

Epilepsy Surgery: An Evidence Summary

Health Quality Ontario

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About Health Quality Ontario

Health Quality Ontario (HQO) is an agency funded by the Ministry of Health and Long-Term Care. An essential part of HQO's mandate is to provide evidence-based recommendations on the coordinated uptake of health care services and health technologies in Ontario to the Ministry of Health and Long-Term Care and to the health care system. This mandate helps to ensure that residents of Ontario have access to the best available and most appropriate health care services and technologies to improve patient outcomes.

To fulfill its mandate, HQO conducts systematic reviews of evidence and consults with experts in the health care services community. The resulting evidence-based analyses are reviewed by the Ontario Health Technology Advisory Committee, and published in the *Ontario Health Technology Assessment Series*.

About the Ontario Health Technology Assessment Series

To conduct its comprehensive analyses, HQO systematically reviews the available scientific literature, making every effort to consider all relevant national and international research; collaborates with partners across relevant government branches; consults with clinical and other external experts and developers of new health technologies; and solicits any necessary supplemental information.

In addition, HQO collects and analyzes information about how a new technology fits within current practice and existing treatment alternatives. Details about the technology's diffusion into current health care practices add an important dimension to the review of the provision and delivery of the health technology in Ontario. Information concerning the health benefits; economic and human resources; and ethical, regulatory, social, and legal issues relating to the technology assist in making timely and relevant decisions to optimize patient outcomes.

The public consultation process is available to individuals wishing to comment on an analysis prior to publication. For more information, please visit: http://www.hqontario.ca/en/mas/ohtac_public_engage_overview.html.

Disclaimer

This evidence-based analysis was prepared by HQO for the Ontario Health Technology Advisory Committee and developed from analysis, interpretation, and comparison of scientific research and/or technology assessments conducted by other organizations. It also incorporates, when available, Ontario data and information provided by experts and applicants to HQO to inform the analysis. While every effort has been made to reflect all scientific research available, this document may not fully do so. Additionally, other relevant scientific findings may have been reported since completion of the review. This evidence-based analysis is current to the date of the literature review specified in the methods section. This analysis may be superseded by an updated publication on the same topic. Please check the HQO website for a list of all evidence-based analyses: http://www.hqontario.ca/en/mas/mas_ohtas_mn.html.

Abstract

Background

The Medical Advisory Secretariat, the predecessor of Health Quality Ontario, published an evidence-based analysis on functional brain imaging. This analysis highlighted the low uptake of epilepsy surgery in Ontario and internationally.

Objective

The objective of this analysis was to review the effectiveness of epilepsy surgery at reducing seizure frequency, as well as the safety of epilepsy surgery.

Data Sources

The literature search included studies published between January 1995 and March 2012. Search terms included epilepsy, surgery, resection, safety, and complications.

Review Methods

Studies were eligible for inclusion if they included at least 20 patients undergoing surgery; had a comparison group of patients with epilepsy who were not undergoing surgery; and reported follow-up periods of at least 1 year. Outcomes of interest included seizure frequency and complications associated with surgery.

Results

Six systematic reviews reported pooled seizure-free rates that ranged from 43% to 75%. Two randomized controlled trials compared the effectiveness of epilepsy surgery with no surgery in patients with drug-refractory epilepsy. Both trials reported significant improvements in the seizure frequency in the surgery group compared with the nonsurgery group.

Eight retrospective cohort studies reported on the safety of epilepsy surgery. Of the 2,725 patients included in these studies, there were 3 deaths reportedly related to surgery. Other complications included hemiparesis, infection, and visual field defects. The studies had long follow-up periods ranging from a mean of 2 to 7 years.

Limitations

The most recent randomized controlled trial was stopped early due to slow enrolment rates. Thus results need to be interpreted with caution.

Conclusions

There is high quality evidence that epilepsy surgery is effective at reducing seizure frequency. Two randomized controlled trials compared surgery to no surgery in patients with drug-refractory epilepsy. Both demonstrated significant reductions in seizure frequency.

There are some complications associated with epilepsy surgery. In the published literature identified, we observed a 0.1% mortality rate associated with the surgery.

Plain Language Summary

About 30% of patients with epilepsy continue to have seizures despite optimal drug treatment. In some of these patients, surgery to control the number of seizures may be an option. Patients are carefully selected based on frequency of seizures, location of seizure in the brain, and type of seizures. There is good evidence to indicate that surgery is an effective and safe option for some patients with drug-refractory epilepsy.

