ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAR1645

A Comparative Study of Two Smartphone Applications and a Traditional Orthodontic Model Analysis Method

Dr. Madhura Pradip Wagh[1]; Dr. Sunilkumar Pulluri[2]; Dr. Akash Lavate[3]; Dr. Sneha Hoshing[4]; Dr. Sneha Shinde[5]; Dr. Phalguni Warate[6]
Pandit Deendayal Upadhyay Dental College, Solapur, Maharashtra, India

Abstract:-

➢ ***Introduction***

An orthodontic study used to determine whether teeth are positioned appropriately and whether there is an opportunity for orthodontic therapy or tooth extractions by model analysis. While certain manual model studies can be laborious and time-consuming, there are smartphone applications that can simplify the mathematical calculations necessary for orthodontic cast model analysis.

➢ ***Objective***

The purpose of this research is to compare the outcomes and processing times of model analysis utilizing two smartphone apps, such as Model Analysis App and iModel Analysis, and the traditional technique.

➢ ***Materials And Methods***

This is a comparative analytic study. The samples are made up of thirty dental casts that underwent several model studies, including as the Boltons, Ashley-Howe, Carey's and Arch Perimeter assessments. A comparison in results and time was carried out for these model analyses using three methods - conventional method, iModel Analysis App and Model Analysis App.

➢ ***Results***

The conventional technique gave results for a Bolton's overall ratio analysis of 3.3967±3.44579, iModel Analysis produced results of 3.4333±3.77709, while the Model Analysis app produced results of 4.6200±6.83744. The conventional technique yielded results for Bolton's anterior ratio analysis of 4.9133±5.81969; iModel Analysis produced results of 4.7700±5.57743; and the Model Analysis app produced results of 4.7500±5.59068. The results of arch perimeter discrepancy analysis for conventional method were 4.0000±3.15135, those for iModel Analysis was 4.0000±3.15135, and for Model Analysis app it was 4.0000±3.15135. The results of Carey's discrepancy analysis for conventional method were 3.8667±2.59620, those for iModel Analysis was 3.8667±2.59620, and for Model Analysis app it was 3.8667±2.59620. The results of Ashley - Howe PMBAW% analysis for conventional method were 44.0200±3.71255, those for iModelAnalysis was 42.1367±5.74531, and for Model Analysis app it was 43.8133±3.71787. The results of Pont's expansion analysis for conventional method, iModel Analysis and for Model Analysis app showed p value 0.114 (not significant = p>0.05). The results of period required for the analysis by conventional method were 903.3000±30.19951, while those for iModelAnalysis was 399.2000±42.94375, and for Model Analysis app it was 392.0333±35.58233.

➢ ***Conclusion***

There was no critical distinction within the results of the examinations done by the different methods. However, there was a noteworthy contrast within the time duration required to carry out the examination by conventional methods and that of iModelAnalysis and Model Analysis App.

Keywords:- *Conventional; imodel Analysis; Model Analysis App.; Model Analysis; Time of Analysis.*

I. INTRODUCTION

Early in the 18th century, dentistry used dental arch study models, and as a result, manufacturing materials and technology evolved, so did the model's utility. For more than a century, orthodontists have utilized plaster casts for diagnostic and treatment planning purposes. They are analysed by orthodontists to determine the presence and kind of malocclusions, as well as to evaluate variations in arch lengths.

Because of their exceptional portability, electronic devices like smartphones and tablets are being used more frequently these days. To help dentists and patients seek a treatment, a variety of programs for tooth ratio calculations through model analysis are accessible on the Google Play Store for Android and the Apple App Store for iOS [1]. Computer analyses that can simplify the dentist's work are being developed by experts. The models were analysed computationally; they were not measured. Despite the fact that they might make dentistry easier, these devices are rarely used since more work needs to be done to develop them for greater accuracy, and producing them in large quantities would be costly and complex [1].

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAR1645

The conventional approach and applications that can be downloaded onto smartphones or other handheld electronic gadgets were used to carry out the model study. Model Analysis App and iModelAnalysis are two examples of such apps that are accessible through the Apple App Store and Google Play Store. These free apps simplify and improve the accuracy of mathematical computations. The aim of this research is to compare the model analysis time and results utilizing smart applications like iModelAnalysis and Model Analysis App, with traditional methods.

