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# Retrospective Analysis of Cartilage-Sparing Resection of Melanoma of the External Ear

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## ABSTRACT

**Background:** The optimal surgical technique for managing external ear melanoma and its corresponding prognosis remain areas lacking comprehensive data. In this retrospective study were patients treated with a cartilage-sparing excision of melanoma of the external ear. The primary objectives are to evaluate local control rates, overall survival, and disease-specific survival.

**Methods:** After conducting a structured review encompassing surgical methodologies and survival rates, a clinical retrospective analysis was undertaken involving patients treated from 2011 to 2022. The treatment approach across all cases involved cartilage-sparing resection followed by wound closure utilizing primary closure or split/full-thickness skin grafting for reconstruction. Statistical analysis was conducted employing the Kaplan–Meier survival analysis.

**Results:** Superficial spreading melanoma represents the predominant histological subtype observed. In all cases, patients underwent cartilage-sparing resection of the tumor. Among them, 9 patients underwent simultaneous sentinel lymph node biopsy during resection, all of which yielded negative results. Subsequent to treatment, 1 patient experienced local recurrence after 9 months, while another presented with locoregional recurrence in a lymph node after 15 months. No instances of distant metastasis were recorded within the patient cohort. The local control rate was 92.86%, the overall survival 100% and the disease-specific survival 100%. The average follow-up was 41 months.

**Conclusion:** The outcomes regarding local control rate, overall survival, and disease-specific survival underscore the efficacy of cartilage-sparing resection as a viable treatment modality, particularly for early-stage melanoma cases. These results not only highlight the significance of achieving tumor-free margins but also emphasize the importance of attaining aesthetically satisfactory outcomes. Consequently, cartilage-sparing resection emerges as an acceptable therapeutic approach for managing melanoma of the external ear, offering promising prospects for patients in terms of both medical and cosmetic considerations.

**Keywords:** Cartilage-sparing resection, cutaneaous maligne melanoma, external ear, primary tumor, sentinel lymph node biopsies

## Introduction

The head and neck region is a common site for melanoma, with literature reports indicating that around 25% of all cutaneous melanomas manifest in this area. Ear melanoma accounts for only 1%-4% of all cutaneous melanomas or approximately 7%-20% of all the head and neck melanoma.[1-7] The helical rim stands out as the most prevalent site of occurrence on the ear, accounting for approximately 57% of all cases, followed by the ear lobe, which represents approximately 17% of all cases.[2,3,6,8,9]

Histologic subtypes are typically categorized into 4 primary groups: superficial spreading melanoma, which constitutes approximately 41% of cases, nodular melanoma, representing around 22%, and lentigo maligna melanoma, comprising about 21%. The remaining category, labeled as "others/unknown," encompasses melanoma subtypes that are either unspecified or represent a minority within the population. Examples include spindle cell melanoma, amelanotic melanoma, and desmoplastic melanoma.[3,6,8] Men typically face an elevated risk of developing melanoma on the external ear, primarily attributable to factors such as increased sun exposure, divergent lifestyle choices, and haircut styles that expose the ear to prolonged sunlight.[8]

The systematic review conducted by Francesca Toia et al in 2015 revealed that tumor thickness serves as the most

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significant prognostic factor in melanoma. This measure can be quantified using Breslow thickness or Clark level.[6] Several authors also agree on the negative prognostic role of ulceration.[3,8,10] Contradictory findings have emerged in published literature. Additional significant prognostic factors for survival or recurrence rates include age, particularly those over 59 years old, as well as sentinel lymph node (SLN) positivity and the presence of clinically positive nodes.[6]

