



## Case Report

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# Primary Intracranial Squamous Cell Carcinoma: Case Report and Literature Review

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### Abstract

Intracranial Squamous Cell Carcinoma (SCC) is a rare condition and relatively few cases have been described in the literature. Despite the poor prognosis, no standardized treatment protocols have been developed. In the present article, we report a case of primary intracranial SCC with a review of the literature. A 42-year-old woman presented with intracranial SCC in the right cerebellopontine angle. The patient underwent gross total resection of the tumour followed by adjuvant radiotherapy (50 Gy in 25 fractions). The patient died 26 months after the initial treatment due to leptomeningeal progression without local relapse. This case illustrates the complexity of this rare condition and the need for multimodal management.

**Keywords:** Epidermoid cyst; Squamous cell carcinoma; Primary; Intracranial; Malignant transformation.

### Introduction

Intracranial epidermoid cysts are rare but generally benign intracranial tumours [1,2].

These cysts can undergo malignant transformation into squamous cell carcinoma (SCC), but only a few such cases have been described since the first report in 1912 [1]. Intracranial SCC may originate from a known intracranial epidermoid cyst or it may be a de novo tumour [3].

Here we report a case of primary intracranial SCC. In addition, we review the literature on this rare tumour type.

### Case report

#### History and examination

A 42-year-old woman presented with a 6-month history of right-side deafness and a 5-month history of dizziness and tinnitus. She had no relevant medical history.

#### Imaging studies

Contrast-enhanced Computed Tomography (CT) revealed a lesion with multicystic heterogeneous enhancement and Magnetic Resonance Imaging (MRI) showed a right Cerebellopontine Angle (CPA) mass invading the right inner auditory canal (Figure 1).

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These radiological features, together with the clinical presentation, mimicked a schwannoma of cranial nerve VIII.

### Surgical treatment and postoperative course

A right retrosigmoid craniotomy with gross total resection of the tumour was performed on November 13, 2019. Intraoperatively, the macroscopic appearance of the tumour was heterogeneous, consisting of fibrous, highly vascularized areas alternating with necrotic and cystic areas. The tumour was indistinguishable from an acoustic schwannoma. The postoperative course was uneventful and the patient was discharged home with no new neurological deficits. During clinical follow-up, the dizziness decreased and the tinnitus resolved, but the ipsilateral hypoacusis remained unchanged.

### Pathological findings

Histologic examination of the resected specimen revealed a solid-cystic lesion lined by squamous epithelium with moderate atypia and abundant mitotic figures consistent with SCC (Figure 2). These features were suggestive of a primary central nervous system SCC arising from a pre-existing epidermoid cyst.

To rule out the presence of an extracranial primary tumour, Positron Emission Tomography (PET) was performed. The results of this scan were normal.

### Radiation therapy

This case was presented to a multidisciplinary tumour board, which decided that the patient was a candidate for adjuvant radiotherapy. Fractionated stereotactic radiotherapy was prescribed (50 Gy in 25 fractions) (Figure 3). The treatment was well-tolerated and the final session was delivered in late February 2020.

### Treatment outcomes

An MRI performed in June 2020 (7 months after surgery) revealed focal enhancement in the surgical margin on the right cerebellar peduncle and a thin enhancement in the right internal acoustic canal. On a follow-up MRI (January 2022), the previous findings remained stable, but revealed the presence of leptomeningeal progression in the cervical and thoracic spinal cord, resulting in spinal cord compression (Figure 4a,b). Consequently, local radiotherapy (30 Gy in 10 fractions) was administered to that region. The patient started intrathecal treatment with methotrexate in March 2022. A follow-up MRI (April 2022) revealed leptomeningeal progression with secondary spinal cord compression from T9 to T11. Another course of radiotherapy was prescribed (30 Gy). However, the patient did not complete radiotherapy (receiving only 6 Gy) (Figure 5a,b) and died on May 5, 2022 due to neurological impairment.

### Methods and results

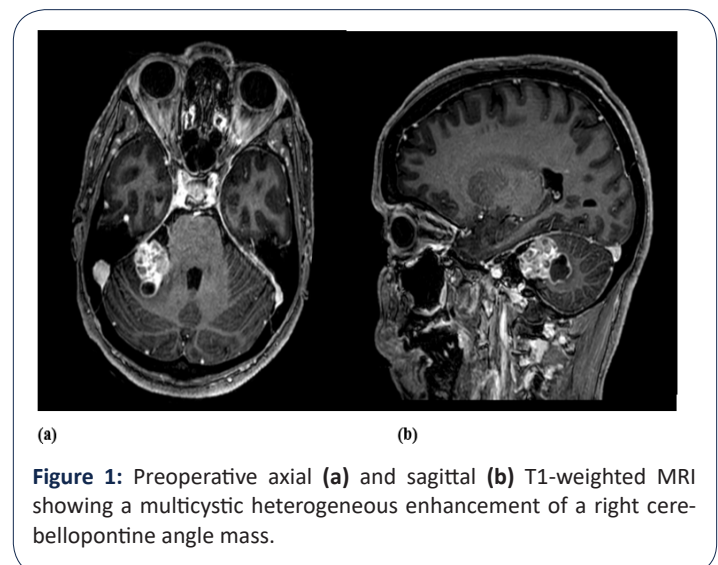
We performed a systematic review of the literature using the criteria established in the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA). We searched the PubMed and Medline databases for relevant articles published through March 31, 2021 using the following search terms were used: "intracranial squamous cell carcinoma" OR "intracranial epidermoid cyst" OR "malignant transformation of intracranial epidermoid cyst". The inclusion and exclusion criteria are shown

in Figure 6.

