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Comparative Evaluation of Nemoceph and Foxit PDF Reader for Steiner's Cephalometric Analysis.

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ABSTRACT

Background: Cephalometry is used to quantify and qualify the type of malocclusion. The digital technology has overcome the limitations of manual method. A high cost of the commercially available software is unaffordable for its wide spread use. **Objectives:** The aim of this study was to evaluate and compare the values of Steiner's cephalometric analysis using Nemoceph and Foxit PDF reader. No significant difference between the two methods will result in that Foxit PDF reader can be used as an cost effective alternative. **Methods:** This study was conducted on 100 digital lateral cephalogram taken from the same machine. The samples were collected by non-probability convenience sampling procedures. These images were analyzed for Steiner's Cephalometric Analysis using the two software. **Results:** The skeletal and dental values showed no statistical significant difference in the majority, except for the L1-NA (Linear) and L1-NB (Linear). **Conclusion:** Results showed that there is a high agreement between the two methods.

Keywords: Cephalometry; Digital Imaging ; Software.

INTRODUCTION

Harmonious facial esthetics and optimal functional occlusion with a firm structural balance is a recognized canon for orthodontists.[1,2] A scientific approach to analyze the human craniofacial patterns was pioneered by anthropologists and anatomists.[3-5] Since the introduction of cephalometric radiography by Broadbent in 1931, significant advancement has been achieved over the years.[4-7] The vital role of cephalometric analysis in orthodontic diagnosis, treatment planning, and monitoring treatment and growth changes is well established.[7-9]

The traditional hand-tracing process of cephalometric analysis uses an acetate overlays, pencil, ruler and protractor to measure the linear and angular values. Though most economical and accessible, the potential systematic and random error (Bregersen 1980, Houston 1983), high time demand, special dark chamber, chemical hazard, together with difficult archiving are amongst the possible cause of its set back.[10-11]

Digital radiographic technique emerged During the 1980s and early 1990s. These digital cephalometric images created a surge for computer cephalometric software.[12] This technological advancement not only overcome the limitations of the conventional technique but enabled brightness and contrast control facilitating easy landmark identification for accuracy.[13-16]

The availability, and affordability and user friendly score of these commercially available software remained questionable. (Nouri M. et.al. 2015).[17] Therefore, the present study was conducted with an objective to compare and evaluate the measurement obtained using NEMOCEPH (a commercially available software for cephalometric analysis) and the measurement tool of FOXIT PDF READER for STEINER'S Cephalometric Analysis.

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MATERIALS & METHODS

Soft copy images of digital lateral cephalograms of 100 prospective orthodontic patients were include in the study. All the radiographs were taken from the same digital OPG machine with an automatic KVp and mA setting. The samples were selected through a non-probability convenience sampling procedures. All the radiographs were selected on the basis of quality and clarity of images and with ease for identification of landmarks. The selection criteria were not be affected by age, gender, machine, head positioning and tooth contact. Poor quality image, distortion, artifact and craniofacial anomalies were excluded from the study.

The lateral cephalometric images were cropped to the size of standard lateral cephalogram film (8x10 inch) using Adobe Photoshop. A ruler scale image of 8 inch was added on the top of this image, extending from the right margin to the left margin for easy caliberation with the software to be tested. The standardized and caliberated images were numbered 1-100 on the upper right hand side corner of the images for identification. The images were saved in JPEG format, with maximum quality setting at 200 dpi.

The Landmark identification was carried using -

NEMOCEPH NX 2009 for Windows and

FOXIT PDF READER, version 3.0 (a free download software)

A laptop with a mouse-controlled cursor was used for on screen landmark identification and cephalometric analysis using NemoCeph NX 2009 for Windows (Nemotec, Madrid, Spain). The cephalometric image to be evaluated was marked for the cephalometric landmarks as demanded by the software. The same laptop with a mouse-controlled cursor was used for on screen cephalometric analysis using the measurement tools in the tool bar of FOXIT PDF READER software. The "Distance Tool" and the "Area Tool" were used for the linear and the angular measurements and immediately the observed values were recorded manually on a paper. Image magnification and contrast enhancement tool was used for easy identification of landmarks.

The data was subjected to statistical analyses using Statistical Package for Social Sciences Software version 11.0 (SPSS Inc, Chicago, IL). Oneway ANOVA was used for comparison between the variables and Post Hoc test followed by Turkey's test was done to check the level of significance.

RESULTS

The pre-standardized and pre-calibrated digital lateral cephalometric radiographs evaluated for the five skeletal and five dental values of Steiner's Analysis using the FOXIT PDF READER and NEMOCEPH showed – The mean difference of the skeletal values obtained using the two software showed no significant statistical difference [Table 1 & 2].

Table 1: Comparison Of Skeletal Values Between Groups (One way ANOVA)

Variable	Group	Mean value	S.D	p-value
SNA	Nemoceph	82.83	4.45	0.79
	Foxit	82.16	4.97	
SNB	Nemoceph	78.00	5.48	0.95
	Foxit	77.83	6.09	
ANB	Nemoceph	5.15	3.15	0.69
	Foxit	5.53	3.93	
Mandibular Plane Angle	Nemoceph	28.95	7.69	0.80
	Foxit	27.73	9.03	
Occlusal Plane Angle	Nemoceph	15.85	6.31	0.51
	Foxit	14.28	5.49	

(*p ≤ 0.5 Significant).

