



# Clinical guide for the management of Paediatric Neurosurgery patients during the coronavirus pandemic

## 24<sup>th</sup> April 2020

Paediatric neurosurgery accounts for 10-15 per cent of neurosurgery. The management of hydrocephalus, trauma, craniofacial conditions, congenital spinal defects, CNS infections brain and spinal tumours, vascular conditions, the surgical management of epilepsy, spasticity, functional disorders and other rarer conditions form the majority of the interventions.

The evidence to date (24<sup>th</sup> April 2020) suggests that although children do develop COVID-19, very few children will develop a severe infection with COVID-19, whether they are immune-compromised or not. The main consideration therefore is protection of the surgical team from infection.

Most neurosurgical cranial and spinal procedures should be safe. Surgery in close proximity to the face, eyes and paranasal sinuses poses the greatest risk to neurosurgeons, ENT, Ophthalmic, maxillofacial, craniofacial and dental surgeons. Covid-19 appears to be transmitted via droplets, surface contact, and aerosols produced by procedures on the upper airways; transmission by aerosols produced by surgery (ultrasonic tumour resection, cranial or spinal drilling) may be possible, and while not currently thought to be a significant risk, full PPE should be used (see below). Where appropriate consider alternative surgery or non-operative management. In the high risk group or symptomatic patients, when time permits, test for covid-19 prior to surgery.

Paediatric neurosurgery practice differs to some extent from adult practice and we provide specific recommendations for our subspecialty. The guiding principles are that we continue to provide urgently needed surgical care despite the reduced availability of resources during the SARS-Cov-2 pandemic. Where surgery is deemed to be less urgent, this must be based on shared MDT or consultant consensus to provide robust decision making and optimise general surgical resource sharing within the hospital.

### **OUTPATIENT ACTIVITY:**

- Postpone all **non-essential outpatient** procedures and appointments to support transfer of resources to more needy areas.
- **New & Ongoing referrals considered urgent** should be reviewed and a decision made regarding a video/telephone consultation or in exceptional cases a direct face to face review
- **For antenatal diagnosis of open spina bifida,**
  - Attempt to have a telephone consultation with the couple or expectant mother.
  - Convey information on NICE guidance on prenatal surgery for repair of myelomeningocele.
  - If criteria for prenatal surgery is fulfilled and expectant mother/parents wish to consider it, they should be referred to a prenatal surgery centre
  - decisions around place and time of delivery are best defined by the obstetrician
- **Head Circumference Measurements:** Please see [APPENDIX 4](#)
  - For ongoing reviews is usually measured by parents once they have been shown how.
  - If the head circumference has risen fast, treat as appropriate.
- An **auditable record of all postponements**, cancellations must be created. to ensure adequate follow-up and monitoring and reschedule safely.



### **MDT ACTIVITY:**

- Maintain essential MDT activity, consider reducing attendance to key decision makers, hold MDTs with online video to help maintain social distancing.
- Keep MDT discussions to new cases, major decisions/care withdrawal, urgent treatment, therapy change
- Maintain and auditable record of patients that have not been discussed and need to be brought back to the MDT at a later time.

### **SURGICAL ACTIVITY:**

- An urgent review of all surgical activity and waiting lists to determine cases that need urgent surgery and those that can safely be postponed.
- Consider contingency planning with your regional network and evaluate resource availability.

### **Reducing Resource Utilisation:**

- Admit on day of surgery wherever possible rather than previous day.
- Use of absorbable sutures to minimise clinical contact.
- Where appropriate reduce length of stay with home convalescence for children e.g. shunt revisions
- Post-op routine care in ward HDU, use critical care beds only for ventilated cases or those needing invasive monitoring.
- Review post-op care by video/photographic assessment of wounds and clinical progress
- Instruct parents on head circumference measurement where required so that parents can send results back to the team for serial assessments.
- Provision of adequate dressings and cleaning solutions to manage wounds at home.

