3D LASER SCANNING OF DENTAL IMPRESSIONS

Volume 1.

Purpose:
A Thesis Submitted in Partial Fulfilment for the Degree of Doctorate in Clinical Dentistry.

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Abstract

The 3D laser scanning of dental impressions has always been considered difficult if not impossible to do. The problem arises from the inability of the laser scanner to scan the deeper portions of an impression which are often also undercut. This has always been a known limitation of laser scanning. The review of literature confirmed this as there was very little written on the laser scanning of dental impressions.

In this research project, a philosophy was adopted whereby an insurmountable problem was transferred to one which was not – a common technique used in mathematics to solve difficult problems. To this end, a new technique was developed. In order to successfully scan the deep indents formed by the dentition, half-impressions were taken. These half-impressions were of the lingual occlusal and buccal occlusal surfaces. This, by simple design, resulted in the elimination of the undercuts allowing the laser scanner to scan the areas which were previously considered difficult or impossible. The problem then became one of inverting the scans and combining them to form a complete 3D virtual image of the dental arch. The occlusal surface was used as the area of commonality and each half-scan was inverted and aligned to form the full virtual image of the dental arch.

Once the technique was developed, the scans were compared against other known methods for generating virtual models as well as against the plaster reference models.

There were five pairs of plaster models used, each with an increasing amount of crowding. Half-impressions were taken of the models and laser-scanned. This resulted in ten sets of virtual models derived from the scans of the half-impressions.

The four groups compared were as follows:

1. Plaster Models with measures taken with vernier callipers and dividers.
2. Laser-scanned plaster models with measures taken using computer software.
3. Combined laser-scans of the half-impressions with measures taken using specific orthodontic software for virtual models.
4. CT-scanned full impressions with measures taken using proprietary software provided by the scanner manufacturer.

The measures used to compare the four groups were individual tooth sizes and arch widths. For this research project, the statement was made – *"There is no gold standard for measuring the size of teeth to the standard required for study models"*. The aim of the statistical design was to compare the four methods as a whole and to show that there was no significant difference between any method when compared against the others, i.e. that all methods were essentially equivalent. This was achieved by using a Repeated Measures ANOVA to compare the four groups of measures.

The measuring of the models was performed in two distinct ways. Firstly, all models were measured quickly to simulate how they would be measured in a clinic. The same groups were them measured precisely with the measures being

taken in a way which provided the best possible chance of measuring identical points on the same model across the different groups.

The results indicated no significant difference between the four methods whether they were measured quickly or precisely. The scanning and combining of the half-impressions to form a complete virtual image is considered a valid method for producing virtual images of a dental arch.

Future research could concentrate on refining the technique, hardware and software required.

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