Impact of magnification when measuring VA at shorter distance than 6 m

The ETDRS chart is labeled in the visual angle that the letters subtend. However, in order to make the ETDRS chart practical in size, the chart was designed for testing the visual acuity at 4 m. But, if the visual acuity is tested at 4 m, an addition of 0.25 D is required and the addition creates an angular magnification (Figure 1).

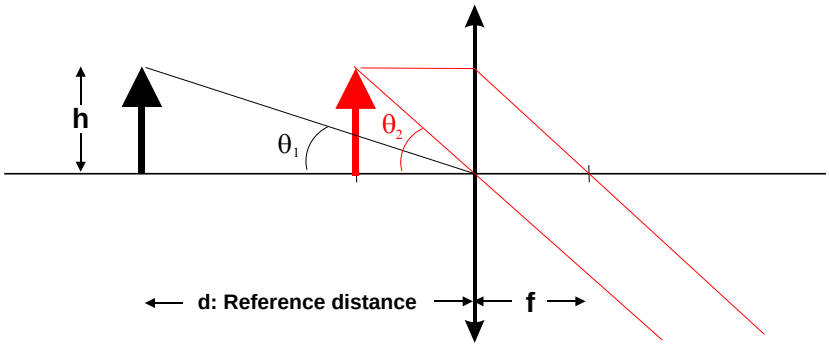

Figure 1 Angular magnification

If an object is clearly seen at a reference distance, *d* (m), without addition, an addition of f (m) or F=1/f (D) is requied to be able to see the object at the distance f (m). Then, an angular magnification, *M* (rel), occurs that can be derived from Figure 1 (Eq. 1).

$$M = \frac{\theta_2}{\theta_1} \qquad \text{Eq. 1}$$

It is seeen in the figure that

$$\tan\theta_1 = \frac{h}{d} \text{ and } \tan\theta_2 = \frac{h}{f}$$

For small θ *(radians) holds that* $\tan(\theta) \approx \theta$. *Then*

$$\frac{\theta_2}{\theta_1} = \frac{\frac{h}{f}}{\frac{h}{d}} \text{ or } \frac{\theta_2}{\theta_1} = \frac{d}{f} \text{ or } \frac{\theta_2}{\theta_1} = d \cdot F \text{ . Thus}$$

$M = d \cdot F$ *, and for d= 6 m holds*

$$M = 6 \cdot F$$

Thus, since the ETDRS chart is placed at shorter distance than 6 m, the magnification due to the need for addition induced a false high estimation of visual acuity (Table 1).

Table 1 Magnification due to addition for closer distance

Distance to chart (m)	Addition (D)	Magnification (Rel.)	Error (logMar)
4	0.25	1.5	0.17
2	0.5	3.0	0.48
1	1	6.0	0.78

1. Legends

1.1 Equations

Eq. 1 Angular magnification due to addition

1.2 Figures

Figure 1 Angular magnification

1.3 Tables

Table 1 Magnification due to addition for closer distance