### **Prioritisation of Surgery in Paediatric Patients:** Please see [APPENDIX 5](#)

- Children presenting with raised intracranial pressure with mass lesions or hydrocephalus, compression of vital structures compromising vision, and other critical CNS functions must be considered for immediate to urgent surgery.
- Acute trauma, acute hydrocephalus, open dysraphic conditions, instability from any cause, acute CNS infections, compressive tumours and lesions should be prioritised to urgent surgery (see above)
- Children with mild closed head injury without intracranial haemorrhage and stable neurology, stable spinal fractures could be treated at local hospitals. These children should be monitored closely. Please refer to neurotrauma group guidance.
- Other urgent electives should be prioritised, through team discussions or shared responsibility through MDT and listed when resources are available. PICU access may be restricted.
- Congenital conditions, such as most of the craniofacial disorders, closed dysraphic conditions, skeletal dysplasias, stable oncological disease including some benign recurrences, epilepsy, spasticity and other functional surgery could be postponed to 3 to 6 months following an MDT discussion with adequate monitoring.

### **Additional Considerations to Choice of Surgery:**

- Whenever possible use the simplest and fastest surgical option.
- **PICU support or prolonged in-hospital stay**
  - Avoid non-urgent procedures where there is a high risk of prolonged ICU stay.
- **In the treatment of hydrocephalus**, consider using the **ETV success score (ETVSS)** using the option most likely to succeed to avoid second surgery. Please see [APPENDIX 3](#)
  - If ETVSS is less than 70 a shunt should be performed
    - At that score, the initial success of an ETV is likely less than for a VP shunt.



- If an ETV is performed, consider a ventricular access device to allow rescue drainage of CSF. This is particularly relevant as in case of failure of ETV and where an immediate access to theatres is not guaranteed.
- **Surgery for Oncology,**
- **Consider prioritising patients for surgery within 1 week for**
  - All symptomatic Posterior fossa tumours with or without hydrocephalus
  - All symptomatic Supratentorial brain tumours with mass effect with or without seizures or hydrocephalus
  - Resection of malignant tumours in children suitable for adjuvant therapy
  - Intraventricular (lateral/third) and periventricular (callosal/thalamic/pineal) causing hydrocephalus.
  - Tectal Plate lesions with acute hydrocephalus: consider ETV alone
  - Large Pineal region tumour
    - Blood and CSF tumour markers with ETV and endoscopic Biopsy
    - Consider surgery in pineoblastoma
    - Non-surgical treatment of germ cell tumours, non-germinomatous germ cell tumours
    - Consider delaying definitive surgery in benign lesions
    - Consider whether treatment or what treatment is appropriate in high grade lesions through MDT
- **Consider alternative to standard Options**
  - Consider biopsy where radiology suggests adjuvant therapy will be indicated such as in high grade tumours in appropriate age groups
  - For Biopsy or aspirations, consider an image guided procedure instead of stereotactic procedures where appropriate to reduce travel out of theatres, usage of radiology.
  - In medium to large cystic lesions, use image-guided drainage and insertion of a subcutaneous reservoir to release mass effect and allow repeated drainage.
  - In suitable suprasellar cystic lesions with hydrocephalus consider an endoscopic trans ventricular drainage and fenestration of cystic cavity.
- **Consider deferment of cases to 3 months, re-image with MRI and re-evaluate**
  - **New cases, radiology/spectroscopy indicates low grade glioma (LGG), no mass effect**
  - **Planned for surgery LGG cases** where no growth evident, consider further deferment.
  - **New or planned skull base tumours** (Chordomas, meningioma, vestibular schwannoma) asymptomatic or minimally symptomatic
- **Deferred Surgery:**
  - Where surgery or other treatment is not currently offered, maintain an auditable record of the reasons why standard treatment was not offered and plans to review decision.
  - Ensure that patients not suitable for surgery are supported through the oncology service.
- **Surgery involving the sinuses**
  - Non-urgent fronto-orbital craniofacial surgery where vision is not compromised, should be postponed
  - Anterior craniofacial distraction should be postponed if possible.
  - Repair of anterior fossa and CSF leak:
    - give consideration to an alternative extra nasal/ sinus approach such as a frontal craniotomy **with full PPE precautions as described in the PPE section.**
- **Endonasal Surgery:**
  - These are much less frequently carried in children. **They carry a very significant risk.**
    - Use of debridors and drills within the nasal cavity will produce a droplet aerosol which is highly dangerous.



