



Technical Note

Endoscopic-assisted evacuation of subdural collections

Ralph Mobbs, Peter Khong*

Department of Neurosurgery, Prince of Wales Hospital, Barker Street, Randwick, New South Wales 2031, Australia

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ABSTRACT

Treatment of chronic subdural haematoma (SDH) using endoscopic-assisted techniques is a minimally invasive method that may provide an addition to the standard technique of burr-hole craniostomy drainage.

Over a 12-month period the authors used endoscopic assistance with burr-hole craniostomy drainage, and prospectively collected data to review the technique. Ten patients were treated during the study, with an average age of 67. Subsequent to the study, one further procedure was performed on a 79-year-old man.

Although endoscopic assistance did not alter the intra-operative plan in most patients, it did assist with inserting a subdural catheter for washout of the subdural space, assessing for multi-loculation of the SDH and providing visual images that were captured for discussion with the patient/family and for later study. In one patient, endoscopy assisted with the visualisation and destruction of neomembranes.

We conclude that the technique is unlikely to alter the surgeon's pre-operative or intra-operative plan; however, in selected circumstances, it could make the procedure safer with enhanced intra-operative visualization and may also allow for the identification and destruction of neomembranes or solid clots under direct vision.

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1. Introduction

There are three principal techniques to address chronic subdural haematoma (SDH): (i) twist drill craniostomy, (ii) burr-hole craniostomy, and (iii) craniotomy. They have different profiles for morbidity, mortality, recurrence rate and cure rate.¹ Twist drill and burr-hole craniostomy can be considered first tier treatments, whereas craniotomy may be used as a second tier treatment.

The overall post-operative outcome of surgical treatment for chronic SDH has not improved substantially over the past 20 years.² We conducted the present study to establish technical issues and safety of endoscopic-assisted burr-hole craniostomy prior to a more comprehensive longer-term outcome study. There is little in the literature that explores the use of endoscopy for the evacuation of chronic SDH.

The treatment of loculated chronic SDH using endoscopic-assisted operative techniques is a minimally invasive method and a potential therapeutic addition or alternative to the standard technique. The application of intracranial endoscopy in neurotraumatology was first considered as a technical principle in the 1980s.³ We aimed to investigate the hypothesis that minimally invasive inspection of haematoma cavities is possible and may potentially enhance the therapeutic intervention of burr-hole drainage of

chronic subdural collections. Over a 12-month period, we have used endoscopic assistance with single burr-hole drainage, and prospectively collected data to review the technique.

2. Materials and methods

The indications for burr-hole craniostomy surgery are beyond the scope of this article; however, all 10 of the initial patients in this study had CT scan findings consistent with either a chronic or subacute subdural collection (Table 1). The authors prefer a single burr-hole technique, with the incision and burr-hole over the subdural collection at its maximal depth. All burr-holes were performed with a high-speed drill, with the diameter of the hole ranging from 20 mm to 35 mm. Following exposure and haemostasis, the dura was incised in a cruciate fashion and diathermied to the burr-hole limits. Initial evacuation of the haematoma was performed in the standard fashion with warm isotonic saline irrigation of the subdural plane. The head of the bed was angled towards the floor to aid gravity drainage of the subdural remnants. The bed was returned to neutral or slightly head-up and a 30-degree endoscope introduced under direct vision so as to not damage the cortical surface. Inspection of the subdural space was now commenced looking specifically for areas of loculation and, if necessary, to aid the introduction of a subdural catheter for a more comprehensive washout. The technique of endoscopic inspection of the subdural space is relatively simple. The surgeon may use a small joint

* Corresponding author. Tel.: +61 2 93822222.

E-mail address: petekhong@yahoo.com (P. Khong).

