

Awake craniotomy: first experience

*Atroun.L¹, Djafer.M¹

¹(Neurosurgery, Mustapha Bacha Hospital, University of Algiers, Algeria)

Corresponding Author: *Atroun.L

Abstract: Surgery for infiltrative gliomas aims to balance tumor removal with preservation of functional integrity. Awake craniotomy with intraoperative electrical mapping is a reliable method to minimize the risk of permanent deficit during surgery for low-grade gliomas located within eloquent areas classically considered inoperable. However, it could be argued that preservation of functional sites might lead to a lesser degree of tumor removal. We report our first experience concerning series of patients who underwent awake mapping. Twenty patients underwent surgery for a low-grade glioma in functional sites under local anesthesia in the awake condition with intraoperative electrostimulation. The resection was performed according to functional boundaries at both the cortical and subcortical levels. Postoperative MRI showed that the resection was complete in 4 cases, subtotal in 12 cases and partial removal in 4 cases (paracentral area). All patients returned to normal professional and social lives. Glioma resection using ISM are associated with fewer late severe neurologic deficits and more extensive resection, and they involve eloquent locations more frequently. This indicates that ISM should be universally implemented as standard of care for glioma surgery.

Keywords: awake surgery, direct electrical stimulation, functional brain mapping, low grade gliomas

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I. Introduction

Indications for surgical treatment of low grade gliomas depend on the risk of a definitive neurological deficit, related to the benefit of resection. Detection of eloquent neural structures is then mandatory, taking account of the major individual anatomic-functional variability both for sensorimotor and language functions. The more precise and reliable method nowadays is represented by intra-operative direct electrical stimulations (DES) of the central nervous system, which allows a safe real-time identification and hence preservation of essential pathways. This technique can provide intra-operative functional mapping at the cortical and sub-cortical brain level.

II. Patients And Methods

All patients with low grade gliomas close to an eloquent area seen in our institution between July 2015 and July 2017 were considered for entry into this prospective study. Patients were excluded in case of severe pre-operative deficit. In all surgical procedures, the location of the lesion was intra-operatively verified using ultrasonography (fig 1). All subjects underwent surgical resection using DES. The principle consists in the direct application on the neural structures of a 5 mm spaced tips bipolar probe delivering a biphasic current with an intensity non-deleterious to the nervous system (current amplitude from 3 to 5mA) (fig 2). Under local anesthesia to perform surgery on an awake co-operating patient without any pain or discomfort for him, to study during operation not only essential cortico-sub-cortical areas of motricity, but also of sensitivity, language, and even memory. Patient is installed in the lateral position with great efforts to ensure that he could remain in this position for the duration of the procedure (fig 3). Patient was during opening and closing of the craniotomy anaesthetized without intubation using Propofol and Alfentanyl, with infiltration (Xylocaine 2%) of the skin and the dura-mater as a regional field block. Patient is awakened before the opening of the dura, and the mapping performed.

III. Results

There were 15 males and 5 females with an age range of 15 to 60 years (median 35 years). Presenting symptoms were seizures in 9 cases, with normal neurological examination, progressive mild deficit (2 motor deficits, 1 language disturbances). Concerning location, MRI revealed 4 central lesions, 6 fronto-temporo-insular lesions, 8 fronto-opercular lesions, 2 parieto-occipital lesions (fig 4). All patients were operated on awake under local anesthesia: 4 with sensori-motor mapping (central lesions), and 16 with sensori-motor and language mapping (perisylvian lesions). In all cases, eloquent areas were identified, without any "negative" brain mapping: it means that the motor sites were detected in the 10 patients, the somatosensory areas in the 2 awake

patients, and the language (speech arrest and naming) sites in the 8 patients with specific language mapping. The resection was then systematically pursued up to contact with the eloquent cortical and sub-cortical areas detected by stimulations (with a 7 mm margin around). All procedures under local anesthesia were well tolerated (median duration 5 hours). No complication was noted due to the use of DES. Immediate and transitory worsening of the neurological status was observed 2 motor impairments in which 1 supplementary motor area syndrome, 3 language, 1 somatosensorial worsening. All these patients recovered within 15 days to 3 months. For all lesions, resection was considered subtotal in case of a residue with a volume less than 10 cc, and partial if the volume is more than 10 cc. Resections were supratotal in 4 cases, subtotal in 12 cases, and partial in 4 cases because of infiltration of eloquent areas by the tumor (fig 5,6).

