Precision in Cephalometric Measurements: Comparison of Cone Beam CT Lateral Cephalogram and Direct Digital Lateral Cephalogram

Language: English

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Introduction

Objective: Determine whether cone beam computed tomography lateral cephalograms (CBCT-LC) are of equal precision in diagnosis and treatment planning as direct digital lateral cephalograms (DD-LC) or not.

Material and Methods

Ten skeletal Class II patients were selected randomly from the records of orthodontic department, Damascus University. Using InVivo5 Dental software, CBCT data of each patient was imported and the head position was reoriented digitally, then CBCT-reconstructed lateral cephalograms of the same patients were generated. A total of 20 simultaneously recorded lateral cephalograms (10 DD-LC and 10 CBCT-LC) were analyzed. On each cephalogram, 26 parameters (25 angular and 1 ratio) were traced and measured and repeated after 2 weeks by one examiner (O.A).
Statistical Analyses: A paired samples t-test was used to compare the mean values of differences and intraclass correlation coefficients (ICC) were calculated to determine intra-examiner and inter-group correlations.

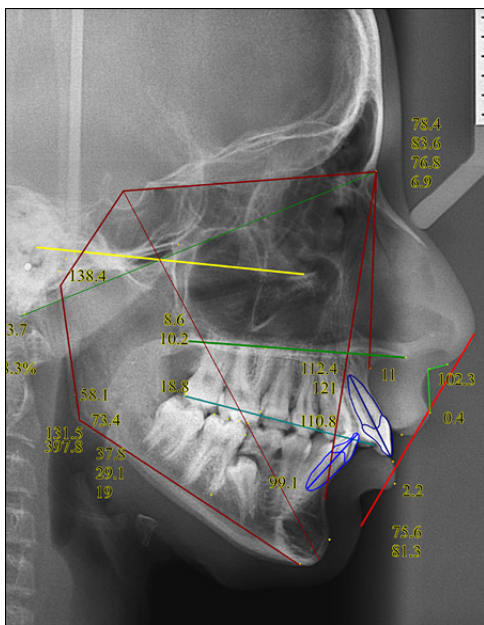Fig. 1a: PAX 400 (VATECH CO., Korea).   Fig. 1b: DD-LC.

Fig. 1c: Cephalometric analysis performed using the Viewbox 3.1.1.13 cephalometric software (Halazonetis, Athens, Greece).
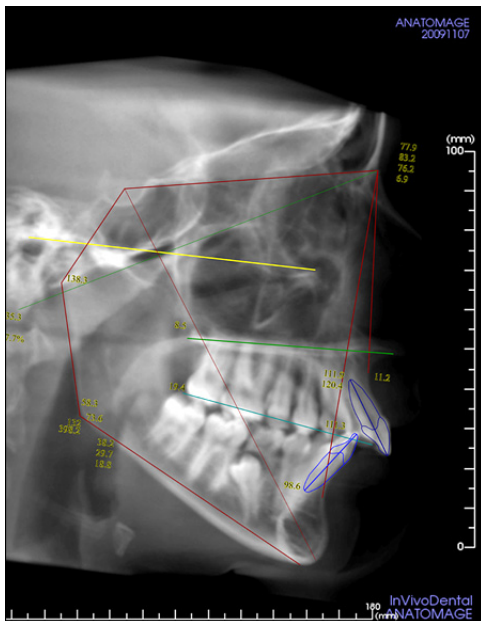
Fig. 2a: SCANORA (Soredex, Finland).

