

Smartphone as an alternative in taking Micrographs in Orthodontics

Annamaneni Rakesh Rao¹ Nemani Shivaram^{2*} Shubhaker Rao Juvvadi³

¹Professor, Department of Orthodontics & Dentofacial Orthopedics, Sri Sai College of Dental Surgery, Hyderabad, India.

²Senior Lecturer, Department of Orthodontics & Dentofacial Orthopedics, Panineeya Institute of Dental Sciences & Research Centre, Hyderabad, India.

³Professor and Head, Department of Orthodontics & Dentofacial Orthopedics, Sri Balaji Dental College, Hyderabad, India.

ABSTRACT

Background: Apart from being part of the clinical diagnostic tool various imaging techniques help in understanding the brackets and other biomaterials used in orthodontics at a microscopic level. The aim of this study was to find chair side alternative to one such imaging technique in evaluating the bracket dimensions (slot height, mesh design, torque) and Adhesive Remnant Index using stereomicroscope.

Methods and Material: Images of 10 central incisor brackets, Seven 2nd premolars buccal surfaces after debonding procedure were taken using a lens attached to Smartphone camera. The images were then calibrated and measured using ImageJ software.

Results: The images of the brackets and the tooth surfaces were taken with three combinations of lenses. The clarity of the images taken was sufficient to accurately measure the slot height, torque and to estimate the Adhesive Remnant Index. The analysis of the images showed that the dimensions of slot height, torque were within the range as prescribed by MBT.

Conclusions: The present method of taking the images with Smartphone offers an invaluable alternative to the images obtained from stereomicroscope to a limited magnification.

Keywords: Smartphone, torque, adhesive Remnant Index, stereomicroscope.

INTRODUCTION

Imaging is one of the most important tools for orthodontists to evaluate & record size and form of craniofacial structures which form one of the essential parts of diagnosis and treatment planning. A varied array of imaging techniques has been used to record the entire course of the orthodontic treatment in a static 2D form. These data form an essential part of record keeping and also help in communication amongst the peers. There are various forms of images used in orthodontics namely photographs from DSLR camera, SEM pictures, stereomicroscope pictures, which help

understanding the armamentarium used in orthodontics. Images from DSLR camera helps in assessment of the facial and intraoral features of the patient, stereomicroscopic images help in determining the bracket mesh and bracket slot deformation before and after debonding procedure, ARI scores. Scanning Electron Microscope technique is used in determining the surface characteristics of archwires, bracket mesh design at microscopic level and the morphological characteristics of the implants used as temporary anchorage devices.

Apart from the techniques described above Macrophotography and Photomicrography are two

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*Correspondence Dr. Nemani Shivaram.

Department of Orthodontics & Dentofacial Orthopedics, Panineeya Institute of Dental Sciences & Research Centre, Hyderabad, India.

Email: src_nemani@yahoo.com



Fig 1: Smartphone with the Lens attachment.

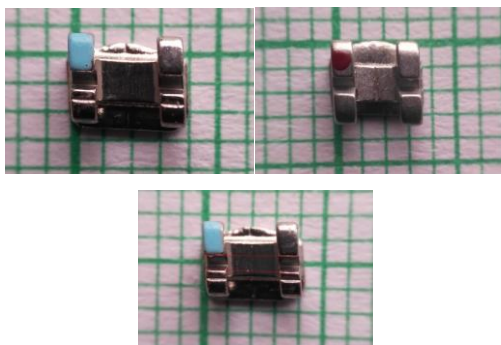


Fig 2: Face of the Central incisor bracket (Metal) fromOrmco, 3M.

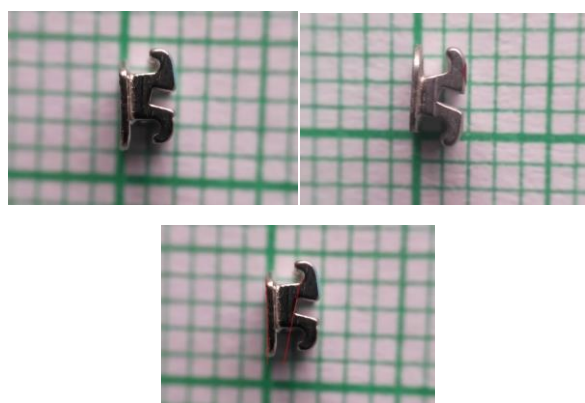


Fig 3: Slot of the Central incisor bracket (Metal) fromOrmco, 3M.



Fig 4: Mesh design of Central incisor bracket (Metal) fromOrmco, 3M.

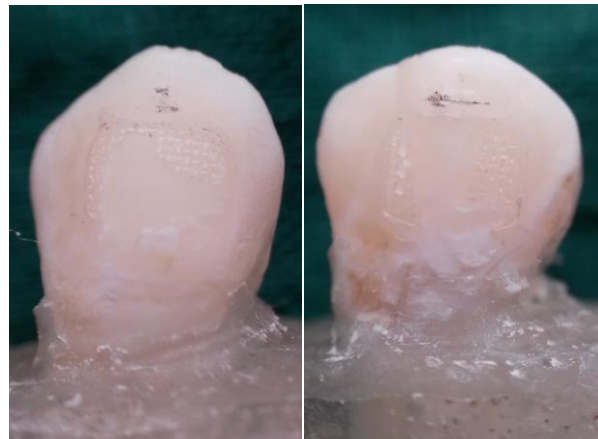


Fig 5: Adhesive Remnant Index Score 1 (Less than 50% of the adhesive remained on the enamel).



