RCSLT

Position paper: the role of speech and language therapists in awake craniotomy (Draft for consultation)

9th April 2025

The information in this document is currently in development and has been shared as part of a consultation. If you are seeking guidance or information on this topic, please ensure you refer to final published content which can be found on rcslt.org.

We appreciate any comments provided to us during the consultation, all of which will be reviewed by the working group within the context and scope of the project. We ask that, where possible and relevant, you accompany any counter arguments to statements made in the document with supporting evidence e.g. a research reference.

Members of the working group should not be contacted directly, and all feedback should be made through the assigned route e.g. via survey or project manager. Feedback made through unassigned routes or after the closing date will not be accepted or responded to.

Thank you for your support with this project.

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1. Summary and practice recommendations

I. Specialist speech and language assessment in an awake craniotomy is within the scope of practice for speech and language therapists (SLTs).

II. Speech and language therapists are experts in communication and offer specialist assessment, detection and interpretation of language network disruption. This contribution can lead to better functional outcomes, optimal tumour resection, reduced length of hospital stays and overall success of surgery.

III. Specialist speech and language therapy service provision is needed across the awake craniotomy patient pathway (pre-, intra- and post-operative stages). Workforce planning with organisations and commissioners is recommended to ensure an equitable and specialised speech and language therapy workforce is available to provide high-quality patient care.

IV. SLTs working in awake craniotomy are part of a specialist neurosurgical multidisciplinary team (MDT). SLTs should work collaboratively with MDT colleagues at all stages of the surgical pathway.

V. Referral to speech and language therapy should be timely to enable a comprehensive pre-operative assessment for all patients. The assessment should involve; obtaining baseline speech and language skills, rapport building with the patient and family (if present), confirm patient suitability for awake craniotomy and, crucially, ensure the intra-operative testing paradigms correspond to the patient's baseline function and cultural norms.

VI. To ensure consistency of care, it is strongly recommended that the same clinician works with a patient across the pathway.

VII. Currently, there is no national competency framework for SLTs working in awake craniotomy. This paper is the first to detail SLT clinical practice across the pathway and detail the minimum theoretical standards required, as well as recommendations for skill acquisition.

VIII. SLTs should promote the specialist role of the profession in awake craniotomy services, locally and nationally. Influencing and campaigning is essential for adequate funding of services.

IX. Multilingual patients and non-English speaking patients should be considered for testing of their primary and additional language(s) via an experienced interpreter. Factors such as language proficiency, age of acquisition, patient goals and quality of life should be considered.

X. Testing materials should be patient-centred, culturally appropriate and tailored to the needs and background of the patient.

XI. Speech and language therapy expertise in awake craniotomy is novel and evolving. Quality research is recommended to further evidence the added value of speech and language therapy.

XII. Speech and language therapists should contribute to local and national service development or research agendas within awake craniotomy, e.g. in the use of AI or in embedding new testing protocols.

2. Introduction

This position paper details the role, value and contribution of speech and language therapists who work in awake craniotomy services. It also highlights the key role that SLTs have within the multidisciplinary team.

The purpose of this position paper is to provide clinicians working in this field with an outline of best clinical practice in the context of the current and up to date evidence base and research. The position paper is also relevant to clinicians or students developing an understanding of the role of SLTs in awake craniotomy.

This paper should be read by those seeking to advocate for, or develop, a business plan for speech and language therapy service provision in awake craniotomy (including managers and commissioners).

This paper is relevant to speech and language therapy services across the UK. However, regional variations in the access to resources and clinical nuances may be present. SLT should take consider the guidance outlined in this paper, while also working within local policy and practice.

The paper should be read in conjunction with other relevant guidance from RCSLT, including guidance on aphasia, supported decision making and mental capacity, interpreters, bilingualism and augmentative and alternative communication (AAC).

3. Process

To be completed in final draft:

- Scoping the evidence
- Co-production
- Consultations and feedback process
- Organisations involved

4. Context and evidence base

4.1 Clinical population

In the UK, over 12,000 people are diagnosed with a primary brain tumour each year (The Brain Tumour Charity, 2025). A primary brain tumour refers to a tumour originating in the brain. A glioma is the most common type of primary brain tumour, corresponding to approximately 30% of primary brain tumours and 80% of malignant brain tumours (Goodenberger and Jenkins, 2012). A secondary brain tumour is cancer that starts somewhere else in the body and spreads to the brain. It may also be called brain metastases. It is a type of advanced cancer (Macmillan Cancer Support, 2025).

The World Health Organisation (WHO) grades primary brain tumours from 1-4. Grade 1 and grade 2 tumours are low grade, benign and slow growing. Grade 1 tumours are unlikely to recur after treatment, whilst grade 2 tumours may recur after treatment and transform to a high-grade tumour depending on the tumour type. Grade 3 and grade 4 tumours are high-grade, fast growing and malignant (Macmillan Cancer Support, 2025).

Primary brain tumours within language eloquent cortical or sub-cortical areas of the brain have been associated with language impairment in 69% and 89% of low- and high-grade tumours, respectively (Brownsett et al, 2019). Surgical removal of brain tumour is a common treatment.

4.2 Awake craniotomy and brain mapping

Awake craniotomy is the removal of a brain tumour whilst the patient remains conscious and able to interact. It was first proposed in the 1950s for the surgical treatment of epilepsy. In subsequent decades awake craniotomy has become the gold standard practice for resection of eloquent brain tumours.

