Photoreceptor inner and outer segments

Rod outer segments

	Diameter (μm)	Length (μm)	Reference/comments
salamander	11	22	Pugh & Lamb, 1993
toad	6	60	Pugh & Lamb, 1993
human	2	25	Pugh & Lamb, 1993
human parafoveal	2	35.2	Young, 1971; ecc: 0.75–1.25 mm (2.6°–4.3°)
human perifoveal	2	**31.2**	Young, 1971; ecc: 1.25–2.75 mm (4.3°–9.4°)
human periphery	2	23.9	Young, 1971
macaque		28	Polyak, 1941, p. 237
macaque		25	Baylor, Nunn, & Schnapf, 1984

Note the large size of the amphibian rods, compared with those of mammals. For example, the volume of a salamander rod outer segment is about 20 times greater than that of a human's. Small outer segments give mammalian rods a faster response time simply because there are fewer cG molecules to be removed. See Pugh and Lamb (1993) for a more detailed discussion of this point.

Rod inner segments

Eccentricity (mm)	Young (μm)	Old (μm)	Species
1.0	2.05	2.32	human
2.0	2.11	2.38	human
2.9	2.16	2.43	human
3.0	2.16	2.44	human
4.1	**2.22**	2.50	human
5.0	2.27	2.56	human

Because the inner segments funnel the photons into the outer segment, these values are important in determining the photon catch, given the flux density of the incident photons. From: Curcio et al., 1993

Rod discs and peak absorption

Parameter	Value/measure	Reference/comments
Disc spacing	28 nm	Pugh & Lamb, 1993
Disc packing density	*36* μm^{-1}	Reciprocal of disc spacing
Discs/rod outer segment	*1100*	Parafoveal, 31.2 × 36
Peak specific optical density	0.015 μm^{-1}	Hárosi & MacNichol, 1974; Hárosi, 1975
Peak absorbance of rod	*0.47*	Parafoveal, 31.2 × 0.015
Peak absorptance of rod	*0.66*	$1 - 10^{-0.47}$

Photoreceptor inner and outer segments (continued)

Human foveal cone outer segments

Reference	Length (μm)	Peak absorbance	Peak absorptance	Comments
Polyak, 1941, p. 448	35	*0.53*	*0.70*	
Polyak, 1941, Fig. 38	43	*0.65*	*0.77*	(Diagram is partly schematic)
M. Schultze	36	*0.54*	*0.71*	Cited by Polyak, 1941, p. 448
R. Greeff	38	*0.57*	*0.73*	Cited by Polyak, 1941, p. 448
Stockman et al., 1993	27	*0.40*	*0.60*	
Standard observer	**33**	***0.50***	***0.68***	Based in part on Stockman et al., 1993, p. 2509

Macaque foveal cone outer segments

Reference	Length (μm)	Peak absorbance	Peak absorptance	Comments
Polyak, 1941, p. 200	67	1.01	0.90	
Polyak, 1941, p. 200	64	0.96	0.89	
Polyak, 1941, p. 200	46	0.69	0.80	
Dowling, 1965	40	0.60	0.75	
Borwein et al., 1980 (min)	30	0.45	0.65	
Borwein et al., 1980 (max)	40	0.60	0.75	
J. Neumann, *Rhesus*	45	0.68	0.79	Cited by Polyak, 1941, p. 448
J. Neumann, *Nemestrina*	54	0.81	0.85	Cited by Polyak, 1941, p. 448

Human cone inner segments

Eccentricity (mm)	Eccentricity (deg)	Diameter (mm)	Area (μm^2)	Area ratio	Reference
0	0	2.3	*4.2*	*1.0*	Curcio, 1987
1.40	5	3.3	*8.6*	*2.1*	Curcio, 1987
2.80	10	7.5	*44.2*	*10.6*	Curcio, 1987 (temporal retina)
4.21	15	7.9	*49.0*	*11.8*	Hecht & Mandelbaum, 1939
8.41	30	7.9	*49.3*	*11.9*	Hecht, Haig, & Chase, 1937 (nasal retina)

The large increase in the cross-sectional area of cone inner segments with eccentricity implies a corresponding increase in photon catch rate.