II. MATERIALS AND METHODS

This research aimed at identifying major differences in both the time and results of model analysis using traditional methods and the iModelAnalysis and Model Analysis App for smartphones.

The software used in the study was initially selected. Therefore, a literature review was also conducted. The selection of the software was established by the subsequent norms:

- Publications within the literature
- A free version is available for download from the manufacturer's website.

After that, the two chosen programs were then downloaded to the smartphone. Measurements were made using both conventional and smart phone applications when collecting samples for research models. The following were the inclusion criteria: the study models had twelve teeth that erupted from the first molar on left side to the first molar of right side; none of the twelve teeth were extracted; they were in perfect condition and devoid of any flaws; and the impression clearly showed the dental anatomy. The following were among the exclusion criteria: the study models with loss of dental features, carious teeth with severe crown structure loss, and teeth that were broken or decaying.

This study was conducted in Pandit Deendayal Upadhyay dental college, Solapur on study models of 30 patients reporting to department of Orthodontics and Dentofacial Orthopaedics. Measurements were taken once for a sample size of 30 pairs of study models, for each analysis using a conventional method and iModelAnalysis and Model Analysis App.

Study casts, pencils or markers, dividers, rulers, calliper, notebooks to record measurements, Android or Apple smartphones running the iModelAnalysis and Model Analysis App applications, and stopwatches were needed for this investigation. Boltons, Arch Perimeter, Carey, Ashley-Howe, and Pont's analyses were among the model analyses performed on dental casts, as these analyses are commonly carried out in orthodontic practice on a regular basis.

A stopwatch was used to track how long it took to complete the calculations for the model analysis using the conventional procedures (Figure 1). Arch perimeter analysis, Carey's analysis involves mesiodistal measurement of each tooth with calliper, starting at area on one of the proposed study models and recording the measurements on a notebook. The upper jaw has twelve teeth (16–26) and the lower jaw has twelve teeth (36–46). The jaw was then divided into six segments, each containing two teeth ranging from the first molar of right side to the first molar of left side, in order to determine the length of the maxillary arch. Using a calliper, the length of every segment was measured and summed. The difference within the length of the jaw arch and the number of mesiodistal twelve teeth was then used to determine the results [1].

The Carey analysis was carried out similarly on the suggested research model of lower jaw, and the Bolton analysis was carried out using callipers to determine the mesiodistal aspect of the teeth in the identical manner as the Arch Perimeter analysis. Twelve lower jaw teeth (numbered 36–46) and twelve upper jaw teeth (numbered 16–26) were measured. The formula was used to enter the estimation data, and the result was computed and then noted [1].

In the suggested study model, teeth 16–26 were measured mesiodistally using Ashley-Howe's methodology. Using a calliper, the basal arch width (PMBAW) of both maxillary canine fossa region and the premolar diameter (PMD) between the points of the maxillary first premolars were determined from the anterior direction of the dental model. The result of the measurement was incorporated into the current formula, which produced the desired outcome. The analysis results produced by using the Ashley-Howes formula were recorded [1].

In the study model, Pont's technique calculates four maxillary incisors mesiodistally. At that point, callipers were used to measure the premolar region, the distance from the distal pit of the maxillary right and left first premolar on the occlusal surface, the molar region, and the distance from the mesial pit of the upper right and left first molar on the occlusal surface Pont's formula was used to determine the dental arch width within the optimal premolar and molar region. The timer was paused, and using standard procedures, the amount of time needed to get the analytical findings was noted.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAR1645

