Outcomes of Surgical Treatment and Radiation Therapy in En Plaque Sphenoid Wing Meningioma

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Objective: *En plaque sphenoid wing meningioma is a rare tumor. Complete surgical resection is difficult. Role of adjuvant radiation therapy in treatment of meningiomas is still controversial. This present study aimed to examine the clinical outcomes and to evaluate the role of adjuvant radiation for the residual tumors.*
Material and Method: *A retrospective study was performed in 26 patients with en plaque sphenoid wing meningioma, who underwent operation at Prasat Neurological Institution between January 2008 and December 2012. Presenting symptoms, location of tumor, surgical approach, postoperative outcomes, and adjuvant radiation were reviewed and analyzed.*
Results: *Among the 26 patients, their ages ranged from 31 to 57 years. All tumors were removed by transcranial approach. Eleven of the patients underwent adjuvant radiation therapy and post-radiation imaging revealed tumors being stable in size. Nine patients that had regrowth tumors were not radiated. Mean followed-up time was 51.77 months (range 18-96 months).*
Conclusion: *Proptosis, visual acuity and cosmetic problems can be improved by surgery. Postoperative adjuvant radiation therapy may be an option for residual en plaque sphenoid wing meningioma.*

Keywords: *En plaque sphenoid wing meningioma, Proptosis, Visual acuity, Pterional approach, Endoscopic endonasal approach, Orbital decompression, Radiation*

J Med Assoc Thai 2016; 99 (Suppl. 3): S54-S61
Full text. e-Journal: *http://www.jmatonline.com*

En plaque meningiomas are rare and constitute approximately 4% of all meningiomas[1,2]. In Prasat Neurological Institution, en plaque sphenoid wing meningiomas are approximately 3.7% of all intracranial meningiomas. The most common location of meningiomas en plaque type is sphenoid wing[3]. The characteristics of en plaque meningioma area thin, widespread carpet or sheet-like lesion that infiltrates the dura and sometimes invades the bone with the intraosseous tumor growth leading to significant hyperostosis[3,4]. This type of meningioma is usually diagnosed based on clinical presentation and brain images, rather than pathological reports[6].

The hyperostosis bone associated with en plaque sphenoid wing meningioma is mainly located in the lateral and superior orbital walls, superior orbital fissure, optic canal and anterior clinoid process[5]. Tumor growth can extend anteriorly into the orbital apex, posteriorly into the cavernous sinus, medially into sphenoid and ethmoidal sinus, and inferiorly into infratemporalfossa[7]. Proptosis, the early and most common symptom, can be lead to functional problems and cosmetic deformity[8]. The most common cranial nerve deficit is optic neuropathy[9].

Nowadays, the standard treatment for en plaque sphenoid wing meningioma is surgery, since the high-quality imaging and modern surgical techniques have been developed[1]. However, gross total tumor removal is difficult because of the location and extension of the tumor[3,10]. The goal of surgery is to remove the entire tumor or as much as possible, including hyperostosis bone, thickening dura and intradural parts[1,11]. Additionally, the adjuvant radiation therapy is still controversial for residual meningioma, especially benign type (WHO grade I)[13-15].

The objectives of this present study were to examinethe results of surgical treatment by comparing preoperative and postoperative symptoms, and to determine the role of the adjuvant radiation therapy for postsurgical residual tumor.

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Material and Method

This present study was a descriptive study.Twenty-six patients,who were diagnosed with en plaque sphenoid wing meningioma and underwent operation at Prasat Neurological Institution between January 2008 and December 2012, were retrospectively reviewed. The study was approved by the institutional review board of Prasat Neurological Institute (PNI). The inclusion criteria included intraosseous meningiomas at the base of the anterior and middle cranial fossa, involving the sphenoid wing and the orbit with carpet-like, soft tissue component with or without invading the dura and intradural component. Exclusion criteria consisted of clinoidal meningiomas, optic nerve sheath meningiomas, cavernous sinus meningiomas with intraorbital extension and non-hyperostosis or en mass sphenoid wing meningioma. The data were collected from medical records, CT and/or MRI images, operative notes and pathological reports. Demographic data, duration of symptoms, location of tumors, histology, treatment modalities, postoperative clinical outcomes and imaging were analyzed and summarized. Following data were collected for preoperative and postoperative comparison. The visual acuity (VA) was assessed by Snellen's chart and classified into fivegroups[1]: 1) Normal vision; 2) Good vision ($\geq$0.5); 3) Fair vision (<0.5 to >0.1); 4) No useful vision ($\leq$0.1 to 0, Hand movement, finger count or light perception); and 5) Blindness. Preoperative VA was compared with postoperative VA. Proptosis was evaluated using exophthalmos index (EI). The EI was measured from image either CT or MRI scan. The distance in millimeters from the most anterior aspect of the globe on a section, including the lens to a line between the bilateral anterior tips of the frontal process of the zygomas, was measured both affected and normal sides. The ratio of these measures were defined as the EI[8] (Fig. 1).

