

Early Post Operative Visual Outcome in Microsurgically Treated Suprasellar Meningiomas Predict Long-Term Visual Outcome

Mikrocerrahi Yöntem ile Çıkarılmış Suprasellar Yerleşimli Menenjiom Olgularında Erken Postoperatif Dönem Görmenin Uzun Dönem Görme Prognozunun Belirlenmesindeki Etkisi

ABSTRACT

BACKGROUND: Different data exist regarding long-term visual prognosis associated with suprasellar meningiomas. The aim of this study was to determine the outcome of suprasellar meningiomas with respect to short and long-term visual outcomes.

METHOD: During the period of 1997 to 2006, 45 patients were operated either through a pterional (30) or bifrontal (15) approach. Visual parameters were evaluated early and late post-operatively.

RESULTS: 5 patients died post-operatively and 2 cases failed to attend follow up. During the early post-operative period, 15 (39.5%) showed improvement and 9 (23.7%) worsening of vision among 38 patients. Patients were followed-up for 1 to 8 years with mean of 4.1 years. Follow-up data revealed that 26 (68.4%) patients had visual improvement in at least one eye (10 of them in both eyes) while 10 (26.3%) patients had visual deterioration in one or both eyes. Data showed no significant correlation between visual outcome and extent of tumor removal or surgical approach. Visual outcome was better in patients with preoperative vision >1mfc (p-value=0.001). Data also showed that early post-op vision significantly correlates with long term visual outcome (p-value =0.003).

CONCLUSION: Visual outcome is better in patients with preoperative vision >1 mfc and early post-operative vision significantly correlates with long term visual outcome.

KEY WORDS: Suprasellar meningioma, Visual outcome, Surgical resection, Recurrence, Radiotherapy

ÖZ

GİRİŞ: Suprasellar menenjiomlar ile ilgili olarak uzun dönemli görme prognozuna ilişkin değişik bilgiler vardır. Bu çalışmanın amacı uzun ve kısa dönemli süreçte görmenin prognozunu incelemektir.

YÖNTEM: 1997 – 2006 yılları arasında pterional veya bifrontal kraniyotomi ile açılan suprasellar menenjiom olgularında (toplam 45 olgu, 30 olgu pterional, 15 olgu bifrontal açılım) erken ve geç dönemde erken ve geç postoperatif görme fonksiyonları değerlendirilmiştir.

SONUÇLAR: Postoperatif dönemde 5 hasta eksitus oldu, 2 hasta ise kontrole gelmedi. Toplam 38 hasta değerlendirildi. Erken postoperative dönemde 15 hastanın (% 39,5) görmesi daha iyi hale geldi, 9 (% 23,7) hastanın görmesi daha kötü hale geldi. Hastalar 1 – 8 yıl boyunca takip edildi. Ortalama izleme süresi 4.1 yıl. Takipler sonucu elde edilen verilere göre 26 hastanın en az bir gözü daha iyi görmeye başlamıştı, bu hastalarında 10'unda her iki gözde daha iyi görme meydana geldi. Hastaların 10'unda (%26,3) ise görme preoperative döneme göre bir gözde veya iki gözde daha kötü olarak bulundu. Verilerin incelenmesi sonucunda görme ölçütlerinin cerrahi yaklaşım ya da cerrahi tümör rezeksiyonu ile bir ilişki olmadığını göstermiştir. Preoperatif dönemde görmesi ? 1 mfc (p- value= 0.001) olan hastalarda görme sonuçlarının daha iyi olduğu gösterilmiştir. Ayrıca; erken dönem görme ölçütleri ile geç dönem görme ölçütleri arasında anlamlı derecede ilişki bulunmuştur (p-value= 0.003).

SONUÇ: Preoperatif dönemde görmesi ? 1 mfc üzerinde olan hastalarda görme prognozu daha iyidir ve erken ve geç dönem görme sonuçları da anlamlı olarak birbiri ile ilişkili görülmektedir.

