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Endoscopic Endonasal Surgical Treatment of Large Pituitary Adenoma Spreading into the Posterior Fossa

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The objective of the study was to develop the tactics of surgical treatment of large and giant pituitary adenomas spreading into the posterior cranial fossa. **Material and Methods.** A patient with a large hormonally inactive pituitary adenoma extending to the right cavernous sinus and the posterior cranial fossa. **Results.** Endoscopic endonasal resection of a large endo-supra-latero(D)-retrosellar pituitary tumor was conducted. Control MRI shows that the tumor was radically removed. Oculomotor disturbances were observed in the early postoperative period; thet significantly regressed within 6 months. The article provides a detailed analysis of the world literature on the issue under discussion. Illustrative pre-, intra-, and post-operative photographs, as well as histological preparations are shown. Conclusions. Modern minimally invasive techniques make it possible to remove large pituitary adenomas (and other tumors) of the posterior cranial fossa using the endoscopic endonasal approach. These operations must be carried out at highly specialized institutions by surgeons who have vast experience in endoscopic transnasal surgery of skull base tumors.

Keywords: *endoscopic endonasal surgery of pituitary adenomas, endoscopic endonasal surgery of the tumors of the posterior cranial fossa.*

Pituitary tumors are typically benign. They often reach giant sizes and spread into the cavernous sinus, suprasellarly, and into the posterior cranial fossa [1]. Pituitary adenomas spreading into the posterior cranial fossa are extremely rare. In 2011, J. Malik et al. [2] have published a case report on a giant prolactinoma that caused instability of the craniovertebral junction. Bing Zhao et al. [3] have provided their findings about the high efficiency of the extended endoscopic transsphenoidal approach in surgery of giant pituitary adenomas. In the Western researchers consider pituitary adenomas with one of dimensions larger than 4 cm as giant [4]. According to the classification used at the Burdenko Neurosurgical Institute, giant pituitary adenomas are those that have at least one of dimensions no smaller than 60 mm [5]. Before endoscopic endonasal neurosurgery had started to be actively applied, spreading of pituitary adenoma into the posterior cranial fossa was an indication for using the transcranial approach [6]. Today, due to the advance in new minimally invasive surgical techniques, it is possible to use the endoscopic transnasal approach to partially resect the tumor residing in the posterior cranial fossa [4]. In 2009, an article presenting a rare clinical case involving the resection of a giant pituitary adenoma spreading into the posterior cranial fossa through the retrosigmoid approach was published in the journal 'Problems of Neurosurgery named after N.N. Burdenko' [7].

In this article, we report our experience in resecting a large pituitary adenoma spreading into the posterior cranial fossa using the endoscopic endonasal approach.

Case history

A 33-year-old man was admitted to the Burdenko Neurosurgical Institute on November 17, 2010 to undergo surgical treatment of a pituitary tumor. Since August 2010, the patient has been having visual loss in both eyes and diplopia. Two year prior to being admitted to hospital, the patient had noticed sexual malfunction. Hormone testing has shown that the tumor is hormonally inactive. The neurological examination has revealed the chiasmal syndrome failure of the first and second branches of cranial nerve V on the left side.

Ophthalmic examination showed VIS OD=OS=1.0 and bitemporal hemianopsy. No oculomotor disturbances were detected. Funduscopy showed that the optic discs were discolored with clear margin and plethoric tortuous veins.

The preoperative Karnofsky score was 80.

MRI scanning showed a large endo-supra-latero(D)-retrosellar pituitary tumor. The retrosellar extracapsular portion of the tumor coarsely compressed the brain stem structures near the pons, mostly on the right side. The tumor infiltrates the right cavernous sinus, overgrows the right carotid artery, and compresses the chiasm. Tumor size is 51×37×29 mm **(Fig. 1)**.

Endoscopic endonasal resection of the giant endo-supra-latero(D)-retrosellar pituitary tumor was performed on November 24, 2010.