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List of Abbreviations

CI	Confidence interval
HQO	Health Quality Ontario
MAS	Medical Advisory Secretariat
RCT	Randomized controlled trial
RR	Relative risk

Background

Objective of Analysis

The objective of this analysis was to review the published data on the effectiveness and safety of epilepsy surgery.

Clinical Need and Target Population

Description of Disease/Condition

Epilepsy is a chronic disorder characterized by repetitive seizures. It may have a variety of etiologies that range from genetic or developmental anomalies, to multiple types of brain trauma (e.g., injury, stroke, or tumour). For some patients, there may be no apparent cause. (1)

Global Prevalence and Incidence

The rate of patients undergoing epilepsy surgery worldwide is much lower than the number of patients who are eligible for this surgery. Of the 100,000 patients eligible for epilepsy surgery in the United States, only about 2,000 undergo such surgeries every year. (2) In a review of epilepsy surgery, Siegel (2) suggested a rationale for the difference between the need for and utilization of epilepsy surgery:

- primary care physicians' lack of awareness
- patients' preference to tolerate seizures rather than undergo surgery
- a lack of third-party funding for procedure (in the United States)

Since epilepsy surgery is not being widely adopted, Health Quality Ontario (HQO) chose to review the effectiveness and safety of epilepsy surgery.

Ontario Prevalence and Incidence

In 2006, the Medical Advisory Secretariat, the predecessor of HQO, published an evidence-based analysis on functional brain imaging. (1) The report stated that “based on the literature and health administrative data from the Provincial Health Planning Database the potential number of prevalent epilepsy cases eligible for surgery is estimated to be 9,375.” (1)

Despite this, there are only about 150 surgeries for epilepsy per year in Ontario. (1)

Evidence-Based Analysis

Research Questions

- Is epilepsy surgery effective at reducing seizure frequency compared with drug therapy in patients with drug-refractory epilepsy?
- What risks are associated with epilepsy surgery?

Research Methods

Literature Search

Search Strategy

A literature search was performed on March 2, 2012, using OVID MEDLINE, OVID EMBASE, and the Centre for Reviews and Dissemination database, for studies published from January 1, 1995, until March 2, 2012. Search terms included epilepsy, surgery, resection, safety, and complications. Abstracts were reviewed by a single reviewer and, for those studies meeting the eligibility criteria, full-text articles were obtained. Reference lists were also examined for any additional relevant studies not identified through the search.

Inclusion Criteria

Effectiveness of epilepsy surgery:

- at least 20 patients undergoing surgery
- must have a control/comparison group of patients with epilepsy who are not undergoing surgery
- at least 1 year follow-up
- English language full-text reports

Safety of epilepsy surgery:

- at least 100 patients undergoing surgery
- English language full-text reports

Exclusion Criteria

- case series, case reports, editorials
- grey literature
- non-English studies
- nonhuman studies

Outcomes of Interest

- number of seizure-free patients (with "seizure-free" clearly defined)
- short-term and long-term complications associated with surgery

Quality of Evidence

The quality of the body of evidence for each outcome is examined according to the GRADE Working Group criteria. (3) The overall quality is determined to be very low, low, moderate, or high using a step-wise, structural methodology.

Study design is the first consideration; the starting assumption is that randomized controlled trials are high quality, whereas observational studies are low quality. Five additional factors—risk of bias, inconsistency, indirectness, imprecision, and publication bias—are then taken into account. Limitations or serious limitations in these areas result in downgrading the quality of evidence. Finally, 3 main factors are considered which may raise the quality of evidence: large magnitude of effect, dose response gradient, and accounting for all residual confounding. (3) For more detailed information, please refer to the latest series of GRADE articles. (3)

As stated by the GRADE Working Group, the final quality score can be interpreted using the following definitions:

High	Very confident that the true effect lies close to the estimate of the effect
Moderate	Moderately confident in the effect estimate—the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
Low	Confidence in the effect estimate is limited—the true effect may be substantially different from the estimate of the effect
Very Low	Very little confidence in the effect estimate—the true effect is likely to be substantially different from the estimate of effect

Results of Evidence-Based Analysis

The database search yielded 740 citations published between January 1, 1995, and March 15, 2012 (with duplicates removed). Articles were excluded based on information in the title and abstract. The full texts of potentially relevant articles were obtained for further assessment. Figure 1 shows the breakdown of when and for what reason citations were excluded in the analysis.

Thirty-two studies (6 systematic reviews, 2 randomized controlled trials [RCTs], 16 case-control studies, and 8 retrospective cohort studies) met the inclusion criteria. The references lists of the included studies and health technology assessment websites were also hand searched to identify any additional potentially relevant studies.

