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Is There a Difference Between Dental Measurements on Conventional Plaster Models and Digital Models?

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Abstract

Background: Comparison of dental measurements between conventional plaster models and digital models.

Methods: The sample consisted of 41 final models from the archive of the Department of Orthodontics, Faculty of Dentistry, Ordu University. Mesiodistal tooth widths, intercanine and intermolar arch widths, and Bolton tooth size discrepancies were evaluated on both plaster and digital models. Digital models were obtained by scanning the plaster models using 3Shape Trios 3 Move+ and iTero Lumina scanners. The resulting standard triangle language files were imported into OrthoAnalyzer software for measurement. Tooth widths on plaster models were measured using a digital caliper. All measurements were performed by a single examiner. To assess the intra-observer reliability, a second set of measurements was taken from a random subset of models, and intraclass correlation coefficients were calculated. Data from the 3 groups were analyzed using the Kruskal–Wallis and Dunn tests. A P-value <.05 was considered statistically significant.

Results: Significant differences were found in the mesiodistal widths of several teeth, including the upper right first molar, canine, and lateral incisor; upper left second premolar and canine; lower right second premolar, first premolar, central and lateral incisors; and lower left first and second premolars and first molar. Mandibular intercanine and intermolar widths also showed significant differences. Digital measurements were generally larger than those from plaster models. No significant differences were observed between the 2 digital systems, or in total and anterior Bolton analyses.

Conclusion: Despite some discrepancies between manual and digital methods, digital models provided consistent and clinically reliable measurements.

Keywords: 3 Move Plus, 3Shape Trios, Bolton analysis, digital model, iTero Lumina, plaster model

What is already known on this topic?

- *Conventional plaster models are considered the gold standard for orthodontic measurements.*
- *Digital orthodontic models provide three-dimensional analysis, faster measurements, and easier data storage and sharing.*
- *Previous studies have reported small but statistically significant differences between digital and manual measurements, though these differences are often deemed clinically insignificant.*

What this study adds on this topic?

- *No significant differences were found in Bolton analysis results between digital and plaster models, confirming the reliability of digital models for this assessment.*
- *Models scanned with iTero Lumina and 3Shape Trios 3 Move Plus gave similar results.*
- *Despite statistical differences, digital models provide clinically acceptable and reliable measurements, making them a viable alternative for orthodontic diagnosis and treatment planning.*

INTRODUCTION

The success of orthodontic treatment relies on a detailed and meticulous diagnostic process along with a well-prepared treatment plan. The accurate diagnosis of orthodontic problems is achieved through the utilization of dental models, radiographs, photographs, and clinical examination. In the diagnostic phase, the following basic elements are evaluated: tooth size, arch form and size, amount of crowding and diastema, overjet-overbite relationship, and Bolton analysis. Study models constitute a standard component

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of orthodontic records. They are essential for the diagnosis, presentation of cases, planning of treatments, monitoring of the treatment process, and the maintenance of records.[1,2]

Model analysis is an essential component of the diagnosis and treatment planning process. Traditional model analysis is performed using caliper measurements on dental plaster models and has been widely used for many years. However, the reliability of measurements on plaster models can be affected by anatomical variations, positional and axial discrepancies of teeth, and individual factors. In recent years, digital model analysis has been proposed as an alternative to traditional methods, offering advantages in terms of measurement accuracy and reproducibility. In this study, the measurement reliability of digital and traditional model analysis methods were compared.[2-5]

In recent years, digitalisation has become an indispensable element in the fields of medicine and dentistry, leading to the development of dental scanning methods and digital models. The emergence of digital technology has enabled the development of three-dimensional (3D) digital orthodontic models, produced using intraoral scanning and CAD/CAM technologies. The first digital models were made available on the commercial market in 1999 by OrthoCad (Cadent, Carlstadt, NJ, USA) and in 2001 by Emodels (GeoDigm, Chanhassen, MN, USA).

Digital models are more sophisticated than conventional plaster models, offering the key advantage of 3D analysis. This approach allows for more precise measurements to be made, thereby reducing the margin of error inherent to conventional methods. Furthermore, they reduce the time required for analysis, facilitate the sharing of information with other experts via the internet, and provide immediate access to 3D data, thereby eliminating the storage issue associated with conventional plaster models.[6-8]

The most frequently cited tooth size analysis in the orthodontic literature is that proposed by Bolton. This analysis examines the ratios of the mesiodistal widths of the mandibular and maxillary teeth. In analysis, Bolton identifies 2 distinct ratios: the overall ratio, which encompasses all 12 teeth, and the anterior ratio, which focuses on the 6 anterior teeth. The anterior ratio is determined by dividing the total mesiodistal width of the 6 mandibular anterior teeth by the total mesiodistal width of the 6 maxillary anterior teeth. Similarly, the overall ratio is obtained by dividing the combined mesiodistal width of all twelve mandibular teeth by the combined mesiodistal width of all twelve maxillary teeth. The mean and SD values obtained for the overall ratio are 91.3% and 77.2% for the anterior ratio, as a consequence of the aforementioned calculation.[9-11]

In recent years, numerous studies have compared digital and conventional models; however, many of these investigations have focused on a limited number of parameters or employed only a single type of digital scanner. Unlike previous research, the present study simultaneously evaluates multiple critical orthodontic measurements—including mesiodistal tooth widths, intercanine and intermolar distances, and Bolton tooth size discrepancies—using both conventional plaster models and 3D digital models obtained with 2 different intraoral scanning systems (3Shape Trios 3 Move Plus and iTero Lumina). All measurements were performed within the same software platform (OrthoAnalyzer) to eliminate software-related variability. By applying consistent measurement protocols across the same sample and assessing all key parameters, this study aims to provide a comprehensive and reliable comparison of measurement accuracy and consistency between conventional and digital methods. This approach offers clinically relevant insights for orthodontists seeking to integrate digital workflows into routine practice.

