De-afferentation pain treatment with DBS - a case series of 7 patients

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Introduction

Deafferentation pain constitutes one of the most difficult pathological pain states to manage and it is often refractory to medical treatment. It is described as a disturbance in sensory input where both non-nociceptive and nociceptive input, is lost or attenuated. Common causes include amputation, which can lead to phantom limb pain and brachial plexus injuries. Combined targeting of the periaqueductal grey (PAG) and the ventral posteriorlateral (VPL) nucleus of the sensory thalamus is the most commonly used target combination in chronic pain1. As the understanding of the pain matrix develops, other potential target sites such as the centromedian-parafascicular (Cm-Pf) nucleus are being investigated supported by strong preclinical data demonstrating the role of the parafascicular complex in nociception.

Methods

All patients underwent DBS surgery under GA using our MRI-directed guide tube method3. In order to maximize the number of contacts within the structure, a transventricular trajectory was used aided by the guide tube (Fig 1).

Within the CmPf, the parafasciular component of the nucleus was targeted (Fig 2). Assessments were carried out using the Visual Analog Scale (VAS), Neuropathic pain scale (NPS), brief pain inventory (BPI), the SF-36 form and quantitative sensory testing (QST) for a median follow up of 3 years. Patient characteristics are outlined in Table 1. PAG was stimulated at 10Hz whilst VPL and CmPf were stimulated at 130Hz.

Results

Pain

Pain scores remained diminished across all measures for the entire follow up period, though this was only statistically significant for the 6 monthly follow up with the BPI summary. (Fig. 3 A to D)

QST

No changes in heat pain threshold or painful punctate mechanical threshold were detected in the non affected areas. All 6 patients tested demonstrated a degree of mechanical allodynia (cotton tip) pre-operatively in affected areas. This was dramatically reduced in all patient post-operatively ($P<0.05$).

QOL

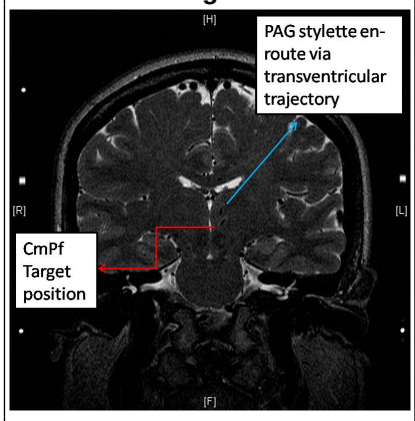
The time course of the mental component of health (Figure 4A) increases from pre operative levels each year. In contrast the time course of the physical component of health (Figure 4B) follows a similar trend to the pain measure data shown above. One year post operatively there is a non-sginificant improvement but this then reduces by two years post operatively. Pain Interference (Figure 4C) is significantly reduced, to approximately a quarter of preoperative levels, both immediately and at six months post operatively. Furthermore, it is still reduced, albeit non-significantly, at 12 months. Table 2 depicts other subjective QOL improvements.

Table 1

Patient Number	Sex	Age at surgery	Duration of pain pre-operatively	Average pain severity preoperatively (max = 10)	Cause of deafferentation pain.	Location of Pain	DBS Target Location from post op notes
1	M	59	12 years	8	Right brachial plexus avulsion injury with subsequent above elbow amputation	Right arm, right chest, right back (of amputated limb)	Left PVG and VPL
2	M	37	17 years	6	Right brachial plexus avulsion injury with subsequent above elbow amputation	Right volar forearm and hand (of amputated limb)	Left PVG/PAG and CMPf
3	M	39	10 years	8	Right shoulder avulsion with secondary amputation of the upper right limb with disarticulation of the shoulder joint	Right forearm (of amputated limb)	Left PVG/PAG and CMPf
4	M	46	2 years	2	Above elbow traumatic amputation of left upper limb	Posterior and lateral aspects of proximal half of upper left limb	Right PVG/PAG and CMPf
5	M	49	32 years	6	Right brachial plexus avulsion injury	Right arm, right chest, right back (of amputated limb)	Left PVG/PAG and CMPf
6	M	58	18 years	10	Left brachial plexus avulsion injury	Left forearm	Right PVG/PAG and VCL
7	F	50	6 years	7	Left trigeminal neuralgia (V2&V3). Poor response to microvascular decompression. Subsequent sensory rhizotomy also failed to provide pain relief. Developed anaesthesia dolorosa affecting all three divisions of the trigeminal nerve.	Left mandibular region with left tongue and left cheek and eye	Right PVG/PAG and CMPf

Patient characteristics

Fig.1



CmPf and PAG electrode positions