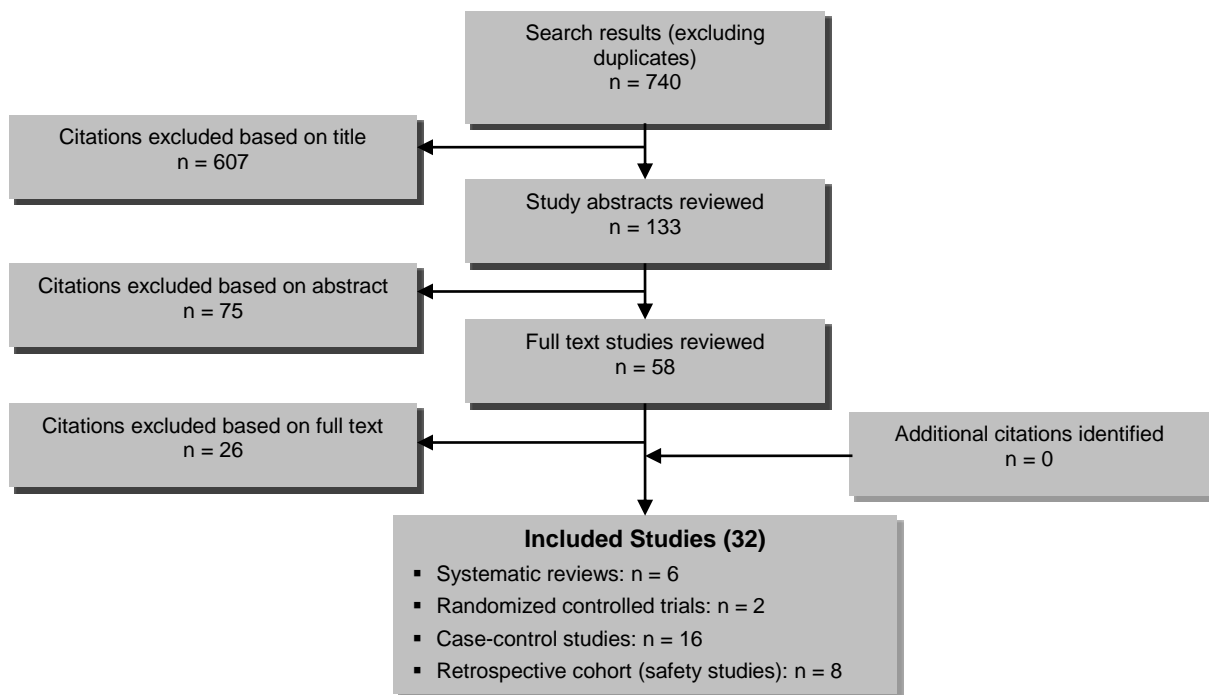


Figure 1: Citation Flow Chart

For each included study, the study design was identified and is summarized below in Table 1, which is a modified version of a hierarchy of study design by Goodman. (4)

Table 1: Body of Evidence Examined According to Study Design

Study Design	Number of Eligible Studies
RCT Studies	
Systematic review of RCTs	
Large RCT	
Small RCT	2
Observational Studies	
Systematic review of non-RCTs with contemporaneous controls	
Non-RCT with non-contemporaneous controls	
Systematic review of non-RCTs with historical controls	6
Non-RCT with historical controls	16
Database, registry, or cross-sectional study	
Case series	
Retrospective review, modelling	8
Studies presented at an international conference	
Expert opinion	
Total	32

Abbreviation: RCT, randomized controlled trial.

Effectiveness of Epilepsy Surgery

Systematic Reviews

Six systematic reviews that reported pooled results of seizure outcome were identified. The range of seizure-free rates varied across the analyses from 43% to 75%. Only 1 systematic review reported the seizure-free rates of patients with epilepsy not undergoing surgery. (5) This systematic review reported a significant improvement in the seizure-free rate in the surgical group compared with the control group (relative risk [RR], 4.26; 95% confidence interval [CI], 3.03–5.98). Table 2 describes the systematic reviews.