The aim of awake craniotomy is to locate and preserve function, while maximising safe tumour resection. The process of 'brain mapping' involves the use of direct electrical stimulation (DES) to cortical or sub-cortical anatomy, which temporarily inhibits function for up to 4 seconds (Morshed, et al 2021; Papatzalas et al 2022). Cortical stimulation and patient responses are synchronised in order to create a personalised 'functional map'. The functional map will enable the neurosurgeon to identify and spare eloquent anatomy with the aim to reduce the incidence of post-operative speech and language deficits.

The benefits of awake craniotomy in the resection of tumours include shorter hospital stays (4 days vs. 9 days), and less frequent post-operative deficits (7% vs. 23%) in matched procedures done under general anaesthesia (Brown et al, 2013).

4.3 Direct electrical stimulation

For language mapping, direct electrical stimulation is typically administered via a bipolar stimulation, with frequency starting at 2mAmps with an upper limit of 5mAmps or the appearance of after-discharge potentials (Klitsinikos et al 2021; Leon-Rojas, 2020). A 6-contact electrode strip is inserted for electrocorticography and after discharge potentials. Neurophysiologists will monitor discharge potentials and seizure activity.

4.4 Patient selection and suitability

Selecting suitable candidates for awake craniotomy requires careful consideration and is a critical factor to the success or failure of the procedure. Failed awake craniotomy is associated with sub-optimal tumour resection, increased neurological morbidity, an increase in major complications, and longer length of hospital stay (Fiore et al 2022; Kram, et al 2024). Awake craniotomy requires patients to perform speech and language tasks under the time constraints of cortical stimulation and transient language network disruption. Therefore, sufficient baseline language skills to engage in this task is a pre-requisite (Kram et al 2024). A pre-operative speech and language assessment is essential to ensure appropriate patient selection and reduce the incidence of failed awake craniotomy (O'Neill et al, 2020).

The process of determining patient suitability for awake craniotomy can be variable and often nuanced. Some studies suggest a 25% error rate cut off during baseline testing or 50% error rate in all aspects of a standardised test battery (Hervey-Jumper et al, 2016). Others consider wider patient factors such as: lower age (<65 years); psychological resilience; baseline language eloquence; and other medical conditions such as cardiovascular disease or obesity (Burnand and Sebastian, 2014., Kram, et al., 2024).

A recent national survey on awake craniotomy practice found clinicians (SLTs, neurosurgeons and neuropsychologists) agreed that patients should be communicating at a minimum of phrase or sentence level to be a suitable candidate for awake craniotomy. Clinicians also adjust language testing resources for patients who obtain scores of less than 75% in pre-operative testing (Mariotti et al, 2025).

4.5 Anaesthetic approaches

There are two recognised anaesthetic techniques used in awake craniotomy: the 'asleep-awake-asleep' (AAA) approach and 'awake throughout craniotomy' (ATC) approach. Both techniques have been proven to be safe with a low rate of failed procedures. There is no recognised consensus on the best anaesthetic approach, therefore surgeon preference, pathology, length of stay and patient factors contribute to determining which approach is used (Brunand and Sebastian, 2014).

The AAA approach involves the induction of general anaesthesia, such as propofol-remifentanil, dexmedetomidine-remifentanil or a combination of propofol-dexmedetomidine-remifentanil. Control of the patient's airway is established via either a supraglottic device or intubation (Morshed et al 2021). The patient is asleep during the scalp block, head clamping, drilling and removal of skull flap. The anaesthetic agents are typically weaned or terminated entirely at the point of craniotomy (bone removal). Within practice, there may be variation to patients being put back to sleep after tumour resection. This may then represent as 'asleep- awake- awake'. The decision to remain awake versus asleep should be made by the neurosurgeon and anaesthetist.

A common advantage to AAA is the ability for anaesthetists to control patient ventilation, prevent airway obstructions or hypoventilation. It also enables greater depth of anaesthesia during painful parts of surgery (Brunand and Sebastian, 2014). A disadvantage to the AAA approach is that it can be associated with a longer "wake up" time for patients. The length of time it takes for patients to suitably wake from the anaesthesia varies from 5 minutes up to 39 minutes (Shen et al 2013., Leon-Rojas, 2020., Deras et al 2012).

A patient's ability to appropriately engage in language assessment is critical to the success of the awake craniotomy. Aabedi and colleagues (2020) measured wakefulness in 21 patients following general anaesthesia and found a functional decline in multiple parameters, including language performance. These were in the absence of patient self-reported changes in arousal. They propose the administration of objective wakefulness measures prior to the commencement of brain mapping and language testing to mitigate the risk of anaesthetic induced sub-optimal performance.

Advantages to ATC includes constant patient awareness and involvement in positioning, avoidance of two intubation cycles and immediate brain mapping with full patient participation. Emphasis is made on the need for pre- and intra-operative multidisciplinary team coaching. This team effort allows for instant mapping, which may lead to reduced overall surgery time and high patient satisfaction rates (Leon-Rojas et al 2020).

4.6 Intra-operative language assessment

A 2022 scoping review (Papaztalas et al) of the use of standardised intra-operative language tests, highlighted two strands of assessment: A) those using the validated and standardised intra-operative language batteries, and B) the use of mixed batteries which consists of home-made tests and tests borrowed from other settings e.g. Boston Naming Test (Kaplan et al 1983).

The scoping review yielded four validated and standardised intra-operative language assessment batteries are available - none of which are in the English language.

1. Dutch Linguistic Intra-operative Protocol (De Witte et al 2015)*

The Dutch Linguistic Intra-operative Protocol (DuLIP) uses a neurolinguistic approach to develop a battery for awake craniotomy in eloquent brain areas. The battery consists of 17 linguistic tasks evaluating multiple language domains (phonology, semantics, syntax, morphology). Normative data was attained with 250 healthy, native Dutch speaking participants, while the pathological population consisted of 5 brain tumour patients. The battery offers a clinico-anatomical correlation of each task, which is based almost exclusively on retrospective DES studies.

