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Research Article

Accuracy and Efficiency of Model Analysis Using an App Based Model Analysis Software

Purohit Aastha, Paul Rahul, Golchha Vineet*, Yadav Deepti, Gupta Mudita and Sharma K Ish

Department of Orthodontics and Orthopaedics, Inderprastha Dental College and Hospital, Ghaziabad, India

***Corresponding Author:** Golchha Vineet, Department of Orthodontics and Orthopaedics, Inderprastha Dental College and Hospital, Ghaziabad, India.

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Abstract

Context: Model analysis is an important diagnostic tool and aids in framing dental treatment, but consumes a significant time. Mamillapalli., *et al*. the creators of application iModelAnalysis2 which performs mathematical calculations easily and accurately as part of model study analysis, claims to be faster, accurate and user friendly than conventional method.

Aims: This *in-vitro* study evaluates the efficacy and efficiency of the results achieved by iModelAnalysis2 application and compares it with the conventional method.

Methods and Material: Bolton analysis, Ashley Howes Analysis, Pont analysis, Linder Harth Analysis, Carey's Analysis, Arch Perimeter Analysis model were performed on 30 casts. The duration of the count model analysis using conventional methods and app was recorded with a stopwatch. The results obtained were statistically compared for accuracy.

Results: The test results were non significant with p value of >0.05. This indicates that the overall results of analysis through both conventional and application means are equally accurate. The result of the comparison in the time taken to do the analysis through conventional means and application was highly significant with p value of 0.000.

Conclusions: This application has a great potential to aid clinician in quick calculations and thereby quicker diagnosis and treatment planning saving their crucial time with accurate result.

Keywords: Model Analysis; iModelAnalysis2; Bolton analysis; Ashley Howes Analysis; Pont; Carey's Analysis

Key Messages: The app based software's have a potential to be a huge support to a clinician, saving their time with accurate result. However, a clinician's decision should never be solely dependent on an application or a software and must consider it more of a helping hand.

Need for the Study

Orthodontics, the ever evolving field of dentistry is in midst of a digital revolution. Orthodontics from diagnosis to treatment planning and from customisation of brackets to developing intelligent wires, everything is using technology or artificial intelligence to make it better and smarter. Model analysis is one of the pillars of

orthodontic diagnosis and treatment planning. One of the drawbacks of orthodontic treatment planning is the amount of time spent over mathematical calculation and drawing inferences from abundant of model analysis methods being used.

Models are used to visualize the morphology and spatial arrangement of teeth in their respective dental arches and provide a three dimensional view of a patient's occlusion. Compared to a mere clinical examination, this enables the clinician to evaluate a possible malocclusion more accurately and indubitably. Model analysis is an important diagnostic tool and aids in framing dental treatment, but consumes a significant time. Generally 4 analysis are carried out in order to analyse and aid in diagnosis as well as treatment planning. The whole process consumes ample of time and also involves manual error. Though the use of vernier calliper have reduced it considerably still there is a need of applications or software which can simplify, reduces the time span and give us accurate results and along with are easy to operate.

There has been an increase in demand of application which can simplify the process within a very short span of time along with accurate results. Over 12 years, dental technology has developed considerably in the area of model analysis like in diagnosis using a digital model. Experts are developing computer based analyzes that can simplify the work of dentists, to scan the model for analysis and to measure it [1]. The development of an application iModelAnalysis2 wherein the measurements are put followed by the app doing all the calculations further providing us with the results within a very short time.

This app claims to be faster than conventional method, accurate and user friendly. According to Mamillapalli., *et al*. [2] who were its creators, iModelAnalysis2 performs mathematical calculations easily and accurately as part of model study analysis. Model analysis done by conventional method is a relatively time-consuming process so the iModelAnalysis2 application is expected to be more efficient than conventional methods. This application is available on Google Play Store and Apple's App Store. This downloadable application is available free of charge.

This study was designed to evaluate the efficacy and efficiency in the results and time taken for model analysis using iModelAnalysis2 application and compare it with conventional manual method of study model analysis.

