



## ***Combined endoscopic and microscopic transnasal approach for removal of large pituitary macroadenomas extending to paranasal sinuses.***

### **Kombinirani endoskopsko-mikroskopski transnazalni pristop za odstranitev velikih hipofiznih makroadenomov s širjenjem v obnosne votline**

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#### ***Abstract***

***Introduction.*** Removal of large pituitary macroadenomas with extrasellar extension to paranasal sinuses is a challenging field of skull base surgery that necessitates cooperation between a neurosurgeon and a rinologist. Combined endoscopic and microscopic transnasal approach extends the classic exposure via the transsphenoidal approach for intra- and suprasellar macroadenomas and gains added exposure of the parasellar, ethmoid and clival regions.

***Methods and Patients.*** Three patients with large nonsecretory intra-extracranial macroadenomas and panhypopituitarism were operated on by combined microscopic and endoscopic approach. In all cases intranasal, intraethmoid and intrasphenoid parts of macroadenoma were removed first by endoscopic technique followed by microscopic technique of removal of the intrasellar, suprasellar and parasellar parts of the tumor. One patient had a previous transcranial surgery four years ago. Other two patients had tumors of similar large size, but underwent only one-staged transnasal surgery.

***Results.*** In all cases, the tumor was gross-totally removed from all extrasellar parts, except from parasellar space where incomplete removal was revealed by postoperative MRI scan. Visual symptoms were improved in all patients. Intraoperative CSF leak occurred in one patient and was successfully treated by lumbar drainage. She also had a mild transient diabetes insipidus. There were no additional neurological deficits and no rhinological problems.

***Key words.*** Transsphenoidal surgery, pituitary adenoma, skull base, endoscopy.



## Izveleček

**Uvod.** Odstranitev velikih hipofiznih adenomov s širjenjem izven selarnega področja v obnosne votline je kirurški izziv, kjer je nujno sodelovanje nevrokirurga in rinokirurga. Kombinirani endoskopsko-mikroskopski pristop razširja klasični transfenoidni pristop do turškega sedla in intar-supraselarnih adenomov z dostopom do paraselarnega prostora, ethmoidnih celic in klivusa.

**Metode in bolniki.** Tri bolnike z velikimi neseekretornimi makroadenomi in panhipopituitarizmom smo operirali s kombiniranim endoskopsko-mikroskopskim transnazalnim pristopom. V vseh treh primerih je bil z endoskopsko tehniko odstranjen najprej intranasalni, intraethmoidni in intrasfenoidni del makroadenom, čemur je sledila mikroskopska odstranitev intraselarnega, supraselarnega in paraselarnega dela tumorja. Ena bolnica je imela pred štirimi leti delno transkranialno odstranitev, druga dva bolnika pa sta imela enako velik tumor odstranjen s kombinirano tehniko v eni seji.

**Rezultati.** V vseh primerih je bil tumor makroskopsko odstranjen iz vseh ekstraselarnih lokacij, razen paraselarnega prostora, kjer je kontrolno MRI slikanje pokazalo delno odstranitev. Vidni simptomi so se popravili. Intraoperativno likvorejo pri eni bolnici smo odpravili z ledveno drenažo. Ista bolnica je imela prehodno tudi diabetes insipidus. Nihče ni imel novih nevroloških ali rinoloških težav.

**Zaključek.** Transnazalna odstranitev adenomov je metoda prvega izbora tudi za velike makroadenome, ki se širijo izven turškega sedla v obnosne votline. Maksimalno odstranitev lahko izvedemo s kombinirano endoskopsko in mikroskopsko tehniko, s katero se v večini primerov lahko izognemo transkranialnemu pristopu.

**Ključne besede.** Transfenoidna kirurgija, hipofizni adenom, lobanjsko dno, endoskopija.

## Introduction

Removal of large pituitary macroadenomas with extrasellar extension to paranasal sinuses is a challenging field of skull base surgery that necessitates cooperation between a neurosurgeon and a rhinologist. A pituitary macroadenoma grows into several extracranial directions – intrasphenoidal, intraethmoidal, intranasal and intracanalicular, in severe cases also into the orbit, maxillary sinus, pterygopalatine fossa, pyramidal apex, epipharynx, etc. However, these cases are more and more rare, because of faster diagnostic workup and modern imaging. On the other side, 3-4 centimetres large or larger nonsecretory adenomas can be diagnosed nowadays relatively often (1). A parasellar extension uni- or bilaterally generally accompanies large adenomas (2,3). Visual symptoms and partial hypopituitarism are the leading symptoms. Partial ptosis and diplopia may reveal parasellar extension. Since half or more tumor is located extracranially, a cooperation between rhinologist and a pituitary neurosurgeon is mandatory for maximal adenoma removal from intra- and extracranial compartments in one stage surgery (4-7).

