Visual Acuity: Decoded

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Summary

In the current scenario of competition, paper writing, critical analysis and stardom, we forget to analyse the basics of the subject, one of which is a visual acuity standard. Being an ophthalmologist demands good understanding of visual acuity in all formats. This article emphasise on visual acuity conversions from logarithm to Snellen visual chart at 6 meter, 4 meter, 20 feet and decimal forms.

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Introduction

Worldwide, ophthalmologists face this challenge of visual acuity conversion in day-to-day clinical practice. From writing a thesis to analyzing and presenting an article requires knowledge of different visual acuity formats. In this busy complicated super specialized scenario, there exists an easy way to understand what standardized 1.9 logarithm visual acuity means or 20/250 means on Snellens 6 meter or 4 meter chart. From our days of education to days of practice, we get to encounter Snellens chart most frequently and thus our mind likes to perceive all visual acuity in 6 meters form. Co-relation between Snellen and Log MAR is not well established and this creates a variability of representation which at times become difficult for an ophthalmologist to decipher, leading to retake of visual acuity in the format of choice. Also, it is not intuitive as poorer vision is recorded as a higher number in the other chart e.g. 6/36 Snellen is 0.80 Log MAR and 6/6 Snellen is 0.00 Log MAR. This paper gives an overview of different possible methods to decode the visual acuity.

Materials

Scientific calculator or Mobile phone calculator (iOS or android version; both have inbuilt scientific calculator).

Methodology

Descriptive log mar is to be read as Log MAR where MAR is Minimum Angle of resolution (in degree of arc). MAR value is one of the most important pivot to various other formats of conversion.

Basics

Four vision charts namely Log MAR chart, Snellens chart (20 feet), Snellen chart (6 meters) and Decimal chart are used in ophthalmic work up. Few set of basic rules are to be kept in mind before jumping into conversion.

1. To find visual acuity in Decimal chart; divide numerator with denominator.

$$\text{Decimal VA} = \frac{\text{Numerator Visual Acuity}}{\text{Denominator Visual Acuity}}$$

2. MAR is the abbreviated form of Minimal Angle Of Resolution

$$\text{MAR} = \frac{\text{Denominator Visual Acuity}}{\text{Numerator Visual Acuity}}$$

3. When logarithm visual acuity is mentioned, it always means logarithm to the base 10 or Log 10.

4. To find visual acuity in logarithm, the concept is Log_{10}(MAR) i.e. to find out Log of MAR (Minimum angle of resolution). To do this, we will need a calculator.

Different Case Scenarios

Scenario 1

- Visual acuity of patient 20/25.

$$\text{VA in decimal form} = \frac{\text{Numerator}}{\text{Denominator}} = \frac{20}{25} = 0.8$$

$$\text{MAR} = \frac{\text{Denominator Visual Acuity}}{\text{Numerator Visual Acuity}} = \frac{25}{20} = 1.25$$

- Logarithm visual acuity = Log (MAR)

$$\text{Log} = \frac{(25)}{20} = \text{Log}\,(1.25) = 0.96 = 0.1 \text{ (round off)}$$

- To find visual acuity on 6 meter Snellen chart

$$\frac{\text{Numerator}}{\text{Denominator}} = \frac{20}{25} = 0.8$$

To convert it into 6 meter or 4 meter or 3 meter, we will keep numerator as 6 or 4 or 3 and denominator as 'y'

$$\frac{\text{Numerator}}{\text{Denominator}} = \frac{20}{25} = 0.8 = \frac{6}{y} \text{ or } \frac{4}{y} \text{ or } \frac{3}{y}$$

$$20 \times y = 6 \times 25 \text{ ———> } y = 7.5$$

so on 6 meter, Snellen conversion would be 6/7.5
or on 4 meter, Snellen conversion would be 4/5
or on 3 meter, Snellen conversion would be 3/3.6

Scenario 2

- Snellen visual acuity is 6/3.

$$\text{VA in decimal form} = \frac{\text{Numerator}}{\text{Denominator}} = \frac{6}{3} = 2$$

$$\text{MAR} = \frac{\text{Denominator Visual Acuity}}{\text{Numerator Visual Acuity}} = \frac{3}{6} = 0.3$$

- Logarithm visual acuity = Log (MAR)

$$\text{Log} = \frac{(3)}{6} = \text{Log}\,(0.3) = -0.52 = 0.1 \text{ (round off)}$$

