



## Endoscopic Versus Microscopic Transcallosal Excision of Colloid Cysts: A Systematic Review in the Era of Complete Endoscopic Excision

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■ **OBJECTIVE:** Transcallosal microscopic and endoscopic excisions are both well established approaches to colloid cyst resection; however, there has been no clear consensus regarding the favored approach. We performed a systematic review comparing the transcallosal microscopic and endoscopic transcortical approaches for colloid cyst excision.

■ **METHODS:** We performed a systematic review from 2000–2018 of patients undergoing colloid cyst excision via a microscopic transcallosal or endoscopic transcortical approach where the surgical intent was gross total resection. Studies that included multiple approaches were included if the reported results were stratified by approach.

■ **RESULTS:** The microsurgical transcallosal approach had a higher rate of gross total resection when compared with endoscopic excision (96% for transcallosal vs. 78.5% endoscopic;  $P < 0.0001$ ). There was also a lower recurrence rate with the transcallosal approach (0.98% vs. 2.16%;  $P = 0.0036$ ); however, there was no difference in reoperation rates with similar length of follow-up (0.33% transcallosal, 0.61% endoscopic;  $P = 1.000$ ). Endoscopy had lower overall morbidity when compared with transcallosal approaches (8.7% vs. 18.6%;  $P = 0.0001$ ), including statistically significant lower rates of infection, infarct, and seizures in the endoscopic cohort. Rates of permanent memory deficit were similar (6.55% transcallosal vs. 4.5% endoscopic;  $P = 0.52$ ). Shunt dependency was 9.8% after transcallosal excision versus 3.5% after endoscopic excision ( $P = 0.0002$ ).

■ **CONCLUSIONS:** Modern series of colloid cyst excision continue to favor transcallosal approaches in achieving gross total resection. Nevertheless, endoscopic techniques

have significantly reduced morbidity compared to transcallosal approaches, including lower rates of infection, infarct, and seizure. Endoscopic approaches also have a statistically significant decreased rate of shunt dependency—arguably the most important primary endpoint of surgery. With improving endoscopic technology and mastery of the technique, endoscopic excision is maturing into a standard first-line approach for colloid cyst excision.

### INTRODUCTION

Colloid cysts are histologically benign epithelial-lined tumors, with an unclear developmental origin, that represent about 1% of all intracranial lesions.<sup>1</sup> They are almost always found posterior to the foramen of Monro, in the roof of the third ventricle. Most colloid cysts are asymptomatic and found incidentally, but sometimes they can obstruct the foramen of Monro and cause hydrocephalus. In certain cases, rapid neurological deterioration and even sudden death can occur.<sup>2–5</sup> There is consensus in the literature that symptomatic colloid cysts should be treated, but treatment of asymptomatic lesions remains controversial.<sup>1,6</sup>

Historically, colloid cysts were treated with either the transcortical-transventricular or the transcallosal microsurgical approach. There has been some discussion in the literature regarding the favored microscopic approach; the transcallosal approach has been reported more frequently, however, often citing a decreased overall morbidity, especially the risk of seizure.<sup>3</sup> Over the past few decades, the burr hole endoscopic transcortical technique has gained popularity because it is believed to be a less invasive procedure with fewer complications and shorter inpatient stays.<sup>1</sup> Early endoscopic

#### Key words

- Colloid cyst
- Endoscopic
- Microscopic
- Transcallosal

#### Abbreviations and Acronyms

**GTR:** Gross total resection

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Citation: *World Neurosurg.* (2019) 132:e53–e58.  
<https://doi.org/10.1016/j.wneu.2019.08.259>

Journal homepage: [www.journals.elsevier.com/world-neurosurgery](http://www.journals.elsevier.com/world-neurosurgery)

Available online: [www.sciencedirect.com](http://www.sciencedirect.com)

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**Table 1.** Endoscopic Approaches Gross Data