Table 1
Burr-hole drainage procedures in 10 consecutive patients using endoscopic assistance

Age/Sex	Pathology	Suitable?	Membrane	Multiloc.	Craniotomy?
74/F	SubASDH	Y	N	Y	N
68/M	CSDH	Y	N	N	N
53/M	CSDH	N (no space)	Y	?	N
89/M	CSDH	Y	Y	Y	N
82/F	CSDH	Y	N	N	N
64/M	CSDH	Y	Y	Y	Y
90/M	Hygroma	Y	N	N	N
72/F	CSDH	Y	N	N	N
76/F	CSDH	Y	N	N	N
61/M	CSDH	N (no space)	Y	Y	Y
79/M	SubASDH	Y	Y	Y	N

CSDH = chronic subdural haematoma, multiloc = multiloculations; N = no; SubASDH = subacute subdural haematoma; Y = yes.

arthroscope or cystoscope connected to a light source and video-scope chain. A 30-degree scope is of most value as the operator can “see around the corner” (Fig. 1). An optimal diameter scope should be no more than 4 mm in diameter. If the scope is too wide, it may “crowd” the burr-hole making it difficult to introduce other instruments or catheters through the confined volume. Images can now be taken to attach to the patient file and to show the patient or family. In patients with a thick subdural membrane, or when the brain re-expansion was rapid following initial drainage, an endoscope could not be introduced due to inadequate working space.

Towards the end of the study period, to aid introduction of the endoscope, the authors “undercut” the burr-hole, making the internal diameter of the burr-hole at the inner table greater than at the outer table. This aided the initial angulation and introduction of the endoscope. At the end of the procedure, gel foam or a burr-hole cover was placed over the defect. A subgaleal drain on minimal suction was placed if there was a residual “empty space” in the subdural plane.⁴ If the brain had re-expanded to occupy the subdural volume, no drain was used. Standard care was administered in the post-operative phase.

3. Results

Over 12 months, a total of 10 procedures were attempted with endoscopic assistance. Subsequent to this, 1 further patient was in-

volved in the study. In 2 patients, conditions were not suitable for the introduction of an endoscope due to inadequate working volume. Eight of the 10 procedures were documented with still picture capture. Six procedures were timed with a mean additional time of 22 min due to endoscopic intervention. There was no additional morbidity throughout the study as a result of endoscopic inspection.

Although the potential risk of cortical damage with endoscope insertion has been discussed,⁵ we did not experience this complication. The addition of endoscopic inspection did not alter the intra-operative decision-making for any of the operations performed.

3.1. Case illustrations

Patient 1 is a 74-year-old female presenting with headaches with a history of minor head trauma 3 weeks prior. The CT scan revealed an isodense subdural collection. Fig. 2 demonstrates the intra-operative finding of considerable subdural loculation that was addressed with multiple passes of a subdural catheter and subsequent washout. The patient did not require further surgical treatment.

Patient 2 is a 90-year-old male who presents with progressive deterioration in mentation over 6 months. The CT scan revealed a bilateral hypodense subdural collection. The geriatric physician was adamant that burr-hole drainage should be attempted. At operation, (Fig. 3) endoscopic examination demonstrated a generous subdural space with no suggestion of any blood products. The diagnosis of cerebrospinal fluid hygroma was confirmed. The patient did not improve following the procedure. Still images were of benefit in explaining the findings to both the geriatric physician and the patients' family.

Patient 3 is a 79-year-old male who presented with a gradual decline, with worsening orientation, language, and increasing confusion. The CT scan revealed a large right-sided subacute subdural collection, with about 10 mm of midline shift and significant effacement of the right lateral ventricle. The haematoma appeared heterogeneous and loculated, which suggested the possible presence of neomembranes. Significant past medical history included atrial fibrillation for which the patient was on warfarin - the admitting international normalised ratio (INR) was 2.2. After treatment

