

# Efficacy and Safety of CyberKnife Stereotactic Radiosurgery for Occipital Condyle Metastasis

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## Introduction

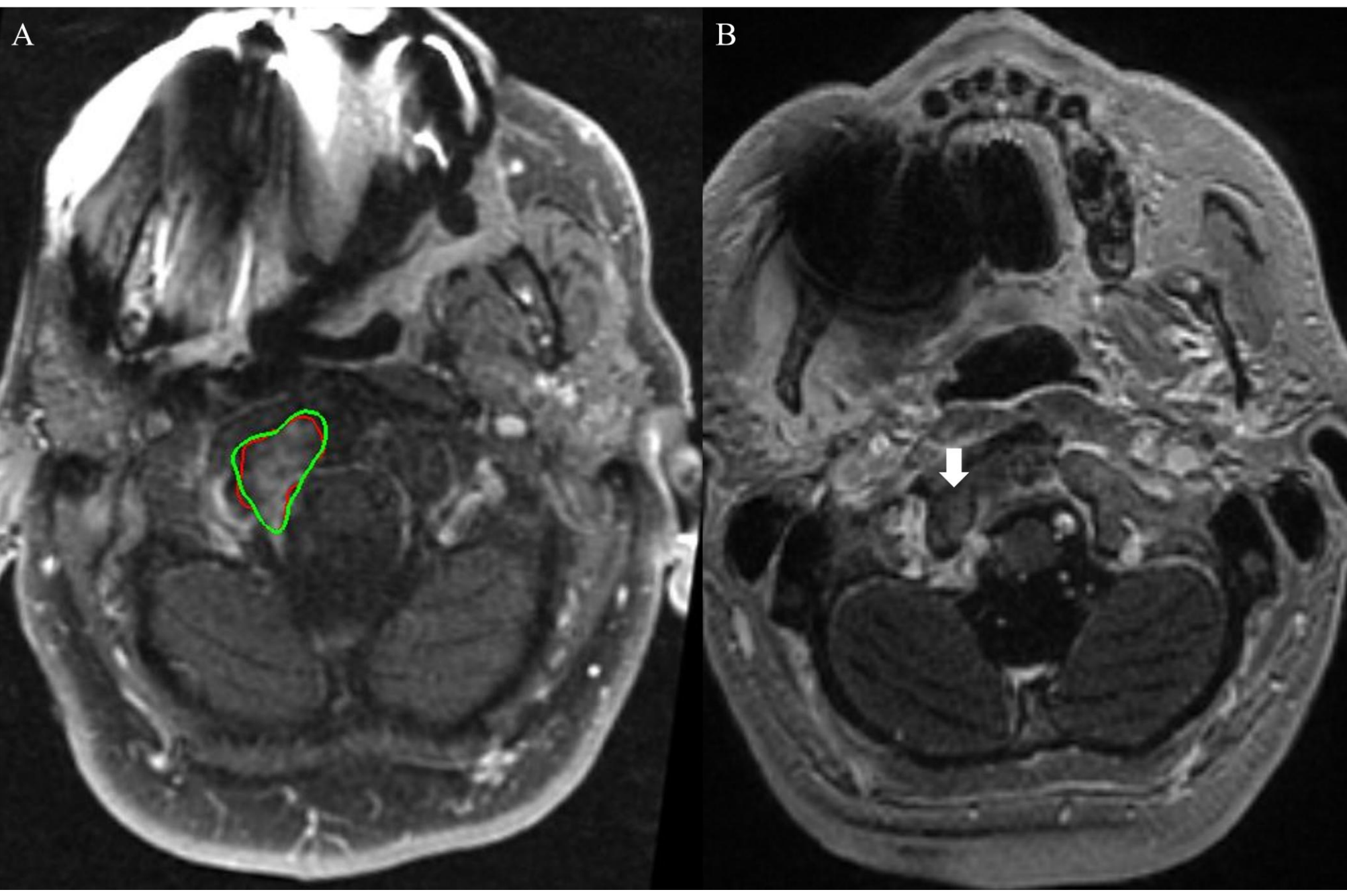
- Occipital condyle metastasis (OCM) is a rare condition characterized by severe occipital pain and neurological symptoms due to lower cranial nerve deficits, stemming from its anatomical location.
- Despite the widespread use of stereotactic radiosurgery (SRS) for cranial metastases, its specific impact on OCM remains underexplored.

## Objectives

- This study evaluates the efficacy and safety of CyberKnife SRS in treating OCM, focusing on symptom control and local tumor control.

## Methods

- We retrospectively analyzed cases of OCM treated with SRS at our institute from 2012 to 2023, evaluating patient demographics, presenting symptoms, treatment parameters, and outcomes.
- Key measures included occipital pain, dysfunctions of lower cranial nerves, and local tumor control.



