

## Acquired Colour Vision Deficiencies

By Monika Formankiewicz

### References

1. Mollon JD (2003) The origins of modern colour science. In: Shevell S, editor. *The Science of Colour*. Optical Society of America, Washington. p. 1-39.
2. Marre M (1973) Investigation of acquired colour vision deficiencies. In: Hunt RWG, editor. *Colour 73*. Adam Hilger, London. p. 99-136.
3. Verriest G (1963) Further studies on acquired deficiency of colour discrimination. *Journal of the Optical Society of America* 53: 185-195.
4. Quigley HA, Sanchez RM, Dunkelberger GR, L'Hernault NL, Baginski TA (1987) Chronic glaucoma selectively damages large optic nerve fibres. *Investigative Ophthalmology and Visual Science* 28(6): 913-920.
5. Greenstein V, Sarter B, Hood D, Noble K, Carr R (1990) Hue discrimination and S cone pathway sensitivity in early diabetic retinopathy. *Investigative Ophthalmology and Visual Science* 31(6): 1008-1014.
6. Gunduz K, Arden GB, Perry S, Weinstein GW, Hitchings RA (1988) Colour vision defects in ocular hypertension and glaucoma. Quantification with a computer-driven colour television system. *Archives of Ophthalmology* 106(7): 929-935.
7. Birch J (2003) *Diagnosis of Defective Colour Vision*. Butterworth-Heinemann, Edinburgh.
8. Cole BL, Lian KY, Lakkis C (2006) The new Richmond HRR pseudoisochromatic test for colour vision is better than the Ishihara test. *Clinical and Experimental Optometry* 89(2): 73-80.
9. Dain SJ, Pereira SM, Palmer BG, Lewis P, Hammond T (1980) Illuminance and the FM 100 Hue Test. In: Verriest G, editor. *Colour Deficiencies V*. Adam Hilger, London. p. 162-163.
10. Hardy KJ, Craven B, Foster DH, Scarpello JH (1994) Extent and duration of practice effects on performance with the Farnsworth-Munsell 100-Hue test. *Ophthalmic and Physiological Optics* 14(3): 306-309.
11. Birch J, Dain SJ (1987) An averaging method for the interpretation of the Farnsworth-Munsell 100-Hue Test--II. Colour vision defects acquired in diabetic retinopathy. *Ophthalmic and Physiological Optics* 7(3): 281-291.

12. Kurtenbach A, Flögel W, Erb C (2002) Anomaloscope matches in patients with diabetes mellitus. *Graefes Archive for Clinical and Experimental Ophthalmology* 240(2): 79-84.
13. Dain SJ (2004) Clinical colour vision tests. *Clinical & Experimental Optometry* 87(4-5): 276-293.
14. McCulley TJ, Golnik KC, Lam BL, Feuer WJ (2006) The effect of decreased visual acuity on clinical colour vision testing. *American Journal of Ophthalmology* 141(1): 194-196.
15. Simunovic MP, Votruba M, Regan BC, Mollon JD (1998) Colour discrimination ellipses in patients with dominant optic atrophy. *Vision Research* 38(21): 3413-9.
16. Beirne RO, McIlreavy L, Zlatkova MB (2008) The effect of age-related lens yellowing on Farnsworth-Munsell 100 hue error score. *Ophthalmic and Physiological Optics* 28(5): 448-456.
17. Kinnear PR, Sahraie A (2002) New Farnsworth-Munsell 100 hue test norms of normal observers for each year of age 5-22 and for age decades 30-70. *British Journal of Ophthalmology* 86(12): 1408-1411.
18. Pokorny J, Smith VC (1990) Colour matching as a clinical tool. Theory of modification by disease. In: Ohta Y, editor. *Colour Vision Deficiencies*. Kugler & Ghedini, Amstelveen. p. 255-268.
19. Bresnick GH, Condit RS, Palta M, Korth K, Groo A, Syrjala S (1985) Association of hue discrimination loss and diabetic retinopathy. *Archives of Ophthalmology* 103(9): 1317-1324.
20. Kessel L, Alsing A, Larsen M (1999) Diabetic versus non-diabetic colour vision after cataract surgery. *British Journal of Ophthalmology* 83(9): 1042-1045.
21. Green FD, Ghafour IM, Allan D, Barrie T, McClure E, Foulds WS (1985) Colour vision of diabetics. *British Journal of Ophthalmology* 69(7): 533-536.
22. Ismail GM, Whitaker D (1998) Early detection of changes in visual function in diabetes mellitus. *Ophthalmic and Physiological Optics* 18(1): 3-12.
23. Barton FB, Fong DS, Knatterud GL, ETDRS Research Group (2004) Classification of Farnsworth-Munsell 100-hue test results in the early treatment diabetic retinopathy study. *American Journal of Ophthalmology* 138(1): 119-124.
24. Davies N, Morland A (2003) Extent of foveal tritanopia in diabetes mellitus. *British Journal of Ophthalmology* 87(6): 742-746.