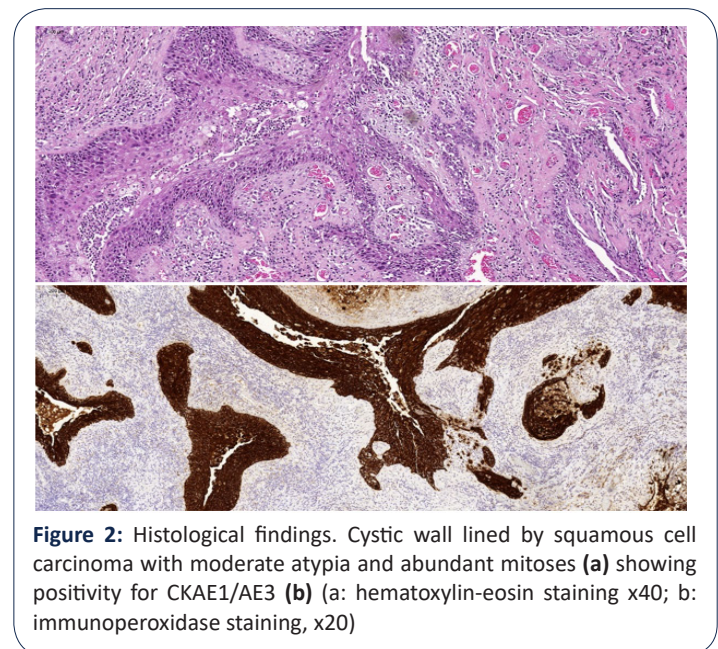
A total of 90 articles were identified for further review. Of these, 69 case reports describing secondary malignant transformation of intracranial epidermoid cysts were identified (Table 1). Most of the patients described in these case reports were males (n=41; 59.4%). The mean age was 52.5 years (range, 20-77). Six of the cases were diagnosed during the autopsy.

In most cases (61/69; 88.4%) surgery was the primary treatment. Thirty-one patients received adjuvant radiotherapy (conventional radiotherapy, radiosurgery, or proton beam therapy), with or without chemotherapy.

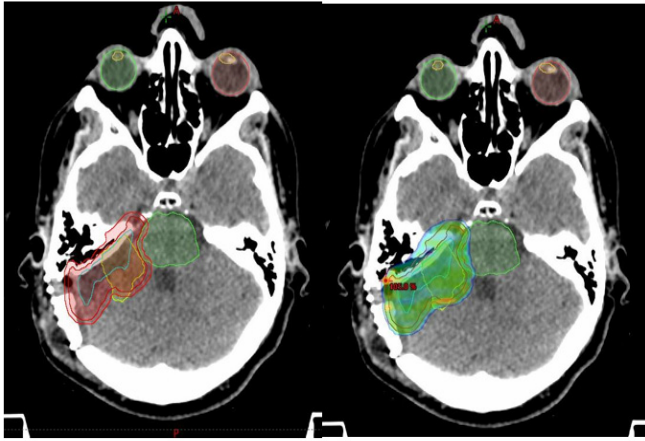
Apart from the current case, a total of ten cases involving primary intracranial SCC have been reported to date (Table 2). The most commonly reported location is the CPA (5/10 cases), which was the same area as secondary malignant carcinomas. Most of these patients (8/10) underwent surgery, with four also receiving adjuvant radiation therapy. Of the two nonsurgical patients, one received definitive radiotherapy and the other was diagnosed at autopsy.



**Figure 1:** Preoperative axial (a) and sagittal (b) T1-weighted MRI showing a multicystic heterogeneous enhancement of a right cerebellopontine angle mass.

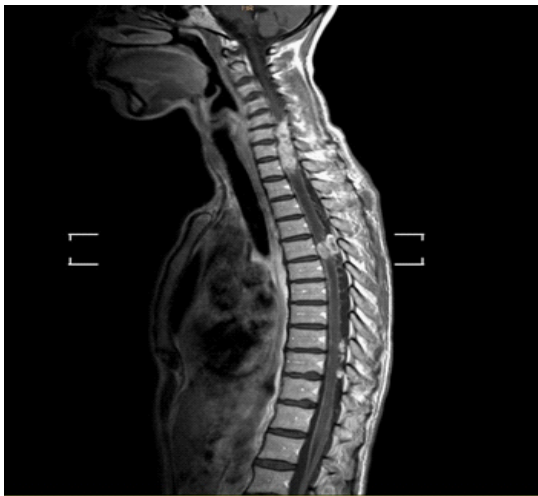


**Figure 2:** Histological findings. Cystic wall lined by squamous cell carcinoma with moderate atypia and abundant mitoses (a) showing positivity for CKAE1/AE3 (b) (a: hematoxylin-eosin staining x40; b: immunoperoxidase staining, x20)



(a) | (b)

**Figure 3:** Radiation therapy treatment planning and dose distribution. (a) The image on the left shows the contouring of the proposed treatment. The tumour bed is contoured in blue and the original mass in light green. (b) The image on the right shows the dose distribution with 95% isodose curves (47.5 Gy)



**Figure 4:** First evidence of progression on T1-weighted MRI on January 2022.

### Discussion

Intracranial epidermoid cysts account for 0.2-1.8% of all intracranial tumours [2,3]. These tumours are generally slow growing and histologically benign. Malignant transformation of an epidermoid tumour is rare and de novo intracranial SCC is even more uncommon.

