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2D Photograpic Image: A Reliable Substitute For Traditional Casts ???

Dr Jakati Sanjeev V.

Dr Harish Atram

Dr Mugdha Mankar

MDS, Assistant Professor,
Orthodontics & Dentofacial Orthopaedics
Swargiya Dadasaheb, Kalmegh Smruti Dental,
College & Hospital Nagpur Maharashtra India

Dr Mrunal Aley

Dr Achint Chachada

MDS, Associate Professor,
Orthodontics & Dentofacial Orthopaedics
Swargiya Dadasaheb, Kalmegh Smruti Dental,
College & Hospital Nagpur Maharashtra India

Abstract:

Introduction: Digital technology has made significant changes in orthodontics. Digital photography and radiographs are rapidly replacing traditional methods. The progression to a completely ''paperless office'' has incorporated use of digital models & have eliminated need for storage space and have made retrieval and transfer of models easier. Dental casts have been reproduced in two-dimensions by taking photocopies and photographs of casts. Three-dimensional (3D) reproduction of study models has been achieved but shortcomings that have been identified with them mean that conventional casts have still not been replaced & traditional method of treatment planning using dental casts is still applicable.

Aim: As storage of dental casts is the usual problem, utilization of digital photographs as storage media is explored as an option in this paper.

Materials and Method: 50 pretreatment plaster dental models irrespective of malocclusion & gender between age group of 10-25 years fulfilling inclusion criteria were selected. Results: concurrence between digital and actual plaster models in maxilla is 51.2% agreement but mandible only 8% agreements. However photocopies are unreliable in arch length and space analysis determination but stated that photocopies of dental casts were nevertheless useful for comparing pre and post treatment arch forms, communicating with other practitioners and producing occlusograms for demonstration purposes.

Conclusion: Digital photographs of the dental models are a poor replica for the study models in estimation of arch length. However, for the purpose of mere storage, the same could be retained.

Keywords: plaster models, digital models, Arch length

Key message: Digital photographs of the dental models are a poor replica for the study models in estimation of arch length

I. INTRODUCTION

The vital information required to diagnose a malocclusion and develop an orthodontic treatment plan consists of models, photographs, panoramic and lateral Cephalometric radiographs, and a clinical examination. Digital technology has made significant changes in orthodontics. Digital photography and radiographs are rapidly replacing traditional methods. The progression to a completely ''paperless office'' has incorporated the use of digital models, records, consents,

and financial agreements. Digital models have eliminated the need for storage space and have made retrieval and transfer of models easier.

Study models are also used in research, audit, and teaching. The medico-legal requirement in the United Kingdom is that all clinical records, including study models, should be retained for a period of 11 years, or 11 years after a child patient reaches the age of 18 years. The need to retain dental casts for future reference has created storage problems for orthodontists. A more convenient and cost-effective means of recording and maintaining this information accurately is needed. Dental casts have been reproduced in two-dimensions by taking photocopies and photographs of the casts. Three-dimensional (3D) reproduction of study models has been achieved using holography and stereo photogrammetry. The shortcomings that have been identified with stereo photogrammetry and holography mean that conventional casts have still not been replaced.

Amongst the varied companies offering computer-based three-dimensional models SureSmile^{TM*}, OrthoCAD^{TM**}, and E-Models^{TM***,} are a few of the companies listed. Diagnostic TM* Ora Metrix Inc., Dallas, Texas; TM** Cadent Inc., Carlstadt, NJ; TM *** GeoDigm corporation Inc., Chanhassen; Minn

Impressions of the patient's dentition are mailed to the company, and the impressions are scanned using various technologies unique to the company. These scanned images are uploaded to the company software, allowing viewing of the three dimensional models. The clinician, using the company's software program, can access these images. The program also allows the orthodontist to perform measurements and manipulate the models to achieve proper diagnosis.

In India, the technology is still unavailable to a majority of the practising orthodontists yet orthodontists are required to keep records of the patient for a minimum of 5 years following orthodontic treatment. This results in the use of storage space and models cluttered orthodontic offices. The application of CADCAM in diagnosis and treatment planning is also unaffordable to many Indian Orthodontists. Hence, the traditional method of treatment planning using dental casts is still applicable. As storage of the dental casts is the usual problem, the utilisation of digital photographs as a storage media is explored as an option in this paper. Should there be a need to assess the arch length at a later time; this paper aims to evaluate the accuracy of arch length determination from the stored photograph with the dental cast.

