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Comparative Evaluation Of The Reliability Of Cephalometric Analysis Using Oneceph And Dolphin Imaging Software Against Manual Tracing - A Cephalometric Study

Anfiya Nazeer[1], Sam Paul [2] ,Prince C Chacko[3],Varun Peter[4]
[1](Pg Student, Dept. Of Orthodontics/ Educare Institute Of Dental Science, India)
[2](Professor And Hod, Dept. Of Orthodontics/ Educare Institute Of Dental Science, India)
[3](Professor, Dept. Of Orthodontics/ Educare Institute Of Dental Science, India)
[4](Reader, Dept. Of Orthodontics/ Educare Institute Of Dental Science, India)

Abstract:
Background*: There are numerous uses for cephalometric analysis in orthodontics. Lateral cephalometric analysis is one of the gold standard diagnostic aids in orthodontics, with various software available to enhance this. This study was done to compare and evaluate the reliability of cephalometric analysis using; Android based OneCeph version 9 and Dolphin imaging software version 11.95 programs with conventional manual tracing.*
Materials and Methods*: This is a cephalometric study done on 50 pre-treatment lateral cephalometric radiographs of subjects who reported to the postgraduate orthodontic clinic for orthodontic treatment over six month. Cephalometric tracings were done using OneCeph digital software, Dolphin imaging software and manual tracing method to evaluate ten parameters of Steiner's cephalometric analysis. ANOVA test was done between the mean values of manual, dolphin digital method and OneCeph tracing. For the difference found Post-Hoc Tukey's test was done for multiple comparisons.*
Results*: No significant statistical difference was seen as the p-value was greater than 0.05 for all the parameters in the three groups.*
Conclusion: *The reliability of OneCeph software application was found to be at par with dolphin imaging software and manual cephalometric tracing.*
Key Word*: Cephalometric analysis, OneCeph, Dolphinsoftware, Digital ceph tracing*

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I. Introduction

In 1931, Broadbent (USA) and Hofrath (Germany) simultaneously introduced a standardized cephalometric technique with a high-powered X-ray machine and a head holder named Cephalostat or cephalometer.[1] Cephalometric analysis has been universally used since then in the field of orthodontics for case diagnosis, treatment planning, evaluation of treatment progress, evaluation of treatment results, and prediction of growth. Cephalometric analysis can be carried out with manual or digital methods. Manual cephalometric analysis consumes valuable time due to its tedious procedures. Numerous cephalometric software is presently available in the market, which are easy to use, and conserve time.[2-9] These softwares are costly and would require a laptop or a desktop which makes it laborious and less accessible. Practitioners in most developing and underdeveloped countries find it hard to pay for such software.

Traditional cephalometric analysis is done by identifying radiographic landmarks on an acetate transparent sheet and marking the linear and angular values with a protractor and ruler. The progress in the field of computer science has led to the extensive use of computers in orthodontic cephalometry. The Dolphin imaging software was the first digital innovation that was employed in the orthodontic field, which was introduced in 1994. The manual approach is the oldest and most popular one[10.]

Mobile phones have made far-reaching changes in our way of life and have become an integral part of our day-to-day life. From being used for the simple purpose of communication to currently being used for a wide range of purposes including finance, entertainment, defence, education, and medicine; they have undergone a rapid transformation. Over the past few years, mobile phones have quickly changed how we treat our patients and hence artfully named smartphones. In orthodontics, smartphone apps are used for patient education, diagnosis, and treatment planning .[11,12]

The word "mobile phone" implies the advantage of accessibility and mobility on the go. Mobile cephalometric software app which is quickly accessible through our smartphones is a necessity of the present day. One such app is the OneCeph (version 9 NXS Hyderabad, India) which is free to use app available on the Android play store.[13] In this study, we compared the reliability of cephalometric measurements made using the OneCeph app against the dolphin imaging software and conventional manual tracing.

