ARTICULAR-EMINENCE MEASUREMENTS PERFORMED BY CONVENTIONAL AND THREE-DIMENSIONAL METHOD

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PURPOSE

Articular eminence (AE) morphology could be expressed by dimensions and angles measured by different methods. The aim of this study was to compare conventional two-dimensional with three-dimensional laser method.

MATERIALS AND METHODS

The study was carried out on 20 human dry skulls (18 to 65 years) from medieval and contemporary period. Measurements were performed on sections (real and virtual) through the AE silicone impressions (lateral-medial) using two-dimensional and three-dimensional (laser) digitalization. First section was the most lateral section through the silicone impression. AE inclination (first method *(M1) "fossa roof – eminence top"* and second method *(M2) "best fit line"* method) in relation to the Frankfurt horizontal, AE height and the length of curved line (highest to the lowest AE point) were measured (Figures 1-6). Results were statistically analyzed with significance level of 0.05

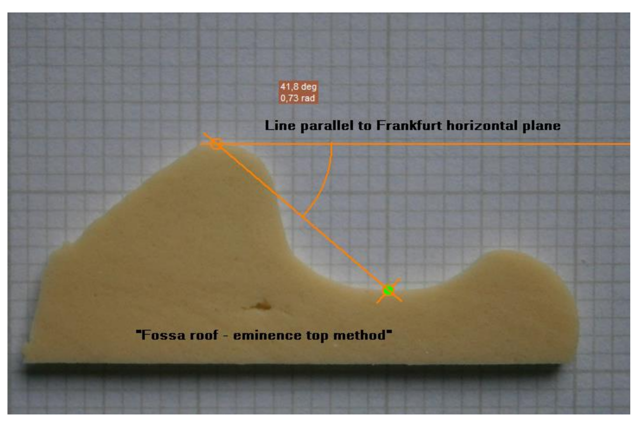

Figure 1. AE inclination measurement by conventional (two-dimensional) method in VistaMetrix software.

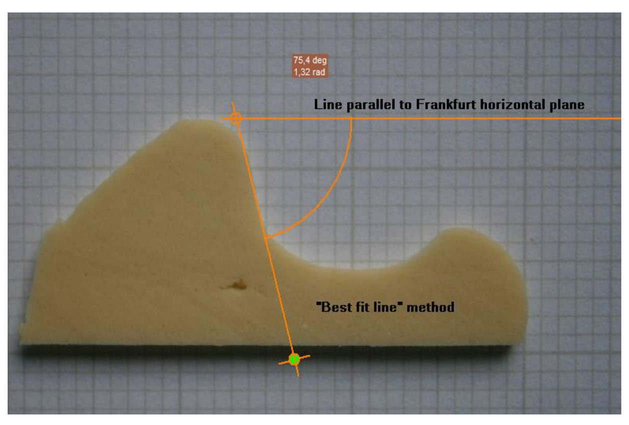

Figure 2. AE inclination measurement by conventional (two-dimensional) method in VistaMetrix software.

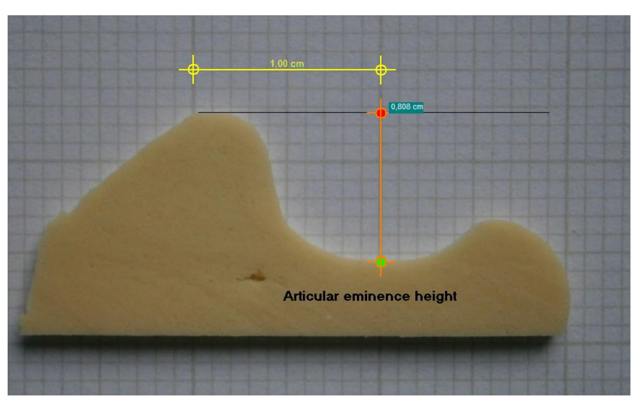

Figure 3. AE height measurement by conventional (two-dimensional) method in VistaMetrix software.