The typical endoscopic approach to the projection of the anterior wall of the main sinus through the right nasal passage was used. The sinus and the floor of the enlarged sella turcica were trepanized. A moderately bleeding tumor of gray color and moderate density was exposed after the dura mater of the sella turcica had been opened. The tumor was removed using curettes and a suction device. Two small secondary (acapsular) nodes were detected after the suprasellar portion of the tumor had been resected; they were removed using the suction device. The tumor spread into the cavity of the right cavernous sinus and was removed using the suction device. The right carotid artery was surrounded on three sides by the tumor. The tumor retrosellarly spread as a separate large node through the posterior wall of the cavernous sinus into the interpeduncular cistern, mostly on the right side, and compressed the brain stem structures at this level. The initial portions of the tumor in the interpeduncular cistern were dense, stringy, and difficult to remove. In the posterior sections, this portion of the tumor was less dense and was removed using a suction device. The

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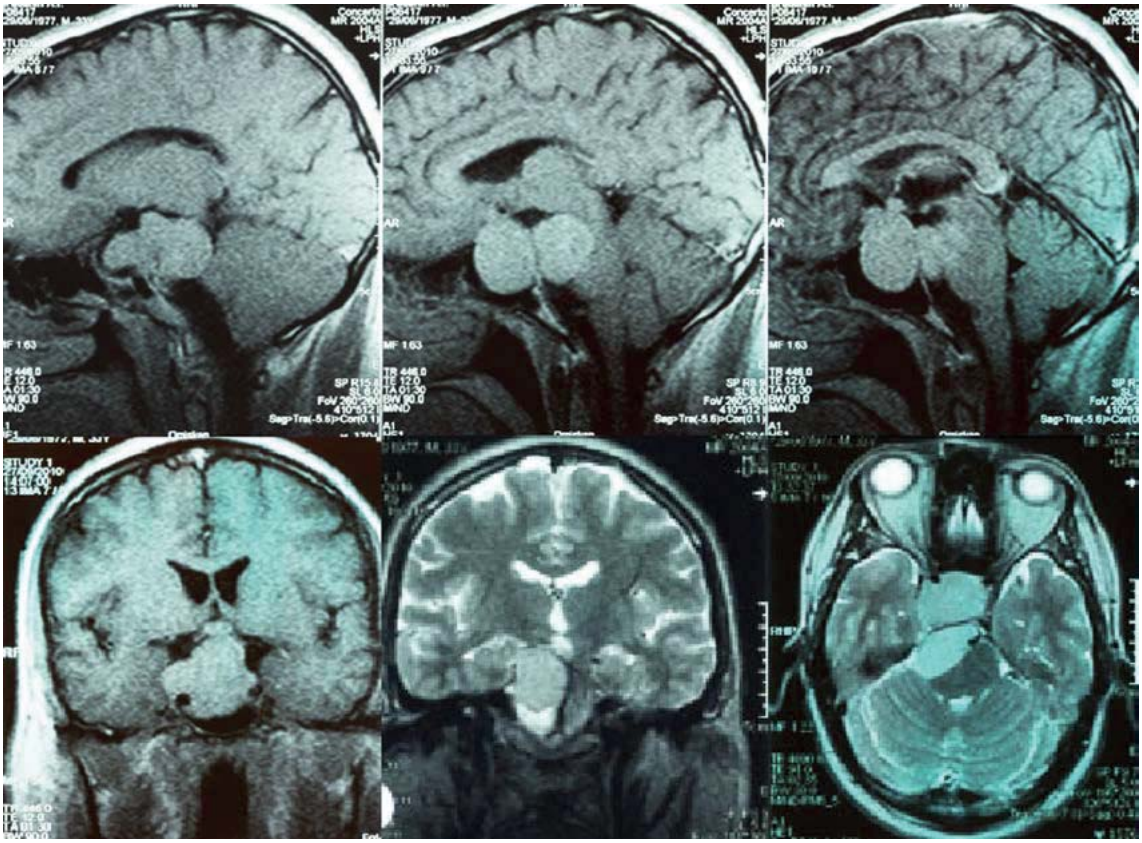


Fig. 1. **Preoperative MRI scan (see description in the text).**

retrosellar portion of the tumor was covered with the arachnoid mater, which has been successfully dislocated and coagulated. The tumor was resected using 0°, 30° and 45° endoscopes **(Fig. 2)**.

Control helical CT was performed immediately after surgery while the patient was still anesthetized. It showed total resection of the tumor; the cavity of the resected tumor (endo-supra-latero(D)-retrosellarly) contained air. Air was also detected above both frontal lobes. No hemorrhagic complications within the area that had been operated on were revealed **(Fig. 3)**.