Historically, ear melanomas were perceived as more aggressive and associated with a poorer prognosis compared to other melanomas occurring in the head and neck region.[5] As a consequence, certain authors advocated for total or partial amputation of the auricle as the primary treatment option for melanoma of the external ear, regardless of the histological subtype.[5,10] The first report dates from the mid-1990s. They advise for total amputation, prophylactic lymph node resection of the neck, and parotidectomy.[11] Recent studies have indicated that the prognosis of melanoma affecting the auricle does not significantly differ from that of melanomas in other anatomical regions. Consequently, there is a growing trend towards adopting a more conservative surgical approach. It is imperative to strike a balance between achieving tumor-free margins, ensuring aesthetically satisfactory outcomes, and preserving the functional integrity of the ear. Several surgical techniques are available for the treatment of auricular melanoma, including complete amputation, partial amputation, wide excision of the primary tumor followed by reconstruction using chondrocutaneous advancement flaps or full-thickness skin grafts, as well as primary closure.[2,4,6,11] External ear melanomas frequently manifest as superficial lesions, and despite the thin dermis of the auricle, their spread predominantly occurs locally through lateral extension rather than penetration into the underlying cartilage.[4-6,10,11] Studies conducted by McCarty et al, Sartore et al, and Jahn et al recommend for the preservation of the underlying perichondrium and cartilage in cases where they remain uninvaded by the tumor and where their removal is not deemed necessary for reconstructive purposes.[2,4,12,13] Sartore et. al and Craig et. al even suggest a protective role of the perichondrial cartilage against tumor invasion.[4,13] Other authors believe that it is safer to remove the cartilage.[14,15] There remains a significant lack of consensus regarding the surgical management of ear melanoma. The choice of techniques and resection margins lack a solid foundation in evidence or outcomes and are primarily influenced by the personal experience and opinions of individual surgeons. Furthermore, available data on the prognosis of ear melanoma present conflicting results. Consequently, there is insufficient evidence or widespread agreement regarding a more conservative treatment approach for this condition. In this study, we conducted a retrospective analysis involving 14 patients who underwent a cartilage-sparing resection for external ear melanoma between 2011 and 2022. The surgical approach involved a wide local excision while preserving the underlying cartilage, followed by reconstruction using split-thickness skin grafts, full-thickness skin grafts, or primary closure. Subsequently, we calculated the local control rate, overall survival, and disease-specific survival.

### Main Points

- Insufficient data persist regarding the optimal surgical technique and associated prognosis in the treatment of external ear melanoma.
- A wide excision margin around a melanoma can have a significant impact on form and function of the external ear.
- A cartilage-sparing resection for melanoma of the external ear represents a viable treatment option, especially for early-stage cases, ensuring both tumor-free margins and aesthetically pleasing outcomes.

## Methods

### Literature Review

A literature review of English language studies was performed using the PubMed electronic database.

The search strategy was "Melanoma, excision, and ear" resulting in 140 studies (Figure 1).

The inclusion criteria for papers involved the availability of a full peer-reviewed manuscript and publication within the last 15 years (between 2005 and 2020). Only studies written in English were considered. Exclusion criteria encompassed studies pertaining to non-melanoma skin cancers, mucosal melanoma, or melanoma affecting other parts of the head and neck region. These criteria yielded 13 relevant articles.

Additionally, a search strategy conducted on PubMed utilizing keywords "cartilage-sparing, melanoma, and ear" yielded 5 articles. One study was excluded due to its outdated publication date (1988). Duplicate entries from this search were eliminated, resulting in the inclusion of 2 additional pertinent articles.

### Ethical Approval Declarations

This study was performed at the Ghent University Hospital. The Ghent University Hospital ethics committee has approved the study (approval number: THE- 2022-0279; date: 6th November 2022). Informed consent was not obtained from the subjects. All patients were diagnosed with cancer. Therefore, we opted not to burden patients and those around them with the confrontation by asking their permission to access their patient data. The data will be pseudonymized by researchers of this study for use in this study. All procedures performed were in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

### Retrospective Study

Our study is a retrospective study in compliance with the University of Ghent and the Ghent University Hospital, department of Head and Neck Surgery. We included 14 patients with a primary cutaneous melanoma of the external ear who were treated at the University Hospital from 2011 till 2022. Before surgery, all patients underwent accurate staging as discussed in the tumor board (Table 1).

In all cases, a cartilage-sparing wide local excision was performed to address the melanoma. Among the patients, 9 underwent concurrent sentinel lymph node biopsy at the time of primary melanoma resection. Sentinel node biopsy was deemed essential for T2a melanoma or higher (Breslow thickness >1 mm), while it was optional for T1b melanoma. Scintigraphy was utilized to identify the nodes, with their

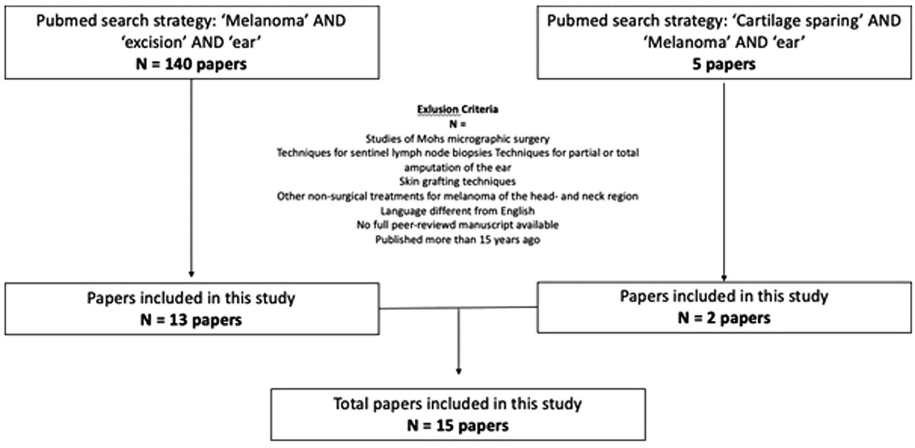


Figure 1. Search strategy employed in literature review.

locations marked on the skin preoperatively. Intraoperatively, a gamma probe facilitated the localization of the sentinel nodes (Table 1).