ANAHTAR SÖZCÜKLER: Suprasellar menenjioma, Görme sonucu, Cerrahi rezeksiyon, Rekürrens, Radyoterapi

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INTRODUCTION

Suprasellar meningiomas are defined as tumors that arise from the tuberculum sellae, planum sphenoidale, anterior and posterior clinoidal process, and rarely diaphragma sellae. They may compress visual pathway and manifest with visual complaints. They may also encase major vessels in the suprasellar region that makes their total removal a high-risk procedure. Although these tumors are benign in nature, they have a tendency to regrow and reoccur if incompletely excised. Since the classic monograph by Cushing and Eisenhardt (9) in 1938, many large series have established the role of surgery in the treatment of suprasellar meningiomas. Although attempted, removal of these tumors was initially associated with significant mortality and morbidity. Today, a number of factors such as advanced microsurgical techniques, intraoperative electrophysiological monitoring of cranial nerve functions, improved neuro-anesthesia regimens, and postoperative supportive care have reduced operative as well as post-operative mortality and morbidity (10-16). In the recent decade, visual outcome has become a major concern that influences the patient's quality of life. We decided to review our results and evaluate factors that may influence visual outcome post-operatively.

MATERIAL and METHODS

This prospective study includes all 45 suprasellar meningioma cases that were operated by the senior author between 1997 and 2006. All of the patients in this study were referred to our clinic for complaints of headache and/or visual problems.

All patients underwent evaluation by Computed Tomography (CT) scan and/or Magnetic Resonance Imaging (MRI) with and without intravenous administration of a contrast agent. High-resolution CT scans, displaying axial and/or coronal images, best revealed bone changes in the region of the planum sphenoidale and tuberculum sellae. Both T1- and T2-weighted MR imaging was performed in three planes. We did not perform angiography in our patients. Follow-up imaging for assessment of tumor recurrence were performed using MRI only. Ophthalmological examinations were performed by members of the Ophthalmology department at our institution. Patients' visual acuity was tested by the best-correcting glasses for both eyes, funduscopy, and measuring intraocular pressure for diagnosis of

concomitant glaucoma. Goldmann perimetry was performed using red color dots of different sizes and brightness. Endocrinological tests for assessment of anterior pituitary function were performed before operation as well as 1 week and 3 months post-operatively. Function of the hypothalamopituitary-adrenal -thyroidal -gonadal axes were assessed using a combined ACTH, GnRH, and TRH stimulation test.

After obtaining informed consent, all patients were pre-treated with 8 mg dexamethasone, administered every 6 hours, the day before the surgery. Depending on tumor location, size and extension, tumor was approached via unilateral or bilateral craniotomy. We applied standard microscopic aid microsurgical techniques for piecemeal tumor resection with least traction on the optic apparatus. If the dural attachment and underlying bone showed signs of tumor invasion, excision of basal dura mater, drilling any suspicious hyperostotic planum sphenoidale, and removal of anterior clinoid process were performed.

After the operation, the patients were admitted to the neuro ICU and observed closely for at least 24 hours. The vision was re-evaluated and data recorded after extubation and regaining of consciousness.

Our Department of Pathology performed the histological assessment: 37 (79%) meningothelial, 5 (11%) transitional type, 1 Fibroblastic, 1 psammomatous, 1 angiomatous subtype, 1 Grade II (WHO scale) meningioma, and 1 anaplastic type were diagnosed.

At the time of study, charts were reviewed, and the following data were recorded: age at presentation, gender, presenting symptoms, size and location of tumor, type of treatment, surgical approach, extent of resection, tumor re-growth or recurrence, time from surgery to regrowth or recurrence of tumor, and years of follow-up. Ophthalmologic findings were noted at the time of diagnosis, early postoperatively (before discharge), and at the most recent follow up. Patients were evaluated in the neurosurgical clinic randomly by neurosurgery residents who were not involved in this study. For purposes of analysis, improvement in visual acuity (VA) was defined as improvement of Snellen acuity or a change from no light perception (NLP) to light perception (LP), LP to hand

movements, hand movements to finger counting, finger counting to 1/ 10 vision, or 1 / 10 to 10/10 vision or any changes in visual field in perimetry. Decreased V/A was defined as worsening Snellen acuity or a change from 1/10 to counting fingers, counting fingers to hand movements, hand movements to LP, or LP to NIP or any change in visual field in perimetry.