II. Material And Methods

This retrospective cephalometric study was performed on pre-treatment lateral cephalometric radiographs gathered from subjects who reported for orthodontic treatment over a period of 6 months. The institutional ethical committee approved this study design.

Study Design: Retrospective cephalometric study

Study Location: Department of Orthodontics and Dentofacial Orthopaedics, Educare Institute of Dental Sciences, Malappuram, Kerala.

Study Duration: October 2023 to February 2024.

Sample size: 50 lateral cephalograms

Sample size calculation: The sample size was determined using data obtained from the previous study conducted by Christos Livas.[14] The calculated effect size was 0.25 with an alpha error probably of 0.05 and a power of 0.80. The sample size was calculated using G*Power 3.1.9.4. So the calculated total sample size was 50.

Subjects & selection method: Fifty lateral cephalograms were collected. Patients with gross asymmetry, syndromes, radiographs with poor quality, faulty head positions, or any other conditions that make it difficult to identify the landmarks were rejected from the study. All the participants were within the age group 15–25 years with a mean age of 15.4 ± 3 years.

Inclusion criteria:

1. Lateral cephalograms taken for the treatment purpose in the department
2. Lateral cephalograms taken on the same cephalostat machine.
3. Lateral cephalograms of the patients with class I, II and III skeletal bases.
4. Lateral cephalograms of patients between the age of 15 and 25
5. High quality radiographs without any artifacts that could interfere with locating anatomical points.
6. Cephalograms with permanent dentition

Exclusion criteria:

1. Cephalograms with craniofacial deformity.
2. Cephalograms with congenital abnormality of craniofacial region.

Procedure methodology

The lateral cephalograms were taken in natural head position with eyes looking straight ahead, teeth in maximum intercuspation and the lips in a relaxed position. The patient's head was immobilized using a cephalostat. Patients were positioned with Frankfort horizontal plane parallel to the ground and perpendicular to midsagital plane before taking radiographs. All cephalograms were captured with CS-9300S digital panoramic and cephalometric system (Figure1) to ensure standardization of cephalograms. The tube potential was 90 Kvp and the current was 15 mA. The radiographs were obtained in the JPG image format. All digital cephalograms were printed using Carestream Dryview 5700 laser imager (Figure 2). All digital radiographs and printouts were of magnification 0 %.

Outcome measurement

Manual tracing:

Manual tracing was performed on an illuminated view box in a dark room. The same examiner carried out all the cephalometric analysis. A well-experienced examiner verified the lateral cephalograms, disagreements will be resolved to the satisfaction of both investigators. Transparent tracing paper (Garware Economy Acetate Tracing Paper) Sheets, Size 8 inches*10 inches, 0.002 mm was used for manual tracing. Tracing was done on tracing sheets taped over the X-ray printout and using a 0.5 mm HB mechanical lead pencil. To avoid inaccuracy due to fatigue, not more than 4 cephalograms were traced per day. Linear and

angular measurements of Steiner's cephalometric analysis[15] were measured to the nearest 0.5 mm and 0.5° respectively. Steiner's analysis (10 parameters) was performed because of the recurrent use of this analysis in our department and its availability for cephalometric analysis in the android app selection menu and in the computer-based digital software menu.