The DuLIP is used widely as a framework for intra-operative mapping paradigms and in 2021 a Portuguese version of the DuLIP has been created (Alves, et al. 2021).

Collée and colleagues (2023) offer an updated version to the DuLIP model based off their findings from a systematic review of localisation pattens of speech and language errors during brain mapping in glioma patients. This included 102 studies until July 2020. Their findings offer a crude overview of language localisation, and they argue their additions to the original DuLIP model offer more adequate 'location-to-function' language tasks, which may improve validity of tasks and improve intra-operative language monitoring.

2. ECCO and Verb production In Sentence Context (VISC) tests (Rofes et al 2015)

This battery consists of two tasks: object naming (ECCO) and verb naming (VISC). It was created for brain mapping in Italian-speaking natives. In total, 75 participants were involved in the standardisation and stimuli norming process.

3. Russian Intra-operative Naming Test (Dragoy et al 2016).

This battery also consists of two tasks: object naming (50 items) and verb naming (50 items) and evaluates lexical and grammatical aspects of language. For object naming the patient names images using nouns, whilst they name actions by using verbs. Stimuli were extracted from a Russian normative database of 100 Russian-speaking, healthy participants.

4. Greek Linguistic Assessment for Awake Brain Surgery (Papatzalas et al 2021)

The Greek Linguistic Assessment for Awake Brain Surgery (GRAABS) is based heavily on the clinico-anatomical correlations presented by the DuLIP. The GRAABS involves 15 tasks which test different linguistic functions. It approaches mapping and resection tasks differently in the context of time-restricted and unrestricted responses. The normative data consisted of 80 right-handed, healthy, Greek-speaking individuals aged between 20 and 60 years.

Each of the intra-operative language batteries account for the time-constraints and have normed response times (4 seconds). Each require a 'preparatory' phase (i.e. training of the patient and selection of stimuli, before the surgery).

In addition to the four batteries identified in the scoping review by Papatzalas and collesgues in 2021. There is another available testing paradigm,

5. The verb and noun test for peri-operative testing (VAN-POP) is a two-component language test standardised for nTMS and intra-operative direct cortical stimulation. It focuses on noun and verb word retrieval in a sentence context. This test has been standardised in English, German and Dutch speakers, under the time constraints of nTMS and DES conditions (Ohlerth, et al., 2019).

Workforce surveys of clinical practice highlight that SLTs based in the UK have used the 'location-to-function' and suggested intra-operative tests of the DuLIP to support the development of local intra-operative tests (Mariotti et al 2025, O'Neill et al 2020).

5. The need for speech and language therapy service provision

5.1 Workforce contribution

The remit of SLTs working in awake craniotomy is multifaceted, specialised and evolving. The precise number of SLTs working in awake craniotomy is unknown (O'Neill et at, 2020). The speech and language therapy workforce have the skillset to work across the patient pathway and offer dynamic and specialist speech and language assessment in pre-, intra- and post-operative phases. This contribution supports the overall success of an awake craniotomy, which is associated with better language and neurological outcomes, greater extent of tumour resection and a shorter length of hospital stay (Bu et al 2021).

Focus group feedback highlighted the key role in educating and counselling patients about the process of awake craniotomy, setting expectations and helping them prepare psychologically. Group members commented on how SLTs' expertise, confidence and experience with language assessment and management helped to alleviate patient anxiety and put them at ease. SLTs' pre-operative contributions also include aligning patient testing paradigms with baseline function, and the of training interpreters (as needed).

Intra-operatively, SLTs provide targeted assessment and collaborate with the neurosurgeon to avoid permanent language network disruption. They also act as a patient advocate between the patient and rest of the surgical MDT, e.g. alerting the anaesthetist to any discomfort.

Post-operatively, SLTs can support patients and family/friends if any immediate post-operative communication difficulties occur; offering bespoke therapeutic interventions and support. Finally, they facilitate and engage in a safe transition from hospital to home, which may include onward referral to other services.

5.2 National guidelines

The need for speech and language therapy service provision in awake craniotomy is specified in the National Institute of Clinical Excellence (NICE) guidelines for brain tumours (primary) and brain metastases in over 16s (2021), stating that a Speech and Language Therapist should be involved for language assessment before, during and after awake craniotomy.

The Tessa Jowell Academy (TJA) Brain Cancer Mission report (2023) features speech and language therapy expertise in awake craniotomy as an example of "excellence" and the report advocates for the integration of SLTs across awake craniotomy MDTs, nationally. The report also highlights the benefit of AHP-led clinics, within neuro-oncology, to provide holistic and patient-centred care/to optimise quality of life.

5.3 Service planning

An online survey of SLT practice conducted in 2020, highlighted an average overall time spent with an individual patient is approximately 10.5 hours (O'Neill, et al). However, this number does not take into consideration the breadth of SLT role within an awake craniotomy service, such as;

- SLT workforce training, supervision and shadowing
- Continual professional development
- Attendance at weekly multi-disciplinary meetings
- Attendance at pre or post operative multi/uni-disciplinary clinics
- MDT training
- Service audit and improvement
- Attendance and contribution to local, national and international conferences, research or training forums

Currently there are various models of service which exist for the SLT workforce is awake craniotomy. Table 1. below outlines the risks versus benefits of different models of service provision.