Table 2: Description of Systematic Reviews Included in the Evidence Summary of Epilepsy Surgery

Study	Research Question	Years, Sources Searched	Number of Studies Included	Pooled Seizure Outcome
Englot et al, 2011 (6)	What are the predictors of seizure freedom in the surgical treatment of supratentorial cavernous malformations?	1985–2011, PubMed	31 (1,226 patients)	75% seizure-free
Seiam et al, 2011 (7)	What are the preoperative, operative, and postoperative variables that influence HRQOL after epilepsy surgery in adults?	1950–2008; MEDLINE, EMBASE, Cochrane	39 (3,373 patients)	58.1% seizure-free 35.4% seizure improvement 6.5% no improvement
Tellez-Zenteno et al, 2010 (8)	What are the seizure outcomes in patients undergoing epilepsy surgery and how consistent are the results across studies?	1995–2007, MEDLINE, EMBASE, Cochrane	40 (3,557 patients)	TL + XTL 68% seizure-free (lesional) (95% CI, 66–70) 43% seizure-free (nonlesional) (95% CI, 39–46) TL 69% seizure-free (lesional) (95% CI, 66–70) 45% seizure-free (nonlesional) (95% CI, 40–49)
Schmidt & Stavem, 2009 (5)	What are the long-term seizure outcomes of surgery versus no surgery for drug-resistant partial epilepsy?	1947–2007, MEDLINE, EMBASE, Index Medicus, Cochrane	20 (1,621 patients)	Surgical: 44% seizure-free; control: 12% seizure-free (RR 4.26; 95% CI, 3.03–5.98)
Tellez-Zenteno et al, 2005 (9)	What are the long-term (> 5 years) seizure outcomes following epilepsy surgery?	1991–2003, MEDLINE, Index Medicus, Cochrane	76 (7,343 patients)	TL 66% seizure-free (95% CI, 62–70) TL + XTL 59% seizure-free (95% CI, 56–62) Frontal 27% seizure-free (95% CI, 23–30)
Tonini et al, 2004 (10)	What are the predictors of epilepsy surgery outcome?	1984–2001, MEDLINE	47 (3,511 patients)	63% 'good outcome' 21% 'improved outcome' 12% 'poor outcome'

Abbreviations: CI, confidence interval; HRQOL, health-related quality of life; RR, relative risk; TL, temporal lobe; XTL, extratemporal lobe.

Randomized Controlled Trials—Epilepsy Surgery Versus No Surgery

Two published RCTs compared the effectiveness of epilepsy surgery with no surgery in patients with drug-refractory epilepsy. (11;12)

In March 2012, Engel et al (11) reported the results of their RCT comparing epilepsy surgery to no surgery. The study was designed to recruit 200 patients, but was stopped early due to slow enrolment rates. Of the 38 patients in the study, 15 were randomized to receive surgery and 23 were randomized to the control group. Patients in the control group were offered surgery at the end of the study (after 2 years). The authors reported an intention-to-treat analysis—7 patients in the control group received surgery but continued to be analyzed as part of the control group. Of the 15 patients in the surgery group, 11 were free of disabling seizures at 2 years, whereas none of the patients in the control group were free of disabling seizures at 2 years ($P < 0.001$). However, it is important to note that this study was stopped early and results need to be interpreted with caution.

In 2001, Wiebe et al (12) published their study of 80 patients randomized to receive surgery ($n = 40$) or to continue with medical management of their epilepsy and have their surgery delayed for 1 year ($n = 40$). The trial was powered to detect an absolute difference of 34% between the patients in the 2 groups who were free of those seizures that impaired awareness. They reported a 50% absolute difference between the surgical and medication groups ($P < 0.001$). None of the patients crossed over into the other group. Patients could not be blinded.

Wiebe et al (12) also reported safety outcomes for patients in the RCT. Of the 40 patients who had surgery, 4 had adverse effects: 1 developed a small thalamic infarct that caused sensory abnormalities in the leg; another patient's wound became infected; and 2 experienced a decline in verbal memory that interfered with their occupations at 1 year. Depression was diagnosed in 7 patients in the surgical group and 8 patients in the nonsurgical group. Transient psychosis developed in 1 patient in each group. No deaths were reported in the surgical group, though 1 patient in the nonsurgical group died ("sudden, unexplained death").

Studies With Comparison Group—Epilepsy Surgery Versus No Surgery

Schmidt and Stavem's (5) systematic review included studies that compared patients undergoing epilepsy surgery with a comparison group of patients not undergoing surgery. This is unlike the other systematic reviews identified, which did not require a comparison group. Schmidt and Stavem (5) identified 20 studies published between 1947 and 2007 that met their criteria. Health Quality Ontario updated this search to March 2012 and identified 1 additional study. (13) Health Quality Ontario also excluded studies prior to 1995 to try to ensure that all patients in all the studies underwent surgical procedures with similar technological innovations. Some studies were also excluded if the results reported by Schmidt and Stavem (5) could not be confirmed in the original publication. Schmidt and Stavem (5) reported contacting authors directly for additional information, but due to the time limitations, HQO was unable to further verify results from the original sources.