25. Mortlock KE, Chiti Z, Drasdo N, Owens DR, North RV (2005) Silent substitution S-cone electroretinogram in subjects with diabetes mellitus. *Ophthalmic and Physiological Optics* 25(5): 392-399.
26. Yamamoto S, Kamiyama M, Nitta K, Noble K, Hayasaka S (1996) Selective reduction of the S cone electroretinogram in diabetes. *British Journal of Ophthalmology* 80: 973-975.
27. Maar N, Tittl M, Stur M, Zajic B, Reitner A (2001) A new colour vision arrangement test to detect functional changes in diabetic macular oedema. *British Journal of Ophthalmology* 85(1): 47-51.
28. Tregear SJ, Knowles PJ, Ripley LG, Casswell AG (1997) Chromatic-contrast threshold impairment in diabetes. *Eye* 11(Pt 4): 537-546.
29. Roy MS, McCulloch C, Hanna AK, Mortimer C (1984) Colour vision in long-standing diabetes mellitus. *British Journal of Ophthalmology* 68(3): 215-217.
30. Ong GL, Ripley LG, Newsom RS, Casswell AG (2003) Assessment of colour vision as a screening test for sight threatening diabetic retinopathy before loss of vision. *British Journal of Ophthalmology* 87(6): 747-752.
31. Kurtenbach A, Schiefer U, Neu A, Zrenner E (1999) Preretinopic changes in the colour vision of juvenile diabetics. *British Journal of Ophthalmology* 83(1): 43-46.
32. Pacheco-Cutillas M, Edgar DF, Sahraie A (1999) Acquired colour vision defects in glaucoma-their detection and clinical significance. *British Journal of Ophthalmology* 83(12): 1396-1402.
33. Sample PA, Boynton RM, Weinreb RN (1988) Isolating the colour vision loss in primary open-angle glaucoma. *American Journal of Ophthalmology* 106(6): 686-691.
34. Greenstein VC, Halevy D, Zaidi Q, Koenig KL, Ritch RH (1996) Chromatic and luminance systems deficits in glaucoma. *Vision Research* 36(4): 621-629.
35. Papaconstantinou D, Georgalas I, Kalantzis G, Karmiris E, Koutsandrea C, Diagourtas A, et al (2009) Acquired colour vision and visual field defects in patients with ocular hypertension and early glaucoma. *Clinical Ophthalmology* 3: 251-257.
36. Castelo-Branco M, Faria P, Forjaz V, Kozak LR, Azevedo H (2004) Simultaneous comparison of relative damage to chromatic pathways in ocular hypertension and glaucoma: correlation with clinical measures. *Investigative Ophthalmology and Visual Science* 45(2): 499-505.
37. Drance SM, Lakowski R, Schulzer M, Douglas GR (1981) Acquired colour vision

changes in glaucoma. Use of 100-hue test and Pickford anomaloscope as predictors of glaucomatous field change. *Archives of Ophthalmology* 99(5): 829-831.

38. Flammer J, Drance SM (1984) Correlation between colour vision scores and quantitative perimetry in suspected glaucoma. *Archives of Ophthalmology* 102(1): 38-39.

39. Breton ME, Krupin T (1987) Age covariance between 100-Hue colour scores and quantitative perimetry in primary open angle glaucoma. *Archives of Ophthalmology* 105(5): 642-645.

40. Yamazaki Y, Lakowski R, Drance SM (1989) A comparison of the blue colour mechanism in high- and low-tension glaucoma. *Ophthalmology* 96(1): 12-15.

41. Trick GL (1993) Visual dysfunction in normotensive glaucoma. *Documenta Ophthalmologica* 85(2): 125-133.

42. Budde WM, Junemann A, Korth M (1996) Colour axis evaluation of the Farnsworth Munsell 100-hue test in primary open-angle glaucoma and normal-pressure glaucoma. *Graefe's Archive for Clinical and Experimental Ophthalmology* 234 Suppl 1: S180-6.