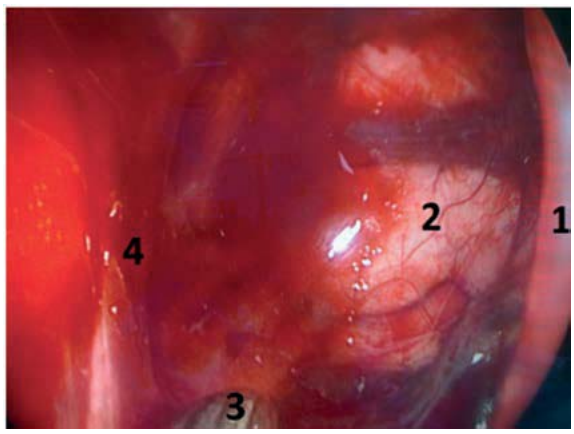


Fig. 2. **Intraoperative presentation after total resection of the tumor.**
1 — basilar artery; 2 — pons Varolii; 3 — the suction device; and 4 — the medial wall of the right cavernous sinus.

Upward, downward, and lateral gaze was assessed during pre- and postoperative physical examination (score 0—5). The absence of defects was considered normal (score 0). Insignificant limitation corresponded to score 1. Limitation of gaze by 1/3 corresponded to score 2; by 1/2, to score 4; absence of voluntary gaze corresponded to score 5. The presence and severity of ptosis was also assessed using score 0—5 [8].

The patient developed right oculomotor nerve palsy on postoperative day 1: upward, downward gaze, and inward eye movement was assessed as score 5; outward eye movement was completely preserved. The total score of oculomotor nerve palsy was 19 **(Fig. 4)**.

It is most likely that the right oculomotor nerve was partially injured when the tumor was resected from the right cavernous sinus area.

Two weeks after the surgery, signs of partial regression of oculomotor nerve palsy were detected.

The follow-up MRI scans (postoperative day 13) showed that the tumor was resected radically, no contrast agent accumulation was detected **(Fig. 5)**.

According to histological examination, it was a pituitary adenoma with nuclear polymorphism **(Fig. 6)**.

Follow-up MRI scan 6 months after surgery showed no tumor recurrence and complete decompression of brain stem structures **(Fig. 7)**.

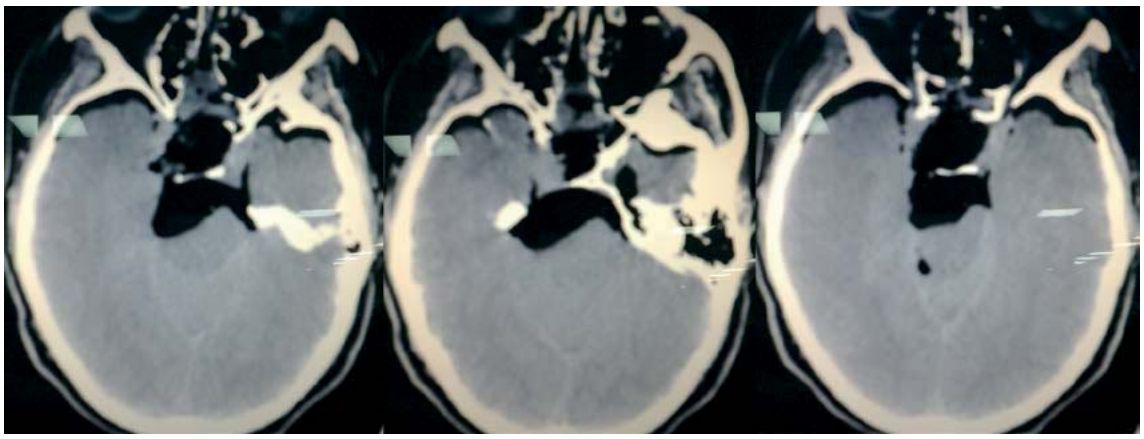


Fig. 3. **Helical computed tomography immediately after surgery: total resection of the tumor (see description in the text).**