The first case of SCC was reported by P. Ernst in 1912. This case involved a 52-year-old man diagnosed with SCC of the CPA arising from a known epidermoid cyst [1]. Since that time, a total of 73 cases of malignant transformation of epidermoid cysts have been reported [2,4]. Primary intracranial SCC was first described in 1976 by Wong et al. [5]. To our knowledge, only nine other cases have been reported since [6-14].

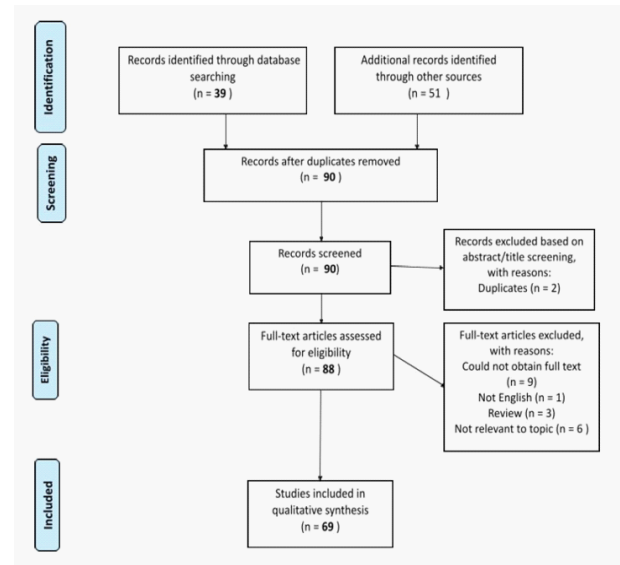
Intracranial SCC appears to be more common in males [6,15,16], although Lakhdar et al described a greater predominance in women [9].



Figure 5 (a)

Figure 5 (b)

**Figure 5:** T1-weighted MRI (April 2022) showing the second and final evidence of progression in the cervicothoracic (a) and thoracolumbar (b) regions.



**Figure 6:** Prisma flow diagram.

### Types

Hamlat et al. [16] classified SCC into five different categories according to the type of malignant transformation, as follows: 1) initial malignant transformation of an epidermoid cyst, which is the most common type; 2) malignant transformation from a remnant epidermoid cyst; 3) malignant transformation with leptomeningeal carcinomatosis (LC); 4) SCC carcinoma arising from other benign cysts; and 5) other malignancies arising in benign cysts.

### Malignant transformation

Based on the available reports, malignant transformation can occur anywhere from 3 months to 33 years from diagnosis of the benign lesion [16], with a median interval of 24 months [15].

### Diagnosis

The symptoms of SCC are non-specific, which is why diagnosis can be challenging. Selection of the appropriate diagnostic tests depends on the symptoms, which vary according to the tumour location. Rapid progression of symptoms may be an important clinical sign of malignant transformation [6].

**Table 1:** Reported cases of malignant transformation from epidermoid tumours.

Author and year	Age (Sex)	Location	Treatment	Dose	Survival status at last evaluation (time from surgery)	Interval to MT, months
Ernst 1912 [1]	52(M)	CPA	Autopsy			NS
Hug 1942 [27]	42(M)	Parapontine	Autopsy			NS
Yamanaka 1955 [28]	57(M)	Base of brain	Autopsy			NS
Davidson 1960 [29]	46(M)	Frontal	S + RT	NS	NS	5
Landers 1960 [30]	73(F)	Cerebellar	Autopsy			1
Komjatszeg 1964 [31]	45(F)	Base of brain	Autopsy			NS
Toglia 1965 [32]	54(F)	Base of brain	S		NS	12
Fox 1965 [33]	43(M)	Temporal lobe	S		Deceased (1 month)	84
Dubois 1981 [34]	53(M)	Fourth ventricle	S + RT	50 Gy	Deceased (2 months)	NS
Takado 1982 [35]	53(F)	CPA	Autopsy			NS
Lewis 1983 [36]	54(F)	Parasellar	S		Deceased (1 month)	36
Gianguaspero 1984 [37]	45(M)	Parieto-Occipital	S + RT	45 Gy	Deceased (8 months)	0.3
Meffazoni 1986 [38]	45(M)	Frontal	S		NS	NS
Kubokura 1986 [39]	60(F)	Temporal lobe	S		Deceased (8 days)	NS
Goldman 1987 [40]	59(F)	Intraventricular	S + RT	50 Gy	Alive (36 months)	396
Salazar 1987 [41]	49(M)	CPA + pons	S + RT	NS	Alive (10 months)	3
Abramson 1989 [42]	36(M)	CPA	S		NS	24
Nishiura 1989 [43]	38(M)	CAP	S + ChT		Alive (24 months)	6
Gi 1990 [44]	39(M)	CPA	S + RT	50 Gy	Deceased (15 months)	6
Tognetti 1991 [45]	67(F)	Temporal lobe	S		Deceased (1 month)	372
Acciarri 1993 [46]	62(M)	Parasellar	S		Deceased (1 week)	2
Nishio 1995 [47]	57(M)	CPA	S + RT	50 Gy	Alive (30 months)	12
Nishio 1995 [47]	42(M)	Middle-posterior fossa	S + RT	60 Gy	Deceased (3.5 months)	NS
Uchino 1995 [48]	57(M)	CPA	S + RT	60 Gy	Alive (4 months)	18
Ogata 1996 [49]	63(F)	Dorsolateral pons	S		Recurrence (3 months)	NS
Mohanty 1996 [50]	20(M)	Posterior fossa	S + RT	NS	Deceased (11 months)	3
Bayindir 1996 [51]	67(F)	Lateral ventricle	S		Alive (36 months)	NS
Murase 1999 [52]	50(F)	CPA	S + ChT + SRS	14 Gy	Alive (60 months)	120
Asahi 2001 [53]	55(F)	CPA	S		Deceased (3 months)	66
Nawashiro 2001 [24]	46(M)	Left temporal lobe	S		NS	NS
Khan 2001 [54]	53(M)	Prepontine	BSC		Deceased (10 months)	7
Link 2002 [55]	57(F)	CPA	S + RT + SRS	45 Gy + 15 Gy	Deceased (32 months)	12
Monaco 2003 [56]	36(M)	Cisterna magna	S		Alive (24 months)	6
Shirabe 2003 [57]	49(M)	Ventral pons	S + RT	60 Gy	Deceased (42 months)	18
Hamlat 2003 [58]	54(F)	Parieto-temporal	ChT		Deceased (7 months)	3
Park 2003 [59]	65(F)	CPA	S + RT	50 Gy	Alive (6 months)	NS
Michael 2005 [60]	45(M)	Petroclival	S + RT + ChT	59.4 Gy	Deceased (12 months)	1
Tamura 2006 [22]	56(F)	CPA	S + SRS	15 Gy	Alive (13 months)	96
Kodama 2007 [61]	67(M)	CPA	S + SRS	14 Gy	Deceased (11 months)	NS
Pagni 2007 [62]	65(F)	Pineal	S		NS	NS
Agarwal 2007 [63]	45(M)	Posterior fossa	S		NS	NS

