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A COMPARISON OF HAND TRACED CONVENTIONAL LATERAL CEPHALOGRAM WITH DIGITAL LATERAL CEPHALOGRAM USING DIFFERENT CALIBRATION TECHNIQUES OF DOLPHIN IMAGING (Version 11.5)

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ABSTRACT: Objective: The purpose of the study was to evaluate and compare hand tracings on conventional lateral cephalograms with different calibration techniques available in dolphin imaging on digital lateral cephalogram.
Materials and Methods:50 Conventional lateral cephalogram and 50 digital lateral cephalogram were taken in (NHP) at same period of timeon the same patient. Two angular measurements Facial Axis Angle and ANB angle two linear measurements Sella to Nasion and Sella to articulare have been taken. The digital images were traced by calibration 3 techniques Ruler, DPI and Land mark available in Dolphin Imaging Software Version 11.5.The conventional were traced on lead acetate paper and data has been collected.**Results:** In measurement of Facial Axis Angle conventional when compared with different calibration techniques Ruler Land Mark technique show <0.001significantvalue. In measurement of ANB angle shows no significant values. In measurement of S-N length Ruler compared with DPI has shown significant p value <0.001. DPI compared with conventional shows 0.001. S-AR length has shown significant value p value 0.006, DPI compared with Landmark shows 0.007,Landmark compared with conventional shows 0.003. **Conclusion**: According to our study conventional when compared with calibration techniques ruler has show only one significant value DPI and land mark has shown two significant values so our study conclude that using ruler is the better option for calibration of digital radiograph. As ruler is more accurate to conventional we compare DPI and Landmark techniques to ruler, landmark shows less variation with ruler so according to our study the second option for calibration of digital radiograph is landmark and last option comes DPI.

KEYWORDS: Cephalogram, Dolphin Imaging, DPI, Landmark, Ruler

INTRODUCTION

It is said that cephalometrics is the language in which poetry of orthodontic diagnosis and treatment planning is written. Broadbent in USA and Hofrath in Germany introduced a standardized cephalometric technique using a high powered X – ray machine and a head holder called a cephalostat or cephalometer in the year 1931[1, 2.] The radiographic image thus obtained is the cephalogram, which is analyzed so as to come to an understanding about the facial skeleton. Growth of teeth and dental age play quite an important role in orthodontics.[3]

Imaging is one of the most important tools for orthodontists to evaluate and record size and form of craniofacial structures. [4] The application of cephalometrics includes diagnosis, treatment planning, and evaluation of treatment results and prediction of growth. Cephalometrics is also useful in deciding the choice of mechanics, to evaluate pre and post treatment changes, efficacy of treatment mechanics and also to study relapse.[2,6, 7]

Computers have changed the way we lead our daily lives. Ricketts pioneered use of computers in orthodontics in 1971. Cumbersome and tedious manual work, which is repeated in short intervals, can be easily handled by computerization. Cephalometric tracing is one such job an orthodontist would always look out for automation.[[5]With the advent of the computer age and today's ever-changing technological environment, new methods for obtaining radiographic images have emerged. The rapid evolution of digital radiographic systems and digital tracing software is having an impact on cephalometrics, slowly replacing traditional hand-tracing methods on hard copies of radiographic films.

A substantial number of digital tracing software's are available in the domestic and international market offering a wide array of features and they have been widely used in orthodontics, especially for storing documentation and facilitating cephalometric tracings.one among those programs is Dolphin imaging software.

Since the cephalometric analysis method is frequently used by orthodontists and researchers and due to continuous advances in Cephalometric software, the need was felt to assess and compare the accuracy of cephalograms by manual methods and digital imaging using Dolphin (vesion11.5) software.

Thus the aim of this study is to check the accuracy of different calibration techniques available in dolphin imaging software (version 11.5) on digital lateral cephalogram comparing with manual tracings on conventional lateral cephalogram

Materials and Methods

Fifty conventional lateral cephalogram and 50 digital lateral cephalogram were taken in (NHP) at same period of time, by asking the patient to keep their head erect and look into his eyes in a mirror, which was kept 109 cm away. The cephalograms were of good contrast, no distortion, minimal radiographic artifacts and magnification errors. The 50 digital radiographic images are saved in 300 dpi, jpg format and traced with calibration techniques (Ruler, DPI, Landmark) of Dolphin Imaging Software version 11.5 [Figure: 1a,b &c] and 50 Conventional radiographs manually by using radiograph view box on lead acetate with a sharp 3H pencil, keeping the cephalograms on a well illuminated light box. The two linear S-N and S-Ar and two angular Facial Axis and ANB measurements were traced on both conventional and digital lateral cephalogram The total data obtained from all the groups (Ruler DPI Land Mark & Conventional) were recorded in master charts were statistically analyzed, comparison of measuring techniques for all four measurements using Friedman test and Wilcoxon signed-rank test is used when comparing two related samples.

