EXAMINATION OF THE VISUAL ACUITY ON THE LCD OPTOTYPE WITH WHOLE-LINE AND INTERPOLATION METHOD

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Introduction: In human history visual acuity has been defined many times. One conventional definition, which also describes the resolution of the eye is as follows: “Visual acuity is the eye’s ability to distinguish two points lying as close as possible." [1, p. 71] Resolution of two of values was points that lie at a distance from each other perceived below 1 arc minute is possible, because in the macula there are the images of these two points separated by one cone. [1] It is necessary to realize that the patient´s visual acuity and even the minimum separabile does not reflect only on the state of macula but also the whole refractive condition of the eye. The work focuses on the visual acuity value differences measured with whole–line and threshold interpolation method. It includes also a comparison of measured values (between these two methods). Measurement was performed on LCD optotype in order to maintain the opportunity to repeat this study. The purpose of this work is to highlight the differences between whole – line and threshold interpolation visual acuity scoring methods. It should be pointed the fact that the methods and measurements procedure were inspired by the optometric practice. For this reason there was the optotype which is used in practice used for each method. In this period of time fairly comprehensive set measured that can be processed in various ways. In this work there was chosen such processing methods which allow investigators to choose the appropriate method, according to the character of the measured values, available equipment and possibilities for the investigation. These methods of measuring visual acuity will be evaluated and compared. It is necessary to remark that if there is a comparison of the results from different measuring methods and optotype boards, the finally output could be affected by the conversion of the result to a common unit (logMAR).

Hypotheses:

First hypothesis: The value of visual acuity measured with whole-line method on Snellen chart is not equal to the value measured by interpolation method on ETDRS chart.

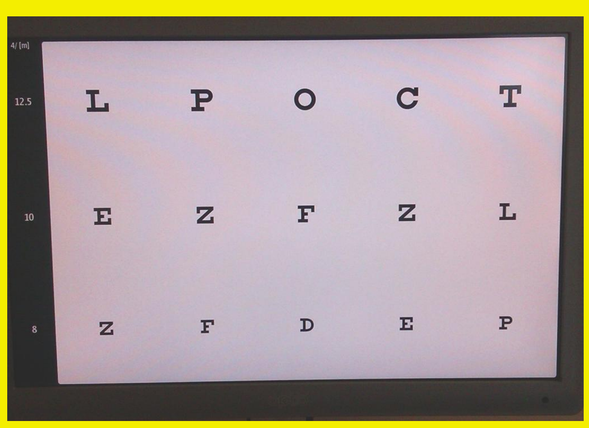
Second hypothesis: Interpolation method has better repeatability, so it is more reliable than the whole-line method.

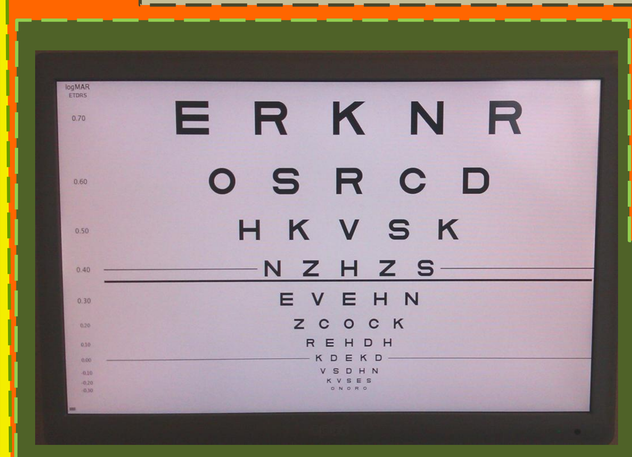
Participants and methods:

Sample FNUSA: Number of respondents was 36, in the range of age from 22 to 88 years. Some patients had artificial mydriasis, or had an amblyopic eye, that is why only 66 eyes were measured. The measurements were performed only with letter optotype characters. The charts were presented with a LCD optotype Smartchart LCD CP-400 made by Opto, which has 24-bit display and a diagonal dimension of 19 inches. The testing distance was 4 meters, the background brightness was constant (200 cd/m2).

Sample LF: Number of respondents was 33, including 7 men 26 women (age 19-30). The measurements were performed with letter optotype characters and some with Landolt rings. The measurement was carried out with LCD optotype Smartchart CP-200 made by Opto, which has 18-bit display and a diagonal dimension of 15 inches. The testing distance was 5 meters, the background brightness was constant (200 cd/m2).

Snellen chart: The vision testing started with the top of the chart and continued until a line was reached where more than 60% of the letters (eg, 2 of 3, 3 of 5) were read incorrectly or the patient read all letters on the chart. The visual acuity was scored using whole-line scoring method, with the lowest value of the line, where at least 60% of the letters (eg, 2 of 3, 3 of 5) were identified correctly.