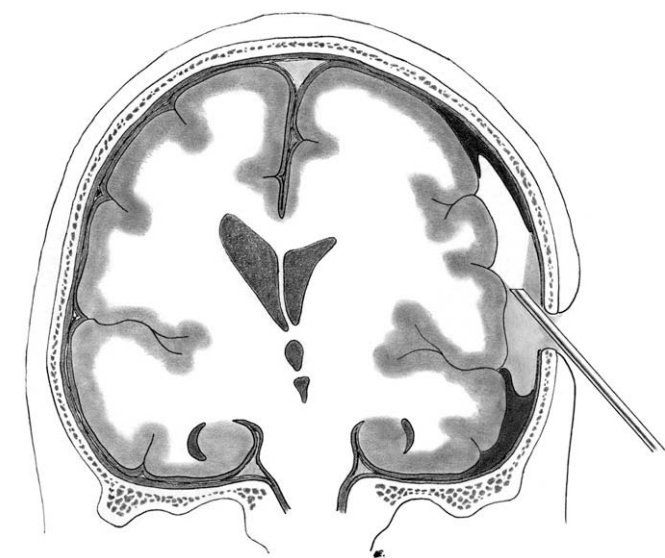


Fig. 1. The endoscope is introduced through the burr-hole to visualize “around the corner” to observe the subdural plane.

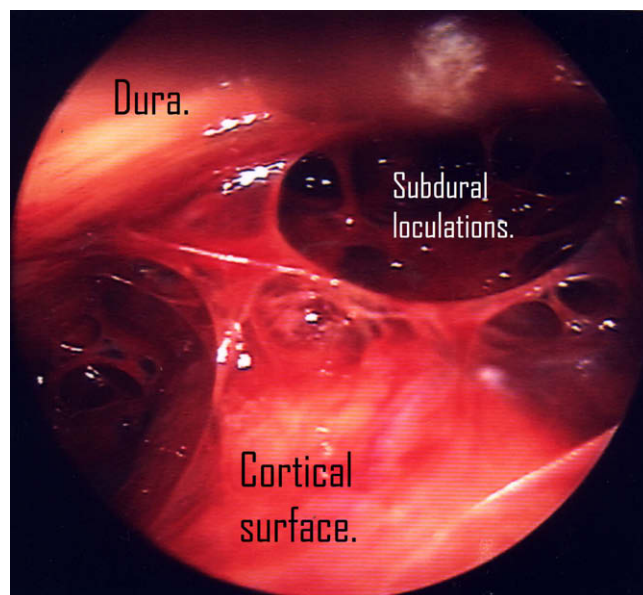


Fig. 2. Multiple loculations – the insertion of a subdural catheter can be performed safely under direct visualization.

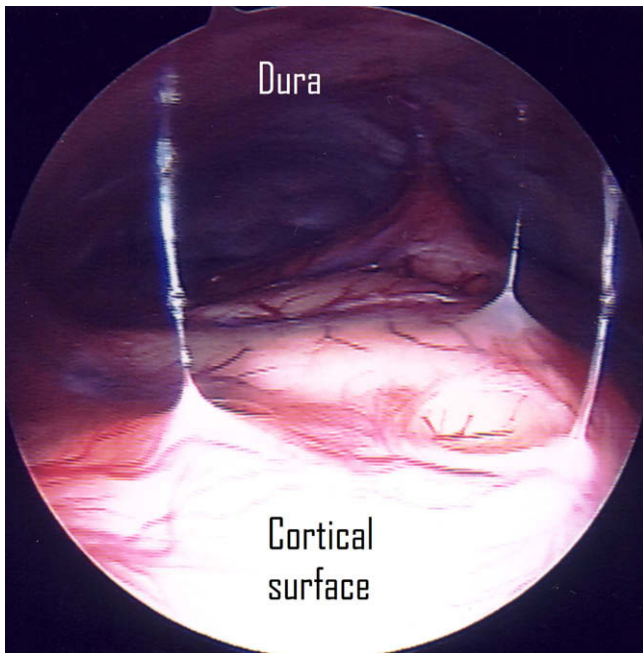


Fig. 3. Hygroma – the endoscope pictures are useful in documenting the absence of blood for medico-legal reasons and for discussion with the family. (This figure is available in colour at www.sciencedirect.com.)