Results

Table 1 shows the comparison among the four groups they are angular measurements are Facial Axis and ANB and two linear measurements are S-N and S-AR. Freidman test is used for comparison among the groups according Friedman test NS: $p > 0.05$; Not Significant; $p < 0.05$; Significant.

Facial axis angle show statistically highly significant vale (p=0.003*) when compared with other groups. ANB angle shows (p=0.644NS) insignificant value when compared with other groups. The linear measurement S-N value show significant (p=0.008*) when compared with other groups. The linear measurement S-AR value shows (p=0.010*) show significant when compared with other groups.

Table 2 shows the comparison among each digitation technique ie. Ruler, DPI Land Mark and conventional for all groups using Wilcoxon-Sign Rank Test; according to it *$p < 0.05$; Significant; **$p<0.001$; Highly significant p.

In measurement of Facial Axis Angle conventional when compared with different calibration techniques Ruler, DPI and Land Mark technique show p value <0.001 indicates significant changes in measurement. Landmark technique compared when compared shows $p < 0.05$ indicates insignificant In measurement of ANB angle conventional when compared with Ruler, DPI and Land Mark techniques show p value >0.001 indicates insignificant changes in measurement between the techniques.

In measurement of Sella to Nasion (S-N) length DPI to has shown significant value p value <0.001 compared with Ruler and Conventional and other techniques shows $p <0.05$ insignificant changes in measurement.
In the measurement of Sella to Articulare (S-AR) length DPI, Land Mark, Ruler and between Landmark and Conventional shows significant change p value <0.001 and other techniques insignificant change $p < 0.05$ in measurement.

Table:1 infers the variation among cephalometric anatomical landmark value analyzed with all the calibration techniques. For statistical analysis Friedman Test has been used according to this analysis pvalue > 0.05; Not Significant, and $p < 0.05$ Significant. Facial axis angle show statistically highly significant vale (p=0.003*) when compared with other groups. ANB angle shows ($p=0.644^{NS}$) insignificant value when compared with other groups. The linear measurement SellatoNasion (S-N) value show significant (p=0.008*) when compared with other groups. The linear measurement Sellato Articular S-AR value shows (p=0.010*) show significant when compared with other groups.

Table: 2 infers the variation among the calibration groups and stastical analysis was done using Wilcoxon-Sign Rank Test according to test $p < 0.05$ Significant and $p<0.001$ highly significant. In measurement of facial axis angle by various calibration techniques conventional technique show highly significant variation $p<0.001$ with ruler and land mark, and significant with dpi p0.001. There are insignificant changes between ruler and dpi p 0.141, and 0.163 for ruler and landmark and 0.086 for dpi and landmark.

Discussion

Cephalometric radiographs play an important role in diagnosis, treatment planning and for evaluating treatment progress. Hand traced cephalometric tracings on traditional radiographic film has been for many years the “gold standard” for analyzing cephalometric radiograph and for collecting cephalometric data, which of course is time consuming and laborious.[6] A substantial number of digital tracing software’s are available in the domestic and international market offering a wide array of features and they have been widely used in orthodontics,

