Frontal Lobe Decortication (Frontal Lobectomy with Ventricular Preservation) in Epilepsy—Part 1: Anatomic Landmarks and Surgical Technique

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■ BACKGROUND: **An extensive frontal resection is a frequently performed neurosurgical procedure, especially for treating brain tumor and refractory epilepsy. However, there is a paucity of reports available regarding its surgical anatomy and technique.**

■ OBJECTIVES: **We sought to present the anatomic landmarks and surgical technique of the frontal lobe decortication (FLD) in epilepsy. The goals were to maximize the gray matter removal, spare primary and supplementary motor areas, and preserve the frontal horn.**

■ MATERIAL AND METHODS: **The anatomic study was based on dissections performed in 15 formalin-fixed adult cadaveric heads. The clinical experience with 15 patients is summarized.**

■ RESULT: **FLD consists of 5 steps: 1) coagulation and section of arterial branches of lateral surface; 2) paramedian subpial resection 3 cm ahead of the precentral sulcus to reach the genu of corpus callosum; 3) resection of gray matter of lateral surface, preserving the frontal horn; 4) removal of gray matter of basal surface preserving olfactory tract; 5) removal of gray matter of the medial surface under the rostrum of corpus callosum.**

The frontal horn was preserved in all 15 patients; 12 patients (80%) had no complications; 2 patients presented temporary hemiparesis; and 1 Rasmussen syndrome patient developed postoperative fever. The best seizure control was in cases with focal magnetic resonance imaging abnormalities limited to the frontal lobe.

■ CONCLUSION: **FLD is an anatomy-based surgical technique for extensive frontal lobe resection. It presents reliable anatomic landmarks, selective gray matter removal, preservation of frontal horn, and low complication rate in our series. It can be an alternative option to the classical frontal lobectomy.**

INTRODUCTION

The frontal lobe is the largest lobe of the brain, comprising approximately one third of the hemispheric surface,[1,2] and it is a frequent resection target in neurosurgery. However, the technical aspects, anatomic landmarks, and complication avoidance of an extensive frontal lobe resection have received little attention in the neurosurgical literature. This was one of the difficulties the lead author (H.T.W.) encountered in the early stage of his career as an epilepsy surgeon (1996) when dealing with patients with refractory epilepsy that required extensive frontal lobe resection.

The classical technique of frontal lobectomy as described in the literature[3-6] consists of placing the patient in supine position with the head turned 20–40° toward the contralateral side; by means of a transcoronal skin incision, a unilateral frontal craniotomy is performed, having the anteromedial edge of the craniotomy located 1.5 cm lateral to the midline and just above the frontal sinus. The frontal lobe is then resected from the lateral surface toward the interhemispheric surface by following the plane traced between the anterior limit of the pars opercularis of the inferior frontal gyrus to the superior frontal gyrus, approximately 7–8 cm

Key words
- Epilepsy surgery
- Frontal lobe
- Frontal lobectomy
- Microsurgical anatomy
- Neurosurgery
- Surgical technique

Abbreviations and Acronyms
FAM: Frontotemporal arachnoid membrane
FLD: Frontal lobe decortication
MRI: Magnetic resonance imaging
SMA: Supplementary motor area

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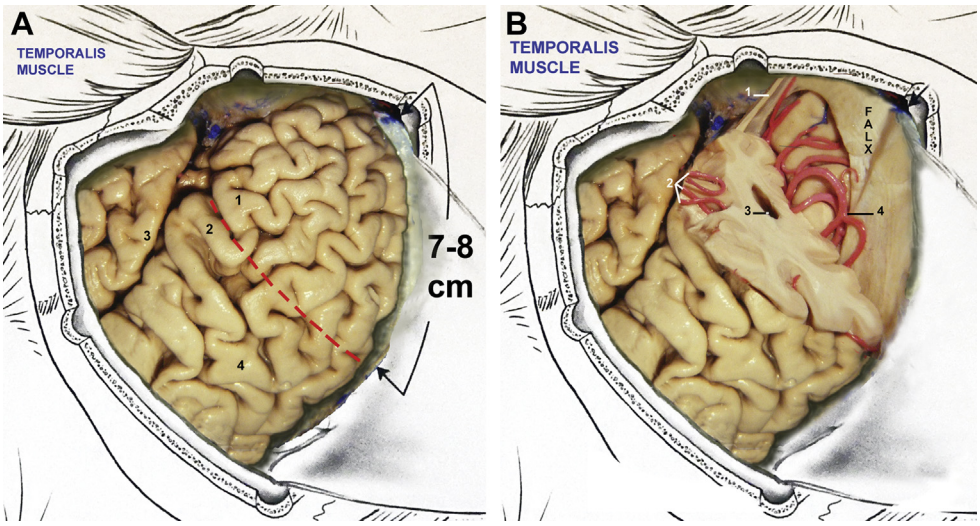