Kim 2008 [64]	72(F)	CPA	S + RT	54 Gy	Alive (12 months)	NS
Ge 2009 [65]	50(M)	Temporal lobe	S		NS	72
Hao 2010 [66]	61(F)	CPA	S		Deceased (1.2 months)	36
Nakao 2010 [67]	74(F)	CPA	S + RT		Alive (17 months)	240
Lakhdar 2011 [6]	52(M)	CPA	S		NS	6
Chon 2012 [68]	43(M)	CPA	S + SRS	25 Gy	Alive (40 months)	24
Feng 2014 [69]	42(M)	CPA	S + RT	36 Gy	Alive (6 months)	-
Raheja 2016 [70]	54(F)	Prepontine	S		NS	NS
Raheja 2016 [70]	37(F)	CPA	S		Deceased (17 months)	NS
Pikis 2016 [23]	77(M)	CPA	S + RT	55 Gy	Deceased (6 months)	12
Solanki 2016 [71]	47(F)	CPA	S		Deceased (6 weeks)	12
Ding 2016 [72]	55(F)	Temporal lobe	S		Deceased (12 months)	7
Ozudemiz 2017 [73]	64(M)	Lateral ventricle	S		NS	273
Mascarenhas 2017 [74]	35(F)	Prepontine	S		NS	NS
Roh 2017 [21]	53(F)	CPA	S + RT	67.2 Gy	Deceased (4 years)	NS
Kwon 2019 [15]	71(M)	CPA	S		Alive (2 months)	NS
Cuoco 2019 [20]	71(M)	CPA	S + SRS	25 Gy	NS	60
Fereydonyan 2019[2]	30(M)	CPA	S + RT	NS	Alive (2 years)	60
Demuth 2019 [75]	67(F)	CPA	S + ChT		Deceased (time NS)	NS
Zuo 2021 [76]	39(M)	CPA	S		Deceased (4 months)	NS
Zuo 2021 [76]	54(F)	Suprasellar	S		Deceased (4 months)	NS
Zuo 2021 [76]	43(M)	CPA	S + PB	NS	Alive (72 months)	NS
Zuo 2021 [76]	44(M)	CPA	S + RT	NS	Deceased (10 months)	48
Zuo 2021 [76]	51(M)	CPA	S + RT	NS	Deceased (3 months)	NS
Zuo 2021 [76]	48(M)	CPA	S		Deceased (9 months)	180
Zuo 2021 [76]	61(M)	CPA	S + RT	NS	Deceased (23 months)	336
Zuo 2021 [76]	61(M)	CPA	S		Deceased (12 months)	
Zuo 2021 [76]	60(M)	CPA	S + SRS	NS	Deceased (13 months)	60

**Abbreviations:** MT: Malignant Transformation; M: Male; F: Female; CPA: Cerebellopontine Angle; S: Surgery; RT: Radiation Therapy; SRS: Stereotactic Radiosurgery; PB: Proton Beam; ChT: Chemotherapy; BSC: Best Supportive Care; NS: Not Specified.