Author, Year	No. of Patients	Mean Age (years)	Mean Cyst Size (mm)	Preoperative Hydrocephalus	Gross Total Resection	Mortality	Shunt Dependency	Memory	Infection
Ibañez-Botella et al., 2014 <sup>8</sup>	24	39.6	16.3	2	23	N/A	0	4	1
Bergsneider et al., 2007 <sup>9</sup>	11	43	12	11	10	0	1	1	0
Birski et al., 2016 <sup>10</sup>	27	37.2	12.5	23	27	0	1	1	0
Chibbaro et al., 2014 <sup>11</sup>	29	34	11	25	25	N/A	N/A	0	0
Greenlee et al., 2008 <sup>12</sup>	35	32.4	18	N/A	29	0	0	0	0
Hoffman et al., 2013 <sup>10</sup>	56	41	12.8	37	45	0	2	2	1
Horn et al., 2007 <sup>13</sup>	28	49	13	17	10	0	2	2	0
Levine et al., 2007 <sup>14</sup>	35	35.9	N/A	N/A	33	0	0	0	0
Margetis et al., 2014 <sup>15</sup>	77	42.4	12.75	N/A	65	0	2	2	1
Sharifi et al., 2015 <sup>16</sup>	18	35	25	0	16	1	0	2	0
Sribnick et al., 2014 <sup>17</sup>	56	N/A	9.8	33	56	2	3	6	3
Stachura et al., 2009 <sup>4</sup>	10	39	N/A	23	6	0	1	0	0
Wait et al., 2013 <sup>18</sup>	16	42.5	11	0	13	0	0	4	0
Wilson et al., 2012 <sup>2</sup>	22	47	12	19	18	1	4	1	0
Yadav et al., 2014 <sup>19</sup>	24	41	20	24	21	0	1	0	0
Samadian et al., 2017 <sup>20</sup>	112	34.45	N/A	N/A	103	2	4	5	9
Mishra et al., 2010 <sup>21</sup>	59	32	N/A	59	7	1	2	0	1
Kwiek et al., 2012 <sup>22</sup>	17	44	14	17	8	0	0	N/A	N/A
Total*	656	39.4	14.3	290	515	7	23	30	16

N/A, no data available.  
\*Average in boldface.

series attempted simple cyst aspiration, but did not attempt complete excision of the cyst wall and its contents. Unfortunately, leaving the capsule significantly increases the recurrence rate.<sup>1</sup> With the advancement of the endoscopic technique and improved technology, more recent endoscopic series have included intent for gross total resection of the cyst wall and its contents, instead of cyst aspiration alone.

There is currently no established consensus regarding the optimal technique to remove colloid cysts. In their 2014 meta-analysis, Sheik et al. reported on 1278 patients comparing endoscopic versus microsurgical resection of colloid cysts and concluded that microsurgical approaches resulted in higher gross total resection (GTR) rates, lower recurrence rates, and lower re-operation rates,<sup>3</sup> although endoscopic advocates continue to point to lower morbidity and microsurgical advocates point to higher GTR and lower recurrence rates. Previous meta-analyses, including that by Sheik et al., reviewed all endoscopic series

together, including series where the intent of the endoscopic procedure was aspiration only and not GTR, skewing results in favor of microscopic approaches with regard to GTR, recurrence, and re-operation rates. In an attempt to answer this question more definitively, we performed a systematic review of the current literature comparing the endoscopic approaches with the intent to resect the cyst contents along with its capsule with the trans-callosal microsurgical approach.

## METHODS

### Search Strategy

We searched PubMed for studies analyzing the surgical options to treat colloid cysts of the third ventricle. The database was searched using the following terms: “colloid cyst”, “colloid cyst third ventricle”, “colloid cyst endoscopic”, “colloid cyst surgery”, and “colloid cyst resection” in papers published between 2000 and

Table 1. Continued

Extra-axial Hematoma	Intra-axial Hematoma	Intraventricular Hematoma	Venous Infarction	Seizures	Hemiparesis	Recurrence	Follow-Up (months)	Reoperation
0	0	3	0	0	0	1	67.2	0
0	0	0	0	0	0	N/A	N/A	N/A
0	0	1	0	0	0	2	6	1
0	0	1	0	0	0	0	N/A	0
0	0	0	0	0	0	1	88	0
0	0	2	0	0	0	4	40	0
0	0	0	0	0	1	1	10	0
1	1	1	1	0	0	2	6	0
0	0	0	0	0	0	2	18	0
0	0	6	0	0	0	0	44	0
1	0	0	0	0	0	1	14.9	0
0	0	0	0	0	0	1	6	1
0	0	0	0	0	0	0	25	0
0	0	0	0	0	0	0	19.8	0
0	0	4	0	1	0	0	37	0
0	0	0	0	0	3	4	17	0
1	1	1	0	0	0	5	13	0
N/A	N/A	N/A	N/A	N/A	N/A	6	12	2
3	2	19	1	1	4	30	26.5	4