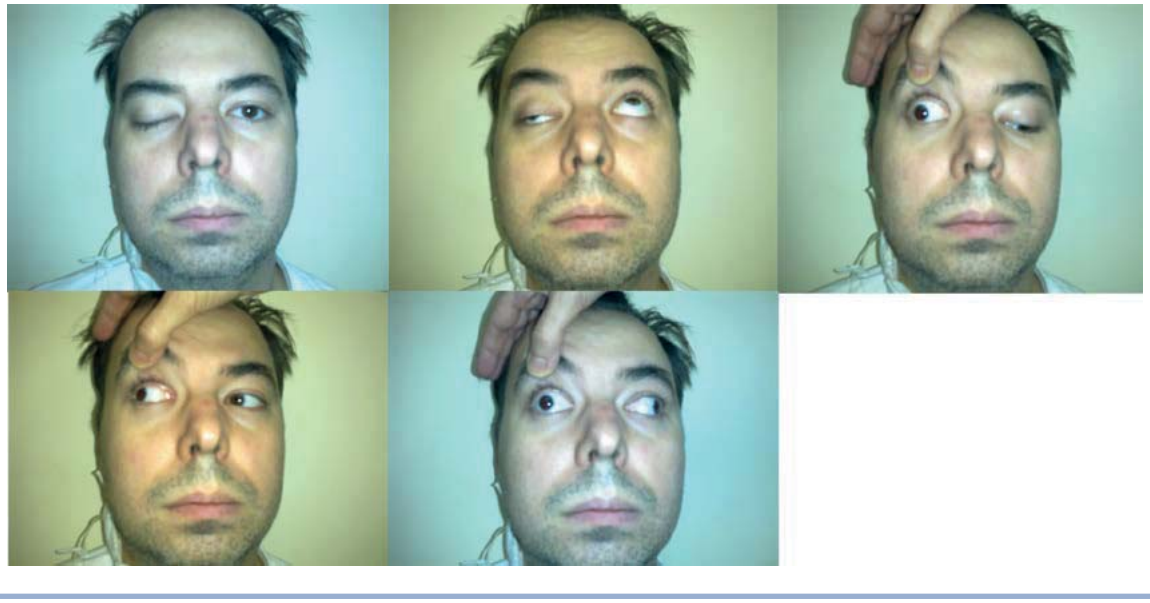


Fig. 4. **The first day after the surgery. Third nerve palsy developed on the right side.**

Neuro-ophthalmological examination 6 months after surgery showed further regression of right oculomotor nerve palsy; the total score of its lesion was 12 **(Fig. 8)**

Discussion

According to [9], no more than 5% of giant pituitary adenomas spread into the posterior cranial fossa. The treatment tactics for these adenomas is complex and ambiguous. Conservative treatment with dopamine agonists is indicated for prolactinomas spreading into the posterior cranial fossa. Surgical interventions through the retrosigmoid approach have been proposed in other cases [7].

M. Koutourousiou, P. Gardner (2013) and M. De Paivo Neto (2010) believe that surgical treatment of giant pituitary adenomas is a challenge for neurosurgeons. It is particularly difficult to resect tumor fragments with the parastem localization. Conservative management under certain indications and probably radiation therapy usually play a key role in achieving long-term remission [4, 10].

The extended transsphenoidal approach ensures panoramic visualization, which is required to remove tumors similar to the one described in our case report.

Today, despite the numerous positive aspects of the transsphenoidal approach, this surgical procedure is not completely devoid of postoperative complications. According to the literature data, the frequency of nasal liquorrhea in transsphenoidal surgery is 6—20% [11—13]; both conservative and surgical treatments are used. Paresis of the craniocerebral nerves is an appreciably common complication after tumor resection through the extended transsphenoidal approach [11]. In our case report, right oculomotor nerve palsy that emerged in the postoperative period regressed to a significant extent 6 months after the surgery.