Funded SLT service provision embedded in awake craniotomy services	**Ad-hoc unfunded SLT service provision**
Dedicated and ring-fenced awake craniotomy time to establish and maintain a responsive, engaged and equitable service.	Ad-hoc service delivery which is unfunded, and time taken from other clinical areas of SLT provision. Service is not guaranteed and inequitable due to high clinical demands.
SLT is embedded as a core member of the MDT awake craniotomy team, enabling opportunities to build working relationships, establish role and presence at MDT meetings or clinics.	SLT role under-recognised and under- valued. Limited opportunity to engage in regular MDT meetings or clinics due to other caseload demands.

Funded SLT service provision embedded in awake craniotomy services	Ad-hoc unfunded SLT service provision
Dedicated time to engage in SLT training and clinical development, ensuring a confident and highly skilled workforce.	Under-resourced service resulting in reduced training opportunities, leading to reduced workforce confidence and competence.
Dedicated time for service audit, improvements, and contribution to research. Ensuring practice is innovative and high quality.	Limited resources or time available to evaluate and improve service provision.

Table 1. The benefits versus risks of two separate service delivery models

Workforce planning with organisations and commissioners is recommended to ensure an equitable and specialised speech and language therapy workforce is available to provide high-quality service-level and patient care.

6. Multidisciplinary team working

6.1 MDT working

MDT working is an integral role of SLTs in awake craniotomy. SLTs work collaboratively with MDT members across the patient pathway. If services have an established brain mapping multi-disciplinary team (BM-MDT) meeting, SLT presence and contribution should be strongly encouraged. Klitsinikos and colleagues (2021), demonstrate the expertise and benefit of SLT in their local BM-MDT with specific reference to establishing mapping paradigms for the supplementary motor area (SMA) with MDT consensus.

The MDT could include:

- neurosurgeons
- neuropsychologists
- anaesthetists
- neurologists
- clinical nurse specialists
- neuro-radiographers
- surgical nurses
- neurophysiologists
- neuroradiologists
- physiotherapists
- orthoptists
- occupational therapists

SLTs will work closely with all AHPs (occupational therapists, dietitians etc), as per the usual practice for any non-awake post-operative patients.

6.2 Extended scope of practice and clinical variations

6.2.1 Additional intra-operative neurological testing

Language is the most frequent superior function tested in awake craniotomy, but other functions can include sensori-motor functions, the visuo-spatial pathway, and executive function and emotions (Fiore et al 2022). Access to neuropsychology or physiotherapy may vary between institutions. Therefore, as an established member of the awake craniotomy MDT, SLTs may

conduct the assessment of praxis (motor function) or other cognitive functions during mapping, e.g. using the STROOP test (a neuropsychological assessment of the ability to inhibit cognitive interference) (Scarpina and Tagini, 2017). This should be in accordance with local MDT consensus, SLT confidence, skills and understanding of the paradigms.

6.2.2 Additional clinical diagnosis

Primary brain tumours are the most common diagnosis requiring awake craniotomy treatment, and therefore the focus of this position paper has been on brain tumours. However, the authors recognise the growing body of evidence and clinical practice in the use of awake craniotomy in the case of cavernomas (Pamias-Portalatin et al 2018), aneurysms (Abdulrauf et al 2017), arteriovenous malformations (Tariq et al 2024), and deep brain stimulation (Vesper et al 2022).

Despite the different primary diagnoses, the principles of language localisation, brain mapping and speech and language assessment peri-operatively remain the same.

6.2.3 Awake craniotomy in the paediatric population

It is not in the scope of this document to offer a full overview and recommendations for paediatric awake craniotomy. While the practice of awake craniotomy in the paediatric population is uncommon, there is a growing body of evidence about its feasibility, clinical indications and potential benefits (Al Fudhaili et al, 2023). It is recommended that SLT expertise should be strongly considered in the process of paediatric patient selection, patient and family preparation and language assessment in the pre-/intra-/post-operative phases. Service planning in the neurosurgical paediatric population should include speech and language therapy service provision and development.

7. Clinical management

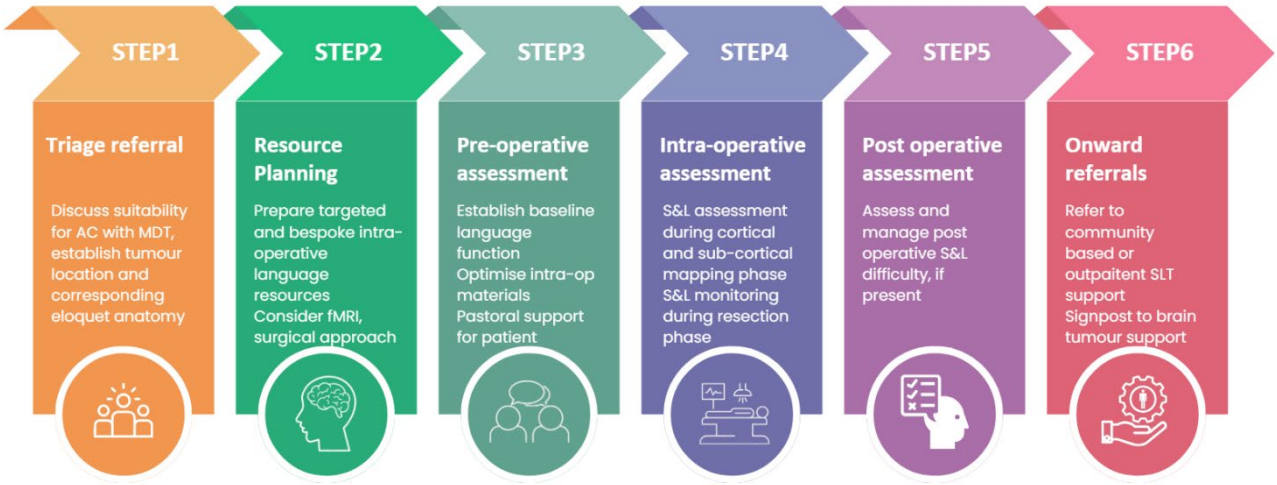

Figure 1. Schematic representation of SLT role and contribution peri-operatively

7.1. Pre-operative planning

7.1.1. Neuroimaging

While tumour location can be a predictive factor for aphasia, there is individual variability as well as tumour-induced functional reorganisation (Ille et al, 2019). Pre-surgical neuroimaging is warranted to identify language neuro-activation.

