

CURRICULUM FOR THE EUROPEAN FELLOWSHIP EXAMINATION IN NEUROPATHOLOGY

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1 INTRODUCTION

1.1. Aim

The curriculum is based on the *Curriculum and Assessment Scheme in Diagnostic Neuropathology* of the Royal College of Pathologists of the United Kingdom. The aim of the Euro-CNS in modifying this document for use in support of the European Fellowship in neuropathology (EFN) examination is to ensure that all trainees, trainers, educational supervisors and education providers in *Neuropathology* are aware of the knowledge, skills and attitudes necessary for success in the examination for European Fellowship in Neuropathology.

1.2. Objective

The objective of this Curriculum is to set out in detail the competences that a candidate will have to demonstrate in order to be successful in the EFN examination, since Fellowship is considered evidence of competence to practise as an independent specialist in neuropathology. The breadth of the curriculum across all aspects of Neuropathology (the principal ones being neuropathological autopsy, neurosurgical biopsies, skeletal muscle biopsies, cerebrospinal fluid cytology, paediatric neuropathology, forensic neuropathology) serves as a statement that Euro-CNS believes that trainees should ensure that they have the opportunity to acquire knowledge and skills across the specialty, even if they intend to take up limited practice on completion of training.

The key elements to be achieved *before* admission for entry to the EFN examination are as follows:

1.2.1. Diagnostic and interpretative skills in anatomic and microscopic pathology to the standards expected of an independent practitioner in neuropathology (consultant neuropathologist):

- **Competence** in general surgical and autopsy pathology, including gross description, dissection of specimens and histological diagnosis and reporting is expected.
- **Proficiency** in diagnostic surgical and autopsy neuropathology (examination of formalin-fixed, intact or sliced, brain and spinal cord); including recognised sub-specialties of skeletal muscle pathology, peripheral nerve pathology, paediatric neuropathology and forensic neuropathology.

1.2.2. Understanding of basic scientific principles:

- Acquiring adequate levels of factual knowledge in normal anatomy, histology and basic science underlying pathological processes, modern laboratory techniques, especially in relation to the nervous system
- Understanding the limitations of human interpretation of images and data and also those of new technologies.

1.2.3. Familiarity with routine laboratory techniques and health and safety issues:

- Requirements of and implementation of health and safety legislation
- Rational use of special stains to achieve diagnostic benefit
- Appropriate use of special techniques (e.g. Cytogenetics, molecular diagnostics, electron microscopy etc).

1.2.4. Lifelong learning habits and data acquisition/interpretation:

- To develop lifelong learning habits in reading, information gathering, consultation with colleagues and attendance at scientific meetings as part of continuing professional development
- To understand research and development methods and to be involved in research projects which should lead to scientific presentations and publication
- To be able to critically assess published scientific data.

1.2.5. Understanding of information technology:

- Laboratory data entry and retrieval systems
- Ability to search electronic databases
- Use of the World Wide Web as a learning and communication resource
- Understanding of the importance of data protection and requirements for patient confidentiality.

1.2.6. Laboratory management and communication expertise:

- To understand the organisation and structure of a histopathology/neuropathology laboratory including staffing and financial issues
- To understand the concepts of good laboratory practice, and criteria for laboratory accreditation and how to implement these
- To develop management and communication skills, including the planning and implementation of policies which require leadership skills
- To understand the importance of audit and the ability to audit their personal and departmental activities
- To develop the ability to evaluate and audit existing and new tests, techniques and services
- To gain experience in planning and implementation of departmental policies and rotas
- To develop an ability to work as part of a team including close liaison with clinicians
- To be able to present pathological data to clinicians and other health care workers in an effective manner.

1.2.7. Responsibility for maintaining and developing standards of professional practice:

- To understand the importance of clinical governance and delivery of high quality standards in histopathology and neuropathology

- To understand the concept of clinical risk management and procedures designed to minimise risks
- To understand the importance of patient consent to the use of data or biomaterials for ethically approved research and for teaching.

The EFN examination will assess a candidate's directly and practically for the competences set out in sections 1.2.1 to 1.2.3 above. However, the examination does not include an autopsy examination. An applicant will be required to submit evidence of competence in that s/he can perform a full neuropathological autopsy, as well as evidence in support of competences 1.2.4 to 1.2.7, which may take the form of a detailed statement from the applicant's sponsor or Head of Institute/Department (see Euro-CNS website).

The following sections set out the knowledge-based, skill-based and behaviour-based competences that must be demonstrable to examiners for success in the EFN examination.

2. Overview of Knowledge & Skills

2.1. Examiners require candidates to show evidence of competence in the following areas:

2.1.1. Knowledge

- Basic knowledge of the full spectrum of systemic gross pathology
- Expert knowledge of:
 - External and internal gross anatomy of the brain, including blood supply and the afferent and efferent projection pathways of major cortical areas and subcortical, brainstem and cerebellar nuclei
 - Gross pathology of the spinal cord and its coverings, including the vertebral column
 - Clinical-anatomical correlation
 - Sampling protocols according to clinical problem
- Diagnostic expertise in surgical neuropathology
 - Use of H&E-stained sections to provide:
 - Reasonably narrow differential diagnosis
 - Distinguish between a reactive process and neoplasm
 - Distinguish between a tumour that is benign (low grade) or malignant (high grade)
 - Judicious use of immunohistochemical preparations to assist neuropathological differential diagnosis
 - Judicious use of electron microscopy, in situ hybridization and other molecular biology techniques to assist neuropathological differential

diagnosis

2.1.2. Skills

- Provide advice on which parts of the central and peripheral nervous system (including the autonomic nervous system) and other tissues should be removed and/or sampled at autopsy in a case of neurological injury or illness
- Provide advice on the identification of, and the technique for removal of, such tissues at autopsy
- Examination of skull and intracranial contents, including dural venous sinuses, pituitary gland, cranial nerves, middle ear cavities and sinuses of the skull
- Examination of the fresh or formalin-fixed brain
- Examination and dissection of the arterial circle of Willis
- Examination of the spinal cord and dorsal root ganglia
- Dissection, examination and sampling of the fixed brain (in coronal and/or horizontal plane) and spinal cord
- Observational skills (must not miss macroscopical neuropathology)
- Diagnostic interpretation of neurosurgical biopsies
- Diagnostic interpretation of cytological preparations of cerebrospinal fluid
- Diagnostic interpretation of skeletal muscle biopsies
- Diagnostic interpretation of peripheral nerve biopsies
- Ability to correlate anatomical and pathological features of the lesion(s) to the clinical details of the case.
- Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed.
- Ability to make oneself understood to lay persons and to professionals at all levels.