Fig. 2b-c: CBCT-reconstructed cephalogram created using InVivo5 Dental software (Anatomage, San Jose, CA, USA).
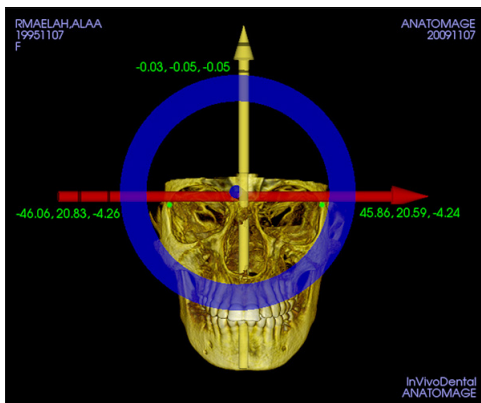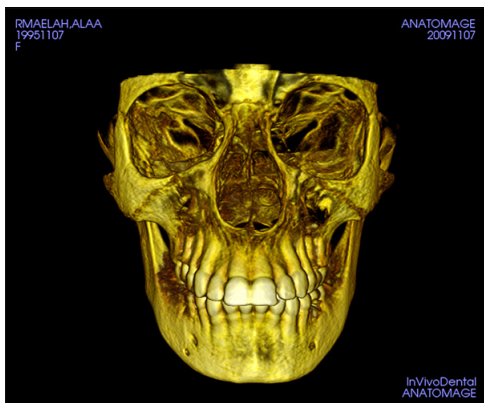
Fig. 3: CBCT 3-D Image. DICOM files were imported and 3-D images were created using InVivo 5 Dental software (Trademark of Anatomage Inc., 111 N. Market St. #800, San Jose, Calif, CA 95113).
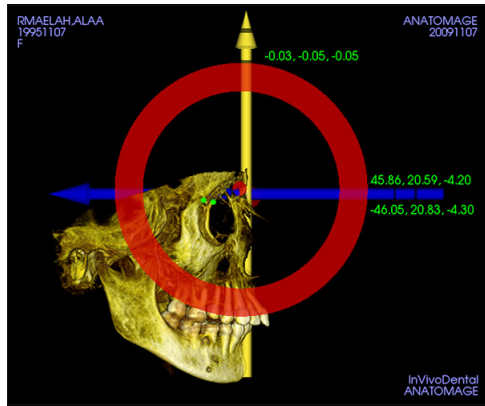
Fig. 4a: Reoriantation. 3-D images were reoriented as suggested by Cho 2009.*
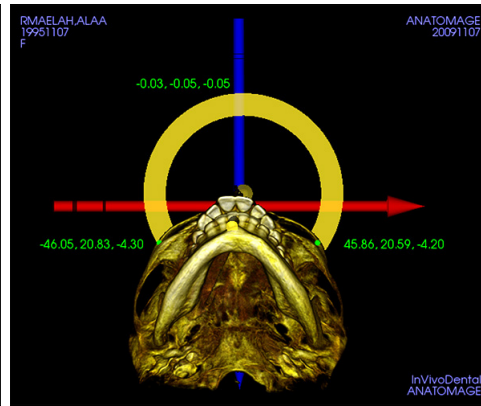

Fig. 4b-c: Reoriantation. 3-D images were reoriented as suggested by Cho 2009.*

Results

The intra-examiner reproducibility for all measurements were not significantly different between the 2 cephalogram types. ICC were found to be high (.862 - .999, P < .001). The differences of measurements obtained from CBCT-LC and their DD-LC counterparts were statistically significant for 7 angular variables (Table 1). The differences were less than two degrees, which is generally within one standard deviation of norm values in conventional cephalometric analysis. The measurements related to the area around the point A were the least precision.

Repeated Measurements Intra-Examiner Reliability DD LC				Variables	Inter-Group Comparison DD LC X CBCT LC					Repeated Measurements Intra-Examiner Reliability CBCT LC			
1st session	2nd session	ICC	Sig.		DD LC Mean	CBCT LC Mean	paired t-test P value	ICC	Sig.	1st session	2nd session	ICC	Sig.
				Angular (°)									
11,21	10,96	0,962	0,000	NSL^NL	11,21	11,11	0,742	0,971	0,000	11,11	11,11	0,995	0,000
36,78	36,8	0,998	0,000	NSL^ML	36,78	37,54	0,063	09,45	0,000	37,54	37,58	0,998	0,000
69,12	69,34	0,996	0,000	N-S-Gn	69,12	69,82	0,021	0,962	0,000	69,82	69,91	0,998	0,000
125,8	126,1	0,994	0,000	N-S-Ar	125,82	126,39	0,18	0,975	0,000	126,4	126,1	0,996	0,000
144,9	144,7	0,996	0,000	S-Ar-Go	144,86	145,12	0,68	0,973	0,000	145,1	145,5	0,994	0,000
126,1	126	0,997	0,000	Ar-Go-Me	126,1	126,03	0,875	0,987	0,000	126	125,9	0,998	0,000
396,8	396,8	0,998	0,000	Sum (Björk)	396,78	397,54	0,063	0,945	0,000	397,5	397,6	0,998	0,000
51,54	51,47	0,998	0,000	N-Go-Ar	51,54	51,07	0,193	0,981	0,000	51,07	50,94	0,998	0,000
74,54	74,51	0,996	0,000	N-Go-Me	74,54	74,98	0,143	0,955	0,000	74,98	74,98	0,994	0,000
132,9	132,9	0,998	0,000	N-S-Ba	132,93	133,72	0,08	0,939	0,000	133,7	133,5	0,993	0,000
77,54	77,54	0,995	0,000	S-N-Pg	77,54	77,21	0,141	0,971	0,000	77,21	77,16	0,999	0,000
82,83	82,9	0,978	0,000	S-N-A	82,83	83,4	0,029	0,874	0,000	83,4	83,22	0,973	0,000
76,57	76,59	0,996	0,000	S-N-B	76,57	76,28	0,264	0,953	0,000	76,28	76,26	0,998	0,000
6,27	6,32	0,981	0,000	A-N-B	6,27	7,13	0,004	0,783	0,000	7,13	7,00	0,981	0,000
11,29	11,48	0,993	0,000	N-A-Pg	11,29	13,31	0,003	0,843	0,000	13,31	13,07	0,989	0,000
78,71	78,31	0,964	0,000	A-B^NL	78,71	76,89	0,002	0,849	0,000	76,89	77,00	0,989	0,000
82,78	82,36	0,955	0,000	A-Pg^NL	82,78	81,23	0,004	0,863	0,000	81,23	81,27	0,996	0,000
25,54	25,87	0,983	0,000	NL^ML	25,54	26,41	0,039	0,962	0,000	26,41	26,48	0,999	0,000
102,7	102,6	0,999	0,000	U1L^NSL	102,73	102,57	0,871	0,942	0,000	102,6	103,1	0,992	0,000
114	113,5	0,985	0,000	U1L^NL	113,96	113,68	0,749	0,902	0,000	113,7	114,2	0,983	0,000
99,34	98,92	0,961	0,000	U1L^ML	99,34	98,53	0,194	0,809	0,002	98,53	98,04	0,916	0,000
121,1	121,7	0,992	0,000	U1L^L1L	121,13	121,37	0,858	0,901	0,000	121,4	121,3	0,985	0,000
21,59	21,56	0,991	0,000	NSL^OL	21,59	21,34	0,539	0,935	0,000	21,34	21,47	0,914	0,000
10,37	10,62	0,862	0,000	OL^NL	10,37	10,23	0,78	0,872	0,029	10,23	10,34	0,964	0,035
15,18	15,26	0,996	0,000	OL^ML	15,18	16,19	0,12	0,860	0,000	16,19	16,16	0,926	0,000
				Ratio (%)									

