Computerised and manual cephalometry used for accuracy and reliability of landmark identification

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Abstract
Introduction: Digital imaging offers several potentials advantages over traditional radiography like reduced radiation eposure, elimination of chemical processing and image enhancement using various algorithms.
Materials and Methods: The study sample consisted of 25 lateral cephalometric radiographs which were selected randomly from the data files.
Results: The Result of computerised cephalometric tracing method by digitization is more reliable and consistent as compared to manual cephalometric tracing method.

Keywords: Digital cephalometry, Manual cephalometric tracings, Cephalometric data, Cephalometric analysis.

The cephalometric parameters were statistically analyzed by calculating their means and standard deviations i.e. descriptive statistics. Then the means of measurements obtained by manual cephalometric tracings were compared with means of computerized lateral cephalometric tracings with the help of student's unpaired 't' test.

The definitions and formulae for calculating the mean, standard deviation, and tests for significance are given below:-

Mean
It is defined as summing up all observations and dividing the total by the number of observations. It is calculated as,

$$\overline{X} = \frac{\Sigma X}{n}$$

Mean, x
Where,
X = The value of the variables.
Σ = Sum of the values.
n = Number of observations.

Standard deviation
The standard deviation is the most frequently used measure of deviation. It is the most frequently used measure of deviation. It is defined as the root mean square deviation and is denoted by s or SD.

$$s = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \bar{x})^2}$$

Where,
X = mean
Σ = Sum of the values
N̄ = Number of observations

Standard error of mean
Standard error of mean measures how precisely the population mean is estimated by the mean of the given sample. The standard error various with the size of the standard deviation. Greater the SD, greater the SE>

$$SE = \frac{S}{\sqrt{n}}$$

Where,
S = Standard deviation
N = Number of observations

Student's "t-test"
It is used to test whether the means of two independent samples are significantly different. It is denoted by "t" The formula is

$$t = \frac{\bar{X_1} - \bar{X_2}}{sx_1x_2 - \sqrt{\frac{2}{n}}}$$

Where in,

$$s_{x1x2} = \sqrt{\frac{1}{2}(s^2x_1 + s^2x_2)}$$

Where,
S_{x1x2} = Combined standard deviation
$\bar{X}_1$ = Mean of the first Sample
$\bar{X}_2$ = Meant of the second sample
n_1 = Sample size of the first sample
n_2 = Sample size of the second sample
s_{x1} = Standard deviation of the first sample
s_{x2} = Standard deviation of the second sample

Digital Imaging offers several potential advantages over traditional radiography like reduced radiation exposure, elimination of chemical processing and image enhancement. It also allows automated cephalometric analysis, soft tissue superimposition/morphing, archiving and transmission of the digital images. Digital radiography gives us the advantage of enhancing the diagnostic quality of digital images using various algorithms.[2]

Studies have shown that images captured from flatbed scanner are reliable as compared to their corresponding analogue headfilms for use in clinical practice, but cannot be used for research products. Many factors affect the quality of the scanned image like dpi value, number of piels and amount of illumination, which have a direct effect on the landmark identification. Thus a standardition of the scanning setup is mandatory to advice a good quality image.[3]

Discussion

Many Computer systems were developed in the following years with an aim to simplify the process of cephalometric analysis. It is found that Manual tracing was less precise than digital tracing. Digital cephalometric analysis not only saves time but also makes the landmark identification more precise by removing the errors caused during measurement using ruler and protector. Additionally, digital image can be manipulated to process the image and alter its visual appearance which can facilitate landmark identification.

Table 1: Mean, minimum, maximum & standard deviation of various parameters in Steiner's Analysis

Sl. No.	Parameter	Mean		Minimum		Maximum		Standard Deviation	
		Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
1	SNA Angle (degree)	81.9	82.2	72.1	72.9	90.3	91.3	8.2	7.9
2	SNB Angle (degree)	77.8	78.5	70.4	71.4	88.4	89.3	6.9	7.1
3	ANB Angle (degree)	3.6	4.1	-2.1	-2.6	6.8	7.1	3.1	3.8
4	GoGn - SN Angle (degree)	31.2	30.8	27.4	26.4	40.2	41.3	8.7	8.3
5	U1 - NA angular (degree)	24.7	23.4	18.3	17.7	36.1	37.1	5.1	5.3
6	U1 - NA linear (mm)	6.2	6.1	3.7	4.1	8.5	8.8	3.4	3.6
7	L1 - NB angular (degree)	23.9	22.7	17.9	17.3	32.5	33.2	5.6	5.9
8	L1 - NB linear (mm)	5.3	5.9	3.6	3.4	7.1	7.4	2.9	3.1
9	Interincisal angle (degree)	124.5	125.7	111.6	112.5	145.8	146.2	11.8	12.2
10	Occlusal - SN (angular)	14.1	14.9	11.5	12.1	19.2	19.8	3.8	4.1

Key:
Group A: Manual cephalometric tracing group
Group B: Computerized cephalometric tracing group (B)

Table 2: "t" values for various parameters between Group A and Group B

S. No.	Parameter	''t'' value	Probability	Significance
1	SNA Angle (degree)	0.74	0.51	NS
2	SNB Angle (degree)	1.13	0.41	NS
3	ANB Angle (degree)	0.64	0.471	NS
4	GoGn - SN Angle (degree)	1.26	0.87	NS
5	U1 - NA angular (degree)	0.34	0.72	NS
6	U1 - NA linear (mm)	6.3	0.1	HS
7	L1 - NB angular (degree)	1.52	0.272	NS
8	L1 - NB linear (mm)	8.31	0.21	HS
9	Interincisal angle (degree)	1.37	0.862	NS
10	Occlusal - SN (angular)	3.24	0.001	HS

Key:
NS: Not Significant
HS: Highly Significant

Table 3:

S. No.	Parameter	"t" value	Probability	Significance
1	SNA Angle (degree)	0.74	0.51	NS
2	SNB Angle (degree)	1.13	0.41	NS
3	ANB Angle (degree)	0.64	0.471	NS
4	GoGn - SN Angle (degree)	1.26	0.87	NS
5	U1 - NA angular (degree)	0.34	0.72	NS
6	U1 - NA linear (mm)	6.3	0.1	HS
7	L1 - NB angular (degree)	1.52	0.272	NS
8	L1 - NB linear (mm)	8.31	0.21	HS
9	Interincisal angle (degree)	1.37	0.862	NS
10	Occlusal - SN (angular)	3.24	0.001	HS

Source of Funding

None.

Conflict of Interest

None.

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How to cite: Gaharwar JS. Computerised and manual cephalometry used for accuracy and reliability of landmark identification. *Indian J Orthod Dentofacial Res*. 2020;6(1):12-5.