Aim

To evaluate the efficacy and efficiency of the results achieved by iModelAnalysis2 application and compare it with the conventional method.

Null hypothesis

There is no difference in the results and time periods of model analysis using conventional means and iModelAnalysis2.

Sample selection and sampling technique

A sample size of 30 casts of patients coming to the Department of Orthodontics and Dentofacial Orthopaedics, in the Hospital, for the fixed orthodontic treatment was considered for the study. Models having any visible defects or missing teeth were excluded from the study.

Materials and Methods:

- Rabbit Force Digital Vernier Caliper 0-150 mm (Premium)
- Brass Wire
- Models selected according to inclusion and exclusion criteria
- Pencil, Marker, Paper
- Android smart phone with an iModelAnalysis2 application and Stop Watch.

Figure 1: Rabbit force digital Vernier Caliper, brass wire and study models.

Figure 2: Android smartphone with Imodelanalysis2 and stop watch.

Method

Model analysis performed were Bolton, Ashley Howe's, Pont, Linder Harth, Carey's, Arch Perimeter Analysis [3-5] through first conventional method using vernier calliper, brass wire and was carefully noted down. The calculation was made and timer was used to calculate time needed for individual analysis and also for all the analysis (Figure 3).

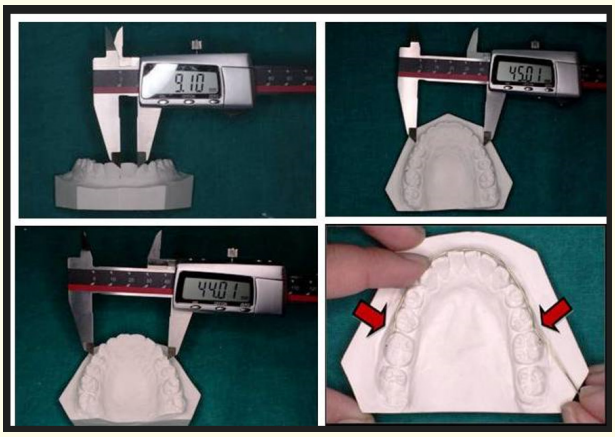

Figure 3: Manual measurements for ModelAnalysis2.

This was then followed by followed by the application[1] based method and the duration for was recorded each analysis and also for all the analysis with a stopwatch (Figure 4). The statistical analysis was performed to compare the accuracy of data for each individual analysis and also for overall time taken.

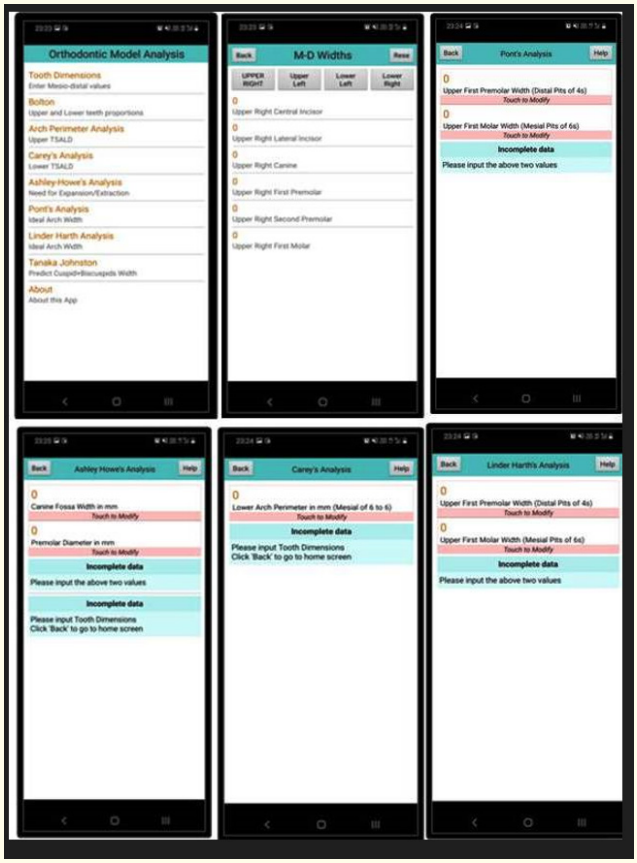

Figure 4: Model analysis in Imodelanalysis2 application.

