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Original Article

COMPARISON OF MANUAL AND COMPUTERIZED TRACING USING COMPUTER SOFTWARE: BURSTONE ANALYSIS

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ABSTRACT:

Background: This study was to evaluate the accuracy and reliability of cephalometric measurements using a nemotech method of direct digital radiographs when compared with the measurements obtained with a computerized method that uses a digitizing pad and hand tracing of printout radiographs.

Material and Method: 60 Pre-treatment digital cephalometric radiographs were traced using nemo tech software programs and by hand tracing of the printouts. Various landmarks were defined on each radiograph by a single investigator by same method.

Result: Statistical analysis was undertaken using paired t-test at a significance level of 0.05.Low correlation coefficients indicated poor reproducibility for nasolabial angle for each of the three methods ($P > 0.05$). The findings indicated that most of the cephalometric measurements were highly reproducible with direct digital radiographs using nemo tech with printouts and hand tracing.

Conclusion: It can be concluded that user-friendly and time-saving nature of the computerized method using digital radiographs makes it the preferred option.

Key words: Computerized , Hand ,Digital, Cephalometrics, Landmarks.

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INTRODUCTION:

The main interest of orthodontic therapy is the supervision, guidance and correction of the growing and mature dentofacial structures. To correct the facial harmony certain cephalometrics analysis like Burstrone's soft tissue, Ricketts and McNamara have been accepted by majority of orthodontists because of their wider applications in diagnosis and treatment planning.[1-3]

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For physical storage of conventional radiographs more space is required, the technique for analyzing and tracing is more time consuming and involves high risk of errors during hand tracing, landmark identification and measurement. And to a larger extent the greater radiation exposure from the conventional cephalmeters .[4-7]

Recently, third generation systems have been introduced[2] that the transmit digital radiographs directly to the computer data base through the use of photo stimulate phosphor plates , charged couple devices or direct digital systems. The use of direct digital images offers several advantages such as instant image acquisition, reduction of radiation dose , facilitated image enhancement and archiving , elimination of technique sensitive developing progress , and easier image sharing.

Recent advances in radiographic technology have led to the development of reliable digital cephalograms obtained from digital cephalometers. This method has several advantages for the clinicians and the patients, e.g. instant image acquisition, reduction of radiation dose, facilitated image, and enhancement image and archiving, elimination of technique sensitive developing processes and facilitated image enhancement and archiving, elimination of technique sensitive developing processes and facilitated image sharing. Moreover digital cephalograms require less storage space than conventional image enhancement and archiving, elimination of technique sensitive developing progress, and easier image sharing.[7-8]

Several studies have been undertaken to compare the accuracy of scanned, digitized and digitally obtained radiographs with analog methods. However, no clear consensus has arisen as to which method is preferable because the conversion of analog film to digital format requires several additional steps that are not only time consuming but may also introduce magnifying errors .[9-11]

Keeping this in view this study has been designed with the aim to evaluate and compare the accuracy and reliability of commonly used cephlometric analyses using Nemo-Ceph cephalometric analysis program with those obtained from hand tracing of printout cephalograms. The aim of this study is to evaluate and compare the accuracy and reliability Of computerized cephalometric methods by using burstone hard tissue analysis.

MATERIAL AND METHODS:

In our study, pretreatment lateral cephalograms of 60 patients of 14-25 years old which were selected from m.m University, Department of Orthodontics, Haryana were used. All cephalograms were taken with the same orthopantomogram and were evaluated by the same investigator for each method.

The following criteria was used for the selection of subjects of the study: No Craniofacial deformity and asymmetry. All the teeth up to second permanent molars were fully erupted, no facial asymmetry and there was no history of subject having

undergone any orthodontic treatment. Radiographs were exposed in centric occlusion with lips in relaxed contact.