Three patients with large pituitary adenomas extending into paranasal sinuses are presented here in details.

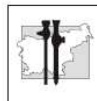
## Methods and Patients

Three patients with large non-secretory macroadenomas with an extension into paranasal sinuses and parasellar space were operated on, using a combined transnasal approach (endoscopic & microscopic) in one-staged surgery. Bilateral ethmoidectomy and broad sphenoidectomy were done in every case. The follow-up period was three years.

Case I. was a female, 62 yr, with lateral hemianopsia for the last 6 months. A non-secretory macroadenoma measured 4,5 x 3,5 cm, only hypogonadism was present. She had 1<sup>st</sup> surgery by transcranial route 4 yr before. DI & mild III. palsy were both transient, panhypopituitarism was present postoperatively, but visual problems disappeared completely in a short time.

A residual tumor was revealed after transcranial surgery paranasally & parasellarly on the left.

A gradual growth of the tumor the over next four years indicated a second surgery, which was per-



formed a single stage, transnasal, using endonasal endoscopic – microscopic approach.

Case II. was a female, 52 yr, who had transsphenoidal surgery 12 yr ago for STH microadenoma. She was cured, pituitary function was normal.

Visual problems (relative scotomas L>R) were present for the last 6 months. She was taking thyroid hormones for primary hypothyroidism for the last 3 years. A MRI revealed non-secretory macroadenoma 4 x 3,5 cm. She underwent transnasal surgery. Endoscopically ethmoidectomy and sphenoidectomy were performed bilaterally. Under microscopic magnification the tumor entering parasellar space under horizontal ICA on the left (medial cavernous sinus) was tried to be removed.

Case III. Was a male, 55 yr, who presented with headache, blurred vision and visual field deficit for the last 3 weeks. He was almost blind in his left eye since childhood (accident). Panhypopituitarism was revealed by endocrinological

tests and MRI showed 4,5 x 3 cm non-secretory macroadenoma. He underwent single staged transnasal surgery by endoscopic and microscopic techniques as in previous cases. The tumor entering parasellar space under the horizontal ICA on the right was tried to remove.

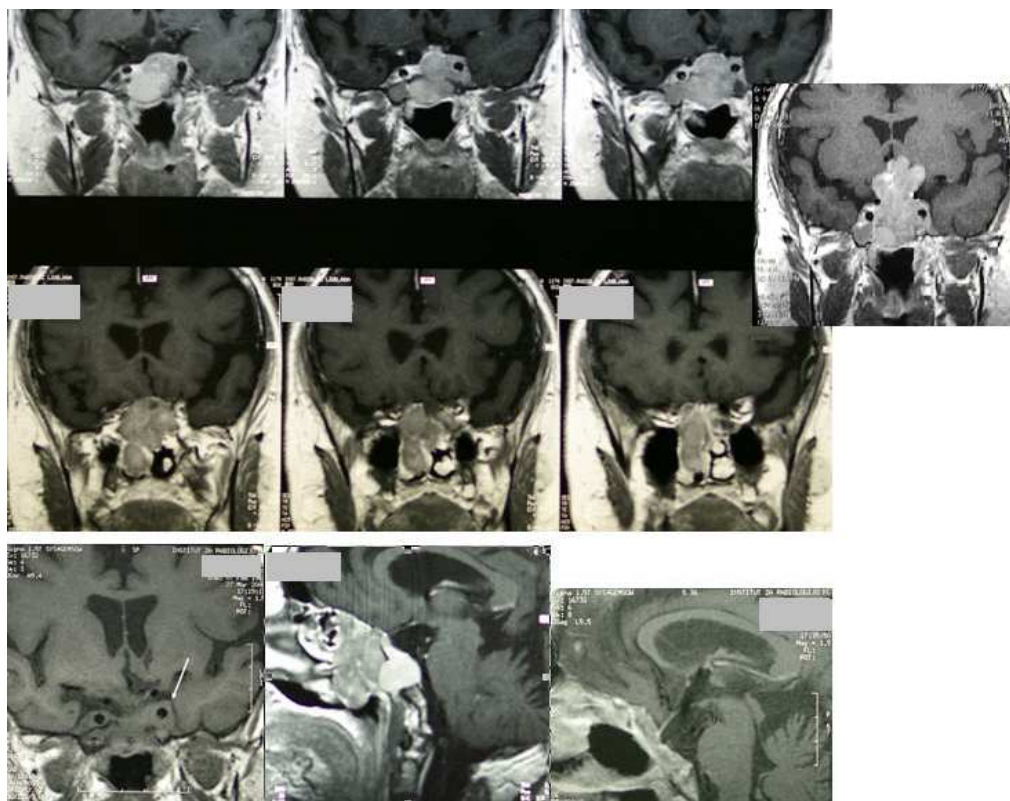
### Results

The surgery resulted in no postop CSF leak, no DI and no new deficits in case I. and III.