**Table 2:** Reported cases of primary intracranial squamous cell carcinoma.

Author, year	Age (sex)	Location	Treatment	Dose	Survival status at last evaluation (time from surgery)
Wong 1976 [5]	4(M)	Parapontine	Autopsy		Deceased (1 day)
Nosaka 1979 [7]	46(M)	CPA	S		Deceased (7 months)
Garcia 1981 [18]	61(M)	CPA	RT	NS	Deceased (9 months)
Ebisudani 1990 [8]	68(M)	CPA	S		Deceased (1 month)
Jain 2003 [9]	5(F)	Temporal lobe	S + ChT + RT	NS	Alive (10 months)
Mallick 2012 [10]	35(F)	Frontal lobe	S + RT	60 Gy	Alive (12 months)
O'Neill 2016 [11]	49(M)	Sellar	S + SRS	NS	Alive (12 months)
Liu 2018 [12]	20(M)	Lateral ventricle	S		Alive (9 months)
Pisano 2020 [13]	35(M)	CPA	S		Deceased (1 month)

Mula-Hussain 2021 [14]	NS(M)	CPA	S + RT + SRS	RT: 54 Gy SRS: 20 Gy	Alive (42 months)
Garcia-Exposito 2023 (present case report)	42(F)	CPA	S + RT	50 Gy	Deceased (26 months)

**Abbreviations:** M: male; F: female; CPA: cerebellopontine angle; S: surgery; RT: radiation therapy; SRS: stereotactic radiosurgery; ChT: chemotherapy; NS: not specified.

### Diagnostic criteria

In 1982, Garcia et al. [18] proposed the following diagnostic criteria for primary intracranial SCC: Tumour limited to the intracranial, intradural compartment without extension beyond the dura, cranial orifices, or connection with the middle ear, air sinuses, or sella turcica. Nasopharyngeal cancer must also be ruled out. According to those authors, only cases that meet all of these criteria should be considered primary intracranial SCC. In their study, Hamlat and colleagues [16] included two other diagnostic criteria: the presence of a benign squamous cell epithelium within the malignant tumour and the absence of metastatic carcinoma.

### Radiological findings

The most commonly reported location of these lesions is the CPA (45% of cases), followed by the temporal lobe (12%), and, less commonly, the prepontine area and cerebellum [15,17].

Most lesions described to date have a low signal intensity on T1-Weighted MRI Images (T1-WI) and high signal intensity on T2-weighted images (T2WI) [4,20-22]. The presence of contrast enhancement and oedema may be key findings suggestive of malignant transformation [23]. Nawashiro et al. [24] found that epidermoid cysts could be differentiated from malignant tumours on Diffusion-Weighted Imaging (DWI), with a high signal on DWI in benign cysts versus a low signal in malignant transformations.

Leptomeningeal carcinomatosis, which is associated with a poor prognosis, has been reported in 27.8% of patients [4]. The development of LC may be due to leptomeningeal seeding by tumour cells or wide dissemination of malignant cells from an intradural primary lesion. Given that leptomeningeal metastases have been described in locations far from the primary lesion and without clear continuity, some authors have suggested that LC could also be due to surgical dissemination [25].

### Treatment

In benign intracranial epidermoid lesions, the initial approach is usually surgery. By contrast, no standard approach has yet been developed for SCC. Liu et al. [4] categorized the treatment options into several groups, as follows: surgical management alone; surgery plus radiotherapy (either radiosurgery or stereotactic radiosurgery); chemotherapy alone; or chemotherapy in combination with either surgery or radiotherapy; or surgery plus one or more adjuvant therapies.

### Surgery

Surgically-treated patients appear to have a significantly better prognosis than patients who receive palliative treatments (median survival: 25 vs. 8 months); moreover, gross total resection is associated with better survival outcomes than subtotal resections (median survival: 48 vs. 35 months, respectively) [15]. The addition of adjuvant radiotherapy to primary surgery is also associated with better survival than surgery alone (35 vs. 5 months, respectively) [15,17].

of adjuvant radiotherapy to primary surgery is also associated with better survival than surgery alone (35 vs. 5 months, respectively) [15,17].

### Radiation therapy

In the patients included in the studies in this review (Table 1), the mean radiation dose was 52.0 Gy (range, 36.0-67.2 Gy); however, higher doses were not associated with better survival outcomes [15,17]. Moreover, according to Alvord's model [26], a 2 cm epidermoid tumour has a 90% probability of growth inhibition when the total dose is 50 Gy (2 Gy daily fractions), without an increased risk of radionecrosis or optic or neurocognitive impairment.

Tamura et al. [22] found that the addition of either conventional radiotherapy or radiosurgery to primary surgery positively impacted survival outcomes. In that study, median survival times for patients treated with surgery alone, surgery plus conventional radiotherapy, and surgery plus radiosurgery were 1,18, and 44 months, respectively.

### Chemotherapy

Adjuvant chemotherapy may improve local control but its impact on survival is not clear due to the heterogeneous treatment protocols applied to date and to the limited number of reported cases in the literature.

### Survival

Regardless of the specific treatment protocol, the reported recurrence rate is approximately 20%, with an average recurrence time of 17 months [15,16]. Median survival following detection of a recurrence is five months [15].

In patients with intracranial SCC, survival outcomes are poor, and most patients die within 12 months following symptom onset or diagnosis [16].

### Conclusion

Primary intracranial squamous cell carcinomas are rare and the optimal treatment approach remains unclear. The most common approach appears to be surgery with adjuvant radiotherapy. Nevertheless, the probability of long-term survival in these patients remains low, even in those who undergo gross total resection with adjuvant radiotherapy.

In the present case, the presence of leptomeningeal progression (Figures 4 and 5) underscores the importance of neural axis follow-up. Moreover, given that leptomeningeal dissemination has been reported in close to 30% of patients, prophylactic irradiation of the entire neuroaxis should be considered as this treatment could potentially improve survival outcomes.