Figure 1: CS-9300S digital machine

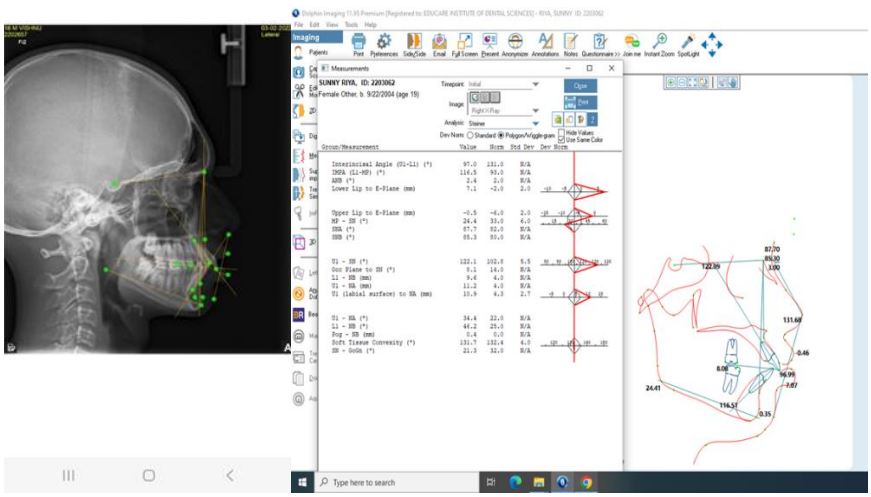
Figure 2: Carestream Dryview 5700 laser imager

OneCeph Analysis:

For digital cephalometric measurements, digital images of selected cephalograms in JPG format were imported to the OneCeph (Google Play Store, Google Inc, Mountain View, Calif) application on an android smartphone (Samsung Galaxy A12 Smartphone, Samsung Telecommunications, Suwon, South Korea). After calibration of the images based on the calibration scale, the same operator on digital images using a stylus pointed out skeletal and dental landmarks for Steiner's analysis. After finishing landmark plotting, linear and angular measurements of Steiner's analysis were derived from the OneCeph application.[15] All cephalometric measurements observed were entered into the Excel spread sheet. (Figure 3)

Figure 3: One ceph app

Figure 4 : Dolphin imaging software 11.95



Dolphin imaging software:

The same radiographs were used for Dolphin 11.95 program analyses. Same examiner digitized the landmarks required in Dolphin program and the computer accessed Steiner's analysis and produced the results. All cephalometric measurements were entered into the Excel spread sheet.(Figure 4)

Statistical analysis

IBM SPSS Software version 21 was used for statistical analysis. Statistical analysis was performed using One-way analysis of variance. For difference found post HOC TUKEY'S test was used for multiple comparison. The level $P < 0.05$ was considered as the cutoff value or significance.

III. Result

The comparison of the mean measurements for all the parameters of Steiner's analysis between the groups showed that there was no significant difference between all the three techniques.(Table 1).

The skeletal measurements such as SNA,SNB,ANB,Occlusal plane angle(OP), Mandibular plane angle(MP) ,when compared between the dolphin method of digital tracing ,OneCeph app and manual tracing,the results were almost maching .

Similarly, when the dental measurements such as Upper incisor to NA angular measurement (U1 to NA) , Upper incisor to NA linear measurements (U1 to NA mm) , Lower incisor to NB angular measurement (L1 to NB), Lower incisor to NB linear measurement (L1 to NB mm), Interincisal angle (II) were compared,the values obtained from all the three methods were similar.

Table no 1 : Shows Comparison of results of the tests between three different methods tracings using one way ANOVA

Parameters	Sum of Squares	DF	Mean Square	F	P value
SNA	8.871	2	4.436	.221	.802
SNB	2.580	2	1.290	.089	.916
ANB	2.474	2	1.237	.180	.836
OP	144.871	2	72.435	2.895	.058
MP	45.734	2	22.864	.530	.589
U1 to NA	18.960	2	9.480	.175	.840
U1 to NA mm	10.903	2	5.451	.665	.516
L1 to NB	4.192	2	2.096	.046	.955
L1 to NB mm	.052	2	.096	.002	.998
II	38.195	2	19.098	.253	.777

