Comparative Evaluation of CephNinja for Ios/Android and Nemoceph for Computer for Cephalometric Analysis: A Study to Evaluate the Diagnostic Performance for CephNinja for Cephalometric Analysis.

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KEYWORDS

Dental Occlusion, Incisor, Reproducibility of Results, Sample size, Computers, Mobile Applications, Telemedicine

ABSTRACT

This study aimed to evaluate and compare the accuracy and reliability of cephalometric analysis performed using the mobile-based application CephNinja (version 5.09) and the computer-based software NemoCeph (version 6.00). A sample of 60 pretreatment digital lateral cephalometric radiographs was analyzed for skeletal, dental, and soft tissue parameters using both software tools. The results showed no significant differences in most skeletal and soft tissue measurements between the two platforms. However, significant differences were observed in specific dental parameters, including the incisor occlusal plane angle, U1-NA (linear), and L1-NB (linear). The findings suggest that both CephNinja and NemoCeph are reliable for cephalometric analysis, with CephNinja emerging as a viable alternative to NemoCeph. Limitations include a small sample size and single-center data collection, warranting further research with larger, diverse populations and extended study durations to validate these findings.

Introduction:

Radiograph originally developed as research laboratory tool has become a diagnostic necessity in the field of Orthodontics, cephalometric radiography is an essential tool for the treatment planning of underlying dental and skeletal discrepancies.[1] The orthodontic procedure's effectiveness is generally evaluated by assessing improvements in both the soft and the hard tissues. One of the most crucial aspects of the planning and execution of orthodontic treatment is evaluating and measuring soft tissue changes.[2]

It is also a valuable tool to evaluate treatment outcome and research. *William Downs* (1948) is credited with developing the first cephalometric analysis. With time, several cephalometric analyses and population-specific cephalometric norms were provided for clinical use.[3] The standards of facial profile vary with races, places, and time. The morphological features are ethnic characteristics too.[1] Due to factors like age, sex, and ethnicity which require distinct cephalometric norms. These norms serve as reference points for assessing skeletal and dental characteristics in specific populations.

Conventional manual analysis involves tracing of anatomic landmarks on an acetate sheet and measurement of the cephalometric parameters. The technique is time-consuming despite the wide-spread use in Orthodontics, and is largely dependent on the skills and knowledge of the clinician. In this context, errors in landmark identification due to fatigue may occur.[4] Traditional cephalometric analysis technique has many inherent disadvantages such as time-consuming, tedious, large inventory, archiving records, communication of data, and associated chemical hazard.[5] Cephalometric radiographs made a paradigm shift in clinical orthodontics and research.

Recently, computer technology has enabled digital processing and on-screen cephalometric tracing.[6] Computerized cephalometric has gained popularity because of simplicity, quick, precise, and easy archiving. Facility of resolution enhancement adds to the accuracy of digitization.[7]

Advancements in the field of computerized radiography over the past decades have led digital radiographs to gain popularity. With this invention, digital tracing has gradually replaced manual tracing methods.[7] The computerized cephalometric software has several advantages it is user friendly, provides the benefit of time, requires only limited storage space, allows manipulation of image size and contrast adjustment of the radiograph, and radiation exposure is comparatively low and superimposition errors are avoided.[3] The main disadvantage of the computerized cephalometric software is that it is expensive[4] and due to this, many orthodontists did not consider investing in the computerized cephalometric software.

Smartphones have provided new opportunities to integrate mobile technology into routine dental practice. Intrigued by the possibility of using smartphones for cephalometric analysis, rigorous research was performed.[8] Subsequently, a countable number of software solutions for cephalometric analysis was developed as applications on smartphones. These applications allow orthodontists to perform analysis in a short duration and also transfer data in to other devices.

Not only do mobile phones benefit orthodontists with cephalometric analysis, but there is also a wealth of information provided, much of which can be openly accessed by doctors and patients.[9] The adoption of mobile technologies by health care professionals has been associated with several advantages, including improved practice productivity and clinical decision making, rapid access to information and multimedia resources, and more accurate patient documentation.[8] There is emerging evidence supporting the efficacy of teledentistry, that is, the combination of telecommunications and dentistry in the exchange of clinical information and images between distant locations, in remote dental consultation and treatment planning.

Computer based NemoCeph is a powerful orthodontic software tool designed for diagnosis, treatment planning, and case presentation. It offers a range of features that make it an essential tool for orthodontists worldwide.NemoCeph allows you to import patient records, including radiographs, photographs, and other relevant data.[7]The software provides tools for analyzing facial features, which is crucial for orthodontic treatment planning.