ETDRS	Snellen	4/m	Decimál	logMAR
	F	4/160	0,028	
	T	4/125	0,032	
	F	4/100	0,04	
	D	4/80	0,05	
	B	4/63	0,063	
	O	4/50	0,08	
VDB	CE	4/40	0,1	1,0
CNDB	FD	4/32	0,125	0,9
VCRCV	CBT	4/25	0,16	0,8
GVHKO	OEP	4/20	0,2	0,7
DSCDN	DFO	4/16	0,25	0,6
CKRSV	ZPCLO	4/12,5	0,32	0,5
NVEOC	PLPCE	4/10	0,04	0,4
ZSNEK	ETFLT	4/8	0,05	0,3
CZSRS	DFOZO	4/6,3	0,63	0,2
	ZTBCP	4/6	0,66	0,18
ODEVK	OCTLO	4/5	0,08	0,1
	PFPFE	4/4,5	0,88	0,05
DSCZR	BODTF	4/4	1	0
	CPBLP	4/3,5	1,14	-0,05
CHNDS	TFCEO	4/3,2	1,25	-0,1
NCKOR	DBPFP	4/2,5	1,32	-0,2
KVEVE	PCLCP	4/2	2	-0,3

ETDRS chart: The patient read the lines one by one from the top. The testing continued to the bottom until the patient made a complete line of errors or read all letters on the chart. The visual acuity was scored using interpolation method, where the examiner calculated the value of visual acuity in logMAR units.

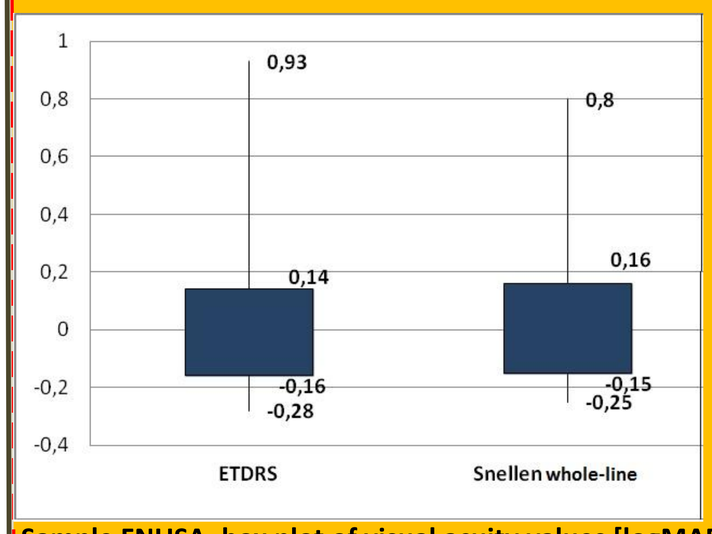
DECIMAL	LOGMAR	20/ft	10/ft	6/m	5/m
0,032	1,50	630	315	190	160
0,040	1,40	500	250	150	125
0,050	1,30	400	200	120	100
0,063	1,20	320	160	95	80
0,080	1,10	250	125	75	63
0,100	1,00	200	100	60	50
0,125	0,90	160	80	48	40
0,160	0,80	125	63	38	32
0,20	0,70	100	50	30	25
0,25	0,60	80	40	24	20
0,32	0,50	63	32	19	16
0,40	0,40	50	25	15	12,5
0,50	0,30	40	20	12	10
0,63	0,20	32	16	9,5	8
0,80	0,10	25	13	7,5	6,3
1,00	0,00	20	10	6	5
1,25	-0,10	16	8	4,8	4
1,60	-0,20	12,5	6,3	3,8	3,2
2,00	-0,20	10	5	3	2,5

Results: A total of 1034 measurements of visual acuity, were divided into different groups and evaluated.

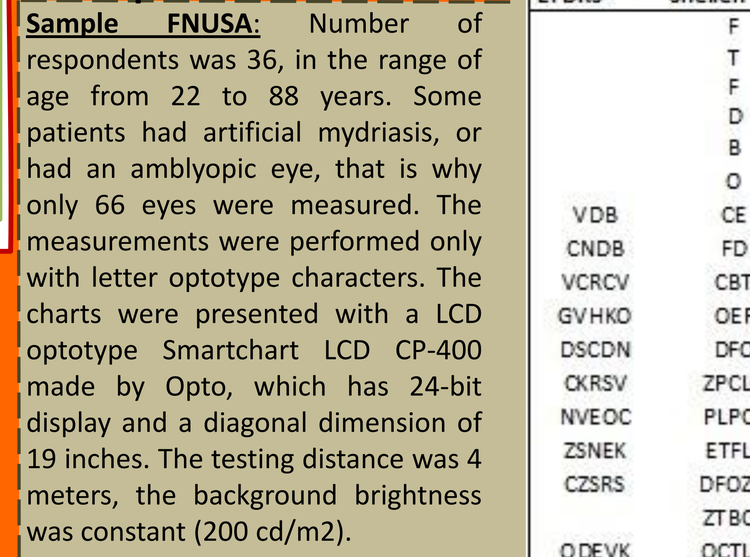
Sample	Method of scoring	Average visual acuity [logMAR]
FNUSA	ETDRS-interpolation	0,0247
	Snellen-whole-line	0,0454
LF	ETDRS-interpolation	-0,0184
	Snellen-whole line	-0,0431