MATERIAL AND METHODS

The research was conducted in alignment with the ethical principles outlined in the Declaration of Helsinki and received approval from the Ordu University Clinical Research Ethics Committee (Approval no: 2024/61; Date: June 7, 2024).

The study sample comprises 41 patients' final models from the archive of Ordu University Faculty of Dentistry, Department of Orthodontics. The study has a retrospective design, utilizing the final models of patients treated in the department. At the beginning of orthodontic treatment, informed consent forms were obtained from all patients, allowing the use of their records for scientific research. As the study involved only retrospective analysis of existing records, no additional patient consent was necessary.

The study included all models that met the following criteria:

- Patient models with complete maxillary and mandibular dentition, including permanent incisors, canines, premolars and first molars, and no missing teeth
- Patient models with normal dental morphology without fractures, wear, deformation, and size-shape anomalies
- Patient models with minimal crowding and Class I molar relationship

Digital models were obtained by scanning traditional plaster models rather than intraoral or impression scanning. The scans were performed by the same clinician. The digital models underwent scanning in accordance with the instructions provided by the manufacturer. The model scans were conducted using the 3Shape Trios 3 Move Plus (3 Shape Co., Copenhagen, Denmark) and the iTero Lumina (Align Technology, Santa Clara, Calif.). The standard triangle language files obtained from the scans were imported into OrthoAnalyzer (3Shape, Copenhagen, Denmark), where measurements were performed on the digitised models. In order to obtain the requisite data, the magnification tools available in the software were employed on the occlusal images of the jaws, with a view to measuring the largest mesiodistal dimensions of the teeth (Figure 1-3).

Manual measurements were conducted on plaster study models utilizing a digital caliper (Mitutoyo, Tokyo, Japan, 150 mm, 0.01 mm) with an accuracy of 0.01 mm. During the procedure, the model was held stationary on a flat surface, and the caliper was moved and adjusted by the operator to reach the mesiodistal contacts. The model itself was not rotated during the measurement. In the case of the incisors and canines, measurements were taken from the labial surfaces. In contrast, for the premolars and molars, measurements were taken from the occlusal plane. (Figure 4-6) All measurements, both manual and digital, were performed by a single experienced examiner. Ten randomly selected models were re-measured to assess intra-observer reliability, and intraclass correlation coefficients (ICCs) were calculated to assess measurement consistency.

The following parameters were subjected to examination in the model analysis, employing both conventional and digital methodologies:

- Mesiodistal Dimensions of Teeth
- Intercanine Width: The distance between cusp tips of the right and left maxillary and mandibular permanent canines.
- Intermolar Width: The distance between the mesiobuccal cusp tips of the right and left maxillary and mandibular first molars.
- Bolton Analysis: The anterior ratio is the percentage of the sum of the mesiodistal widths of the mandibular anterior 6 teeth to the maxillary anterior 6 teeth. The overall ratio is the percentage of the sum of the mesiodistal widths of the mandibular twelve teeth to the maxillary twelve teeth.

Statistical Analysis

A power analysis was conducted using the G*Power 3.1.9.7 software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany), which indicated that 41 cases should be examined in each group with 95% confidence ($1-\alpha$), 80% test power ($1-\beta$), and an effect size of $d=0.557086$.

All measurements were recorded in a Microsoft Excel 2000 spreadsheet (Microsoft, Redmond, Wash) and analyzed with SPSS, version 25.0 (IBM SPSS Corp.; Armonk, NY, USA). The Kruskal–Wallis test and Dunn's test were used for the analysis of the measurement data obtained from the 3 groups. The intraclass correlation coefficient was calculated in order to assess the reliability and consistency of the measurements. The ICC is a preferred statistical method for determining the agreement between different measurements made according to the same measurement protocol. It is widely used for