**Figure 1.** (A) T1-weighted MRI Brain with contrast axial image showing a CyberKnife SRS plan targeting an expansile metastasis involving the right occipital condyle and cranial nerves VII, VIII, IX, and XII in a 68-year-old patient with an unknown primary cancer. Radiosurgical treatment was administered in 5 fractions, with a marginal dose of 35 Gy and a maximum dose of 43.75 Gy at the 80% isodose line. The green line indicates the marginal dose (isodose line of the prescription dose), and the red line outlines the contour of the metastatic lesion. (B) A 2-year follow-up demonstrates stable control of the tumor (treated area indicated by the white arrow).

## Results

- Eighteen patients (10 females) with a median age of 64 years (range: 40-79) were treated.
- Common presentations included occipital pain (44%) and lower cranial nerve deficits (28%).
- The median target volume was 6.95 cc (range: 0.95-72.7), and the median margin dose was 20 Gy (range: 16-40).
- The median follow-up period was 7 months (range: 1-44).
- Notably, only one patient experienced tumor recurrence and subsequently died from primary cancer progression five months after treatment.
- SRS achieved a 93.8% local tumor control rate over three years, with a median overall survival of 13 months.
- Among those presenting with symptoms, 87.5% reported pain relief (p=0.04), and 80% observed improvements in cranial nerve function (p=0.003).
- The only patient without clinical symptom improvement also had tumor recurrence.

**Table 1.** Patient Demographics

Characteristics	N (%)
<b>Total patients</b>	<b>18 (100%)</b>
Age	
≥65	9 (50%)
19-64	9 (50%)
≤18	0 (0%)
Gender	
Female	10 (56%)
Male	8 (44%)
Pathology	
Primary of metastasis	
Lung	7 (39%)
Breast	4 (22%)
Thyroid	2 (11%)
Sarcoma	2 (11%)
Prostate	1 (6%)
Renal	1 (6%)
Hepatobiliary	1 (6%)
Endometrial	0 (0%)
<b>Total lesions</b>	<b>20 (100%)</b>
Location of the tumor	
Right occipital condyle	10 (50%)
Left occipital condyle	8 (40%)
Bilateral occipital condyle	2 (10%)
Radiation marginal dose	
< 24 Gy	11 (55%)
≥ 24 Gy	9 (45%)
Fractions	
One fraction	10 (50%)
Two fractions	2 (10%)
Three fractions	4 (20%)
Five fractions	4 (20%)
Number of recurrence	1 (5%)
Pre-SRS hypoglossal nerve palsy	
No	15 (75%)
Yes	5 (25%)

**Table 3.** Post SRS outcomes grouped by hypoglossal canal involvement.

	No Canal Involvement (n=10)	Canal Involvement (n=8)	p-value
<b>Local Recurrence</b>	0 (0.0)	1 (12.5)	0.25
<b>CN XII Symptoms</b>	0 (0.0)	1 (12.5)	0.25
PFS	7.2 ± 6.88	20.3 ± 14.9	<b>0.025</b>
OS	10.2 ± 8.73	30.9 ± 22.6	<b>0.017</b>
Death	9 (90)	3 (37.5)	<b>0.019</b>