Results

T-test was performed for quantitative data and Chi square test was performed for qualitative data.p value is set at ≤ 0.05. The test results were non significant with p value of >0.05 (Table 1) (Figure 5 and 6). This indicates that the overall results of analysis through both conventional and application means are equally accurate.

The result of the comparison in the time taken to do the analysis through conventional means and application was highly signifi-

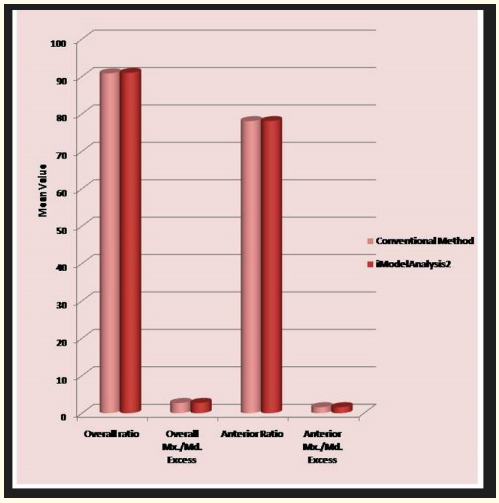

Figure 5: Comparison B/W conventional and iModelAnalysis2 method for Bolton analysis.

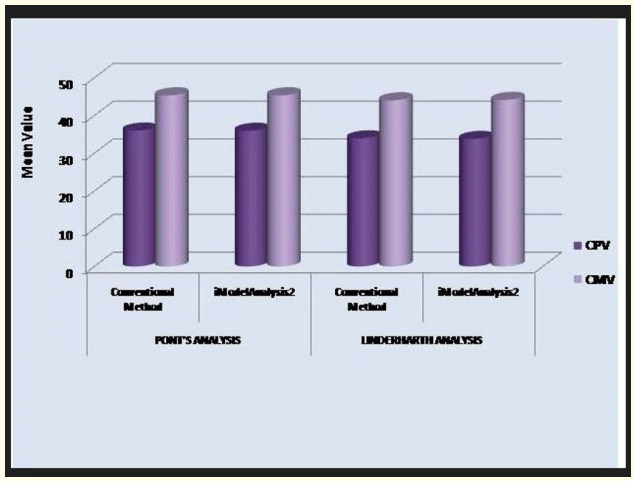

Figure 6: Comparison B/W conventional and iModelAnalysis2 method for ponts and Linderharth analysis.

cant with a mean of 36.3100 and p value of 0.000 (Figure 7). This indicates that the time taken by the conventional method is much higher than the application, therefore the use of application will save time of the clinicians.

	Conventional Method		iModelAnalysis2				
Variable	**Mean**	**SD**	**Mean**	**SD**	**Mean Difference**	**p-value**	**S/NS**
Bolton's Analysis							
Overall ratio	90.86	5.05	90.98	4.97	-0.11133	0.289	NS
Overall Mx./Md. Excess	2.7343	1.90452	2.7413	1.90058	-0.00700	0.886	NS
Anterior Ratio	78.0900	3.92932	78.1000	3.90499	-0.01000	0.375	NS
Anterior Mx./Md. Excess	1.6080	1.03654	1.6053	0.82514	0.00267	0.985	NS
Arch Perimeter Analysis							
Difference	2.5500	3.06355	2.5667	3.05900	-0.01667	0.326	NS
Pont's Analysis							
CPV	36.0233	1.32787	35.9667	1.32700	1.416	0.167	NS
CMV	45.3467	1.23253	45.3567	1.24005	-0.01000	0.184	NS
Linderharth Analysis							
CPV	33.9667	1.32361	33.8000	1.40000	1.409	0.169	NS
CMV	44.0333	1.49605	44.1467	1.48620	-0.11333	0.184	NS
Time Taken	36.3100	2.19864	8.7783	0.41929	27.5317	0.000	Sig

Table 1: Comparison b/w conventional and iModel Analysis2 Method.