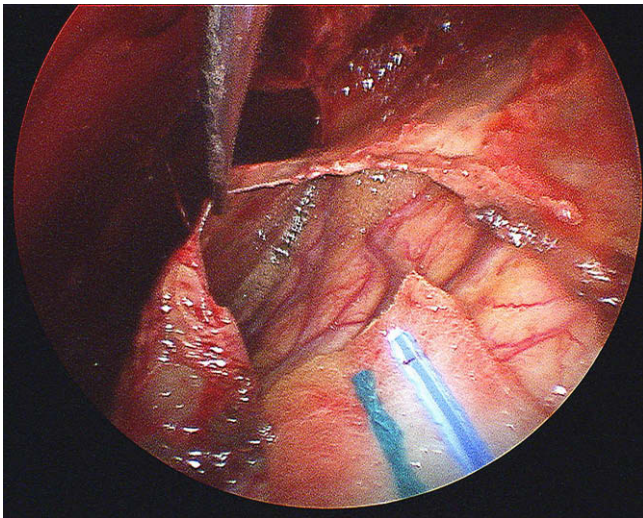


Fig. 4. Division of the subdural membrane with a sharp hook under endoscopic guidance. (This figure is available in colour at www.sciencedirect.com.)

with Vitamin K and fresh frozen plasma, a mini-craniotomy was performed. Endoscopy revealed extensive neomembranes within the chronic SDH, and assisted in the division and destruction of these membranes (Figs. 4 and 5).

4. Discussion

Chronic SDHs can be treated operatively via twist drill craniotomy, burr-hole craniostomy or craniotomy. There is an abundance of literature advocating which is the best technique yielding the lowest morbidity and mortality given the clinical picture and radiological findings. Burr-hole treatment is generally accepted as being safer than a craniotomy, and the latter should be reserved

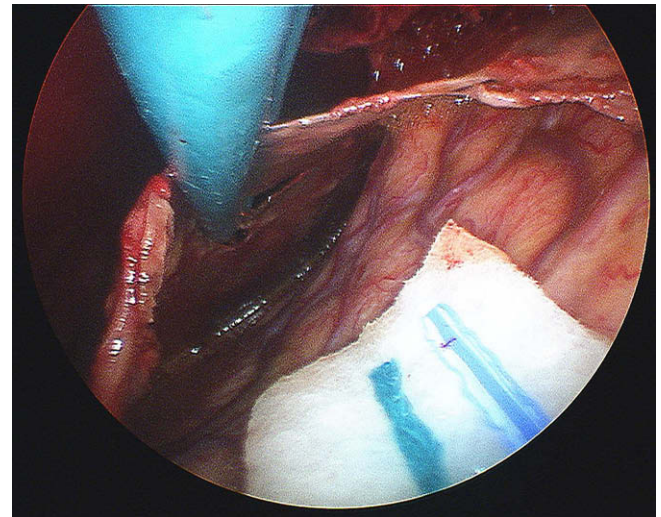


Fig. 5. Diathermy of the subdural membrane under endoscopic guidance.

for such indications as repeated recurrence of the haematoma, solid consistency of the haematoma, lack of re-expansion of the shifted brain tissue, and space-occupying brain oedema of the involved hemisphere.⁶

In a large evidence-based review, Weigel et al. demonstrated that the morbidity was significantly higher for craniotomy compared to twist drill or burr-hole craniostomy, but craniotomy was still the surgical approach with the least recurrence.¹ Smely et al. found significantly better clinical results using twist-drill trephination with the insertion of a special subdural catheter over burr-hole craniotomy.⁷ Hamilton, however, found no difference in outcomes between burr-hole versus craniotomy.⁸ Sambasivan, in his experience with 2300 cases, actually advocated the use of craniotomy with subtemporal marsupialisation over multiple burr-hole drainage for all cases, finding a recurrence rate of 0.35% versus 21.5% respectively and a mortality rate of 0.5% versus 4% respectively.⁹ Hennig et al. demonstrated the benefit of continuous irrigation over burrhole drainage with passive drainage (without irrigation), and even over craniotomy.¹⁰

