonirradiated Patients*

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**Background:** Basal cell carcinoma (BCC) is the most common human malignant neoplasm. Some patients with scalp BCC have had a history of childhood scalp radiation for the treatment of tinea capitis. It is not clear whether BCC in these cases has a more aggressive nature and requires a more aggressive resection. We performed a retrospective study to compare BCC tumor specification and treatment results between irradiated and nonirradiated patients.

**Materials and Methods:** From 1995 to 2005, a total of 74 patients were diagnosed with scalp BCC. Thirty-eight patients (group A) had a history of childhood radiation to the scalp for the treatment of tinea capitis, and the other 36 (group B) did not. We compared these 2 groups in 16 different parameters, which included general information (age, sex), disease history (time interval from onset of lesion to the first office visit, number of admissions, total length of hospital stay), tumor specifications (number of primary lesions, invasion depth, histologic subtypes, location), surgical history (number of operations in our center and other hospitals, type of surgical treatment, margins of resection), recurrences, new lesions, and metastasis. Statistical analysis was performed using SPSS 13.0 software.

**Results:** No significant difference in gender and age was observed between the 2 groups ($P = 0.06$ and $P = 0.35$, respectively). Patients in group A had a longer history of scalp lesions ($P = 0.001$). They also had more hospital admissions ($P = 0.008$) and operations ($P = 0.01$) in our center, with a longer period of hospitalization ($P = 0.01$). Mean number of primary lesions, the location of tumor, and the depth of invasion did not differ significantly between the 2 groups ($P = 0.34$, $P = 0.78$, and $P = 0.73$, respectively). There was no meaningful difference in safe resection margin for the first lesion between the 2 groups ($P = 0.27$); however, the number of recurrent lesions was significantly higher in group A ($P = 0.003$). Also, need for more aggressive resection and more complicated reconstruction was more in group A patients ($P = 0.01$ and $P = 0.015$, respectively). Only in group A new lesions and metastasis were found.

**Conclusion:** BCC in irradiated scalp has a more aggressive behavior and may need a more aggressive surgical resection. Also, these patients should be under close observation because there is a higher chance for tumor recurrence and also new lesions occurring elsewhere in the scalp.

**Key Words:** BCC, radiotherapy, scalp, tinea capitis

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Basal cell carcinoma (BCC) is the most common human malignant neoplasm, with at least 900,000 new cases diagnosed annually in the United States.[1] Most commonly, BCC is observed in sun-exposed areas of skin.[2] Head and neck are the most common sites of involvement, which is about 85% of cases.[3] There are many patients with BCC of the scalp who have a history of childhood radiation to scalp for treatment of tinea capitis. Radiotherapy of the scalp is a well-known risk factor for BCC,[4] but it is not known whether these BCCs have a more aggressive nature and need a more aggressive modality of treatment. We reviewed the literature and found no study that compared treatment results of BCC of the scalp in patients with history of scalp radiotherapy and other patients. So we performed a retrospective study to compare tumor specification and treatment results between these groups.

## MATERIALS AND METHODS

From January 1995 to February 2005, 96 patients with the diagnosis of BCC of the scalp had been referred to our hospital and operated on by the authors. We reviewed medical records of these patients, and we excluded those cases with no definitive pathology report of BCC. There were 74 patients with definitive diagnosis of scalp BCC tumor. These patients were divided in 2 groups. The first group (38 patients) had a history of childhood radiation to the scalp for the treatment of tinea capitis, and the second group (36 patients) did not (all the patients had been questioned about radiation history in childhood).

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We considered 16 different parameters for comparison of these 2 groups. These parameters were included:

Patient general information: Age, sex.
Disease history: Time interval from occurrence of the first lesion to the first visit in our center, number of admissions, total hospital stay in our hospital.
Tumor specification: Number of primary lesions, depth of invasion, histologic tumor subtype, location of tumor in the scalp.
Surgical history: Number of operations in other hospitals before the first office visit at our hospital, number of operations for each patient in our center, surgical techniques that were performed in our hospital, margin of resection for the first treated lesion.
Recurrence: Number of recurrent lesions (recurrence was defined as a new lesion in the previous scar region, or grafted area, or within 1-cm margin of the resected area[5]).
New lesions: Number of new lesions (new lesion was defined as a new appearing lesion at another area of the scalp which was not located at or within 1 cm of the previous scar or graft[5]).
Metastasis: Presence of metastasis at first visit or appearance of metastasis during the period of study.