Intraoperative CSF leak happened only in case II and was successfully treated by lumbar drainage (10 days). DI was transient. Asymptomatic mucocoele was observed on control MRI, but disappeared spontaneously in 1 year. However, hormonal status was unchanged – pituitary was preserved.

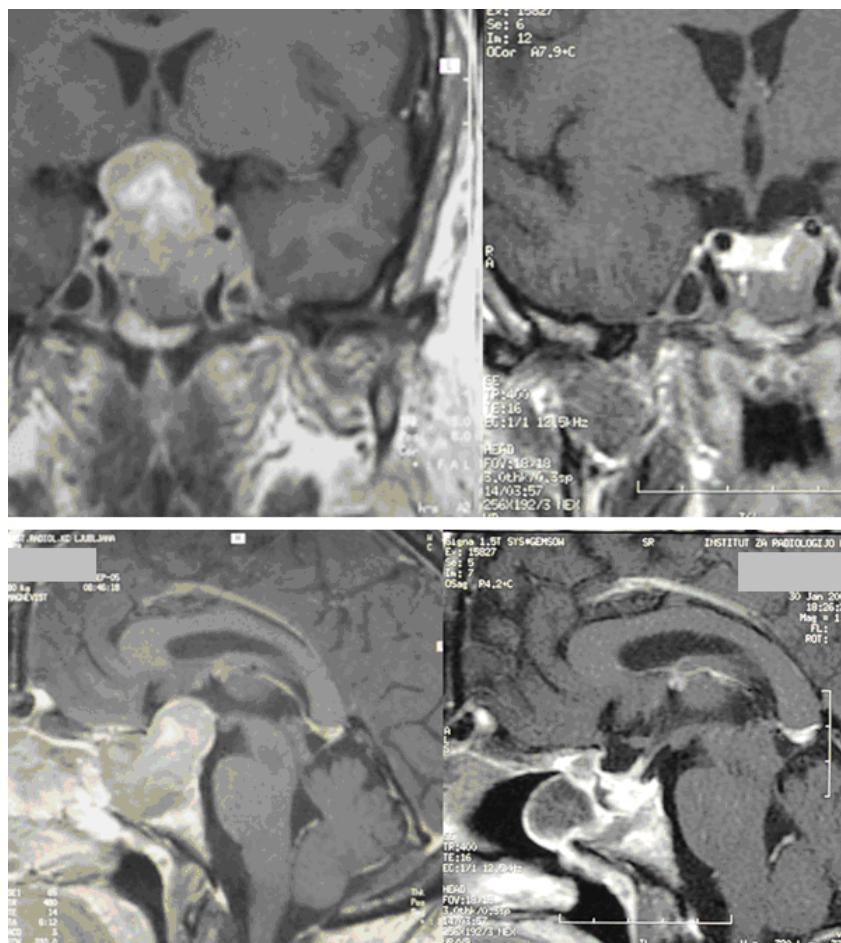
Visual normalisation was present in all cases.

Fig. 1-3. show preoperative and postoperative MRI scans of our patients.



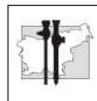
**Figure 1**

Case I. A separate picture on the right shows adenoma before any surgery. Residual adenoma after transcranial surgery is shown in the upper two rows and middle photo in the lower row. Result of transsphenoidal resection by combined technique is seen in the lower row (left and right photos). A white arrow denotes a small parasellar residual tumor above the intracavernous ICA.



**Figure 2**

Case II. 4 x 3,5 cm non-secretory macroadenoma was removed completely (note removal of the parasellar tumor anterior and lateral to the posterior loop of the ICA – rt, up). A pituitary was preserved (see enhancement of irregular pituitary in the intrasellar space –rt, low). An asymptomatic muccocoele (rt, low) disappeared after 1 year postoperatively.



**Figure 3**

Case III. A 4,5 x 3 cm non-secretory macroadenoma was successfully removed also from right medial cavernous sinus using combined technique.