A common post-operative complication that arises from surgical evacuation of a chronic SDH is reaccumulation of the haematoma – although residual fluid is often detected on post-operative CT scanning (up to 80%¹¹), the symptomatic recurrence rate is about 8% to 37%.¹² Recurrent bleeding from the haematoma capsule is the most widely accepted theory that explains the growth of a chronic SDH.¹³ Whereas non-septated chronic SDHs can be easily treated with burr-hole evacuation and washout, the septated form is often much more difficult to treat, with a much higher rate of recurrence due to inadequate washout and division of neomembranes.

Rocchi et al. recently suggested that contrast-enhanced MRI would greatly improve the opportunity for discovering thick and extensive neomembrane or solid clot before surgical intervention,¹⁴ allowing for immediate craniotomy without initially attempting drainage by burr-hole. They recognised that failure to recognise and properly treat chronic SDH was the primary reason for reaccumulation. They recommended pre-operative MRI for chronic SDHs that had an unusual appearance on CT scans, cases of recurrent chronic SDH, or enhancement of some portions of the haematoma and its membranes after contrast.¹⁴ We propose that in select circumstances, endoscopy could be used to assist in recognising neomembranes intra-operatively, and possibly aid in its treatment – this may be either through endoscopy-guided destruction of the neomembrane or through conversion to a formal craniotomy.

Table 2

Potential indications for endoscopic assistance with burr-hole subdural drainage

1. Subdural catheter insertion with loculated haematoma
2. Visualisation and destruction of neomembranes and solid clot
3. Possible medico-legal issues requiring visual documentation
4. Confirm diagnosis of subdural hygroma

Although it was not possible in most cases to demonstrate the advantages of the technique in this study, endoscopic assistance could possibly aid in the washout and destruction of this membrane, possibly reducing the rate of reaccumulation, such as in the 79-year-old male patient who was treated after the initial study period. Hellwig et al. are one of the few who have advocated the use of endoscopic operative technique combined with a closed drainage system as an alternative to craniostomy-membranectomy.⁶ They described the successful use of endoscopy and resection of neomembranes in the treatment of 13 out of 14 patients who had had previously ineffective burr-hole drainage, in which no recurrence occurred. Rodziewicz et al. presented two cases in which endoscopy was used through a small craniectomy to successfully remove organised chronic SDH.¹⁵

Of the 11 patients in the trial, 9 procedures were suitable for endoscopic assistance, with 2 procedures not suitable for the introduction of an endoscope. The first failure was due to rapid re-expansion of the brain following decompression, with loss of space to introduce the endoscope. The second failure was due to a thick subdural membrane with minimal egress of subdural fluid. There was no potential volume/space in which to fit the endoscope.

Potential advantages of the described technique (Table 2) are a reflection of the improved visualization of the subdural plane. The potential to image separate septum formation and multi-loculation is a definite advantage over the usual “blind” procedure. Various methods of breaking down more solid haematomas or neomembranes have been described, including continuous (and post-operative) irrigation¹⁰ and craniotomy for membranectomy. Hamilton⁸ noted that some surgeons advocated that craniotomy provided a better and safer opportunity to adequately deal with the haematoma, its membranes, and occasional troublesome bleeding, while allowing for the safe and controlled insertion of a subdural drain. Many surgeons use a subdural catheter to wash out the SDH with the potential for cortical damage with the initial insertion of such a device. Endoscopic assistance can potentially provide all of this, and aid in positioning of a subdural catheter and avoid cortical laceration. Where hygroma is suspected, the visualization of the cerebral cortex to confirm the absence of clot and membrane formation is of benefit to the surgeon and the patient. Intra-operative pictures can help explain the underlying problem to the patient and family members, and to provide a visual aid to discuss post-operative problems such as recurrence.