43. Yu TC, Falcao-Reis F, Spileers W, Arden GB (1991) Peripheral colour contrast. A new screening test for preglaucomatous visual loss. *Investigative Ophthalmology and Visual Science* 32(10): 2779-2789.

44. Felius J, van den Berg TJ, Spekrijse H (1995) Peripheral cone contrast sensitivity in glaucoma. *Vision Research* 35(12): 1791-1797.

45. Falcao-Reis FM, O'Sullivan F, Spileers W, Hogg C, Arden GB (1991) Macular colour contrast sensitivity in ocular hypertension and glaucoma: evidence for two types of defect. *British Journal of Ophthalmology* 75(10): 598-602.

46. Fristrom B (2002) Colour contrast sensitivity in ocular hypertension. A five-year prospective study. *Acta Ophthalmologica Scandinavica* 80(2): 155-162.

47. Johnson CA, Adams AJ, Casson EJ, Brandt JD (1993) Blue-on-yellow perimetry can predict the development of glaucomatous visual field loss. *Archives of Ophthalmology* 111(5): 645-650.

48. Johnson CA, Adams AJ, Casson EJ, Brandt JD (1993) Progression of early glaucomatous visual field loss as detected by blue-on-yellow and standard white-on-white automated perimetry. *Archives of Ophthalmology* 111(5): 651-656.

49. Wild JM, Cubbidge RP, Pacey IE, Robinson R (1998) Statistical aspects of the

- normal visual field in short-wavelength automated perimetry. *Investigative Ophthalmology and Visual Science* 39(1): 54-63.
50. McNaught EI, Rennie A, McClure E, Chisholm IA (1974) Pattern of visual damage after acute angle-closure glaucoma. *Transactions of the Ophthalmological Societies of the United Kingdom* 94(2): 406-415.
51. Foulds WS, Chisholm IA, Reid HCR (1972) The effects of raised intraocular pressure on visual function. In: Cant JS, editor. *The optic nerve*. Kimpton, London. p. 323-330.
52. Cheng AS, Vingrys AJ (1993) Visual losses in early age-related maculopathy. *Optometry and Vision Science* 70(2): 89-96.
53. Feigl B, Brown B, Lovie-Kitchin J, Swann P (2005) Monitoring retinal function in early age-related maculopathy: visual performance after 1 year. *Eye* 19(11): 1169-1177.
54. Collins MJ (1986) Pre-age related maculopathy and the desaturated D15 colour vision test. *Clinical & Experimental Optometry* 69(6): 223-227.
55. Midena E, Degli Angeli C, Blarzino MC, Valenti M, Segato T (1997) Macular function impairment in eyes with early age-related macular degeneration. *Investigative Ophthalmology and Visual Science* 38(2): 469-477.
56. Arden GB, Wolf JE (2004) Colour vision testing as an aid to diagnosis and management of age related maculopathy. *British Journal of Ophthalmology* 88(9): 1180-1185.
57. Remky A, Elsner AE (2005) Blue on yellow perimetry with scanning laser ophthalmoscopy in patients with age related macular disease. *British Journal of Ophthalmology* 89(4): 464-469.
58. Smith VC, Pokorny J, Diddie KR (1978) Colour matching and Stiles-Crawford effect in central serous choroidopathy. *Modern Problems in Ophthalmology* 19: 284-295.
59. Maaranen TH, Tuppurainen KT, Mantyarvi MI (2000) Colour vision defects after central serous chorioretinopathy. *Retina* 20(6): 633-637.
60. Schneck ME, Haegerstrom-Portnoy G (1997) Colour vision defect type and spatial vision in the optic neuritis treatment trial. *Investigative Ophthalmology and Visual Science* 38(11): 2278-2289.
61. Nikoskelainen E (1975) Symptoms, signs and early course of optic neuritis. *Acta*

Ophthalmologica 53(2): 254-272.

62. Jameson D, M HL (1956) Theoretical Analysis of Anomalous Colour Vision. *Journal of the Optical Society of America* 46(12): 1075-1089.

63. Dain SJ, Rammohan KW, Benes SC, King-Smith PE (1990) Chromatic, spatial, and temporal losses of sensitivity in multiple sclerosis. *Investigative Ophthalmology and Visual Science* 31(3): 548-558.

64. Katz B (1995) The dyschromatopsia of optic neuritis: a descriptive analysis of data from the optic neuritis treatment trial. *Transactions of the American Ophthalmological Society* 93: 685-708.

