# THE RADICALITY OF PITUITARY ADENOMA REMOVAL IN THE REPUBLIC OF KAZAKHSTAN

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**Abstract**

**Background.** Pituitary adenoma is a common tumor of the chiasmosellar region. By hormonal activity, pituitary adenoma's are classified as somatotropinomas, non-functioning, prolactinomas, corticotropinomas, and mixed types. Treatment tactics vary by type. Objective:To assess radicality of removal of different pituitary adenoma types in patients operated.

**Materials and methods.** Retrospective analysis of 929 patients (721 – endoscopic transnasal approach) treated at JSC "National Centre for Neurosurgery" between 2010–2022. Clinical data and magnetic resonance imaging findings were evaluated.

**Results.** Significant differences in "Extent of Resection" were found among pituitary adenoma types. The highest rate of total resection occurred in mixed tumors compared to prolactinomas (76.5% vs 50%). Subtotal removal was seen in 23.5% of mixed tumors, none had partial resection. Prolactinomas showed total removal in 50%, subtotal in 41.9%, partial in 8.1%. Conservative resection of prolactinomas is linked to their high sensitivity to medical therapy, enabling full recovery with dopamine agonists postoperatively. More radical removal of mixed pituitary adenoma's is justified by their aggressive behavior and relative drug resistance.

**Conclusion.** Extent of resection correlates with pituitary adenoma type. Lower radicality in prolactinomas reflects their benign course and responsiveness to drugs, whereas mixed pituitary adenoma's require aggressive surgery due to severe hormonal disturbances. Greater radicality should be pursued when possible while preserving quality of life. The transnasal endoscopic approach remains the safest and most effective surgical method for pituitary adenoma's in Kazakhstan, as confirmed by high total resection rates and low postoperative complications.

## Introduction

Pituitary adenomas (PAs) are benign neoplasms originating from the anterior lobe of the pituitary gland and account for a significant proportion of all intracranial tumors. According to large meta-analyses, the prevalence of PAs in the general population ranges from 78 to 116 cases per 100,000 people.[1,2] Despite their widespread occurrence, late diagnosis of PAs remains common, particularly in developing countries. This may be attributed to the nonspecific nature of clinical manifestations and limited patient access to neuroimaging techniques.[3,4]

Depending on their hormonal activity, pituitary adenomas (PAs) are classified into somatotropinomas, non-functioning adenomas, prolactinomas, corticotropinomas, and mixed types. The treatment approach for each type has its own specific features. Mixed forms of PAs are less common than other types but are characterized by complex clinical manifestations, as these tumors secrete two types of hormones into the bloodstream rather than one.[5] As a result, more severe hormonal imbalances occur in the body.

There are three morphological types of mixed adenomas: mixed GH-cell/PRL-cell adenoma, mammosomatotroph adenoma, and acidophilic stem cell adenoma.[5] *Kreutzer et al.* state that mixed PAs behave more aggressively than other GH-secreting types and have a lower

success rate of surgical treatment.[6,7]

This is why greater attention should be given to this type of PA, as mixed adenomas cause significant hormonal disturbances in patients with pituitary adenomas.

**Material and methods**

Study Design: Retrospective analysis was performed at JSC National Center for Neurosurgery, Astana, Kazakhstan, between 2010 and 2022.

Inclusion Criteria of patients: with a confirmed diagnosis of pituitary adenoma, who underwent transnasal endoscopic surgical treatment.

Data collection performed: Clinical characteristics: age, gender, symptoms, as well as hormonal profile: levels of prolactin, ACTH, TSH, etc.

Neuroimaging using magnetic resonance imaging (MRI) of the brain. Analysis of surgical data: resection volume, complications.

**Ethical approval:** Ethical commission protocol №4 10th July 2025.

**Statistical Analysis.** Descriptive statistics were used to summarize the demographic, clinical, radiological, and histopathological characteristics of the patients. Quantitative variables were presented as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on data distribution. Categorical variables were expressed as absolute numbers and percentages. Comparisons between groups (based on histological type of pituitary adenoma) were performed using the Chi-square test exact test for categorical variables and the Student's t-test test for continuous variables, as appropriate. The extent of tumor resection was compared among groups using contingency tables and significance testing. The level of statistical significance was set at $p < 0.05$. All analyses were conducted using SPSS Statistics (IBM).