Unlike Nemoceph, the main CephNinja software functionality includes image visualization and cephalometric tracing and measurements. CephNinja is used by dental professionals for the visualization of patient images retrieved from a dental cephalometric imaging device scanner for assisting in case diagnosis, review, and treatment planning for orthodontic applications. If a suitable JPEG image (specifically, a lateral cephalometric x-ray) has been imported into the software, the software can be utilized to define a number of structures and landmarks to establish specific anatomical features. The positions of specific landmarks are used to render tracing lines and calculate measurements used in orthodontic treatment planning. The software operates on standard iPhone/iPad (minimum OS 9.0) hardware or on Mac/iMac

(minimum OS Big Sur M1) hardware. When iMac hardware is used, images are displayed on the connected display/monitor.[10]

Comparing Nemoceph and Ceph Ninja for cephalometric analysis is essential to ensure that orthodontic professionals have the best tools at their disposal for precise diagnostic measurements, crucial part of orthodontic treatment planning, as it involves the study of dental and skeletal relationships in the head.[7] The accuracy and reliability of cephalometric software can significantly impact treatment outcomes, making it vital to choose the right tool. Both Nemoceph and CephNinja offer various features and benefits that cater to the needs of orthodontists, but understanding their differences and advantages requires a detailed comparison for orthodontists to make an informed decision about which software will best meet their needs and helps determine which software provides more accurate and reliable measurements for orthodontic diagnosis and treatment planning.[8] By evaluating their performance, you can ensure that the chosen software meets clinical needs, improves diagnostic precision, and potentially offers a more cost-effective solution.

Aim of the study:

To assess, evaluate and compare values of cephalometric analysis performed by phone-based application CephNinja version 5.09 and computer-based application NemoCeph version 6.00 for a composite Dental, Hard Tissue and Soft Tissue Analysis.

Objectives:

- To evaluate the values of cephalometric analysis obtained by CephNinja
- To evaluate the values of cephalometric analysis obtained by NemoCeph
- To compare the values of cephalometric analysis both obtained by CephNinja and NemoCeph

Null hypothesis:

There is no significant difference between the values of cephalometric analysis obtained by CephNinja and Nemoceph.

Materials and methodology:

A sample of 60 pretreatment digital cephalometric radiographs selected for this study and record were obtained from the Department of Orthodontics and Dentofacial Orthopedics in Inderprastha Dental College and Hospital, Ghaziabad, India.

Selection of the sample was done by the following inclusion and exclusion criteria

Inclusion Criteria

- Radiograph of subjects with permanent set of dentitions.
- Digital lateral cephalogram taken in Natural Head Position.
- Good-quality radiographs with calibration marks
- Cephalograms with good contrast and sharp images

Exclusion Criteria

- Radiographs of subjects with missing upper and/or lower first molars and incisors
- Radiographs with poor-quality image
- Radiographs with distorted image
- Radiographs with artifacts
- Subjects with craniofacial anomalies

Armamentarium

- Digital lateral cephalogram
- NemoCeph application version 127.0.0.1
- Ceph Ninja application version 5.09