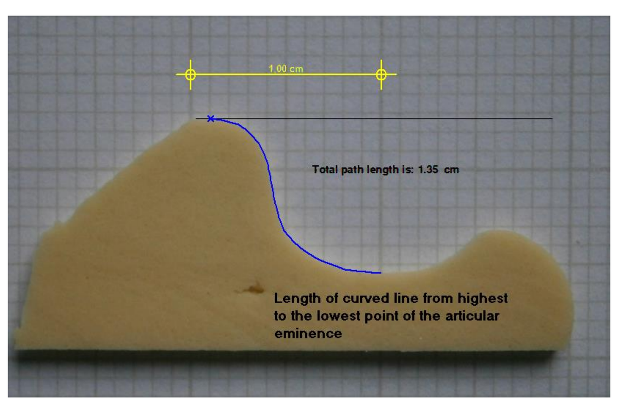

Figure 4. AE curved line length measurement by conventional (two-dimensional) method in VistaMetrix software.

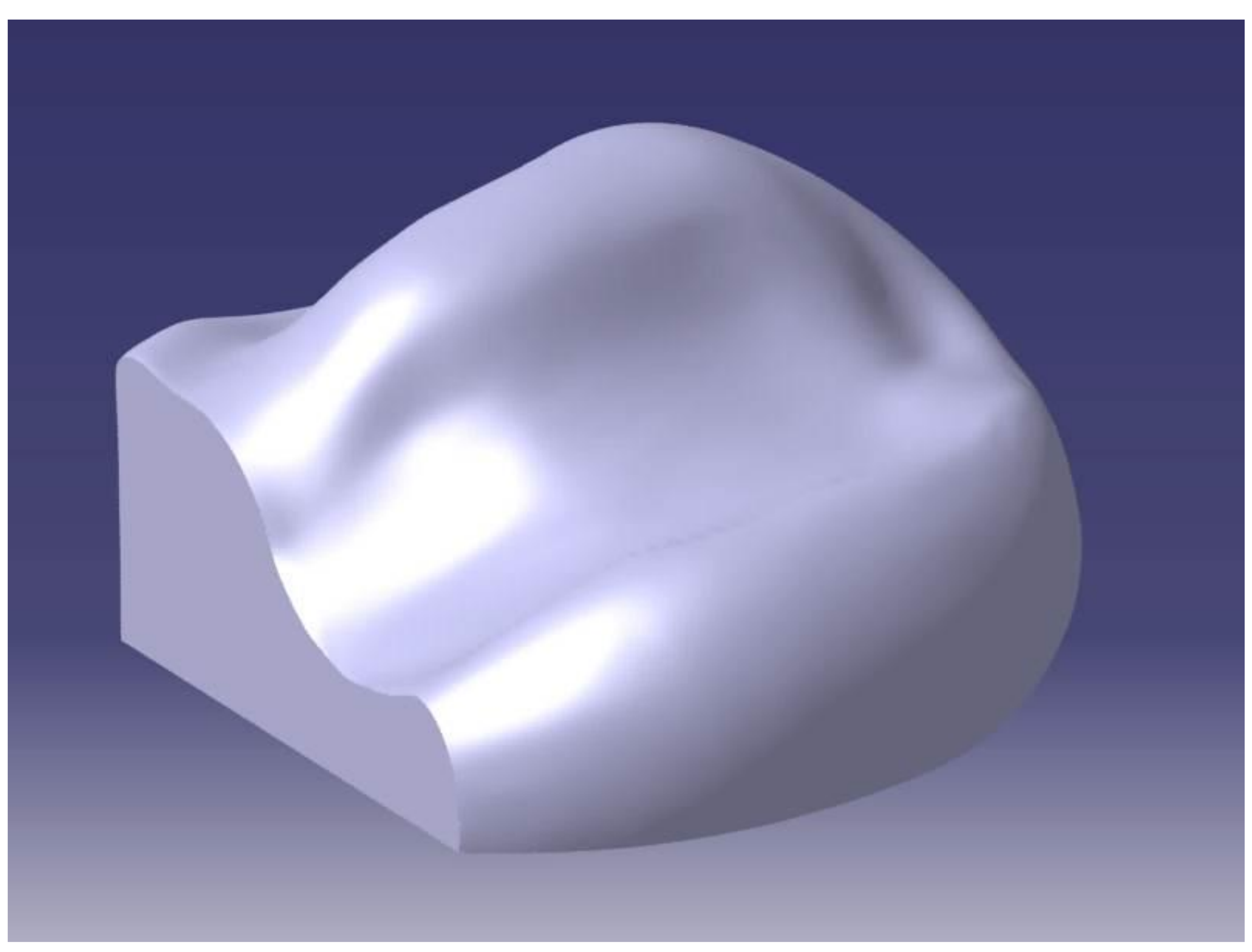

Figure 5. Three-dimensional laser scan of AE silicone impression.

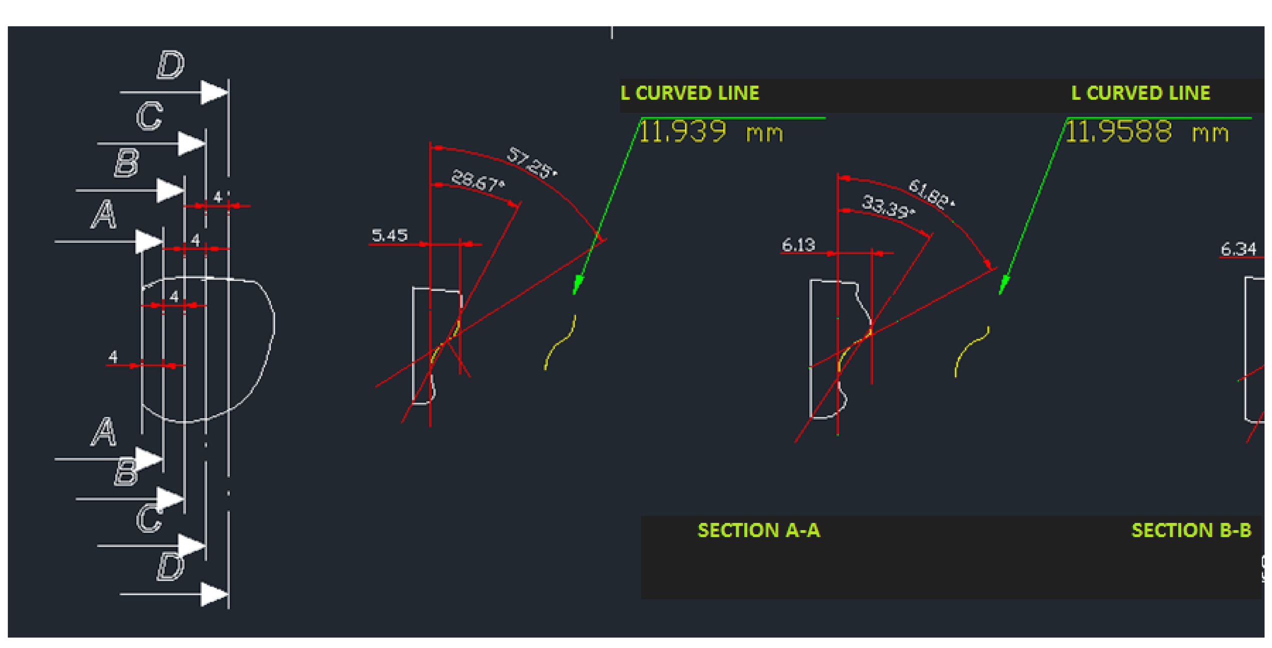

Figure 6. AE measurements on virtual sections through the three-dimensional laser scan of AE silicone impression.

RESULTS

Although small differences existed between AE measurements performed by conventional and three-dimensional laser technology, most of obtained differences (Tables 1 - 10) were not statistically significant (p values: AE inclination 0.003 to 1.0; AE height 0.012 to 1.0; curved line length of 0.115 to 1.0). Differences between AE inclination values measured by "best fit line" method and "fossa roof – eminence top" method were statistically significant (p<0.001).

Table 1. Statistical parameters of AE measurements on **first section, right** (N-number of specimens; SD-standard deviation; p-p value; I1–AE inclination, first method; I2-AE inclination, second method; H-AE height, L-AE curved line length, R-right side).