IV. Discussion

Low-grade intrinsic brain tumors represent a therapeutic conundrum for neurosurgeons and neurooncologists. The risk of resection can be substantial due to the vicinity of the tumor relative to the surrounding functional cortex and vascular structures[3.4]. The major goals of surgery are to avoid neurological morbidity, relieve any mass effect (which is rare), provide a diagnosis (and avoid sampling error), control seizures, and decrease the likelihood of recurrence and malignant transformation by cytoreduction. Surgical management of low-grade gliomas changed dramatically in the past decade, especially concerning those involving brain crucial regions [1.16]. Advances in methods of intraoperative functional mapping in awake patients have been demonstrated to significantly increase indications of surgical resection while minimizing the risk of permanent deficit for low-grade gliomas located within the so-called eloquent areas, classically considered inoperable [1.2.3.6]. Emerging literature strongly suggests that a greater extent of resection portends better oncological outcomes, specifically longer overall patient survival, longer progression-free survival, and decreased malignant transformation[4.5]. Direct electrical stimulations are known for more than a century; this method was used in neurosurgery only since 1930, first by Foerster[7], and then developed by Penfield who described the famous Homunculus [12.13.14]. DES represent a reliable method but the sine qua non condition is to identify the eloquent areas before any resection. The recent use of a bipolar probe allowed the avoidance of local diffusion and a more precise mapping [8], with an accuracy estimated around 5 mm. Moreover, DES is safe for the central nervous system, as observed by the histological examination of resected structures first stimulated *in vivo*. In this way, Taylor described in a recent study five patients with permanent worsening despite negative brain mapping [19]. Consequently, we perform in our experience systematically a wide bone flap, to expose the lesion and the functional regions both to be detected before the resection. Prediction of functional organization of the brain areas using classical anatomical criteria is not reliable, because of the existence of an important individual variability in normal subjects as in patients with a brain lesion and the possible functional reorganization by cerebral plasticity mechanisms [17.10]. Moreover, tumors may contain functional tissue in a patient without any deficit [9]. The use of intra-operative DES allowing a real-time and accurate detection of the essential functional neural structures seems then mandatory[16]. Stimulations do not prevent and do not predict a transitory immediate neurological worsening when the resection is pursued close to the functional networks [18].

Figures and Tables



Fig 1: In all surgical procedures, the location of the lesion was intra-operatively verified using ultrasonography



Fig 2: direct application on the neural structures of a 5-mm spaced tips bipolar probe delivering a biphasic current