The macroscopic dimensions of the resection ranged from 0.6 cm to 5 cm, as documented in the operative or pathological reports. A crucial criterion for inclusion was the presence of a well-defined dissection plane between the melanoma and the underlying perichondrium, with no evidence of direct invasion of the perichondrium. Patients exhibiting direct invasion of the perichondrium were excluded from the study cohort.

Following resection, the samples were transferred to the pathology department for histological evaluation. Subsequently, all patients underwent reconstruction, which involved primary closure of the wound or the application of split-thickness or full-thickness skin grafts (Figure 2).

Follow-up information was collected through routine clinical visits (Table 2). The site, time of recurrence, and the adjuvant therapy were noted.

## Results

The average age of patients undergoing cartilage-sparing excision for external ear melanoma was 66.6 ± 14.29 years. All patients in the study cohort were males (14/14). The majority of tumors were located on the helix of the ear (9/14 patients). Histologically, superficial spreading melanoma was the most prevalent subtype (7/14), followed by lentigo maligna melanoma (5/14), and nodular melanoma (2/14).

**Table 1. Preoperative Staging and Indication for Sentinel Lymph Node Biopsy at the Ghent University Hospital**

| | T in situ | T1a | T1b | T2a | T2b | T3a | T3b | T4a | T4b |
|---|---|---|---|---|---|---|---|---|---|
| Preoperative | / | X-ray thorax, ultrasound abdomen and lymph nodes | X-ray thorax, ultrasound abdomen and lymph nodes | X-ray thorax, ultrasound abdomen and lymph nodes | X-ray thorax, ultrasound abdomen and lymph nodes | X-ray thorax, ultrasound abdomen and lymph nodes | CT | CT | CT or PET-CT |
| | | In case of negative staging: | In case of negative staging: | In case of negative staging: | In case of negative staging: | In case of negative staging: | In case of negative staging: | In case of negative staging: | In case of negative staging: |
| Sentinel | / | / | Possible | Yes | Yes | Yes | Yes | Yes | Yes |

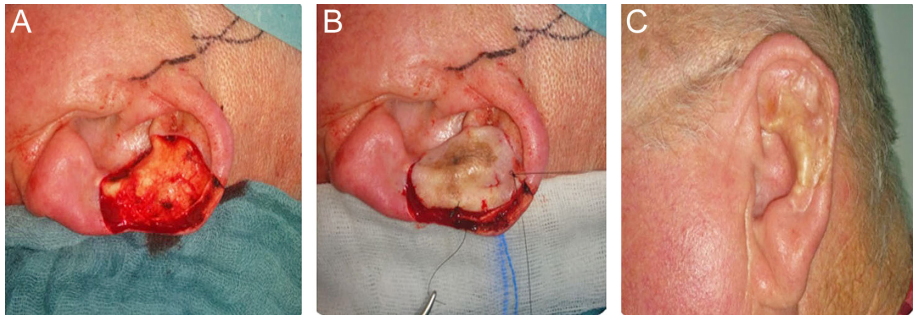


Figure 2. (A) Cartilage-sparing resection of ear melanoma. (B) Reconstruction using a full-thickness skin graft. (C) Result after reconstruction.

**Table 2. Follow-up of patients with Melanoma at the Ghent University Hospital, based on 8th edition of the American Joint Committee on cancer (AJCC) melanoma staging system [16]**

