Expert Review Examination of the Paediatric Cranial Nerves

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Abstract: The paediatric cranial nerve examination is complicated by the fact that the patient may not be able to cooperate fully with the examiner. This necessitates the use of a clearly structured and age appropriate approach to ensure that important clinical signs are elicited. This review aims to present a reproducible schema for examination of cranial nerves in neonates, infants and children. Some important clinical findings are also briefly discussed. It is hoped that this review will provide a platform on which the individual practitioner may, with the aid of their own clinical experience, develop an effective method for assessment of cranial nerve function in all ages of child. Word Count: 2549 (excluding abstract, tables and references).

Key Words: Paediatric, Children, Cranial, Nerve, Examination

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Introduction Neurological examination is considered by some to be mystifyingly complex at the best of times, and when performed in a paediatric context it may seem even more daunting. However as with most things in clinical medicine, there are fundamentals which apply in all cases [1-2], that which if adhered to can go a long way to ensuring that examination of cranial nerves in children is not as onerous a task as it may seem.

In all interactions with patients it is important to do your utmost to ensure they are at ease. This is particularly so when dealing with a child and his/her (most probably somewhat anxious) parents. Introduce yourself to the parents and the patient, be friendly and warm and explain what you intend to do. It is important not to address the parents exclusively. Appearing confident and competent, while demonstrating respect for the child as an individual by speaking directly to them and explaining in an age-appropriate way what you intend to do will serve to set both patient and parents at ease, while helping to develop a rapport with the child which you will need in order to complete your examination. It is vital to gain the confidence of the parents as their response to you will be reflected in the child’s behaviour. A wary mother will result in a defensive and uncooperative patient.

Neurological assessment in a child must be tailored to the age of the patient [3]. In neonates and infants, where the patient is usually unable to comply with specific and necessarily complex requests, a certain degree of creativity is required to elicit the required response. Even so, it is clear that some aspects of the cranial nerve examination cannot be satisfactorily performed in this age group, and as such can be omitted. In children above the age of 4 years it should be possible to examine the cranial nerves in much the same way as in adults [4-5]. That said, the examination must still be performed in an age-sensitive manner and may require a playful demeanour and the cooperation of the parents to maintain the child’s attention. While it is preferable to examine the cranial nerves in the systematic fashion as favoured in adults, an opportunist’s approach may be the only way to get it done (with eye movements assessed by waving a large teddy, after the child has been seen to turn his head to localise a hidden sound source, for example).

Examination in Neonates and Infants

In this age group, observation of the patient is a particularly important aspect of the examination [6]. With careful inspection it is usually possible to gain the majority of information that would be obtained from an older child or adult. Possible examination methods are presented below in nerve order. As previously emphasised though, it is likely that cranial nerve examination in this age group cannot be performed in a systematic manner. The
examinations suggested also assume that conventional means of cranial nerve examination are impossible or impractical due to the age of the child.

**Olfactory (CN I):** Disorders of olfaction are rare in paediatrics, and testing in this age group is unfruitful.

**Optic (CN II):** It is important to try and ensure the child is relaxed when examining the eyes. Acuity cannot be formally quantified in the neonate or infant. However, gross abnormalities can be elicited by assessing the child’s ability to fix upon faces, lights or brightly-coloured objects (e.g. Does the baby recognise and follow mother’s face? Does the infant reach for small building bricks to play with?). The parents may report that the child does not seem to respond to them as expected, which may arouse suspicion. In a young child, acuity may be assessed by asking the child to count your fingers. Note eye position and movement on spontaneous eye opening. The pupillary reflex is tested by shining a light into each eye in turn. In the normal case, the pupil in the examined eye constricts with consensual constriction of the contralateral pupil. The pupils should be equally reactive to light and symmetrical within the orbits. Asymmetry of pupil position implies a squint (strabismus) and mandates further assessment (for example by the ‘cover test’, which shall not be discussed here). The parents have a role to play in helping to calm the child and may also be asked to gently restrain the child to enable better visualisation of the fundus. Be sure to check the red reflex in both eyes. See table 1 for possible ophthalmoscopic findings.

Complete examination of the eyes requires use of the direct ophthalmoscope. Clearly, ophthalmoscopy may be difficult, particularly in the younger child. Again the parents have a role to play in helping to calm the child and may also be asked to gently restrain the child to enable better visualisation of the fundus. Be sure to check the red reflex in both eyes. See table 1 for possible ophthalmoscopic findings.