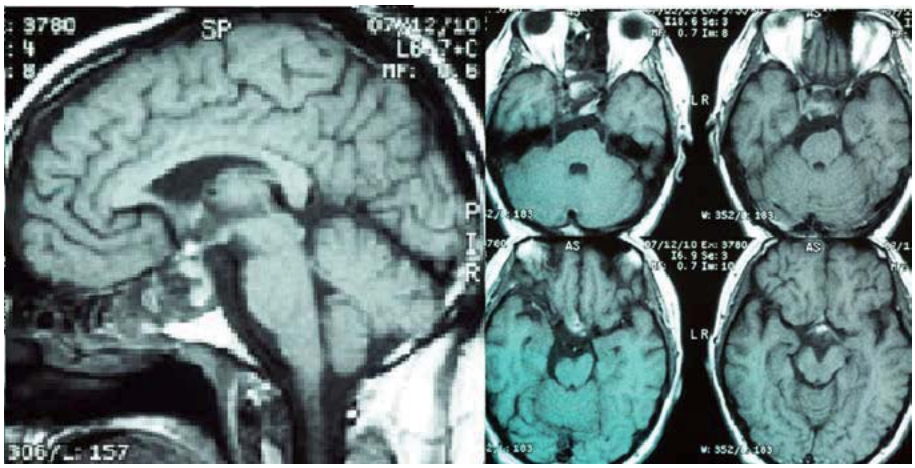
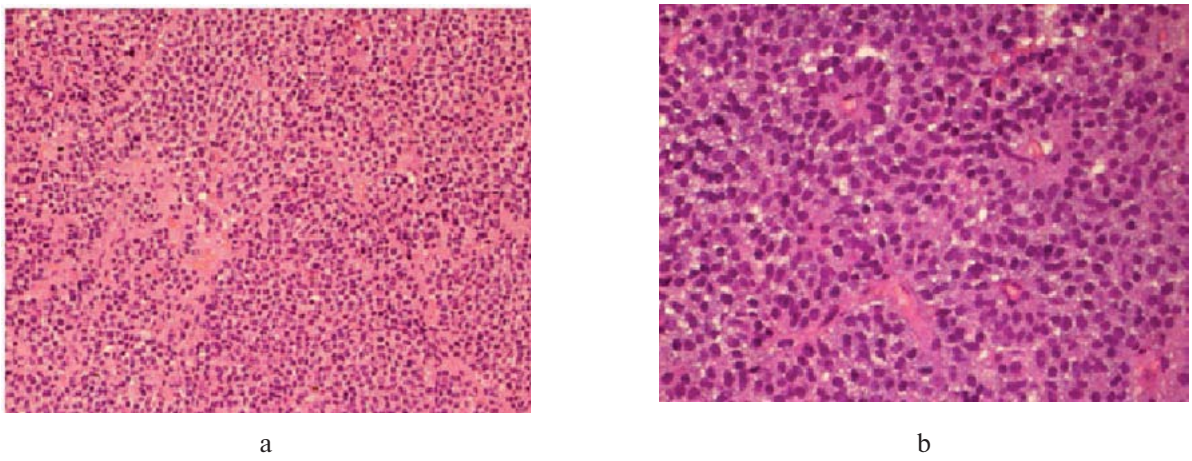


Fig. 5. **T1-weighted MRI scan on day 13 after the surgery.**

Total resection of the tumor and decompression of brain stem structures. Hemostatic and plastic material (fragment of the fascia lata) is visualized near the sella turcica. A fragment of adipose tissue is detected in the basilar sinus.



a b

Fig. 6. **A histological specimen.**

a — ×200; b — ×400. Pituitary adenoma: a monomorphic tumor with the predominantly solid architecture and few perivascular rosettes. Hematoxylin and eosin staining.

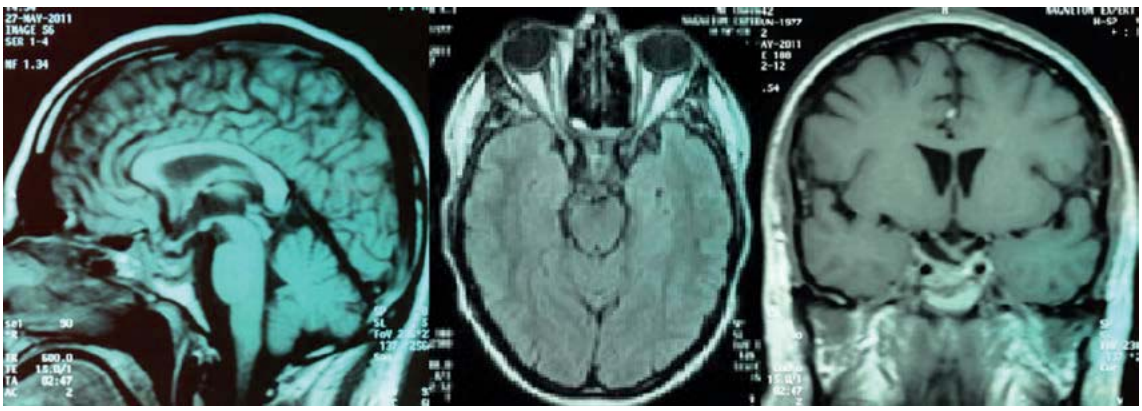


Fig. 7. **MRI scan 6 months after the surgery.**

Total resection of the tumor. Plastic material (fascia lata) is visualized in the basilar sinus.