65. Menage MJ, Papakostopoulos D, Dean Hart JC, Papakostopoulos S, Gogolitsyn Y (1993) The Farnsworth-Munsell 100 hue test in the first episode of demyelinating optic neuritis. *British Journal of Ophthalmology* 77(2): 68-74.

66. Mullen KT, Plant GT (1986) Colour and luminance vision in human optic neuritis. *Brain* 109(Pt 1): 1-13.

67. Moro SI, Rodriguez-Carmona ML, Frost EC, Plant GT, Barbur JL (2007) Recovery of vision and pupil responses in optic neuritis and multiple sclerosis. *Ophthalmic and Physiological Optics* 27(5): 451-460.

68. Koh SB, Kim BJ, Lee J, Suh SI, Kim TK, Kim SH (2008) Stereopsis and colour vision impairment in patients with right extrastriate cerebral lesions. *European Neurology* 60(4): 174-178.

69. Pearlman AL, Birch J, Meadows JC (1979) Cerebral colour blindness: an acquired defect in hue discrimination. *Annals of Neurology* 5(3): 253-261.

70. Zeki S, Bartels A (1999) The clinical and functional measurement of cortical (in)activity in the visual brain, with special reference to the two subdivisions (V4 and V4 alpha) of the human colour centre. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences* 354(1387): 1371-1382.

71. Lely AH, van Enter CH (1970) Large-scale digitoxin intoxication. *British Medical Journal* 3(5725): 737-740.

72. Manninen V (1974) Letter: impaired colour vision in diagnosis of digitalis intoxication. *British Medical Journal* 4(5945): 653-654.

73. Aronson JK, Ford AR (1980) The use of colour vision measurement in the diagnosis of digoxin toxicity. *Quarterly Journal of Medicine* 49(195): 273-282.

74. Rietbrock N, Alken RG (1980) Colour vision deficiencies: a common sign of intoxication in chronically digoxin-treated patients. *Journal of Cardiovascular Pharmacology* 2(1): 93-99.
75. Lawrenson JG, Kelly C, Lawrenson AL, Birch J (2002) Acquired colour vision deficiency in patients receiving digoxin maintenance therapy. *British Journal of Ophthalmology* 86(11): 1259-1261.
76. Laties AM, Fraunfelder FT (1999) Ocular safety of Viagra, (sildenafil citrate). *Transactions of the American Ophthalmological Society* 97: 115-128.
77. Neubauer AS, Samari-Kermani K, Schaller U, Welge-Lubetaen U, Rudolph G, Berninger T (2003) Detecting chloroquine retinopathy: electro-oculogram versus colour vision. *British Journal of Ophthalmology* 87(7): 902-908.
78. Vu BL, Easterbrook M, Hovis JK (1999) Detection of colour vision defects in chloroquine retinopathy. *Ophthalmology* 106(9): 1799-1804.
79. Ventura DF (2003) Colour vision loss in patients treated with chloroquine. *Arq Bras Oftalmol* 66: 9-15.
80. Zrenner E, Kruger CJ (1981) Ethambutol mainly affects the function of red/green opponent neurons. *Documenta Ophthalmologica Proceedings Series* 27(13): 18.
81. Joubert PH, Strobele JG, Ogle CW, van der Merwe CA (1986) Subclinical impairment of colour vision in patients receiving ethambutol. *Br.J.Clin.Pharmacol.* 21(2): 213-216.
82. Polak BC, Leys M, van Lith GH (1985) Blue-yellow colour vision changes as early symptoms of ethambutol oculotoxicity. *Ophthalmologica* 191(4): 223-226.
83. Nasemann J, Zrenner E, Riedel KG (1989) Recovery after severe ethambutol intoxication--psychophysical and electrophysiological correlations. *Doc.Ophthalmol.* 71(3): 279-292.
84. Bayer AU, Thiel HJ, Zrenner E, Dichgans J, Kuehn M, Paulus W, et al (1997) Colour vision tests for early detection of antiepileptic drug toxicity. *Neurology* 48(5): 1394-1397.
85. Lopez L, Thomson A, Rabinowicz AL (1999) Assessment of colour vision in epileptic patients exposed to single-drug therapy. *European Neurology* 41(4): 201-205.
86. Iregren A, Andersson M, Nylen P (2002) Colour vision and occupational chemical exposures: I. An overview of tests and effects. *Neurotoxicology* 23(6): 719-

733.