| | In Situ | Stadium IA, IB | Stadium IIA, IIB | Stadium IIC | Stadium IIIA, IIIB, IIIC, IIID |
|---|---|---|---|---|---|
| Year 1 | | | | | |
| Clinical | Every 6 months | Every 4 months | Every 3 months | Every 2 months | Every 2 months |
| Imaging | | On a clinical basis | On a clinical basis | Every 4 months: CT/ PET-CT alternating with x-ray and ultrasound | Every 4 months: CT or PET-CT/MRI alternating with ultrasound |
| Year 2 | | | | | |
| Clinical | Annual | Every 6 months | Every 3 months | Every 2 months | Every 2 months |
| Imaging | | On a clinical basis | On a clinical basis | Every 4 months: CT/ PET-CT alternating with x-ray and ultrasound | Every 4 months: CT or PET-CT/MRI alternating with ultrasound |
| Year 3-5 | | | | | |
| Clinical | Annual | Annual | Every 6 months | Every 6 months | Every 3 months |
| Imaging | | On a clinical basis | On a clinical basis | Yearly x-ray and ultrasound | Every 6 months CT or PET-CT |
| Year 5-10 | | | | | |
| Clinical | Annual | Annual | Annual | Every 6 months | Every 6 months |
| Imaging | | On a clinical basis | On a clinical basis | On a clinical basis | Possibly annual re-staging |
| >10 years | | | | | |
| Clinical | Annual | Annual | Annual | Annual | Annual |
| Imaging | | On a clinical basis | On a clinical basis | On a clinical basis | Possibly annual re-staging |

CT head and neck PET-CT/MRI, PET-CT added with MRI brain if needed; CT refers to CT brain/thorax/abdomen; x-ray and ultrasound refer to x-ray thorax and ultrasound abdomen/lymph nodes.

The average Breslow thickness of the melanomas was 1.24 ± 0.84 mm, with macroscopic dimensions ranging from 0.6 cm to 5 cm. One patient required a wider local excision due to the lateral margin not being free of melanoma; this second cartilage-sparing resection was subsequently clear of melanoma. Among the patients, 5 exhibited a mitosis-index of 1 mitosis/mm$^2$ or higher (5/14), and 2 pathological reports indicated the presence of ulceration (2/14). Information regarding ulceration was not provided in the pathological reports of 2 patients. Lymphovascular or perineural invasion was absent in 12 patients; data on these factors were missing in 2 patients.

After pathological analysis, most of the tumors were staged as a pT1aN0M0 tumor (6/14), 3 tumors were staged as a pT1bN0M0, and 3 as a pT3aN0M0. Only one tumor was staged as a pT2aN0M0 and one as a pT3bN0M0.

Among the various surgical strategies employed, 4 patients underwent reconstruction using a full-thickness skin graft, nine patients received a split-thickness skin graft, and 1 patient underwent primary closure of the wound. Figure 3 illustrates the outcomes following reconstruction.

Furthermore, sentinel lymph node biopsy was performed in nine patients concurrently with the resection of the primary melanoma. It is noteworthy that all of these sentinel lymph node biopsies yielded negative results. Follow-up of the patients was performed like mentioned in Table 2. Average follow-up was 41 months. One patient experienced a local recurrence