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## References

1. Ernst P. Haufung dysontogenetischer Bildungen am Zentralnervensystem. *Verb Dtsch Pathol Ges.* 1912; 15: 226-230.
2. Fereydonyan N, Taheri M, Kazemi F. Cerebellar Squamous Cell Carcinoma Due to Malignant Transformation of Cerebellopontine Angle Epidermoid Cyst, Report an Interesting Case and Review the Literature. *Prague Medical Report.* 2019; 120: 95-102.
3. Lewis A, Cooper P, Kassel E, et al. Squamous cell carcinoma arising in a suprasellar epidermoid cyst. *Journal of Neurosurgery.* 1983; 59: 538-541.
4. Liu X, Chen Z, Dong Y, et al. Primary Intracranial Squamous Cell Carcinoma Arising De Novo: A Case Report and Review of the Literature. *World Neurosurgery.* 2018; 120: 372-381.
5. Wong S, Ducker T, Powers J. Fulminating parapontine epidermoid carcinoma in a four-year-old boy. *Cancer.* 1976; 37: 1525-1531.
6. Lakhdar F, Hakkou E, Gana et al. Malignant Transformation Six Months after Removal of Intracranial Epidermoid Cyst: A Case Report. *Case Reports in Neurological Medicine.* 2011; 2011: 1-4.
7. Nosaka Y, Nagao S, Tabuchi K. et al. Primary intracranial epidermoid carcinoma. *Journal of Neurosurgery.* 1979; 50: 830-833.
8. Ebisudani D, Hamazaki F, Oka H, et al. An autopsy case of primary intracranial squamous cell carcinoma. *Neurological surgery.* 1990; 18: 193-198.
9. Jain R, Gujar S, McKeever P, et al. Imaging findings associated with childhood primary intracranial squamous cell carcinoma. *AJNR. American journal of neuroradiology.* 2003; 24: 109-111.
10. Mallick S, Biswas A, Kumar et al. Primary intracranial basaloid squamous cell carcinoma: An enigma. *Neurologia i Neurochirurgia Polska.* 2012; 46: 489-495.
11. O'Neill B, Segkos K, Kasper E, et al. Non-metastatic squamous cell carcinoma within a Rathke's cleft cyst. *Pituitary.* 2015; 19: 105-109.
12. Liu X, Chen Z, Dong Y, et al. Primary Intracranial Squamous Cell Carcinoma Arising De Novo: A Case Report and Review of the Literature. *World Neurosurgery.* 2018; 120: 372-381.
13. Pisano P, Lombardi F, Bongetta D, et al. Primary intracranial squamous cell carcinoma with a fatal course. *Asian Journal of Neurosurgery.* 2020; 15: 722.
14. Mula-Hussain L, Malone J, dos Santos M, et al. Surgery and dose-escalated radiotherapy for a de novo intracranial squamous cell carcinoma of the cerebellopontine angle. *Clinical and Translational Radiation Oncology.* 2021; 27: 99-102.
15. Kwon S, Kim J, Kim Y, et al. Treatment and Survival Outcomes of Primary Intracranial Squamous Cell Carcinoma. *World Neurosurgery.* 2019; 125: e1-e9.
16. Hamlat A, Hua Z, Saikali S, et al. Malignant Transformation of Intra-Cranial Epithelial Cysts: Systematic Article Review. *Journal of Neuro-Oncology.* 2005; 74: 187-194.
17. Nagasawa D, Yew A, Spasic M, Choy W, Gopen Q, et al. Survival outcomes for radiotherapy treatment of epidermoid tumors with malignant transformation. *Journal of Clinical Neuroscience.* 2012; 19: 21-26.
18. Garcia C, McGarry P, Rodriguez F. Primary intracranial squamous cell carcinoma of the right cerebellopontine angle. *Journal of Neurosurgery.* 1981; 54: 824-828.
19. Nagasawa D, Choy W, Spasic M, Yew A, Trang A, et al. An analysis of intracranial epidermoid tumors with malignant transformation: treatment and outcomes. *Clinical Neurology and Neurosurgery.* 2012; 115: 1071-1078.
20. Cuoco J, Rogers C, Busch C, Apfel L, Entwistle J, et al. Intracranial Squamous Cell Carcinoma Arising From a Cerebellopontine Angle Epidermoid Cyst Remnant Four Decades After Partial Resection. *Frontiers in Oncology.* 2019; 9.
21. Roh T, Park Y, Park Y, Kim S, Chang J. Intracranial squamous cell carcinoma arising in a cerebellopontine angle epidermoid cyst. *Medicine.* 2017; 96: e9423.
22. Tamura K, Aoyagi M, Wakimoto H, Tamaki M, Yamamoto K, et al. Malignant transformation eight years after removal of a benign epidermoid cyst: A case report. *Journal of Neuro-Oncology.* 2006; 79: 67-72.
23. Pikiş S, and Margolin, E, 2016. Malignant transformation of a residual cerebellopontine angle epidermoid cyst. *Journal of Clinical Neuroscience.* 2016; 33: 59-62.
24. Nawashiro H, Higo R, Tokumaru A, Tsuzuki N, Shima K. Diffusion-weighted MRI of an intracranial epidermoid with malignant transformation. *Neuroradiology.* 2001; 43: 891-891.
25. Kano T, Ikota H, Kobayashi S, Iwasa S, Kurosaki S, et al. Malignant transformation of an intracranial large epidermoid cyst with leptomeningeal carcinomatosis -case report-. *Neurologia medico-chirurgica.* 2010; 50: 349-353.
26. Alvord E. Growth rates of epidermoid tumors. *Annals of Neurology.* 1977; 2: 367-370.
27. Hug O. Krebsbildung aus einem pialen Epidermoid. *Virchows Archiv für Pathologische Anatomie und Physiologie und für Klinische Medizin.* 1942; 308: 679-689.
28. Yamanaka A, Hinohara S, Hashimoto T. Primary diffuse carcinomatosis of the spinal meninges accompanied with cancerous epidermal cyst of the base of the brain; report of a case of autopsy. *Gan.* 1955; 46: 274-276.
29. Davidson S, Small J. Malignant Change in an Intracranial Epidermoid. *Journal of Neurology, Neurosurgery & Psychiatry.* 1960; 23: 176-178.
30. Landers J, Danielski J. Malignant intracranial epidermoid cyst. Report of a case with leptomeningeal spread. *Archives of Pathology & Laboratory Medicine.* 1960; 70: 419-423.
31. Komjatszegi S. Primary Intracranial Epidermoid Carcinoma. *Journal of Neurosurgery.* 1980; 52.
32. Togliola J, Netsky M, Alexander E. Epithelial (Epidermoid) Tumors of the Cranium. *Journal of Neurosurgery.* 1965; 23: 384-393.
33. Fox H, South E. Squamous cell carcinoma developing in an intracranial epidermoid cyst (cholesteatoma). *Journal of Neurology, Neurosurgery & Psychiatry.* 1965; 28: 276-281.
34. Dubois P, Sage M, Luther J, et al. Malignant Change in an Intracranial Epidermoid Cyst. *Journal of Computer Assisted Tomography.* 1981; 5: 433-435.
35. Takado M, Hirose Genjiro, et al. An autopsy case of primary parapontine epidermoid carcinoma. *Rinshō shinkeigaku = Clinical neurology.* 1982; 22: 579-85.