All radiographs were traced on .003'' thickness Adequate film with 4h lead pencil each cephalogram was traced in standardized manner

Standardized radiographs for this study were taken using ortho phox XG5 dental system digital cephalometer, a kodak 5800 dry view laser imager for printing the digitally obtained cephalometric image on 8X10 '' radiographic film compatible with same was used for printing the radiograph . For importing tracing and analyzing the digitally obtained lateralcephalometric image nemo ceph. Software was used for producing the values of different analysis a printer was used to produce hard copy.

Following landmarks were used in our study:

The Lower Face Throat Angle: it is formed by the intersection of the lines Subnasale to Gnathion and gnathion to cervical point.

G-Pg. : it is measured parallel to HP from the perpendicular line dropped from glabella.

Mentolabial sulcus: it is measured from the depth of the sulcus perpendicular to the Li-Pg line.

Upper Lip Length: it is measured by drawing a line from labrae superius and subnasale to soft tissue tissue pogonion.

Lower Lip Length: it is measured by drawing a line from labarale inferius and subnasale to soft tissue pogonion.

Inter Labial Gap: It is the vertical distance between the upper and lower lip with the lips in repose.

Lower face vertical height to depth ratio: it is the ratio of the distances subnasale to gnathion and cervical point to gnathion.

Maxillary prognathism : it is the distance between line perpendicular to horizontal plane dropped from glabella and subnasale measured parallel to the horizontal plane.

Mandibular prognathism: it is the distance between line perpendicular to horizontal plane dropped from glabellla and soft tissue pogonion measured parallel to the horizontal plane.

Vertical lip chin ratio: it is the ratio of the distance between subnasale to stomian superius parallel to horizontal plane and menton to stomian inferius parallel to horizontal plane.

Maxillary incisor exposure: it is the distance from stomian superius to upper incisor.

Vertical height ratio : it is the assessed by taking the ratio of the middle third facial height to lower third facial height measured perpendicular to horizontal plane.

For the various landmarks linear and angular parameter as described by Bustone in the cephalometric landmarks were used in the study using these

landmarks. Different parameters were derived and compared using nemo ceph and by tracing hard copy of printout cephalograms and analysis were determined and compared. Analysis to all the patient was performed manually and digitally and then 10 radiograph were randomly selected from the total sample size and were reproduced manually and digitally one week later.

Statistical Method: Both statistical analyses were performed using the statistical package for social sciences windows version. Statistical significance was set at $p< 0.05$. Means and standard deviations were calculated for all data. Paired students t-tests were used to compare the mean values between the first and second measurements. A student's t-test for independent samples was used to compare the mean values of intra and inter examiner differences. Interclass correlation coefficients were calculated to determine intra and inter examiner correlation. The level of statistical significance was set at $P<0.05$.

RESULTS:

Descriptive statistics and results of variant analysis with Mean and P value are presented in Table 2 and 3. Intraclass correlation coefficients (ICC) are presented in Table 1. Table 2 shows that the mean values for Ar-Ptm, Art-Aon, B-pg and Ptm-n were significantly lower for the conventional group than the nemoceph group, respectively. No statistically significant differences were found for other parameter among two groups.

All the parameter which are used in burstone analysis showed highest level of reliability while Ao-Bo found statistically significant among all measurements (Table 1). Upper lip length, nasolabial angle, Inter labial gap, Lower Face Throat angle, Lip embrasure to occlusal plane statistically significant among all parameter for burstone soft tissue analysis (Table 3)

DISCUSSION:

The interpretation of cephalometric films is a prerequisite in the diagnosis of malocclusion and the analysis of treatment results. Developments in computer technology have led to increasing use of digital systems both for tracing and analyzing cephalometric films several studies have compared the accuracy of scanned [12], digitized [13-14], and digitally obtained [15] radiographs with analog radiographic films.

The main advantage of digital radiology are the reduced radiation dose and improved data storage, information access and image manipulation. Regardless of whether the chosen method is mechanical or digital, it is essential that it is accurate, precise and shows a high rate of reproducibility in both tracing and analysis to ensure that errors are kept to a minimum.