Section	Variables		N	Mean	SD	p
FIRST SECTION	I1R (degrees)	CONVENTIONAL	20	30,230	4,430	0,824
		LASER	20	30,250	4,590	
	I2R (degrees)	CONVENTIONAL	20	47,610	5,240	0,167
		LASER	20	47,890	5,490	
	HR (mm)	CONVENTIONAL	20	5,280	1,160	1,000
		LASER	20	5,270	7,540	
	LR (mm)	CONVENTIONAL	20	10,770	1,550	0,115
		LASER	20	10,830	13,470	

Table 2. Statistical parameters of AE measurements on **second section,** right (N-number of specimens; SD-standard deviation; p-p value; I1–AE inclination, first method; I2-AE inclination, second method; H-AE height, L-AE curved line length, R-right side).

Section	Variables		N	Mean	SD	p
SECOND SECTION	I1R (degrees)	CONVENTIONAL	20	33,800	3,930	0,503
		LASER	20	33,830	4,050	
	I2R (degrees)	CONVENTIONAL	20	54,350	10,420	0,012*
		LASER	20	54,520	10,270	
	HR (mm)	CONVENTIONAL	20	6,520	1,020	0,115
		LASER	20	6,570	0,960	
	LR (mm)	CONVENTIONAL	20	12,420	1,650	0,824
		LASER	20	12,520	1,660	

Table 3. Statistical parameters of AE measurements on **third section, right** (N-number of specimens; SD-standard deviation; p-p value; I1–AE inclination, first method; I2-AE inclination, second method; H-AE height, L-AE curved line length, R-right side).

Section	Variables		N	Mean	SD	p
THIRD SECTION	I1R (degrees)	CONVENTIONAL	20	35,410	4,440	1,000
		LASER	20	35,100	4,190	
	I2R (degrees)	CONVENTIONAL	20	57,270	10,330	0,115
		LASER	20	57,250	10,470	
	HR (mm)	CONVENTIONAL	20	7,300	1,050	0,263
		LASER	20	7,230	1,030	
	LR (mm)	CONVENTIONAL	20	13,340	1,170	0,503
		LASER	20	13,360	1,140	

Table 4. Statistical parameters of AE measurements on **fourth section, right** (N-number of specimens; SD-standard deviation; p-p value; I1–AE inclination, first method; I2-AE inclination, second method; H-AE height, L-AE curved line length, R-right side).

Section	Variables		N	Mean	SD	p
FOURTH SECTION	I1R (degrees)	CONVENTIONAL	20	34,400	4,760	0,824
		LASER	20	34,440	4,610	
	I2R (degrees)	CONVENTIONAL	20	57,940	8,710	0,263
		LASER	20	57,580	9,520	
	HR (mm)	CONVENTIONAL	20	7,080	1,000	0,167
		LASER	20	7,020	0,950	
	LR (mm)	CONVENTIONAL	20	13,180	1,440	1,000
		LASER	20	13,170	1,390	

Table 5. Statistical parameters of AE measurements on **fifth section, right** (N-number of specimens; SD-standard deviation; p-p value; I1–AE inclination, first method; I2-AE inclination, second method; H-AE height, L-AE curved line length, R-right side).

Section	Variables		N	Mean	SD	p
FIFTH SECTION	I1R (degrees)	CONVENTIONAL	20	33,470	5,540	0,824
		LASER	20	33,440	5,580	
	I2R (degrees)	CONVENTIONAL	20	53,450	9,590	0,041*
		LASER	20	53,680	9,590	
	HR (mm)	CONVENTIONAL	20	6,030	1,180	0,041*
		LASER	20	6,190	1,240	
	LR (mm)	CONVENTIONAL	20	11,970	1,640	0,503
		LASER	20	11,860	1,590	

Table 6. Statistical parameters of AE measurements on **first section, left** (N-number of specimens; SD-standard deviation; p-p value; I1–AE inclination, first method; I2-AE inclination, second method; H-AE height, L-AE curved line length, L-left side).