**Results**

790 patients (85.06%) had complete data on all required clinical, radiological, and histopathological parameters for statistical analysis, which supports the reliability of the results. The patients were distributed according to their hormonal activity as follows: non-functioning adenomas (NFA) – 549 (59.09%), somatotropinomas – 172 (18.51%), prolactinomas – 154 (16.57%), corticotropinomas – 34 (3.66%), and mixed adenomas – 20 (2.15%). See Table 1

The primary treatment method was endoscopic transnasaladenomectomy, performed in 721 cases (90.1%). The rate of gross total resection in mixed adenomas reached 76.5%. Subtotal resection was mainly performed in cases involving cavernous sinus invasion or other complicating factors. These data are consistent with international experience, demonstrating comparable efficacy rates.[8,9] The comparison was statistically significant ($p < 0.05$).

| Type of Pituitary Adenoma and resection | **Somato tropinomas, (N=143)** | **Non-functioning Adenomas (NFA), (N=404)** | **Prolac tinomas,** | **25/01** | **29/01** | **03/02** |
|---|---|---|---|---|---|---|
| (N=124) | Cortico tropinomas (N=25) | Mixed Adenomas (N=17) | Level P, (df=8) | 66.80 | 52.40 | 52.20 |
| Partial | 7 (4.9%) | 39 (9.7%) | 10 (8.1%) | (0.0%) | - | 0.005 |
| Subtotal | 32 (22.4%) | 150 (37.1%) | 52 (41.9%) | 6 (24.0%) | 4 (23.5%) | |
| Total | 104 (72.7%) | 215 (53.2%) | 62 (50.0%) | 19 (76.0%) | 13 (76.5) | |

**Table 1.** Distribution of Different Types of Pituitary Adenomas According to the Extent of Tumor Resection. Different degrees of resection were compared across various histological groups

Total resection was performed in 413 (52.3%) cases, compared to subtotal 244 (30.8%), Chi-squared 28.688, 95% CI [13.7;28.7], P< 0.0001. With Somatotropinomas 104 (72.7%) more often than Non-functioning Adenomas 215 (53.2%), Chi-squared 11.03, 95% CI [8.2; 11.6], P = 0.0009. The frequency of total resection in Non-functioning Adenomas and in Prolactinomas 62 (50.0%) did not have a statistically significant difference, Chi-squared 0.197, 95% CI [10.5; 16.9], P = 0.6572

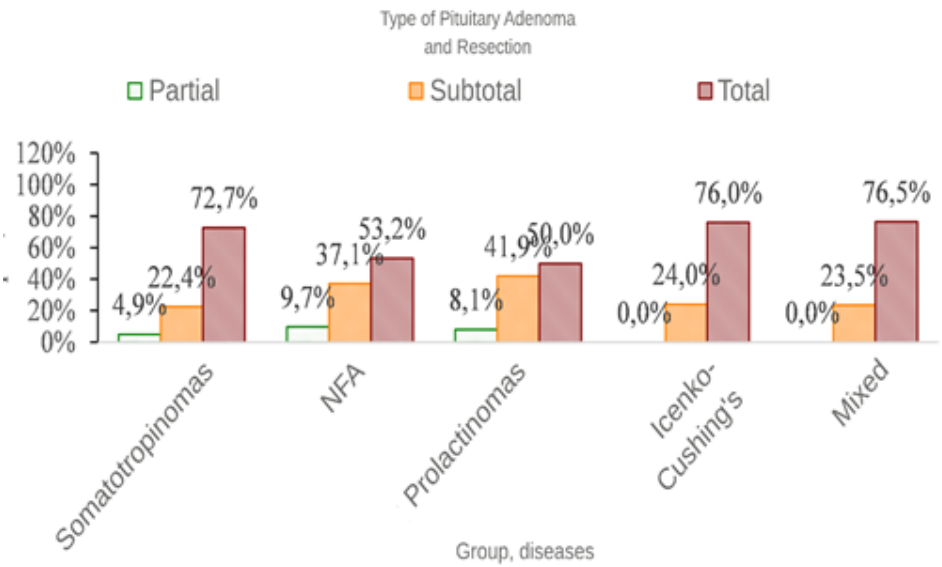


**Figure 1.** Percentage Distribution of the "Resection, Type" Indicators Across All Levels of the "Group, Disease" Variable.

## Discussion

Our study analyzed 929 patients with various types of pituitary adenomas treated at the JSC "National Centre for Neurosurgery" over a 12-year period, focusing on the relationship between tumor type and the extent of surgical resection. The results demonstrate that tumor biology, hormonal activity, and morphometric features significantly influence surgical strategy and radicality.