Table 3 describes the studies included in this analysis of effectiveness. With the exception of the RCTs by Wiebe et al (12) and Engel et al, (11) all of the studies were retrospective or prospective studies with comparison groups. The comparison groups varied across the studies. Many were formed by including those patients identified as ineligible for surgery during the presurgical assessment. The limitation of this format is that the surgical and control groups are not equivalent because the patients in the control group were not surgical candidates. There were 2 studies, however, that chose the control group patients from among those awaiting surgery, (14;15) thus making a more appropriate comparison group.

Table 3: Characteristics of Studies Investigating the Effectiveness of Epilepsy Surgery

Study	Study Design	Number of Patients	Patient Population	Controls	Type of Surgery	Length of Follow-up
Engel et al, 2012 (11)	RCT	38 (15 surgical, 23 control)	≥ 12 years, with seizures for no more than 2 years; ≥ 2 drugs that did not alleviate seizures	Same as treatment (randomized)	TL	2 years
Mikati et al, 2010 (13)	Retrospective cohort	38 (19 surgical, 19 control)	Children 2–14 years with intractable partial epilepsy	Matched controls who were ineligible for surgery	unclear	Surgical: mean [SD] = 3.84 [2.26] years Control: 3.44 [2.95] years
Picot et al, 2008 (16)	Prospective cohort	289 (119 surgery, 161 control, 6 ineligible, 3 lost to follow-up)	Adults	Matched controls: 44% were ineligible for surgery, others chose not to undergo surgery	unclear	1, 2, 3 years
Stavem et al, 2008 (17)	Retrospective cohort	140 (70 surgical, matched control)	All ages, epilepsy primary indication for surgery	Matched for age, epilepsy, gender	TL + XTL	2 years
Bien et al, 2006 (18)	Retrospective cohort	384 (131 surgical, 253 control)	Adults	Awaiting presurgical assessment, withdrew from presurgical assessment, ineligible for surgery	Mostly TL (84%)	Mean 6.9 years since presurgical assessment in surgical patients
Mikati et al, 2006 (19)	Retrospective cohort	37 (20 surgical, 17 control)	Adults	Ineligible for surgery	TL	Mean [SD] = 33.8 [9.1] months
Yasuda et al, 2006 (15)	Prospective observational	101 (26 surgical, 75 control)	≥ 12 years	Awaiting presurgical assessment, chose not to undergo surgery	TL	Mean = 12.7 months (range, 3–24 months)
Kumlien et al, 2002 (20)	Retrospective cohort	83 (36 surgical, 47 control)	Adults	Ineligible for surgery	TL	> 4 years
Jones et al, 2002 (21)	Retrospective cohort	84 (61 surgical, 23 control)	Adults (>18 years)	Ineligible for surgery or chose not to undergo surgery	TL	Mean [SD] = 5.8 [2.1] years
Derry et al, 2001 (abstract) (22)	Prospective observational	39 (30 surgical, 9 control)	Adults	Ineligible for surgery	TL	Mean 8.5 years
Wiebe et al, 2001 (12)	RCT	80 (40 surgical, 40 control) no dropouts	≥ 16 years with temporal lobe epilepsy; ≥ 2 drugs that did not alleviate seizures	Same as treatment (randomized)	TL	1 year
Markand et al, 2000 (23)	Prospective observational	90 (53 surgery, 37 control)	Adults (>18 years)	Ineligible for surgery or chose not to undergo surgery	TL	1 year
Altshuler et al, 1999 (24)	Retrospective cohort	62 (49 surgical, 13 control)	Adults	Ineligible for surgery	TL	Mean 10.9 years
Gilliam et al, 1999 (14)	Retrospective cohort	196 (125 surgical, 71 control)	All ages	Patients awaiting surgery	TL	2 years
McLachlan et al, 1997 (25)	Prospective cohort	81 (56 surgical, 25 control) Results for 53 (28 drop outs)	≥ 17 years with temporal lobe epilepsy; use of ≥ 3 anticonvulsant drugs that have not reduced seizure frequency over ≥ 3 years	Ineligible for surgery or chose not to undergo surgery	TL	24 months
Vickrey et al, 1995 (26)	Retrospective, consecutive cohort	248 (202 surgical, 46 control)	Adults and adolescents with intractable epilepsy	Ineligible for surgery or chose not to undergo surgery	TL	Surgical: 5.8 years Control: 5.7 years

Abbreviations: RCT, randomized controlled trial; SD, standard deviation; TL, temporal lobe; XTL, extratemporal lobe.

Source: Schmidt and Stavem, 2009 (5).