Functional magnetic resonance imaging (fMRI) is a non-invasive brain imaging technique commonly used for surgical planning. A patient performs a language task, such as verb generation or object naming, and the neuroanatomical activation for that task is identified. SLTs should be mindful that the language tasks completed during fMRI may not be the same as the language tasks required intra-operatively. However, fMRI findings can determine hemispheric dominance for language. The fMRI activation maps allow neurosurgeons to better plan for intra-operative mapping and optimal surgical approach to avoid damage to potentially eloquent cortex (Connelly et al, 2022).

Navigated Transcranial Magnetic Stimulation (nTMS) is a non-invasive procedure which delivers transcranial magnetic stimulation through the skull to the left cerebral cortex for the purposes of creating a functional language map, pre-operatively. NTMS has been shown to be highly

sensitive, but less specific for language mapping. A potential benefit is that it can offer a 'negative map', screening out unlikely language sites (Lehtinen et al., 2018).

Diffusion tensor imaging (DTI) tractography is an MRI that shows the probable location of sub-cortical white matter tracts and their proximity to the brain tumour (Shalan et al, 2021).

7.1.2 Formulation of intra-operative language testing

SLTs should use the following surgical work-up results (if available) to contribute to the formulation of their intra-operative testing paradigms.

- MRI findings
- fMRI findings
- DTI findings
- NTMS findings
- Neuropsychology assessment outcomes
- Patient case history and background of symptoms
- Liaison with the neurosurgeon to confirm any at risk cortical and sub-cortical anatomy, including from the point of entry to access the tumour / tissue to be resected

With the combined findings of the list above, SLTs can reference known anatomo-functional paradigms, such as the DuLIP, to create an individualised and targeted intra-operative assessment.

7.2 Pre-operative assessment

7.2.1. Referral, timings and aims of assessment

The pre-operative SLT assessment is a crucial part of the awake craniotomy process and should be completed for all awake craniotomy patients (O'Neill et al 2020, Trimble et al 2015, Papatzalas 2022, De Witte et al 2015). As such, early and timely referral to SLT is strongly recommended to ensure sufficient time to plan and complete a comprehensive pre-operative assessment.

SLT pre-operative assessment can be done as an outpatient or in the acute setting in the days or weeks preceding the surgery. SLTs should consider the timeliness of their assessment in the context of tumour-induced neurological changes, particularly in those patients with a high-grade, fast-growing tumour.

The pre-operative assessment should achieve the following aims:

- Explore suitability for awake craniotomy in the context of psychological resilience and baseline language function, alongside MDT consensus.

- Conduct a baseline assessment of the patient's speech, language and communication skills.
- Provide pre-operative counselling and preparation for the patient and their family or friends, if present. This should include discussions regarding potential speech and language difficulties the patient may experience intra and/or post operatively. An example of this would be in educating patients on supplementary motor area (SMA) syndrome, if their SMA is at risk.
- Build rapport with the patient and establish preferred conversation topics to support bespoke dynamic conversational assessment intra-operatively.
- Practise intra-operative language tasks and, crucially, exclude incorrect or delayed latency responses to ensure an optimal sample is obtained for intra-operative purposes.

The same process should be followed for all patients undergoing repeat awake craniotomies as patient language eloquence may differ from their original surgery. Furthermore, patients value the time taken to re-educate and prepare them for the surgical process.

7.2.2 Pre-operative counselling and pastoral role

A recent systematic review by Mofatteh et al (2023) concluded that an awake craniotomy does not increase psychological symptoms like stress, anxiety or depression. Nevertheless, it is important for SLTs to spend time preparing the patient and explaining the process of mapping and language assessment. Often patients have a fear of pain, so informing them that that brain does not have pain receptors, and they will be unable to feel the tumour resection, can be helpful to relieve anxiety. Pre-operative counselling should be provided to patients, and any family members or friends present regarding potential post-operative language deficits, speech and language therapy interventions and course of recovery.

7.2.3 Rapport building and person-centred approach

The pre-operative speech and language therapy assessment offers an excellent opportunity to establish a rapport with the patient and enable trust and familiarity. The SLT should ensure a trusting relationship is established as they are the professional primarily interacting with the awake patient. Conversation is often used during the resection phase of the surgery to continuously monitor dynamic language and offer the patient a break from formal testing. Understanding the patient's interests and preferred topics of conversation will enable a more person-centred approach.

7.2.4 Practice of intra-operative language tests

Practice of the intra-operative language tests is paramount to the success of the awake craniotomy. The SLT should ensure that the patient is able to perform the tasks seamlessly and within a 3-4 second timeframe. If errors are made, or there is a delayed response time of more than 3 seconds, then those stimuli should be removed from the intra-operative language battery.