| | | | | S-Go:N-Me | 62,08 | 61,47 | 0,088 | 0,946 | 0,000 | 61,47 | 61,4 | | 0,998 | 0,000 |
| 62,08 | 62,08 | 0,996 | 0,000 | | | | | | | | | | | |

Tab. 1: Intra-Examiner and Inter-Group Correlations

Conclusion

Precision was similar in both image types. The measurement differences between image types were statistically significant. Current findings substantiated the benefits of CBCT cephalometry in terms of the reliability of two-dimensional cephalometric analysis.

Literature

1. * CHO HJ. A Three-Dimensional Cephalometric Analysis. J Clin Orthod 2009;43(4):235-252.

Abbreviations

CBCT-LC: Cone Beam Computed Tomography Lateral Cephalogram.
DD-LC: Direct Digital Lateral Cephalogram.
ICC: intraclass correlation coefficients.

This Poster was submitted by Dr. Osama Al-ali.

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Poster Faksimile:

Precision in Cephalometric Measurements: Comparison of Cone Beam CT Lateral Cephalogram and Direct Digital Lateral Cephalogram

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[2]Department of Orthodontics, Faculty of Dentistry, Izmir Katip Celebi University, Turkey
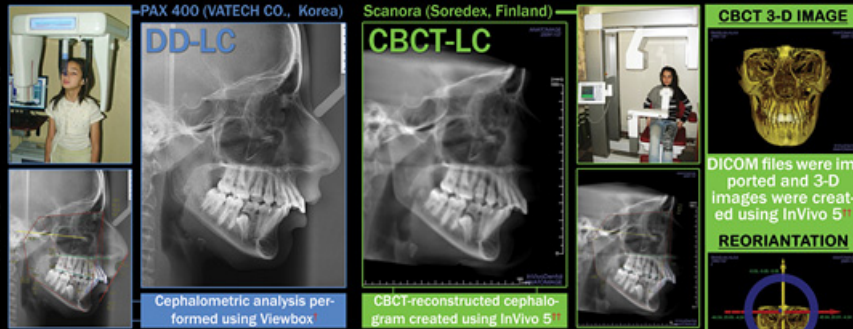
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CONCLUSION:
Precision was similar in both image types. The measurement differences between image types were statistically significant. Current findings substantiated the benefits of CBCT cephalometry in terms of the reliability of two-dimensional cephalometric analysis.

PAX 400 (VATECH CO., Korea) — DD-LC

Scanora (Soredex, Finland) — CBCT-LC

Cephalometric analysis performed using Viewbox[?]

CBCT-reconstructed cephalogram created using InVivo 5[??]

CBCT 3-D IMAGE

DICOM files were imported and 3-D images were created using InVivo 5[??]