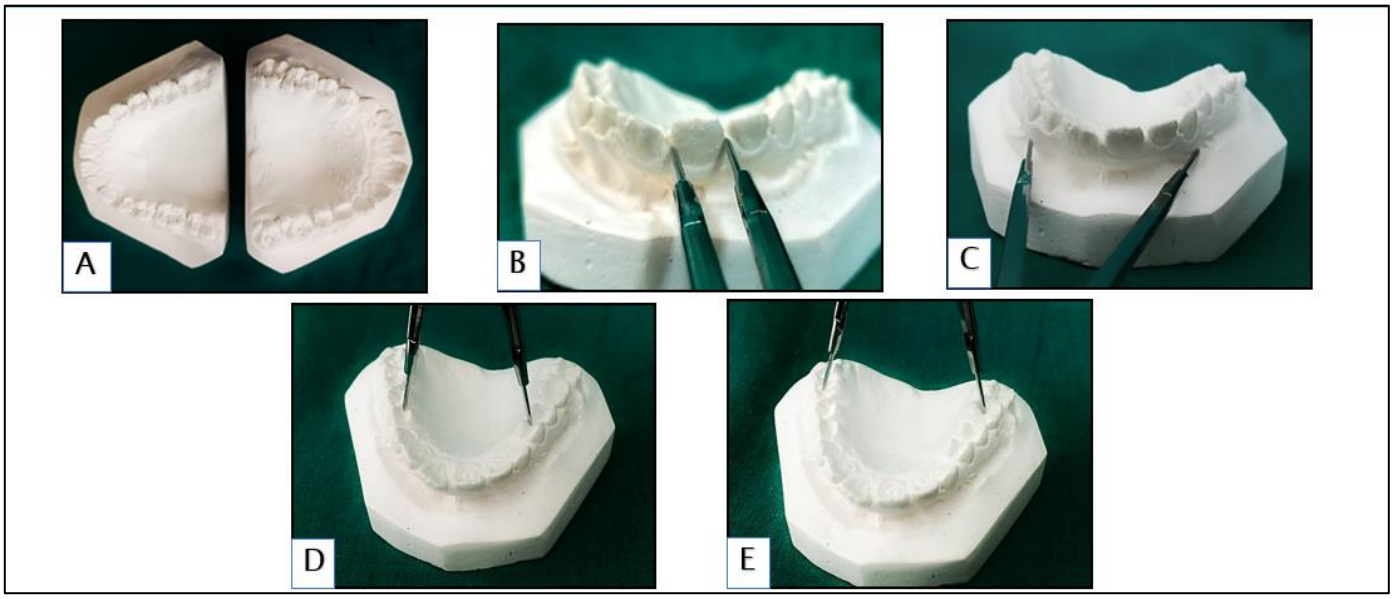

Fig 1: A) One of the Study Models for this Research B) the Conventional Method of Showing Measuring Points for Tooth Dimensions C) Measuring Points for the Apical Base for Ashley-Howe's Analysis, D) Measuring Points in the Premolar Region during Pont's Analysis and E) Measuring Points in the Molar Region during Pont's Analysis

Time was recorded using a timer before beginning model analysis with iModelAnalysis and ModelAnalysis (Figure 2 and 3). Because this model analysis uses an automated system to do the analysis, measurement results do not need to be included in the analytical formula [1]. Using callipers, the mesiodistal of each tooth, beginning with 12 maxillary teeth (16–26) and 12 mandibular teeth (36–46), was first measured [1]. To process the analysis's findings, the measurements were entered into the iModelAnalysis and Model Analysis App applications.