IV. Discussion

OneCeph is one of the few simply available software, which can be downloaded from the Google Play store app in any of the recent smartphones, which run on the Android operating systems. The reliability and reproducibility of this recently launched software have not been compared at the same time with the Dolphin digital method and conventional manual tracing. Therefor in our study, we compared the reliability of cephalometric analysis done using OneCeph software,Dolphin digital method and manual tracing .Steiner's analysis was selected for this study because it is one of the most widely used cephalometric analyses which has both angular and linear measurements as well as skeletal and dental parameters.[15] Ten parameters from the Steiner's analysis were measured . They are SNA,SNB,ANB ,Occlusal plane angle (OP) ,Mandibular plane angle (MP) , Upper incisor to NA angle (U1 to NA), Upper incisor to NA linear measurement (U1 to NA mm),), Lower incisor to NB angle (L1 to NB), Lower incisor to NB linear measurement (L1 to NB mm) ,Interincisal angle.[15]

The comparison of the mean measurements for all parameters of Steiner's analysis between the groups showed that there was no significant difference between both the techniques. Similar studies have been done for desktop software like Dolphin® , NemoCeph, VistadentTM, Quick Ceph, AOCephTM, FACAD® , and AutoCEPH©. The authors have claimed that the accuracy and reliability of this software are similar to the manual cephalometric tracing and therefore can be used as an aid in diagnosing, planning, monitoring, and evaluating orthodontic treatment both in clinical and research settings.[2–9] However, the drawbacks of desktop cephalometric software are that it can only be used on a desktop or a laptop,which is expensive, and require an internet connection.

In recent years, much cephalometric software like Smile-Ceph, Ceph Ninja, and Smart Ceph Pro apps have been launched in the market, which can be performed on tablets and smartphones. Few of the studies have found that these mobile digital cephalometric software and applications were more accurate and can be used as an substitute to manual tracing.[16-17] A study by Gorracci et.al showed good reliability for all cephalometric measurements calculated with the iPad-based software Smile-Ceph, desktop software NemoCeph and manual tracing.[18] One of the drawbacks of this software is that it can be accessed on an iPad tablet and IOS devices only.

OneCeph is on& such mobile software that is easy to use, quick, & easily dispensable, and user-friendly as it is operated by Android mobile phones.[13] The software is multifaceted as it can be used to do most of the conventional as well as contemporary cephalometric analysis. OneCeph can function on a smartphone

even without an internet connection; thus, can be used in doing studies in rural centers with less convenience to the internet. However, this software is currently available only in the android play store and not available in other operating systems like Windows, IOS, etc. Android smartphones are broadly used in developing countries as it is easily available and reasonable. Hence, dental practitioners and dental students working in primary health care centers in rural locations can handily use OneCeph software. Since this software can do analysis only on 2D images hence the disbenefits of all the 2D analysis apply to this software as well. An integrated approach of diagnosis and treatment planning using smartphone cephalometric analysis software will be a valuable platform in rural villages in developing countries with little access to specialized oral health care services, where there is a huge need for orthodontic treatment, orthognathic surgery, cleft, and craniofacial deformity management. With the recent advent of the COVID-19 pandemic, orthodontic expertise can be shared with the general dental practitioners serving in rural dental clinics via teleconferencing and can successfully enhance the timely orthodontic intervention for patients with an urgent need

The influence of technology has become very prominent and has emerged as a critical part of medical and dental education, clinical research, diagnosis, and treatment planning. The widespread use of dentistry-related smartphone apps by students and practitioners to supplement their learning and clinical practice is a testimony of technological advancement. These apps can easily be integrated into the digital workflow thus improving patient management efficiency. Moreover, the cephalometric results obtained from the OneCeph app can be stored, used, and retrieved as per the need saving a lot of office space that would otherwise be consumed in the storage of records. This study used variables from an extensively practiced cephalometric analysis to simulate a real-life experience and to test uniformly the performance of the app.

V. Conclusion

The reliability of the OneCeph software application was at par Dolphin digital method and with manual tracing. OneCeph is a simple, reliable, accurate alternative to manual tracing that can be easily accessed on a smartphone without an internet connection thereby saving clinical time and armamentarium.

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