The results of the studies comparing patients who underwent epilepsy surgery with controls who did not were pooled (Figure 2). Despite the high risk ratio in favour of surgery over no surgery (risk ratio, 4.30; 95% CI, 3.14–5.87), there was a high degree of statistical heterogeneity associated with this analysis ($I^2 = 51\%$). To attempt to understand this heterogeneity, the studies were subgrouped according to duration of follow-up: 1 to 2 years versus greater than or equal to 3 years (Figures 3 and 4 respectively). These results also support surgery over no surgery. Interestingly, the statistical heterogeneity was still high for the studies in the 1- to 2-year follow-up subgroup ($I^2 = 59\%$), but quite low for the longer follow-up subgroup ($I^2 = 1\%$).

The studies were also stratified according to type of control group: patients ineligible for surgery versus patients awaiting surgery. The statistical heterogeneity was still high for these studies and the risk ratio was still significantly in favour of surgery in both subgroups (results not shown).

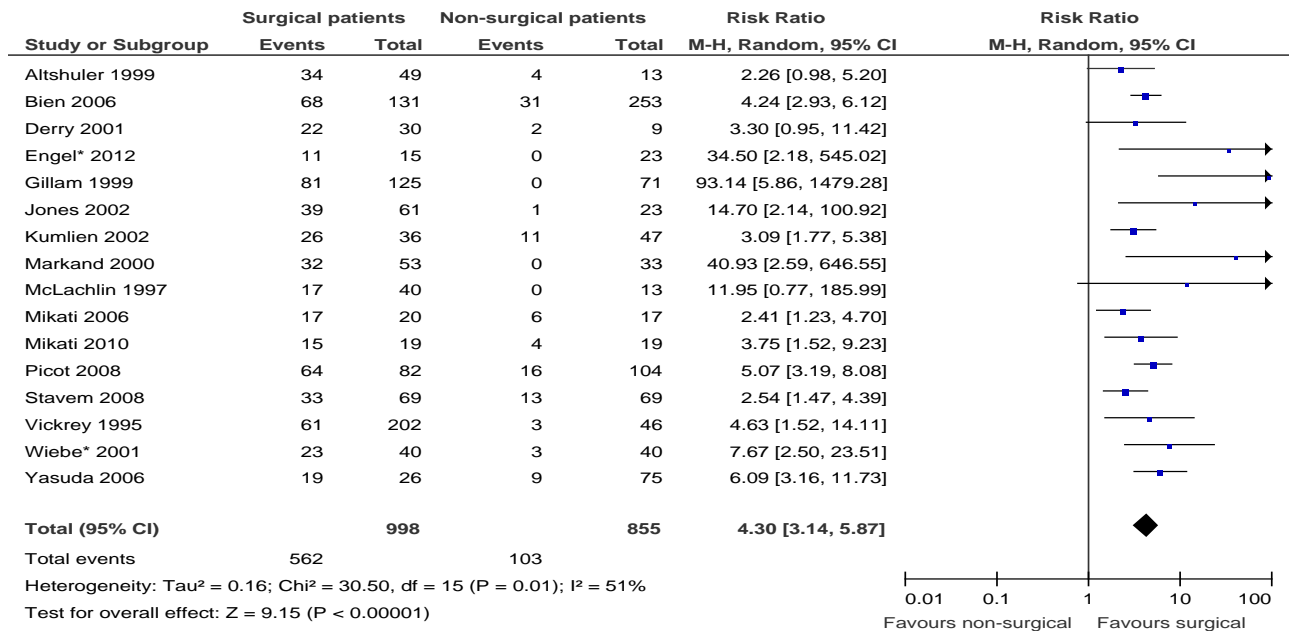


Figure 2: Forest Plot of All Studies Comparing Epilepsy Surgery to No Surgery Since 1995

Abbreviations: CI, confidence interval; M-H, Mantel-Haenszel.

* Randomized controlled trials (11;12)