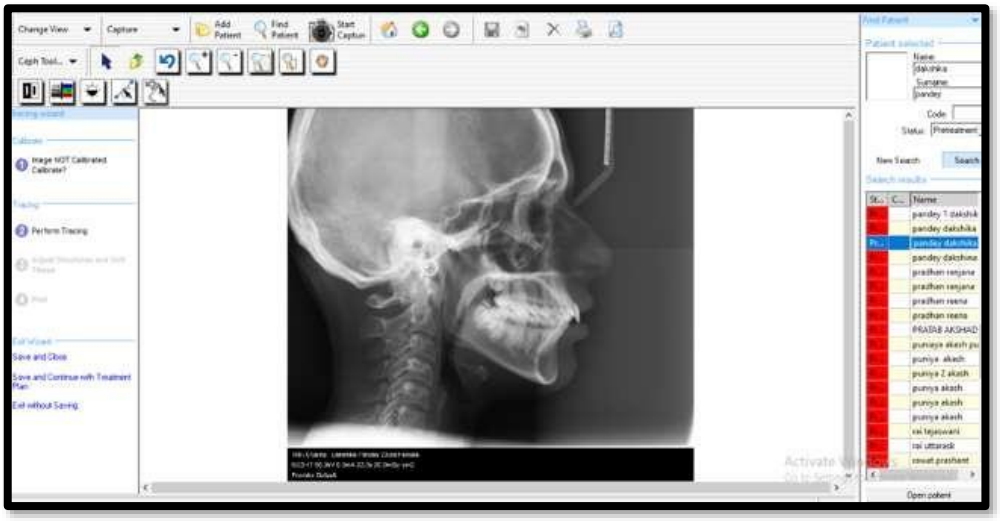


Figure 1: NemoCeph Application Interface

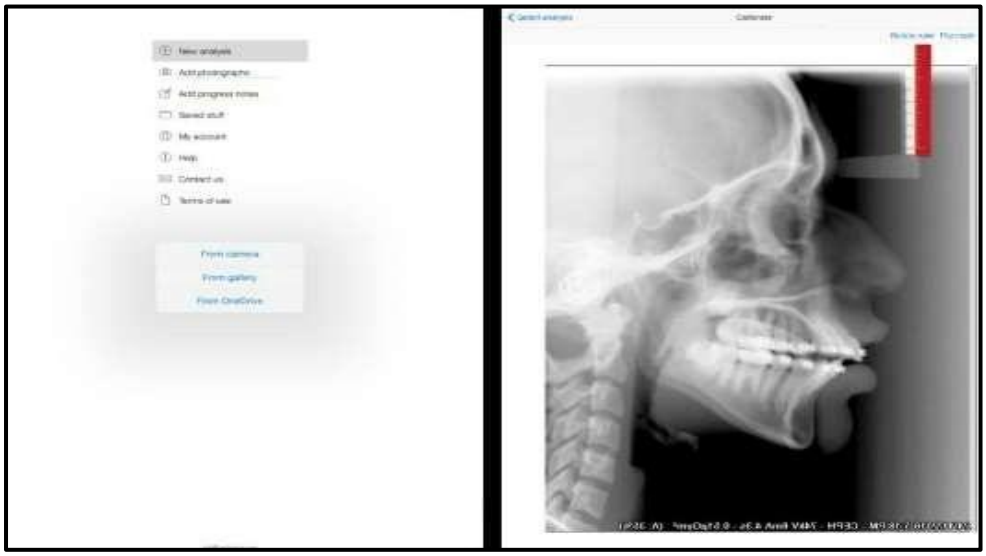


Figure 2: CephNinja Application Interface

Methodology:

Selected 60 digital lateral cephalograms were Group into A and B

Group A	Analysis using NemoCeph
Group B	Analysis using CephNinja

All the digital lateral cephalometric radiographs were taken and Upload on respective application and Calibration and tracing were done Composite Parameters recording of

Skeletal Parameters:

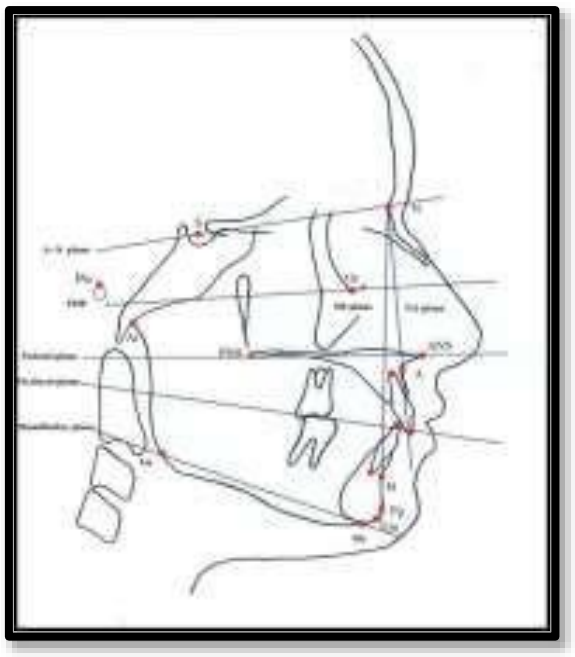


Figure 3: Skeletal Parameters

Sl.No.	PARAMETERS	NEMOCEPH VALUES	CEPHNINJA VALUES
1.	Facial Angle (◦)		
2.	Angle of convexity (◦)		
3.	A-B Angle (◦)		
4.	Mandibular plane Angle (◦)		
5.	SNA (◦)		
6.	SNB(◦)		
7.	ANB(◦)		
8.	FMA(◦)		
9.	FMIA(◦)		
10.	IMPA(◦)		

Dental Parameters:

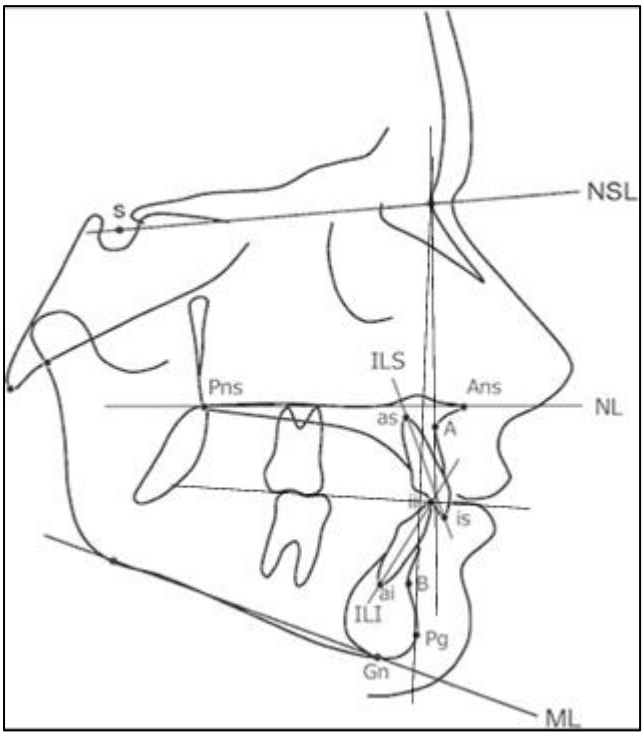


Figure 4: Dental Parameters

Sl.No.	PARAMETERS	NEMOCEPH VALUES	CEPHNINJA VALUES
1.	Incisor Occlusal plane angle		
2.	Incisor mandibular plane angle		
3.	U1-NA(Angular)		
4.	U1-NA(Linear)		
5.	L1-NB(Angular)		
6.	L1-NB(Linear)		
7.	Interincisal angle		

Soft tissue parameters:

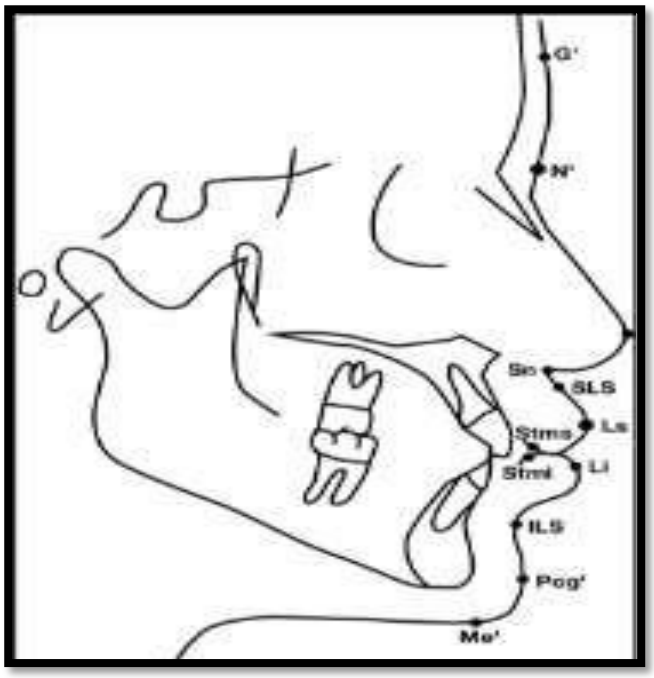


Figure 5: Soft Tissue parameters

Sl.No.	PARAMETERS	NEMOCEPH VALUES	CEPHNINJA VALUES
1.	Nasolabial Angle		
2.	Upper lip length		
3.	Lower lip length		
4.	Upper lip thickness		
5.	Lower lip thickness		
6.	Lower lip Eline		
7.	Me-me’		
8.	Inter labial gap		
9.	A’-B’		

For the reliability of the cephalometric reading, only a single examiner (I.e, the principal investigator) marked the landmarks and asses the measurements.Dahlbergs formula is used to assess the method error.

Statistical Analysis:

The data was then 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 was done to check the level of significance.

The Descriptive Analysis statics include frequency and percentage

The Level of significance for the present study was fixed at 5%.

Result:

The pre-standardized and pre-calibrated digital lateral cephalometric radiographs evaluated for various skeletal, Dental and soft tissue Analysis using the two software i.e.; CEPH NINJA, and NEMOCEPH. The values of cephalometric analysis obtained using the CephNinja software for mobile were compared with the values of cephalometric analysis performed on NemoCeph software for computers.

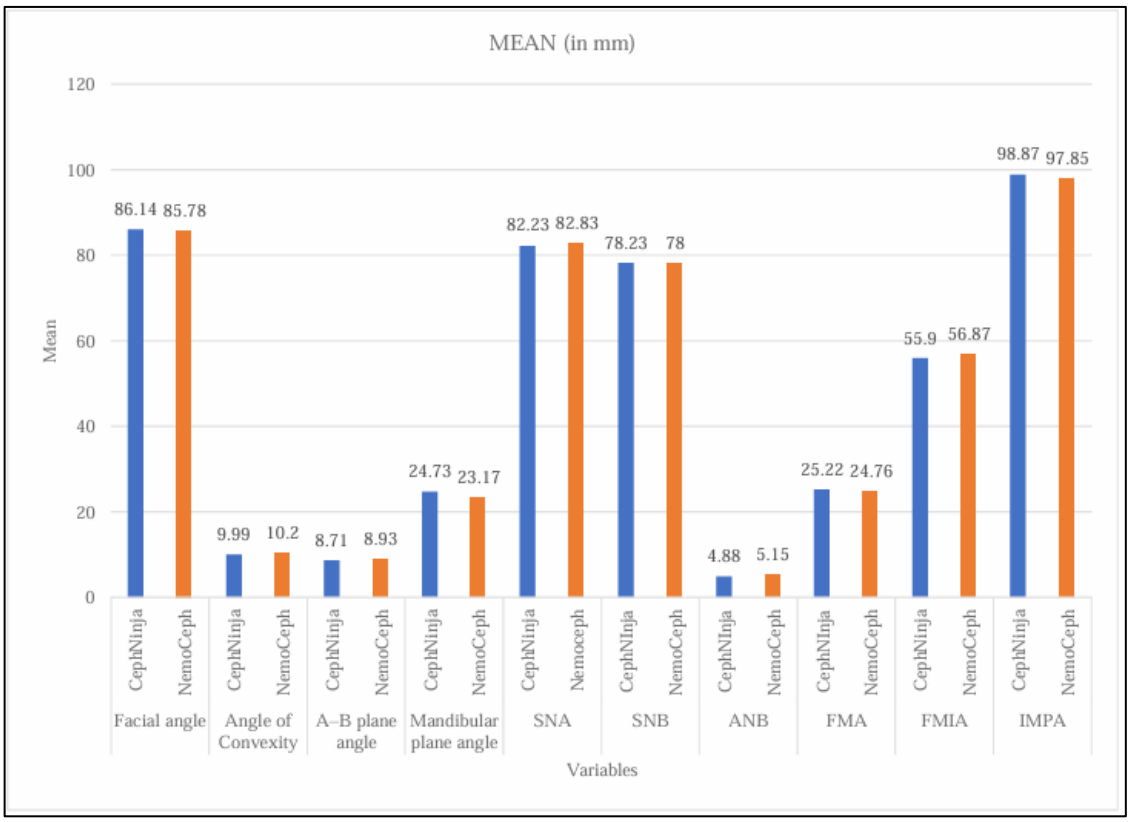
Table1: Comparison of skeletal values between Group A and Group B (one-way analysis of variance)