Table 2: Comparison Of Skeletal Values Between Groups (Post Hoc Test)

Variable	Group	Group	Mean difference	p-value
SNA	Nemoceph	Foxit	0.67	0.80
SNB	Nemoceph	Foxit	0.17	0.99
ANB	Nemoceph	Foxit	0.38	0.87
Mandibular Plane Angle	Nemoceph	Foxit	1.23	0.78
Occlusal Plane Angle	Nemoceph	Foxit	1.57	0.49

(*p ≤ 0.5 Significant).

Table 3: Comparison of Dental values between Groups (One way ANOVA)

Variable	Group	Mean value	S.D	p-value
U-1 to NA (Angle)	Nemoceph	24.98	9.44	0.34
	Foxit	28.23	10.79	
U-1 to NA (Linear)	Nemoceph	0.22	0.15	0.0001
	Foxit	6.55	4.21	
L-1 to NB (Angle)	Nemoceph	29.83	6.87	0.12
	Foxit	29.85	8.33	
L-1 to NB (Linear)	Nemoceph	0.28	0.11	0.0001
	Foxit	7.29	2.85	
Inter Incisal Angle	Nemoceph	120.29	11.93	0.73
	Foxit	118.59	10.92	

(*p ≤ 0.5 Significant).

Table 4: Comparison of Dental values between Groups (Post Hoc Test)

Variable	Group	Group	Mean difference	p-value
U-1 to NA (Angle)	Nemoceph	Foxit	3.25	0.33
U-1 to NA (Linear)	Nemoceph	Foxit	6.33	0.0001
L-1 to NB (Angle)	Nemoceph	Foxit	0.02	1.00
L-1 to NB (Linear)	Nemoceph	Foxit	7.02	0.0001
Inter Incisal Angle	Nemoceph	Foxit	1.70	0.83

(*p ≤ 0.5 Significant).

The dental values showed no statistical significant difference in the majority, except for the L1-NA (Linear) and L1-NB (Linear). (*p ≤ 0.5 Significant). [Table 3 and 4]

DISCUSSION

A precise diagnosis and treatment planning is essential to the success of orthodontic treatment. In 1931, Orthodontics ushered in the age of radiographic cephalometry.[18] Since then, the orthodontic domain has achieved a new horizon both in research and clinical science.[19,20] A number of different cephalometric analyses and norms are available today.[21,22]

Traditional cephalometric radiography and analysis were done manually using a large inventory and was prone to errors. The technique also is laden with weakness.[23,24]

With the rapid evolution of digital radiography landmark location and on screen tracing has become area of interest for researchers. Computer-aided cephalometric analysis on digitized cephalogram substantially reduces the potential errors, eliminate the production of hard copies and is time saving as well. Currently, cephalometric analyses for orthodontic diagnosis, treatment planning, and research are often performed on digital images by means of computer software.[25,26] The high cost and availability account limitation of these software programs.

The innovative techniques of Prawat J.S. et. al. (1995) , Shahidi S. et.al.; (2013) and Nouri M. et.al.; (2015) have attempted cost effective options with success.[17,27,28]

Precision and reproducibility in data is an essential requirement.[7] Durao et.al.; (2015)reported a lower level of reproducibility in landmarks identification among orthodontists compared to maxillofacial radiologist.[29]

The current study compared the NEMOCEPH and the measurement tools in the tool bar of FOXIT PDF READER for cephalometric analysis. The pre-standardized and pre-calibrated digital lateral cephalometric radiographs evaluated for the five skeletal and five dental values of Steiner's Analysis revealed – the mean difference of the skeletal values obtained using the two software showed no significant statistical difference. This was in consonance with the study reports of Erkan M., et. al.; (2012), Goracci C. and Ferrari M. (2014) , Rusa O et. al. (2015) and CORREIA T.R.G.S. (2017) who reported a high consistency between the different software evaluated.[30-32]

T Sommer et. al. (2009) reported a difference of below 2˚ but clinically acceptable for the mid face structures. The dental values in our study showed no statistical significant difference in the majority, except for the L1-NA (Linear) and L1-NB (Linear). A similar finding was reported by Celik E. et. al.; (2009) and ALDREES A. M.(2010). Study report of Tsorovas G. and Karsten A.L.(2010) showed better agreement with the advanced features of software for [(L1 to NB (mm)], compared to standard feature.[33-36]

The overall finding of our study showed 80 percent agreement between the two methods. Therefore, FOXIT PDF READER can be used as an alternative to commercially available NEMOCEPH software.

CONCLUSION

Orthodontics is undergoing a gradual transition and has reached a digital era. The specialty has experienced advancements both in techniques and technology. The present study has shown a comparable and non significant difference between the data obtained with the two softwares, except for a few exceptions. Therefore, FOXIT PDF READER can be considered as an cost effective alternative.

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