Previous studies have reported high rates of gross total resection (GTR) with the endoscopic endonasal approach. For example, *Chao Tao et al.* achieved GTR in 74.7% of cases, with cerebrospinal fluid (CSF) leakage occurring in 2.7%.[10] In our series, GTR was achieved in 65% of patients, which is within the range of international reports, particularly given our higher proportion of complex and hormonally active tumors.[11,12]

Mixed adenomas, although relatively rare (2.1% of our cohort), exhibited more aggressive behavior and were associated with severe hormonal disturbances. Statistical analysis revealed significant intergroup differences in "Extent of Resection" ($p < 0.0001$), with total removal achieved in 76.5% of mixed adenomas compared to 50% of prolactinomas. The high total resection rate in mixed adenomas can be explained by their relative resistance to pharmacological therapy, necessitating maximal cytoreduction. By contrast, prolactinomas showed a more conservative surgical profile (subtotal resection in 41.9%, partial in 8.1%), reflecting their excellent response to dopamine agonists, consistent with the literature.[13,14]

Beyond resection patterns, our extended statistical analysis of 30 parameters across five histological groups identified significant differences in 9 of 14 general clinical variables, 1 of 16 hematological parameters, and 11 of 19 binary characteristics. IGF1 levels in mixed adenomas were markedly higher than in non-functioning adenomas (difference of 1624.5 ng/mL; $p < 0.0001$), and GH levels in corticotropinomas exceeded those in prolactinomas by 1636.8 ng/mL ($p < 0.0001$). These hormonal patterns likely influence tumor invasiveness and surgical difficulty.

Risk factor modeling for pituitary apoplexy highlighted three key predictors: treatment period 2010–2011, diagnosis before 2013, and presence of chiasmal syndrome. Each of these factors more than doubled the risk of hemorrhage into the pituitary, consistent with earlier findings that tumor size, vascular compromise, and delayed diagnosis predispose to apoplexy. Similarly, predictors of poor outcomes included disease duration ⩾ 24 months, hypopituitarism, and prior cranial surgery, each tripling the risk of adverse prognosis.[10]

Our findings align with other large series, which emphasize that surgical

radicality should be individualized, balancing the goal of complete tumor removal against the risk of hypopituitarism and other complications. The transnasal endoscopic approach proved to be effective and safe, with low complication rates and outcomes comparable to leading neurosurgical centers worldwide.[12]

In conclusion, the extent of pituitary adenoma resection is closely linked to tumor type, hormonal profile, and specific clinical factors. Aggressive resection is justified for mixed and hormonally active tumors, while a conservative strategy is preferable for prolactinomas due to their responsiveness to medical therapy. Incorporating risk factor analysis into preoperative planning can further optimize outcomes and reduce the likelihood of recurrence or complications.

**Limitations.** This study has several limitations. First, its retrospective design carries an inherent risk of selection and information bias, as the data were collected from existing medical records. Second, although our sample size was large, the distribution of patients across tumor subtypes was uneven, with a relatively small number of cases in the mixed adenoma and corticotropinoma groups. This imbalance may limit the statistical power for subgroup analyses. Third, the follow-up period was not uniform for all patients, making it difficult to assess long-term recurrence rates and endocrine outcomes consistently.

Another limitation is the reliance on MRI and intraoperative assessments for determining the extent of resection; histopathological confirmation of residual tumor was not performed in all cases. Additionally, variations in surgical techniques and surgeon experience over the 12-year study period could have influenced the results. Finally, some clinical and laboratory parameters had incomplete data, which, although not critical for the main statistical analysis, may have introduced minor inaccuracies.

Future prospective studies with standardized follow-up protocols, balanced representation of tumor subtypes, and integration of advanced imaging modalities are needed to validate our findings and refine surgical decision-making strategies.

**What's Known?** Pituitary adenomas vary in hormonal activity and aggressiveness, influencing surgical radicality. Endoscopic transnasal approaches are widely used, with reported gross total resection rates of 60–75% internationally.

**What's New?** This study links adenoma type to resection extent using large-scale of Kazakhstan data, identifying key clinical and hormonal predictors influencing surgical strategy.