**Oculomotor (CN III), Trochlear (CN IV), Abducens (CN VI):** Initial observation is again useful. Look for any obvious paralysis of ocular movements. In the neonate or young infant, try gaining the attention with a toy or large coloured object and move this through the vertical and horizontal axes once the child has fixed it in his gaze. In older children able to follow commands it should be possible to assess eye movements by stabilising the head with one hand while asking the child to follow your finger. Look carefully for paralysis of ocular movement or nystagmus. Jerk nystagmus (containing a slow and fast phase) suggests vestibular dysfunction, while a pendular nystagmus suggests disease of the cerebellum or retina.

<table>
<thead>
<tr>
<th>Table 1 – Important signs on fundoscopy.</th>
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<tr>
<td>Cataract</td>
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<td>Glaucoma – increased corneal diameter, corneal clouding</td>
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<td>Retinoblastoma – leukocoria</td>
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<td>Retinal haemorrhage – may indicate traumatic birth or non-accidental injury</td>
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<td>Retinitis – may indicate congenital infection</td>
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<td>Pale disc – may indicate congenital optic neuropathy</td>
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<td>Papilloedema</td>
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The doll’s eye response can be elicited by slowly turning the head from left to right. In the normal case, the eyes will not move with the head, essentially moving in the opposite direction to head movement. Asymmetry of this movement implies a lesion of the oculomotor or abducens nerve.

**Trigeminal (CN V):** The rooting response tests facial sensation. Light touch at the corner of the mouth causes mouth opening and rotation of the head towards the stimulus.

**Facial (CN VII):** Observe the child for a few moments. Note the symmetry of facial movements and expression and look for any abnormality or asymmetry in opening of the mouth when the child cries or smiles.

**Vestibulocochlear (CN VIII):** The neonate will respond to sudden loud sounds by blinking and momentarily ‘freezing’. If a tuning fork is handy, use this to quickly assess hearing. Strike the fork and introduce to the ear. The infant should turn towards the tuning fork and may also be quietened. Repeat on the other side.

The parents may have concerns about the child’s hearing and it is important to elicit any such concerns in the preceding history. It is vital to detect
any hearing deficit as early as possible so as to reduce the resultant effect on the child’s language and learning development. As such, any suspicion of hearing loss either from the history or clinical examination warrants further investigation.[8]

Glossopharyngeal (CN IX) and Vagus (CN X): Cranial nerves IX and X are commonly assessed together as between them they mediate sucking and swallowing. Look at the position of the palate and uvula when the child is crying, or is otherwise open-mouthed. A unilateral droop of the palate or deviation of the uvula suggests a lesion of the vagus nerve. The uvula deviates away from the side of the lesion.

Gently insert a finger into the neonate’s mouth. If cranial nerve IX (sensory) is intact the child should respond by trying to suck your finger.

It is also useful to ask the parents if there have been any difficulties with feeding as this may indicate an underlying cranial nerve lesion.

Accessory (CN XI): Difficult to assess directly in young children, although it will be possible to gain a general impression of the function of the muscles innervated by the accessory nerve (primarily the sternomastoid and trapezius) by observation of the child and by the response to other parts of the examination. Inability to turn the head will be detected when eliciting the rooting response (trigeminal nerve).

Hypoglossal (CN XII): The hypoglossal nerve innervates the muscles of the tongue. Lesion of this nerve will contribute to dysfunction of sucking and swallowing. Again, it is important to establish if there have been any difficulties with feeding. If possible, observe the tongue for wasting, fasciculation or abnormalities of movement, which are indicative of a hypoglossal lesion. In the presence of a lesion, the tongue deviates to the side of the lesion on protrusion.

Examination in Older Children
Where possible, cranial nerve examination in children older than 4 can be performed in much the same way as in adults. Below is a brief schema of the examination routine, with particular emphasis given to areas which differ significantly from examination in adults:

Olfactory (CN I): Ask the child if he can smell his mother’s cooking at home. While occluding each nostril in turn, present the child with familiar smells (e.g. mint, coffee, oranges).

Optic (CN II): Visual acuity is tested using a Snellen chart or a modification thereof (e.g. letters replaced by small recognisable objects). Colour vision can be assessed with Ishihara plates.

Visual fields can be grossly assessed by confrontation. Sit facing the child at a distance of approximately 1 metre. The child is asked to cover his right eye while the examiner covers his left eye. Extend the arm and slowly bring the index finger into the field of vision from an oblique angle. Repeat in order to assess the four quadrants of the visual field. Ask the child to say when he first sees the finger. Repeat with the other eye.

Assess the pupillary reflex with a pen torch as previously described. The accommodation reflex is assessed by asking the child to look at a distant object before looking at the pen torch held at a distance of 5-10 cm from the nose. Observe the pupils for constriction as the patient focuses on the near object.