For the cosmetic results, we used the criteria that proposed by Carrizo and Basso[16]: Level 1: very good with excellent clinical, surgical, and cosmetic results and without neurological sequelae; Level 2: good, with acceptable clinical, surgical, and cosmetics results; Level 3: moderate, with mild to moderate neurological sequelae (Incomplete reduction of exophthalmos, partial opthalmoplegia); and Level 4: poor, with severe sequelae and serious complications. The assessment of EI and tumor locations from images was performed by one radiologist. Tumor locations were classified into two types: Type I tumor was located at bone, dura and intradural, but not involved intraconal, medial orbital wall, cavernous sinus, infratemporal fossa orsphenoid and ethmoid sinus. Type II tumor involved intraconal, medial orbital wall, cavernous sinus, infratemporal fossa orsphenoid and ethmoid sinus (Fig. 2).

The main surgical approach was fronto-temporosphenoidal (Pterional) approach. Every surgeon tried to obtain the maximal removal of tumor, and achieve the decompression of orbit and optic nerve. Four patients underwent endoscopic endonasal approach with assisted-navigation for tumor that located medial orbital wall, sphenoid and ethmoid sinus, or compressed optic nerve medially. The extent of resection was evaluated according to the Simpson's grading scale[17]. Orbital wall reconstruction was performed in only one case. All tissues, including tumor involved temporal muscle, bone, dura and intradural tumor parts were sent for histopathology and classified along with WHO 2007 classification criteria. Patients were followed-up using both clinical symptoms and images. After surgical resection, the patients were sent for postoperative images either CT or MRI for evaluating the residual tumors. Eleven from twenty-five patients that had residual tumors were referred to the radiooncology center for adjuvant radiotherapy. The radiation techniques, doses, duration and complications were recorded from the charts.

Statistical analysis

Descriptive statistics (mean, median, and standard deviation) wereused for demographic data; Chi-square tests were calculated for comparisons between preoperative and postoperative vision, and the measured size of tumor between stable and regrowth groups. The non-parametric Mann-Whitney U-test was applied to independent samples (age and duration).

Results

Twenty-six patients had median age of 44 years (range 31-57 years). Twenty-five were females and one was male. Multiple meningiomas were found in 12 patients. Median period of symptoms were 5.5 months (range 1-24 month(s)). All patients presented with proptosis and median of pre-operative exophthalmos index was 1.37 (range 1.1-2.43). Nineteen patients had decreased visual acuity and were classified into four groups: good vision (n = 4, 15.4%), fair vision (n = 2, 7.7%), no useful vision (n = 12, 46.2%) and blindness (n = 1, 3.8%) (Table 1). Seventeen patients had visual field defects and mostly were generalized visual field defect or central visual field defect. Ten patients experienced headache and seven

patients had orbital pain. Diplopia was found in two patients. Cranial nerve III, IV, V, and VI deficit were presented in 1, 1, 3 and 2 patients, respectively (Table 2).

The locations of all en plaque sphenoid wing meningioma were found at sphenoid bone, lateral orbital wall, anterior clinoid process and intradural tumor parts. Tumors were at superior orbital fissures in 24 patients. Twenty-one and five patients had extraconal and intraconal lesions, respectively. Eighteen patients had optic canal invasion. Cavernous sinus lesions were detected in 18 patients. Ten patients had infratemporal fossa invasion. Sphenoid and ethmoid sinus lesions were found in 11 and six patients, respectively. Tumors were classified as type I (n = 7) and type II (n = 19) (Table 3).

