# Comparison of Duration Between Manual and Digital Measurement of Peer Assessment Rating (PAR) Index In A System Based on 2D Image

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**Abstract**

In orthodontics, the malalignment of teeth could be measured using many types of indexes. The Peer Assessment Rating (PAR) Index is one of the most common indexes in Orthodontics which has a 98% validity, especially from the occlusal surface. Many researchers use a PAR ruler to measure the PAR Index manually. The aim of this study is to compare the duration between the manual and digital measurement of PAR index in a system based on the 2-dimensional (2D) image. **Materials & methods**: The 110 dental casts in octagonal base form pre-orthodontic treatment were scanned to get the digital image data. Eleven components of PAR index of 110 dental casts in octagonal base form pre-orthodontic treatment were calculated manually and digitally. Both of duration were compared with the paired t-test. **Result:** The time consuming of manual measurement was 378.01 seconds and digital was 177.05 seconds. The paired t-test comparing to systems were significant (p=0.001). The average difference of 3 PAR index scores in assessing the same study model, that shows Digital is more thorough at 3 PAR parity score. **Discussion:** The paired T-test has been performed to the 11 PAR index component. A digital measurement of 11 PAR component is reliable and faster than using a measurement manually by model studies. The 2D image is clearer so that point determination is easier hence the measurement time is faster. **Conclusions:** It is a solution and recommended for the orthodontist to consider of using PARIndex system as one of the alternative tools to have a faster PAR index measurement.

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## Introduction

Peer Assessment Rating (PAR) Index is one of the most common indexes in orthodontics. The index has 98% accuracy and it could calculate teeth alignment deviation from almost every side of the tooth, especially from the occlusal surface of the dental cast.[1]

PAR index consists of 11 components: 1) Upper right segment, 2) Upper anterior segment, 3) Upper left segment, 4) Lower right segment, 5) Lower anterior segment, 6) Lower left segment, 7) Right buccal occlusion, 8) Overjet, 9) Overbite, 10) Centerline, 11) Left buccal occlusion.[1-4] The PAR index was used to evaluate dental and occlusal changes. PAR index is used to find out the need of orthodontic treatment. PAR index can also show 1) comparison malocclusion before, after treatment and after retention, 2) quality evaluation of treatment outcomes, 3) the severity of malocclusion and treatment requirements.[1,5] Analysis of the study model can be done in various ways, can use calipers, scan and use 2-dimensional (2D) images or 3-dimensional (3D) imagery. PAR index is accurate and can be implemented to measure malocclusion in digital and manual study models.[6] Referring to the

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previous study on speed assessment, reliability, accuracy, and reproducibility, the difference is less than one percent. The images are equally accurate and reliable as long as the digital image is derived from the conventional study model. The differences that exist between the two methods are clinically accepted. Digital measurement time is faster than manual.[7]

The study will discuss 11 components of the PAR index from all surface, which usually, PAR index is calculated manually from measurements of the dental cast. However, in this research, we used 3D dental casts to produce the 2D data image that processed in "A new PAR index in a system based on 2D image". The system uses the Open Source Computer Vision Library (Open CV) libraries for counting the distance between each tooth's contact point and Cute (QT) for creating the interface of the program.[8] QT is a cross-platform application framework that is used for developing application software that can be run on various software and hardware platforms with little or no change in the underlying codebase, while still being a native application with native capabilities and speed.[2,8-10] The program reads 2D image data and process it into the result of PAR score index.

## Material & Methods

The dental cast of 110 patients in an octagonal base form pre-orthodontic treatment was measured with PAR ruler manually. And 110 dental cast in octagonal base form pre-orthodontic treatment were scanned to get the digital image data. The process of developing dental cast in the octagonal base can be seen in figure 1. To scan the dental cast, conventional flat bed scanner with the base of dental cast taped to the lid of the scanner were used. The dental cast scanned with 300-pixel density per inch (dpi).[4]

A new PAR index in a system based on 2D image program uses Open CV libraries for counting the distance between each contact points and QT for creating the software's interface. A new PAR index in a system based on 2D image program will read the 2D model's image and measure the distance between each contact point of every tooth which produce the 11 PAR index score.[2] Then the results will be shown on the application. Every study cast measured with time-consuming either manual or digital by stopwatch. All image digital data set from the occlusal, buccal and anterior segment from 110 dental casts were measured in this software and compared with 110 same dental casts that are measured manually.

The PAR program could measure 11 components from 11 PAR index in a new PAR index in a system based on the 2D image. This PAR index software was undertaken by several tests and the result was valid and reliable.

The paired T-test has also been performed to the eleven PAR index components on both manual and digital calculation

## Results

There are 110 dental casts that are measured manually and 110 the same dental casts that are measured digitally. The paired T-test from the 11 components of PAR index variables is significant (p=0.001) when comparing manual with digital measured. The time consuming of the manual measurements is higher than digital. In average, the outcomes from the measurement of 11 PAR component are 378.01 second for manual and 177.05 seconds for digital (table 1).

The result of paired T-test analysis on the total value of manual and digital PAR index on the eleven PAR Index compent there is an average difference of 3 PAR index scores in assessing the same study model. The difference of 3 PAR index scores resulted in a significant difference between total manual and digital PAR index counts. Digital is more thorough at 3 PAR parity score. Component of PAR passive bite induction index has a mean of 1.27 while digital equal to 2.55, it can be concluded that the calculation of PAR index of bite passengers can only be detected equal to 1.27 whereas in digital calculation using automatic two-dim PAR system indication able to detect 2.55. Digital PAR index calculations are more accurate in determining PAR index scores.

**Table 1:** Comparison of Peer Assessment Rating Index Duration Analysis between Manual and Digital.

| Duration PAR Index | n | Average Second± SD | p |
|---|---|---|---|
| Manual | 110 | 378,01 ± 132,81 | 0,000 |
| Digital | 110 | 177,05 ± 34,05 | |

**Figure 1:** 2 D Dental Image

## Discussion

The 110 dental casts were measured both manually and digitally calculated using a new PAR index in a system based on 2D Image. The data were analyzed with a statistical program. The normality and homogeneity test was applied to see the distribution of the data compare to manual and digital data.

The analysis was applied for several variables that showed significantly different (p=0.001) for 11 PAR index components. The image of the 2D digital study model was accurate, reliable and clinically accepted. Based on the T-test analysis, there is an average difference of 3 PAR index scores in assessing the same study model, that shows Digital is more thorough at 3 PAR parity score. Digital measurement time is faster than manual.[7]

Referring to the previous study on speed assessment, reliability, accuracy, and reproducibility, the difference between manual and digital model study is less than one percent.

The images are equally accurate and reliable as long as the digital image is derived from the conventional study model. The differences that exist between the two methods are clinically accepted. Digital measurement time is faster than manual.[7]

## Conclusion

We have built a software that could measure the PAR index of a dental cast. A PAR index in a system based on the 2D image for PAR Index in this new software is faster than the manual measurement. A digital measurement to the 11 PAR component is faster than using a measurement manually by model studies.

This new PAR Index software in a system based on the 2D image for PAR Index recommended for orthodontist as one of the alternative tools for PAR index measurement.

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