

Original Article**Pseudo-Capsule Based Extracapsular Resection of Pituitary Adenoma**¹*Amr K. Elsamman** and ²*Abdelrahman Younes*Departments of Neurosurgery¹ and E.N.T.² Cairo University Hospital**ABSTRACT****Received:**

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Background: Pituitary adenomas are the most common tumor in the sellar region. Different excision techniques were described to facilitate resection of tumors. The presence of pseudo-capsule allows en bloc resection in this plane. **Objective:** The aim of this study is to assess the efficacy of extracapsular resection technique as regards the feasibility, value, extent of resection, biochemical remission and the incidence of postoperative complications. **Patients and Methods:** No special inclusion or exclusion criteria were used. The decision to use extra capsular technique was an intra operative one. All patients had MRI of the sella and CT of the paranasal sinuses before operation. Post operative assessment of the extent of resection was done by MRI on regular follow-up periods. Post operative hormonal assay was routinely done. **Results:** Twenty two patients were excised by this technique in the period between 2008 and 2014. Nine were hormone active and the other thirteen were non-functioning adenomas. Total resection was achieved in twenty one cases. Two cases had hypofunction and 27% had temporary Diabetes Insipidus (DI) postoperatively with no cases of permanent DI. **Conclusion:** extracapsular resection is a safe and effective technique in resection of pituitary adenomas especially in hormone active ones.

INTRODUCTION

Pituitary adenomas are the most common tumor in the sellar region and come after gliomas and meningiomas in the whole central nervous system neoplasms⁴. Endoscopic endonasal approach has undergone remarkable progress and is gaining wide popularity. After introduction of the high definition endoscopes, tissue distinction became more and more easier.⁸

Costello² in 1936 was the first to describe the pseudocapsule between the pituitary adenoma and the pituitary gland itself. The pseudocapsule is made up of peritumoral compressed cells between the adenoma and the gland tissue. These are thought to develop in response to pressure within the pituitary gland itself and become thin multiple layers of compressed pituitary gland tissue containing a reticulin network. It is found in about 50% of patients with a pituitary adenoma and tends to be more frequent in larger tumors.¹

Histopathological studies of the pseudocapsule have proven that tumor tissue is frequently found in it, which warrants the more aggressive resection especially in hormone active pituitary tumors. Thus, recently, many authors are adopting the extracapsular resection using the pituitary pseudocapsule as a surgical plane.^{6,10}

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Amr K. Elsamman.

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Between 2008 and 2015, endoscopic transsphenoidal surgery had been performed by the authors hundred and eighty seven times. Extracapsular technique was adopted lately mainly for the endocrine active tumors especially for growth hormone adenomas or in tough fibrous adenomas where piecemeal excision is not possible. Before that, piecemeal resection technique was used for all tumors. This means that there was no inclusion or exclusion criteria in this study. The decision to proceed for extracapsular resection was an intraoperative one. In total, extracapsular dissection (**Fig. 1**) and resection were performed for twenty two adenomas. In Microadenomas and small tumors, masses were excised as one mass but in larger tumors, initial debulking is done followed by dissection within the pseudocapsule. Early localization of the normal gland was always done to prevent dissection of the true capsule of the gland avoiding subsequent hypo function. Specimens were sent to histopathological examination (**Fig. 2**).

Outcome is assessed both anatomically and functionally. If the surgeon believes that total excision was accomplished intra-operatively, then, MRI of the sella is routinely done 3 months after surgery and can be used to determine the extent of resection. However, if the surgeon wasn't sure regarding completeness of excision, immediate MRI is usually done postoperatively for a chance of an early redo. The radiological imagines were done yearly afterwards.

Biochemical control of prolactinomas was confirmed by normalization of prolactin levels. Control of acromegaly was confirmed by normalization of glucose-suppressed plasma growth hormone level and normalization of serum insulin-like growth factor 1. In case of ACTH adenomas, 24-h urinary free cortisol level had to normalize together with serum morning cortisol and ACTH levels. Laboratory tests were done immediate (if possible), 6 weeks, and annual afterwards.

RESULTS

In the period between 2008 and 2014, hundred and eighty seven pituitary adenomas were operated upon. Among them, twenty two patients were removed using the extracapsular technique. There were twelve males and ten females. The age ranged between 19 and 51 with an average of 36.5 years. Tumor size ranged between 0.5 cm and 3.2 cm with an average of 2.02 cm. Both authors operated upon all patients as a team. Out of the twenty two cases, nine were hormone active and the other thirteen were non-functioning adenomas (**Table 1**). Visual field deficit was the main indication in the non-functioning cases. In three cases, the tumor extended into the sphenoid sinus while in seventeen cases, the tumor extended into the suprasellar cistern. No cases with cavernous sinus extension were included in this study as these lesions were removed in a piecemeal fashion. Gross total resection was achieved in twenty one cases. One case (4.5%) had a small 2mm residual in a non-functioning adenoma and is followed afterwards with no growth until latest follow up. Only four (18%) patients had pituitary hypofunction following surgery. Two of those four cases had hypofunction before surgery. The other two (9%) had hypofunction as postoperative sequel. This hypofunction was in the form of hypocortisolism and