All 26 patients underwent surgery via the fronto-temporosphenoidal (Pterional) approach. Four patients underwent second stage endoscopic endonasal approach with navigation-assisted, because invasion of tumor at sphenoid, ethmoid sinus and medial orbital wall parts and patients still had symptoms both decreased visual acuity and nasal obstruction. Twenty-five patients were classified as Simpson grade IV along with the extension of resection. Only one patient had Simpson grade II. The intradural temporobasal and frontotemporal tumor parts could be totally removed in 19 patients (80.77%). The optic canal and extraconal lesions were drilled and totally removed in 12 and 14, respectively (50% and 66.67%). The lateral wall andorbital roof were totally removed in 3 (11.05%) and 4 (21.05%), respectively. Bony resection, especially sphenoid bone was totally removed inone patient (3.80%). Tumor at cavernous sinus, infratemporal fossa,

Table 1. Visual acuity outcomes

Visual acuity	Number of patients					
	Preoperative	Postoperative				
		Normal	Good	Fair	No useful	Blind
Normal	7 (26.9%)	7 (26.9%)	0	0	0	0
Good vision	4 (15.4%)	2 (7.7%)	2 (7.7%)	0	0	0
Fair vision	2 (7.7%)	1 (3.8%)	1 (3.8%)	0	0	0
No useful vision	12 (46.2%)	2 (7.7%)	3 (11.5%)	2 (7.7%)	4 (15.4%)	1 (3.8%)
Blind	1 (3.8%)	0	0	0	0	1 (3.8%)

Table 2. Preoperative and postoperative presenting symptoms

Symptoms	Number of patients			
	Preoperative symptoms	Postoperative symptoms		
		Improved	Unchanged	Worsened
Proptosis	26 (100%)	24 (92.3%)	-	2 (7.7%)
Decrease visual acuity	19 (73.1%)	11 (57.9%)	7 (36.8%)	1 (5.3%)
Visual field defect	17 (65.4%)	5 (29.4%)	9 (52.9%)	3 (17.7%)
Headache	10 (38.5%)	10 (100.0%)	-	-
Orbital pain	7 (26.9%)	7 (100.0%)	-	-
Diplopia	2 (7.7%)	-	2 (100%)	-
Cranial III deficit	1 (3.8%)	-	1 (100%)	-
Cranial IV deficit	1 (3.8%)	-	1 (100%)	-
Cranial V deficit	3 (11.5%)	-	3 (100%)	-
Cranial VI deficit	2 (7.7%)	-	2 (100%)	-

Table 3. Locations of 26 tumors from preoperative and postoperative images,including percent of complete resection

Locations	Number of patients with preoperative imaging findings	Number of patients with postoperative imaging findings	% complete resection
Sphenoid bone	26 (100%)	25 (96.2%)	3.8%
Temporal bone	23 (88.5%)	18 (69.2%)	21.7%
Frontal bone	8 (30.8%)	3 (11.5%)	62.5%
Lateral orbital wall	26 (100%)	23 (88.5%)	11.5%
Orbital roof	19 (73.1%)	15 (57.7%)	21.1%
Medial orbital wall	4 (15.4%)	3 (11.5%)	25.0%
Superior orbital fissure	24 (92.3%)	12 (46.2%)	50%
Inferior orbital fissure	11 (42.3%)	11 (42.3%)	0
Anterior clinoid process	26 (100%)	13 (50.0%)	50.0%
Optic canal	18 (69.2%)	6 (23.1%)	66.7%
Extraconal invasion	21 (80.8%)	7 (26.9%)	66.7%
Intraconal invasion	5 (19.2%)	3 (11.5%)	40.0%
Cavernous sinus	18 (69.2%)	18 (69.2%)	0
Infratemporal fossa	10 (38.5%)	10 (38.5%)	0
Foramen rotundum	10 (38.5%)	10 (38.5%)	0
Foramen ovale	5 (19.2%)	5 (19.2%)	0
Temporal muscle	10 (38.5%)	7 (26.9%)	30.0%
Sphenoid sinus	11 (42.3%)	10 (38.5%)	9.1%
Ethmoid sinus	6 (23.1%)	3 (11.5%)	50.0%
Intradural temporobasal region	24 (100%)	5 (19.2%)	79.2%
Intradural fronto & temporal region	2 (7.7%)	0 (0%)	100%

inferior orbital fissure, foramen rotundum and foramen ovale parts were not removed. Medial orbital part was drilled and totally removed in onepatient (25%). Sphenoid sinus and ethmoid sinus parts were totally removed in one (9.09%) and three patients (50%), respectively. Orbital wall reconstruction was performed in only one case (Table 3).