The present study evaluated the reliability and reproducibility of commonly used cephalometric measurements obtained from Nemo Ceph software program as well as the hand tracing method. In order to eliminate errors due to

magnification, the present study was based on digital radiographs rather than scanned images. Moreover because it was not possible to use a 'sandwich technique' in which digital and conventional radiographs are obtained.[8-9]

Simultaneously conventional measurements were taken using hard copy printouts of the digital radiographs. Although a previous study found that slight enlargement may occur when printing hard copies of digital cephalograms the size difference is minimal and regarded as clinically acceptable.

Furthermore AO-BO also involved statistically significant difference as it could have been affected by the double images of the occlusal surfaces of the teeth [11] interfering with easy identification of the occlusal plane and also by its small absolute value making it more sensitive to differences in manual and digital methods. It could be probable that for the same reason other measurements that involve occlusal plane such as occlusal plane to ramus and occlusal palne inclination.

Statistically significant differences were also for PNS-N (p-value =0.0001). Intra and interaexaminer reproducibility for the digital method was also found to be i.e. -1.169 and -1.169 respectively for the digital method nut fair for the manual method i.e. 0.643 and 0.580 respectively. This is probably so because the software measured the distance between these points parallel to the True Vertical Line. Whereas using the manual method a Horizontal plane 7 degree to Sella Nasion is taken and then the distance between PNS and N is taken perpendicular to horizontal plane. According to the results of present study, differences in measurements of linear parameters were greater than those of angular parameters. The differences could result from calibration. Effective maxillary length and corpus length showed statistically significant differences b/w the groups. However, it should be noted that not all linear parameters showed low rates of reproducibility.

The validity and reproducibility of the cephalometric measurements with the Nemotec digital studio NX software and with the conventional method are highly correlated, apart from this the digital software is less time consuming and offers other advantages of digital imaging such as archiving, archiving, transmission, and enhancement, hence the digitized method could be preferred in daily use and for research purposes without loss of quality.

CONCLUSION:

Discrepancies found between the measurements of manual and computerized tracings were, in their majority, statistically non-significant. Although small discrepancies were found between the hand-tracing and computerized measurements, the differences were minimal and clinically acceptable. The use of the computerized cephalometric tracing software, such as zoom changes in brightness, density, speed, preparation of data for computer

analysis and contrast, were useful to determine cephalometric landmarks.

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TABLES:

Table 1: Intraclass correlation coefficients (ICC)

Differences in cephalometric measurements generated by manual and digital cephalometric analysing methods by two examiners analysed using independent t-test for Burstone's hard tissue Analysis					
BURSTONE HARD TISSUE ANALYSIS	Examiner 1		Examiner 2		*Statistically significant (p-value<0.0)
	Mean	S.D.	Mean	S.D.	p-value
L1 M.P.(0)	109.021	10.9654	97.93	10.3042	0.02
L1 M.P.(mm)	43.207	8.2275	42.4	5.0113	0.786
U1 N.F. (mm)	29.433	5.7816	28.52	3.4444	0.695
U1 N.F. (0)	123.233	10.2254	114.36	11.5214	0.143
ANS-Gn	62.18	8.5581	64.22	7.7714	0.584
AO-BO	-3.62	3.4995	2.6	4.458	.003*
Ar-PtM	38.58	0.9682	39.65	4.2714	0.45
Art-GoN	46.76	2.9338	49.76	4.8795	0.113
B-Pg	5.76	1.8739	7.14	1.3826	0.077
Go-Pg	76.93	3.2907	80.49	6.3976	0.135
L6 MP (mm)	33.18	2.0569	33.19	2.8869	0.993
MP-HP	22.57	4.6493	22.77	9.1129	0.951
N-A(H.P.)	1.58	3.7371	2.46	3.4846	0.593
N-ANS	55.99	3.2378	106	158.6261	0.332
N-B(H.P.)	-6.9	4.3901	-2.59	7.8687	0.148
N-Pog(H.P.)	-6.58	5.2565	-1.25	9.7001	0.144
N-A-Pog	10.82	5.3824	6.17	6.0292	0.086
PNS-N	56.32	5.2514	56.65	4.3689	0.88
ptm-N	52.88	4.7138	51.91	4.318	0.637
U6 NF(mm)	23.19	3.838	24.5	3.5144	0.436