## Statistical Methods

Statistical analysis was performed with SPSS 13.0 software. We compared mean values by independent-sample 2-tailed $t$ test. We used the $\chi^2$ test for nonparametric analyzing. Confidence interval was considered as 95%.

## RESULTS

Group A consisted of 38 patients with BCC of the scalp who had a history of childhood radiation to the scalp. There were 28 males and 10 females in this study group. The mean age of patients was 56.66 years (44 to 76 years). In group B, there were 36 patients with scalp BCC who did not have any history of scalp irradiation. This group included 19 male and 17 female patients. The mean age of patients in this group was 58.69 years (32 to 78 years). No significant difference for gender and age was observed between the 2 groups ($P = 0.062$ and $P = 0.35$, respectively).

In group A, the mean interval from appearance of the first lesion to the first visit of the patient in our center was 94.54 months (6–312 months) for 37 patients in group A. This value was 43.30 months (2–192 months) for 33 patients of group B (this interval could not be determined for 1 patient in group A and 3 patients in group B). Comparison of these 2 values indicates a significant difference between the 2 groups ($P = 0.001$). This means that patients in group A had a longer history of scalp lesions.

Mean admission number in our center was 2.87 times (1–18 admissions) for group A and 1.14 times (1–4 admissions) for group B. This indicates that group A patients had more admissions in our hospital; which is statistically significant ($P = 0.008$). According to the data, patients in group A stayed much longer in our hospital: mean total length of hospital stay was 48.45 days (3 to 413 days) for group A and 14.92 days (1 to 67 days) for group B ($P = 0.013$).

Mean number of primary lesions did not differ significantly between 2 groups: It was 2.13 lesions (1–10 lesions) for group A and 1.13 lesions (1–4 lesions) for group B ($P = 0.34$). In addition, there was no statistically significant difference between the 2 groups regarding the location of the primary tumors in the scalp ($P = 0.78$) (Table 1). Because the classification system used for determining histologic subtypes of BCC was not uniform, we were not able to compare histologic subtype of tumors within the 2 groups (although the nodular type was more common in both groups). There was no significant difference in the depth of invasion by the first tumor in the 2 groups ($P = 0.73$) (Table 2).

Patients in group A had a mean of 0.82 operations (0 to 6 operations) before being referred to our hospital, which was more than group B, who had a mean of 0.22 operations (0 to 2 operations). The difference between the 2 groups is statistically significant ($P = 0.018$). In our hospital, the mean number of operations preformed for patients was 3.13 (1 to 24 operations) for group A and 1.17 operations (1 to 4 operations) for group B, which shows a significant difference ($P = 0.013$).

Difference in safe margin of first tumor resection was not meaningful: mean safe margin of resection was 1.73 cm (0.5 to 6 cm) for 28 patients in group A (in 8 patients this margin was unknown) and 1.37 cm (0.5 to 3 cm) for 22 patients in group B ($P = 0.27$) (14 data points were missed).

Mean number of recurrent lesions was 1.58 (0 to 10 lesions) and 0.33 (0 to 3 lesions) for patients in groups A and B, respectively. The recurrence rate was significantly higher in group A ($P = 0.003$). Also, mean number of new lesions

**TABLE 1.** Comparison of Location of Primary Tumor(s) Between Groups A and B

| | No. Lesions (% of Total) | |
|---|---|---|
| **Location** | **Group A** | **Group B** |
| Frontal | 9 (13.8) | 9 (17.3) |
| Occipital | 12 (18.5) | 7 (13.5) |
| Parietal | 18 (27.7) | 16 (30.8) |
| Temporal | 16 (24.6) | 15 (28.8) |
| Vertex | 10 (15.4) | 5 (9.6) |

The difference was not meaningful ($P = 0.78$).