2018. All the abstracts were carefully analyzed as well as the full text articles after selection.

### Selection Criteria

We included papers that discussed treatment options for colloid cysts—selecting all those that reported at least some or all of the following: symptoms, treatment, postoperative complications, reoperation, and follow-up. Papers that described the goal of treatment as cyst aspiration without intent for GTR, non-human studies, and studies with insufficient data were excluded. Only 1 series within the study timeframe included a microscopic transcortical approach to colloid cysts, and included surgeries performed only at a single center. Therefore, it was excluded from direct comparison in this analysis.<sup>7</sup>

### Data Extraction

We extracted the following from the papers: sex, age, surgical technique (transcallosal or endoscopic), postoperative

complications, follow-up, shunt dependency, resection (GTR or partial), recurrence, and reoperation. We considered GTR a complete removal of both the intracystic contents well as the wall as defined in the selected studies.

### Data Analysis

All the data were carefully reviewed regarding patients who went through endoscopic excision or those who underwent a transcallosal microsurgical approach. Fisher's exact test was used for statistical analysis with a P value set to less than 0.05 for significance. We compared the rates of GTR, reoperation, recurrence, morbidity, mortality, and shunt dependence.

### RESULTS

We selected 22 studies for inclusion from which we could extract the following data: age, sex, GTR rate, radiologic imaging, outcome, length of follow-up, cyst recurrence, and type of procedure.

Table 2. Transcallosal Approaches Gross Data

Author, Year	No. of Patients	Male	Mean Age (years)	Mean Cyst Size (mm)	Hydrocephalus	Shunt Dependency	Memory	Infection	Extra-axial Hematoma	Intra-axial Hematoma	Intraventricular Hematoma	Venous Infarction	Seizures	Hemiparesis	Recurrence	Follow-up	Re-operation
Hernesmi et al., 2008 <sup>23</sup>	134	73	43	10	44	17	4	6	0	0	0	0	0	1	1	23	1
Horn et al., 2007 <sup>24</sup>	27	N/A	45	13	17	5	N/A	5	1	0	0	1	2	0	0	11	0
Sampath et al., 2010 <sup>25</sup>	10	5	N/A	16	7	1	2	1	0	0	0	0	0	1	0	50	0
Shapiro et al., 2009 <sup>26</sup>	57	39	36.8	17	50	3	2	1	1	0	1	0	0	0	0	144	0
Syness et al., 2011 <sup>27</sup>	78	43	N/A	N/A	65	4	9	3	1	0	0	4	0	4	2	14	0
Total*	306		<b>41.6</b>	14	183	30	17	16	3	0	1	5	2	6	3	48.4	1

N/A, no data available.  
\*Average in boldface.

Table 3. Comparison (Statistics) Between Endoscopic and Transcallosal Approaches

Measure	Transcallosal	Endoscopic Procedure	P Value
Mean age, years	41.6	39.4	
Mean cyst size, mm	14	14.3	
Gross total resection	96.1%	78.5%	<b>&lt;0.0001</b>
Recurrence	0.98%	4.57%	<b>0.0036</b>
Mortality	0.65%	1.06%	0.7269
Reoperation	0.33%	0.61%	1
Shunt dependence	9.80%	3.51%	<b>0.0002</b>
Morbidity	25.4%	12.4%	<0.0001
Follow-up, months	48.4 (11–144)	26.5 (6–88)	

Significant P values are in bold type  
Data in parentheses are ranges.

Seventeen of the studies had endoscopic approaches and 5 had transcallosal microsurgical approaches, as shown in Tables 1 and 2, respectively. Information for a total of 962 patients was collected: 306 transcallosal procedures and 656 endoscopic procedures. Among the transcallosal series, only 1 study (Sampath et al.<sup>18</sup>) described the size of their callosotomy, at less than 1 cm in size and 2–3 cm posterior to the genu.

For the microsurgical group, mean age was 41.6 years and mean follow-up was 48.4 months; for the endoscopic cohort, mean age was 39.4 years and mean follow-up was 26.5 months. The mean size was 14.0 mm for the microsurgical group and 14.3 mm for the endoscopic cohort.

The transcallosal group had 294 GTR from a total of 306 cases (96%) compared with the endoscopic group, where 515 patients had a GTR from 656 cases (78.5%) (P < 0.0001) (Table 3). Recurrence rates were lower in the transcallosal group versus the endoscopic group, at 0.98% and 4.57%, respectively (P = 0.0036).

The reoperation rates between the 2 approaches did not differ greatly, with 0.33% and 0.61% for transcallosal and endoscopic approaches, respectively (P = 1.0).