**Conclusion**

Our observations confirm a correlation between the extent of pituitary adenoma (PA) resection and the tumor type: a high rate of gross total resection in mixed adenomas, and a lower rate in prolactinomas within the studied group. This may be explained by the fact that mixed PAs cause more severe hormonal imbalances in patients, necessitating a more radical surgical approach. In contrast, prolactinomas typically follow a more benign and favorable course and can often be effectively managed with medical therapy, thus not requiring the same level of surgical radicality. Additionally, mixed adenomas tend to behave more aggressively than other hormone-secreting types, such as GH-secreting tumors, and have a lower surgical success rate. The findings of our study clearly demonstrate a link between the extent of resection and the type of PA. We believe that regardless of adenoma type, the surgical goal should be maximal tumor removal while preserving the patient's quality of life. The transnasal endoscopic approach remains the most effective and safest treatment method for pituitary adenomas in Kazakhstan. This is supported by the high rate of total resections and the low rate of postoperative complications observed at the JSC "National Centre for Neurosurgery."

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**References**

1. Daly AF, Beckers A. The Epidemiology of Pituitary Adenomas. Endocrinol Metab Clin North Am. Sep 2020;49(3):347-355. doi:10.1016/j.ecl.2020.04.002
2. Araujo-Castro M, Berrocal VR, Pascual-Corrales E. Pituitary tumors: epidemiology and clinical presentation spectrum. Hormones (Athens). Jun 2020;19(2):145-155. doi:10.1007/s42000-019-00168-8
3. Tritos NA, Miller KK. Diagnosis and Management of Pituitary Adenomas: A Review. JAMA. Apr 25 2023;329(16):1386-1398. doi:10.1001/jama.2023.5444
4. Chin SO. Epidemiology of Functioning Pituitary Adenomas. Endocrinol Metab (Seoul). Jun 2020;35(2):237-242. doi:10.3803/EnM.2020.35.2.237
5. Pekic S, Stojanovic M, Popovic V. Pituitary tumors and the risk of other malignancies: is the relationship coincidental or causal? Endocr Oncol. Jan 2022;2(1):R1-R13. doi:10.1530/EO-21-0033
6. Taghvaei M, Sadrehosseini SM, Ardakani JB, Nakhjavani M, Zeinalizadeh M. Endoscopic Endonasal Approach to the Growth Hormone-Secreting Pituitary Adenomas: Endocrinologic Outcome in 68 Patients. World Neurosurg. Sep 2018;117:e259-e268. doi:10.1016/j.wneu.2018.06.009
7. Kreutzer E, Short JL, Nicolazzo JA. Effect of Apolipoprotein E isoforms on the Abundance and Function of P-glycoprotein in Human Brain Microvascular Endothelial Cells. Pharm Res. Jul 2024;41(7):1427-1441. doi:10.1007/s11095-024-03731-0
8. Riley G, Scheyer N, Klein M, et al. Prognostic indicators in pituitary adenoma surgery: a comprehensive analysis of surgical outcomes and complications. Front Endocrinol (Lausanne). 2023;14:1327404. doi:10.3389/fendo.2023.1327404
9. Gurses ME, Gokalp E, Gecici NN, et al. The learning curve and outcomes of 1038 endoscopic endonasal transsphenoidal pituitary tumor surgeries - A single surgical team experience. Surg Neurol Int. 2024;15:407. doi:10.25259/SNI_750_2024
10. Tao C, Cheng G, Chen Y, Gu P, Hu W. Early outcomes of endoscopic endonasal approach pituitary adenomas resection with minimal nasal injury. Medicine (Baltimore). Nov 19 2021;100(46):e27843. doi:10.1097/MD.0000000000027843
11. Shen A, Min Y, Zhou D, et al. Adaptive evaluation of gross total resection rates for endoscopic endonasal approach based on preoperative MRI morphological features of pituitary adenomas. Front Oncol. 2024;14:1481899. doi:10.3389/fonc.2024.1481899
12. Godil SS, Tosi U, Gerges M, et al. Long-term tumor control after endoscopic endonasal resection of craniopharyngiomas: comparison of gross-total resection versus subtotal resection with radiation therapy. J Neurosurg. May 1 2022;136(5):1347-1355. doi:10.3171/2021.5.JNS202011
13. Zhang G, Wang P, Wang J, et al. Endoscopic endonasal surgery for non-invasive pituitary neuroendocrinology tumors with incomplete pseudocapsule. Front Neurol. 2023;14:1109388. doi:10.3389/fneur.2023.1109388
14. Yagnik KJ, Erickson D, Bancos I, et al. Surgical outcomes of medically failed prolactinomas: a systematic review and meta-analysis. Pituitary. Dec 2021;24(6):978-988. doi:10.1007/s11102-021-01188-7