gonadal axis, which was replaced for a period of time ranging from one to few weeks until hormones are normalized by our endocrinologist. Five cases (22%) with temporary diabetes insipidus (**Table 2**) were reported. All of these cases improved during the follow up period. Postoperative hormonal assessment revealed endocrinological control of all hormone active tumors except one case of prolactinoma (**Table 3**). This case was managed with dopamine agonist for about three months post-resection after which the prolactin was normalized.

Intraoperative CSF leak was encountered in only two cases and was managed by onlay nasal septal flap which was prepared as a rescue flap.

Table 1: Distribution of patients according to hormone function

Non functioning tumors	13
GH secreting adenomas	3
Prolactinomas	3
ACTH secreting adenomas	2
TSH secreting adenomas	1
Total	22

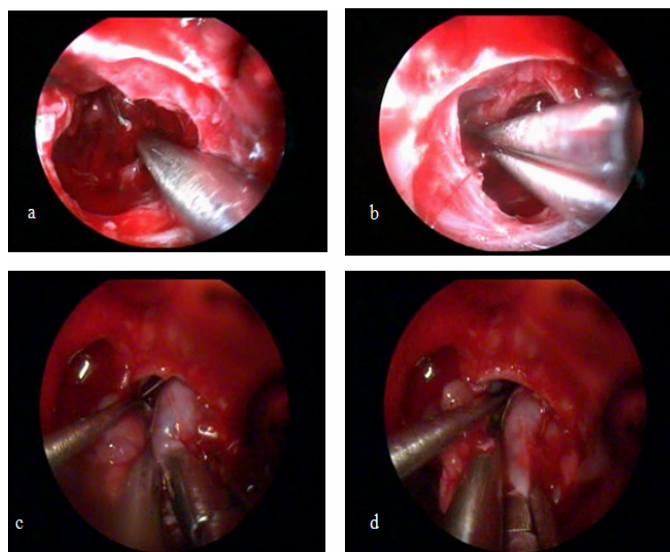
Table 2: Post operative complications

	NF	GH	PRL	ACTH	TSH
DI	5/13	1/3	0/3	0/2	0/1
Hypofunction	4/13	0/3	0/3	0/2	0/1

Table 3: Biochemical remission post resection

GH secreting adenomas	3/3 (100%)
Prolactinomas	2/3 (66.6%)
ACTH secreting adenomas	2/2 (100%)
TSH secreting adenomas	1/1 (100%)

Fig. 1a-d: Steps of extracapsular resection, a: Starts with initial debulking, followed by b: identification of the pseudocapsule, then c: proceeding with dissection in all directions, and d: careful separation from the normal gland



