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ORIGINAL ARTICLE

Determining the Correlation amount of Ordinary and Digital Cephalometric lateral Radiography in angular Measurements by using Dolphin Imaging 10 software

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ABSTRACT
Cephalometric lateral radiography is an important paraclinical tool in diagnosing and treatment design of skeletal-dental malocclusions. Objective of this study is to determine accuracy amount of measurements of cephalometry in two types of digital and ordinary graphy to specify the more beneficial method having more accuracy.
In this descriptive-analytical study samples include digital and ordinary lateral cephalometric radiographic images of 8 human dried skulls. In this study for every skull one digital and one ordinary image was obtained. 16 cephalometric landmarks and 12 angular measurements in both digital and ordinary images by Dolphin Imaging 10 software by three observers (2 persons general dentist and 1 person orthodontic specialist) were measured and analyzed. For testing repeatability all measurements were again measured one month later by three observers and by using Pearson correlation coefficient were calculated. For comparing two methods paired sample T-test was used.
Results obtained showed, among three observers statistical difference about measuring angles in ordinary and digital lateral cephalometry radiography (p>0.05). Repeatability correlation coefficient (Intra observer) of results after one month in all cases except SNA and saddle angles was above 0.83. Measurements obtained in two methods digital and ordinary compared with one-another showed that there was no significant difference observed (p>0.05). Also correlation coefficient among different measurements except for angles S (0.47), SNA (0.57) Pa-P1-In (0.76), SN-FH (0.73) in rest of cases correlation coefficient was above 0.87.
Generally Both methods provided us with similar clinical results so for that digital cephalometry could be a reliable choice as a common diagnostic tool due to advantages like decreasing radiations receiving patients eliminating printing stages fixity chemical materials, stock, processing and quality gradation of digital images by computer as compared to ordinary images.
Key words: Digital cephalometry, lateral cephalometry, Dolphin Imaging 10 soft ware

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INTRODUCTION

Lateral cephalometric radiography is an important paraclinic .tool in diagnosing and treatment design skeletal-dental malformation. This radiography draws most of the anatomical structure of skull face and mouth from lateral view [1]. Before replacing ordinary cephalometry by digital cephalometry, diagnostic accuracy of digital system should be analyzed especially in quantitative analyses in orthodency (determine landmark location, and angular measurements) compared to ordinary radiography 960.Recent progress in extra oral technology that took place also by computer application extension in orthodontic clinic, cophalometric performance by direct digital method is an obvious choice for many physicians [11]. Now a day conventional radiographies are based on films increasingly are now being replaced by direct digital Imaging. All aspects of orthodency from cephalometric digital radiography apparatus and panoramic to imaging soft wares and management system are affected by this progress [12]. Hagemann et al analyzing mean repeatability digital cephalometric land marks concluded that cephalometric land marks are sizably more and also radiations were reduced to 23.7% [19]. Ralf et al compared ordinary and digital radiographies in cephalometric land marks location accuracy. They measured 6 land marks in two times in 3 digital radiography and 3 ordinary radiography that were prepared from 3 simple skulls and after adjustment of radiographies from zooming point of view and intra observer error measurement concluded that in two location points N-PNS-S-A in two methods, there was a significant difference. Although the difference observed in that points was less than 1mm and indeed systematic difference between two methods was not observed [6]. Ye-Jane et al calculated 27 cephalometric measurements including 13 lines and 24 angles by a computer program from land marks. 7 land marks from 27 land marks in observers were having significant statistical difference. They concluded that digital cephalogram measurement was having statistical difference and digital radiography was more reliable in cephalometric analysis [21]. But Tamara et al in their study didn't find any significant difference in ability of different systems of ordinary and digital radiography and kind of cephalometric analysis (manual, Dolphin, Vistadent). Also among usage of manual tracing and Dolphin scanned soft ware's no significant difference was found where as rest of the methods (Dolphin digital-Vistadent scanned-Vistadent digital) significant statistical difference in comparison with manual tracing was found (23). Merck et al calculated 10 angles dispersion and 5 lines ordinary and digital radiographic cephalometry by using manual method and 3 soft ware (Dolphin imaging v.6.7-Vistadent v.7.33-Vistadent v.8.01) but significant difference was found between manual tracing and rest of the models of radiography and analysis where as Sayinsu et al and Hedayati et al didn't observe any difference between cephalometry soft ware usage and manual calculations [27, 28].