3 SPECIFIC OBJECTIVES IN NEUROPATHOLOGY

3.1 Examination of Neurosurgical Biopsy (including intra-operative diagnosis) & of tissue removed at Neuropathological Autopsy

Objective	Subject matter	Teaching / Learning method
Diagnosis of a mass lesion or lytic lesion in bones of skull or vertebrae	(1) Knowledge Microscopical features of: <ul style="list-style-type: none">▪ Myeloma	Textbook: <ul style="list-style-type: none">▪ Robbins & Cotran's Pathologic Basis of

	<ul style="list-style-type: none"> ▪ Lymphoma ▪ Metastases ▪ Giant cell tumour of bone ▪ Langerhans' Cell Histiocytosis ▪ Chordoma ▪ Chondrosarcoma <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Anatomical site ▪ Natural history ▪ Features on imaging of conditions listed above. <p>(2) Skills</p> <p><i>In the case of neurosurgical biopsy work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of intra-operative wet smear preparation stained with toluidine blue or haematoxylin & eosin. ▪ Interpretation of frozen section stained with haematoxylin & eosin. ▪ Interpretation of paraffin-processed neurosurgical biopsy ▪ Ability to communicate the diagnosis clearly ▪ Ability to advise on the likely biological behaviour of the lesion ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of neurohistological sections ▪ Ability to correlate anatomical and pathological features of lesion to the clinical details of the case. ▪ Ability to relate findings to cause or manner of death <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Awareness of the need to comment on the extent of excision of the lesion, when 	<p>Disease, 8th edition (Kumar, Abbas, Fausto & Aster)</p> <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
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	<p>appropriate.</p> <ul style="list-style-type: none"> ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy. 	
<p>Diagnosis of a mass lesion arising from the meningeal coverings of the brain or spinal cord</p>	<p>(1) Knowledge</p> <p>Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Meningioma ▪ Lymphoma ▪ Metastases ▪ Gliosarcoma ▪ Melanoma <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Gender predisposition ▪ Anatomical site ▪ Natural history ▪ Features on imaging of conditions listed above. <p>(2) Skills</p> <p><i>In the case of neurosurgical biopsy work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of intra-operative wet smear preparation stained with toluidine blue or haematoxylin & eosin. ▪ Interpretation of frozen section stained with haematoxylin & eosin. ▪ Interpretation of paraffin-processed neurosurgical biopsy ▪ Ability to communicate the diagnosis clearly ▪ Ability to advise on the likely biological behaviour of the lesion ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of neurohistological sections ▪ Ability to correlate anatomical and pathological features of lesion to the clinical details 	<p>Textbooks:</p> <ul style="list-style-type: none"> ▪ WHO Classification of Tumours of the Central Nervous System 4th edition 2007 (Ed: Louis, Oligaki, Wiestler & Cavanee) ▪ Diagnostic Pathology of Nervous System Tumours (Ironsides, Moss, Louis, Lowe, Weller) ▪ Smears and Frozen Sections in Surgical Neuropathology: A Manual (Burger) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>

	<p>of the case.</p> <ul style="list-style-type: none"> ▪ Ability to relate findings to cause or manner of death <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Awareness of the need to comment on the extent of excision of the lesion, when appropriate. ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy. 	
<p>Diagnosis of a mass lesion in the region of the sella turcica</p>	<p>(1) Knowledge</p> <p>Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Hypophysitis ▪ Sarcoidosis ▪ Infarction ▪ Pituitary adenoma ▪ Craniopharyngioma ▪ Pilocytic astrocytoma ▪ Meningioma ▪ Lymphoma ▪ Germ cell tumours ▪ Granular cell tumour of the neurohypophysis ▪ Spindle cell oncocytoma of the adenohypophysis <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Gender predisposition ▪ Anatomical site ▪ Natural history ▪ Features on imaging of conditions listed above. 	<p>Textbooks:</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ WHO Classification of Tumours of the Central Nervous System 4th edition 2007 (Ed: Louis, Oligaki, Wiestler & Cavanee) ▪ Histological Typing of Endocrine Tumours (WHO. World Health Organization. International Histological Classification of Tumours) by E. Solcia, G.

	<p>(2) Skills <i>In the case of neurosurgical biopsy work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of intra-operative wet smear preparation stained with toluidine blue or haematoxylin & eosin. ▪ Interpretation of frozen section stained with haematoxylin & eosin. ▪ Interpretation of paraffin-processed neurosurgical biopsy ▪ Ability to communicate the diagnosis clearly ▪ Ability to advise on the likely biological behaviour of the lesion ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of neurohistological sections ▪ Ability to correlate anatomical and pathological features of lesion to the clinical details of the case. ▪ Ability to relate findings to cause or manner of death <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Awareness of the need to comment on the extent of excision of the lesion, when appropriate. ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy. 	<p>Klöppel, L.H. Sobin</p> <ul style="list-style-type: none"> ▪ Diagnostic Pathology of Nervous System Tumours (Ironsides, Moss, Louis, Lowe, Weller) ▪ Smears and Frozen Sections in Surgical Neuropathology: A Manual (Burger) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
<p>Diagnosis of a mass lesion in the region of the pineal gland</p>	<p>(1) Knowledge Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Pineocytoma ▪ Pineal parenchymal tumour of intermediate differentiation ▪ Pineoblastoma ▪ Papillary tumour of the pineal region ▪ Atypical teratoid / rhabdoid tumour ▪ Germ cell tumours 	<p>Textbooks:</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ WHO Classification of