**TABLE 2.** Comparison of Depth of Invasion by Primary Tumor(s) Between Groups A and B

| | No. Lesions (% of Total) | |
|---|---|---|
| **Depth of Invasion** | **Group A** | **Group B*** |
| Soft tissue involvement | 20 (52.6) | 21 (61.8) |
| Bone invasion | 10 (26.3) | 7 (20.6) |
| Dural or cerebral invasion | 8 (21.1) | 6 (17.6) |

The difference was not meaningful ($P = 0.73$).
*Two data points in group B were missed.

**TABLE 3.** Comparison of Types of Operation in the 2 Groups

| Types of Surgery | No. Surgeries (% of Total) | |
|---|---|---|
| | Group A | Group B |
| Resection | | |
| Soft tissue resection | 15 (39.47) | 25 (69.44) |
| Bone resection or craniectomy | 23 (60.52) | 11 (30.55) |
| Reconstruction | | |
| Primary repair or skin graft | 18 (47.38) | 27 (75) |
| Flap coverage (local, regional and free flaps) | 20 (52.62) | 9 (25) |

The difference was significant ($P = 0.010$ for resection and $P = 0.015$ for reconstruction).

in group A was 2.11 lesions (0 to 8 lesions). No new lesion was observed in group B.

Types of operation performed for these patients for all lesions, including primary and recurrent lesions, are summarized in Table 3. In group A, need for bone resection rather than soft tissue resection, and flap coverage rather than primary repair or skin graft, was significantly more than group B ($P = 0.010$ and $P = 0.015$, respectively).

Four patients in group A developed regional metastasis to cervical nodes during the period of this study, and one of the patients died because of old age, cerebral invasion, and comorbid disease. None of patients in group B had regional or distant metastasis.

## DISCUSSION

BCC is the most common malignancy in the white population. The incidence of BCC is increasing worldwide by up to 10% per year.[4,6] At least 900,000 new cases of BCC are diagnosed annually in the United States.[2] Although exposure to ultraviolet radiation is the main causative factor in the pathogenesis of BCC,[7] development of BCC in the black population[8] and in nonexposed areas[2] in whites may represent a different pathogenesis for the condition. Most BCC cases are observed on sun-exposed skin, with nearly 85% of the tumors occurring in the head and neck regions.[3,9]

History of exposure to previous therapeutic ionizing radiation is a well-known risk factor for BCC.[10,11] It has been shown that individuals that are treated with x-ray in childhood for tinea capitis or for thymic enlargement have an increased risk for BCC.[12] BCCs are the most frequent tumors arising on chronic radiodermitis.[13] We frequently encounter patients with scalp BCC, but the important question is whether the patient has had a history of childhood irradiation and whether it should alter the treatment modality or surgical technique. In other words, considering whether BCCs in patients with a history of irradiation behave more aggressively is important.

BCC generally has a clinical course characterized by slow growth, minimal soft tissue invasiveness, and a high cure rate. Several factors, including tumor size, duration, histology, and perineural spread, have been postulated as markers of the aggressive BCC.[14]

We reviewed the literature and found no study that compared treatment results of scalp BCC in patients with history of scalp radiotherapy and other patients. One study that has focused on scalp BCC in patients with a history of childhood irradiation is from Tunisia: Mseddi et al[15] reviewed BCC of the scalp in 33 patient with history of radiotherapy for tinea capitis. From 1995 to 2000, 27 men and 6 women were diagnosed with scalp BCC. The age of the onset of the condition varied from 32 to 62 years. Radiotherapy was received between 5 and 17 years of age. The interval between irradiation and onset of carcinoma ranged between 21 and 51 years. Total number of lesions was 55. The most frequent location of tumor was occipital area (45%). Both clinically and histologically, nodular BCC was the predominant tumor subtype. They also observed pigmented BCC subtypes that were not reported in the previous studies. Unfortunately, they did not review surgical therapy and outcome in these patients.