Section	Variables		N	Mean	SD	p
FIRST SECTION	I1L (degrees)	CONVENTIONAL	20	33,020	4,320	0,824
		LASER	20	33,110	4,510	
	I2L (degrees)	CONVENTIONAL	20	50,040	7,780	0,041*
		LASER	20	50,240	7,900	
	HL (mm)	CONVENTIONAL	20	5,760	0,960	0,263
		LASER	20	5,750	1,170	
	LL (mm)	CONVENTIONAL	20	11,120	2,190	1,000
		LASER	20	11,130	2,290	

Table 7. Statistical parameters of AE measurements on **second section, left** (N-number of specimens; SD-standard deviation; p-p value; I1–AE inclination, first method; I2-AE inclination, second method; H-AE height, L-AE curved line length, L-left side).

Section	Variables		N	Mean	SD	p
SECOND SECTION	I1L (degrees)	CONVENTIONAL	20	33,680	5,060	0,041*
		LASER	20	33,940	5,060	
	I2L (degrees)	CONVENTIONAL	20	56,120	12,310	0,263
		LASER	20	56,270	12,330	
	HL (mm)	CONVENTIONAL	20	6,490	1,080	0,012*
		LASER	20	6,630	1,030	
	LL (mm)	CONVENTIONAL	20	12,610	1,300	1,000
		LASER	20	12,190	2,790	

Table 8. Statistical parameters of AE measurements on **third section, left** (N-number of specimens; SD-standard deviation; p-p value; I1–AE inclination, first method; I2-AE inclination, second method; H-AE height, L-AE curved line length, L-left side).

Section	Variables		N	Mean	SD	p
THIRD SECTION	I1L (degrees)	CONVENTIONAL	20	36,800	4,710	0,503
		LASER	20	36,720	4,720	
	I2L (degrees)	CONVENTIONAL	20	60,140	12,260	0,115
		LASER	20	60,580	12,230	
	HL (mm)	CONVENTIONAL	20	7,560	0,980	0,263
		LASER	20	7,600	1,030	
	LL (mm)	CONVENTIONAL	20	13,480	1,630	0,503
		LASER	20	13,530	1,590	

Table 9. Statistical parameters of AE measurements on **fourth section, left** (N-number of specimens; SD-standard deviation; p-p value; I1–AE inclination, first method; I2-AE inclination, second method; H-AE height, L-AE curved line length, L-left side).

Section	Variables		N	Mean	SD	p
FOURTH SECTION	I1L (degrees)	CONVENTIONAL	20	35,980	4,360	0,263
		LASER	20	36,110	4,190	
	I2L (degrees)	CONVENTIONAL	20	61,180	10,780	0,815
		LASER	20	60,990	10,760	
	HL (mm)	CONVENTIONAL	20	7,410	0,880	0,815
		LASER	20	7,500	0,910	
	LL (mm)	CONVENTIONAL	20	13,530	1,120	0,115
		LASER	20	13,650	1,210	

Table 10. Statistical parameters of AE measurements on **fifth section, left** (N-number of specimens; SD-standard deviation; p-p value; I1–AE inclination, first method; I2-AE inclination, second method; H-AE height, L-AE curved line length, L-left side).

Section	Variables		N	Mean	SD	p
FIFTH SECTION	I1L (degrees)	CONVENTIONAL	20	36,020	6,070	0,003*
		LASER	20	36,320	5,980	
	I2L (degrees)	CONVENTIONAL	20	58,500	12,750	0,263
		LASER	20	58,150	11,850	
	HL (mm)	CONVENTIONAL	20	6,790	9,400	1,000
		LASER	20	6,760	1,090	
	LL (mm)	CONVENTIONAL	20	12,070	1,380	0,824
		LASER	20	12,160	1,320	

CONCLUSIONS

Silicone impressions eased the procedure and retained accuracy for AE measurements. Differences for most of the performed measurements by conventional and three-dimensional method were not significant, thus indicating same reliability of the used methods. AE values by „best fit line" method were higher than by „fossa roof–eminence top" method no matter which measuring method was used. These values are more affected by the eminence height thus representing simplified but actual condylar path significant for adjustment of articulators.

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