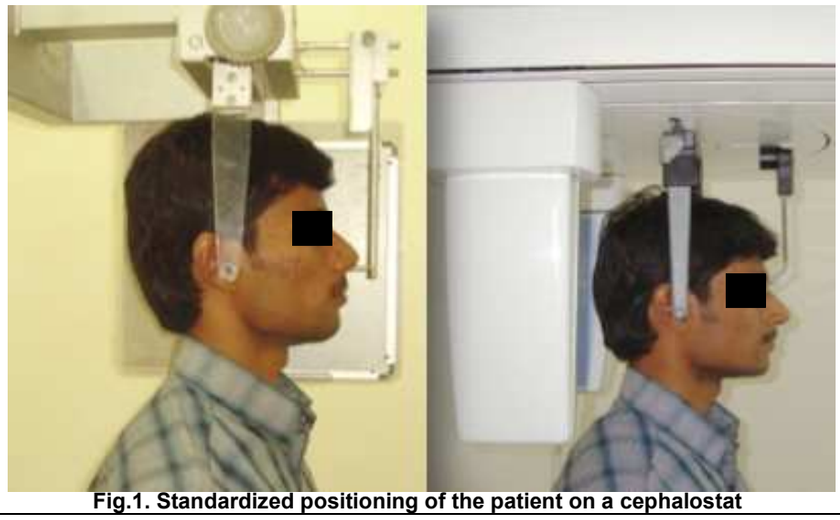

Fig.1. Standardized positioning of the patient on a cephalostat

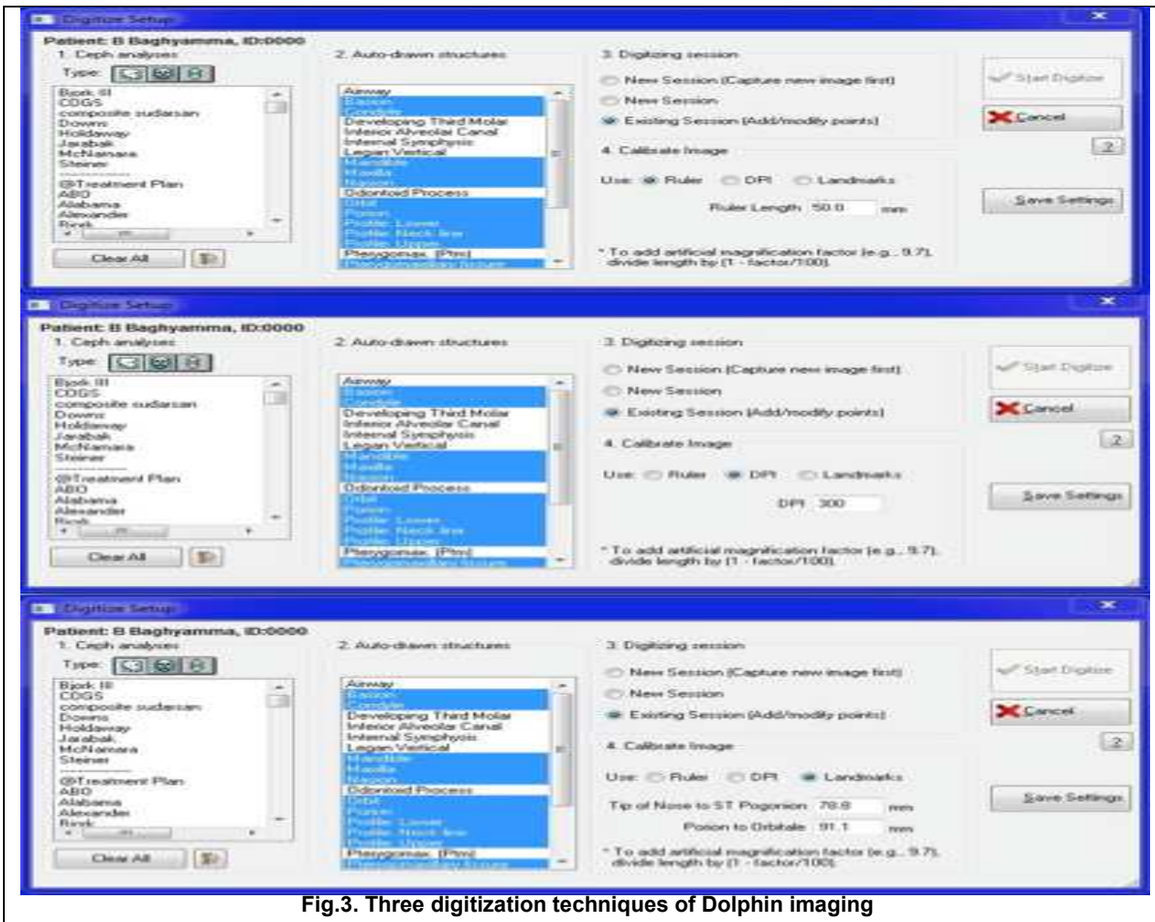

Fig.3. Three digitization techniques of Dolphin imaging

TABLE 1 COMPARISON OF MEASURING TECHNIQUES FOR ALL FOUR MEASUREMENTS USING FRIEDMAN TEST

Measurement	Technique	N	Mean ± SD	Median	Mean Rank	P value#
F Axis	Ruler	50	88.5380 ± 5.14	89.55	2.36	0.003*
	DPI	50	88.7200 ± 5.28	89.55	2.43	
	Land Mark	50	88.0200 ± 6.16	89.45	2.18	
	Conventional	50	89.5800 ± 5.40	90.50	3.03	
ANB	Ruler	50	3.5980 ± 2.21	3.60	2.56	0.644^{NS}
	DPI	50	3.5800 ± 2.22	3.60	2.55	
	Land Mark	50	3.5800 ± 2.21	3.50	2.33	
	Conventional	50	3.5700 ± 2.14	3.00	2.56	
S-N	Ruler	50	72.9280 ± 4.15	72.50	2.91	0.008*
	DPI	50	72.3440 ± 4.00	71.90	2.06	
	Land Mark	50	72.5890 ± 4.84	72.05	2.43	
	Conventional	50	72.7200 ± 3.83	73.00	2.60	
S-AR	Ruler	50	36.4820 ± 3.70	35.45	2.69	0.010*
	DPI	50	36.1220 ± 3.71	34.85	2.07	
	Land Mark	50	36.7580 ± 4.05	35.60	2.86	
	Conventional	50	35.7800 ± 3.47	35.00	2.38	