- Evidence from Wuhan indicates that ENT surgeons were amongst the worst affected and that the FFP3/N95 masks did not prevent infection.
- **The current society recommendation is: see SBNS guidance [HERE](#)**
  - With patients for whom surgery cannot be deferred, consideration should be given to alternatives to endoscopic surgery:
  - Perform a Craniotomy or a minimal access brow surgery with microscopic and endoscopic assistance for suprasellar lesions.
  - Microscope based trans-sphenoidal surgery, where a sinus is developed, with a submucosal approach and entry to the sella using non-drill techniques **only after an external MDT or peer discussion.**
  - Where surgery is urgently required but such precautions are not possible, the child should be urgently referred to another centre or a national MDT considered
- **Implanting Devices:**
  - **Deep Brain stimulator (DBS) for Dystonia:**
    - Consider insertion only in exceptional circumstances after an external/national MDT
    - Parent/carer battery check may indicate loss of battery charge.
    - Consider urgent revision of DBS (battery) device in compromised breathing or swallowing or history of status dystonicus
    - In other patients medical therapy may be appropriate with neurology input
  - **Insertion & Revision of Intrathecal Baclofen (ITB) pumps:**
    - Defer insertion of new intrathecal baclofen pumps for at least 3 months
    - Acute baclofen withdrawal should be treated urgently.
    - Consider planned change of Baclofen Pump when the alarm starts beeping. This normally occurs around 90 days of charge left, but usually lasts longer. Hence consider change of battery around 3 months.
    - If the device has a two tone alarm this suggests impending pump failure or the pump is empty. Admit urgently and intervene as appropriate.
    - If pump malfunction, these are generally considered as an emergency to avoid acute baclofen withdrawal and should be urgently investigated and repaired.
    - Temporarily with oral baclofen and additional medical therapy.
    - Baclofen refills should continue per schedule
  - **Insertion & Revision of Vagal Nerve Stimulator (VNS)**
    - Insertion of new VNS should be postponed for 3 to 6 months.
    - If the battery charge drops to <10% consider a planned change 1 to 3 months.
    - Consider increasing oral therapy if effectiveness drops during this period to avoid increased seizure activity.
  - **Intrathecal drug delivery devices (ITDD devices):**
    - **Treatment for enzyme replacement therapy**
      - If malfunction, enzyme replacement therapy can be given IV in most cases.
      - Intrathecal ERT can also be provided by a LP bolus. However this is not always easy or possible even in normal situations.
      - Where alternative route of treatment is not available consider urgent replacement of device.
    - **Treatment of spinal Muscular atrophy (SMA) with intrathecal antisense oligonucleotide (ASO)**
      - Existing approved cases should be considered for continued lumbar puncture bolus therapy
      - New referrals for ITDDD should be postponed for 3 months and reviewed at that stage
    - **Treatment of Nieman-Pick C disease**



- If device malfunction, consider temporising with lumbar puncture bolus of cyclodextrine treatment wherever possible.
- The trial of intrathecal therapy using Celsite as intrathecal drug delivery device has been halted for new implants.
- **Treatment of Metachromatic Leukodystrophy**
  - The trial has been paused.
  - The recommendation is not to implant new devices for 3 months pending a further review.
  - Existing cases can be treated with LP bolus therapy

**PERSONAL PROTECTION DURING SURGERY: Please see [APPENDIX 1](#)**

**FULL PPE: - FFP3 Mask, Visor, sterile gown, sterile surgical gloves, and shoe covers**

- The surgical management in unknown status of covid-19 should mirror that of Covid-19 positive cases
- Details on infection prevention & control during Aerosol Generating Procedures as well as in high risk areas such as the face, sinus and endonasal surgery as detailed later in a separate appendix.
- **Please see further details in Appendix 1**

**THEATRE ENVIRONMENT- PLANNING, SURGERY, POST SURGERY: Please see [APPENDIX 2](#)**

- The critical maintenance of personal protection is discussed in the theatre environment
- **Please see further details in Appendix 2**

