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# Comparative Evaluation of CEPH Ninja for Android and Nemoceph for Computer for Steiner's Cephalometric Analysis.

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## ABSTRACT

**Background:** Orthodontics and Dentofacial Orthopaedics, requires a cautious acquisition and interpretation of a large amount of information to achieve a correct diagnosis and treatment planning. Manual techniques are time consuming and tedious. The digital technology is advantageous but the affordability remains obstacle. **Objectives:** The main aim of this study was to compare the linear and angular measures between the two methods, Ceph Ninja and Nemoceph. No significant difference between the two methods will result in that Ceph Ninja can be used as an 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 results of this study showed the skeletal and dental values had no statistical significant difference in the majority, except for the linear values of Lower Incisor and Upper Incisor with N-A and N-B respectively. **Conclusion:** It seems that the two software can be used interchangeably with high confidence.

***Keywords:*** Cephalometric Radiography, Cephalometric Analysis Software, Manual Analysis.

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## INTRODUCTION

Orthodontics and Dentofacial Orthopaedics, requires a cautious acquisition and interpretation of a large amount of information to achieve a correct diagnosis and treatment planning.[1] The introduction of cephalometrics by Broadbent in USA and Hofrath in Germany has offered a new stature to the speciality.[2-4] Cephalometry summarizes the architect of the human craniofacial structure into distances and angles.[5] and therefore, cephalometric analysis becomes an important clinical tool for diagnosis, treatment planning and evaluation post treatment changes together with the growth studies.[5-9]

Conventionally, cephalometric images were analyzed by manual tracing of radiographs, and has the disadvantage of being time consuming, tedious, requires special armamentarium and subject to random and systematic error.[3,5]

With the development of computer technology, on screen tracing and analysis has become a dream come true.[6] Recently, computer software supporting cephalometric analysis have gained more popularity and wide spread use because of ease, less time consuming, and precise together with the ease in archiving and communication of data.[2] The digital technology offers several other advantages over conventional method in terms of chemical causing environmental hazards are eliminated.[1,6,10] A prime factor deciding the accuracy of on screen method is - resolution, pixel size, shades of grey, and compression format.[6] The inherent disadvantages of these on screen tracing systems are – affordability, availability and specific training.

Therefore, the present study was conducted with an objective to compare and evaluate the measurement obtained using CEPH NINJA (a free software for cephalometric analysis) and NEMOCEPH (a commercially available software for cephalometric analysis) 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 -**

1. NEMOCEPH NX 2009 for Windows and
2. CEPHNINZA for android (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). An android phone was used for cephalometric analysis using CEPH NINJA (free download) Software. The cephalometric image to be evaluated was marked for the cephalometric landmarks as demanded by the software. 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 two software i.e.; CEPH NINJA, 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 | N | Mean ± SD | F-Statistics | P-value | | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | lower | upper |
| SNA | Ceph Ninja | 100 | 82.23±4.92 | 0.24 | 0.79 | No Significance | 80.67 | 83.78 |
| | Nemoceph | 100 | 82.83±4.45 | | | | 81.42 | 84.24 |
| SNB | Ceph Ninja | 100 | 78.23±5.62 | 0.05 | 0.95 | No Significance | 76.46 | 80.01 |
| | Nemoceph | 100 | 78.00±5.48 | | | | 76.27 | 79.73 |
| ANB | Ceph Ninja | 100 | 4.88±3.09 | 0.38 | 0.69 | No Significance | 3.90 | 5.85 |
| | Nemoceph | 100 | 5.15±3.15 | | | | 4.15 | 6.14 |
| Mandibular Plane Angle | Ceph Ninja | 100 | 28.44±7.93 | 0.23 | 0.80 | No Significance | 25.93 | 30.94 |
| | Nemoceph | 100 | 28.95±7.69 | | | | 26.52 | 31.38 |
| Occlusal Plane Angle | Ceph Ninja | 100 | 15.24±6.75 | 0.67 | 0.51 | No Significance | 13.11 | 17.37 |
| | Nemoceph | 100 | 15.85±6.31 | | | | 13.86 | 17.84 |

(*p ≤ 0.5 Significant).

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

| Dependent Variable | Group | Group | Mean Difference | 95% Confidence interval | | p- value |
|---|---|---|---|---|---|---|
| | | | | Lower limit | Upper limit | |
| SNA Angle | Nemoceph | Ceph Ninja | 0.60 | -1.90 | 3.11 | 0.84 |
| SNB Angle | Nemoceph | Ceph Ninja | -0.23 | -3.24 | 2.77 | 0.98 |
| ANB Angle | Nemoceph | Ceph Ninja | 0.27 | -1.52 | 2.06 | 0.93 |
| Mandibular Plane Angle | Nemoceph | Ceph Ninja | 0.51 | -3.80 | 4.83 | 0.96 |
| Occlusal Plane Angle | Nemoceph | Ceph Ninja | 0.61 | -2.64 | 3.86 | 0.90 |

(*p ≤ 0.5 Significant).