	<ul style="list-style-type: none"> ➤ Germinoma ➤ Teratoma: mature, immature, malignant ➤ Yolk sac tumour ➤ Embryonal carcinoma ➤ Choriocarcinoma <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Gender predisposition ▪ Anatomical site ▪ Natural history ▪ Features on imaging of conditions listed above. <p>(2) Skills</p> <p><i>In the case of neurosurgical biopsy work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of intra-operative wet smear preparation stained with toluidine blue or haematoxylin & eosin. ▪ Interpretation of frozen section stained with haematoxylin & eosin. ▪ Interpretation of paraffin-processed neurosurgical biopsy ▪ Dissection, sampling and examination of neurosurgical lobectomy ▪ Ability to distinguish between: <ul style="list-style-type: none"> ➤ Abscess, infarction, demyelination and tumour ➤ Primary brain tumour and metastases ➤ Glioma and lymphoma ➤ Low and high-grade glioma ▪ Ability to apply WHO classification to a tumour ▪ Ability to accurately grade glioma or lymphoma ▪ Ability to communicate the diagnosis clearly ▪ Ability to advise on the likely biological behaviour of the lesion ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of neurohistological sections ▪ Ability to correlate anatomical and pathological features of lesion to the clinical details 	<p>Tumours of the Central Nervous System 4th edition 2007 (Ed: Louis, Oligaki, Wiestler & Cavanee)</p> <ul style="list-style-type: none"> ▪ Diagnostic Pathology of Nervous System Tumours (Ironside, Moss, Louis, Lowe, Weller) ▪ Smears and Frozen Sections in Surgical Neuropathology: A Manual (Burger) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
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	<p>of the case.</p> <ul style="list-style-type: none"> ▪ Ability to relate findings to cause or manner of death <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Awareness of the need to comment on the extent of excision of the lesion, when appropriate. ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy. 	
<p>Diagnosis of a mass lesion within the brain or spinal cord</p>	<p>(1) Knowledge</p> <p>Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Abscess, infarction, demyelination and tumour ▪ Primary brain tumour and metastases ▪ Glioma and lymphoma ▪ Low and high-grade glioma <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Gender predisposition ▪ Anatomical site ▪ Natural history ▪ Features on imaging of conditions listed above. <p>(2) Skills</p> <p><i>In the case of neurosurgical biopsy work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of intra-operative wet smear preparation stained with toluidine blue or haematoxylin & eosin. ▪ Interpretation of frozen section stained with haematoxylin & eosin. ▪ Interpretation of paraffin-processed neurosurgical biopsy ▪ Dissection, sampling and examination of neurosurgical lobectomy ▪ Ability to distinguish between: 	<p>Textbooks:</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ WHO Classification of Tumours of the Central Nervous System 4th edition 2007 (Ed: Louis, Oligaki, Wiestler & Cavanee) ▪ Diagnostic Pathology of Nervous System Tumours (Ironsides, Moss, Louis, Lowe, Weller) ▪ Smears and Frozen Sections in Surgical Neuropathology: A Manual (Burger) ▪ Neuropathology

	<ul style="list-style-type: none"> ➤ Abscess, infarction, demyelination and tumour ➤ Primary brain tumour and metastases ➤ Glioma and lymphoma ➤ Low and high-grade glioma <ul style="list-style-type: none"> ▪ Ability to apply WHO classification to a tumour ▪ Ability to accurately grade glioma or lymphoma ▪ Ability to communicate the diagnosis clearly ▪ Ability to advise on the likely biological behaviour of the lesion ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of neurohistological sections ▪ Ability to correlate anatomical and pathological features of lesion to the clinical details of the case. ▪ Ability to relate findings to cause or manner of death. <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Awareness of the need to comment on the extent of excision of the lesion, when appropriate. ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy. 	<p>Techniques (Dawson, Neal, Llewellyn, Thomas)</p> <ul style="list-style-type: none"> • WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues, Fourth Edition 2008, Swerdlow et al. <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
<p>Diagnosis of a mass lesion arising from nerve root or from the trunk of a cranial or peripheral nerve</p>	<p>(1) Knowledge</p> <p>Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Schwannoma ▪ Neurofibroma ▪ Perineurioma ▪ Malignant peripheral nerve sheath tumour (MPNST) <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age 	<p>Textbooks:</p> <ul style="list-style-type: none"> ▪ WHO Classification of Tumours of the Central Nervous System 4th edition 2007 (Ed: Louis, Oligaki, Wiestler & Cavanee) ▪ Diagnostic Pathology of Nervous System Tumours

	<ul style="list-style-type: none"> ▪ Genetic predisposition ▪ Anatomical site ▪ Natural history ▪ Features on imaging of conditions listed above. <p>(2) Skills</p> <ul style="list-style-type: none"> ▪ Interpretation of intra-operative wet smear preparation stained with toluidine blue or haematoxylin & eosin. ▪ Interpretation of frozen section stained with haematoxylin & eosin. ▪ Interpretation of paraffin-processed neurosurgical biopsy ▪ Ability to distinguish between: <ul style="list-style-type: none"> ➢ Schwannoma ➢ Neurofibroma ➢ Perineurioma ➢ Malignant peripheral nerve sheath tumour (MPNST) ▪ Ability to apply WHO classification to a tumour ▪ Ability to communicate the diagnosis clearly ▪ Ability to advise on the likely biological behaviour of the lesion ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Awareness of the need to comment on the extent of excision of the lesion, when appropriate. ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting 	<p>(Ironside, Moss, Louis, Lowe, Weller)</p> <ul style="list-style-type: none"> ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
<p>Diagnosis of a lesion causing intractable temporal lobe epilepsy</p>	<p>(1) Knowledge</p> <p>Microscopical features of the lesions associated with symptomatic epilepsy</p> <ul style="list-style-type: none"> ▪ Cerebral malformations ▪ Cortical dysplasia ▪ Vascular malformations ▪ Infections and non-infective inflammatory conditions 	<p>Textbooks:</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love)

	<ul style="list-style-type: none"> ▪ Neoplasms ▪ Mesial temporal sclerosis <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Genetic predisposition ▪ Anatomical site ▪ Natural history ▪ Features on imaging of conditions listed above. <p>(2) Skills</p> <p><i>In the case of neurosurgical biopsy work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of intra-operative wet smear preparation stained with toluidine blue or haematoxylin & eosin. ▪ Interpretation of frozen section stained with haematoxylin & eosin. ▪ Interpretation of paraffin-processed neurosurgical biopsy ▪ Dissection, sampling and examination of neurosurgical lobectomy ▪ Ability to determine specific nature of a structural lesion causing epilepsy ▪ Ability to distinguish between infective and non-infective inflammatory lesions causing epilepsy ▪ Ability to identify mesial temporal sclerosis ▪ Ability to advise on the likely biological behaviour of the lesion ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of neurohistological sections ▪ Ability to correlate anatomical and pathological features of lesion to the clinical details of the case. ▪ Ability to relate findings to cause or manner of death. <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Awareness of the need to comment on the extent of excision of the lesion, when appropriate. 	<ul style="list-style-type: none"> ▪ WHO Classification of Tumours of the Central Nervous System 4th edition 2007 (Ed: Louis, Oligaki, Wiestler & Cavanee) ▪ Diagnostic Pathology of Nervous System Tumours (Ironsides, Moss, Louis, Lowe, Weller) ▪ Pathology & Genetics: Developmental Neuropathology (Golden & Harding) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
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	<ul style="list-style-type: none"> ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy. 	
Diagnosis of a case of dementia	<p>(1) Knowledge</p> <p>Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Amyloid angiopathy ▪ Cerebral vasculitis ▪ CADASIL ▪ Cranial (giant cell) arteritis ▪ Meningeal carcinomatosis ▪ Paraneoplastic encephalitides ▪ Chronic inflammation of meninges ▪ Prion disease ▪ AIDS and opportunistic infection ▪ Metabolic disease (leukodystrophy, lysosomal storage disease, mitochondrial disease, peroxisomal disorders etc) ▪ Neurodegenerative disease <ul style="list-style-type: none"> ➢ Alzheimer's disease ➢ Dementia with Lewy bodies ➢ Frontotemporal lobar degenerations ➢ Corticobasal degeneration ➢ Progressive supranuclear palsy ➢ Other (argyrophilic grain dementia, etc.) <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Genetic predisposition ▪ Anatomical distribution ▪ Natural history ▪ Features on imaging of conditions listed above. 	<p>Textbooks:</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ Oppenheimer's Diagnostic Neuropathology: A practical manual, 2nd edition (Esiri) ▪ Pathology & Genetics: Developmental Neuropathology (Golden & Harding) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Consider possibility of</p>