For comparisons between different groups, statistical analysis were performed by Binary logistic regression analysis and kappa correlation test with SPSS ver 15.

RESULTS

Among 45 patients included in this study, 35 (77.8%) were female and 10 (22.2%) were male. The ages ranged from 22 to 75 years with a mean of 45.7 ± 12.69 years. All of the patients had visual problems at the time of operation: 27 patients had bilateral visual loss, 15 patients unilateral visual loss, and the remaining 3 cases had only visual field defect in preoperative evaluation. Only 15 patients suffered from significant headache that brought them to the clinic. Six patients also had complaints of diplopia and ptosis for which neurology exam revealed 3rd nerve palsy. The interval between the onset of symptoms and diagnosis and treatment was documented. The mean time to diagnosis was 10 months with range of 2 months to 2.5 years. Mean tumor size was 26.2 mm with a range of 14 to 52 mm. Twenty patients had a tumor greater than 30 mm and the other 25 patients had smaller tumors. Fifteen patients were operated by the bifrontal approach and the other 30 cases underwent pterional craniotomy. Visual data revealed that approximately 70% of both groups achieved some benefit from surgery and that the approach to surgery was not a significant variable in our study (p -value=0.709).

Total and sub-total resection of tumor was performed in 34 (71.1%) and 11 (28.9%) patients respectively. Vision improved in 22 (81.5%) of 26 patients who had received total tumor removal, while 6 (54.5%) of 11 patients with subtotal tumor removal achieved benefit. Data analysis showed that extent of tumor removal had no significant effect on visual outcome (p -value=0.116). Although total tumor removal was the main objective of the operation, meticulous decompression of the optic apparatus was attempted for better outcome. Imaging modalities and surgical findings revealed

25 tuberculum sellae, 10 planum sphenoidale, 9 clinoidal, and 1 diaphragma sellae tumors. In 38 patients for whom follow-up data were available, the mean follow up period was 4.1 years (range 1 to 8 years). We had 11 (28.9%) cases of recurrence or re-growth in our series, 3 of which underwent a second operation. Seven cases were referred to radiotherapy and 1 patient was treated by both modalities. Data analysis showed sight improvement in at least one eye in 6 of these patients. The success rate was similar to the overall success rate of the first operation when comparing visual outcome (p -value=0.116). However, the absolute visual state was poor after recurrence or re-growth.

Five patients (11 %) died early postoperatively and causes of death were vascular damage (2 cases), myocardial infarction (1 case), operative site intracerebral hemorrhage (ICH) and cerebral edema after hematoma evacuation (1 case), and fulminant meningitis (1 case). Tumor was removed totally in all of these patients. Among other patients, we had 2 cases of post-operative ICH that required re-exploration and 1 case of CSF leak and meningitis which was managed medically. Five patients developed signs of deep vein thrombosis (DVT), the presence of which was confirmed by Doppler sonography, and managed with systemic anticoagulation therapy (None of these patients showed signs of pulmonary embolism). One patient had delayed fluid leak from the operative site and the bone scan revealed osteomyelitis of the bone flap that was managed surgically by bone flap removal and delayed cranioplasty.

Figure 1 indicates early postoperative visual outcome in 38 surviving and followed-up patients. Data shows that vision improved in 2 (5.3%), worsened in 5 (13.2%) and was unchanged in 14 (36.8%) patients. On the other hand, 13 (34.2%) patients experienced mono-ocular visual improvement and 4 (10.5%) patients had visual worsening in one eye with stable vision in other one. This means that 37.5% of patients had visual improvement in at least one eye while 23.7% of them had visual worsening without any improvement in their vision in the early post-operative period.