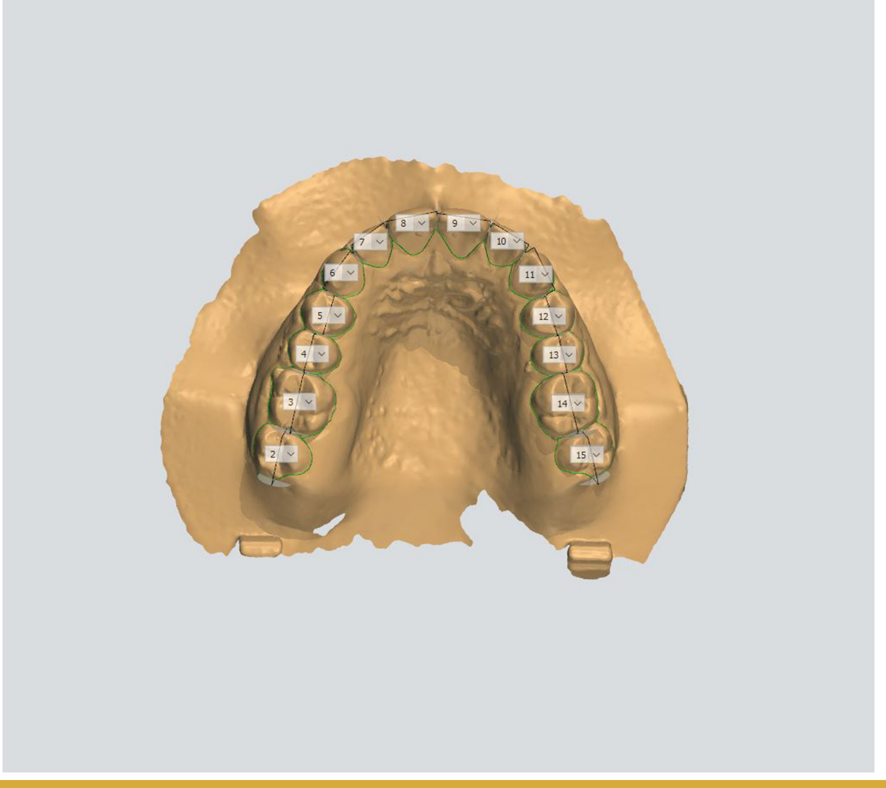

Figure 1. Mesiodistal measurements of teeth on digital models using 3Shape OrthoAnalyzer.

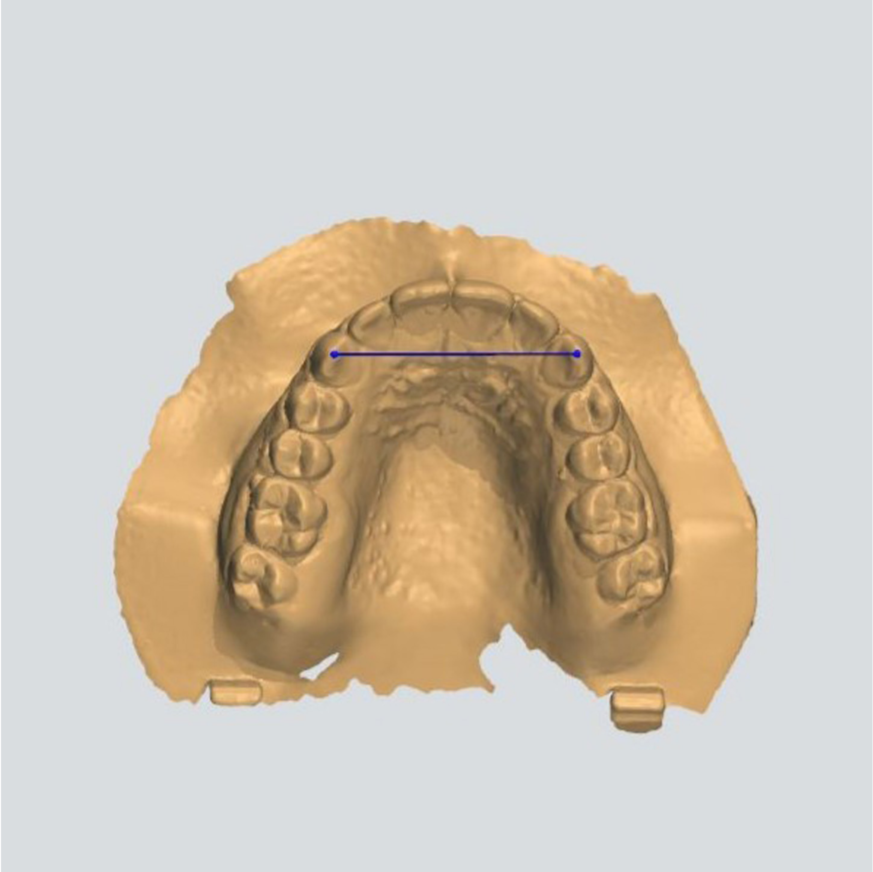

Figure 2. Intercanine width on digital models using 3Shape OrthoAnalyzer.

the evaluation of the reliability of repeated measurements. For the purpose of this study, 10 randomly selected models were subjected to a second evaluation. A *P*-value of less than .05 was deemed to be statistically significant in all statistical evaluations.

RESULTS

The study sample comprises 41 models.

A. Comparison of Tooth Widths
A comparison of crown widths using manual and digital methods revealed statistically significant discrepancies in the measurements of twelve teeth: right maxillary lateral incisor, right maxillary canine, right maxillary first molar, left maxillary canine, left maxillary second premolar, left mandibular first premolar, left mandibular second premolar, left mandibular first molar, right mandibular central incisor, right mandibular lateral incisor, right mandibular first premolar, and right mandibular second premolar. The most pronounced differences in measurements between the manual and digital methods were observed in the left maxillary lateral incisor, left maxillary first premolar, left maxillary second premolar, left mandibular first premolar ($P < .01$) (Tables 1 and 2).

The mean values obtained from the manual method were found to be equal to or smaller than those obtained from the digital method for tooth width. Nevertheless, a comparison of the digital measurements with those obtained using 3Shape and iTero reveals no significant difference between the 2 methods (Tables 1 and 2).