variables	Group	n	mean± SD	f-statistics	P value	95% confidence interval	
						Lower	Upper
Facial angle	CephNInja	60	86.14 ± 6.20	0.10	0.90	84.18	88.10
	NemoCeph	60	85.78 ± 6.11			83.85	87.17
Angle of Convexity	CephNInja	60	9.99 ± 7.00	0.90	0.41	7.78	12.20
	NemoCeph	60	10.20 ± 7.17			7.93	12.46
A–B plane angle	CephNInja	60	8.71 ± 5.14	0.69	0.50	7.09	10.34
	NemoCeph	60	8.93 ± 4.78			7.42	10.44
Mandibular plane angle	CephNinja	60	24.73 ± 8.63	0.58	0.56	22.00	27.45
	NemoCeph	60	23.17 ± 8.78			20.40	25.94
SNA	CephNinja	60	82.23±4.92	0.24	0.79	80.67	83.74
	Nemoceph	60	82.83±4.45			81.42	84.24
SNB	CephNInja	60	78.23±5.62	0.05	0.95	76.46	80.01
	NemoCeph	60	78.00±5.48			76.27	79.73
ANB	CephNInja	60	4.88±3.09	0.38	0.69	3.90	5.85
	NemoCeph	60	5.15±3.15			4.15	6.14
FMA	CephNInja	60	25.22± 6.01	0.52	0.826	22.23	28.95
	NemoCeph	60	24.76 ±7.06			21.67	27.98
FMIA	CephNinja	60	55.90 ±10.48	0.97	0.764	53.34	65.78
	NemoCeph	60	56.87± 9.89			52.12	62.75

IMPA	CephNinja	60	98.87± 9.00	1.02	0.720	92.76	105.4
	NemoCeph	60	97.85 ±8.89			90.3	102.5

(*p ≤ 0.5 Significant).

The mean difference of the skeletal values obtained using the two software for the variables facial angle, angle of convexity, mandibular plane angle, SNA, SNB and rest of the skeletal variables showed no significant statistical difference at P ≤ 0.5 (Table 1)



Graph 1: Comparison of skeletal values between NemoCeph and CephNinja

A further post hoc test was done between the two group to find the mean difference.

Table 2: Comparison Of Skeletal Values Between Group A and Group B (Post Hoc Test)

Dependent Variable	Group A	Group B	Mean Difference	95% Confidence interval		p-value
				Lower limit	Upper limit	
Facial angle	NemoCeph	CephNinja	-0.36	-3.92	3.20	0.97
Angle of Convexity	NemoCeph	CephNinja	0.20	-3.37	3.78	0.99
A–B plane angle	NemoCeph	CephNinja	0.21	-2.28	2.71	0.98

Mandibular plane angle	NemoCeph	CephNinja	-1.55	-6.07	2.96	0.69
SNA	NemoCeph	CephNinja	0.60	-1.90	3.11	0.84
SNB	NemoCeph	CephNinja	-0.23	-3.24	2.77	0.98
ANB	NemoCeph	CephNinja	0.27	-1.52	2.06	0.93
FMA	NemoCeph	CephNinja	-1.05	-3.44	4.31	0.86
FMIA	NemoCeph	CephNinja	0.89	-5.39	3.54	0.20
IMPA	NemoCeph	CephNinja	0.11	-2.16	4.72	0.64

(*$p \leq 0.5$ Significant).