Mean values of visual acuity [logMAR]

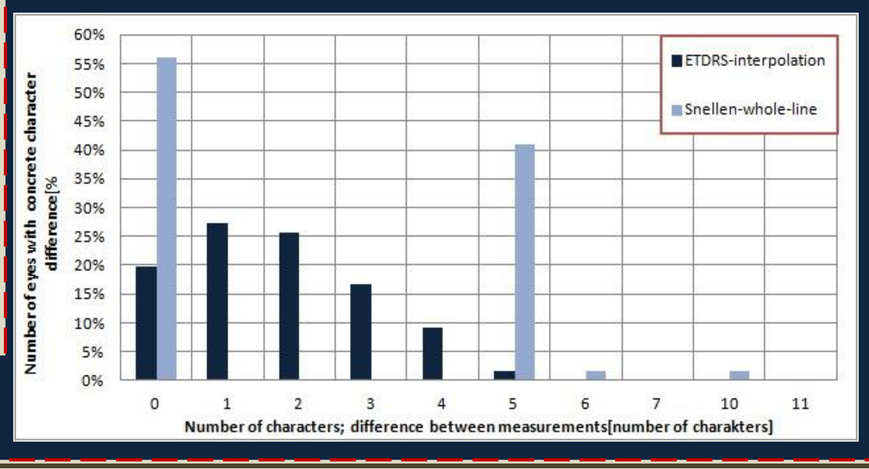
First hypothesis



Sample FNUSA, box plot of visual acuity values [logMAR]



Sample LF, box plot of visual acuity values [logMAR]

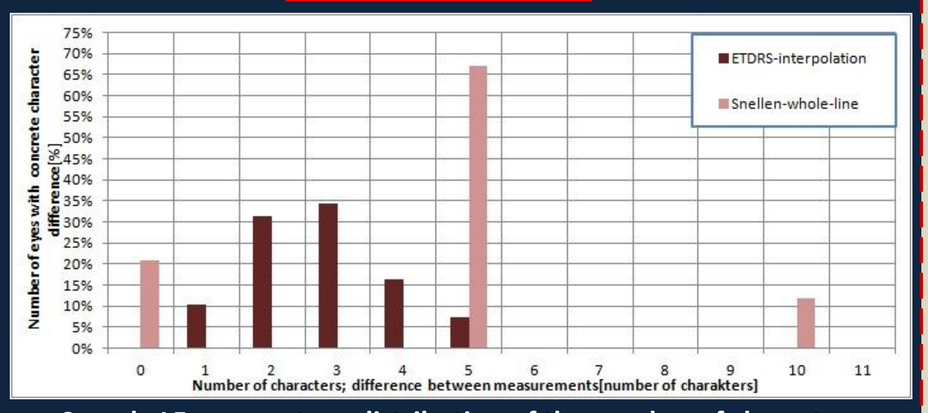


Sample FNUSA-percentage distribution of the number of characters differences according to the methods of measurement

Sample	Method of scoring	Average character difference [number of characters]
FNUSA	ETDRS-interpolation	1,727
	Snellen-whole-line	2,288
LF	ETDRS-interpolation	2,279
	Snellen-whole line	4,552

Average character differences between the measurements

Second hypothesis



Sample LF - percentage distribution of the number of characters differences according to the methods of measurement

In a sample where only two measurements (FNUSA) were performed the average is "repeatability" at ETDRS chart 1,7, at Snellen chart 2,3 characters. This represents 25% difference between the two methods. In the second sample, where 5 repeated measurements were made the difference grows up to 50% (mean difference at ETDRS chart is 2,3, at Snellen chart 4,6 characters).

Conclusion: From the measured results implies that there is significant difference between the measurement of visual acuity with whole-line and interpolation method. It is also confirmed that the interpolation method on ETDRS chart has a better repeatability than the whole-line method on the Snellen chart. Similar results describe authors of following studies [3,4,5,6,7,8,9]. In this study there have been not described all the factors by which these two methods could be examined and compared (e.g. measuring length, intensity of the patient and examiner), so it would be premature to draw absolute conclusions about determining the better method. However, on the base of results, it can be formulated some recommendations for practice:

•If comparing the patient's visual acuity measured by these different methods, you must pay attention to that the actual visual acuity will be different even if the measurements indicate the same value. The worse vision is, the greater the deviation. (see hypothesis 1)

•If we wanted to compare the visual acuity measured by several different examinators in different offices, it is better to perform these measurements on ETDRS chart. It is more reliable and standardized in practice than the Snellen chart. (see hypothesis 2)

•In the case of repeated measurements, such as long-term monitoring of the patient's visual acuity the interpolation method on the ETDRS chart is more efficient than the whole-line method to eliminate errors. (see hypothesis2)

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