After initial evaluation, patients were followed-up regularly in the clinic and reevaluated with ophthalmologic tests. Figure 2 shows that 10 (26.3%) patients had better vision in both eyes relative to pre-operative condition. Thirteen (34.2%) patients

achieved improvement in the vision of one eye and had stable vision in the other. Seven (18.4%) and 3 (7.9%) patients experienced worsening of visual acuity in both eyes or one eye respectively. In 3 (7.9%) patients, one eye got better while the other worsened. Two (5.3%) patients indicated no changes in visual status and 26 (68.4%) patients had some improvements in at least one eye. Ten (26.3%) patients worsened in at least one eye vision without any improvement. In a separate analysis, each eye was indicated as a separate studying unit. Results are shown in figure 3. The figure shows that 44.3% of eyes with pre-operative vision <1 meter finger count got worse in long-term follow-up and only 21.4% of these patients achieved some benefit from the operation. In contrast, approximately 62.5% of eye-

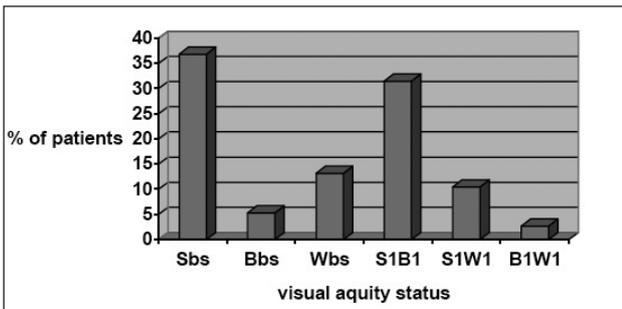


Figure 1: Early postoperative visual outcome (first week) compared with pre operative status by patients;
 In early postoperative period, 37.5% of patients had visual improvement in at least one eye while 23.7% of them had visual worsening without any improvement in their vision. (S bs: same both side; B bs: better both side; W bs: worse both side; S1B1: same one better one; S1W1: same one worse one; B1W1: better one worse one).

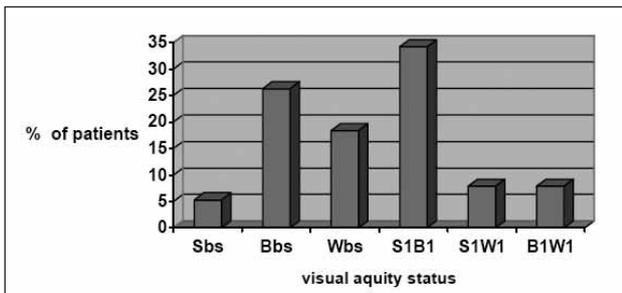


Figure 2: Long-term visual outcome compared with pre operative status by patients;
 In long-term follow-up, 26 (68.4%) of patients had some improvement in at least one eye, but 10 (26.3%) of them got worse in at least one eye without any improvement. (S bs: same both side; B bs: better both side; W bs: worse both side; S1B1: same one better one; S1W1:same one worse one; B1W1: better one worse one).

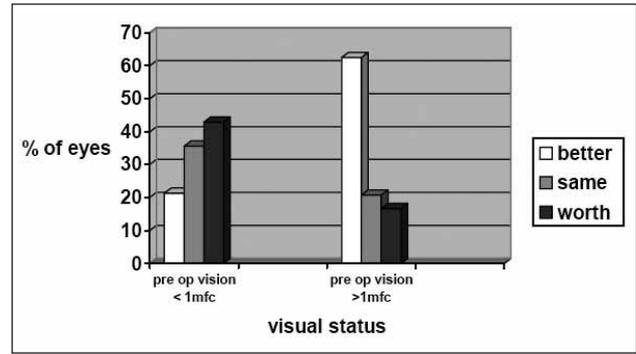


Figure 3: Long term visual outcome (by eyes);
 Only 21.4% of eyes with preoperative vision less than 1 meter finger count achieved some benefit from the surgery. In contrast, 62.5% of eyes with preoperative vision more than 1 meter finger count had improvement (p value =0.003)

sights with pre-operative vision >1 meter finger count showed improvement in long term follow-up and only 14.5% of them got worse. Data analysis by binary logistic regression shows that pre-operative visual status influences long-term visual outcome significantly (p-value =0.001). Also, our data reveals that among 26 patients with good visual outcome, 14 (53.8%) patients had achieved some improvement early post-operatively while 11 (91.7%) of 12 patients with long term poor result had no improvement or had worsening of vision early post-operatively (p-value=0.003).