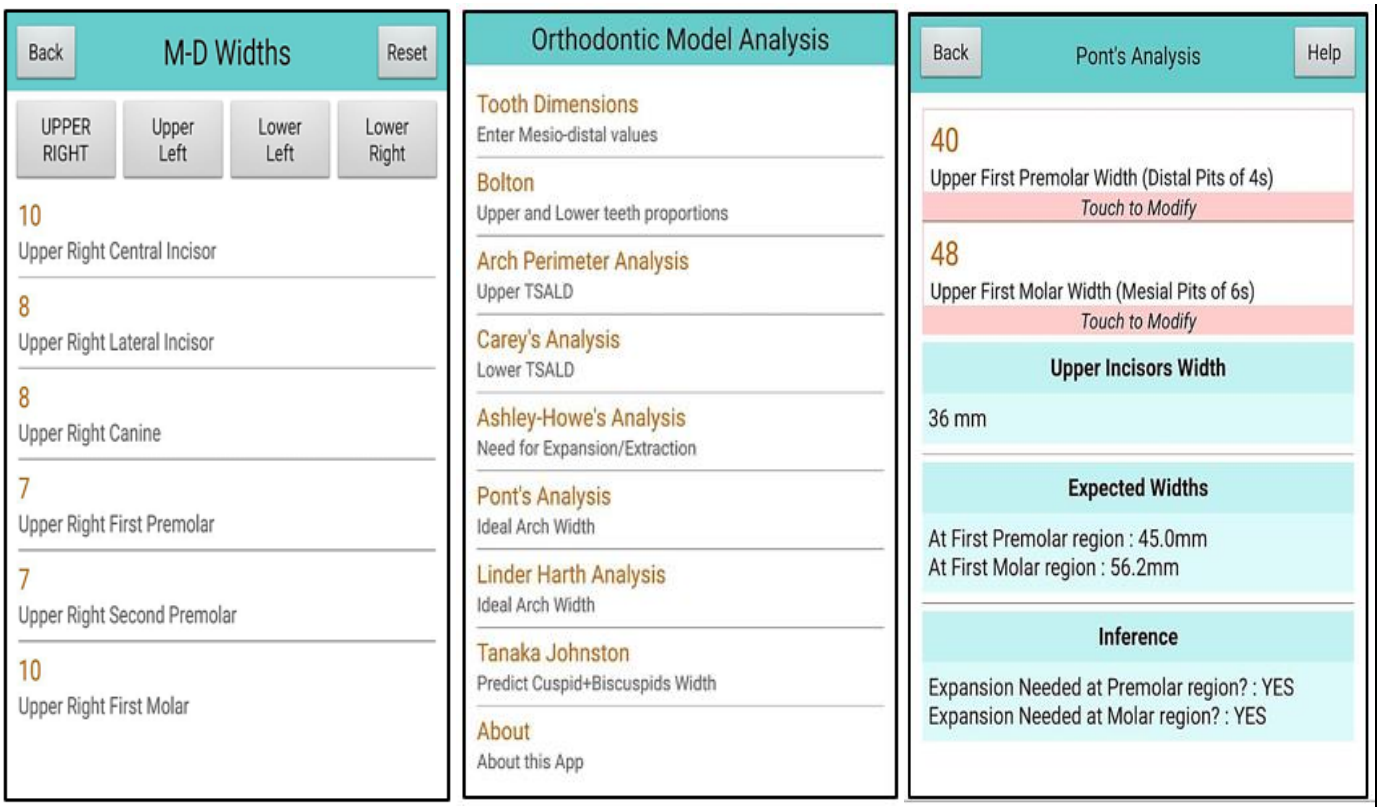

Fig 2: The Measurement of the Model Study Inputed in iModelAnalysis Application, Selection of Respective Analysis and the Model Analysis Results in iModelAnalysis Application