**Discussion**

Pituitary adenoma are benign tumors with soft consistency. This enables removal by aspiration. However, complex extrasellar anatomy makes removal of these tumors a true challenge in endosurgery of skull base. A classical trans-sphenoidal approach has been extended for removal of adenoma from planum sphenoidale, clivus (4,5,8-10) and parasellar space (3,9), pterygopalatine fossa (7)... A fine anatomical knowledge and experience in neurosurgery and rhinology are essential for maximal removal. Endonasal endoscopic technique and dedicated instruments enable removal of lateral parts of the tumor by angle vision. Wide sphenoidectomy enables neurosurgeon, who is using microscopic technique, making an equally wide trephination of sellar floor. Identification of carotid protuberances, optico-carotid recessus and superior intercavernous sinus are landmarks for dural flap sizing. A separate incision to dura just below the carotid protuberance enables entering cavernous sinus and removing the tumor

between the horizontal and vertical part of ICA - in the medial cavernous sinus (1,2). Ethmoidectomy enables lateral extension of sphenoidotomy to expose dura of cavernous sinus lateral to ICA. This latter was never entered in our patients. However, medial cavernous sinus was entered in all three cases and tumor removed from medial cavernous sinus. The judgement of total removal of parasellar tumor of non-functional adenomas is difficult. In Case I. parasellar residuum is minimal but obvious and expectable, since it is located above the horizontal ICA. In Case III. removal from underneath the horizontal ICA was expected. In Case II. better-than-expected removal of the tumor was possible, since intrasellar space was bulging or destroyed medial CS wall to make one single intra-parasellar space that could be cleaned off the tumor. However, parasellar space doesn't collapse after tumor removal (Fig. 2) and is filled with organized clot that enhances irregularly – this fibrous emptied space can become thinner and shrunk on next MRI scans. Using angled view for final check can improve



results in parasellar space. Neuronavigation is another tool to enhance orientation and location of critical structures and enable a more confident removal of tumor from parasellar space. A gamma-knife treatment is reserved for parasellar residual tumor, so this kind of surgery shouldn't be aggressive at the expense of safety.

## Conclusions

Transnasal removal of adenomas is a first-choice approach also in large intracranial macroadenomas with paranasal extension. Maximal removal can be achieved by combined microscopic and endoscopic approach and transcranial route avoided in majority of cases.

## References

1. Bošnjak R, Pfeifer M, Kocjan T, Bačovnik U, Popović M, Knific J, Dolenc VV. Surgical outcome in transsphenoidal approach to pituitary adenomas. In: Dolenc VV. (ed.). Proceedings of the 3rd CENS meeting, [Ljubljana, Slovenia, September 1-4, 2004]. [Ljubljana: Slovenian neurosurgical society, 2004], p. 43
2. Bošnjak R, Boršoš I, Podboj J. Razširjeni transnazalni pristop do hipofiznih in drugih tumorjev na lobanjskem dnu. In: Zbornik predavanj XLI. podiplomskega tečaja kirurgije, 10.-11. februar 2006. Ljubljana: Kirurška klinika, Klinični center, 2006, pp. 198-201
3. Frank G, Pasquini E. Approach to the cavernous sinus. In: de Divitiis E, Cappabianca P (eds): Endoscopic endonasal transsphenoidal surgery. New York, Springer-Verlag, 2003, pp 159-175
4. Cavallo LM, Messina A, Cappabianca P, Esposito F, de Divitiis E, Tschabitscher M, Gardner P. Endoscopic endonasal surgery of the midline skull base: anatomical and clinical considerations. *Neurosurg Focus* 2005; 19: E2. Available at <http://www.neurosurgery.org/focus/archives.html>
5. Kassam A, Snyderman CH, Mintz A, Gardner P, Carrau RL. Expanded endonasal approach: the rostrocaudal axis. Part I. Crista galli to the sella turcica. *Neurosurg Focus* 2005; 19: E3. Available at <http://www.neurosurgery.org/focus/archives.html>
6. Kassam A, Snyderman CH, Mintz A, Gardner P, Carrau RL. Expanded endonasal approach: the rostrocaudal axis. Part II. Posterior clinoids to the foramen magnum. *Neurosurg Focus* 2005; 19: E4. Available at <http://www.neurosurgery.org/focus/archives.html>
7. Cavallo LM, Messina A, Gardner P, Esposito F, Kassam AB, Cappabianca P, de Divitiis E, Tschabitscher M. Extended endoscopic endonasal approach to the pterygopalatine fossa: anatomical study and clinical considerations. *Neurosurg Focus* 2005; 19: E5. Available at <http://www.neurosurgery.org/focus/archives.html>
8. Jho HD, Ha HG. Endoscopic endonasal skull base surgery: Part 1--The midline anterior fossa skull base. *Minim Invasive Neurosurg.* 2004 Feb; 47(1): 1-8
9. Jho HD, Ha HG. Endoscopic endonasal skull base surgery: Part 2--The cavernous sinus. *Minim Invasive Neurosurg.* 2004 Feb; 47(1): 9-15
10. Jho HD, Ha HG. Endoscopic endonasal skull base surgery: Part 3--The clivus and posterior fossa. *Minim Invasive Neurosurg.* 2004 Feb; 47(1): 16-23