MATERIALS AND METHODS

For performing this study 8 dried human skulls were analyzed for being in good condition of bilateral and also having all anatomic points needed. Mandible and maxilla of each skull is fixed by elastomers frame materials between two jaws. And also for fixing dried skull locations in preparation of two kind of radiography and similar deployment in two ordinary and digital apparatus, metallic rods were used that were fixed by poty in foramen magnum. After that fixed skulls on a wooden base were deployed in cephalometric device. And ear rods and nasal support were fixed. Ordinary radiographies of each 8 skulls were prepared by using Planmeca 2002 device and AGFA film (15-30 cm) and most desirable radiation (0.32s, 9 mA, 60 kvp). Then regarding same conditions, extra- oral digital radiographies were prepared by using Fuji film (20-25 cm) and Granex D device, CCD sensors were fixed and digital images were fixed by JPEG 100 format and saved. In digital system radiation and exposure conditions were arranged automatically. Ordinary graphies were scanned by LIDE scanners with characteristic Resolution 900 dote per inch (dpi).

Angular and linear measurements and land marks were selected on basis of two characters.

1. Availability of slightly land marks in dried skulls
2. Location of points should be at different distances from radiation centre.

Selected points included followings

N (anterior most point on nose- forehead)

Ar (junction place of posterior ramus limit and skull base external part)

Ba (anterior limit of foramen magnum)

Por (superior most point on external ear duct)

Or (inferior most point on bone edge of eye cavity)

Pog (anterior most point of chin bone)

Me (inferior most point of chin)

Gn (anterior most and inferior most of chin symphysis)

Go (middle point of mandible angle)

A (posterior most part of maxilla anterior shadow)

B (on posterior most point on anterior mandible border shadow)

Ans (anterior nasal iscium)

Pns (posterior nasal iscium)

S (central point of sella trusica)

Co (superior most point on condyll)

Digital and ordinary graphies were transferred to Dolphin Imaging 10 soft ware for tracing. All radiographies were drawn by three observers (one person orthodontic specialist and two people's general dentists) and 17 skeletal anatomic land marks were specified in each radiography.

Points were specified on a monitor Pixel 1280-1024. Skeletal analysis were done automatically by Dolphin soft ware after specifying defined land marks on radiography.3

Cephalometric measurements include Saddle (SN-Ar) angle, SNA angle, SNB angle, ANB angle, Articular angle, FH-SN angle, Gonial angle (Ar-Go-Me) sum of posterior angles, P-A-MP-SN angle, Y-axis (S-N-GN)angle, face height (S-Go/N-Me), palatal plane inclination were specified on each radiography by software.

Statistical analysis:

Data were processed by the help of statistical soft ware SPSS 19 and analyzed under t-test and ANOVA. Pearson correlation coefficient and standard deviation and mean for each index was calculated and compared. Operator errors (Inter observer), repeatability and systematic errors were investigated between two radiographies. Significant surface P<0.05 was aimed. Pearson correlation coefficient was used for external agreement analysis.

RESULTS

Results difference obtained among three observers (Inter observer) were analyzed and calculated. According to table 1 in all cases P>0.05 was obtained and no statistical diffrenece was seen. Results repeatability was analyzed after one month (Intra observer). In all cases correlation coefficient except for Saddle angle, SNA was above 0.83. Results are shown in table 2 and 3. After certainty of ability of repeatability aspect and also without relations of observers, measurements obtained in two digital and ordinary methods were compared with each other and in none of them no significant difference was observed (P>0.05). Also correlation coefficient among different measurements in two methods was calculated. Except for angles S(0.47), SNA (0.57), Pa-P1-In (0.76), SN-FH (0.73) in rest of the cases correlation coefficient was above 0.87. Results are showed in table 4.

DISCUSSION

Various studies are done on previous years that reported that CCD system as compared to ordinary system and PSP needs fewer amounts of radiations. Farman et al reported decreased amount of radiations to 70%. Dawood in specific case 98% and Visser et al reported 50%. Sturt et al reported by decreasing radiations amount and performing contrast variations, shinning adjustment and decreasing noise quality of image increases from diagnostic point of view. According to the results obtained in current study there was no significant difference in cephalometry analysis between two kinds of radiography.