Disadvantages of the procedure are based on the surgeons' comfort with using endoscopes and working in a two-dimensional environment. The major problem is the potential to damage the cortical surface with the introduction of a rigid endoscope into a

confined space. The surgeon should make sure the corridor for endoscope introduction is adequate and initially use both hands on the endoscope to avoid plunging into the cortex. A mini-craniotomy is another alternative to provide adequate room for the introduction of an endoscope along with other instruments.

In addition, the extra time taken with the set-up of the endoscope and video chain is a disadvantage, considering that burr-hole craniostomy is usually a short procedure. The addition of an extra 20 min may deter surgeons from adopting the procedure. However, it may ultimately save time in not requiring pre-operative MRI scanning, should one be inclined to use this to anticipate the presence of a neomembrane or solid clot, and may also potentially save time in preventing the need for craniotomy or allowing for the immediate conversion to craniotomy if indicated.

In conclusion, endoscopic assistance is unlikely to be of long-term benefit for use with every procedure for chronic SDH craniostomy drainage in terms of reducing the number of repeat procedures or requirement for a second-tier therapy such as craniotomy. We think, however, that for selected indications, it may be of additional benefit. These benefits include subdural catheter insertion for subdural washout, endoscopy-guided destruction and removal of neomembranes or solid clots, record-keeping and medico-legal documentation.

References

1. Weigel R, Schmeidek P, Krauss JK. Outcome of contemporary surgery for chronic subdural haematoma: evidence based review. *Neurol Neurosurg Psychiatry* 2003;**74**:937–43.
2. Gelabert-Gonzalez M, Iglesias-Pais M, Garcia-Allut A, et al. Chronic subdural haematoma: surgical treatment and outcome in 1000 cases. *Clin Neurol Neurosurg* 2005;**107**:223–9.
3. Karakhan VB. Experience using intracranial endoscopy in neurologic traumatology. *Vestn Khir Im I I Grek* 1988;**140**:102–8.
4. Lind CR, Mee EW. Reduction in the number of repeated operations for the treatment of subacute and chronic subdural hematomas by placement of subdural drains. *J Neurosurg* 2003;**99**:44–6.
5. Teo C, Rhaman S, Boop F. Complications of endoscopic neurosurgery. *Childs Nerv Syst* 1996;**12**:248–53.
6. Hellwig D, Kuhn TJ, Bauer BL, et al. Endoscopic treatment of septated chronic subdural hematoma. *Surg Neurol* 1996;**45**:272–7.
7. Smely C, Madlinger A, Scheremet R. Chronic subdural haematoma—a comparison of two different treatment modalities. *Acta Neurochir (Wien)* 1997;**139**:818–26.
8. Hamilton MG, Frizzell JB, Tranmer BI. Chronic subdural hematoma: the role for craniotomy reevaluated. *Neurosurgery* 1993;**33**:67–72.
9. Sambasivan M. An overview of chronic subdural hematoma: experience with 2300 cases. *Surg Neurol* 1997;**47**:418–22.
10. Hennig R, Kloster R. Burr-hole evacuation of chronic subdural haematomas followed by continuous inflow and outflow irrigation. *Acta Neurochir (Wien)* 1999;**141**:171–6.
11. Adhiyaman V, Asghar M, Baneshram KN, et al. Chronic subdural haematoma in the elderly. *Postgrad Med J* 2002;**78**:71–5.
12. Traynelis VC. Chronic subdural haematoma in the elderly. *Clin Geriatr Med* 1997;**7**:281–94.
13. Sato S, Suzuki J. Ultrastructural observations of the capsule of chronic subdural haematoma in various clinical stages. *J Neurosurg* 1975;**43**:569–78.
14. Rocchi G, Caroli E, Salvati M, et al. Membranectomy in organised chronic subdural hematomas: indications and technical notes. *Surg Neurol* 2007;**67**:374–80.
15. Rodziewicz GS, Chuang WC. Endoscopic removal of organized chronic subdural hematoma. *Surg Neurol* 1995;**43**:569–73.