- To find visual acuity in feet form

$$\frac{\text{Numerator}}{\text{Denominator}} = \frac{6}{3} = 2$$

To convert it into feet form, we will keep numerator as 20 and denominator as 'y'

$$\frac{\text{Numerator}}{\text{Denominator}} = \frac{6}{3} = \frac{2}{y} = 20$$

$$6 \times y = 20 \times 3 \text{ ———> } y = 10$$

so in feet form, visual acuity would be depicted as VA

$$\text{VA (ft)} = \frac{20}{10}$$

The scenario is quite different when it comes to understanding published articles since the data only mentions the logMAR values. To reduplicate the study model, to compare the data or for self-understanding, the role of conversion to various other practical forms become important. To cope with such scenario, the subsequent scenario will be of good help.

Scenario 3

- Visual acuity of patient is 0.50 on logarithm chart.

The above statement is deciphered to simpler form as:

$$\text{Log}_{10}\,\text{MAR} = 0.50$$

$$\frac{\text{Log}_{10}(\text{Denominator})}{\text{Numerator}} = 0.50$$

$$\frac{\text{Denominator}}{\text{Numerator}} = 10^{0.50}$$

[Use x^y on scientific calculator]

$$\frac{\text{Denominator}}{\text{Numerator}} = 3.16 = \text{MAR}$$

- To convert it into 6 meter or 4 meter or 3 meter or 20 feet, we will keep numerator as 6 or 4 or 3 or 20 and denominator as 'y'

$$\frac{\text{Denominator}}{\text{Numerator}} = 3.16 = \text{MAR} = \frac{y}{6} \text{ or } \frac{y}{4} \text{ or } \frac{y}{3} \text{ or } \frac{y}{20}$$

$$3.16 \times 6 = y \text{ ———> } y = 19 \text{ (round off)}$$

so on 6 meter, Snellen conversion would be 6/19

or on 4 meter, Snellen conversion would be 4/12.6

or on 3 meter, Snellen conversion would be 3/10.5

or on 20 feet, chart conversion would be 20/63

Scenario 4

- Visual acuity of patient is -0.2 on logarithm chart. [Such visual acuity can exist!]

The above statement is deciphered to simpler form as: -

$$\text{Log}_{10}\,(\text{MAR}) = -0.2.$$

$$\frac{\text{Log}_{10}(\text{Denominator})}{\text{Numerator}} = -0.2$$

$$\frac{\text{Denominator}}{\text{Numerator}} = 10^{(-0.2)}$$

$$\frac{\text{Denominator}}{\text{Numerator}} = [1]^{0.2} = \text{MAR}$$

[Use xy on scientific calculator]

$$\frac{\text{Denominator}}{\text{Numerator}} = 0.6309 = \text{MAR}$$

- To convert it into 6 meter or 4 meter or 3 meter or 20 feet, we will keep numerator as 6 or 4 or 3 or 20 and denominator as 'y'

$$\frac{\text{Denominator}}{\text{Numerator}} = 0.63 = \text{MAR} = \frac{y}{6} \text{ or } \frac{y}{4} \text{ or } \frac{y}{3} \text{ or } \frac{y}{20}$$

$$0.63 \times 6 = y \text{ ———> } y = 3.8$$

so on 6 meter, Snellen conversion would be 6\ 3.8

or on 4 meter, Snellen conversion would be 4\2.5

or on 3 meter, Snellen conversion would be 3\1.9

or on 20 feet, chart conversion would be 20\12.6

Visual Acuity Score (VAS Scale)

Another expressive entity with all values in positive numbers is Visual acuity scale (VAS). Smaller the VAS value (minimum being 0), lesser the visual acuity. Higher the VAS value (maximum being 100), better the visual acuity.

VAS = 100- 50 LogMAR.

Discussion

The Snellen chart, which has been used since 1862, is easily recognized and is one of the hallmarks of the ophthalmologists consulting room. LogMAR chart has been introduced into clinical practice since it takes into account every notation, which is read by the patient accurately and it doesn't have discrepancy of letters as previously noted with Love-Baileys chart. Testing children's acuity accurately has always been a challenge and now even the best charts are those utilizing Log MAR.[1]

Conclusion

In view of research and rapidly growing new technology, standardization of methods and terminologies is very

important. This article highlights the range of notations used by optometrists and ophthalmologists around the world for vision measurement, and gives a detailed insight on how to interpret one form from another.[2]

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