DISCUSSION

Suprasellar meningiomas are relatively common and are a formidable surgical problem (5, 21, 27,). They represent approximately 4 to 10% of all intracranial meningiomas (7, 19, 20). They are generally benign, well-circumscribed, and slow growing (1, 3, 5). They are usually asymptomatic until they damage the anterior visual system (8), when they produce visual loss in one or both eyes. In addition, they may encase major blood vessels, thus compromising the potential for total removal (3). Although suprasellar meningiomas are thought to respond well to surgical treatment, little information exists regarding long-term visual prognosis. The time of evaluation of visual status was not known, and appropriate methods of reflecting the essential status of vision that simultaneously assessed the visual acuity and visual field was lacking. In all 45 cases that were operated in our center, anatomical details and extension of tumor were detected by images and the surgery was performed via unilateral or bilateral craniotomy. Regardless of which surgical

approach is selected, we think it is paramount to pay special attention to the anatomy and function of the arachnoid cisterns to ensure good post-operative visual outcome. Less brain retraction and CSF drainage from cisterns, careful opening of the carotid and sylvian cistern and in some cases lamina terminalis and preservation of the perforating arteries were used in our series as prescribed by Bergland and Yasargil (4, 33). We applied microsurgical techniques for piecemeal tumor resection with less traction on the optic apparatus as much as possible. Immediate post-operative deterioration and progressive aggravation of vision, as shown in the present series, reflect the high possibility of direct vascular insult to the optic apparatus during surgery rather than simply transient neural edema. Therefore, the process was almost irreversible despite meticulous medical therapy. The importance of post-operative short-term visual outcome, which has a good predictive value for permanent outcome, as shown in the present study, is related to this difficult situation (p -value=0.001) (7,23-27). Visual loss is the most important neurological complication in suprasellar meningioma. Table 1 shows surgical results in suprasellar meningiomas operated by neurosurgeons in the macro and micro-neurosurgical era (6-27). Cushing and Eisenhardt reported a 50% improvement rate in their series of 10 surviving patients (9, 10). During the macro-surgical era, this figure varied from 40 to 63% and lay within a range similar to that of mixed macro/micro-surgical series (28-80%) (1-32). One series in which there was a 100% improvement rate consisted of only four surviving patients (20). A review of the literature demonstrates that attempts have been made to determine factors influencing visual outcomes (1-27). In our series, almost 70% of patients had good visual outcome in follow-up and we found that the main factor influencing visual outcomes was the pre-operative visual status. This means that prolonged duration of symptoms and greater pressure on the optic system will result in worse visual outcome. Duration of symptoms prior to treatment is thought to be an important factor in the visual outcome of patients with suprasellar meningiomas. Indeed, most authors emphasize that the shorter the duration of symptoms prior to treatment, the better the outcome will be. Our findings indicate that patients with poor pre-