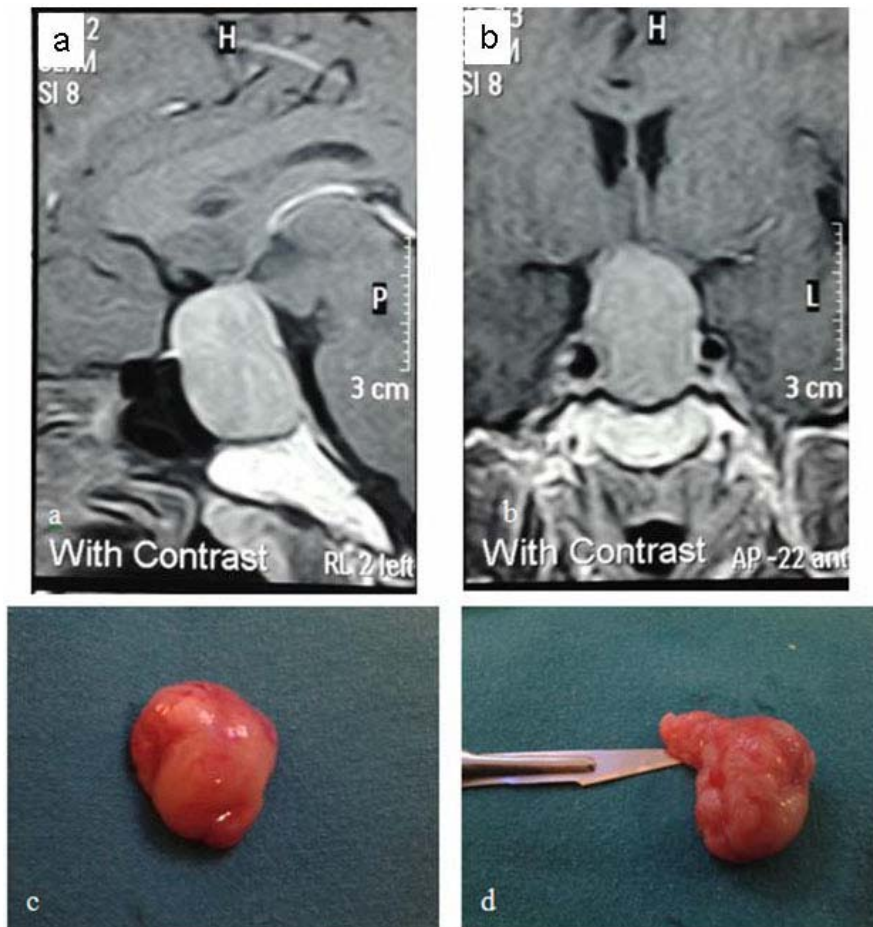


Fig. 2a-d: Extra-capsular en block excision of pituitary adenoma. a&b: sagittal and coronal section of preoperative MRI of a case of non functioning adenoma. c&d: mass after enblock excision.

DISCUSSION

Despite the fact that the presence of pseudocapsules was first described in the early 1900s², understanding their formation and highlighting their clinical significance have been recent developments. Kawamata T. et al⁵ emphasized that the pseudocapsule is extremely helpful for complete tumor excision. There have been many reports^{1,4,5,6} describing surgical techniques using a pseudocapsule as a surgical dissection plane. In those reports, the dissection was performed along the interface between the outer surface of a pseudocapsule and a normal pituitary gland. These techniques, not only increased the complete tumor removal, but also, improved endocrinological remission rates and minimized recurrences and complications rates.

Two factors mainly determine the feasibility of the extracapsular technique. First is the consistency of the mass, and second is the degree of development of the pseudocapsule. In one study⁷, authors demonstrated that a micro- surgical pseudocapsule was found in 55.7

% of patients with pituitary adenomas. The degree and characteristics of pseudocapsule varied widely: (1) entirely covering the tumor mass; (2) a thin, fibrous envelope; (3) a yellowish, discolored, normal gland-like, thin membrane; (4) thick, fibrous tissue; and (5) sometimes dense fibrosis or calcifications. Thus, the nature of the tumor dictates the technique of resection. If the tumor is tough or has a firm capsule, then extracapsular dissection can be performed, however, in soft friable adenomas, piecemeal excision is inevitable.

This study has shown that resection in the extracapsular plane has significantly accomplished better biochemical remission in hormone secreting adenomas. Near 100% remission in growth hormone secreting adenoma has been achieved. This is much better than old results with piecemeal resection of about 65% obtained but same authors in unpublished data. This is almost similar to what Kawamata and colleagues published in 2005⁵. This seemingly better outcome maybe attributed due to fewer numbers of cases and lack of invasive adenomas in challenging locations (eg: the cavernous sinus).

Similar good outcome was obtained in ACTH secreting adenomas and correlates to what Jagannathan et al published in 2009³.

Prolactin secreting adenoma was the most frequent to have a pseudocapsule amenable for resection, probably related to previous treatment with dopamine agonist. In our series, about 66% hormonal remission had been achieved in prolactinomas, which is close to the results of Kim et al in 2015⁶.

The incidence of postoperative CSF rhinorrhea after endonasal trans-sphenoidal surgery has been reported to range from 0.5 to 6.0 %. The extracapsular resection was found to be associated with higher incidence of cerebrospinal fluid leakage than piecemeal resection. This is attributed to the more aggressive maneuvers used to resect the tumor from the gland and the arachnoid membrane. Two cases of intraoperative CSF leak were encountered representing 9%. Both were managed by reflecting the prepared rescue nasal septal flap. No postoperative CSF leak was faced.⁹

One of the big concerns in extracapsular technique is the aggravation of pituitary hypofunction owing to the assumption that part of the normal gland can be resected along the plane of dissection. Also in some cases of thin stretched gland, it can be mistaken for the pseudocapsule; hence, dissection continues outside the gland itself resulting in severe postoperative hypofunction. This issue can be managed by using high definition cameras, meticulous dissection techniques and good preoperative study of the MRI to identify the relation of the normal gland to the adenoma. Many reports stated that not only that extracapsular resection is not associated with hypofunction, but, it actually reduces this risk by careful delineation of the plane between the tumor and the gland.^{7,11}

In this current series, there had been two cases (9%) of postoperative pituitary hypofunction, related to surgery, that was replaced medically. This is slightly better than the 15% incidence found in Kim et al.⁶ and again can be a result of the fewer number of cases.

Total resection was achieved in the majority of the cases (95.5%) which coincides with most of the reports.^{1,3,5,7,10,11}

CONCLUSION

Extracapsular resection of pituitary adenomas is a safe technique for excision of pituitary adenomas. It requires good optics and it provides better outcome

both radiological and functional as well as reduces morbidity.

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