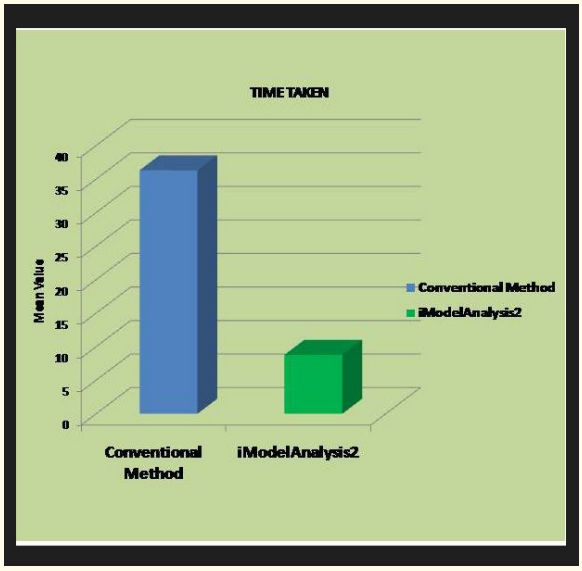

Figure 7: Comparison B/W conventional and iModelAnalysis2 method for time taken.

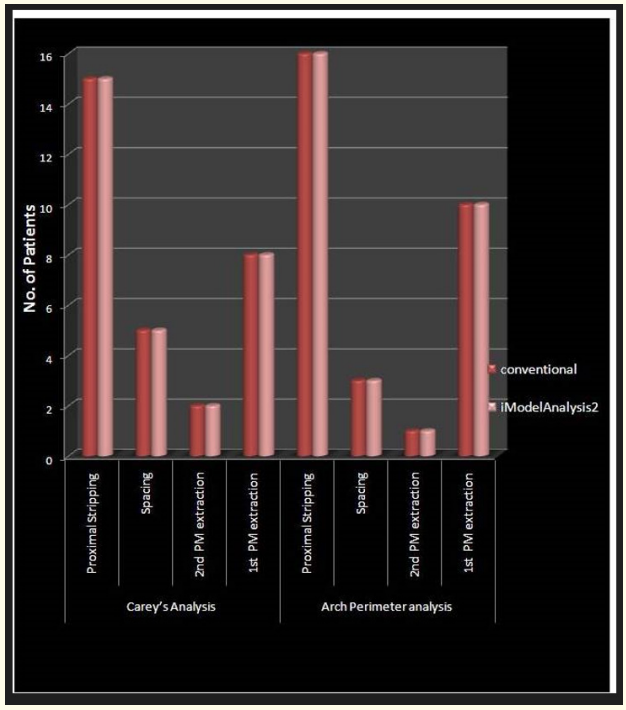

Figure 8: Comparison of results by conventional means and Imodelanalysis2 in Carey's and arch perimeter analysis.

The inference obtained for Carey's analysis and Arch Perimeter analysis through conventional means and the application showed similar results and was highly significant through both the means with a p value of 0.000 (Table 2) (Figure 8). This indicates that the application is equally accurate when compared with conventional means.

		Proximal Stripping	Spacing	2nd PM Extraction	1st PM Extraction	p Value
Carey's Analysis	Conventional	15 (20%)	5 (16.7%)	2 (6.6%)	8 (26.7%)	0.000
	iModelAnalysis2	15 (20%)	5 (16.7%)	2 (6.6%)	8 (26.7%)	0.000
Arch Perimeter analysis	Conventional	16 (53.3%)	3 (10.0%)	1 (3.3%)	10 (33.3%)	0.000
	iModelAnalysis2	16 (53.3%)	3 (10.0%)	1 (3.3%)	10 (33.3%)	0.000

Table 2: Comparison of results by Conventional means and iModelAnalysis2 in Carey's and Arch Perimeter Analysis.