Fundoscopy is an essential component of the examination and must always be performed.

Oculomotor (CN III), Trochlear (CN IV), Abducent (CN VI): While holding the head still with one hand, ask the child to follow your finger with his eyes. Moving through the vertical and horizontal axes, observe the eyes for nystagmus and conjugate movement or squint. Ask the child if he saw double at any point, and if so, where.

Trigeminal (CN V): With the child’s eyes closed, assess sensation by touching each side of the face in the distribution of the three divisions of the trigeminal nerve: the forehead (ophthalmic), the midpoint of the cheek (maxillary) and the side of the chin (mandibular). The trigeminal nerve innervates the muscles of mastication (pterygoids, masseters, temporalis, digastric). Motor function of the nerve is tested by asking the child to bite hard while palpating the angle of the mandible bilaterally to assess muscle bulk, which should be symmetrical.

Facial (CN VII): Ask the child to shut their eyes tightly, to smile, to show their teeth and to puff out the cheeks. Look for asymmetry or paralysis of facial movement. The facial nerve also supplies taste fibres on the anterior 2/3 of the tongue. These can be tested by asking the child to identify sugar (sweet) and lemon juice (sour) tastes.
Vestibulocochlear (CN VIII): Hearing is tested at the bedside by whispering into one ear while masking the other ear (e.g. by rubbing the fingers together) and asking the child to repeat what was whispered. Using a tuning fork, Rinne’s and Weber’s tests are performed.

In Rinne’s test, a vibrating tuning fork is placed on the mastoid process and then immediately adjacent to the external auditory meatus. In the normal case, the tone is heard loudest when the tuning fork is placed adjacent to the ear (the opposite finding suggests conductive hearing loss, while diminution of both air and bone conduction suggests sensorineural hearing loss).

In Weber’s test, a vibrating tuning fork is placed in the centre of the forehead and the patient asked in which ear the tone is heard loudest. In the normal case, the sound is heard equally in both ears. In conductive deafness the sound localises to the affected side, while in sensorineural deafness the sound localises to the unaffected (or least affected) side. See the Expert Review in this issue of the JCE for further discussion of the tuning fork tests.

Again, it is important to be receptive to any concerns the parents may have about the child’s hearing, and any child in whom hearing loss is suspected should be referred for formal hearing assessment. Hearing function is tested definitively by audiometry, the description of which is beyond the scope of this article.

In practice, examination of the vestibulocochlear nerve is concerned primarily with hearing alone. However vestibular dysfunction may be suspected if dizziness, vertigo and disabling attacks of nausea and vomiting are prominent features of the history, and although not routine, vestibular function may be assessed in these cases by invoking the oculovestibular reflex. With the patient supine and the neck flexed to 30° above horizontal, the ears are irrigated with water at a temperature of either 30°C or 44°C. Introduction of water into the ear canal induces a characteristic nystagmus in normal cases. Cold (30°C) water causes nystagmus with slow phase deviation towards the stimulated side and fast phase towards the opposite side. Warm water (44°C) produces the opposite effect: nystagmus with slow deviation away from the stimulated ear.

Glossopharyngeal (CN IX) and Vagus (CN X): Again, the close anatomical and functional relationship of these nerves makes joint assessment clinically appropriate. Ask the child to say ‘Ah’ and with the mouth wide open observe the position of the uvula and palatal movement. The ‘gag’ reflex conveniently tests both the ninth (sensory) and tenth (motor) cranial nerves. Using a tongue depressor, gently stimulate the tonsils or pharynx, testing each side in turn. The normal response involves elevation of the palate and the tendency to vomit! This test is unpleasant and can reasonably be omitted. The gag reflex must absolutely not be elicited if epiglottitis is suspected.

Ask the child and parents if there has been any difficulty with swallowing and note any hoarseness of voice, both of which suggest a lesion of IX and X.

Accessory (CN XI): Ask the child to look over each shoulder. This may also be performed with the examiner providing resistance to the side of the head. Ask the child to shrug the shoulders against resistance.

Hypoglossal (CN XII): Ask the child to stick out the tongue and observe for deviation from the midline, fasciculation and wasting, which suggest a lesion of the nerve.

Summary
A structured approach to cranial nerve examination in children is the best way to overcome the intrinsic difficulties that paediatric clinical examination may involve. Remember however, that in young or fractious children a more opportunistic and seemingly unstructured approach may well be required. In such cases, one must remain mindful of the eventual need to present your clinical findings in an ordered and intelligible manner. Examination should be tailored to the age of the patient and the parents should be seen as useful assistants wherever possible. Observation is an integral part of the examination, particularly in infants and neonates, where interactive tasks are not possible.

References


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