**DIFFICULT DECISION-MAKING:**

- Sharing decisions with colleagues with a minimum of 2 consultants is helpful.
- Ad-hoc mini-MDTs made of senior decision makers to help facilitate difficult case decisions and communicate outcomes to parents should be utilised.
- Where local expertise is not available or where there is need for a wider consensus at the request of colleagues, hospital or parents, the BPNG or SBNS will help with further advice.
- **Consider an Ethics committee review for difficult life and or treatment decisions**

In addition, the SBNS are providing additional more specific subspecialty guidance related to certain common conditions, and I refer you to the Trauma, Cancer and Neurovascular recommendations already available. Public Health England regularly updates [guidance on Covid-19 infection prevention and control](#) and this supersedes related advice that may not have yet been updated.

On behalf of the BPNG

**Guirish A Solanki**  
**Chairman of British Paediatric Neurosurgery Group (BPNG)**  
**Society of British Neurological surgeons (SBNS)**



## APPENDIX 1

### PERSONAL PROTECTION DURING SURGERY:

**FULL PPE: - FFP3 Mask, Visor, sterile gown, sterile surgical gloves, and shoe covers**

- Some trusts may be able to segregate from Covid-19 affected areas, others may benefit from looking to provide this service.
- Surgical cases should be given consideration to Covid-19 testing, specially when symptomatic or high risk.
- **Where the Covid-19 status of the child is unknown or positive:**
  - The Airway team (intubating anaesthetist, practitioner and third trained member), should use **FULL PPE**
  - The Surgical team (the operating surgeon, assisting surgeon, scrub nurses): should use **FULL PPE**
- **Surgery within 1 metre of the face**
  - Carries the highest risk to exposure
  - This includes all cranial surgery as well as CCJ and cervical spine surgery
  - **Full PPE precautions must be used**
- **High Speed Drilling (HSD): [see AGP guidance from PHE here](#)**
  - There is evidence that high speed drilling creates an aerosolised mixture that can carry the virus. **Avoid using high speed drilling where possible and** use bone rongeurs or a curette.
  - **Where drilling is necessary** (whether cranial or spinal), use irrigation of drills only when the drill bit is stationary to prevent aerosol. **Full PPE precautions must be used.**
  - Additional care must be taken with anterior skull base procedures which might breach a sinus. This includes anterior skull base fracture repairs, craniofacial surgery, subfrontal /frontal craniotomy approach to brain tumours and other lesions. **Full PPE precautions must be used.**
- **Endonasal procedures: see SBNS guidance [HERE](#):**
  - **FULL PPE should be employed BY ALL THEATRE STAFF and care taken with nasal secretions**