B. Comparison of Intercanine and Intermolar Widths
Although a statistically significant difference was observed between the 3 methods employed to calculate mandibular intercanine and intermolar width measurements, no significant difference was identified in the comparison between maxillary intercanine and intermolar widths (Table 3).

C. Bolton Ratios
A comparative analysis of the anterior and total Bolton ratios utilizing both manual and digital methodologies revealed no statistically significant discrepancy (Table 3).

Intraclass correlation coefficients (ICCs) were calculated to assess intra-observer reliability. The results revealed excellent agreement, supporting the consistency and reproducibility of both manual and digital measurements (Tables 4 and 5).

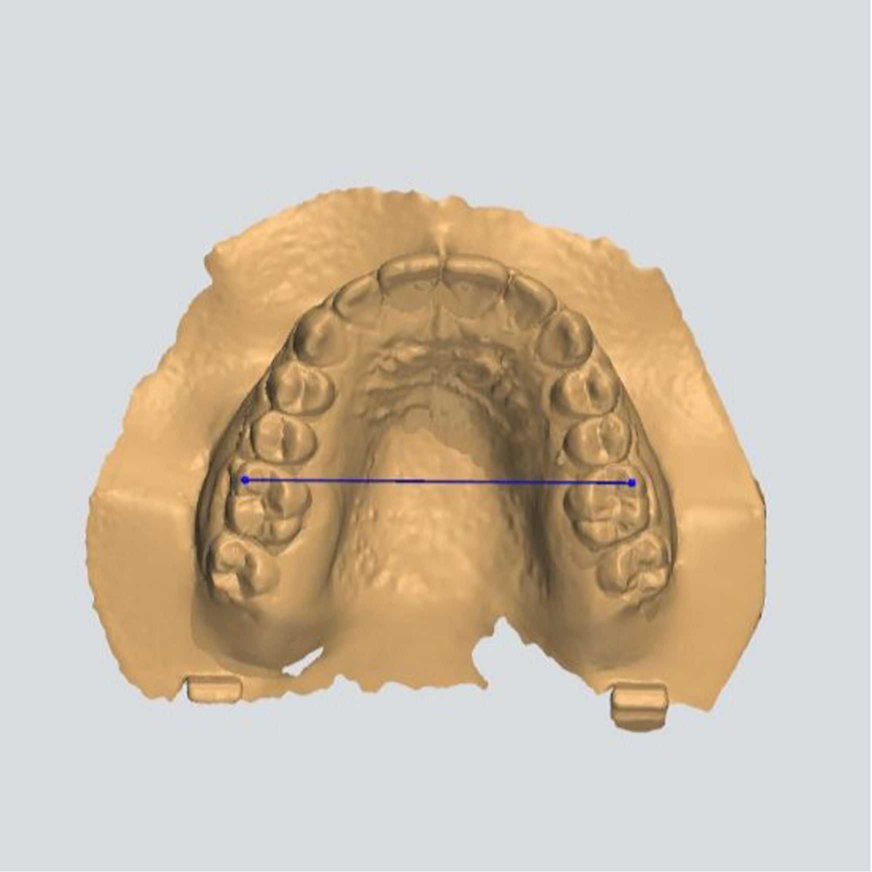

Figure 3. Intermolar width on digital models using 3Shape OrthoAnalyzer.

DISCUSSION

The efficacy of orthodontic treatment is contingent upon accurate diagnosis and meticulous treatment planning. The measurement of teeth and dental arch widths is of particular significance when selecting a treatment method, with or without extraction, for patients presenting with Bolton's discrepancy.[11,12]

Digital techniques have become progressively more prominent in the field of orthodontics in recent times. This has led to the advent of a plethora of software programs designed for the analysis of digital models. Extensive research has been conducted to evaluate the differences between conventional model analysis methods and 3D digital model analysis software.

The utilization of digital methodologies affords orthodontists the opportunity to achieve more exact and enduring outcomes with regard to Bolton analysis and dental measurements. In order to exploit these advantages, it is essential to ascertain the precision and dependability of digital models and to establish their viability as an alternative to conventional models. The aim of this study was to evaluate and compare the accuracy and reliability of Bolton tooth size discrepancy, intercanine distance, and intermolar distance measurements obtained from conventional plaster models and 3D digital models.

The advantages of digital model analysis have become increasingly evident with the advancement of technology. The advantages of digital models include the ability to perform measurements in a more rapid and straightforward manner, as well as the capacity to store and reproduce data with greater ease. In contrast, conventional models are capable of displaying greater detail and, in certain instances, may prove more dependable in the face of the potential inaccuracies inherent to digital technology. Conversely, some studies have indicated the presence of inaccuracies in the measurements obtained from digital models, with the potential for these models to underrepresent certain anatomical structures. This may be of particular significance in the assessment of complex orthodontic cases. Consequently, it is crucial to consider these potential limitations when utilizing digital models.[3,8,13]

Zilberman et al. conducted an evaluation of the accuracy of the measurements taken on the models using OrthoCAD and digital calipers. The greatest discrepancy was observed in the