	<p>(2) Skills</p> <p><i>In the case of neurosurgical biopsy work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of neurosurgical biopsy (meningeal, cerebral cortex and white matter biopsy) ▪ Interpretation of skin biopsy (CADASIL – including electron microscopy) ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of gross neuropathology and neurohistological sections ▪ Ability to correlate anatomical and pathological features of lesion to the clinical details of the case ▪ Ability to relate findings to cause or manner of death <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Awareness of need to communicate concern to Clinical Neurosciences Service Unit Director in unexpected case of prion disease ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy ▪ Awareness of need to communicate concern to Directors of Clinical Neurosciences Service Unit and Public Health Laboratory Service in unexpected case of prion disease 	<p>accessing archived material at:</p> <ul style="list-style-type: none"> ▪ One of the UK brain banks for neurodegenerative disease ▪ National CJD Surveillance Unit
<p><i>Autopsy diagnosis of progressive abnormality of movement or posture</i></p>	<p>(1) Knowledge</p> <p>Microscopical features of::</p> <ul style="list-style-type: none"> • Parkinson syndrome: <ul style="list-style-type: none"> ➤ Parkinson's (Lewy body) Disease ➤ Progressive Supranuclear Palsy ➤ Striatonigral Degeneration ➤ Corticobasal degeneration ➤ Familial Frontal Lobe Dementia with Parkinsonism ➤ Wilson Disease 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Carpenter's Human Neuroanatomy, 9th edition (Parent) ▪ Neurological Differential Diagnosis, 2nd edition (Patten) ▪ Greenfield's Neuropathology, 8th

	<ul style="list-style-type: none"> ➤ Prion disease (Creutzfeldt-Jakob Disease) • Hemiballismus and hemichorea <ul style="list-style-type: none"> ➤ Stroke, tumour or vascular malformation • Chronic chorea of Huntington type • Athetosis and dystonia <ul style="list-style-type: none"> ➤ Hallervorden-Spatz Disease ➤ Wilson Disease • Cerebellar incoordination and intention tremor <ul style="list-style-type: none"> ➤ Olivopontocerebellar atrophy ➤ Brain tumour ➤ Paraneoplastic syndrome ➤ Prion disease (Creutzfeldt-Jakob Disease) ➤ Friedreich's ataxia and other spinocerebellar degenerations ➤ Cerebellar cortical degeneration <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> • Age • Genetic predisposition • Anatomical distribution • Natural history • Features on imaging of conditions listed above. <p>(2) Skills</p> <ul style="list-style-type: none"> • Preparation and interpretation of neurohistological sections • Ability to relate findings to cause or manner of death • Ability to correlate anatomical and pathological features of lesion to the clinical details of the case. • Ability to write clear and comprehensive reports for users, indicating the degree of confidence with which an opinion is expressed. • Ability to make oneself understood to lay persons and to professionals at all levels. <p>(3) Attitude</p> <ul style="list-style-type: none"> • Awareness of need to communicate the diagnosis promptly 	<p>edition (Ed: Love, Louis & Ellison)</p> <ul style="list-style-type: none"> ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ Oppenheimer's Diagnostic Neuropathology: A practical manual, 2nd edition (Esiri) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Specialist Centre: Access archived material at one of the UK brain banks for neurodegenerative disease</p>
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	<ul style="list-style-type: none"> • Participation in multi-disciplinary meeting or other clinico-pathological meeting • Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy. 	
<p>Diagnosis of focal or diffuse cerebral white matter abnormality</p>	<p>(1) Knowledge</p> <p>Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Non-infective inflammatory disease ▪ Infections ▪ Demyelination ▪ Metabolic disease ▪ Neoplastic disease ▪ Vascular / ischaemic disease <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Genetic predisposition ▪ Anatomical distribution ▪ Natural history ▪ Features on imaging of conditions listed above. <p>(2) Skills</p> <p><i>In the case of neurosurgical biopsy work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of neurosurgical biopsy (meningeal, cerebral cortex and white matter biopsy) ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of gross neuropathology and neurohistological sections ▪ Ability to correlate anatomical and pathological features of lesion to the clinical details of the case ▪ Ability to relate findings to cause or manner of death <p>(3) Attitude</p>	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ Oppenheimer's Diagnostic Neuropathology: A practical manual, 2nd edition (Esiri) ▪ Pathology & Genetics: Developmental Neuropathology (Golden & Harding) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p>

	<ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy 	
<p>Diagnosis of focal or diffuse, meningeal or cerebral lesions in immunosuppressed patient</p>	<p>(1) Knowledge</p> <p>Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Opportunistic infections ▪ Lymphoma and other malignancies ▪ CNS changes of AIDS ▪ Other inflammatory / metabolic / neoplastic / ischaemic process <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Genetic predisposition ▪ Anatomical distribution ▪ Natural history ▪ Features on imaging of conditions listed above. <p>(2) Skills</p> <p><i>In the case of neurosurgical biopsy work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of neurosurgical biopsy (meningeal, cerebral cortex and white matter biopsy) ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Interpretation of gross neuropathology and neurohistological sections ▪ Ability to correlate anatomical and pathological features of lesion to the clinical details of the case ▪ Ability to relate findings to cause or manner of death <p>(3) Attitude</p>	<p>Textbooks:</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ WHO Classification of Tumours of the Central Nervous System 4th edition 2007 (Ed: Louis, Oligaki, Wiestler & Cavanee) ▪ Diagnostic Pathology of Nervous System Tumours (Ironside, Moss, Louis, Lowe, Weller) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) ▪ Robbins & Cotran's Pathologic Basis of Disease, 8th edition (Kumar, Abbas, Fausto & Aster) <p>Archived material</p>