Figure 1. (**A**) Anatomic dissection displays the exposure for the classical left frontal lobectomy. *1*, pars triangularis; *2*, pars opercularis; *3*, superior temporal gyrus; *4*, precentral gyrus. The *red dotted line* indicates the approximate resection line. (**B**) Same specimen displayed in (**A**) after the classical left frontal lobectomy. The pars opercularis has been removed to display the proximity of the anterior insula and the resection line. *1*, olfactory tract; *2*, branches of middle cerebral artery over the anterior insula; *3*, frontal horn (opened); *4*, branches of pericallosal artery.

from the anteromedial edge of the craniotomy (Figure 1A). The final aspect of the classical frontal lobectomy can be seen in Figure 1B.

From 1998–2003, the lead author (H.T.W.) performed extensive frontal lobe resections in 7 patients with refractory frontal epilepsy; 6 surgeries followed the basic concept of the classical frontal lobectomy but were tailored for each case, and in 1 surgery the frontal resection was tailored following the intraoperative electrocorticography findings.

The feeling of the lead author after those 7 cases was that it was rather challenging to remove the frontal lobe from its lateral surface toward the midline, following the coronal plane just anterior to the pars opercularis of the inferior frontal gyrus because there was always a possibility of a small but inadvertent deviation occurring along that path. An anterior deviation can result in a suboptimal frontal removal, and a posterior deviation can risk the insula and basal ganglia. When that coronal dissection path was correctly executed, the frontal horn was opened and the opened frontal horn actually served as a landmark for completing the frontal lobectomy.

From that early series, 1 patient developed symptomatic subdural cerebrospinal fluid collection that required a shunt procedure (Figure 2A). The patient with a frontal resection who was guided by electrocorticography (magnetic resonance imaging [MRI] negative right frontal lobe epilepsy) developed supplementary motor area (SMA) syndrome: immediate postoperative left hemiplegia, normal muscle tone, hemispatial neglect syndrome, and sudden and complete recovery after 7 days (Figure 2B and C).

We attributed the subdural cerebrospinal fluid collection to the opening of the frontal horn and the SMA syndrome to the surgical resection of cortex anterior to the precentral gyrus.[7-10]

The risk of inadvertent deviation, frontal horn opening, and SMA injury may be avoided with a more limited frontal resection; however, the risks increase when a more extensive frontal lobe removal is required. Therefore a surgical technique that allows extensive frontal lobe resection with reliable intraoperative guiding landmarks, and at the same time spares both the frontal horn and SMA, is necessary.

These observations led the authors to the laboratory of microneuroanatomy in search of such a surgical technique. They describe the result of this study, a surgical technique suitable for extensive frontal lobe removal based on anatomic landmarks for refractory epilepsy; it maximizes the gray matter resection, spares the supplementary and primary motor areas, and avoids opening the frontal horn. Since the main objective of this technique is to remove the cortex (gray matter) of the frontal lobe, the authors have named it *frontal lobe decortication* (FLD).

A detailed analysis of our series of 15 cases including the indications, complications, short- and long-term follow-up regarding the treatment of epilepsy, and a comparison between the results of FLD and the results of other techniques will be presented in part 2 of this manuscript.

MATERIAL AND METHODS

The anatomic part of the study and its photographic documentation were performed at the microneurosurgical anatomy laboratory of the Department of Neurological Surgery, University of Florida, United States, from 1993–1996 (H.T.W.) and in 2012 and