36. Lewis A, Cooper P, Kassel E, et al. Squamous cell carcinoma arising in a suprasellar epidermoid cyst. *Journal of Neurosurgery*. 1983; 59: 538-541.
37. Giangaspero F, Manetto V, Ferracini R, et al. Squamous cell carcinoma of the brain with sarcoma-like stroma. *Virchows Archiv A Pathological Anatomy and Histopathology*. 1984; 402: 459-464.
38. Maffazzoni D, Barbosa-Coutinho L, Chemalle I, et al. Carcinoma originado em cisto epidermoide intracraniano: registro de caso. *Arquivos de Neuro-Psiquiatria*. 1986; 44: 391-394.
39. Kubokura T, Nishimura T, Tsubone K. Ct Scan Findings of Malignant Epidermoid Cyst. *Neurologia Medico-chirurgica*. 1986; 26: 706-711.
40. Goldman S, Gandy S. Squamous cell carcinoma as a late complication of intracerebroventricular epidermoid cyst. *Journal of Neurosurgery*. 1987; 66: 618-620.
41. Salazar J, Vaquero J, Saucedo G, Bravo G. Posterior fossa epidermoid cysts. *Acta Neurochirurgica*. 1987; 85: 34-39.
42. Abramson R, Morawetz R, Schlitt M. Multiple Complications from an Intracranial Epidermoid Cyst: Case Report and Literature Review. *Neurosurgery*. 1989; 24: 574-578.
43. Nishiura I, Koyama T, Handa J, Amano S. Primary Intracranial Epidermoid Carcinoma. *Neurologia Medico-chirurgica*. 1989; 29: 600-605.
44. Gi H, Yoshizumi H, Nagao S, Nishioka T, Uno J, et al. C-P angle epidermoid carcinoma: A case report. *No shinkei geka. Neurological surgery*. 1990; 18: 1041-1045.
45. Tognetti F, Lanzino G, Manetto V, Calbucci F. Intracranial squamous cell carcinoma arising in remnant of extirpated epidermoid cyst. *British Journal of Neurosurgery*. 1991; 5: 303-305.
46. Acciarri N, Padovani R, Foschini M, Giullioni M, Finizio F. Intracranial squamous cell carcinoma arising in an epidermoid cyst. *British Journal of Neurosurgery*. 1993; 7: 565-569.
47. Nishio S, Takeshita I, Morioka T, Fukui M. Primary Intracranial Squamous Cell Carcinomas. *Neurosurgery*. 1995; 37: 329-332.
48. Uchino A, Hasuo K, Matsumoto S, Uda K, Moriguchi M, et al. Intracranial epidermoid carcinoma: CT and MRI. *Neuroradiology*. 1995; 37: 155-158.
49. Ogata N, Jochum W, Aguzzi A, Fournier J, Yonekawa Y. Total removal of a primary intracranial squamous cell carcinoma invading the brain stem. *Surgical Neurology*. 1996; 46: 477-480.
50. Mohanty A, Kolluri V, Santosh V. Squamous cell carcinomatous change in a posterior fossa epidermoid: Case report with a review of the literature. *British Journal of Neurosurgery*. 1996; 10: 493-496.
51. Bayindir C, Balak N, Karasu A. Micro-invasive squamous cell carcinoma arising in a pre-existing intraventricular epidermoid cyst. *Acta Neurochirurgica*. 1996; 138: 1008-1012.
52. Murase S, Yamakawa H, Ohkuma A, Sumi Y, Kajiwara M, et al. Primary Intracranial Squamous Cell Carcinoma. *Neurologia Medico-chirurgica*. 1999; 39: 49-54.
53. Asahi T, Kurimoto M, Endo S, Monma F, Ohi M, et al. Malignant transformation of cerebello-pontine angle epidermoid. *Journal of Clinical Neuroscience*. 2001; 8: 572-574.
54. Khan R, Giri D, Rosenblum M, Petite F, De Angelis L. Leptomeningeal metastasis from an intracranial epidermoid cyst. *Neurology*. 2001; 56: 1419-1420.
55. Link M, Cohen P, Breneman J, Tew J. Malignant squamous degeneration of a cerebellopontine angle epidermoid tumor. *Journal of Neurosurgery*. 2002; 97: 1237-1243.
56. Monaco R, Boscaino A, Di Blasi A, D'Antonio A, Profeta G, et al. Intraepithelial carcinoma arising in an endodermal cyst of the posterior fossa. *Neuropathology*. 2003; 23: 219-224.
57. Shirabe T, Fukuoka K, Watanabe A, Imamura K, Ishii R. Primary squamous cell carcinoma of the brain. A rare autopsy case. *Neuropathology*. 2003; 23: 225-229.