operative visual acuity tend to have poor post-operative visual acuity and this is in agreement with several other authors (1-27). The size of the tumor and extent of resection are important points in suprasellar meningioma surgery. In our series, the mean tumor size was 26.2 mm with range of 14 to 52 mm. Twenty patients had a tumor >30 mm and the other 25 had smaller tumors. Data analysis showed that tumor size was not a significant factor in our study, and had no influence on the extent of tumor resection and visual outcome. This could be due to the limited number of patients harboring large tumors. In the literature, total removal of the tumor was reported in a range of 35-100% (1-27). In our series, we performed total removal of tumor in 70% of cases. We had 80% visual improvement in patients where the tumor was removed totally, and 54% of patients with sub-total tumor removal were found to have better vision. This difference is not statistically significant. In all patients with subtotal tumor removal, we tried to decompress the optic apparatus as much as possible, and strongly advocate scant use of bipolar coagulation when accessing the optic apparatus to keep its blood supply as intact as possible. Our data shows that although total tumor removal did not influence long-term visual outcome, the risk of recurrence or re-growth must be considered in these patients. Recurrence rates for suprasellar meningiomas range from 5% to more than 30% and the rate increases with longer follow-up (1-31). Factors related to recurrence included extent of tumor removal, strength and extent of dural attachment of the tumor, tumor size, and tumor location (1-31). We followed-up our patients in regular intervals with ophthalmology tests and neuroimaging and found 28.9% recurrence or re-growth. Visual improvement was achieved in almost 54% of these patients. It seems that although recurrence influences visual status, early diagnosis and treatment could result in better improvement. Compared to our results, the published data differ widely regarding mortality and morbidity rates, completeness of resection, and recurrence rate. Mortality rates ranging from 0% to as high as 67% have been reported in other studies (1-30). Nevertheless, the number of cases in these studies vary markedly from 12 to 105, with the highest mortality rate reported in the smallest series. Series in which there have been no fatalities have only been reported during the last two decades, which might

be attributed to the use of micro-surgical procedures and modern neuro-anesthesia (1-31). We had a mortality rate of 11% in 45 operated patients, similar to series published in the recent 2 decades and tumors had been removed completely in all of these patients. It has been uniformly stressed that complete tumor resection should not be achieved at the cost of increased rates of mortality and morbidity, especially the risk of visual deterioration and hypothalamic dysfunction (7, 8, 9, 33). In fact, the risk was not increased in series in which there were high rates of complete tumor resection (6, 7, 9, 14, 33).

CONCLUSIONS

Immediate postoperative deterioration and progressive decrease of vision reflect the high possibility of direct vascular insult to the optic apparatus during surgery rather than simply transient neural edema. With application of neuro-anesthesia, micro-surgical techniques and pre-operative neuro-imaging, surgery could be performed with less mortality and morbidity. Better results would be achievable in suprasellar meningioma when surgery is performed in patients with less visual loss or short duration of symptoms. Patients must be followed at regular intervals due to the risk of recurrence and further treatment modalities must be considered in patients with tumor recurrence.