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAR1645

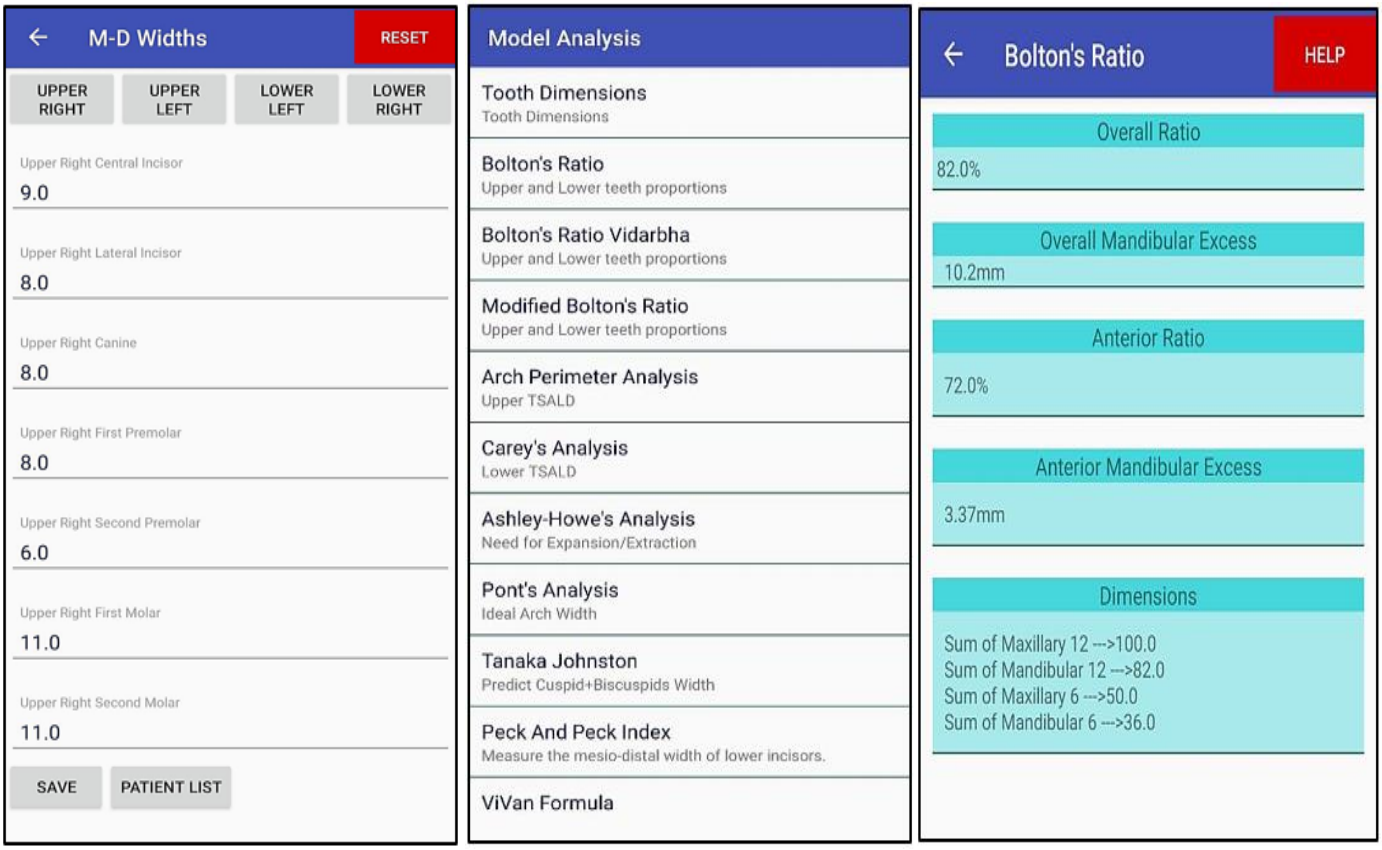

Fig 3: The Measurement of the Model Study Inputed in ModelAnalysis Application, Selection of the Analysis and the Orthodontic Model Analysis Result in ModelAnalysis Application

After determining the length of the jaw arch or the amount of accessible space in the jaw using iModelAnalysis and the Model Analysis App, the Arch Perimeter analysis and Carey's analysis calculation results were achieved. Once the information about the 12 maxillary and mandibular teeth is entered into the iModelAnalysis and Model Analysis App, Bolton's analysis of the findings will be available. The deepest point of the right and left right fossas (the apex tips of teeth 14–24) and the distance from the occlusal orientation between the buccal tips of those teeth were measured in the Ashley–Howe's study [1]. When doing the Pont analysis calculation, the widths of the first upper premolar (14 to 24) in the distal pit and the maxillary first molars (16 to 26) in the mesial pit region were taken into account. Using a stopwatch, the amount of time needed to obtain the analysis results using iModelAnalysis as well as the Model Analysis App were noted.

III. STATISTICAL ANALYSIS

All of the data gathered supported the study's normal distribution when the fraction of data either above or below the average, or mean, was equal, with $p>0.05$ suggesting the collected data was distributed uniformly. A one-way ANOVA test and a Kruskal Wallis test (Pont's expansion) were carried out at a significance level of 0.05 with $p>0.05$ after calculating the average difference between three groups in the same sample. Although there was a noticeable difference between traditional methodologies and iModelAnalysis and Model study App throughout the study, objective measurements of the analysis's results showed no changes (Table 1).

Table 1: Statistical Analysis of Manual Method, iModel Analysis, Model Analysis Application

Results	Manual	Imodel Analysis	Model Analysis App	P Value
Bolton's overall ratio(mm)	3.3967±3.44579	3.4333±3.77709	4.6200±6.83744	0.552 (NS)
Bolton's anterior ratio(mm)	4.9133±5.81969	4.7700±5.57743	4.7500±5.59068	0.993 (NS)
Arch perimeter discrepancy(mm)	4.0000±3.15135	4.0000±3.15135	4.0000±3.15135	1.000 (NS)
Carey's discrepancy(mm)	3.8667±2.5962	3.8667±2.59620	3.8667±2.59620	1.000 (NS)
Ashley - Howe PMBAW%	44.0200±3.71255%	42.1367±5.74531%	43.8133±3.71787%	0.211 (NS)
Pont's expansion	66.7±33.3%	41.9±58.1%	55.2±44.8%	0.114 (NS)
Time required (sec)	903.3000±30.19951	399.2000±42.94375	392.0333±35.58233	0.000 (HS)