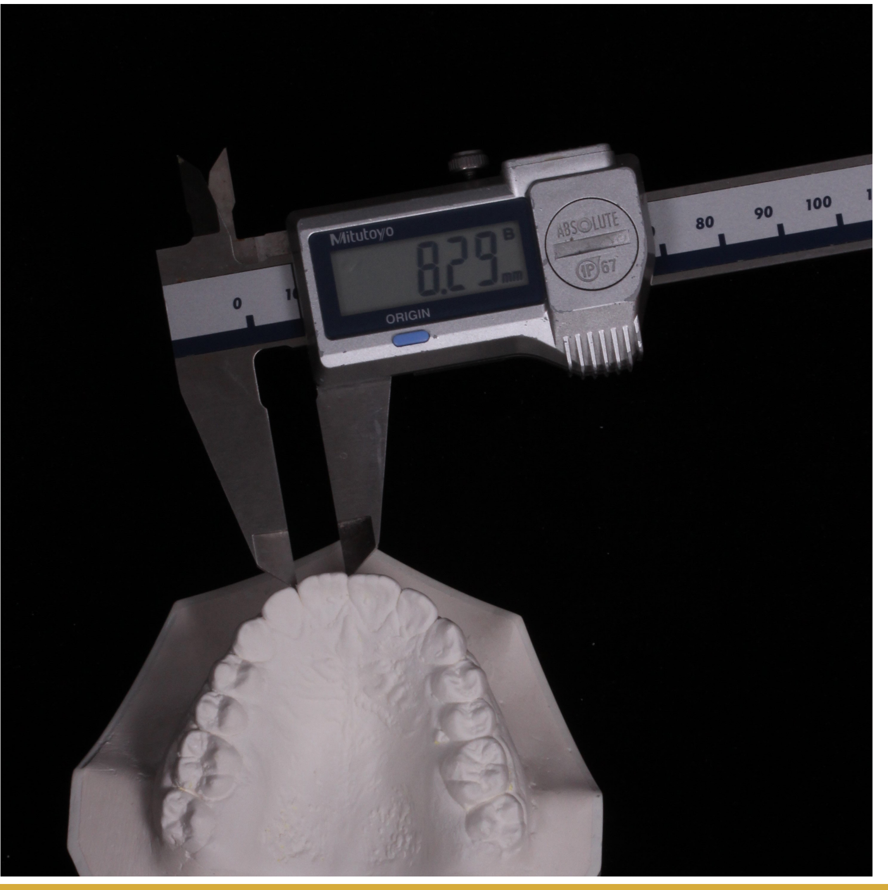

Figure 4. Mesiodistal measurements of teeth on plaster models using Mitutoyo digital calipers.

premolar region, while the largest systematic error was identified in the molar teeth group. The findings indicated that digital caliper measurements on plaster models exhibited the highest accuracy and repeatability, followed by OrthoCAD. Furthermore, the researchers indicated that the accuracy of OrthoCAD was deemed clinically acceptable. In similar fashion to the conclusions reached by Zilberman et al,[2] Quimby et al[14] determined that the measurements obtained with digital calipers were of a superior quality to those obtained using virtual measurement tools. Furthermore, they demonstrated that the validity and reliability of OrthoCad were clinically acceptable. This study also corroborates the findings of the aforementioned studies.[2,14]

Santoro et al[15] conducted a comparative study on the clinical crown widths of teeth in plaster models and digital scans using the OrthoCAD system. In their study, the authors reported that the mean difference between the crown widths of the teeth was statistically significant (ranging from 0.16 to 0.38 mm). Nevertheless, the extent of these discrepancies was deemed to be clinically inconsequential. Additionally, it was observed that the width measurements of the teeth in the scanned models consistently exhibited a reduction in size.[15]

In research undertaken by Cuperes et al,[16] the Lava Chairside Oral Scanner was used to measure tooth widths in digital models, resulting in values that were found to be larger. Similarly, in this study utilizing the 3Shape Trios 3 Move Plus (3 Shape Co., Copenhagen, Denmark) and the iTero Lumina (Align Technology, Santa Clara, Calif.), it was determined that the measurements of tooth width measured from digital models were greater than those obtained from plaster models.

In research by Abizadeh et al,[4] a comparison was made between digital models and the conventional method, revealing statistically significant differences in the measurements. However, the researchers concluded that these variations were of no clinical relevance. Similarly, although statistically significant differences were found in the transversal measurements between the conventional and digital models, the researchers concluded that these differences did not hold clinical importance.

Similarly, Leifert et al[17] employed OrthoCad software to measure the dimensions of the maxillary and mandibular arches, comparing the differences in arch measurements between plaster models and digital models. While a statistically