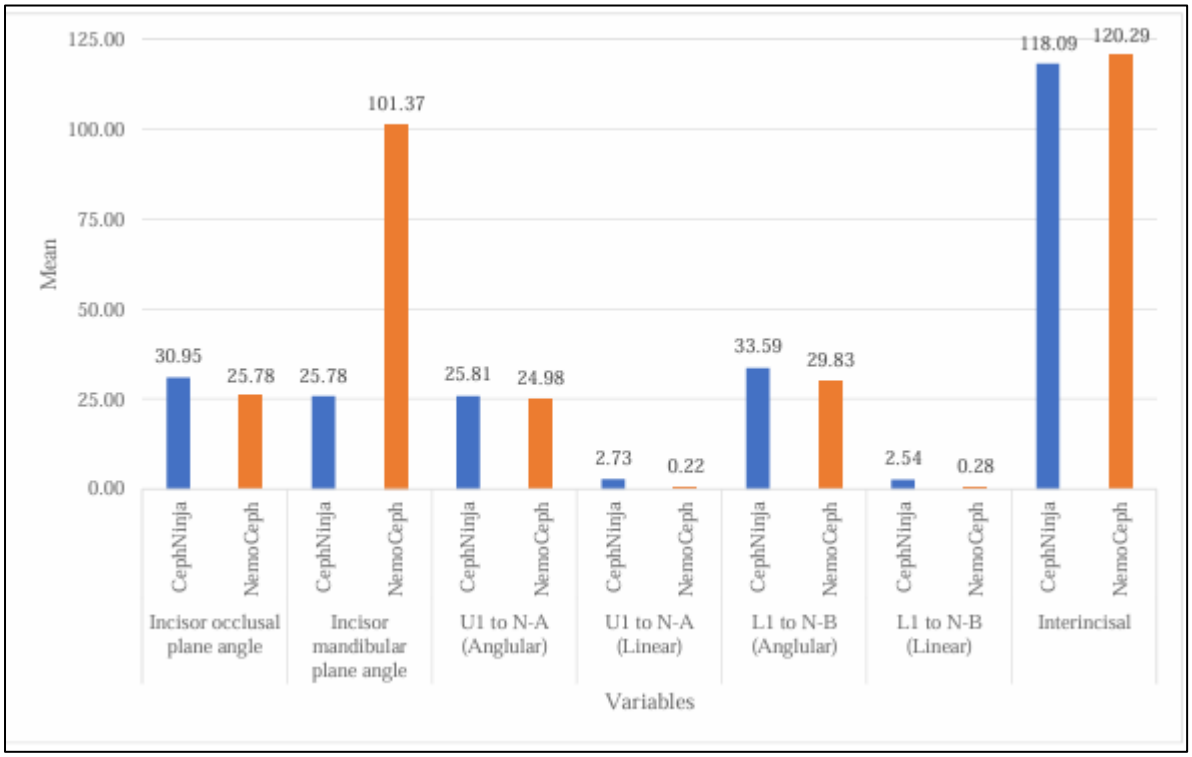
The post hoc test [Table 2] for the skeletal values showed the result with no-significant difference at $p \leq 0.5$.

Table3: Comparison of Dental values between groups (one-way analysis of variance)

Variables	**Group**	**n**	**mean± SD**	**f-statistics**	**P value**	**95% confidence interval**	
						Upper	**Lower**
Incisor occlusal plane angle	CephNinja	60	30.95 ± 7.83	321.31	0.0001	33.42	28.48
	NemoCeph	60	25.78 ± 7.40			28.12	23.44
Incisor mandibular plane angle	CephNinja	60	102.94 ± 6.46	0.41	0.67	104.98	100.90
	NemoCeph	60	101.37 ± 8.73			104.12	98.61
U1 to N-A (Angular)	CephNinja	60	25.81±10.76	1.09	0.34	29.21	22.41
	NemoCeph	60	24.98±9.44			27.96	22.00
U1 to N-A (Linear)	CephNinja	60	2.73±1.38	63.71	0.0001	3.17	2.30
	NemoCeph	60	0.22±0.15			0.26	0.17
L1 to N-B (Angular)	CephNinja	60	33.59±11.86	2.16	0.12	37.26	29.78
	NemoCeph	60	29.83±6.87			32.00	27.66
	CephNinja	60	2.54±0.92			2.83	2.25

L1 to N-B (linear)	NemoCeph	60	0.28±0.11	176.18	0.0001	0.31	0.24
Interincisal	CephNinja	60	118.09±16.06	0.32	0.73	123.16	113.02
	NemoCeph	60	120.29±11.93			124.06	116.53

(*p ≤ 0.5 Significant).



Graph 2: Comparison of Dental values between NemoCeph and CephNinja

The comparison of mean for the dental parameters showed non-significant result for the variables incisor mandibular plane angle, U1 NA angular, L1 NB angular and inter incisor angle at p ≤ 0.5 except for U1 NA Linear and L1 NB Linear which showed highly significant result between the means. (Table 3)

A post hoc test was done between the two group to find the mean difference

Table 4: Comparison Of Dental Values Between Groups (Post Hoc Test)

Dependent Variable	Group A	Group B	Mean Difference	95% Confidence interval		p-value
				Lower limit	Upper limit	
Incisor occlusal plane angle	NemoCeph	CephNinja	-5.17	-8.89	-1.45	0.0001
Incisor mandibular plane angle	NemoCeph	CephNinja	-1.58	-5.81	2.66	0.65
U1 to N-A (Anglular)	NemoCeph	CephNinja	-0.83	-6.26	4.59	0.93

U1 to N-A (Linear)	NemoCeph	CephNinja	-2.52	-3.86	-1.18	0.0001
L1 to N-B (Anglular)	NemoCeph	CephNinja	-3.69	1.16	-8.54	0.17
L1 to N-B (linear)	NemoCeph	CephNinja	-2.26	-3.17	-1.36	0.0001
InterIncisal	NemoCeph	CephNinja	2.20	-5.20	8.60	0.83

(*p ≤ 0.5 Significant).