HS = Highly Significant ($p<0.001$), NS = Not Significant ($p>0.05$)

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAR1645

IV. RESULTS

The conventional technique yielded results for a Bolton's overall ratio analysis of 3.3967±3.44579, iModelAnalysis produced results of 3.4333±3.77709, while the Model Analysis app produced results of 4.6200±6.83744. The conventional technique yielded results for Bolton's anterior ratio analysis of 4.9133±5.81969; iModelAnalysis produced results of 4.7700±5.57743; and the Model Analysis app produced results of 4.7500±5.59068. The results of arch perimeter discrepancy analysis for conventional method were 4.0000±3.15135, those for iModelAnalysis was 4.0000±3.15135, and for Model Analysis app it was 4.0000±3.15135. The results of Carey's discrepancy analysis for conventional method were 3.8667±2.59620, those for iModelAnalysis was 3.8667±2.59620, and for Model Analysis app it was 3.8667±2.59620. The results of Ashley - Howe PMBAW% analysis for conventional method were 44.0200±3.71255, those for iModelAnalysis was 42.1367±5.74531, and for Model Analysis app it was 43.8133±3.71787. The results of Pont's expansion analysis for conventional method, iModelAnalysis and for Model Analysis app showed p value 0.114 (not significant = p>0.05).

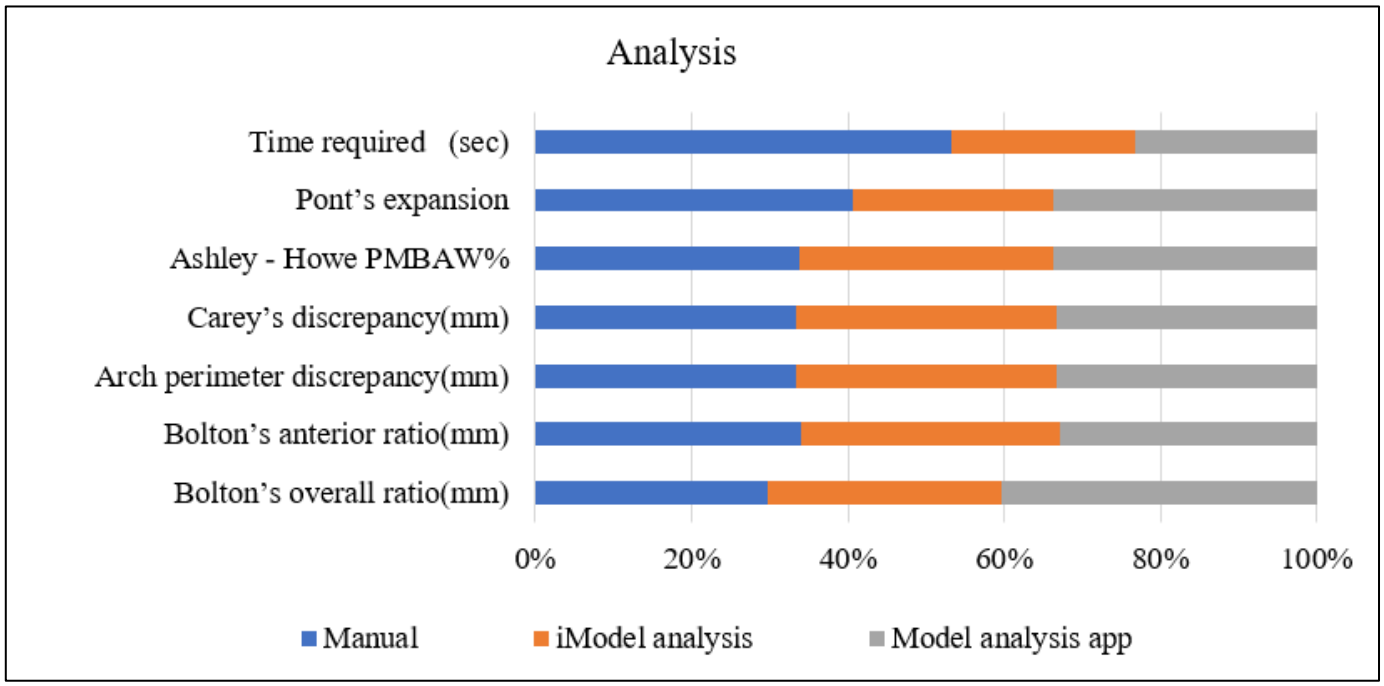

Fig 4: Comparative Analysis of Manual Method, iModel Analysis, Model Analysis Application

The results of period required for the analysis by conventional method 903.3000±30.19951, while those for iModelAnalysis was 399.2000±42.94375, and for Model Analysis app it was 392.0333±35.58233 (Figure 4).