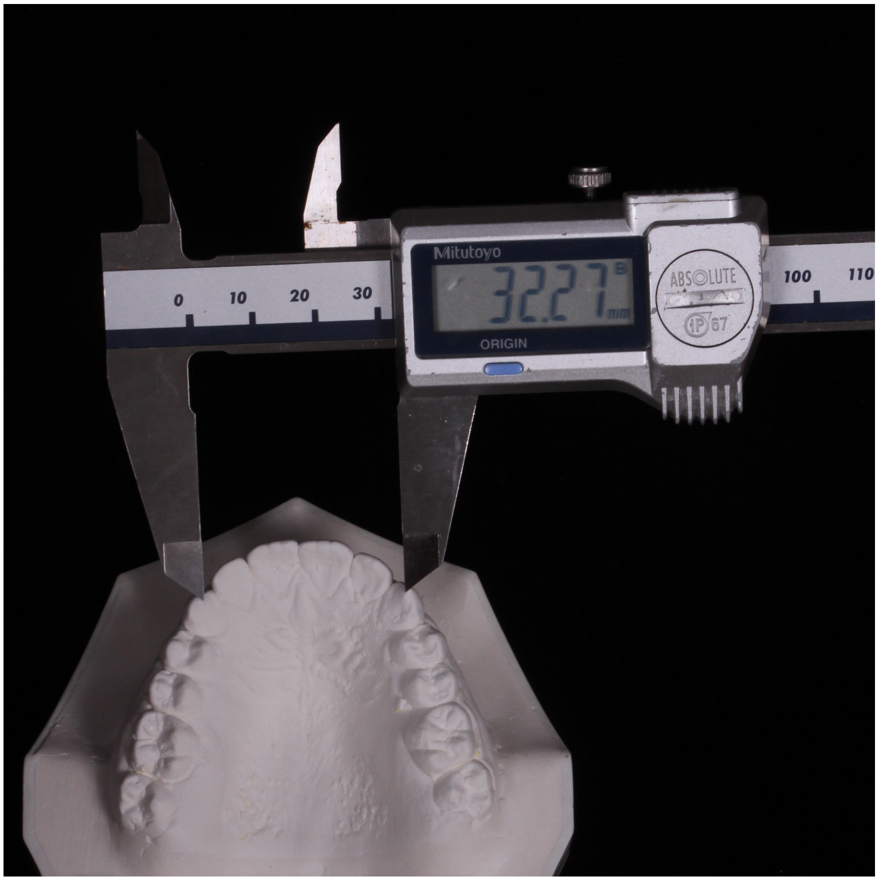

Figure 5. Intercanine width on plaster models using Mitutoyo digital calipers.

significant variation was observed in the measurements from the maxillary arch, the researchers determined that this difference was minor and clinically negligible. The average discrepancies were reported as 0.40 mm for the maxilla and 0.33 mm for the mandible, with an overall mean difference of less than 0.5 mm between measurements obtained from plaster and digital models. Moreover, it was concluded that digital models are both clinically reliable and reproducible when compared to conventional model analysis. A statistically significant difference was identified between the intercanine and intermolar widths of plaster models and digital models in the mandibular arch, whereas no significant discrepancy was observed in the maxillary arch.[4,17]

In their study, Watanebe-Kanno et al[18] employed the Bibliocast Cécile3 software to assess the precision of digital models in comparison to plaster models, which are regarded as the benchmark for accuracy in this field. While measurements obtained from digital models were found to be lower than those from plaster models ($P < .05$), the observed differences were considered clinically negligible (mean difference 0.17 mm). It was noted that the use of Bibliocast Cécile3 digital models for determining tooth size discrepancy and performing Bolton analysis offers a clinically viable alternative that is more time-efficient.[18]

Mullen et al[19] carried out a comparative evaluation of the accuracy and speed of arc length and Bolton ratio measurements on e-models and plaster models. No significant discrepancy was identified between the Bolton ratios obtained through the 2 methods. The measurement of maxillary and mandibular arch length revealed significant discrepancies between the 2 methods, although these were deemed to be clinically inconsequential. It has been documented that plaster models exhibit greater arch length than their electronic counterparts. The findings of this study revealed that there was no significant difference in maxillary arch length, while a significant difference was observed in mandibular arch length. However, in contrast to the findings of Mullen and colleagues, this study revealed that measurements obtained with conventional plaster models exhibited shorter arc length values compared to those derived from digital model analysis.[19]

Other researches have also evaluated the reliability of the digital method compared to the manual method: Naidu et al,[20] Reushl et al,[21] and Wiranto et al.[22]