The results for Ashley Howe's analysis showed equal number and percentage of indicated and non indicated cases among all the variables of Ashley Howe's analysis with a significant p value of 0.000. This again indicates that the application is equally accurate when compared with conventional means (Table 3), (Figure 9).

Discussion

Application did not show any significant differences in term of measurements i.e., stating that the level of accuracy was equivalent for application based as well as manual measurements. In this study, the results of model analysis through conventional means

	Indicated		Non indicated			
Variable	**No.**	**%**	**No.**	**%**	**p-value**	**S/NS**
Ashley howe analysis						
Expansion	10	33.3	20	66.7	0.000	Significant
Extraction	14	46.7%	16	53.3%	0.000	Significant
Borderline case	16	46.7%	14	53.3%	0.000	Significant

Table 3: Comparison of results by Conventional means and iModelAnalysis2 in Ashley Howe Analysis.

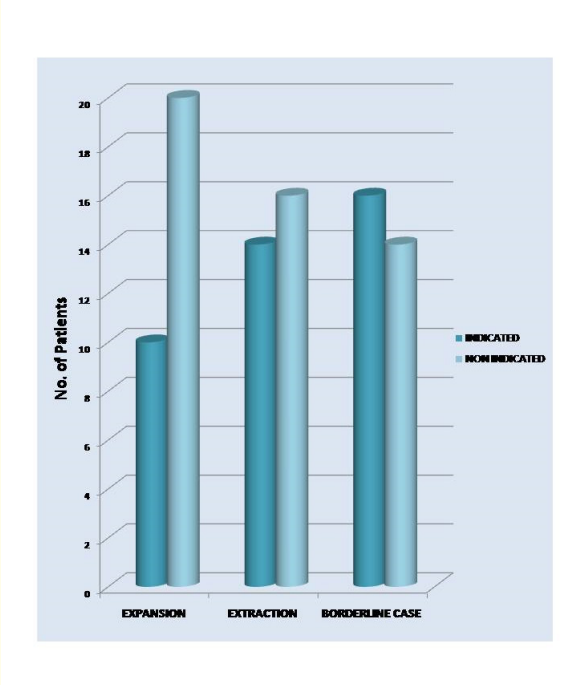

Figure 9: Comparison of results by conventional means and Imodelanalysis2 in Ashley howe analysis.

and iModelAnalysis2 expansion, or extraction is indicated or not indicated and also the borderline cases. These numbers and percentage are same through both the means thereby signifying that the results through application are as accurate as that of conventional means [6].

However, there was a significant difference in the time taken for analysis by conventional methods and iModelAnalysis2. The time taken by the application was much shorter than that of the conventional method. The differential factor in performing model analysis is the usage of calipers and noting it down on paper, apply the technical formula before the overall data is ratified In contrast, iModel Analysis measures all data inputted and then calculates the results directly and automatically [2].

A similar study [7] was performed were 31 dental casts which were subjected to a total sampling method consisting of two treatments; a conventional method calculation and one using iModelAnalysis. There was no difference in the analysis results. However, there was difference in the time period of analysis with the iModelAnalysis2 being significantly faster.

In 2011 a study [8] was conducted to evaluate the validity of the use of digital models to assess tooth size, arch length, irregularity index, arch width and crowding versus measurements generated on hand-held plaster models with digital callipers in patients with and without malocclusion. Seven digital model systems were used OrthoCad, emodel, C3D-builder, ConoProbe, Easy3D Scan, Digimodels and Cecile. The results of this study state that "digital models offer the same level of validity as compared with direct measurements on the plaster model, but the quality of the difference in outcomes is clinically acceptable". Orthodontic measurements with digital models were comparable to those derived from plaster models, similar results were also suggested from our study.

However some researchers believe that factors like competency and experience of the researcher in executing measurements contribute to the advent of differences when comparing the two methods of measurement model analysis [9]. Competent researchers will furnish more accurate results compared to their peer lacking experience.

Conclusion

The use of this application had potential to be a huge support to a clinician, saving their time with accurate result. However, a clinician's decision should never be solely dependent on an application or a software and must consider it more of a helping hand.

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