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

| Variable | Group | N | Mean ± SD | F-Statistics | P-value | | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | lower | upper |
| U1 to N-A (Angle) | Ceph Ninja | 100 | 25.81±10.76 | 1.09 | 0.34 | No Significance | 22.41 | 29.21 |
| | Nemoceph | 100 | 24.98±9.44 | | | | 22.00 | 27.96 |
| U1 to N-A (Linear) | Ceph Ninja | 100 | 2.73±1.38 | 63.71 | 0.0001 | Significance | 2.30 | 3.17 |
| | Nemoceph | 100 | 0.22±0.15 | | | | 0.17 | 0.26 |
| L1 to N-B (Angle) | Ceph Ninja | 100 | 33.59±11.86 | 2.16 | 0.12 | No Significance | 29.78 | 37.26 |
| | Nemoceph | 100 | 29.83±6.87 | | | | 27.66 | 32.00 |
| L1 to N-B | Ceph Ninja | 100 | 2.54±0.92 | 176.18 | 0.0001 | Significance | 2.25 | 2.83 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (Linear) | Nemoceph | 100 | 0.28±0.11 | | | | 0.24 | 0.31 |
| Inter Incisal Angle | Ceph Ninja | 100 | 118.09±16.06 | 0.32 | 0.73 | No Significance | 113.02 | 123.16 |
| | Nemoceph | 100 | 120.29±11.93 | | | | 116.53 | 124.06 |

(*p ≤ 0.5 Significant).

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

| Dependent variable | Group | Group | Mean difference | 95% Confidence interval | | p- value |
|---|---|---|---|---|---|---|
| | | | | Lower limit | Upper limit | |
| Upper Incisor to N-A (Angle) | Nemo | Ninja | -0.83 | -6.26 | 4.59 | 0.93 |
| Upper Incisor to N-A (Linear) | Nemo | Ninja | -2.52 | -3.86 | -1.18 | 0.0001 |
| Lower Incisor to N-B (Angle) | Nemo | Ninja | -3.69 | 1.16 | -8.54 | 0.17 |
| Lower Incisor to N-B (Linear) | Nemo | Ninja | -2.26 | -3.17 | -1.36 | 0.0001 |
| Inter Incisal Angle | Nemo | Ninja | 2.20 | -5.20 | 8.60 | 0.83 |

(*p ≤ 0.5 Significant).

The dental values also showed no statistical significant in the majority, except for the linear values of Lower Incisor and Upper Incisor with N-A and N-B respectively (*p ≤ 0.5 Significant). [Table 3 and 4]

## DISCUSSION

It is important for the orthodontists examining a patient with a malocclusion, to obtain a precise assessment of the craniofacial relationship.[6,11,12] Lateral Cephalogram the tool for research laboratory has become an indispensable article for the orthodontis's inventory.[13-16]

Conventionally, cephalometric radiographs were traced and analyzed manually. The associated drawbacks have proven to be troublesome and burden.[17,18] Digital radiographs and on screen tracing has possibly overcome the limitations of traditional technique.

Recently computers are being utilized for image acquisition, image quality balancing, and interpretation of the cephalometric radiograph.[19] landmark identification and digital tracing has become possible With the development of new technology.[20,21]

Numerous researchers have designed and tried different software with admirable success and have been proved to be landmark in the series. The research reports of sonically generated image (Prawat J.S. et. al.; 1995), FACAD® software (Naoumova J. and Lindman R. 2009), Cef-X 2001 software (Guedes P.D.A. et. al.;2010), Picture Archiving and Communications System (PACS) (Tan S.S.W. et.al.; 2011), e.t.c have all proved to be excellent for landmark reproducibility and clinically acceptable repeatability. With a few exceptions, these are comparable to hand tracings and are all considered reliable for routine use.[12,22-24]

A comparative study by Erkan M., Gurel H.G., Nur M. and Demirel B. (2012),reported smallest difference with Dolphin followed by Nemoceph, Quick Ceph and Vistadent compared to traditional method, with no statistical significant difference.[25]

The availability and affordability of these software remained questionable for routine clinical use in the developing country and for the budding orthodontist. Therefore, a need has arisen for a method of cephalometric analysis that is affordable, less time consuming and available to the orthodontist's office without any monetary burden. The present study compared the NEMOCEPH and CEPH NINJA for Steiner's cephalometric analysis.

In the past two decades, many researchers have analyzed and evaluated the efficacy of various software programs and have compared this with hand tracing. It was declared over and over again that, these software are equivalently good.

The present study showed comparable and non significant statistical difference amongst the software evaluated, with a few exceptions.

This was in consonance with the previous studies of Chen S. K. et.al.; (2004)and Sayinsu K. et.al.; (2007), who reported a reliable and comparable result of computerized software to hand tracings, ,and could used as a preferred option. A similar result was shown by Dvortsin D. P. et. al.; (2008) and SOHRAB SHAHEED S. et al (2011), who reported small significant differences but non relevant clinically.[26-29] Our result showed significant statistical difference for the observed values of Upper Incisor to NA (linear) and Lower Incisor to N-B (linear). This was in consonance to Chen S. K. et.al.; 2004, and Celik E. et. al.; 2009, who reported error in anteroposterior relationship and midface structures, and difficulty in locating lower incisor (Tsorovas G. and Karsten A.L.2010.[20,26,30]

It was found that, the data were comparable clinically, with no statistical significant difference, except for a few points. Therefore, the two software could be used alternatively with equivalent confidence for cephalometric analysis. The CEPH NINJA could be considered as a good alternative to the commercially available NEMOCEPH cephalometric software.

## CONCLUSION

Cephalometrics, the most basic and oldest tool in the orthodontist's inventory has seen many archetype. Cephalometric errors are multifactotial, but a precise location and identification of landmarks has remained the key to success.

Even though the evolving technology has tried to overcome a majority of limitations and has offered a quick serve option for multiple analysis and treatment planning in a single button click. Clinical judgment remains supreme, and the clinicians should understand the weaknesses of each method and interpret the results cautiously.

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