The histological assessment revealed transitional (n = 15, 57.70%), microcystic (n = 7, 26.90%), angiomatous (n = 2, 7.70%), meningothelial (n = 1, 3.80%) and fibrous (n = 1, 3.80%). All subtypes were classified as WHO grade I. The histological examination provided proof of muscle and bone infiltration.

The postoperative proptosis symptom improved in 24 patients (92.30%). The median of postoperative exophthalmos index was 1.34 (range 1.07-1.60). The visual acuity was improved in 11 patients (42.30%), unchanged in seven patients (26.90%) and worsened in one patient (3.80%). The Good and Fair vision groups had visual improvement in four patients and unchanged in two patients. The group of No useful vision had VA improvement in seven patients and no improvement in five patients. The only one patient, who worsened in VA, presented with light perception before surgery and was blinded after surgery (Table 1). Visual field defect improved in five patients (19.20%), unchanged in nine patients (34.60%) and worsened in three patients (11.50%). All patients, who had headache and orbital pain before surgery, improved symptoms after surgery. No cranial nerve deficits improved after surgery (Table 2).

In aspect of cosmetic results, 17 patients (65.40%) were level 2, six patients (23.10%) were level 3 and three patients (11.50%) were level 1. Complications after surgical resection were cranial nerve deficits in four patients (15.40%) and these were transient abducens nerve deficit in two patients, and one each was transient oculomotor nerve deficit and frontalis paralysis. CSF leakage was found in two patients (7.70%) who underwent transcranial approach. Both patients were treated by placement of spinal drain. Postoperative seizure was found in twopatients (7.7%). One patient revealed a postoperative epidural empyema at surgical site. The patient was managed by debridement and removing bone flap, as well as intravenous antibiotics.

Eleven in twenty-five patients that had residual tumor after resection were referred to the radio-

oncological center for adjuvant radiation therapy. Radiation therapy selected for the individual was IMRT (Intensity Modulated Radiation Therapy) in five patients and SRT (Stereotactic Radiation Therapy) in six patients. All radiation fields covered the entire tumor both resection parts and residual parts. The dose per fraction and total doses varied and depended on the recommended dose and tolerated lower daily dose of radiation to the surrounding tissue.

The mean follow-up period was 51.77 months (range 18-96 months); we found regrowth tumors in nine patients and stable in size of tumors in 16 patients. One patient was not found tyo have a recurrent tumor. In stable tumor groups, 11 in 16 patients underwent adjuvant radiation therapy. The median follow-up period in adjuvant radiation group was 21.5 months (range 6-54 months) and stable tumor size was found in all without serious side effects. Nine patients had regrowth tumors. The presenting symptoms of recurrence were proptosis in all and seven patients presented with visual impairment. The mean duration of the regrowth group was 14 months (range 5-33 months). Nine patients, who had regrowth tumor, were underwent surgery via transcranial approach and three patients were given radiation after surgery. Factor that affected the outcomes for stable tumor groups was radiation after surgery (p = 0.002). Neither age nor duration of pre-operative symptoms correlated with stable tumor, including multiple meningioma, tumor type and type of surgery (Table 4).

Discussion

From a literature review, the proptosis was the early and most common (49-100%) presenting symptom in en plaque sphenoid meningiomas[1-3,5,6-10]. In this present study, we found that the proptosis is an early presenting symptom in all cases (100%). Sammartino et al[18] distinguished the differences between the proptosis caused by direct invasion of the orbital cavity and the proptosis caused by cavernous sinus and superior orbital fissure invasion. Scarone et al[8] explained the pathophysiological mechanisms leading to proptosis which were not only based on slow and progressive osseous invasion by the tumor, but dural infiltration at the level of superior orbital fissure can cause reduction of venous drainage from the orbit that induced producing proptosis, and can happen early in the disease process. In this present study, we found the duration of proptosis symptoms occurred between 1-24 months. The early presenting symptom may be explained from the tumors that invaded superior orbital fissure or cavernous sinus. The surgery for orbital decompression can reduce the proptosis (92.3%) by comparing exophthalmos index between pre-operative index of 1.37 and postoperative index of 1.34. The difference between pre-operative and