## APPENDIX 2

### THEATRE ENVIRONMENT- PLANNING, SURGERY, POST SURGERY:

- **Avoiding contamination**
  - **The patient notes MUST be carried in a clear plastic bag by a clean person**
  - There must be a defined **donning and doffing area**
- **Team Brief:**
  - Ensure a careful WHO check list including specific questions about Covid-19
  - Have a plan A and plan B for surgical strategy
  - Agree to PPE for all staff involved in surgery
  - Consider need for extra staff if assistance required to position patient
- **Anaesthesia & Patient Preparation:**
- In case of **unknown or positive Covid-19** follow strict instructions laid down by [PHE](#)
  - Airway management including intubation must be done with **full PPE in Clean anaesthetic room**
  - The patient is brought into the **Exposure Zone (operating theatre) after 20 minutes**
  - **Surgical team then enters with full PPE on**
- **During Surgery:**
  - Maintain PPE at all times.
  - Ensure other participants such as radiologists, neurophysiologists, visitors, temporary staff cover are appropriately protected before they enter the exposure Zone
  - **Surgical equipment** should be covered by adequate drapes
    - Patient care equipment should be single-use items if possible
    - Reusable (communal) non-invasive equipment must be decontaminated between each patient use
    - The microscope helps maintain surgeon-patient face to face distance
  - **Protection from Aerosol Generating Procedures (AGPs)** see [PHE guidance](#) sec 6.5, pg 29
    - All AGP require the use of **Full PPE including use of an FFP3 mask**
    - Airway examples include Intubation, extubation, manual ventilation, open suctioning of the respiratory tract (including the upper respiratory tract), tracheostomy procedures (insertion/open suctioning/removal), Induction of sputum, High flow nasal oxygen (HFNO)
    - There is a significant risk of aerosolization during intubation and extubation. The patient may cough forcibly particularly during extubation and project droplets and particulate material to quite a distance by forceful expiration
    - **During intubation and extubation** the room is emptied of all non-essential staff except the anaesthetist and assistant(s).
    - Surgical examples include use of CUSA, high-speed drilling
    - **During cases involving High speed surgical drilling**
    - All members of the surgical team, anaesthetic team and theatre attendees should be using full PPE (FFP3, eye protection, fluid resistant gown, double gloves, shoe guard)
    - Following exposure of an AGP adequate time must be provide for cleaning the air.
    - A single air change is estimated to remove 63% of airborne contaminants; after 5 air changes, less than 1% of airborne contamination is thought to remain.
    - In an isolation room with 10-12 ACH a minimum of 20 minutes is considered pragmatic.  
*ACH=Air change per hour*
- **Following surgery**
  - At completion of surgery the **surgical team must doff at defined location**
  - **During planned extubation**



- the exposure zone is cleared of all non-essential staff
- **Airway team performs extubation using full PPE**
- Any specimens must be **double bagged and marked as bio-hazard.**
- The Operation notes must be **written outside of the exposure zone after doffing.**
- The **Exposure Zone must be kept empty for 20 minutes** after patient leaves theatre.
- A level II clean is performed for the floor, surfaces and equipment.
- Electrical equipment will require 70% IMS(methylated spirit) to avoid damage by hydrochloride.
- **A sign-out and team debrief must be done in a clean room after doffing.**



## APPENDIX 3 ETV Success Score

The ETV success score is calculated based upon patient characteristics at the time of ETV and gives an approximate percentage success rate for the procedure.\*

### ETV SUCCESS SCORE

$$= \text{Age Score} + \text{Etiology Score} + \text{Previous Shunt Score}$$

≈ percentage probability of ETV success

SCORE	AGE + ETIOLOGY + PREVIOUS SHUNT		
	↓	↓	↓
0	<1 MONTH	POST-INFECTIOUS	PREVIOUS SHUNT
10	1 MONTH TO <6 MONTHS		NO PREVIOUS SHUNT
20		MYELOMENINGOCELE INTRA-VENTRICULAR HEMORRHAGE NON-TECTAL BRAIN TUMOR	
30	6 MONTHS TO <1 YEAR	AQUEDUCTAL STENOSIS TECTAL TUMOR OTHER ETIOLOGY	
40	1 YEAR TO <10 YEARS		
50	≥10 YEARS		

**Figure 2.** The ETV Success Score is easily calculated and closely approximates the percentage probability of successful ETV.

\*Endoscopic Third Ventriculostomy in the Treatment of Childhood Hydrocephalus: Abhaya V. Kulkarni, PhD, James M. Drake, FRCSC, Conor L. Mallucci, FRC(SN), Spyros Sgouros, FRC(SN), Jonathan Roth, MD, and Shlomi Constantini, MD, MSc, for the Canadian Pediatric Neurosurgery Study Group\*. J Pediatr. 2009 Aug;155(2):254-9.e1. doi: 10.1016/j.jpeds.2009.02.048. Epub 2009 May 15.  
<https://www.sciencedirect.com/science/article/pii/S0022347609002078?via%3Dihub>



## APPENDIX 4

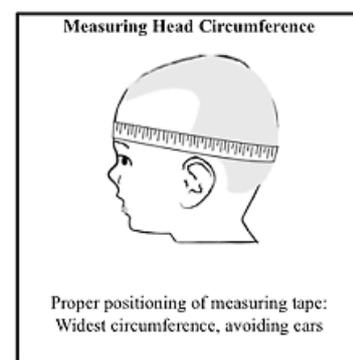
### Head Circumference Measurement Technique

