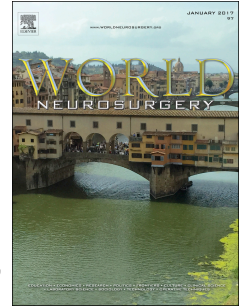


# Accepted Manuscript

Complications of impulse generator exchange surgery for deep brain stimulation: A single-centre, retrospective study

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PII: S1878-8750(18)30226-2

DOI: [10.1016/j.wneu.2018.01.183](https://doi.org/10.1016/j.wneu.2018.01.183)

Reference: WNEU 7381

To appear in: *World Neurosurgery*

Received Date: 26 September 2017

Revised Date: 24 January 2018

Accepted Date: 25 January 2018

Please cite this article as: Helmers A-K, Lübbling I, Birkenfeld F, Witt K, Synowitz M, Mehdorn HM, Falk D, Complications of impulse generator exchange surgery for deep brain stimulation: A single-centre, retrospective study, *World Neurosurgery* (2018), doi: 10.1016/j.wneu.2018.01.183.

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# Complications of impulse generator exchange surgery for deep brain stimulation: A single-centre, retrospective study

## **Abstract**

**Objective** Non-rechargeable deep brain stimulation (DBS) impulse generators (IG) with a low or empty battery status require surgical IG exchange several years after initial implantation. Complication rates in patients undergoing DBS surgery range from 7.6% to 25.3%. The aim of this study was to investigate the complication rates after IG exchange surgery and to identify risk factors for complications.

**Methods** We retrospectively analysed complications following IG exchange surgery from 2008 to 2015 in a single-centre university hospital setting. The medical records of all the patients who underwent IG exchange surgery were systematically reviewed. The shortest follow-up time was 19 months.

**Results** From 2008 to 2015, 438 generators were exchanged in 319 patients. The overall complication rate was 8.90%. Twelve patients (2.74%) developed an infection related to the IG and underwent secondary removal of the IG, and two of these patients died from life-threatening DBS withdrawal syndrome, both of whom had Parkinson's disease. Six patients (1.37%) suffered from local wound erosions surrounding the IG. For this particular complication, local wound revision was sufficient in all the patients. Hardware malfunctions occurred in 11 patients (2.51%), and local haemorrhage surrounding the IG and requiring surgical revision was observed in three cases (0.68%). Repeated fixation of the IG was required in two patients (0.46%). Traction of the connecting cables necessitated surgical revision due to patient discomfort in two patients (0.46%). The IG was placed abdominally or was exchanged for a smaller device due to patient discomfort resulting from the initial position in two cases (0.46%). One 80-year-old patient (0.23%) suffered from severely worsening heart failure and died four days after IG exchange surgery performed under local anaesthesia. The infection rate was 1.79% after the first exchange, 3.23% after the second exchange and 8.57% after three or more exchanges.

**Conclusion** IG exchange surgery, although often considered a minor surgery, is associated with a complication rate of approximately 9% in our centre. Infection is the most relevant complication, as it may require removal of the IG. Implantation of smaller IGs may reduce complications such as wound erosion or local haemorrhage. Patients and physicians should understand the complication rates associated with IG exchange surgery because this information may encourage selection of a rechargeable IG.

Key words: deep brain stimulation, complications, exchange of generator

**Introduction** Deep brain stimulation (DBS) is an accepted standard therapy for movement disorders, such as Parkinson's disease (PD), essential tremors and dystonia, and can result in substantial improvement in motor outcomes and quality of life<sup>1-4</sup>. Until 2008, when Medtronic® introduced the rechargeable Activa-RC®, most of

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