REFERENCE

- Al-Mefty O, Holoubi A, Rifai A, et al: Microsurgical removal of suprasellar meningiomas. *Neurosurgery* 16:364-372, 1985
- Al-Mefty O, Smith RR: Tuberculum sellae meningiomas, in Al-Mefty O (ed) *Meningiomas* New York: Raven Press, 1991 395-411
- Andrews BT, Wilson CB: Suprasellar meningiomas: the effect of tumor location on postoperative visual outcome. *J Neurosurg* 69:523-528, 1988
- Bergland R: The arterial supply of the human optic chiasm. *J Neurosurg* 31:327-334, 1969
- Brihaye J, Brihaye-Van Geertruyden M: Management and surgical outcome of suprasellar meningiomas. *Acta Neurochir Suppl* 42:124-129, 1988
- Chicani,CF MD., Mille NRr, MD: Visual Outcome in Surgically Treated Suprasellar Meningiomas. *J Neuro-Ophthalmol*, Vol. 23, No. 1, 2003.
- Chul-Kee Park, M.D: Surgically treated tuberculum sellae and diaphrag sellae meningioma; the importance of short term visual outcome. *Neurosurgery* 59:238-243, 2006
- Conforti P, Moraci A, Albanese V, et al: Microsurgical management of suprasellar and intraventricular meningiomas. *Neurochirurgia* 34:85-89, 1991
- Cushing H, Eisenhardt L: Meningiomas arising from the tuberculum sellae, with syndrome of primary optic atrophy and bitemporal field defects combined with normal sella turcica in middle-aged person. *Arch Ophthalmol* 1: 1-41, 168-206, 1929
- Cushing H, Eisenhardt L. *Meningiomas: Their Classification, Regional Behavior, Life History, and Surgical End Results*: Springfield. IL pp 224-249, 1983
- Dechaume J, Wertheimer P, Milleret P: Réflexions sur une statistique de 114 méningiomes intracrâniens. *Rev Neurol* 81: 321-331, 1949
- Fahlbusch R, Schott W: Pterional surgery of meningiomas of the tuberculum sellae and planum sphenoidale. *J Neurosurg* 96: February, 2002
- Gregorius KF, Hepler RS, Stern EW: Loss and recovery of vision in early diagnosis of suprasellar meningiomas. *J Neurosurg* 42: 69-75, 1975
- Grisoli F, Dias-Vasquez P, Riss M, et al: Microsurgical management of tuberculum sellae meningiomas. *Surg Neurol* 26: 37-44, 1986
- Jane JA, McKissock W: Importance of failing vision in early diagnosis of suprasellar meningiomas. *Br Med J* 2:5-7, 1962
- Jefferson A, Azzam N: The suprasellar meningiomas: A review of 19 years' experience. *Acta Neurochir Suppl* 28:381-384, 1979
- Kadis GN, Mount LA, Ganti SR: The importance of early diagnosis and treatment of the meningiomas of the planum sphenoidale and tuberculum sellae: a retrospective study of 105 cases. *Surg Neurol* 12:367-371, 1979
- Kempe LG: *Operative Neurosurgery*. New York: Springer-Verlag: 1968
- Klink DF, Sampath P, Miller NR, et al: Long-term visual outcome after nonradical microsurgery in patients with parasellar and cavernous sinus meningiomas. *Neurosurgery* 47:24-32, 2000
- Kunicki A, Uhl A: The clinical picture and results of surgical treatment of meningioma of the tuberculum sellae. *Cesk Neurol* 31:80-92, 1968
- Lundberg PO, Osterman PO, Wide L: Serum prolactin in patients with hypothalamus and pituitary disorders. *J Neurosurg* 55:194-199, 1981
- MacCarty CS, Charles C Thomas: *The surgical treatment of intracranial meningiomas*. IL: Springfield, 1961
- Maxwell RE, Chou SN: Preoperative evaluation and management of meningiomas. In: Schmidek HH, Sweet WH, eds. *Operative neurosurgical techniques: Indications, methods, and results*. New York: Grune & Stratton, 1982:481-9
- Mirimanoff RO, Dosoretz DE, Linggood RM, et al: Meningioma: Analysis of recurrence and progression following neurosurgical resection. *J Neurosurg* 62:18-24, 1985
- Ojemann RG: Meningiomas of the basal paraventricular region: Technical considerations. *Clin Neurosurg* 27:233 262, 1980
- Olivecrona H: The suprasellar meningiomas, in Olivecrona H, Tönnis H (eds): *Handbuch der Neurochirurgie*, Vol 4, Part 4 Berlin: Springer-Verlag, 1967: 67-172
- Poppen JL: Operative techniques for removal of olfactory groove and suprasellar meningiomas. *Clin Neurosurg* 11:1-7, 1964
- Rosenberg LF, Miller NR: Visual results after microsurgical removal of meningiomas involving the anterior visual system. *Arch Ophthalmol* 102:1019-1023, 1984

29. Rosenstein J, Symon L: Surgical management of suprasellar meningioma. Part 2: Prognosis for visual function following craniotomy. *J Neurosurg* 61:642-648, 1984
30. Simpson D: The recurrence of intracranial meningiomas after surgical treatment. *J Neurol Neurosurg Psychiatry* 20:22-39, 1957
31. Solero CL, Giombini S, Morello G: Suprasellar and olfactory meningiomas. Report on a series of 153 personal cases. *Acta Neurochir* 67:181-194, 1983
32. Symon L, Rosenstein J: Surgical management of suprasellar meningioma. Part 1: The influence of tumor size, duration of symptoms, and microsurgery on surgical outcome in 101 consecutive cases. *J Neurosurg* 61:633-641, 1984
33. Yasargil MG: *Microneurosurgery* vol 1 Stuttgart: Thieme, 1984,