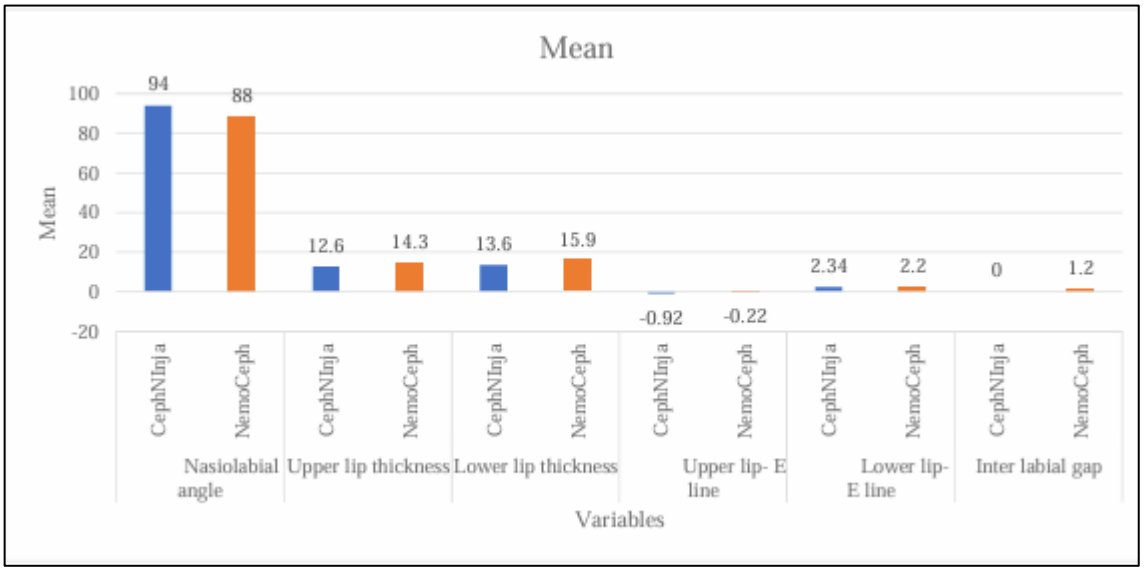
The post hoc test (Table 4) for the dental values obtained using the two different software showed the result with no-significant difference at p ≤ 0.5 for all the variable except-

- Incisor occlusal plane angle
- U1 NA Linear
- L1 NB Linear

Table 5: Comparison of soft tissue values between Group A and Group B (one-way analysis of variance)

variables	**Group**	**n**	**mean± SD**	**f-statistics**	**P value**	**95% confidence interval**	
						Upper	**Lower**
Nasiolabial angle	CephNinja	60	94± 12.23	0.65	0.062	96.78	92.57
	NemoCeph	60	88 ±13.43			90.09	85.32
Upper lip thickness	CephNinja	60	12.6±1.8	0.27	0.53	16.24	10.25
	NemoCeph	60	14.3 ±1.4			16.73	10.43
Lower lip thickness	CephNinja	60	13.6±1.4	0.89	0.76	15.62	9.48
	NemoCeph	60	15.9 ±1.9			19.42	11.64
Upper lip- E line	CephNinja	60	-0.92±2.96	0.21	0.186	-2.54	2.30
	NemoCeph	60	-0.22±2.62			-1.85	1.06
Lower lip-E line	CephNinja	60	2.34±3.03	0.12	0.827	5.68	-1.37
	NemoCeph	60	2.20±2.74			5.31	-1.29
Inter labial gap	CephNinja	60	0.0 ±1.0	0.11	0.24	-1.53	2.56
	NemoCeph	60	1.2±0.5			-2.58	1.39

(*p ≤ 0.5 Significant).



Graph 3: Comparison of soft tissue values between NemoCeph and CephNinj

Table 6: Comparison Of Soft Tissue Values Between Groups (Post Hoc Test)

Dependent Variable	**Group**	**Group**	**Mean Difference**	**95% Confidence interval**		**p-value**
				Lower limit	**Upper limit**	
Nasiolabial angle	NemoCeph	CephNinja	-3.12	-7.35	1.22	0.53
Upper lip thickness	NemoCeph	CephNinja	-1.50	-2.76	2.43	0.21
Lower lip thickness	NemoCeph	CephNinja	-0.57	-3.26	2.58	0.46
Upper lip- E line	NemoCeph	CephNinja	-3.21	-3.95	1.16	0.58
Lower lip-E line	NemoCeph	CephNinja	-4.34	-6.83	1.70	0.87
Inter labial gap	NemoCeph	CephNinja	-1.23	-2.37	2.81	0.32

(*$p \leq 0.5$ Significant).

The post hoc test for the soft tissue values showed the result with no-significant difference at $p \leq 0.5$ (Table 6).

Discussion:

The result of this study states that the average differences in skeletal measurements, such as facial angle, angle of convexity, mandibular plane angle, SNA, SNB, and other skeletal variables, showed no significant statistical differences between the two software programs NemoCeph and CephNinja,

Similarly, the comparison of dental parameters revealed no significant differences for variables like incisor mandibular plane angle, U1 NA angular, L1 NB angular, and inter incisor angle at, except for U1 NA Linear and L1 NB Linear, which showed highly significant differences. Additionally, the values for soft tissue variables obtained using both software programs showed no statistically significant differences.

The study assessed the cephalometric values obtained by two widely used cephalometric analysis software that is CephNinja and NemoCeph and were evaluated and compared for the diagnostic performance for CephNinja for cephalometric analysis. The data collected from both the software for different skeletal, dental and soft tissue parameters demonstrated comparability, with no statistically significant differences except for incisor occlusal plane angle,Upper Incisor to N-A (linear) and Lower Incisor to N-B (linear).