II. AIMS & OBJECTIVES

- ✓ To evaluate the reliability of arch length determination in photographs of the dental casts with the dental casts themselves.
- ✓ To evaluate if digital photographic models could replace the plaster models in future in maintaining patient records.

III. MATERIALS AND METHOD

50 pretreatment plaster dental models of patients irrespective of the malocclusion between the age group of 10-25 years irrespective of the gender were used in this study. The dental casts selected had to fulfill the following inclusion criteria.

INCLUSION CRITERIA

Fully erupted permanent dentitions from the first molar on one side to the first molar on the other side were used. There should have been no previous history of any orthodontic appliances. There was no obvious loss of tooth material mesiodistally as a result of caries, fractures, interproximal wear, congenital defects, or impression flaws. Digital models were the photographic images of their plaster model counter parts. Photographs of all the study casts were taken from a digital SLR camera from a distance of around 2 feet from the photograph. Calibrations were done on all casts by pasting a ruler of 1 mm each on every cast to overcome the factor of photographic magnification.

Dental arch perimeter was calculated on both plaster models and on photographs (maxillary as well as mandibular). A brass wire was used and passed along the basal arch from distal surface of 2nd premolar (Left side) to distal surface of 2nd premolar (Right side) (Carey, 1958; Huckaba, 1964; Hart, 1988, Nance, 1947). The values obtained were calibrated.

The photographic magnification of each cast was estimated from the ruler placed on the cast and the magnification error was corrected and the measurements of arch perimeter tabulated for the photographs.

The measurements were carried out by two observers on the same set of data to check for reliability of methodology.

The data obtained was subjected to statistical analysis. The interobserver error was determined and the co relation between the photographic measurements and those from the cast was obtained.

IV. RESULTS

IN maxilla there is 51.2% agreement but mandible only 8% agreement. (Graph 1 & 2)

Tables 1 indicate that there is concurrence between the two observers and the method used for individual assessment of the records was reliable (p<.001)

Tables 2 indicate that in the maxillary arch there was a 51.2% concurrence between the digital and actual plaster models whilst in the mandibular, there was only 8% concurrence.

Methodology used	N	Observer	Maxillary arch		Interobserver reliability	Mandibular arch		Interobserver reliability
			Mean	Std. Deviation	95% Confidence Interval	Mean	Std. Deviation	F test
Brass wire method	50	1	86.12	6.340	0.985	74.80	6.937	0.978
		2	86.18	6.170	**P<0.001**	75.18	6.356	**P<0.001**
Photographic method		1	71.58	4.883	0.941	60.40	4.375	0.954
		2	69.72	4.969	**P<0.001**	60.52	4.127	**P<0.001**

Table 1: For inter examiner reliability

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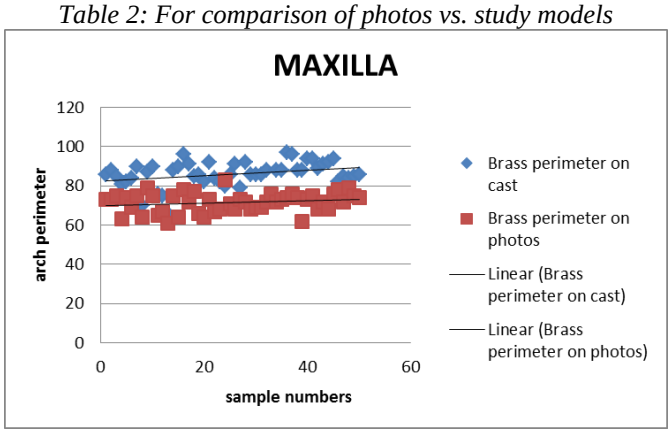
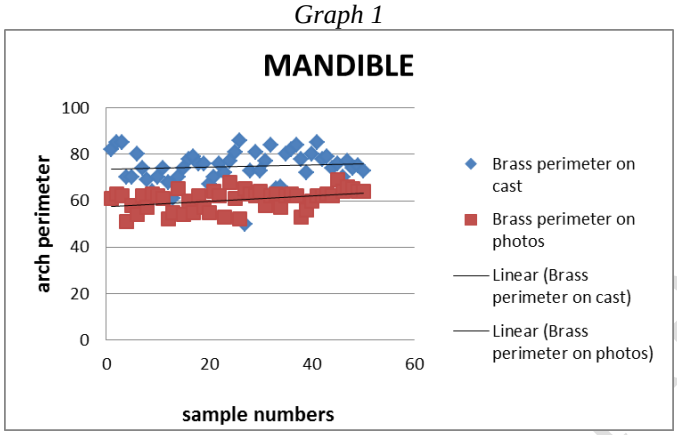
Intraclass Correlation Coefficient