	<ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy 	<p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p>
<p><i>Biopsy diagnosis in a case of headache (in absence of mass lesion)</i></p>	<p>(1) Knowledge Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Amyloid angiopathy ▪ Cerebral vasculitis ▪ Cranial (giant cell) arteritis ▪ Meningeal carcinomatosis ▪ Chronic inflammatory disorders of meninges ▪ Diffusely infiltrative glial tumour <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Genetic predisposition ▪ Anatomical distribution ▪ Natural history ▪ Features on imaging of conditions listed above. <p>(2) Skills Interpretation of:</p> <ul style="list-style-type: none"> ▪ Temporal artery biopsy (cranial arteritis?) ▪ Neurosurgical biopsy (chronic meningitis, meningeal carcinomatosis, meningocerebral vasculitis?) ▪ Skeletal muscle biopsy (sarcoidosis, vasculitis?) ▪ Peripheral nerve biopsy (vasculitis?) ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly 	<p>Textbooks:</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ WHO Classification of Tumours of the Central Nervous System 4th edition 2007 (Ed: Louis, Oligaki, Wiestler & Cavanee) ▪ Diagnostic Pathology of Nervous System Tumours (Ironside, Moss, Louis, Lowe, Weller) ▪ Oppenheimer's Diagnostic Neuropathology: A practical manual, 2nd edition (Esiri) ▪ Structural and Molecular Basis of Skeletal Muscle Diseases (Karpati) ▪ Atlas of Peripheral Nerve Pathology (King) ▪ Neuropathology

	<ul style="list-style-type: none"> ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting 	<p>Techniques (Dawson, Neal, Llewellyn, Thomas)</p> <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p>
<p>Investigation of strokes (cerebral infarction or haemorrhage)</p>	<p>(1) Knowledge Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Amyloid angiopathy ▪ Cerebral vasculitis ▪ Vascular malformation ▪ CADASIL ▪ Mitochondrial cytopathy (MELAS) ▪ Haemorrhage into neoplasm <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Genetic predisposition ▪ Anatomical distribution ▪ Natural history ▪ Features on imaging of conditions listed above. <p>(2) Skills Interpretation of:</p> <ul style="list-style-type: none"> ▪ Skin biopsy (CADASIL – electron microscopy, vasculitis?) ▪ Skeletal muscle biopsy (mitochondrial cytopathy, vasculitis?) ▪ Peripheral nerve biopsy (vasculitis?) ▪ Neurosurgical biopsy (meninges and/or wall of haematoma or edge of infarct) ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. 	<p>Textbooks:</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ Oppenheimer's Diagnostic Neuropathology: A practical manual, 2nd edition (Esiri) ▪ Structural and Molecular Basis of Skeletal Muscle Diseases (Karpati) ▪ Atlas of Peripheral Nerve Pathology (King) ▪ Robbins & Cotran's Pathologic Basis of Disease, 8th edition (Kumar, Abbas, Fausto & Aster) ▪ Neuropathology Techniques (Dawson,

	<p><i>And in the case of an autopsy:</i></p> <ul style="list-style-type: none"> • Interpretation of gross and microscopical pathology of brain and cord • Interpretation of histological sections sections of skeletal muscle • Ability to relate findings to cause or manner of death • Ability to correlate anatomical and pathological features of lesion to the clinical details of the case. <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting <p><i>And in the case of post mortem work:</i></p> <ul style="list-style-type: none"> ▪ Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy 	<p>Neal, Llewellyn, Thomas)</p> <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p>
<p><i>Post mortem</i> investigation of developmental abnormalities and other pathology in the fetus, neonate or child</p>	<p>(1) Knowledge</p> <p>Microscopical features of :</p> <ul style="list-style-type: none"> • Cellular reactions in the developing CNS • Malformations and neuronal migration disorders • Toxic and metabolic CNS damage, <i>including</i>: <ul style="list-style-type: none"> • Kernicterus • Hypoglycaemia • Lysosomal disorders • Peroxisomal disorders • Mitochondrial disorders • Other inborn errors of intermediary metabolism • Hypoxic-ischaemic grey and white matter injury • Perinatal infections of the CNS and its coverings • Neurodegenerative diseases of childhood, <i>including</i>: <ul style="list-style-type: none"> • Spinal muscular and neurogenic atrophies • The neuroaxonal dystrophies • The leukodystrophies • Alpers' syndrome and Rett's syndrome • Arthrogyposis multiplex congenita 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Pathology & Genetics: Developmental Neuropathology (Golden & Harding) ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ Oppenheimer's Diagnostic Neuropathology: A practical manual, 2nd edition (Esiri) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas)

	<ul style="list-style-type: none"> • CNS tumours of childhood <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> • Genetic predisposition • Anatomical distribution • Natural history • Features on imaging of conditions listed above <p>(2) Skills</p> <ul style="list-style-type: none"> • Interpretation of gross neuropathology and neurohistological sections • Interpretation of sections of skeletal muscle and peripheral nerve • Ability to relate findings to cause or manner of death • Ability to correlate anatomical and pathological features of lesion to the clinical details of the case • Judicious selection of fresh or frozen tissue for biochemical and genetic analysis • Judicious selection of tissue samples for EM examination • Ability to correlate anatomical and pathological features of lesion to the clinical details of the case. • Ability to write clear and comprehensive reports for users, indicating the degree of confidence with which an opinion is expressed. • Ability to make oneself understood to lay persons and to professionals at all levels. <p>(3) Attitude</p> <ul style="list-style-type: none"> • Awareness of need to communicate the diagnosis promptly • Participation in multi-disciplinary meeting or other clinico-pathological meeting • Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy. 	<p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Specialist Centre: access archived material at the Institute of Child Health</p>
Investigation of sudden infant death syndrome (SIDS)	<p>(1) Knowledge</p> <p>Microscopical features of :</p> <ul style="list-style-type: none"> • Cellular reactions in the developing CNS • Malformations • Toxic and metabolic CNS damage, including: • Hypoglycaemia 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Pathology & Genetics: Developmental Neuropathology (Golden & Harding) ▪ Forensic Neuropathology