V. DISCUSSION

Since research is one source of data used to draw orthodontic conclusions, demonstrating research is an essential first step. Maximizing the benefits of orthodontic treatment requires a thorough, precise, and unambiguous diagnosis of the extent of therapy. The examination moreover utilizes other instruments, such as measuring apparatuses, radiographic highlights, and mathematical calculations. Analysis can be performed either physically or employing an advanced framework each of which has both preferences and drawbacks. As is the case with research models, it is important to keep in mind that advanced models allow preferences pertaining to the clinical process itself, increasing the demand for physical space to hold the display. Later, it would be invaluable for orthodontists with limited physical space in their workplace, and could be used for purposes other than storing items of critical volume in cabinets or shelves.

Singh (2013) [2] sought a comprehensive suite of smartphone applications that were available to orthodontic patients and professionals [1]. According to Indirayana, Gayatri, and Zenab (2018) [1], there are 32 orthodontics-related Android applications available for download and 57 orthodontics-related Apple applications. Many of these programs provide inaccurate and unsupported data, while some—like FAQ settle, Carriere Ortho 3D, Bolton Calc and iModelAnalysis—have gained recognition and are updated on a regular basis. Because it provides an easy-to-execute demonstration assessment, clients rated iModelAnalysis 4.5 out of 5 [1].

This comes about of this query about no contrast within the demonstrate investigation calculation result between ordinary strategies and Model analysis application, iModelAnalysis employing a smartphone. In any event, there was a noticeable difference between the traditional approach and the smartphone-based apps during the examination period. The data confirmed that the applications produce correct results faster and more efficiently. Because two parameters—specifically, estimation and calculation—must be incorporated in present examination, there can be a notable time difference between ordinary techniques and the

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAR1645

iModelAnalysis show examination application. Using traditional methods of research entails estimating from the outset and applying formulas to calculate the outcome for every investigation. This results in faster processing because iModelAnalysis needs estimates, which arise from its framework organically. This conclusion is in line with that of Gupta and Vaid (2017) [3], who claim that iModelAnalysis is the best smartphone application currently available to orthodontic professionals because it facilitates the numerical computation of results from show examination and makes research more effective [1] [3]. It is significant to note that, in addition to the benefits for clinical workflow, digital models can lessen the requirement for physical storage as compared to conventional approaches like keeping plaster models.

Taking into account that the analysed software's free versions fulfil the requirement for cost-critical availability.

In this regard, it is critical that the free software an orthodontist can use to see and analyse digital models satisfies the relevant requirements and fits their clinical needs for case planning and diagnosis.

VI. CONCLUSION

There was no noteworthy distinction within the examination results as such. Nonetheless, a significant distinction was observed during the research duration between the traditional approaches and iModelAnalysis and Model Analysis Application.

Hence these orthodontic model analysis applications can help in reducing the time span required to carry out these analyses. These apps are just an example of how orthodontist’s diagnosis and treatment plans will be arranged and streamlined in the future.

Extra apps might extend from simple diagnostic tools to full-fledged orthodontic case-management programs and to make the mathematical procedures needed for orthodontic cast evaluation and investigation easier.

SCOPE FOR FUTURE STUDIES

These applications can serve as an essential diagnostic tool that can reduce the time required for the analysis and require less storage space in the clinics. Further modifications and upgradation of these applications will help in easy diagnosis and treatment planning of easy to difficult cases in no time.

(Disclaimer- This study is not intended to endorse or demean any method or software for analysis; rather, it is an honest attempt to provide an understanding of the use of digital technology to reduce the time required for the physicians so that it can be used clinically.

REFERENCES

[1]. P. V. Indirayana, G. Gayatri and Y. . N. R. Zenab, "A comparison between orthodontic model analysis using conventional methods and iModelAnalysis," *Dental Journal(Majalah Kedokteran Gigi)*, vol. 519, p. 173–178, 2018.