Comparison between two methods manual and digital by paired t-test method in none of angles except for SNA reasonable statistical difference was observed where as in studies of Zohre, Jeong, Schulze, Chen and Hedayati reported significant difference in some angles (Saddle, A, N, Or, PNS, Me,Gn) but as regards differences were less than 2 degree, Yi-Jane Chen et al while measuring ordinary and digital cephalogram among 27 land marks observed less than 2 degrees difference in 21 land marks and announced that this difference is obvious from statistical point of view but not significant from clinical point of view. Schulze et al in study on radiographies prepared from skull reported that on two location points A, Saddle, PNS, N, in two methods difference is less than one degree and was significant. Indeed systematic difference was not observed. Method of mentioned study was similar to this study, only in two cases they used skulls without mandible that was different and in their study land mark peculiarities were specified. Lim and Foong results were similar to our results and in land mark locations there was no significant difference observed between two methods of imaging.

Tamara et al, Sayinsu et al, Erkan et al observed that difference in location of land marks used, possibly in composition neutralize each other or may increase discrepancy difference, because generally, difference observed in angles is more than land marks. It seems that another reason of lack of difference in angles obtained in two types of radiography, unlikely high clearance of land marks in digital radiography was that analyses of digital radiography and also of ordinary in current study was done by Dolphin imaging 10 soft ware and soft ware increases this possibility of changing resolution and contrast of ordinary images and increases the quality of image and also in location of land marks for specifying them more accurate can be zoomed. Another reason is lack of difference between two methods is personal ability of distinguishable and clearance of land marks.

In this study correlation coefficient in 4 cases (FH-SN, SNA, Pa-P1-Pn and SNAr) was less than others. Less clearance of points that was due to superimposition of bones on them included Ar on SNAr and porion point in FH-SN causes decreased accuracy and as result decreased correlation in these two angles in two kind of radiography as compared to the rest of angles of study cases. Also difficult specification of points with less bone density like ANS causes decreased accuracy in Pa-P1-Pn measurement and after that decreased correlation measure was obtained in two methods of imaging. Unlikely in Hedayati et al study statistical difference was not observed. But in current also decreased correlation coefficient was observed in this angle (0.57). Jablonsk; Kublashvili et al; Gregston related cause of this difficult circumstance of determining accurate point A location. This point with an unspecified design in relation with anatomic structures is related and is often observed in obliterated form on the film. Jeong-Won Shin et al showed that ability of repeatability of alnd mark locations was high and differences observed were all less than 1mm.

Hagemann et al in a study over 100 ordinary and 100 digital radiographies concluded that ability of repeating land marks in digital lateral cephalometry is more than ordinary. Although images were not related to a patient and radiating conditions and digital and ordinary image preparations were also different. Also unlike our study soft ware was used for tracing.
In this study statistical difference among results obtained was not observed. This result was not analyzed in rest of similar studies. But Kublashvili et al, Sayinsu et al titled that land mark specification is under effect of experience.
One of the reasons that all observers instead of having experience difference approached similar results was that in this study skull used were lacking soft tissue that this matter causes easy determine land marks, because in determination of land marks like point A, Porion, soft tissue super imposition conditions increased error amount.

Table 1: Mean and standard deviation of various angles obtained by each observer

Angles	Observer 1		Observer 2		Observer 3		Total mean	
	Mean	St. D.	Mean	St. D.	Mean	St. D.	Mean	St. D.
Saddle	127.27	9.19	129.78	6.01	130.79	5.89	129.28	7.27
Ar	129.05	10.93	127.77	11.24	128.12	9.63	128.31	10.53
Go	124.78	6.81	124.19	8.02	123.48	6.30	124.15	7.03
Jarabak	382.50	4.63	381.89	4.22	382.48	4.38	382.29	4.38
s-GP/N-Me	73.05	5.53	73.68	4.87	73.14	5.62	73.29	5.30
Pa PI Inc	5.23	3.93	5.36	3.89	4.43	3.30	5.00	3.70
Mp-SN	22.51	4.64	21.87	4.23	22.49	4.39	22.29	4.38
Y-AXI	58.25	2.51	58.19	2.15	59.07	2.34	58.50	2.35
SNA	82.62	4.34	82.47	5.00	78.52	13.42	81.20	8.76
SNB	86.93	3.55	86.65	3.49	85.14	3.38	86.24	3.53
ANB	-4.27	4.92	-4.24	4.77	-4.64	4.76	-4.39	4.77
FH-SN	9.03	3.04	8.77	3.00	8.55	2.75	8.78	2.91

Table 2: Mean and standard deviation of angles in ordinary imaging and comparing the results of first and second imaging stage.