**Table 4.** Univariate and multivariate analysis for patient death.

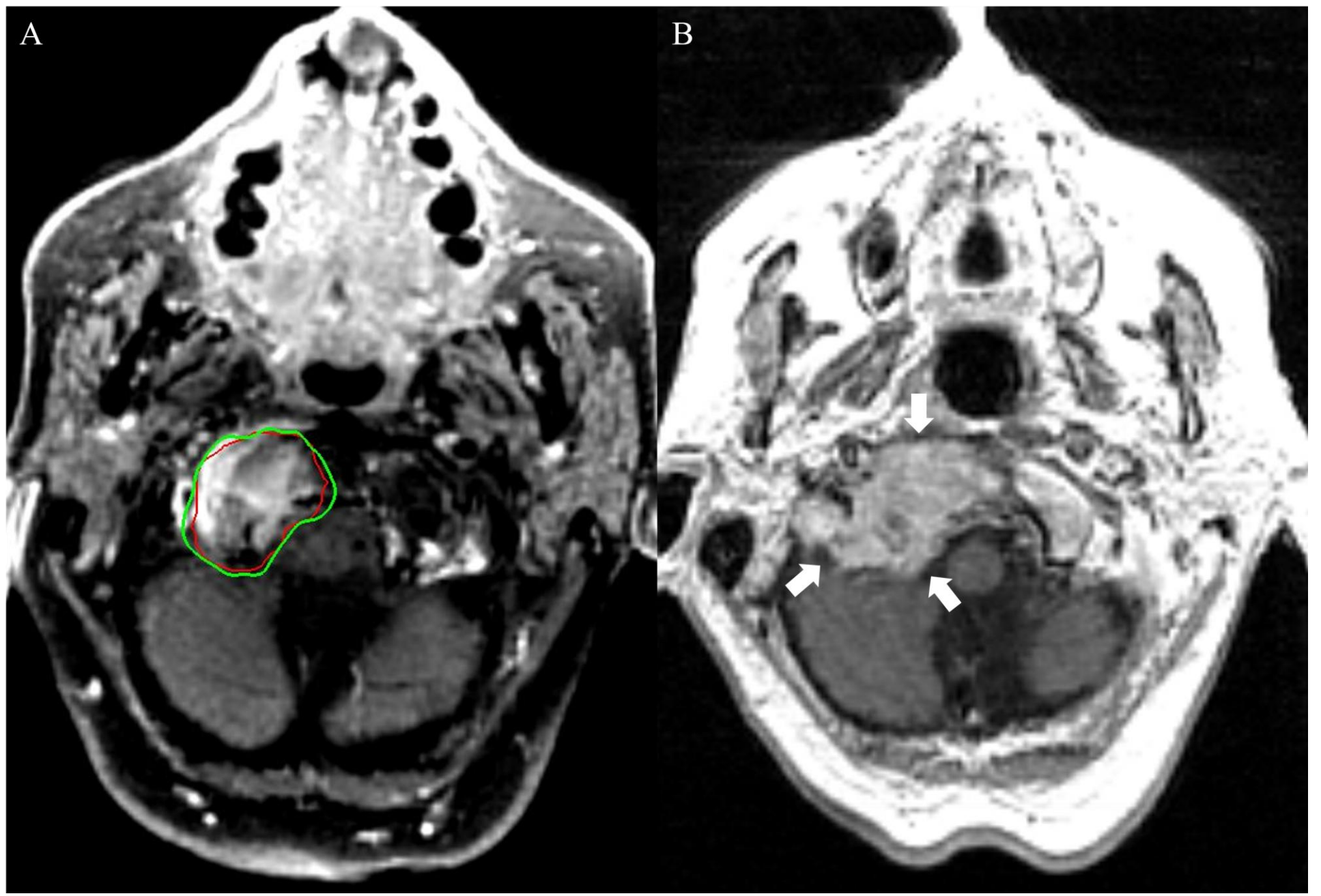
	Univariate	p-value	Multivariate	p-value
Dmax	-0.0713 ± 0.0620	0.25	0.0250 ± 0.119	0.834
Isodose	0.459 ± 0.233	<b>0.049</b>	0.9685 ± 0.640	0.13
<b>Canal Involvement</b>	-2.71 ± 1.28	<b>0.035</b>	-5.7522 ± 3.895	0.14

## Conclusion

- CyberKnife SRS is a promising treatment for OCM, offering significant pain relief and improvement in neurological symptoms, along with excellent local control rates.
- This non-invasive therapy provides a valuable alternative to surgery, potentially enhancing the quality of life for patients with limited treatment options due to this challenging condition.

**Table 2.** Comparison of the lesions with and without CN XII nerve palsy before Cyberknife SRS

	No CN XII palsy	CN XII palsy	P-value
Number of lesions	15	5	
Age (years)	65.08	61.60	
<b>Analysis of the treated lesion</b>			
Volume of Lesion (cc)	17.40	19.61	0.79
Margin Dose (Gy)	23.4	27.4	0.27
Maximum Dose (Gy)	30.01	34.96	0.29
Fractions	1.93	3.4	0.13
Margin dose/Fraction (Gy)	15.13	9.8	0.07
Isodose Line (%)	77.53	78.6	0.48
Conformality Index	1.22	96.26	0.73
Biologically Effective Dose (BED, Gy)	56.22	52.1	0.24
Single Fraction Equivalent Dose (SFED, Gy)	19.13	18.35	0.29



**Figure 2.** (A) T1-weighted MRI Brain with contrast showing a CyberKnife SRS plan targeting a right occipital condyle metastasis from a 74-year-old male with primary hepatocellular carcinoma. Radiosurgical treatment was administered in a single fraction, with a marginal dose of 18 Gy and a maximum dose of 22.5 Gy at the 80% isodose line. The green line indicates the marginal dose (isodose line of the prescription dose), and the red line outlines the contour of the metastatic lesion. (B) A 4-month follow-up demonstrates local recurrence, with an increase in size of the right occipital condyle lesion. This lesion involves the right hypoglossal canal with extension posteriorly and along the left occipital condyle (as indicated by white arrows).

## References

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