[2]. S. P., "Orthodontic apps for smartphones," *J Orthod*, p. 249–55. , 2013.

[3]. G. G and V. N. R, "The world of orthodontic apps," *APOS Trends Orthod*, pp. 73-9, 2017.

[4]. R. G, P. S, C. T, D. A and D. CL, " Diagnostic accuracy and measurement sensitivity of digital models for orthodontic purposes: a systemic review," *Am J Ort hod Dentofac Orthop*, p. 161–70, 2016.

[5]. P. W. R, F. H. W and S. D. M, Contemporary orthodontics., 5 ed., St Louis: Mosby Elsevier, 2012, pp. 247-78.

[6]. V. V. Jadhav, M. M. Tiwari, R. Kamble, D. S. Vasudevan and P. Daigavane, "Model Analysis Android App," *Journal of evolution of medical and dental sciences*, pp. 3825-3827, 2020.

[7]. P. K. Mamillapalli, P. K. Neela and V. M. Sesham, "Model Analysis on a Smartphone," *Journal of Clinical Orthodontics*, pp. 356-358, 2012.

[8]. M. Felter, M. M. d. O. Lenza, . M. G. Lenza, W. M. M. Shibazaki and R. F. Silva, "Comparative study of the usability of two software programs for visualization and analysis of digital orthodontic models.," *Journal of Dental Research, Dental Clinics, Dental Prospects*, pp. 213-220, 2018.

[9]. F. P. S, M. V and J. A, "Orthodontic measurements on digital study models compared with plaster models: a systematic review.," *Journal of Orthodontics and Craniofacial Research*, vol. 14, pp. 1-16, 2011.

[10]. S. M. VS, V. E. C, J. G, G. D and P. A, "Accuracy and reproducibility of 3-dimensional digital model measurements.," *American Journal of Orthodontics and Dentofacial Orthopedics*, pp. 269-73, 2012.

[11]. W. H. WN, O. SA, C. C. S, A. R, A. SNA and A. R. A, "Assessing agreement in measurements of orthodontic study models: digital caliper on plaster models vs 3-dimensional software on models scanned by structured-light scanner.," *American Journal of Orthodontics and Dentofacial Orthopedics*, pp. 886-95, 2016.

[12]. P. B. S., Orthodontics : principles and practice., New Delhi: Jaypee Brother Medical Publishers, 2011, pp. 172-80.

[13]. L. M. F, L. M. M, E. S. S and C. T. J, "Comparison of space analysis evaluations with digital models and plaster dental casts.," *American Journal of Orthodontics and Dentofacial Orthopedics*, pp. 16.e1-16.e4. , 2009.

[14]. L. e. a. C, "Methodological accuracy of digital and manual model analysis in orthodontics-a retrospective clinical study.," *Computers in Biology and Medicine*, pp. 103-9, 2015.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAR1645

[15]. S. V. V, R. R. R and S. V, "Interarch tooth size relationship of Indian population: does Bolton's analysis apply?," *The Journal of Contemporary Dental Practice,* pp. 103-7, 2014.
[16]. J. R and B. E, "Bolton's intermaxillary tooth size ratios among school going children in Punjab population," *Indian Journal of Oral Sciences* , vol. 4(3), p. 110, 2013.
[17]. P. M. J, J. S. D, L. S. W and L. B. J, "Digital models: An introduction.," *Seminars in Orthodontics.*, vol. 10, no. 3, pp. 226-38, 2004.
[18]. K. J, H. G and L. M. O, "Accuracy of laser-scanner models compared to plaster models and cone-beam computed tomography.," *Angle Orthodontist.* , 2014.
[19]. N. D and F. T. J, "Validity, reliability and reproducibility of the iOC intraoral scanner: a comparison of tooth widths and Bolton ratios.," *American Journal of Orthodontics and Dentofacial Orthopedics,* vol. 144, pp. 304-310, 2013.
[20]. P. L. R, M. M. PM, F. J and T. H. H, "Time of guard of orthodontic records versus legal time for their prescription.," *Dental Press Journal of Orthodontics,* vol. 18, no. 3, pp. 113-117, 2013.
[21]. W. A, T. W, R. M, B. A, P. S and T. O, "Digital cast in orthodontics: a comparison of 4 software systems.," *American Journal of Orthodontics and Dentofacial Orthopedics,* vol. 147, pp. 509-16, 2015.