This observation was in accordance to study conducted by Chen S. K. et.al. (2004)[11], Celik E. et. al.; 2009[12] and Mukesh kumar et. al (2019)[13], who concluded the study with significance difference for incisor occlusal plane angle,Upper Incisor to N-A (linear) and Lower Incisor to N-B (linear) and stated that the significance difference could be due to anteroposterior relationship and midface structures, and difficulties in locating its landmarks, mainly point A and the FOP, which are noted for their poor reproducibility. Also,Chen et al. (2004)[11] described the identification of point A as very demanding because of overlapping of ANS and the upper incisors in the two-dimensional projection of the skull.[11]

Over the past two decades, numerous researchers have examined and assessed the effectiveness of various software programs for cephalometric analysis, such as Down's, Steiner's, and Tweed's, comparing them to hand tracing methods. Sayinsu K. et al. (2007)[14] Dvortsin D. P. et al. (2008)[15], Sohrab Shaheed S. et al. (2011)[16] these studies consistently concluded that the software performed equivalently well. This aligns with earlier research by Chen S. K. et al. (2004)[11], who reported reliable and comparable results of computerized software to hand tracings, suggesting it as a preferred option with minor significant differences, which were clinically irrelevant.

Based on the various researches that has been conducted on different software for this purpose, such as the sonically generated images by Prawat J.S. et al. in (1995)[17] where they had compared the validity and reproducibility of cephalometric values generated sonically on a digital image analyzer (Digigraph) with those obtained from standard cephalometric radiographs for 43 different measurements either in dental or skeletal parameters, the study found that the data generated from the digital image analyzer to be markedly variable, while the radiographically obtained data were reproducible.

Naoumova J. and Lindman R. (2009)[18] compared the accuracy of cephalometric measurements made with the FACAD digital tracing software to hand-traced measurements. They evaluated the reproducibility of each method and found that the results were similar, concluding that digital tracing

with FACAD is reliable and can be used routinely.

All previous studies done were found and proved to be excellent for landmark reproducibility and clinically acceptable repeatability.[19] With a few exceptions, these are comparable to hand tracings and are all considered reliable for routine use. A comparative study by Erkan M et al(2012)[20]. and Demirel B (2012)[21], where they had compared the traditional method of manual cephalometric tracing with four different computerized tracing programs, Dolphin Imaging, Vistadent, Nemoceph, and Quick Ceph where the lateral cephalograms were scanned at 300 dpi and digitized onscreen reported smallest difference with Dolphin followed by Nemoceph, Quick Ceph and Vistadent compared to traditional method, with no statistically significant difference. Their study concluded that NemoCeph can be used as an alternative to manual cephalometric analysis.

Computer aided tracing software for Cephalometric Analysis by P.Leevan Paul et al (2023)[21] concluded Angular measurements such as Occlusal plane to SN ($P< 0.05$) and Nasolabial angle ($P< 0.05$) linear parameters such as N perpendicular to Point A ($P< 0.05$) and Wits Appraisal ($P< 0.05$) showed significant difference between the different tracing among the analyzed 10 Angular and 11 Linear measurements, occlusal plane to SN and Wits appraisal measurements varied in Nemoceph and Webceph when compared with the manual tracing ($P< 0.05$). This was consistent with the results of the study done by Tikku et al (2014)[22], where Occlusal plane to SN showed significant variation with Nemoceph when compared to manual tracing. Regarding the parameters Nasolabial angle and N perpendicular to point A, the variation was more with WebCeph when compared to the Semi-automatic tracing (Nemoceph) and manual tracing. The significant difference in the Nasolabial angle in Automatic tracing (WebCeph) may be due to proportionally larger measurement errors as the Nasolabial angle is determined using landmarks positioned on a curve with wide radii.

Both software programs can be used interchangeably with similar confidence for cephalometric analysis. The mobile-based CEPH NINJA application emerges as a viable alternative to the commercially available, computer-based NEMOCEPH software. All the previous study on the accuracy and reliability of an automated tracing Android app compared with conventional and semi-automated methods supports this finding.

Conclusion:

- The study evaluated and compared the cephalometric values obtained by two widely used cephalometric analysis software that is, CephNinja and NemoCeph.
- The findings of the study indicated that there was no significant difference in the parameters except for incisor occlusal plane angle, U1-NA (linear) and L1-NB (linear) that were evaluated and compared for the diagnostic performance for CephNinja for cephalometric analysis.
- Both software tools demonstrated a high level of accuracy and consistency in their measurements.

Limitation of the study

The study relied on a convenience sample of 100 diagnostic digital lateral cephalograms, which may not be representative of the broader population. The sample size of 60 diagnostic digital lateral cephalograms may not provide sufficient statistical power to detect small differences between Nemoceph and CephNinja.

Also, Conducting the study at a single centre may limit the generalizability of the findings to other settings or populations and difference versions of the software may have different features and performance levels.

Scope for further investigation

Conducting studies over a longer period to assess the consistency and reliability of both software systems.

Expanding the sample size to include a more diverse population, which could help improve the generalizability of the results.

Comparing Nemoceph and CephNinja with other cephalometric analysis software to evaluate their relative performance and accuracy.

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