This will allow the SLT to be confident that errors elicited during brain mapping are secondary to DES, and not a baseline aphasia associated with the presence of the brain tumour (Papatzalas, 2022).

Practice of the intra-operative language assessments can also help prepare the patient for surgery and set clear expectations, which may alleviate patient fear or anxiety.

7.2.5 Further communication assessment

SLTs should use their clinical experience and knowledge to determine if further formal language and/or cognitive communication assessment is required, e.g. Comprehensive Aphasia Test (Howard and Patterson 1992) or Measure of Cognitive Linguistics (Ellmo, 1995) in addition to the dynamic conversational analysis, practice of intra-operative language tasks, and neuropsychology report and findings from fMRI, nTMS and DTI (if available).

7.2.6 Patient eligibility

SLTs have an excellent understanding of the demands placed upon a patient intra-operatively. These include a quick speed of auditory or reading processing (3-4 seconds), adequate baseline communication skills and an appropriate level of psychological resilience. Throughout the pre-operative assessment, SLTs should consider these demands in relation to eligibility. For example, Mariotti et al (2025), found in their survey of clinical practice that 97.2% of clinicians agree that patients need to have at least sentence-length communication to be eligible for awake craniotomy. Those patients who are non-verbal were deemed unsuitable by all survey respondents.

If there are concerns about a patient's eligibility, these should be discussed with the neurosurgeon, neuropsychologist and appropriate MDT members as soon as possible. Attempts should be made to support patient eligibility, where possible, e.g. clinicians should attempt to match the intra-operative testing stimuli to the patient's baseline communication capabilities, or in the case of anxious patients, theatre familiarisation visits should be considered.

7.3 Intra-operative assessment

7.3.1 Anaesthetic awareness

The SLT should have knowledge of the anaesthetic approach to be undertaken for each awake craniotomy procedure. They should be aware of the potential benefits and complications to an AAA versus ATC.

The merits of awake throughout craniotomy (ATC) should be explored with both the anaesthetist and neurosurgeon to allow immediate mapping without the possibility of anaesthesia induced sub-optimal language performance.

For 'asleep-awake-asleep' (or asleep-awake-awake) cases, the SLT should practise a sample of the language tests with the patient, prior to the commencement of mapping to confirm adequate patient performance and reliability of responses. If the patient is performing at a sub-optimal standard and off their pre-operative language baseline, the SLT should alert the neurosurgeon and anaesthetist immediately. The patient may benefit from waiting for a longer period for the effects of the anaesthesia to wear off, or the anaesthetist may have to reduce sedatives further.

If after a period of appropriate time the patient remains at a sub-optimal performance level, i.e. they continue to make errors which are unrelated to mapping, then a new baseline language sample of relevant tasks should be taken prior to the introduction of DES. The commencement of DES and mapping should be discussed between the SLT, neurosurgeon, anaesthetist and, where possible, the patient.

7.3.2 Surgical approach

SLTs should be aware of the neurosurgeon's expected resection approach, particularly in the cases of deep-seated tumours, whereby healthy cortical resection or windows are required to access the tumour bulk. If multiple options for entry are available, the SLT should prepare language testing materials for each eloquent area, as per discussion with the neurosurgeon.

7.3.3. Mapping phase

The intra-operative SLT role is dynamic and multi-faceted, consisting of;

- Conducting speech and language testing during both mapping and resection stage
- Constantly communicating with the patient
- Providing calming reassurance throughout
- Identifying and interpreting speech and language errors
- Communicating errors effectively and succinctly to the neurosurgeon
- Keeping a record of error types and their corresponding neuro-anatomy. However, it is recommended that the role of intra-operative data collection is negotiated amongst the MDT, as balancing live record-keeping, alongside patient assessment can be challenging.

Prior to the commencement of mapping SLTs should ensure the patient can see the testing material adequately. If the patient wears glasses or hearing aids, these must be available intra-operatively.

Communication with the neurosurgeon is paramount in the mapping phase of the surgery. Agreement on how to communicate patient errors should be established with the neurosurgeon prior to commencement of mapping.

SLT knowledge of language eloquent functional boundaries is paramount to the selection of suitable language assessment in surgery. As the mapping progresses, SLTs should change the language tasks to correlate with the anatomical areas the neurosurgeon is mapping.

SLTs should present the language tests in synchrony with the DES. It is important the SLT does not present the stimuli prior to the cortex being stimulated; this may result in an unreliable map as the patient has been able to see or hear the language task and formulate a response before the cortical stimulation has temporarily disrupted the language network.

7.3.4. Intra-operative language network disruption

SLTs should recognise and interpret language network disruption and communicate this to the neurosurgeon immediately. Possible language disruption features are:

- hesitancy or delay in response (to an otherwise immediate response at baseline)
- phonological paraphasia
- semantic paraphasia
- speech arrest
- dysarthria
- dysfluency or stammer/phonological repetition or prolongation
- facial droop or twitching on the contralateral side of neurology
- anomia
- reading errors
- auditory comprehension errors
- syntactic or grammatical errors
- writing or spelling errors

SLTs should offer reassurance to the patient throughout the mapping, particularly in the event of temporary language disruption, and highlight that this is a positive and will support the preservation of this function.

For infection control purposes, all language tests should be presented electronically on a single device which can be wiped clean before and after use. An exception to this is for writing assessment which requires pen and paper.

7.3.5. Intra-operative seizures

SLTs should be aware that intra-operative seizures can occur. A systematic review found the incidence of intra-operative seizure to be approximately 8.4%. Patients with a history of seizures, lesions in the frontal lobe and patients taking anti-epileptic medications are at a higher risk of intra-operative seizures (Shakir et al 2023). There is conflicting evidence regarding the correlation between cortical stimulation and seizures. SLTs should be aware of the increase of electrical stimulation during mapping, starting at 2mAmps and increasing up to 5mAmps. Language tasks need to be repeated with each increase of stimulation.