REORIANTATION

3-D images were reoriented as suggested by Cho 2009[???]

STATISTICAL ANALYSES:

A paired samples t-test was used to compare mean values of differences and intraclass correlation coefficients (ICC) were calculated to determine intra-examiner and inter-group correlations.

RESULTS:

The intra-examiner reproducibility for all measurements were not significantly different between the 2 types. ICC were found to be high (.862 - .999, P< .001). The differences of measurements obtained from CBCT-LC and their DD-LC counterparts were statistically significant for 7 angular variables (Table 1). The differences were less than 2°, which is generally within ± 1 SD of norm values in conventional cephalometric analysis. The measurements related to the area around the point A were the least precision.
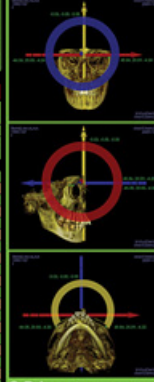
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	Repeated Measurements Intra-Examiner Reliability DD LC			Variables	Inter-Group Comparison DD LC x CBCT LC				Repeated Measurements Intra-Examiner Reliability CBCT LC		
	1st Session	2nd Session	ICC		DD LC Mean	CBCT LC Mean	paired t-test P value	ICC	1st Session	2nd Session	ICC
				Angular (°)							
	11.21	10.96	0.962	NSL^NL	11.21	11.11	0.742	0.971	11.11	11.11	0.995
	36.78	36.80	0.998	NSL^ML	36.78	37.54	0.063	0.945	37.54	37.58	0.998
	69.12	69.34	0.996	N-S-Gn	69.12	69.82	0.021	0.962	69.82	69.91	0.998
	125.82	126.09	0.994	N-S-Ar	125.82	126.39	0.180	0.975	126.39	126.13	0.996
	144.86	144.73	0.996	S-Ar-Go	144.86	145.12	0.680	0.973	145.12	145.52	0.994
	126.10	125.97	0.997	Ar-Go-Me	126.10	126.03	0.875	0.987	126.03	125.92	0.998
	396.78	396.80	0.998	Sum (Bjork)	396.78	397.54	0.063	0.945	397.54	397.58	0.998
	51.54	51.47	0.998	N-Go-Ar	51.54	51.07	0.193	0.981	51.07	50.94	0.998
	74.54	74.51	0.996	N-Go-Me	74.54	74.98	0.143	0.955	74.98	74.98	0.994
	132.93	132.87	0.998	N-S-Ba	132.93	133.72	0.080	0.939	133.72	133.54	0.993
	77.54	77.54	0.995	S-N-Pg	77.54	77.21	0.144	0.971	77.21	77.16	0.990
	62.83	62.90	0.978	S-N-A	62.83	63.40	0.029	0.874	63.40	63.22	0.973
	76.57	76.59	0.996	S-N-B	76.57	76.28	0.264	0.953	76.28	76.26	0.999
	6.27	6.32	0.981	A-N-B	6.27	7.13	0.004	0.783	7.13	7.00	0.981
	11.29	11.48	0.993	N-A-Pg	11.29	13.31	0.003	0.843	13.31	13.07	0.989
	78.71	78.31	0.964	A-B^NL	78.71	76.89	0.002	0.849	76.89	77.00	0.989
	62.78	62.36	0.955	A-Pg^NL	62.78	61.23	0.004	0.861	61.23	61.27	0.996
	25.54	25.87	0.983	NL^ML	25.54	26.41	0.039	0.962	26.41	26.48	0.999
	102.73	102.60	0.999	U1L^NSL	102.73	102.57	0.871	0.942	102.57	103.08	0.992
	113.96	113.53	0.985	U1L^NL	113.96	113.68	0.749	0.902	113.68	114.19	0.983
	99.34	98.92	0.961	L1L^ML	99.34	98.53	0.194	0.809	98.53	98.04	0.916
	121.13	121.66	0.992	U1L^L1L	121.13	121.37	0.858	0.901	121.37	121.27	0.985
	21.59	21.56	0.991	NSL^OL	21.59	21.34	0.539	0.935	21.34	21.47	0.914
	10.37	10.62	0.862	OL^NL	10.37	10.23	0.780	0.872	10.23	10.34	0.864
	15.18	15.26	0.996	OL^ML	15.18	16.19	0.120	0.860	16.19	16.16	0.926
				Ratio (%)							
	62.08	62.08	0.996	S-Go:N-Me	62.08	61.47	0.088	0.946	61.47	61.40	0.998

[?]Viewbox[?] 3.1.1.13 cephalometric software: Halazonetis, Athens, Greece.
[??]InVivo 5 Dental software: Trademark of Anatomage Inc., 111 N. Market St. #800, San Jose, Calif, CA 95113.
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