Fig 3: Patient is installed in the lateral position

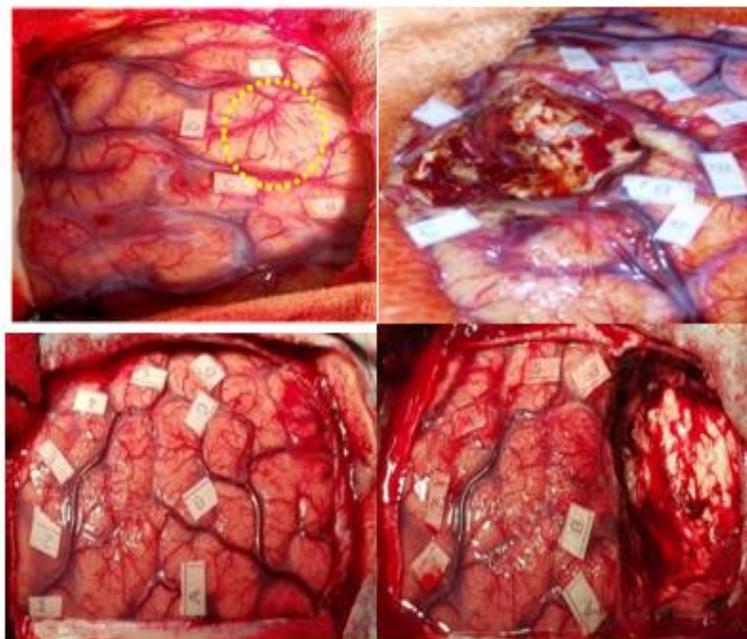


Fig 4: lesions before and after stimulation and resection

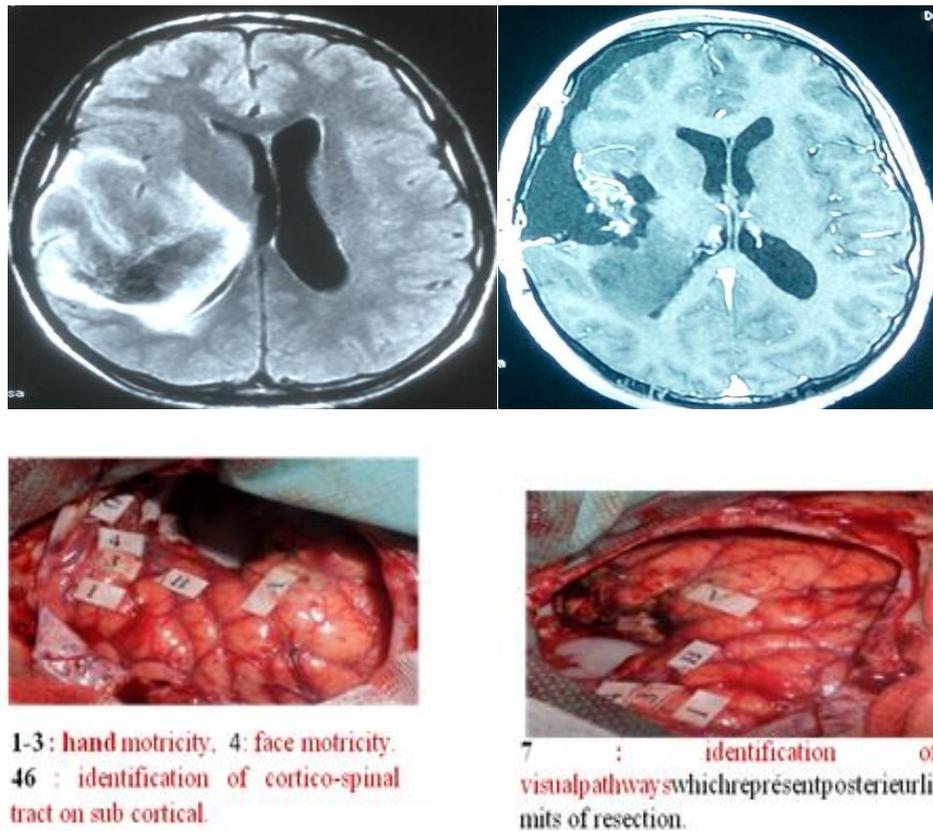


Fig 5: resection of paralympique LGG

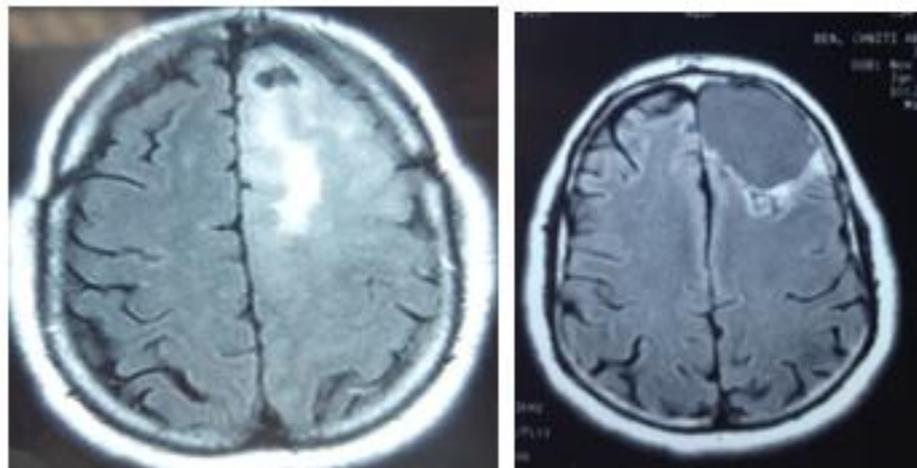


Fig 6: resection of left frontal glioma

Perspectives: A wider pre-operative battery of functional tasks, particularly for language, with the aim of a better selection of the intra-operative tests adapted to the patient. A prospective study of the correlation between pre-operative functional imaging data and intraoperative DES data.