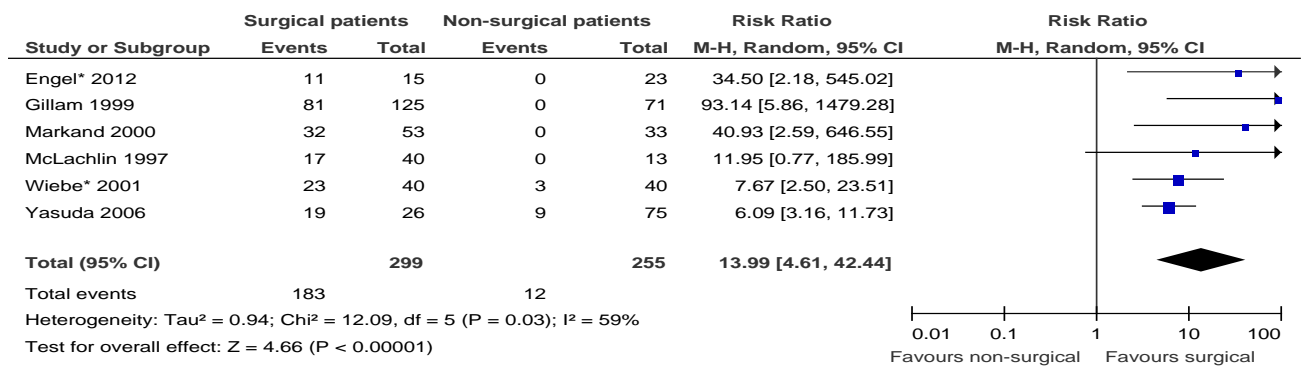


Figure 3: Forest Plot of Studies Comparing Epilepsy Surgery to No Surgery With 1 to 2 Years' Follow-up

Abbreviations: CI, confidence interval; M-H, Mantel-Haenszel.

* Randomized controlled trials (11;12)

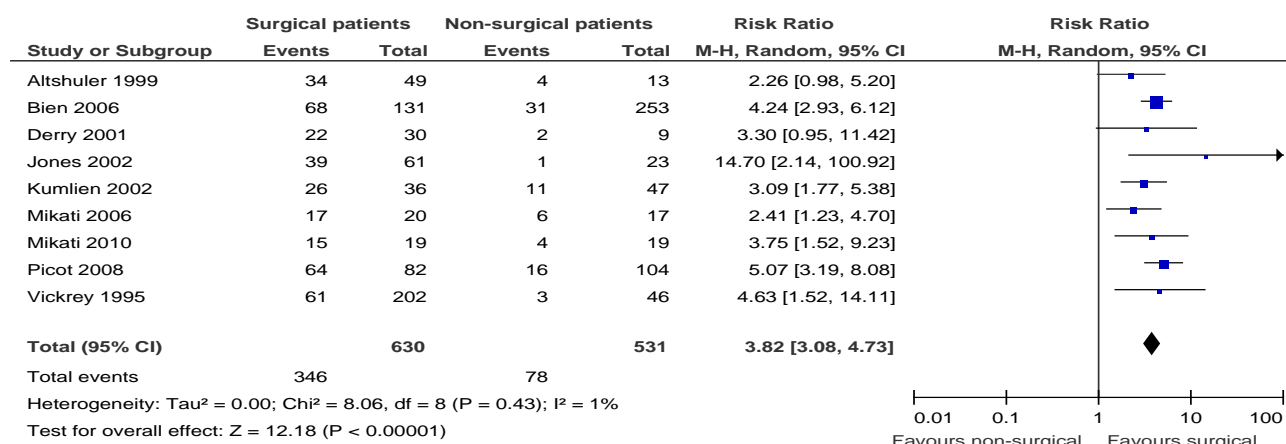


Figure 4: Forest Plot of Studies Comparing Epilepsy Surgery to No Surgery With 3 or More Years' Follow-up

Abbreviations: CI, confidence interval; M-H, Mantel-Haenszel.

Safety of Epilepsy Surgery

Eight studies—all retrospective cohort studies that included a total of 2,725 patients—reported on the safety of epilepsy surgery. Apart from the 3 deaths related to the surgery (0.1%), the majority of the complications reported were transient (see Table 4). With the exception of the study conducted by Koubeissi et al, (27) which specifically focused on in-hospital complications, the studies had long follow-up periods ranging from a mean of 2 to 7 years.

The study by Koubeissi et al (27) used health administrative data to assess in-hospital complications associated with epilepsy surgery. A limitation of this type of study is lack of access to the patient's medical chart to further clarify both the seriousness of complications and whether they resolved over time. For example, they reported that 13 patients suffered from depression during their hospital stay; however, it is not clear whether the patients recovered from the depression postdischarge.