There was a similar overall mortality between the 2 groups, with 0.65% for the transcallosal approach and 1.06% for the endoscopic approach (P = 0.73). Shunt dependence was higher (9.80%) in the transcallosal group in comparison to the endoscopic cohort (3.51%) (P = 0.0002).

The overall morbidity rate (Table 4) was significant between the two groups: 8.7% for the endoscopic procedures and 18.6% for the transcallosal approach (P = 0.0001). There were also statistically significant worse rates of infection, infarct, seizures, and shunt rate in the transcallosal cohort (see Table 2 for additional details).

DISCUSSION

Colloid cysts represent about 1% (range: 0.5% to 2.0%) of all intracranial lesions.<sup>1,3,4</sup> Microsurgical techniques (transcortical

**Table 4.** Morbidity Related to Endoscopic and Transcallosal Approaches

Approach	Memory	Infection	Symptomatic Hemorrhage	Venous Infarction	Seizures	Hemiparesis	Total Morbidity
Endoscopy N = 656	30 (4.5)	16 (2.4)	5 (0.75)	1 (0.15)	1 (0.15)	4 (0.61)	57 (8.7)
Transcallosal N = 306	17 (5.55)	16 (5.22)	5 (1.63)	5 (1.63)	8 (2.61)	6 (1.96)	57 (18.6)
P	0.52	0.0326	0.3037	0.014	0.0006	0.0823	0.0001

Values are presented as n (%).

and transcallosal) have been used for many years, and they remain in common use, but over the past 20 years, the endoscopic, transcortical approach via bur hole has become increasingly more popular. The endoscopic approach was first used with only cyst aspiration due to limitations to technique and technology, resulting in higher recurrence rates. More recently, with increasing mastery of the technique and improving technology, surgeons are now able to more frequently perform a GTR (removing both the cyst content and the capsule).

As previously mentioned, Sheikh et al.<sup>3</sup> concluded, in their meta-analysis of 1278 patients, that the microsurgical approach has a higher rate of GTR and lower recurrence rates than the endoscopic approach. Unfortunately, this meta-analysis included older endoscopic series that did not attempt GTR, potentially biasing results. The authors do note the improvements in endoscopic series resection rates over time, and we believe this warranted a second look at a comparison between the two procedures. In our systematic review of 962 patients, we included more recent studies (2000–2018) to account for improving technology, and excluded any studies that only attempted cyst aspiration without removal of cyst wall. Comparing the endoscopic to the transcallosal group, GTR remained higher with the transcallosal approach (96% vs. 78.5% for transcallosal vs. endoscopic, respectively,  $P < 0.0001$ ). There was also a lower recurrence rate (0.98% vs. 4.57%, respectively,  $P = 0.0036$ ). There was, however, no significant difference in reoperation rates between the 2 approaches. Overall morbidity was significantly higher in the transcallosal group (18.6% vs. 8.7%,  $P < 0.0001$ ). When broken

out by type of morbidity, endoscopy had statistically lower rates of infection, seizures, and infarct. Notably, shunt dependence was significantly lower in the endoscopic group (3.51% vs. 9.8%, respectively,  $P = 0.0002$ ). Additionally, there continue to be further improvements in endoscopic GTR in recent series. For example, recent series such as Wilson et al. report a GTR rate of 82% with no recurrences,<sup>2</sup> and Engh et al. report a GTR rate of 96.9%.<sup>14</sup> Overall, with the improvements made in the endoscopic approach, and in the hands of an experienced neuroendoscopist, endoscopic resection of colloid cysts should be considered a standard approach for treatment of these lesions. Although there is a higher GTR rate and lower recurrence rate with microsurgical transcallosal approaches, the increased morbidity and higher shunt dependency rate arguably offsets this benefit.

## CONCLUSIONS

Modern series of colloid cyst excision continue to favor transcallosal approaches in achieving gross total resection. However, endoscopic techniques have significantly reduced morbidity compared with transcallosal approaches, including lower rates of infection, infarct, and seizure. Endoscopic approaches also have a statistically significant decreased rate of shunt dependency, arguably the most important primary endpoint of surgery. With improving endoscopic technology and mastery of the technique, endoscopic excision is maturing into a standard first-line approach for colloid cyst excision.

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*Conflict of interest statement: The authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.*

*Received 24 May 2019; accepted 31 August 2019*

*Citation: World Neurosurg. (2019) 132:e53-e58.  
https://doi.org/10.1016/j.wneu.2019.08.259*

*Journal homepage: [www.journals.elsevier.com/world-neurosurgery](http://www.journals.elsevier.com/world-neurosurgery)*

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