V. Conclusion

The use of intraoperative direct awake brain stimulation during surgery of low-grade gliomas enables the surgeon to perform a resection according to functional boundaries, minimizing postoperative morbidity and even improving quality of life, but also that this technique has a quantitative impact on the extent of resection.

References

- [1]. Abeloos L, Brotchi J, De Witte O. Management of low-grade glioma: a retrospective study concerning 201 patients [in French]. *Neurochirurgie*. 2007;53(4):277-283
- [2]. Bello L, Gallucci M, Fava M, et al. Intraoperative subcortical language tract mapping guides surgical removal of gliomas involving speech areas. *Neurosurgery*. 2007;60(1):67-82
- [3]. Benzagmout M, Gatignol P, Duffau H. Resection of World Health Organization grade II gliomas involving Broca's area: methodological and functional considerations.
- [4]. Chaichana KL, McGirt MJ, Latta J, Olivi A, Quiñones-Hinojosa A: Recurrence and malignant degeneration after resection of adult hemispheric low-grade gliomas. *Clinical article J Neurosurg* 112:10–17, 2010
- [5]. Duffau, H.(2005).Lessons from brain mapping in surgery for low-grade glioma:insights into associations between tumour and brain plasticity. *Lancet Neurol*. 4,476–486.
- [6]. Duffau H, Lopes M, Arthuis F, et al. Contribution of intraoperative electrical stimulations in surgery of low grade gliomas: a comparative study between two series without (1985-96) and with (1996-2003) functional mapping in the same institution. *J Neurol Neurosurg Psychiatry*. 2005;76(6):845-851
- [7]. Foerster O (1931). The cerebral cortex of man. *Lancet* 2: 309±312
- [8]. Haglund MM, Ojemann GA, Blasdel GG (1993) Optical imaging of bipolar cortical stimulation. *J Neurosurg* 78: 785±793
- [9]. Herholz K, Thiel A, Wienhard K, Pietrzyk U, von Stockhausen HM, Karbe H, Kessler J, Bruckbauer T, Halber M, Heiss WD: Individual functional anatomy of verb generation. *Neuroimage* (1996) 3: 185±194
- [10]. Keles GE, Lamborn KR, Berger MS: Low-grade hemispheric gliomas in adults: a critical review of extent of resection as a factor influencing outcome. *J Neurosurg* 95:735–745, 2001.
- [11]. Ojemann GA, Ojemann JG, Lettich E, Berger MS Cortical language localization in left, dominant hemisphere. An electrical stimulation mapping investigation in 117 patients. *J Neurosurg* (1989) 71: 316±326
- [12]. Penfield W, Bolchey E :Somatic motor and sensory representation in the cerebral cortex of man as studied by electrical stimulation. *Brain* (1937) 60: 389±443
- [13]. Penfield W, Erickson TC Epilepsy and cerebral localization. A study of the mechanism, treatment and prevention of epileptic seizures. Charles C Thomas, Springfield (1941).
- [14]. Penfield W, Rasmussen T: Secondary sensory and motor representation. Macmillan, New York (1950).
- [15]. Sanai N, Chang S, Berger MS: Low-grade gliomas in adults. A review. *J Neurosurg* 115:948–965, 2011
- [16]. Schramm J, Blumcke I, Ostertag CB, Schlegel U, Simon M, Lutterbach J. Low-grade gliomas: current concepts. *Zentralbl Neurochir*. 2006;67(2):55-66.
- [17]. Skirboll SS, Ojemann GA, Berger MS, Lettich E, Winn R (1996) Functional cortex and subcortical white matter located within gliomas. *Neurosurgery* 38: 678±685
- [18]. Smith JS, Chang EF, Lamborn KR, Chang SM, Prados MD, Cha S, et al: Role of extent of resection in the long-term outcome of low-grade hemispheric gliomas. *J Clin Oncol* 26: 1338–1345, 2008
- [19]. Taylor MD, Bernstein M (1999) Awake craniotomy with brain mapping as a routine surgical approach to treating patients with supratentorial intraaxial tumors: a prospective trial of 200 cases. *J Neurosurg* 90: 35±41

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