#Friedman Test; NS: p > 0.05; Not Significant; * p < 0.05; Significant

TABLE 2.COMPARISON OF MEASUREMENT BY FOUR DIGITATION TECHNIQUES WITH EACH OTHER

MEASUREMENT	COMPARISON	Z VALUE#	P VALUE#
F Axis	Ruler – DPI	1.473	0.141
	Ruler – Landmark	1.395	0.163
	Ruler – Conventional	3.558	<0.001**
	DPI – Landmark	1.715	0.086
	DPI – Conventional	3.299	0.001*
	Landmark – Conventional	3.693	<0.001**
ANB	Ruler – DPI	0.447	0.655
	Ruler – Landmark	0.600	0.549
	Ruler – Conventional	0.345	0.730
	DPI – Landmark	0.305	0.761
	DPI – Conventional	0.210	0.833
	Landmark – Conventional	0.144	0.886
S-N	Ruler – DPI	3.730	<0.001**
	Ruler – Landmark	1.793	0.073
	Ruler – Conventional	1.541	0.123
	DPI – Landmark	0.356	0.722
	DPI – Conventional	3.235	0.001*
	Landmark – Conventional	0.623	0.533
S-AR	Ruler – DPI	2.728	0.006*
	Ruler – Landmark	1.140	0.254
	Ruler – Conventional	1.734	0.083
	DPI – Landmark	2.717	0.007*
	DPI – Conventional	0.041	0.967
	Landmark – Conventional	2.996	0.003*

#Wilcoxon-Sign Rank Test; * p < 0.05; Significant; ** p<0.001; Highly significant

specially for storing documentation and facilitating cephalometric tracings. One among those programs is Dolphin imaging software. Since the cephalometric analysis method is frequently used by orthodontists and researchers and due to continuous advances in Cephalometric software, the need was felt to assess and compare the accuracy of cephalograms by manual methods and digital lateral cephalogram using Dolphin imaging (vesion11.5) software.

Rogers[10]and Herald[11] indicated that 75dpi would be sufficient for digital lateral cephalograms. J.collins et al [7]and bruntz et al[8]in their studies on cephalograms at 150dpi felt that during land mark digitization, magnification often was used to more accurately identify certain structures and in several instances the magnification caused significant pixilation and blurriness of images making it difficult to accurately identify the structures and suggested higher dpi hence all the 50 cephalograms in the present study study were standardized at 300dpi saved in JPEG format.

Chen. Y.J, et al[9] studied on the effects of differences in landmark identification on the cephalometric measurements in traditional verses digitized cephalometry on 10 cephalometric radiographs to explore the effects of differences in landmark identification on the values of cephalometric measurements on digitized cephalograms in comparison with those obtained from original radiographs and concluded that the measurement differences between the original cephalograms and digitized images are statistically significant but clinically acceptable.

The variation among the calibration groups in the measurement of ANB angle shows insignificance.For all the groups the p values for ruler-DPI is 0.655 for ruler-landmark is 0.549,ruler – conventional is0.730, DPI-land mark is 0.761,DPI to conventional is 0.833,and for land mark- conventional is-0.886.

The variation among the calibration groups in the measurement of Sella to Nasion Ruler when compared with DPI shows highly significant value <0.001, DPI compared with conventional shows significant value 0.001, Ruler compared with Landmark0.073, conventional compared with ruler 0.123, DPI compared with Landmark 0.722 and land mark compared with Conventional 0.553 shows insignificant.

The variation among the calibration groups in the measurement of Sella to articular when compared conventional to landmark shows 0.003 indicates significant value, land mark when compared with DPI shows 0.007 indicates significant value, DPI when compared with ruler 0.006 indicates significant value landmark when compared with ruler shows 0.245 indicates insignificant, conventional when compared with ruler shows 0.083 indicates insignificant and DPI when compared with conventional shows 0.967 indicates insignificant.

In the present study conventional when compared with calibration techniques ruler has shown only one significant value DPI and land mark has shown two significant values so our study conclude that using ruler is the better option for calibration of digital radiograph. As ruler is more accurate to conventional we compare DPI and Landmark techniques to ruler, landmark shows less variation with ruler so according to the present study the second option for calibration of digital radiograph is landmark and last option comes DPI.

This is the first study done to evaluate and compare the accuracy of calibration techniques, which are used in tracing digital radiographs

CONCLUSION

According to findings in our study Conventional when compared with calibration technique Ruler has shown only one significant value, DPI and landmark has shown two significant values this indicates that using Ruler is the better option for calibration of digital radiograph. As Ruler is more accurate to conventional we compare DPI and Landmark techniques to Ruler, landmark shows less variation with ruler so according to our study the second option for calibration of digital radiograph is Landmark and last option comes DPI.

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