Table 4: Characteristics of Studies Investigating the Safety of Epilepsy Surgery

Study	Study Design	Years	Number of Patients	Patient Population	Duration of Follow-up	Complications
Terra et al, 2010 (28)	Retrospective cohort	1995–2008	267	Children (< 18 years)	Mean [SD] = 5.5 [3.7] years	Only mortality data reported 2 deaths due to acute surgical complications 7 deaths in 2–10 years postsurgery (5 pneumonia, 1 sudden death, 1 status epilepticus)
Koubeissi et al, 2009 (27)	Retrospective cohort (inpatient health administrative data)	2000–2005	484	Inpatients	Duration of in-hospital stay	No surgical mortality Depression (n = 34) Intracerebral hemorrhage (n = 13) Visual field defect (n = 3)
Kim et al, 2008 (29)	Retrospective cohort	1993–2005	134	Children (8 months to 18 years)	62.3 months (range, 12–168 months)	No surgical mortality Brain swelling leading to removal of grid (n = 2) Subdural hematoma (n = 1) Visual field defect (n = 13) Permanent hemiparesis (n = 3)
Sindou et al, 2006 (30)	Retrospective cohort	1994–2003	100	Adults (18–58 years)	Mean 4.5 years (range, 1–10 years)	No surgical mortality Permanent mild hemiparesis (n = 2) Durable depressive state (partial recovery) (n = 3) Transient complications (n = 14)
Clusmann et al, 2004 (31)	Retrospective cohort	1995–2000	442	All ages	Unclear	No surgical mortality Symptomatic postoperative hemorrhages (n = 17) Permanent mild deficits (n = 33)
Salanova et al, 2002 (32)	Retrospective cohort	1984–1999	215	All ages (8 – 57 years) Patients with TLE	Mean 7 years (range, 1–15 years)	No surgical mortality Mortality—3 deaths during seizures, 3 deaths unexplained, 2 suicide, 2 accidents, 1 breast cancer (n = 11) Mild hemiparesis (n = 2) Infections (n = 3) Transient cranial nerve palsies (n = 7) Verbal memory loss (n = 19) Invasive electrode procedures: Infection (n = 4) Hematoma (n = 7) Dislocation of electrode (n = 2)
Rydenhag and Silander, 2001 (33)	Retrospective cohort (data from Swedish National Epilepsy Surgery Register)	1990–1995	654 (205 invasive electrode procedures, 449 therapeutic procedures)	All ages (6 months to 67 years) All surgery types	< 2 years	Therapeutic procedures: Hematoma causing death (n = 1) Hemiparesis (major) (n = 10) Hemianopia (major) (n = 2) Infection (minor) (n = 23) Other minor (n = 17)
Behrens et al, 1997 (34)	Retrospective cohort	1987–1992	429	All ages (4 months to 67 years)	Mean 3 years (range, 1–7.3 years)	No surgical mortality Transient surgical complications (n = 33) Permanent surgical complications (hydrocephalus) (n = 3) Transient neurological complications (n = 13) Permanent neurological complications (hemiparesis, dysphasia, disconnection syndrome) (n = 10)

Abbreviations: SD, standard deviation; TLE, temporal lobe epilepsy.
Note: Bolded entries describe surgery-related death.

Conclusions

There is considerable high quality evidence that epilepsy surgery is effective at reducing seizure frequency. Two RCTs compared surgery to no surgery in patients with drug-refractory epilepsy, and both demonstrated significant reductions in seizure frequency.

Epilepsy surgery has some short- and long-term complications associated with the procedure. In the published literature identified, we observed a 0.1% mortality rate associated with the surgery. Other complications include hemiparesis, infection, and visual field defects.

Acknowledgements

Editorial Staff

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Appendices

Appendix 1: GRADE Tables

Table A1: GRADE Evidence Profile for Comparison of Epilepsy Surgery and No Surgery

No. of Studies (Design)	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Upgrade Considerations	Quality
Outcome: Seizure-Free							
2 (RCTs) 14 (observational)	No serious limitations	No serious limitations	No serious limitations	No serious limitations	Undetected	None	⊕⊕⊕⊕ High
Outcome: Safety							
8 (observational)	Serious limitations (-1) ^a	No serious limitations	No serious limitations	No serious limitations	Undetected	None	⊕⊕⊕ Moderate

Abbreviations: No., number; RCT, randomized controlled trial.

^a The bias in the safety studies is limited to the extent that all complications were reported. Many of the studies were retrospective, thus relying on the adequacy of administrative data or completeness of medical charts.

Table A2: Risk of Bias in Randomized Controlled Trials Comparing Epilepsy Surgery and No Surgery

Author, Year	Allocation Concealment	Blinding	Complete Accounting of Patients and Outcome Events	Selective Reporting Bias	Other Limitations
Engel et al, 2012 (11)	No limitations	Limitations ^a	No limitations	No limitations	Limitations ^{b,c}
Wiebe et al, 2001 (12)	No limitations	Limitations ^a	No limitations	No limitations	Limitations ^b

^a No blinding was used in the Wiebe et al (12) study because doing so was not possible.

^b This study only included patients with temporal lobe epilepsy and not other forms of epilepsy. Thus it may not be generalizable to all types of epilepsy.

^c This study was stopped early due to low enrolment—they recruited 38 participants instead of the planned 200.

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