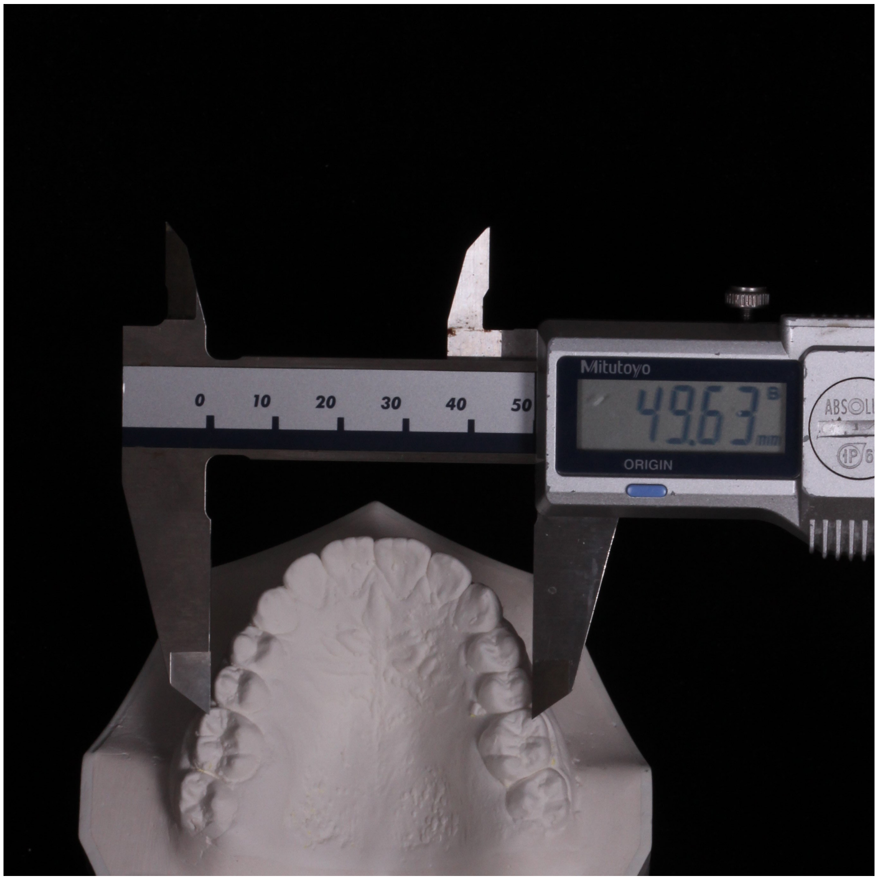

Figure 6. Intermolar width on plaster models using Mitutoyo digital calipers.

The results of these studies revealed a statistically significant discrepancy between the manual and digital methods. Nevertheless, these discrepancies were determined to be clinically inconsequential, and it was thus concluded that the OrthoCAD system represents a clinically acceptable alternative for the measurement of tooth width and the calculation of Bolton ratios.[20-22]

The sample size of this study was limited to 41 models obtained from the archive of the Department of Orthodontics, Faculty of

Table 1. Comparison of the Tooth Width (Mesiodistal) Measurements Between Investigated Methods in the Upper Arch

	Manuel (mm)	3Shape (mm)	iTero (mm)	Test Statistics	P^1
UR6	10.3 (9.1-11.7)[b]	10.6 (9.7-12.4)[a]	10.6 (9.8-12.2)[ab]	7.952	.019
UR5	6.6 (5.7-7.3)	6.7 (6-7.6)	6.7 (5.8-7.5)	3.805	.149
UR4	6.8 (6.1-7.5)	7 (6.2-7.9)	6.9 (6.2-7.7)	1.466	.481
UR3	7.7 (7.1-8.3)[b]	7.9 (7.2-8.7)[ab]	8 (7.1-8.9)[a]	8.117	.017
UR2	6.7 (5.7-7.8)[b]	6.9 (6-8.2)[a]	6.9 (6-8.2)[a]	6.787	.034
UR1	8.7 (7.6-9.7)	8.9 (7.8-9.7)	8.8 (7.7-9.7)	5.190	.075
UL1	8.7 (7.6-10)	8.9 (7.9-10.2)	8.9 (7.6-10.1)	3.385	.184
UL2	6.8 (5.4-7.7)	7 (6-7.9)	7.1 (5.7-7.8)	3.038	.219
UL3	7.8 (6-8.3)[b]	8 (7.3-8.7)[a]	8 (7.2-8.6)[a]	8.882	.012
UL4	6.9 (6.1-7.6)	6.9 (6-7.7)	7 (5.9-7.7)	0.321	.852
UL5	6.5 (5.6-7.3)[b]	6.7 (6-7.5)[a]	6.7 (5.9-7.6)[a]	8.107	.017
UL6	10.4 (8.9-12.1)	10.7 (9.4-12.4)	10.8 (9.8-12.6)	5.789	.055

L, left; R, right.
[1]The Kruskal–Wallis test.
[a-c]For each measurement, there is no significant difference between groups labeled with the same letter (Dunn's test).

Table 2. Comparison of the Tooth Width (Mesiodistal) Measurements Between Investigated Methods in the Lower Arch

	Manuel (mm)	3Shape (mm)	iTero (mm)	Test Statistics	*P*[1]
LR6	11 (9.2-12.3)	11.2 (9.6-12.5)	11.2 (9.6-12.5)	5.128	.077
LR5	7 (6-7.9)[b]	7.3 (6.4-8.1)[a]	7.3 (6.3-8.2)[a]	13.358	.001
LR4	7.1 (6.1-7.6)[b]	7.3 (6.3-7.9)[a]	7.3 (6.3-8.6)[a]	11.247	.004
LR3	6.7 (6-7.6)	6.9 (6.1-7.8)	6.8 (6.1-7.6)	1.887	.389
LR2	5.9 (5.1-6.5)[b]	6.2 (5.3-6.7)[a]	6.2 (5.1-6.8)[a]	10.544	.005
LR1	5.4 (4.5-6.4)[b]	5.6 (4.3-6.7)[a]	5.6 (4.6-6.5)[a]	6.130	.047
LL1	5.4 (4.5-6.1)	5.6 (4.8-6.3)	5.7 (4.6-6.4)	1.974	.373
LL2	6 (5.2-6.8)	6.1 (5.3-6.8)	6.1 (5.4-6.8)	5.086	.079
LL3	6.7 (5.6-7.6)	6.8 (5.7-7.6)	6.7 (5.7-7.6)	1.365	.505
LL4	7 (6-7.7)[b]	7.2 (6.4-7.9)[a]	7.1 (6.5-7.9)[a]	9.530	.009
LL5	7.2 (6.2-8)[b]	7.3 (6.6-8.3)[a]	7.4 (6.5-8.4)[ab]	8.833	.012
LL6	10.8 (9.4-12.3)[b]	11.1 (9.5-12.6)[ab]	11.1 (9.9-12.7)[a]	8.090	.018

L, left; R, right.
[1]The Kruskal-Wallis test.
[a-c]For each measurement, there is no significant difference between groups labeled with the same letter (Dunn's test).