58. Hamlat A, Hua Z, Saikali S, Egretau J, Guegan Y. Malignant transformation of intracranial epidermoid cyst with leptomeningeal carcinomatosis: case report. *Acta Neurologica Belgica*. 2003; 103: 225-229.
59. Park JW, Park YM. Primary intracranial epidermoid carcinoma. *J Korean Neurosurg Soc*. 2003; 34: 159-161.
60. Michael L, Moss T, Madhu T, Coakham H. Malignant transformation of posterior fossa epidermoid cyst. *British Journal of Neurosurgery*. 2005; 19: 505-510.
61. Kodama H, Maeda M, Hirokawa Y, Suzuki H, Hori K, et al. MRI findings of malignant transformation of epidermoid cyst: case report. *Journal of Neuro-Oncology*. 2006; 82: 171-174.
62. Pagni F, Brenna A, Leone B, Vergani F, Isimbaldi G. Malignant epidermoid cyst of the pineal region with lumbar metastasis. *Neuropathology*. 2007; 27: 566-569.
63. Agarwal S, Rishi A, Suri V, Sharma M, Satyarthi G, et al. Primary intracranial squamous cell carcinoma arising in an epidermoid cyst-A case report and review of literature. *Clinical Neurology and Neurosurgery*. 2007; 109: 888-891.
64. Kim M, Kim O. Primary Intracranial Squamous Cell Carcinoma in the Brain Stem with a Cerebellopontine Angle Epidermoid Cyst. *Journal of Korean Neurosurgical Society*. 2008; 44: 401.
65. Ge P, Luo Y, Fu S, et al. Recurrent Epidermoid Cyst With Malignant Transformation Into Squamous Cell Carcinoma. *Neurologia Medico-chirurgica*. 2009; 49: 442-444.
66. Hao S, Tang J, Wu Z, et al. Natural Malignant Transformation of an Intracranial Epidermoid Cyst. *Journal of the Formosan Medical Association*. 2010; 109: 390-396.
67. Nakao Y, Nonaka S, Yamamoto T, et al. Malignant Transformation 20 Years after Partial Removal Of Intracranial Epidermoid Cyst. *Neurologia Medico-chirurgica*. 2010; 50: 236-239.
68. Chon K, Lee J, Koh E, et al. Malignant Transformation of an Epidermoid Cyst in the Cerebellopontine Angle. *Journal of Korean Neurosurgical Society*. 2012; 52: 148.
69. Feng R, Gu X, Hu J, et al. Surgical treatment and radiotherapy of epidermoid cyst with malignant transformation in cerebellopontine angle. *International Journal of Clinical and Experimental Medicine*. 2014; 7: 312-315.
70. Raheja A, Eli I, Bowers C, et al. Primary Intracranial Epidermoid Carcinoma with Diffuse Leptomeningeal Carcinomatosis: Report of Two Cases. *World Neurosurgery*. 2016; 88: 692.e9-692.e16.
71. Solanki S, Maccormac O, Dow G, et al. Malignant transformation of residual posterior fossa epidermoid cyst to squamous cell carcinoma.



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noma. *British Journal of Neurosurgery*. 2016; 31: 497-498.

72. Ding S, Jin Y, Jiang J. Malignant Transformation of an Epidermoid Cyst in the Temporal and Prepontine Region: Report of a Case and Differential Diagnosis. *Oncology Letters*. 2016; 11: 3097-3100.
73. Ozutemiz C, Ada E, Ersen A, et al. Imaging findings of an epidermoid cyst with malignant transformation to squamous cell carcinoma. *Turkish Neurosurgery*. 2014.
74. Mascarenhas A, Parsons A, Smith C, et al. Malignant squamous cell carcinoma arising in a previously resected cerebellopontine angle epidermoid. *Surgical Neurology International*. 2017; 8: 186.
75. Demuth S, Lasry D, Obaid S, et al. Pseudo-Chemical Meningitis and the Malignant Transformation of an Epidermoid Cyst. *Canadian Journal of Neurological Sciences / Journal Canadien des Sciences Neurologiques*. 2019; 46: 642-644.
76. Zuo P, Sun T, Wang Y, et al. Primary Squamous Cell Carcinomas Arising in Intracranial Epidermoid Cysts: A Series of Nine Cases and Systematic Review. *Frontiers in Oncology*. 2021; 11.