

Normative data in ENG and VNG

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Normative data from different papers and reports		
Test items	Normative limits ($\mu \pm 2s$)	Reference, number of cases
Spontaneous nystagmus	α 4°/s	1,2
	α 5°/s	3,4
	α 6°/s	5,6
	α 7°/s	7,8,9
	α 6 beats/10 s	3
Ocular motor testing		
Saccades		
Peak velocity for 20° saccade:	210°/s	4,10
lower limit	252°/s	11, N = 20
	283°/s	12, N = 38
Latency for 20° saccade	104-365 ms	13, N = 34 (IR method)
	128-255 ms	12, N = 38
Smooth pursuit gain at 0.3 Hz	>0.80	1,14,15
Optokinetic nystagmus asymmetry	<13%	12, N = 38
	<16%	1, N = 43

Very important remarks

- Changing light conditions dramatically alter the calibration factors.
- It is crucial to perform calibrations repeatedly throughout the entire ENG.
- The clinician should never rely blindly on the computer output without inspecting the traces and the calculation results.
- Patients referred for ENG should not take tranquillisers, sedatives or alcohol for 48h before testing.
- Continuous visualisation of the patient and monitoring of the eye recordings are essential for test accuracy as well as for patient comfort and safety.
- Patient alertness has a major effect on the VOR. Ensure optimal alertness of the patient throughout the ENG examination.
- A clinically significant spontaneous nystagmus should appear consistently throughout the ENG test.

Normative data from different papers and reports		
Test items ($\mu \pm 2s$)	Normative limits number of cases	Reference, number of cases
Positional testing	<6°/s	5
Rotatory chair testing		
Sinusoidal harmonic acceleration		
Test		
Gain		
0.05 Hz, 60°/s	0.20-0.80	16, N = 20
0.05 Hz, 60°/s	0.13-0.77	17, N = 10
0.05 Hz, 50°/s	0.24-0.85	12, N = 38
0.05 Hz, 60°/s	0.38-0.98	18, N = 167
Phase		
0.05 Hz, 60°/s	6-14°	16, N = 20
0.05 Hz, 60°/s	2-20°	17, N = 10
0.05 Hz, 50°/s	-1-18°	12, N = 38
0.05 Hz, 50°/s	-1.9-24°	19, N = 50
0.05 Hz, 60°/s	0.8-20.2	18, N = 167
Directional preponderance		
0.05 Hz, 60°/s	$\leq 15\%$	18, N = 208
0.05 Hz, 50°/s	$\leq 24\%$	12, N = 38
Velocity step 90°/s		
Gain	0.33-0.72	20, N = 20
Time constant	11-26 s	20, N = 20
Directional preponderance	$\leq 22\%$	20, N = 20
Velocity step 100°/s		
Gain	0.27-0.99	1, N = 43
Time constant	5-19.4 s	1, N = 43

Normative data from different papers and reports		
Test items	Normative limits ($\mu \pm 2s$)	Reference, number of cases
Caloric testing		
Labyrinth asymmetry (%)	$\leq 25\%$	5, $N = 114$
	$\leq 19.8\%$	3, $N = 30$
	$\leq 19\%$	12, $N = 38$
	$\leq 15\%$	21, $N = 47$
	$\leq 22\%$	1,2, $N = 43$
	$\leq 20\%$	8, $N = 58$
	$\leq 20\%$	22, $N = 49$
General labyrinth asymmetry limit	$\leq 25\%$	18, $N = 167$
	$\leq 22\%$	Meta-analysis
Directional preponderance (%)	$\leq 23\%$	5, $N = 114$
	$\leq 22.7\%$	3, $N = 30$
	$\leq 16\%$	12, $N = 38$
	$\leq 18\%$	21, $N = 47$
	$\leq 28\%$	1,2, $N = 43$
	$\leq 26\%$	8, $N = 58$
	$\leq 27\%$	22, $N = 49$
General directional preponderance limit	$\leq 31.8\%$	8, $N = 167$
	$\leq 26\%$	Meta-analysis

Main parameters of interest of the standard vestibular test protocol	
Protocol item	Parameters of interest
Ocular motor screening battery	
Spontaneous nystagmus detection	Nystagmus direction, SCV
Gaze-evoked test (centre, 30° left/right, 15° up/down)	Nystagmus at different positions
Saccades	Velocity, latency, accuracy, binocular asymmetry
Optokinetic nystagmus	Gain, left-right asymmetry
Smooth pursuit	Gain, left-right asymmetry, morphology
Position tests	
Positioning testing	Nystagmus direction, latency, fatigability
Positional testing	Nystagmus SCV, fixation suppression
Vestibular tests	
Rotatory chair test	Gain, phase, time constant, asymmetry
Caloric test	Maximum SCV, labyrinth asymmetry, nystagmus asymmetry, total responsiveness

- Failure in the ocular motor pathways usually leads to consistently abnormal patterns. The patient can therefore either perform the test or not perform the test at all. Decreased alertness interferes with repeatability.
- During rotational testing, let the patient perform mental tasks, such as counting backwards in steps of 3.
- Do not talk continuously to the patient because that provides

orientation clues that influence the VOR.

- If the gain is too low, measures of asymmetry or phase are inaccurate, and should be interpreted with caution.

Caloric test

- Maintain alertness throughout the caloric test.
- Calibrate prior to each irrigation since, in particular, the effect of the stimulus changes

the impedance of the electrodes (due to sweating etc). Calibration is therefore required before each irrigation.

- Caloric responses should be consistent. If one out of four irrigations does not concur with the others, it should be repeated.

Conclusion

- Every laboratory is strongly advised to establish its own normative data.
- Meta-analysis indicates an upper normal limit for labyrinth asymmetry of 22% and for directional labyrinth preponderance of 26%.
- A dedicated and well-trained technician is crucial for the reliability of vestibular tests.

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