Table 2: Results of descriptive statistics and t-test

Comparison of the group for Burstone's hard tissue analysis using a paired t-test					
Burstone Legan Hard Tissue Analysis	Conventional hand tracing		Nematec Dental Studio NX		
	Mean	S.D.	Mean	S.D.	p-value
L1 M.P.(0)	97.664	5.5188	103.18	21.9318	0.053
L1 M.P.(mm)	42.453	1.5906	44.04	6.6659	0.061
U1 N.F. (mm)	30.58	-1.4696	29.11	6.1003	0.077
U1 N.F. (0)	116.821	2.0357	118.86	13.9812	0.281
ANS-Gn	64.669	0.7678	65.44	5.5871	0.296
AO-BO	9.288	-9.5467	-0.26	33.5523	.031*
Ar-PtM	37.267	0.9733	38.24	2.1133	.001*
Art-GoN	51.583	-1.7217	49.86	3.3693	.0*
B-Pg	5.5	1.4898	6.99	5.3543	0.037
Go-Pg	78.542	1.2367	79.78	10.16	0.35
L6 MP (mm)	36.318	-2.1291	34.19	10.7147	0.146
MP-HP	24.05	-1.9933	22.06	7.6403	0.053
N-A(H.P.)	2.083	-0.0017	2.08	4.2815	0.998
N-ANS	54.783	9.1017	63.89	64.8273	0.281
N-B(H.P.)	-4.21	0.7017	-3.51	8.1279	0.506
N-Pog(H.P.)	-2.133	-0.4017	-2.54	8.6604	0.721
N-A-Pog	11.625	-4.7583	6.87	15.6543	0.022
PNS-N	51.942	5.03	56.97	7.0437	.0*
ptm-N	54.508	-2.22	52.29	8.2479	0.051
U6 NF(mm)	25.008	-0.84	24.17	4.8337	0.183

Table 3: Results of descriptive statistics and t-test

Comparison of groups for soft tissue measurements using a paired t-test					
Burstone Legan soft Tissue Analysis	Conventional hand tracing		Nemotec Dental Studio NX		
	Mean	S.D.	Mean	S.D.	p-value
Facial convexity	18.52	6.167	19.165	6.6483	0.065
Inter labial gap	2.67	2.989	2.702	2.9883	.014*
Lower Face Throat angle	108.16	10.504	110.723	10.752	.014*
Lower lip Protrusion	-3.88	2.908	-3.84	2.9318	0.077
Lower Vertical Ht	1.29	0.222	1.32	0.2583	0.131
Mandibular Prog	-0.01	8.216	-1.195	8.0287	0.492
Maxillary Prog	10.94	4.395	10.955	4.4572	0.602
Mentolabial sulcus	5.22	4.97	6.113	2.1505	0.202
Nasolabial	100.3	9.582	101.855	9.9191	.013*
Stomian sup-U1	3.5	2.529	3.297	2.3965	0.161
Upper lip Protrusion	5.44	2.127	5.432	2.1513	0.696
Vertical Ht Ratio	1.02	0.116	1.02	0.1132	0.398
Vertical lip chain Ratio	0.48	0.066	0.472	0.0715	0.054
Lip embrassure to occ plane	-3.13	3.112	-3.182	3.1023	.025*
Lip protrusion	0.43	3.737	0.497	3.917	0.907
Upper lip length	26.07	3.757	27.077	3.311	.002*