To compare tumor specification, degree of aggressiveness, recurrence risk, and occurrence of new lesions in patients with scalp BCC and history of childhood scalp irradiation to nonirradiated patients, we designed a retrospective study of the patients treated in the last 10 years (1995–2005). We had 38 patients with a history of scalp irradiation (group A) and 36 patients without this history (group B). From the standpoint of sex and age, there was no significant difference between the 2 groups.

Mean interval time from appearance of the first lesion to the first office visit was significantly longer in group A. This means that group A patients had a longer history of scalp lesions before they had been referred to our center. Also, patients in group A had a significantly larger number of operations before being referred to our hospital. This shows that patients in group A had been subjected to unsuccessful treatments more than group B. Also, the tumor appearance (in clinical examination) in group A had not been more aggressive than usual: depth of invasion (regarding to invasion to bone or brain) and mean number of primary lesions was not significantly different between the 2 groups. Therefore, similar treatment strategies had been used in them: difference in safe margin of first tumor resection (in our hospital) was not meaningful.

"Safe resection margin" is the amount of resection of clinically normal tissues beyond tumor margin at the first surgical resection. This margin was known for 28 patients in group A and 22 patients in group B. As could be seen, the difference between the amounts of resection of normal tissues in 2 groups was not significant for first resection.

To date, 2 main approaches to the classification of BCC have been suggested. One is based on histopathologic growth pattern and the other on histologic differentiation.[16] Classification by growth pattern is also useful in developing the concept of low- and high-risk histologic subtypes of BCC. High-risk BCCs include superficial, infiltrative (morpheic), micronodular, and BCC associated with squamous atypia. Because of differences in classification systems, we were not able to compare histologic subtype of tumors in our study. Instead, by referring to the Mseddi et al[15] study, it can be seen

that nodular BCC is the predominant subtype of BCC in irradiated patients. According to the literature, nodular BCC is the main low-risk subtype of BCC.[16]

Despite similarity of tumor specifications and depth of invasion, BCCs in group A were more aggressive, with a greater frequency of lesion recurrence. Patients in group A had a longer period of treatment; they had more frequent admissions and longer length of hospital stay. The need for more aggressive surgery (bone resection rather than soft tissue resection) and more complicated reconstruction (flap coverage rather than primary repair or skin graft) in group B patients was less than group A. Longer hospital stay in group A could be attributed to multiple factors: more recurrent and new lesions, more complicated surgical resections, more complicated surgical reconstruction, need for multiple stage operation (such as delay procedures and division of flap pedicle).

In contrast to the Mseddi et al[15] study, in which the most frequent site of tumor in scalp was the occipital area,[15] in our study, the parietal area was the most common site of BCC involvement; however, the difference in distribution of tumors through the scalp was not statistically significant.

The incidence of distant metastatic BCC is very rare: it affects 0.0028% to 0.5% of the population.[17] The lymph nodes, lung, bone, skin, spleen, and brain are the common sites of metastasis.[17] It is suggested that scalp BCC may have greater tendency to metastasize because of the increased concentration of large-caliber vessels.[18,19] Other risk factors for metastatic BCC include a history of persistent BCC for many years, refractory to conventional methods of treatment, and previous radiation treatment.[18] In our study, 4 patients in group A (10%) and none of the patients in group B (0%) developed regional metastasis to cervical nodes during the period of this study. This is confirmatory to the previous concept that history of previous radiation treatment increases likelihood of metastasis.[18]

## CONCLUSION

Scalp BCC in patients with a history of childhood therapeutic radiation may be considered as a malignancy with low invasive nature (like other BCCs); however, our study suggests that BCCs in these patients behave more aggressively. This does not mean that they necessarily appear more invasive in clinical examination or even in histopathologic studies. In addition to the risk factors mentioned above for high-risk BCCs, we suggest that BCCs on irradiated skin should be considered high risk as well.

Because of the increased risk for recurrence of BCC in irradiated scalp, we use a wider margin for resection of them today. This is just our suggestion to use wider margins, but whether this can lower recurrence rate should be proved by prospective studies. Also, these patients should be under close postoperative observation because of a greater risk for lesions occurring elsewhere on the scalp.

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