Table 4. Univariate analysis of stable tumor groups

	Follow-up tumors		*p*-value	Odd ratio	95% CI
	Stable (n = 16)	Regrowth (n = 9)			
Age (years)	Median 44	Median 43	0.465	0.935	0.8-1.093
Duration (months)	Median 4	Median 9	0.624	0.996	0.874-1.136
Multiple meningioma			0.628	1.786	0.349-9.127
Yes	7	5			
No	9	4			
Tumor type			0.611	1.625	0.237-9.658
I	4	3			
II	13	6			
Surgery			1.000	1.714	0.152-19.359
1	14	8			
2	3	1			
Radiation			0.002	0	0
Yes	11	0			
No	5	9			

Total patients = 25, 1 patient had no residual tumor postoperatively.

postoperative exophthalmos index seems to be slight, however, when interviewing with the patients, there were only six patients who were unsatisfied with the cosmetic outcomes from incomplete reduction. The adequate drilling and removal of bony orbital wall were important in reducing proptosis.

Oya et al[5] reported that 37% to 75% of cases experienced the improvement of visual deficit postoperative. In this present study, improvement of the visual acuity was found in 42.30% of the cases. The patients with good and fair vision had a better prognosis than the patients with no useful vision. We concluded that the severity of pre-operative visual acuity impairment was an important prognostic factor of postoperative visual acuity improvement. Optic nerve decompression is one goal of the surgical resection because it can improve the visual acuity or prevent further impairment. Surgeons should try to remove lesions that compressed or located around the optic nerve.

Schick et al[1] explained that en plaque sphenoid wing meningioma was a sub group of meningiomas. Their characteristics were a carpet or sheet-like appearance invading the dura and the bone. The infiltration of bone by meningioma cells stimulates osteoblastic activity, resulting in hyperostosis. The hyperostotic bone is pathological with meningiomatous cells invading the Haversian canals. Therefore, hyperostosis bone should be regarded as part of the tumor. These tumors mostly invaded the adjacent structures, for example optic canal, superior orbital fissure, extraconal, intraconal, cavernous sinus, infratemporal fossa and sphenoid, ethmoid sinus. In this present study, tumor involving the cavernous sinus, infratemporal fossa, inferior orbital fissure, foramen rotundum and foramen ovale were not removed due to the difficulties in surgical resection. The aims of surgical resection are improvement of visual acuity, reducing proptosis, good cosmetic outcome and regrowth or recurrence risk prevention.

Previous studies identified various surgical approaches such as combined transcranialsubfrontal-transmalar approach[15], fronto-temporo-sphenoidal (pterional) approach and fronto-temporal craniotomy extending into the orbito-zygomaticomalar bone ridge[18]. In this present study, all of twenty-six cases underwent surgery with fronto-temporosphenoidal (pterional) approach. For tumors that were located in medial orbital wall, sphenoid sinus and ethmoid sinus, they were difficult to be resected via pterional approach. We proposed that the endoscopic endonasal approach with assisted-navigation to remove the tumor, involving parts of medial orbital wall, sphenoid sinus and ethmoid sinus, may be an alternative treatment. Although these tumor parts could not be totally removed, surgeon could decompress the affected optic nerve and opened the obstructed nasal sinus. Four patients felt of clear nasal airway, reduced orbital pain and had no postoperative complications, but the improvement in visual acuity was unclear due to the worsening initial visual acuity (no useful visual function).

In this present study, most tumors, involving the sphenoid bone, lateral orbital wall, orbital roof, temporal bone and anterior clinoid process, would be attempted to be removed. In addition to the anatomical knowledge, the use of navigation system may have a role in enhancing the volume surgical resection and providing the orientation during the bony removal. For the intradural tumor at temporobasal and fronto-temporal regions, all intradural tumors could be resected about 80.77%, compared to other regions. This could be explained by the location in which the regions may be not so large and not too deep from dura. Maroon et al[9] suggested that it was not necessary to reconstruct the orbital roof or to inlay any bone or other materials in the capacious space after resection of tumor-involved bone which we agreed with.

Pendl et al[20] reported the results about gamma knife therapy in skull base meningioma. In this present study, 51% of cases were found reduction in tumor size, 47% of cases found constant in tumor size, and 2% of cases found increase in tumor size. Maroon et al[9] recommended the postoperative adjuvant radiation in residual en plaque sphenoid wing meningioma or invaded to cavernous sinus. In this present study, eleven patients who had residual tumor after resection, especially in cavernous sinus and infratemporal fossa, were submitted to adjuvant radiation. All patients, who received the adjuvant radiation, were not found to have the regrowth tumors. Thus, we recommended the adjuvant radiation as an option in cases of residual en plaque sphenoid wing meningioma. However, the duration of follow-up after radiation was about 25.57 months, thus the longer duration of follow-up issuggested.