	<ul style="list-style-type: none"> • Hypoxic-ischaemic grey and white matter injury • Perinatal infections of the CNS and its coverings • CNS tumours of childhood <p>(2) Skills</p> <ul style="list-style-type: none"> • Interpretation of gross neuropathology and neurohistological sections • Ability to relate any neuropathological findings to cause or manner of death • Judicious selection of fresh or frozen tissue for biochemical and genetic analysis when appropriate • Judicious selection of tissue samples for EM examination when appropriate • Ability to correlate anatomical and pathological features of lesion to the clinical details of the case. • Ability to write clear and comprehensive reports for users, indicating the degree of confidence with which an opinion is expressed. • Ability to make oneself understood to lay persons and to professionals at all levels. <p>(3) Attitude</p> <ul style="list-style-type: none"> • Awareness of need to liaise with the paediatric pathologist concerned with the case, particularly with regard to the pathological changes found in other organs • Participation in multi-disciplinary meeting or other clinico-pathological meeting • Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy 	<p>(Whitwell)</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ Oppenheimer's Diagnostic Neuropathology: A practical manual, 2nd edition (Esiri) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p>
<p><i>Post mortem</i> investigation in suspected child abuse</p>	<p>(1) Knowledge</p> <p>Microscopical features of :</p> <ul style="list-style-type: none"> • Cellular reaction to epidural, subdural and subarachnoid haemorrhage, which may date the injury • Cellular and tissue reactions of the brain to direct impact injury and shaking injury, including: • Cortical and gliding contusions • Diffuse axonal injury • Diffuse vascular injury • Cerebral infarction 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Forensic Neuropathology (Whitwell) ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ Neuropathology

	<ul style="list-style-type: none"> • Other hypoxic-ischaemic lesions • Cellular and tissue reaction of the eye to shaking injury, including: • Retinal haemorrhages • Any non-traumatic lesions found at autopsy <p>(2) Skills</p> <ul style="list-style-type: none"> • Interpretation of gross neuropathology and neurohistological sections • Ability to relate any neuropathological findings to external injuries in the case and to the findings in the general autopsy • Ability to evaluate consistency of history of trauma with the severity and extent of traumatic brain and ocular injury • Ability to draw up a formal medico-legal report • Ability to act as an expert witness <p>(3) Attitude</p> <ul style="list-style-type: none"> • Awareness of need to liaise fully with the paediatric pathologist, the police and the coroner / procurator fiscal, concerned with the case • Awareness of the responsibilities of an expert witness • Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy 	<p>Techniques (Dawson, Neal, Llewellyn, Thomas)</p> <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Specialist Centre: consider possibility of accessing archived material at the Institute of Child Health</p>
<p><i>Post mortem</i> investigation traumatic injury to the head or spine</p>	<p>(1) Knowledge</p> <p>Microscopical features of :</p> <ul style="list-style-type: none"> • Cellular reaction to extradural/epidural, subdural and subarachnoid haemorrhage, which may date the injury • Cellular and tissue reactions of the brain to direct impact injury and whiplash injury, including: • Cortical and gliding contusions • Diffuse axonal injury • Diffuse vascular injury • Cerebral infarction • Other hypoxic-ischaemic lesions • Brain damage secondary to raised intracranial pressure 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) ▪ Oppenheimer's Diagnostic Neuropathology: A

	<ul style="list-style-type: none"> • Any non-traumatic lesions found at autopsy • Infection complicating head injury, including meningitis and brain abscess • Medical complications following trauma, including: <ul style="list-style-type: none"> • Fat embolism • Venous thrombosis • Disseminated intravascular coagulation • Thiamine deficiency • Central pontine myelinolysis <p>(2) Skills</p> <ul style="list-style-type: none"> • Interpretation of gross neuropathology and neurohistological sections • Ability to relate neuropathological findings to external injuries in the case and to the findings in the general autopsy • Ability to evaluate consistency of history of trauma with the severity and extent of traumatic brain injury • Ability to distinguish between direct consequences and indirect medical complications of trauma • Ability to draw up a formal medico-legal report • Ability to act as an expert witness <p>(3) Attitude</p> <ul style="list-style-type: none"> • Awareness of need to liaise fully with the general pathologist, the police and the coroner / procurator fiscal, concerned with the case • Awareness of the responsibilities of an expert witness • Awareness of consent issues concerning retention and/or disposal of tissues removed at autopsy 	<p>practical manual, 2nd edition (Esiri)</p> <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
<p>3.2 Skeletal Muscle Biopsy</p>		
<i>Objective</i>	Subject matter	Teaching / Learning method
Diagnosis of muscle weakness, muscle pain or muscle wasting	<p>(1) Knowledge</p> <p>Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Muscle diseases associated with sarcolemmal and extracellular matrix defects 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th

	<ul style="list-style-type: none"> ▪ Muscle diseases associated with myonuclear abnormalities ▪ Muscle diseases due to defects of myofibrillar and internal cytoskeletal protein ▪ Muscle diseases associated with defects of ion channels and ion transporters ▪ Developmental disorders of skeletal muscle ▪ Muscle diseases due to defects of catabolic mechanisms ▪ Neuromuscular transmission defects ▪ Myopathies affecting fuel and energy metabolism ▪ Dysimmune and infectious myopathies ▪ Toxic myopathies ▪ Muscle pathology resulting from chronic denervation and disuse ▪ Miscellaneous muscle disorders, including: <ul style="list-style-type: none"> ➢ Repeat expansion myopathies (Myotonic dystrophies) ➢ Large telomeric deletion disease (Faciocaulophumeral dystrophy) ➢ Hereditary inclusion body myopathy ➢ Osteomalacic myopathy ➢ Cancer-related muscle disease ➢ Peripheral neuropathies ➢ Infective, Vasculitic, Carcinomatous, Lymphomatous, Inherited (e.g. Familial Amyloid polyneuropathy, Hereditary Motor and Sensory Neuropathy) <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Genetic predisposition ▪ Anatomical distribution ▪ Natural history <p>(2) Skills Interpretation of:</p> <ul style="list-style-type: none"> ▪ Skeletal muscle biopsy ▪ Peripheral nerve biopsy ▪ Fat and/or rectal biopsy (for amyloid) ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. 	<p>edition (Ed: Love, Louis & Ellison)</p> <ul style="list-style-type: none"> ▪ Structural and Molecular Basis of Skeletal Muscle Diseases (Karpati) ▪ Muscle Biopsy: a practical approach 3rd edition (Dubowitz & Sewry) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
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	<p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting 	
Investigation of strokes (cerebral infarction or haemorrhage)	<p>(1) Knowledge</p> <p>Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Cerebral vasculitis ▪ Mitochondrial cytopathy (MELAS) ▪ Haemorrhage into neoplasm <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Genetic predisposition ▪ Anatomical distribution ▪ Natural history ▪ Features on imaging of conditions listed above. <p>(2) Skills</p> <p>Interpretation of:</p> <ul style="list-style-type: none"> ▪ Skeletal muscle biopsy (mitochondrial cytopathy, vasculitis?) ▪ Skin biopsy (CADASIL – electron microscopy, vasculitis?) ▪ Peripheral nerve biopsy (vasculitis?) ▪ Neurosurgical biopsy (meninges and/or wall of haematoma or edge of infarct) ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Structural and Molecular Basis of Skeletal Muscle Diseases (Karpati) ▪ Muscle Biopsy: a practical approach 3rd edition (Dubowitz & Sewry) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) ▪ Robbins & Cotran's Pathologic Basis of Disease, 8th edition (Kumar, Abbas, Fausto & Aster) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>