Fig 6: Adhesive Remnant Index Score 2 (Less than 50% of the adhesive remained on the enamel)

ways to take the extreme close-up images of usually very small subjects in which the size of the subject in the *photograph* is greater than the actual life size of the same. Macrophotography includes the use macro lenses for the DSLR camera, Photomicrography/ Photomicrograph is a photograph or digital image taken through a microscope or similar device to show a magnified image of a subject in other words it is the practice of using microscopes to make photographs. A micrograph or photomicrograph is

Table 1: Slot dimensions and Slot angulations of the 10 Central Incisor brackets (Ormco).

S. No	Slot Dimensions (mm)	Average	Slot Angulations	Average
1	0.58	0.573 ± 0.015	16.59	16.641 ± 0.21
2	0.57		16.68	
3	0.58		16.89	
4	0.59		16.23	
5	0.57		16.7	
6	0.55		16.37	
7	0.55		16.83	
8	0.6		16.72	
9	0.57		16.54	
10	0.57		16.86	

taken using an optical microscope, a process involves attaching a camera to a microscope, thereby enabling the user to take photographs at reasonably high magnification. All these imaging techniques are expensive and require heavy armamentarium. The present article describes an efficient, reproducible way of taking Micrographs with minimal and cost effective equipment one of which is the SMARTPHONE.

MATERIAL AND METHODS

A 45x magnification objective lens attached to microscopes was used in the present study. Two hemispherical lenses were removed from the objective. The objective front lens element was not used in taking the images as the field of view covered was insufficient. The other objective lens was then attached to a Smartphone with good camera resolution and the images were taken (Figure 1).

Images of 10 central incisor brackets from Ormco, were taken in both profile and lateral view to measure the dimensions of the slot and the torque incorporated in the central brackets. The images were taken with graph paper in background

to help in calibration of the image and to measure the parameters described. The images of the base of the brackets were taken to assess the type of mesh. Seven 2nd premolar brackets (Ormco) were attached to the buccal surface of extracted premolar using standard bonding technique. The brackets were then debonded using the Universal testing machine and later the images were taken using Smartphone as described.

Once the images of brackets slot angulation and slot dimensions were taken they were assessed using ImageJ software. ImageJ software is an open source image processing program designed for scientific multidimensional images [1]. The software is installed and the scale is set by measuring a known distance on the graph sheet and attributing it to the pixels on the image. After calibrating the scale the dimensions are measured on the images taken and assessed.

RESULTS

Images of brackets and premolar tooth surface were taken to show the extent of applications of present technique using the Smartphone camera. The field of view covered by the images taken with the lens was sufficient to assess the slot angulations of the bracket (Torque incorporated) (Figure 3). The images taken by the lens covered both bracket base mesh and the slot dimension in frontal view adequately with the graph paper in the background which aided in the calibration and measuring the image (Figure 2, Figure 4).

The measurements were done on images taken with single lens. The bracket face of 10 central incisor brackets showed that the height of the slot dimension was an average of 0.573 ± 0.015 mm. The angle formed by the slot and bracket base in case of the central incisor brackets was found to be $16.641^\circ \pm 0.213^\circ$. The image of the mesh of brackets showed that they were of single mesh type; foil mesh was seen in brackets from Ormco. Adhesive remnant index scores were given to the 7 premolar tooth surfaces and it was observed that 4 samples had score 2 (Figure 6) and 3 samples showed score 1 (Figure 5).

DISCUSSION

In the present study images of bracket surfaces, buccal surface of the premolar after debonding procedure were taken to help in authenticating the technique in both objective and subjective manner. By attaching a lens to the camera ability to take micrographs was attributed to the Smartphone. It was observed that, images obtained were equal to the images taken with stereomicroscope when at 10x to 20x magnification. The images provided great detail of the materials at microscopic level. The images of the mesh of the two brackets taken showed that they had single mesh design. The 3M bracket had a Micro etch base where as Ormco bracket had a foil mesh (Ormesh base). The type of mesh design helps in evaluating the shear bond strength of the brackets. Bishara observed that the single and double mesh design brackets provided comparable shear bond strengths and bracket failure modes [2]. Knox suggested that the bracket base design improves both the adhesive and light curing penetrations [3].

The images of the brackets in face and in lateral view aids in evaluating the slot dimension of the bracket as well as the angulations of the slot to the bracket base. The angulation of the bracket slot shows the amount of torque incorporated in the bracket. Paul Brown, A.C.Cash observed in their respective studies that the actual slot size and shape of an orthodontic bracket are likely to vary both larger and smaller from the advertised nominal value within a bracket series [4, 5]. In the present study it was observed that the slot angulations of the bracket (mean torque values) were well within the range as prescribed by MBT. The image of buccal surface of the extracted premolar after debonding under the Universal testing machine provided an image of sufficient clarity to perform the Adhesive remanent index.

The images of brackets and the tooth surface taken with the present method make it possible to conduct studies with less expensive and simple equipment which ideally require images taken from a stereomicroscope which is cumbersome and expensive.

CONCLUSION

The images taken by Smartphone with the technique described in the present study makes capturing the micro details of bracket surfaces, slot angulations, evaluating ARI with ease. This procedure requires less expensive equipment, chair side equipment and provides the images on par with that of the stereomicroscope.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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