Limitations of this study included data interpretation based on the patients' records. Moreover, the treatment decision such as the extent of tumor resection was depended on each individual surgeon. There were five neurosurgeons performed operation in this present study. The measurement in exopthalmos

index was done by one radiologist.

Conclusion

En plaque sphenoid wing meningioma is a rare type of benign tumor. Proptosis, visual acuity and cosmetic problems can be improved by surgery. The severity of pre-operative visual acuity impairment is an important factor in prognosis of visual outcomes. The goal of treatment is total removal of tumor because it can improve the presenting symptoms and prevent the regrowth. However, the complete resection of a tumor is difficult due to location and extension of the tumor. Endoscopic endonasal approach can be an alternative approach for tumor in medial orbital wall, sphenoid and ethmoid sinus. Postoperative adjuvant radiation therapy may be an optional treatment for residual en plaque sphenoid wing meningioma.

What is already known on this topic?

Surgical resection can improve the visual acuity and reduce the degree of proptosis. Radical resection decreases the recurrence of tumor. However, aggressive resection of tumor that invades the cavernous sinus and superior orbital fissure can increase the morbidity rate.The adjuvant radiation therapy is still controversial for residual meningioma, especially benign type (WHO grade I).

What this study adds?

Radiation therapy for en plaque sphenoid wing meningioma should be considered if residual tumor remains postoperatively. The endoscopic endonasal approach with navigation-assisted is an option for removing the tumor involving medial orbital wall, sphenoid sinus and ethmoid sinus parts. However, it is not the main surgical approach.

Potential conflicts of interest

None.

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ผลการรักษาของเนื้องอก En Plaque Sphenoid Wing Meningioma

จิโรจน์ จิรานุกูล, ประเสริฐ เอี่ยมปรีชากุล, มัณฑนา ธนะไชย, วุฒิพงษ์ ฐิรโฆไท

วัตถุประสงค์: *En plaque sphenoid wing meningioma เป็นเนื้องอกที่พบไม่บ่อย การผ่าตัดเนื้องอกออกทั้งหมดค่อนข้างยาก บทบาทของรังสีรักษาหลังผ่าตัดของเนื้องอกยังคงไม่ชัดเจน จุดประสงค์งานวิจัยเพื่อศึกษาผลของการรักษา และบทบาทของรังสีรักษาสำหรับเนื้องอกที่เหลือ*

วัสดุและวิธีการ: *การเก็บข้อมูลย้อนหลังของผู้ป่วย En Plaque Sphenoid Wing Meningioma จำนวน 26 คน ที่ได้รับการผ่าตัดที่สถาบันประสาทวิทยาตั้งแต่ เดือนมกราคม พ.ศ. 2551 ถึง เดือนธันวาคม พ.ศ. 2555 โดยทบทวนข้อมูลและวิเคราะห์เกี่ยวกับอาการ ตำแหน่งของ เนื้องอก วิธีการผ่าตัด ผลของการผ่าตัดและรังสีรักษา*

ผลการศึกษา: *ผู้ป่วยทั้งหมด 26 คน อยู่ในช่วงอายุ 31-57 ปี ทุกคนได้รับการผ่าตัดผ่านทางกะโหลกศีรษะหลังผ่าตัดผู้ป่วย 11 คน ได้รับรังสีรักษา และภาพฉายรังสีหลังได้รับรังสีรักษาพบว่าเนื้องอกมีขนาดคงที่ส่วนผู้ป่วยที่มีการโตของเนื้องอกทั้งหมด 9 คน พบว่าไม่มีใครได้รับการฉายแสง ระยะเวลาในการติดตามผู้ป่วยทั้งหมด 51.77 เดือน (18-96 เดือน)*

สรุป: *ปัญหาตาโปน (proptosis), การมองเห็นและปัญหาด้านความสวยงามสามารถดีขึ้นได้ด้วยการผ่าตัดและการได้รับรังสีหลังผ่าตัดเป็นทางเลือกในการป้องกันการโตของเนื้องอกในกลุ่มที่เนื้องอกเหลือหลังผ่าตัด*