Investigation of progressive ptosis and/or ophthalmoplegia	<p>(1) Knowledge Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Muscular dystrophy (Myotonic dystrophy, Oculopharyngeal muscular dystrophy, Facioscapulohumeral syndrome) ▪ Mitochondrial cytopathy (Kearns-Sayre syndrome) ▪ Myasthenia gravis <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> ▪ Age ▪ Genetic predisposition ▪ Anatomical distribution ▪ Natural history ▪ Findings on investigative neurophysiology of conditions listed above <p>(2) Skills Interpretation of:</p> <ul style="list-style-type: none"> ▪ Skeletal muscle biopsy (mitochondrial cytopathy; muscular dystrophy including specific features of Myotonic dystrophy and OPMD; spectrum of changes in FSH) ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. <p>(3) Attitude Awareness of need to communicate the diagnosis promptly.</p> <ul style="list-style-type: none"> ▪ Retention of appropriate sample(s) for genetic analysis and/or respiratory chain enzyme assays. ▪ Recommendation for genetic analysis and/or respiratory chain enzyme assays when biopsy is suggestive of an inherited disorder. ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting. 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology 8th edition (Ed: Love, Louis & Ellison) ▪ Structural and Molecular Basis of Skeletal Muscle Diseases (Karpati) ▪ Muscle Biopsy: a practical approach 3rd edition (Dubowitz & Sewry) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
Investigation of retinitis pigmentosa	<p>(1) Knowledge Microscopical features of:</p> <ul style="list-style-type: none"> ▪ Mitochondrial cytopathy (e.g. Kearns-Sayre syndrome) ▪ Congenital myotubular (centronuclear) myopathy 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison)

	<p>Clinical features of mitochondrial cytopathies:</p> <ul style="list-style-type: none"> ▪ Age ▪ Genetic predisposition ▪ Anatomical distribution ▪ Natural history <p>(2) Skills</p> <ul style="list-style-type: none"> ▪ Interpretation of skeletal muscle biopsy (mitochondrial cytopathy, myotubular myopathy), including enzyme histochemistry and electron microscopy. ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly. ▪ Retention of appropriate sample(s) for genetic analysis and/or respiratory chain enzyme assays. ▪ Recommendation for genetic analysis and/or respiratory chain enzyme assays when biopsy is suggestive of an inherited disorder. ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting. 	<ul style="list-style-type: none"> ▪ Structural and Molecular Basis of Skeletal Muscle Diseases (Karpati) ▪ Muscle Biopsy: a practical approach 3rd edition (Dubowitz & Sewry) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
Investigate cause of arthrogryposis multiplex	<p>(1) Knowledge</p> <ul style="list-style-type: none"> ▪ Myelopathic and muscular forms of <i>arthrogryposis multiplex congenita</i> ▪ Congenital muscular dystrophy <p>(2) Skills</p> <p>Interpretation of:</p> <ul style="list-style-type: none"> ▪ skeletal muscle biopsy ▪ autopsy changes in spinal cord ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. <p>(3) Attitude</p> <ul style="list-style-type: none"> ▪ Awareness of need to communicate the diagnosis promptly. ▪ Retention of appropriate sample(s) for genetic analysis. 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Structural and Molecular Basis of Skeletal Muscle Diseases (Karpati) ▪ Muscle Biopsy: a practical approach 3rd edition (Dubowitz & Sewry) ▪ Pathology & Genetics: Developmental

	<ul style="list-style-type: none"> ▪ Recommendation for genetic analysis when biopsy is suggestive of an inherited disorder. ▪ Participation in multi-disciplinary meeting or other clinicopathological meeting. 	<p>Neuropathology (Golden & Harding)</p> <ul style="list-style-type: none"> ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
3.3 Peripheral Nerve Biopsy		
Objective	Subject matter	Teaching / Learning method
Biopsy to investigate peripheral neuropathy	<p>(1) Knowledge Microscopical features of:</p> <ul style="list-style-type: none"> • Demyelinating neuropathy • Axonal neuropathy • Specific features of neuropathy due to: <ul style="list-style-type: none"> ➢ Infective cause ➢ Vasculitis ➢ Carcinomatous or lymphomatous infiltration ➢ Paraneoplastic effect ➢ Inherited mutations (e.g. Familial Amyloid polyneuropathy, Hereditary Motor and Sensory Neuropathy), <p>(2) Skills Interpretation of:</p> <ul style="list-style-type: none"> • Resin sections stained with thionin and acridine orange or methylene blue, azure II 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Atlas of Peripheral Nerve Pathology (King) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p>

	<p>and basic fuchsin (trichrome preparation)</p> <ul style="list-style-type: none"> • Teased nerve fibre preparation • Electron microscopy to assist identification of: <ul style="list-style-type: none"> ➤ Axonal degeneration and regeneration. ➤ Schwann cell abnormalities. ➤ Myelin abnormalities. ➤ Extracellular proteinaceous deposits and basal lamina abnormalities. ➤ Cellular infiltration ➤ Micro-organisms ➤ Perineurial abnormalities. ➤ Abnormalities of endoneurial blood vessels • Histochemistry to identify nature of any abnormal storage material within Schwann cells • Immunohistochemistry <ul style="list-style-type: none"> ➤ To assist morphology, with antibodies against neurofilament proteins, epithelial membrane antigen and S100 protein ➤ To characterise inflammatory cellular infiltrate ➤ To identify immunoglobulin light chain deposition ➤ To identify specific types of inherited amyloidosis ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. <p>(3) Attitude</p> <ul style="list-style-type: none"> • Awareness of need to communicate the diagnosis promptly. • Retention of appropriate sample(s) for genetic analysis and/or respiratory chain enzyme assays. • Recommendation for genetic analysis and/or respiratory chain enzyme assays when biopsy is suggestive of an inherited disorder. • Participation in multi-disciplinary meeting or other clinicopathological meeting. 	Visit to Specialist Centre
Biopsy to investigate peripheral nerve tumour	<p>(1) Knowledge</p> <p>Microscopical features of:</p> <ul style="list-style-type: none"> • Schwannoma • Neurofibroma 	Textbooks <ul style="list-style-type: none"> ▪ Greenfield's Neuropathology, 8th edition (Ed: Love, Louis)