Table 3. Comparison of Intermolar-Intercanine Widths and Bolton Ratio Measurements Between Investigated Methods

	Manuel (mm)	3Shape (mm)	iTero (mm)	Test Statistics	*P*[1]
UIC	25.2 (22-30.2)	26.1 (23-31)	25.9 (23-35.5)	4.934	.085
UIM	42.7 (38.2-48.1)	43.5 (34.4-48.9)	43.6 (39.2-48.4)	1.973	.373
LIC	33.7 (30.7-36.3)[b]	34.8 (31.9-48.4)[a]	34 (26.8-37.6)[ab]	9.892	.007
LIM	49.5 (45.5-54.5)[b]	50.7 (47.1-55.2)[a]	50.8 (47.2-55.2)[a]	6.258	.044
	Manuel (%)	**3Shape (%)**	**iTero (%)**	**Test Statistics**	***P*[1]**
Anterior Bolton ratio	77.5 (73.8-83.1)	77.5 (73.8-7679)	77.6 (74-89.1)	0.052	.974
Overall Bolton ratio	91.5 (87.8-95)	91.8 (87.2-9167)	91.9 (87.4-95.4)	1.820	.403

LIC, lower intercanine width; LIM, lower intermolar width; UIC, upper intercanine width; UIM, upper intermolar width.
[1]The Kruskal-Wallis test.
[a-c]For each measurement, there is no significant difference between groups labeled with the same letter (Dunn's test).

Dentistry, Ordu University. A larger sample size could increase the statistical power of the results. The accuracy of manual measurements using conventional methods depends on the operator's skill and experience, as well as the precision of the instruments used, which may introduce variability and potential inaccuracy. In this study, all measurements were performed by a single investigator, which prevented the assessment of inter-examiner reliability. Due to the retrospective design of the study, only post-treatment models that were complete and suitable for analysis were available in the archive. Consequently, all measurements were carried out on post-treatment models in both conventional and digital formats. Since both sets of measurements were taken from the same clinical stage, this did not affect the validity of the comparison. However, the absence of pre-treatment models may limit the generalizability of the findings to diagnostic and treatment planning contexts. Although 2 different scanner types (iTero Lumina and 3Shape TRIOS 3 Move Plus) were used, all measurements were performed within a single software platform (OrthoAnalyzer), thereby eliminating software-based variability. Future studies may consider comparing different software platforms to assess reproducibility in orthodontic measurements. Additionally, in the present study, digital models were obtained by scanning plaster models. Further research could compare various digital acquisition methods—such as intraoral scanning, impression

Table 4. Intraexaminer Reproducibility of the Tooth Width Measurements

	ICC			
	Maxilla		Mandible	
	Right	Left	Right	Left
Central incisor	0.966	0.952	0.924	0.956
Lateral incisor	0.989	0.986	0.904	0.914
Canine	0.934	0.937	0.898	0.910
1 Premolar	0.978	0.971	0.967	0.947
2 Premolar	0.958	0.972	0.959	0.943
1 Molar	0.939	0.976	0.956	0.978

ICC, interclass correlation coefficient.

Table 5. Intraexaminer Reproducibility of the Bolton Ratio Measurements

	Mean (mm)	ICC
Upper intercanine	34.949	0.716
Upper intermolar	50.774	0.998
Lower intercanine	26.276	0.985
Lower intermolar	43.665	0.917
	Mean (%)	**ICC**
Anterior Bolton ratio	78.932	0.943
Total Bolton ratio	92.318	0.957

ICC, interclass correlation coefficient.

scanning, and scanning of plaster models—to evaluate their accuracy and clinical effectiveness in orthodontics.

CONCLUSION

The present study compares the accuracy and reliability of dental measurements between conventional plaster models and digital models. The findings indicated that digital models yielded significantly larger mesiodistal tooth width measurements in comparison to conventional plaster models. In particular, the values obtained with digital models were found to be higher for certain teeth, including premolars and molars. Nevertheless, no clinically significant distinction was discerned between digital and conventional methodologies in Bolton's analysis and maxillary intercanine and intermolar width measurements. This indicates that digital models can yield results that are consistent with those obtained from conventional plaster models for specific measurements. Consequently, they can serve as a reliable alternative in the diagnosis and treatment planning of orthodontic cases.

In conclusion, the findings of this study lend support to the proposition that digital models are a viable alternative to conventional plaster models for the purposes of orthodontic measurement. Nevertheless, in light of the ever-changing landscape of digital technologies, it is imperative to undertake more comprehensive investigations into the accuracy and reliability of these techniques.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Ordu University (Approval No: 2024/61; Date: June 7, 2024).

Informed Consent: Due to the retrospective nature of the study and the use of anonymized data, the requirement for individual informed consent was waived.

Peer-review: Externally peer-reviewed.

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