VAR00003		Intraclass Correlation	95% Confidence Interval		F Test with True Value 0			
			Lower Bound	Upper Bound	Value	df1	df2	Sig
MAXILLA	Average Measures	.512	.140	.723	2.048	49	49	.007
MANDIBLE	Average Measures	.080	-.621	.478	1.087	49	49	.385

Table 2: For comparison of photos vs. study models



Graph 1



Graph 2

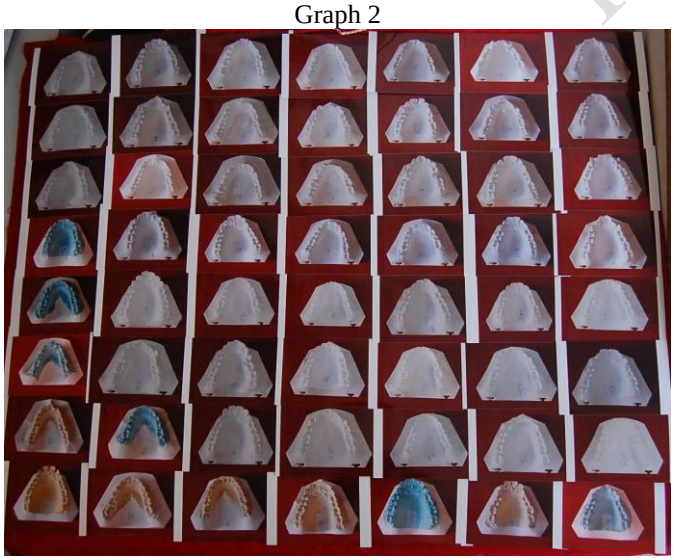


Figure 1

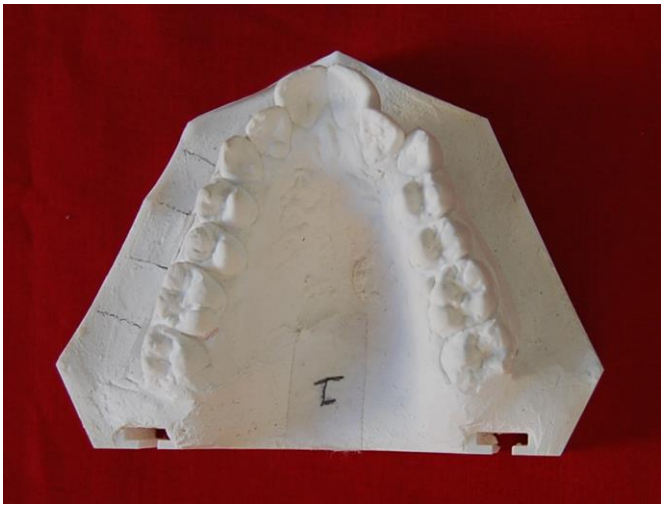


Figure 2

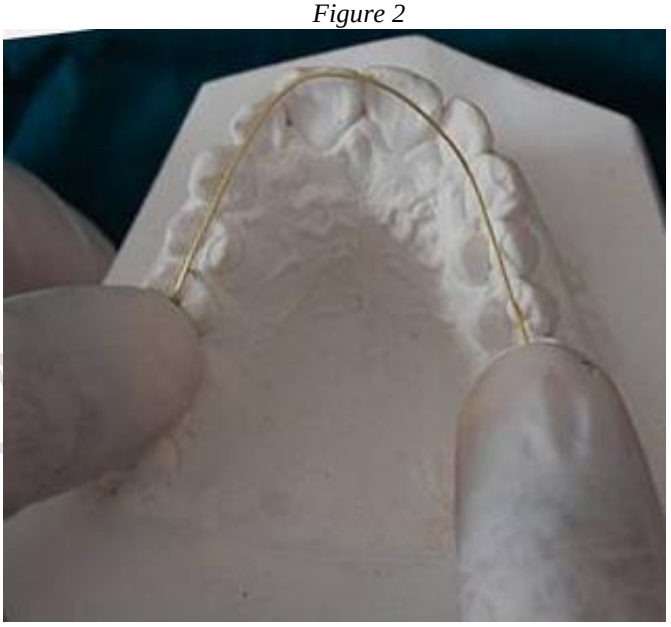


Figure 3

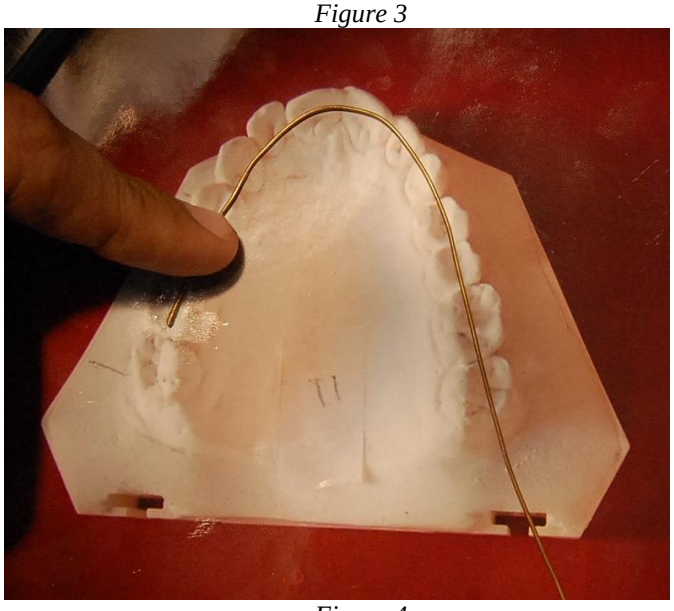


Figure 4

V. DISCUSSION

Yen was the first to introduce a method whereby the mesiodistal tooth sizes could be measured from photocopies of study models by digitizing key landmarks. The method was introduced to increase informatics, reduce error and facilitate transfers of records. The records could be easily assigned to competent assistants saving time for the orthodontist. However, Champagne[4] reported that photocopies are unreliable in arch length and space analysis determination but stated that photocopies of dental casts were nevertheless useful for comparing pretreatment and post treatment arch forms, checking initial arch forms during treatment, communicating with other practitioners and producing occlusograms for demonstration purposes. Nollet PJPM et al[9] proposed the use of photographs of the dental casts and stated that these casts provided a consistent, reproducible method for rating dental arch relationships in patients with UCLP.

From this study, we can deduce that digital photographs of the dental models are a poor replica for the study models in estimation of arch length. However, for the purpose of mere storage, the same could be retained. The photographs could also be used in assessing arch forms, communicating with other practitioners and producing occlusograms for demonstration purposes. Chad Callahan P; Sadowsky L. and Ferreira A carried out a study to evaluate if study models played a role in actual treatment planning and they deduced that plaster models may not be needed for planning of treatment of every orthodontic patient.

VI. CONCLUSION