If seizure activity is evident, SLTs should cease testing and alert the surgical MDT immediately. Cortical cooling through the topical application of cooled saline has proven effective at reducing seizure activity, intra-operatively (Ibayashi, et al,. 2021). Recommencement of mapping and language testing should only be recommenced if the patient is able to appropriately interact with the team and a reliable sample can be obtained from the patient.

7.3.6. Resection phase

During the resection phase, SLTs can monitor language function without the time constraints of mapping. Monitoring of the language network can be dynamic and use a combination of conversational output as well as language assessment.

Spontaneous speech is a complex process which requires integration of multiple linguistic domains (semantics, phonology, morpho-syntax). The use of spontaneous speech is beneficial during the resection phase as it allows for monitoring of the range of linguistic domains, as well as helping to target isolated language testing (Collee, et al 2023). For example, if a patient made a phonological error during conversation, further isolated testing of the phonological network may be warranted. The SLT should feed back to the neurosurgeon any changes to neurology and language performance.

Depending on the length of surgery and the needs of the patient; the SLT and neurosurgeon should balance the continued monitoring of language with the preservation of patient energy. The resection phase may be an opportune time to give the patient a break from testing and speaking to preserve patient energy and avoid high fatigue levels, which can impact testing validity.

7.3.7. Data collection and documentation

Clinical documentation should be line with RCSLT guidance, HCPC standards and local policy.

Speech and language intra-operative data collection is encouraged to;

- Oversee service level evaluation and audit
- Contribute to research at a local, national and international level

Due to the complex and dynamic role of the SLT intra-operatively, collecting live data is challenging. MDT consensus should be established to agree what, when and by whom the data intra-operative data should be captured.

7.4 Post-operative assessment

7.4.1 Assessment and management

It is recommended that patients are treated by the same SLT post-operatively to ensure the detection of new, discrete communication changes and ensure consistency of care.

There are several factors which can impact a patient's performance in the immediate days following surgery, e.g. fatigue, persisting effects of anaesthesia, brain oedema, or post-ictal status (if the patient has seizures intra-operatively).

SLTs should offer a post-operative assessment to diagnose new language deficits (if present), offer education and reassurance to patient and their family or friends, and provide communication support, advice and bespoke therapeutic interventions, as appropriate. Studies have shown that severe deficits in the immediate phase following surgery, will typically improve or resolve in the 6-month post-operative period (Shanai et al 2008., Leon-Rojas et al 2020).

7.4.2. Patient advocacy

In cases where patients have significant language changes, the SLT role is dynamic and tailored to the needs of the individual. SLTs have a key role in supporting patient participation in the following areas:

- mental capacity assessments (for further information please see the RCSLT guidance on supporting decision making and mental capacity)
- diagnosis meetings
- discharge meetings
- medical meetings pertaining to treatment

SLTs can support patient understanding of information and explore alternative and augmentative methods of communication (AAC). Please see the RCSLT guidance on AAC for further information.

7.4.3 Optimisation for hospital discharge

SLTs should be aware of the outcome of histopathology findings from brain biopsy tissue, patient diagnosis and treatment pathway and prognosis. Collaborative working with the MDT is imperative to ensuring safe discharge from hospital to appropriate rehabilitation or home setting. SLTs will identify patients who require further inpatient, outpatient or community-based specialist SLT support. Onward referrals should be made in a timely manner, as well as signposting patients to other supportive bodies, such as the Brain Tumour Charity.

8. Multilingual patients

8.1 Neural language organisation of multilingual individuals

Worldwide, multilingual people are the rule rather than the exception. However, the monolingual brain and language processing system are still considered the norm in neurocognitive models of language and clinical practice. This can make brain mapping and intra-operative language assessment for multilinguals challenging and heterogeneous.

A recent systematic review highlighted certain factors, such as age of acquisition (less than 7 years), language proficiency, language exposure and similarity to other learned languages may play a role in the cortical organisation of language. For example, those languages acquired later in life may have a less predictable pattern to cortical organisation (Pascual et al 2023). This highlights the need for person-centred and bespoke care.

8.2 Considerations for multilingual mapping

SLTs should ascertain what languages a patient speaks as early as possible. Whilst the goal is to ensure each language is mapped and preserved intra-operatively, the following factors should be considered when ascertaining suitability for multilingual brain mapping, as well as prioritising languages:

- language proficiency
- age of acquisition
- primary language(s) used in different settings (educational, professional, familial, social)
- modality of language use (spoken, written, reading, informal, formal)
- dialect of language and access to qualified interpreter
- the patient's own goals for language perseveration and perceptions of quality-of-life implications

SLTs should be aware of the potential risks with multilingual mapping in awake craniotomy. For example, the more languages which are being tested during the mapping process, the more stimulation the cortex will receive and the longer overall length of surgery. There is a possible correlation between cortical mapping and the induction of seizures, therefore prioritisation of languages may be warranted if a patient speaks multiple languages (ReFaey et al 2020). Similarly, the more languages that are tested, the longer the overall time of surgery. This may have implications on patient levels of fatigue and overall performance during language monitoring

within the resection phase, or during language mapping of sub-cortical areas which typically occur further into the surgery timeframe.

Following a comprehensive review of the patient's linguistic profiles and understanding of patient priorities, the SLT is well placed to support MDT discussions on the risks and benefits of multilingual mapping and discuss mapping protocols with the neurosurgeon.

