Chapter 6

Neurosurgery to Enhance Brain Function: Ethical Dilemmas for the Neuroscientist and Society

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ABSTRACT

The aim of this chapter is to evaluate the potential for neurosurgical strategies to enhance brain function. These developments are considered in the context of the history of psychosurgery, which has shaped the ethical landscape in which future invasive surgical interventions will be evaluated. Consideration is given to the ethical, moral, legal, and socioeconomic implications posed by existing electrical modulation technologies, including future neurosurgical strategies, such as deep brain stimulation for cognitive or mood enhancement. The potential demand for the non-therapeutic use of these surgical strategies poses economic and legislative problems.

INTRODUCTION

Therapeutic cognitive enhancement procedures are already an established part of neurosurgical practice. Some fall within the therapeutic repertoire and are uncontroversial for that reason. The most widespread example is the use of cerebrospinal fluid (CSF) diversion procedures to treat cognitive decline in normal pressure hydrocephalus (NPH) (Finney, 2009). NPH is characterized by a clinical triad which includes cognitive decline and memory loss (Hakim and Adams, 1965). Although not yet in widespread clinical use, there has also been some positive albeit transient results in the use of brain stimulation in minimally conscious states (Thibaut et al., 2014), and studies attempting to obtain long term improvements are being initiated. Both CSF diversion and brain stimula-
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tion are now being investigated for efficacy in Alzheimer’s disease and they understandably are in demand not only from the individual patients and their families, but also at the institutional level (Laxton et al., 2013). For example, The UN Covenant on Economic, Social and Cultural Rights has proposed that there is a fundamental individual right to attain the best possible mental and physical health. As new surgical interventions become available there is a perception that there is a right to access these if they are proven to be effective and despite ethical worries that neurological enhancement may carry dangers in terms of social function and competition with resourcing of adequate services for the support of neurologically impaired patients.

It is likely that cognitive-enhancing neurosurgical procedures currently under investigation, such as brain stimulation for dementia, will become more widely available in the next 10 years. The increase in the availability of these procedures poses moral, social and ethical dilemmas, in addition to anarguable additional economic burden in that the cost of the procedures themselves might be offset by decreased costs of care, and this could be very important in some health care systems which are hard-pressed for economic resources.

Although CSF diversion is a therapeutic intervention with clear cut indications in the medical context, there are theoretical reasons to suggest that other procedures may be explored in an attempt to enhance the cognitive functioning of otherwise healthy individuals and slow the effects of ageing (much as we now use Ritalin and the anticholinesterases). In addition, the rapid development of safe electrical implant technologies in the field of psychosurgery is likely to lead to new insights regarding the feasibility of brain enhancement technology. All these developments pose ethical, moral, legal and socio-economic dilemmas. These quandaries are in many ways analogous to those posed by the non-medical use of cognitive enhancing pharmaceuticals (Greely et al., 2008; Racine & Forlini, 2009). However, neurosurgical strategies also pose additional unique dilemmas and some of these will be discussed in the following pages. We will start by a historical overview of psychosurgery and subsequently discuss ethical and legal aspects of potential non-surgical and surgical neuromodulation for enhancement in healthy individuals.

**BACKGROUND**

The most ancient method of enhancing brain activity and function was by taking pharmacological agents. Although the recreational use of pharmacological substances is well documented, there are also instances of pharmacological substances being able to enhance brain function, and in particular mood states, as an aid to the accomplishment of tasks. For example, the Berserkers, the Viking raiders of northern Europe, were known to have taken *Psilocybin semilanceata* (commonly known as magic mushrooms) in order to induce the “Berzerker” state and thereby enhance their performance in battle. In modern times, drugs such as Ritalin and other amphetamines have been used by students to enhance mental performance in examinations (Greely et al., 2008). More recently it has been possible to modulate brain function using a magnetic field (transcranial magnetic stimulation) or electrical current (transcranial direct current stimulation, or implantation of electrodes) (Cohen Kadosh, 2013). There are now data available from human subjects implanted with cortical or subcutaneous electrodes that have demonstrated a clear potential for electrical neuroenhancement in contexts such as movement and psychiatric disorders. Indeed, one of the most well studied areas is in the effect on mood of neuroenhancement via electrical stimulation (Mayberg et al., 2005). These positive findings will lead to the use of stimulation devices more generally in order to harness these enhancing effects. This tendency to generalize the use of successful technologies is shown by the extension