It can thus be concluded that arch length cannot be reliably reproduced in digital photographic models when compared with the plaster counterparts. However, for the purpose of storage the digital images could be used and one could avoid plaster clutter. However, should there be a need for reassessment of the plaster measurements, digital photographs are seen to be a poor replica.

As furtherance to this study, it would be worthwhile studying if the two dimensional photographs themselves could assist in treatment planning and arch length determination and the plaster models could be totally eliminated for the economic orthodontist.

REFERENCES

[1] The present paper is an expanded version of “The pedagogy of English idioms: Insights from applied linguistics” presented at Kisii University Second Annual International Interdisciplinary Conference held from June 24 to 27, 2015.
[2] Other definitions of idioms are propounded by Perce (2007, p.87), Kövecses & Szabó (1996), Cooper (1999), Simpson and Mendis (2003, p.423) et cetra
[3] Idioms are classified using different parameters, for example: types of idioms based on semantic framework or degree of non-literalness (Fernando’s 1996); Makkai’s (1972) classification of idioms into the aspects of grammatical construction including phrasal verb idiom, tournure idiom, irreversible binomial idiom, phrasal compound idiom, and incorporating verb idiom. Grant (2007) also categorizes idioms as core idioms, figuratives or ONCEs (one non-compositional element).
[4] Referring to the etymology of idioms in order to understand their idiomatic meaning is called 'etymological elaboration' (Bagheri & Fazel, 2010).
[5] An action research normally takes place when a teacher works with her/his own class as she/he feels the need to improve her teaching/learning experiences (Cohen & Manion, 1980).
[6] Non compositional idioms or non-decomposable idioms are those whose constituent parts do not contribute to the overall idiomatic interpretation (Fernando & Flavell, 1981). That is, non-compositional idioms have no relations between the idiom's constituents and the idiom's meaning (Glucksberg, 2001, p.73).