8.3 Cultural considerations

Currently, there is no standardised approach or assessment for multilingual patients undergoing an awake craniotomy. Challenges of bias have been highlighted within the literature, i.e. the bias relating to the socio-cultural background of multilingual patients or mono-lingual non-English speaking patients, the bias of culturally inappropriate testing materials (with a monolingual ethnical/linguistic normative group), and potential unpredictable biases may depend on the unique characteristics of the individual, such as the number, type and combination of spoken languages (ReFaey et al 2020; Mariotti et al 2025; De Martino et al 2021).

SLTs working with multilingual or non-English speaking patients should reference the RCSLT bilingualism guidance and align practice with the gold standard principles laid out.

8.4 The use of interpreters

Qualified interpreters should be sought to ensure a high-quality translation of the patient's spoken and/or written output. SLTs have a key role in preparing and training the interpreter for their nuanced role in surgery. It is strongly recommended that the same interpreter is used at the pre-operative, intra-operative, and ideally, post-operative stages. This will support with rapport building with the patient, establish a working relationship with the SLT, enable the interpreter to make quick judgements of a linguistic change and relay these in a timely manner to the SLT and neurosurgeon.

If qualified to do so, an interpreter can also support with the translation of written materials to ensure these are culturally and linguistically appropriate.

Clinicians who work with interpreters should read the RCSLT interpreters guidance.

8.5 Multilingual testing

The process of pre-, intra- and post-operative language testing for multilingual patients, should mirror that of the process for monolingual patients. DeMartino et al (2021), found from their literature search that informal testing and translating testing materials are frequently used within clinical settings and suggest this may be the best compromise when a balance between acceptability and adequacy is warranted.

In a recent UK based survey of clinical practice in multilingual mapping, the results highlight a variety of approaches. The reported intra-operative testing paradigms used for multilingual patients included:

- object naming (29%)
- word repetition (20%)
- language switching (7%)
- sentence completion (15%)
- action naming (18%)
- and 'other', such as conversation or reading (18%)

(Mariotti et al 2025)

In the absence of an established testing paradigm for multilingual or non-English speaking patients, SLTs should use their clinical experience and skills to tailor testing paradigms to fit the needs and background of the patient. They should refer to the evidence base and align test selection with current neural language network systems.

9. SLT training and competence

9.1 Core skills and knowledge

In the absence of a developed training and competency framework, it is recommended that SLTs working in the field of awake craniotomy have as a minimum standard:

- knowledge of the neural basis of language
- knowledge of the research and literature for intra-operative language assessment
- knowledge and understanding of the anatomo-functional cortical and sub-cortical language pathways
- knowledge of a variety of language assessments
- extensive experience in conducting language assessments and interpreting results
- knowledge of anaesthetic approaches and the possible implications for reliability of language testing
- knowledge of low grade and high-grade brain tumours and their prognosis/trajectory
- ability to communicate confidently and assertively within a surgical setting
- knowledge of DTI, nTMS, fMRI and MRI findings
- understanding of the roles of MDT within theatres, awake craniotomy and neuro-oncology
- awareness of relevant local/national policies and guidelines
- awareness of infection prevention control and local induction to theatre setting
- counselling skills and experience in supporting behavioural change
- experience working with interpreters and conducting assessment in additional languages
- understanding of the role of speech and language therapy in the awake craniotomy pathway.

9.1.1 Acquisition of knowledge and skills

Knowledge and skill acquisition may be obtained by a variety of means, including:

- reading up-to-date evidence base and literature
- accessing online tutorials e.g. https://www.futurelearn.com/courses/awake-brain-surgery
- clinical observations
- online educational platform – see RCSLT Awake Craniotomy member resources page [link to be added]
- peer supervision
- professional supervision and mentoring
- attendance at relevant conferences

9.1.2 Supervision

Given the specialist and emerging role of SLTs in awake carniotomy, some clinicians may not have access to an appropriately trained supervisor within their institution. Clinicians will be expected to be proactive in seeking appropriate professional supervision and employers should allow support and time for this. Examples may include negotiated external supervisors, accessing peer supervision and/or ensuring links with RCSLT advisors. For further information, please see RCSLT supervision guidance.

Clinicians are encouraged to enrol with the Tessa Jowel Academy, which offer SLTs e-networking opportunities, as well as courses and seminars to support clinicians continued professional development in both neuro-oncology and awake craniotomy.

10. Leadership and influencing

10.1 Research and innovation

Research relating to the role of speech and language therapists in awake craniotomy is evolving. The evidence base for intra-operative language testing is variable and no consensus has been reached about the choice of intra-operative tests. Consequentially, SLT practice in awake craniotomy is varied (Mariotti, 2025). The speech and language therapy workforce can make a significant contribution in developing a robust evidence base and improving the quality of care provided.

Research and innovation within the field should focus on the creation of an English language validated intra-operative language assessment, reaching a consensus on intra-operative language resources, with considerations for multilingual patients. This will enable streamlined and consistent practice nationally and ensure optimal patient care and outcomes.

There is a growing interest in the use of artificial intelligence and virtual reality within awake carniotomy (Bernard et al, 2023). SLTs should work collaboratively with MDT colleagues to support or lead on the implementation of advancing technologies and innovations. Regular audits, service evaluation and quality improvement projects are recommended.

10.2 Resources

SLTs should reference the RCSLT website for resources in delivering quality services (e.g. sections on service planning and improvement and local influencing). Clinical resources are also available on the RCSLT Awake Craniotomy members resources page [add link]

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