



1. Left Hemisphere:

Interpretation, synthesis and expression of speech and symbols.

Reduced ability to speak, write, read, understand verbal material, difficulty initiating action.

2. Right Hemisphere:

Interpretation, synthesis and expression of spatial concepts.

Impaired recognition of faces or familiarity with objects, rhythm and musical difficulties, difficulty copying designs, difficulty with assembly tasks, spatial disorientation, difficulty with colour discrimination, impaired depth perception, impersistence and lack of concern for the future, visual scanning problems, reduced time sense and reaction time.

3. Indeterminate:

Symptoms showing no correlation with site or degree of injury:

Fatigue, perplexity (self-doubt), distractibility.

Long-term memory problems (usually after only widespread cortical damage).

Psychological sequelae - denial, anger, irritability, anxiety, depression, self-esteem problems.

4. Frontal lobes:

a. Bilateral

Abstraction, flexibility of thought, integration and synthesis of thought and action, the "executive" skills (Luria's attend-plan-monitor-verify sequence), restraining of emotional impulses, motor initiation and integration.

Dorsolateral changes (disorders of intellectual and motor regulation) -

Loss of "executive" skills and consequent effect on recent memory, disorientation for time, place (parietal also) and person, inflexibility and perseveration of (i) speech, (ii) ideas, (iii) motor-actions, (iv) problem solving strategies even when wrong (perseveration may reflect size and not location of the lesion), reduced foresight and insight (especially into implications of disability), reduction in self-criticism, difficulties in training or counselling (insight loss), poor utilisation of errors, poor concrete application of abstract thinking seen as a gap between "knowing and doing" - knowing what is the correct thing to do (abstract) and putting the complex instruction or thought into action (concrete), slower to shift from one abstract concept to another, distractibility, psychomotor-retardation, impaired ability to maintain a verbal or non-verbal sequence (can affect language comprehension), reduced ability to perform activities requiring successive changes, initial but transient deviation of eyes to same side as destructive (non-irritative) lesion, inertia of gaze/haphazard visual searching (worse in visual field contralateral to unilateral lesion), slow to learn complex tasks, preference for old thought and behaviour patterns, language abnormalities reflecting loss of control and initiation, impaired verbal regulation of motor acts and syntactical language disturbances.

Medial changes (disorders of self-programming) -

Lack of drive, disinhibition, indifference, lack of productive thinking, inability to make decisions and harder to motivate.

Basal or *Orbital* changes (personality changes and disorders of inhibitory control) -

Reduced anxiety, disinhibition in social situations, impulsiveness, mild euphoria, puerile humour, overconfidence in abilities, confabulation, flatness or lability of affect, tactlessness, insensitivity, aggression, childish behaviour, demanding attitude, reduced moral, social and personal hygiene standards, more critical and defensive.

b. Left

Verbal reasoning, planning, expression and processes prerequisite to verbal memory.

Deficits in word fluency and learning difficult verbal associations, motor deficits for right handers on grip strength, finger tapping and pegboard tests, verbal memory deficits from instability of intention to remember and impairment of shifting from one recall trace to another, decisions made without enough data, failure to scan.

c. Right

Visual reasoning, planning and processes pre-requisite to non-verbal memory.

Visuoconstructive planning and visual-sequencing problems, motor deficits for left handers reverse of those for right handers non-verbal memory deficits (as for left frontal).

5. Temporal Lobes:

a. Bilateral

Recent and working memory, auditory reception.

Short term memory deficits, difficulties forming new long term memories (i.e. recent memory disorder), auditory receptive difficulties (hearing loss mainly associated with opposite ear), upper visual field losses in opposite visual field.

b. Left

Understanding speech and writing, speech integration, perception of acoustic intensity, verbal memory.

Verbal memory problems, impaired decoding of speech that may range from "word deafness" to problems in phonemic analysis resulting in reading, writing or speech disorders, atypical schizophreniform psychosis, personality changes (depression, anxiety, rage and fear), hyperacusia, and dyslexia (arises from auditory and visual integration problems in occipito-temporal region).

c. Right

Understanding complex non-verbal patterns, recognition of rhythmic patterns, musical abilities including pitch and rhythm, visual memory.

Visual memory problems, difficulty identifying incongruities in pictures, difficulty with picture arrangement, inability to appreciate musical tone, loudness, timbre etc.

6. Parietal Lobes:

a. Bilateral

Reception, interpretation and integration of sensory input.

Disorders in reception, interpretation and integration of somato-sensory impulses.

After deep lesions lower visual-field losses in opposite visual field. Ignoring portions or half of the body.

b. Left

Right-sided sensory functions.

Right-sided sensory problems (naming body parts, appreciating spatial position, finger agnosia) reduced smoothness of speaking (when sounds made by similar muscular movements) and writing disorders arising when letters formed by similar muscular movements (both due to reduced sensory-motor input when speaking or writing), understanding speech denoting spatial relations ("above", "bigger", "minus" etc), inability to perform general arithmetic operations and relations (except for well-learned operations eg $2 + 2$), verbal learning/memory deficits and grammatic/semantic disturbances due to categorising and linguistic organisation, inability to demonstrate use of an object despite knowledge of objects use, construction dyspraxia (assembly and drawing problems - presumes motor strength and motor control areas intact), dysnomia, inability to name colours (can match and grade colours though).

c. Right

Left-sided sensory functions.

Left-sided sensory problems (as above), tactile memory problems, drawing and assembly task difficulties, (construction dyspraxia), unilateral spatial neglect, dressing difficulties, specific mental arithmetic problems involving spatial relationship of numbers (especially multiplication), difficulty with recognition of faces and sense of familiarity with objects.

7. Occipital Lobes:

a. Bilateral

Visual reception, interpretation and integration.

Cortical blindness with damage to both receptive areas, spatial orientation and picture recognition problems with damage to bilateral secondary areas, as well as illusions, hallucinations, transient eye deviations to side of lesion.

b. Left Visual reception, interpretation and integration of right visual field. No practical difficulties in reception (compensation by eye and head movements), interpretation difficulties i.e. recognition of objects by sight (visual agnosia), integration difficulties with disturbances in recognition of numbers or letters.

c. Right Visual reception, interpretation and integration of left visual field. No practical difficulties in reception (compensation by eye and head movements) except if unilateral spatial neglect present may result in ignoring of left visual field, interpretation difficulties i.e. recognition of objects by sight (visual agnosia), integration difficulties with complex non-verbal material (intact left-side can compensate)

Note - The division of well-documented frontal changes into three groups is postulated on a number of sometimes tenuous research findings. Overlap of changes can occur. Similarly, dysfunctions are often due to failure of interlobar dynamics and not just local lesions. For example, working memory problems may be due to deafferentiation of neural connections between frontal and temporal sites.

"Brain-Behaviour Relationships: A table of cortical lesion sites and correlates of functional impairment." From a paper presented in 1984 to an Australian Physiotherapy Association Conference. (Revised 1999.)

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