



## Clinical Postcard

# “I had lost the sense of direction on my left body part”, proprioception and awake brain surgery: A case report

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Proprioception refers to the sense of limb position and movement. The parietal lobe is assumed to play a crucial role in maintaining an internal representation of the body's state (Wolpert, Goodbody, & Husain, 1998) and lesion studies indicate an important role for the posterior parietal cortex in position sense (Findlater et al., 2016; Kenzie et al., 2014; Meyer et al., 2016).

During awake brain surgery, there is usually considerable attention for language and motor functions, while other functions like memory and executive functions are under-exposed (Ruis, 2018). Proprioception has also been neglected during awake brain surgery, even though this function is crucial for normal motor performance and loss of it can have considerable consequences for normal everyday functioning (Rand, 2018). In reviews of intraoperative tests (Coello et al., 2013; Duffau, 2010), proprioception received no or only

limited attention. Other studies describing awake brain surgery procedures claim monitoring of motor and sensory functions, but this is mostly done by simply asking a patient to report any experienced changes in these functions and it is not formally tested.

We present the case of a patient with clearly disturbed proprioceptive functions due to a brain tumour. She underwent awake brain surgery and her proprioceptive functions were tested systematically and extensively preoperatively, during the operation and postoperatively.

The patient is a 64-year old, right-handed woman, a former owner of a drugstore. In a period of two weeks she developed several complaints as a result of impairments in proprioceptive functions and fine motor skills. She could not, for instance, find her pedal when cycling, nor could she put on make-up or earrings with her left hand. In addition, she developed problems walking, climbing stairs, putting in contact lenses, fastening a seat belt, putting on flip-flops, and peeling potatoes. She did not report any other (cognitive) complaints. A Magnetic Resonance Imaging (MRI) scan showed a contrast-enhancing cystic lesion in the right parietal lobe (see Fig. 1) and awake brain tumour surgery was planned based on the expected functionality of this area.

One day before surgery, in addition to previous neurological assessment, examinations revealed that strength and sensibility of the contralateral hand were normal, but motor functions were impaired (for example, difficulties in alternately touching her thumb to her fingers). Additionally, there

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was a motor drift, as the patient's left arm tended to move out to the right when her eyes were closed. A comprehensive neuropsychological assessment was administered, complemented with examination of proprioceptive functions. The latter was done by asking our patient to close her eyes. Then, the distal phalanx of her thumb was moved up and down randomly while the experimenter fixed her joint, and she had to indicate the direction of the movement (up/down). Her wrist, elbow, toe, foot and knee were tested in the same way. Proprioceptive functions were impaired at the contralateral side; our patient was not able to indicate the direction of distal movements of her body (thumb, wrist, toe, foot) at all, and performances were at chance level. Only the more proximal movements of her elbow and knee were reported correctly. Proprioceptive function at the ipsilateral side was unimpaired, proving she was perfectly able to perform the task herself.

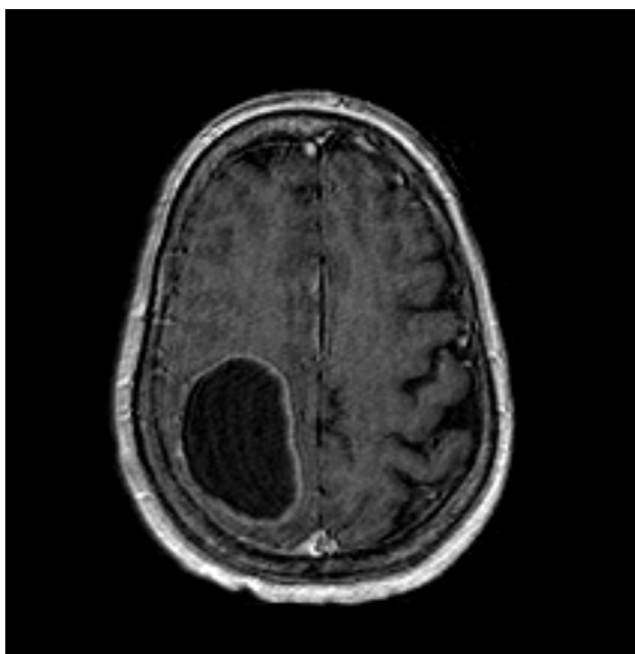
During surgery, proprioceptive function was tested following the same procedure as preoperatively, in addition to motor functions of the hand, reading, calculation and clock reading. After debulking the cyst (resulting in a decrease of the intracranial pressure), an immediate improvement of proprioception and motor functions of the left hand was seen. During intraoperative cortical stimulation of the posterior edge of the tumour, our patient had difficulties in calculation and clock reading tasks. The anterior edge of the tumour was important for motor functions of the hand. Stimulation at the subcortical part of the tumour resulted in misses and mistakes in judging position sense of the toe. No margin of resection could be taken in this direction.

One day after surgery, we tested the motor functions of the left hand and the proprioceptive function of the left thumb; both were unimpaired (100% correct score). Four weeks after surgery, our patient could walk without a walker and taking the stairs was no problem (which was not possible preoperatively). She was able to perform all other

daily activities that were disturbed the weeks before surgery, except for feeling more tired. When reflecting on her complaints before surgery she told us: "I had lost the sense of direction on my left body part". She did not report any changes after surgery in strength, sensory functions, body ownership or in bimanual coordination. The motor drift that was present during the preoperative assessment disappeared after surgery. Formal testing of proprioceptive function resulted again in a 100% correct score, even for the most distal body parts (thumb and toe). Four months after surgery, our patient's functions remained unimpaired. She had no difficulties in performing daily activities and she took a 30-min walk every day, without problems.

Language and motor functions are frequently monitored during awake brain surgery. A recent study of [Liouta et al. \(2018\)](#) demonstrated that patients with a parietal lobe glioma often suffer from various more specific cognitive impairments like apraxia, anomia and subcomponents of the Gerstmann's syndrome. Additionally, in these patients, there should be attention for proprioceptive function, especially because impairment in this function is correlated with the perceived level of physical activity and with social isolation ([Meyer, Karttunen, Thijs, Feys, & Verheyden, 2014](#)). Our patient also experienced limitations in several daily activities as a result of severely impaired proprioceptive function, due to a brain tumour. Intensive monitoring of proprioceptive functions during awake brain surgery resulted in clear improvement and preservation of her position sense. Our patient reported an improved quality of life after surgery and was able to regain her autonomy.

Overall, this case report demonstrates the impact of proprioceptive impairments on daily life and shows that monitoring of this function during awake brain surgery is feasible and useful.



**Fig. 1** – MRI scan.

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### Conflicts of interest

None.

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### Informed consent

Our patient signed an informed consent form for publishing this data. This study was also presented to the Medical Research Ethics Committee UMC Utrecht, who concluded that The Medical Research Involving Human Subjects Act (WMO) did not apply to this study and therefore an official approval of this study by the Medical Research Ethics Committee UMC Utrecht was not required.

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### CRediT authorship contribution statement

**Carla Ruis:** Conceptualization, Investigation, Writing - original draft, Writing - review & editing. **Anouk Smits:** Investigation, Writing - original draft, Writing - review & editing. **Pierre Robe:** Investigation, Writing - review & editing. **Chris Dijkerman:** Writing - original draft, Writing - review & editing. **Martine van Zandvoort:** Investigation, Writing - review & editing.

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