#### How to measure a Child's Head Circumference

#### Parents' /Carers' Guide

##### Introduction

1. Use a measuring tape using the metric system (cm/centimetres)
2. Make sure your tape measure is working normally and not stretching as some plastic ones can do.
3. You will be measuring around the child's head at its largest diameter midway between the eyebrows and the hairline at the front of the head, above the ears and around the prominence at the back of the head (see diagram).
4. Your aim is to always measure the largest circumference possible.
5. It is best practice to take the measurement three times and take the average (the middle measurement in terms of size or the measurement where two or all three of the measurements are the same) to minimise the chance of making an error.
6. It may be distressing for some children but it should not be hurting them.
7. Please keep a record of your baby's head circumference along with the date measured and remember to forward the reading onto your named Health professional.



##### 1 year to 3 years:

1. You may find this easier if you have assistance for one person to hold the child while the other places the tape measure around. It may be necessary for the person holding the child to sit them on their lap and support their head with one hand (under the chin) and hold the child's arms down with their other hand.
2. Remove any hair clips, bobbles, hair bands or hats from the child's hair/head.





## Older children:

### Step 1

1. Place the tape measure just above the eyebrows and ears (as shown in the picture on the right).
2. Set the tape measure from the centre of the forehead above your child's eyebrows and then bring it around above the ears.



### Step 2

- Pull the tape around the back of your child's head.
- Make sure that the tape measure lies around the widest part as shown in the picture (the occipital prominence)
- With the tape measure in place above the ears and eyebrows, wrap it fully around the back of the head.





### Step 3

- Bring the tape around your child's head and overlap the tape measure as shown below.



### Step 4

- Align the tape to the black line indicating zero and this will give you your reading in cm (note that for some tape measures this is the end of the tape, others it is just inside the end).





## **Newborn Babies to Approximately 6 Months of Age**

- Where a child is not able to sit without support, then they should be measured lying down using the same principles as the guidance above.
- If their head is lying to the side then it is better to make the measurement on the side of their head where it is more easily seen (see pictures below).



### **Other resources:**

Royal College of Paediatrics and Child Health

<https://www.rcpch.ac.uk/resources/uk-who-growth-charts-guidance-health-professionals>

<https://www.youtube.com/watch?v=YfFWNP7IBt4&feature=youtu.be>

[https://www.rcpch.ac.uk/sites/default/files/Measuring\\_and\\_plotting\\_advice.pdf](https://www.rcpch.ac.uk/sites/default/files/Measuring_and_plotting_advice.pdf)

Insert local hospital contact details.



## APPENDIX 5

### Summary of Paediatric Neurosurgery Surgical Prioritisation during the Coronavirus Pandemic

Priority	1a	1b	2	3	4
	CNS Infection	ETV/shunt revision – GCS normal	MDT agreed SRS for malignant tumour	MDT agreed Limited craniofacial eg encephalocele repair	MDT agreed Most Craniofacial
	Trauma - haematoma	MDT agreed CNS Tumour resection (most)	MDT agreed Spinal decompression for progressive conditions	MDT agreed Spinal fixation for potentially progressive conditions	MDT agreed Epilepsy surgery
	Acute obstructive hydrocephalus, with decreased GCS or risk of	Ruptured Aneurysm clipping/coiling		MDT agreed Benign non compressive CNS tumours	MDT agreed Unruptured vascular
	ICH	Depressed skull fracture		MDT agreed Dysraphic conditions with neurological progression	MDT agreed SRS for benign lesion
	Myelomeningocele repair	Acute Spinal Cord Compression (any cause)			MDT agreed Functional surgery
					MDT agreed Non-progressive spinal conditions
					Peripheral nerve surgery

CNS: Central Nervous system; ETV: endoscopic third ventriculostomy; GCS: Glasgow Coma Score;

ICH: Intracerebral Haemorrhage; MDT: multi-disciplinary team; SRS: Stereotactic Radiosurgery

Whenever possible cases being postponed or where there is need for earlier surgery need to be discussed through a MDT.