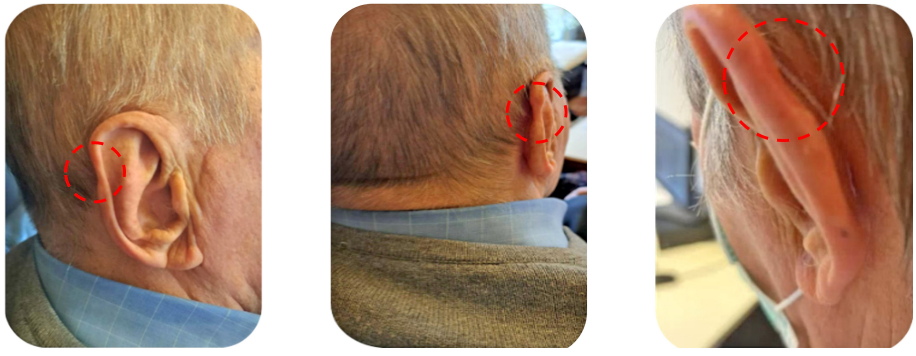

**Figure 3.** Postoperative results after cartilage-sparing resection of melanoma of the external ear.

**Table 3. Patient Demographics and Tumor Characteristics (n = 12)**

| Characteristics | Value |
|---|---|
| Age, years | |
| Average | 66.6 |
| Range | 41-86 |
| Sex, N (%) | |
| Male | 14 (100) |
| Female | 0 (0) |
| Follow-up, months | |
| Average | 41 months |
| Range | 15 months to 11 years |
| Primary tumor location, N (%) | |
| Helix | 9 (64.3) |
| Antihelix | 3 (21.4) |
| Lobule | 1 (7.1) |
| Scapha | 1 (7.1) |
| Histological subtype, N (%) | |
| Superficial spreading melanoma | 7 (50) |
| Nodular melanoma | 2 (14.3) |
| Lentigo maligna melanoma | 5 (35.7) |
| Ulceration, N (%) | |
| Absent | 10 (71.4) |
| Present | 2 (14.3) |
| Unknown | 2 (14.3) |
| Primary tumor mitotic rate, N (%) | |
| Absent | 9 (64.3) |
| >1 per mm$^2$ | 5 (35.7) |
| Tumor T stage, N (%) | |
| T1a | 6 (42.9) |
| T1b | 3 (21.4) |
| T2a | 1 (7,1) |
| T2b | 0 (0) |
| T3a | 3 (21.4) |
| T3b | 1 (7.1) |
| T4a | 0 (0) |
| Lymph node status, N (%) | |
| Positive | 0 (0) |
| Negative | 14 (100) |
| Thickness/Breslow depth, mm | |
| Average | 1,24 |
| Range | 0.34-2.7 |
| Lymphovascular invasion, N (%) | |
| Absent | 12 (85.7) |
| Present | 0 (0) |
| Unknown | 2 (14.3) |
| Perineural invasion, N (%) | |
| Absent | 12 (85.7) |
| Present | 0 (0) |
| Unknown | 2 (14.3) |

after 9 months, with staging indicating a pT3aN0M0 tumor. Subsequently, this patient underwent a wedge excision of the recurrence and received adjuvant therapy in the form of targeted therapy (BRAF/MEK inhibition). Due to side effects, the treatment regimen was switched to adjuvant immunotherapy (nivolumab). The estimated time until local recurrence was 117.9 months (95% CI, 95.401-140.399 months).

Additionally, 1 patient developed a locoregional recurrence in a lymph node in neck region II on the right side after 15 months. This primary tumor was staged as a pT3aN0M0 tumor. The patient underwent a radically modified neck dissection on the right side, with adjuvant radiotherapy recommended thereafter. The estimated time until lymph node metastasis was 117.2 months (95% CI, 93.610-140.834 months). Importantly, no instances of distant metastasis were observed among the patients during the study period.

## Discussion

Large-scale studies investigating the optimal surgical management of melanoma affecting the external ear are currently lacking. However, recent literature indicates a shift in perspective, suggesting that the prognosis of this tumor may be more favorable than previously perceived. Consequently, less extensive surgical approaches have gained prominence and are becoming increasingly prevalent in clinical practice.

The safe excision margins for melanoma of the external ear remain a subject of considerable debate. While wide excision margins are typically recommended for melanomas, concerns arise when considering the auricle, where even minor excess tissue resection can significantly impact the form and function of the external ear. In this study, resection margins ranged from 0.6 cm to 5 cm, based on data extracted from operative or pathological reports. Further research is imperative to establish standardized resection margins for melanoma of the external ear. Such margins should strike a delicate balance between ensuring oncological safety, achieving aesthetically acceptable outcomes, and preserving the functional integrity of the ear.

This study, conducted retrospectively at a single center, primarily comprised male patients with external ear melanoma. All patients had negative sentinel lymph node biopsies and most of them were staged as either pT1aN0M0 (6/14) or pT1bN0M0 (3/14) tumors. None of these patients experienced local recurrence, locoregional recurrence, or distant metastasis. However, 2 patients with more advanced disease (pT3aN0M0) did encounter recurrences, both characterized by a Breslow thickness exceeding 2 mm and a mitotic activity of more than 1 per mm$^2$.

Further investigations are warranted to enhance our understanding of the management of advanced local disease, particularly regarding the significance of Breslow thickness, Clark level, and mitotic activity. A multicenter, prospective, randomized study involving a larger and more diverse patient population, including individuals with positive sentinel lymph node biopsies and more advanced staging, is essential to ensure comprehensive evaluation of oncological safety and treatment efficacy.

The outstanding results regarding local control rate, overall survival, and disease-specific survival highlight the efficacy of cartilage-sparing resection as a viable treatment option for early-stage melanoma affecting the external ear. These findings underscore the importance of achieving tumor-free margins while also prioritizing aesthetically pleasing outcomes and preserving the functional integrity of the ear. As such, cartilage-sparing resection emerges as an acceptable therapeutic approach for managing early-stage melanoma of the external ear.

**Ethics Committee Approval:** This study was approved by the Ethics Committee of the Ghent University Hospital (approval number: THE-2022-0279; date: 6th November 2022).

**Informed Consent:** N/A.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept – W.H.; Design – WH., J.G., L.B.; Supervision – W.H.; Resource – W.H.; Data Collection and/or Processing – J.G.; Analysis and/or Interpretation – J.G.; Literature Search – J.G.; Writing – J.G.; Critical Review – W.H., L.B., N.D., C.J., H.V.

**Declaration of Interests:** Wouter Huvenne is an associate editor at B-ENT, however, his involvement in the peer review process was solely as an author. Other authors have no conflict of interest to declare.

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