Fig. 8. **Partial regression of oculomotor nerve palsy on the right side.**

Our clinical case was characterized by spreading of a large tumor into the posterior cranial fossa through the right cavernous sinus (most likely, along the trigeminal nerve) and successful resection of a large fragment of the tumor with parastem localization through the endoscopic endonasal approach.

Conclusions

1. Modern minimally invasive procedures allow one to resect large pituitary adenomas (among other tumor types) from the posterior cranial fossa through the endoscopic endonasal approach.

2. These surgeries need to be performed at specialized medical centers by surgeons who have vast experience in endoscopic transnasal surgery of skull base tumors.

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Authors declare no conflict of interest.

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Commentary

Surgical treatment of patients with pituitary adenomas still poses a serious problem in modern neurosurgery. Although the development of sparing minimally invasive endoscopic transsphenoidal surgical approaches in 1993 made it possible to solve the problem associated with surgical management of pituitary adenomas to a significant extent, it is still difficult to ensure reliable control over resection of tumors from the parasellar and retrosellar areas. Further development of endoscopic techniques, wide implementation of endoscopic equipment, the experience of using extended approaches in endoscopic surgeries have allowed surgeons to help most patients, regardless of the size and growth direction of pituitary adenomas.

In general, the wide use of the endoscopic methods has made it possible to significantly broaden the indications for transnasal interventions, which has been proved in many studies. Nowadays, up to 95—97% of patients with pituitary adenomas, including giant ones, need to be operated on through the transnasal approach. This is also facilitated by the extended transsphenoidal and endoscopic approaches that have recently started to be used and allow one to resect not only pituitary adenomas but also other sellar and parasellar structures as well. Due to the permanent advance in endoscopic techniques, accumulated surgical experience, development of the modern methods for plastic reconstruction of skull base defects, the extended transsphenoidal endoscopic approaches are used more commonly instead of a series of open intracranial interventions and improve surgical outcomes. However, tumors spreading into the posterior cranial fossa still impose a challenge for neurosurgeons, since this type of pituitary adenoma is appreciably rare, involves numerous functionally important structures, and requires one to use the exclusively delicate surgical technique.

In this regard, the present article about the outcomes of endoscopic treatment of retrosellar pituitary adenoma is undoubtedly extremely relevant, is being waited for and highly demanded. Its authors are among the recognized leaders in endoscopic surgery of pituitary adenomas as they have the vast experience based on the broad data received at clinics of the Burdenko Neurosurgical Institute, one of the key centers for treating the neuroendocrine pathologies.

Based on the vast clinical material, the authors have approached solving a specific clinical problem being fully-armed. Having chosen the optimal yet challenging approach for resecting the tumor, they demonstrated a successful result.

However, I would like to join the authors' warning that this solution to the problem should not be used in a wide range of in-patient clinics, since this intervention requires vast experience and a well-coordinated team of endoscopic surgeons. This type of treatment lies within the competence of specialized clinics. Although many Russian hospitals have had some experience in conducting endoscopic surgeries, it is still very limited in most of them and amounts to single surgeries or, less frequently, dozens of surgeries, whose outcomes are far from being optimistic. According to the published data, there are only 4 in-patient clinics worldwide where neurosurgeons have carried out over 1,000 endoscopic transsphenoidal interventions. To our country's credit, two of these clinics are located in Russia, in Moscow and St. Petersburg. The vast experience in conducting a great number of endoscopic transsphenoidal interventions allows neurosurgeons to achieve high-quality outcomes.

Further improvement of endoscopic technique, in combination with the vast experience in endoscopic transsphenoidal interventions demonstrated by the authors, gives new incentive to improving the outcomes of surgery of pituitary adenomas, which will eventually increase patients' quality of life.

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