	<ul style="list-style-type: none"> • Perineurioma • Malignant peripheral nerve sheath tumour (MPNST) <p>Clinical features of conditions listed above, including:</p> <ul style="list-style-type: none"> • Age • Genetic predisposition • Anatomical site • Natural history • Features on imaging of conditions listed above <p>(2) Skills</p> <ul style="list-style-type: none"> • Preparation of intra-operative wet smear preparation stained with toluidine blue or haematoxylin & eosin. • Preparation of frozen section stained with haematoxylin & eosin. • Interpretation of intra-operative wet smear preparation and/or frozen section <ul style="list-style-type: none"> ➢ Ability to distinguish between benign nerve sheath tumour and malignant peripheral nerve sheath tumour (MPNST) ➢ Ability to advise on the likely biological behaviour of the lesion ▪ Ability to write comprehensive and clear reports for users, indicating the degree of confidence with which an opinion is expressed. <p>(3) Attitude</p> <ul style="list-style-type: none"> • Awareness of need to communicate the diagnosis promptly to the neurosurgeon • Awareness of the need to log the ‘opinion’ given to the surgeon and the date/time of doing so. • Awareness of need to audit intra-operative biopsy diagnosis skills against paraffin processed tissue diagnosis 	<p>& Ellison)</p> <ul style="list-style-type: none"> ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ WHO Classification of Tumours of the Central Nervous System 4th edition 2007 (Ed: Louis, Oligaki, Wiestler & Cavanee) ▪ Diagnostic Pathology of Nervous System Tumours (Ironsides, Moss, Louis, Lowe, Weller) ▪ Atlas of Peripheral Nerve Pathology (King) ▪ Neuropathology ▪ Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p> <p>Visit to Specialist Centre</p>
3.4 Cerebrospinal Fluid Cytology		
Objective	Subject matter	Teaching / Learning method
Cytological examination of cerebrospinal fluid to detect	<p>(1) Knowledge</p> <ul style="list-style-type: none"> • Features of cells normally present within the CSF, including: 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Cytopathology of the

<p>inflammatory disorders of the CNS and its coverings</p>	<ul style="list-style-type: none"> ➤ Lymphocytes and macrophages ➤ Meningothelial cells and cells from the choroids plexus ➤ Ependymal cells and corpora amylacea (in ventricular fluid) ➤ Chondrocytes (in lumbar puncture-derived sample) • Features of leukocytic reaction • Features of micro-organisms <ul style="list-style-type: none"> ➤ Viral cytopathic change: e.g. herpes simplex and cytomegalovirus ➤ Cryptococcus neoformans ➤ Toxoplasma gondii ➤ Hyphae of phycomycete ➤ Bacteria on Gram stain or, in the case of acid fast bacilli, Ziehl Neelsen preparation <p>(2) Skills Ability to:</p> <ul style="list-style-type: none"> • Distinguish between normal appearances, reactive pleocytosis and neoplastic pleocytosis • Identify any micro-organisms • Select judiciously appropriate microbial and immunocytochemical preparations to assist differential diagnosis • To write clear and comprehensive reports for users, indicating the degree of confidence with which an opinion is expressed <p>(3) Attitude</p> <ul style="list-style-type: none"> • Awareness of need to communicate the diagnosis promptly to the clinician. • Awareness of the need to log the ‘opinion’ given to the clinician and the date/time of doing so. • Awareness of need to audit cytological diagnosis skills against any paraffin processed tissue diagnosis 	<p>Central Nervous System (Bingner and Johnson)</p> <ul style="list-style-type: none"> ▪ Smears and Frozen Sections in Surgical Neuropathology: A Manual (Burger) ▪ Greenfield’s Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ Neuropathology ▪ Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p>
<p>Cytological examination of cerebrospinal fluid to detect neoplastic disorders of the CNS and its coverings</p>	<p>(1) Knowledge</p> <ul style="list-style-type: none"> • Features of neoplastic cells present within the CSF, including: <ul style="list-style-type: none"> ➤ Leukemic blasts ➤ Immunoblasts in malignant lymphoma 	<p>Textbooks</p> <ul style="list-style-type: none"> ▪ Cytopathology of the Central Nervous System (Bingner and Johnson)

	<ul style="list-style-type: none"> ➤ Other atypical lymphocytes ➤ Atypical plasma cells of multiple myeloma ➤ Metastatic carcinoma, including ➤ Malignant melanoma ➤ Small cell carcinoma of the lung ➤ Large cell undifferentiated carcinoma ➤ Adenocarcinoma ➤ Squamous cell carcinoma ➤ Malignant neuroblasts of a medulloblastomas or pineoblastoma ➤ Dual population of a pineal germinoma <p>(2) Skills Ability to:</p> <ul style="list-style-type: none"> • Distinguish between reactive pleocytosis and neoplastic pleocytosis • Identify likely histogenesis of neoplastic cells • Select judiciously appropriate immunocytochemical preparations to assist differential diagnosis • To write clear and comprehensive reports for users, indicating the degree of confidence with which an opinion is expressed <p>(3) Attitude</p> <ul style="list-style-type: none"> • Awareness of need to communicate the diagnosis promptly to the clinician. • Awareness of the need to log the ‘opinion’ given to the clinician and the date/time of doing so. • Awareness of need to audit cytological diagnosis skills against any paraffin processed tissue diagnosis 	<ul style="list-style-type: none"> ▪ Smears and Frozen Sections in Surgical Neuropathology: A Manual (Burger) ▪ Greenfield’s Neuropathology, 8th edition (Ed: Love, Louis & Ellison) ▪ Neuropathology, 2nd edition (Ellison & Love) ▪ WHO Classification of Tumours of the Central Nervous System 4th edition 2007 (Ed: Louis, Oligaki, Wiestler & Cavanee) ▪ Diagnostic Pathology of Nervous System Tumours (Ironside, Moss, Louis, Lowe, Weller) ▪ Neuropathology Techniques (Dawson, Neal, Llewellyn, Thomas) <p>Archived material</p> <p>Current clinical cases</p> <p>Multidisciplinary Team Meetings</p>
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