Angles	ordinary				P. value	Correlation coefficient
	First		Second			
	Mean	St. D.	Mean	St. D.		
Saddle	129.98	5.33	130.95	5.87	0.19	0.491
Ar	128.05	9.01	126.88	9.51	0.17	0.955
Go	124.51	6.74	125.08	7.14	0.11	0.955
Jarabak	382.63	4.93	382.74	4.51	0.82	0.952
s-GP/N-Me	72.82	6.10	72.97	5.46	0.90	0.965
Pa PI Inc	5.20	3.53	5.34	3.59	0.28	0.864
Mp-SN	22.66	4.96	22.74	4.51	0.82	0.952
Y-AXI	58.84	2.55	58.82	2.34	0.91	0.955
SNA	81.10	4.48	77.97	15.29	0.24	0.607
SNB	86.11	3.57	85.80	3.53	0.21	0.951
ANB	-5.02	4.88	-5.17	4.44	0.49	0.975
FH-SN	8.57	2.98	9.05	2.84	0.18	0.833

Table 3: Mean and standard deviation of angles in digital imaging and comparing the results of first and second imaging stage.

Angles	Digital				P. value	Correlation coefficient
	First		Second			
	Mean	St. D.	Mean	St. D.		
Saddle	127.17	10.15	129.03	6.67	0.10	0.52
Ar	129.21	11.66	129.11	12.09	0.15	0.92
Go	123.30	7.33	123.72	7.20	0.41	0.96
Jarabak	381.90	4.19	381.88	4.02	0.23	0.91
s-GP/N-Me	73.72	5.11	73.63	4.73	0.31	0.89
Pa PI Inc	4.50	4.06	4.97	3.78	0.09	0.86
Mp-SN	21.87	4.19	21.88	4.02	0.52	0.93
Y-AXI	58.18	2.31	58.17	2.24	0.17	0.95
SNA	82.92	4.74	82.82	4.87	0.19	0.71
SNB	86.57	3.65	86.48	3.53	0.25	0.86
ANB	-3.64	4.89	-3.71	4.92	0.46	0.85
FH-SN	8.67	2.98	8.84	2.99	0.14	0.83

Table4: Mean comparing of digital and ordinary radiography.

Angles	Radiography				P. value	Correlation coefficient
	Digital		ordinary			
	Mean	St. D.	Mean	St. D.		
Saddle	128.10	8.55	130.46	5.57	0.11	0.477
Ar	129.16	11.75	127.46	9.18	0.43	0.913
Go	123.51	7.19	124.79	6.87	0.37	0.870
Jarabak	381.89	4.06	382.69	4.68	0.37	0.911
s-GP/N-Me	73.68	4.87	72.90	5.72	0.47	0.915
Pa PI Inc	4.74	3.89	5.27	3.52	0.48	0.767
Mp-SN	21.88	4.07	22.70	4.69	0.36	0.912
Y-AXI	58.17	2.25	58.83	2.42	0.17	0.896
SNA	82.87	4.75	79.53	11.26	0.06	0.577
SNB	86.53	3.55	85.96	3.52	0.43	0.934
ANB	-3.67	4.86	-5.10	4.62	0.14	0.929
FH-SN	8.75	2.96	8.81	2.89	0.99	0.732

CONCLUSION

Data analyzing and results obtained explained that digital and ordinary radiography presents similar results while the two kind of digital and ordinary radiography are compared with each other, difference in mean measurements is rarely above one unit (degree or percent).

So for that digital method is similar to ordinary method and with good diagnostic accuracy that are similar to digital method could be a reliable and trustable use up, but advantages like decreased radiation amount, eliminating printing stages, fixity and chemical materials, processing, stock and easy image recovery by using computer and easy calculation measurements with the help of soft ware as compared to ordinary method.

From other important results that are proved in this study is that beginners (general physicians) like specialist people are able to use soft ware and cephalometric analysis and can enjoy from its advantages.

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