5.5 Calcium Content

The results obtained for the relative calcium concentration of the root surface were collective peak to background ratios of all the nine teeth studied (Appendix Table. 9.41, 9.42, 9.43, 9.44 and 9.45).

A statistically significant correlation was shown to occur with respect to hardness and elasticity within the layers tested in the teeth (p=0.130 and p=0.008, respectively). Elasticity was affected by calcium content more so than hardness.

The typical spectrum obtained with the use of EDAX enabled two integration windows to be used to obtain the peak to background ratio of the Calcium, Fluoride and Phosphate peaks (Fig. 4.11).

The relationship to the Calcium content and the four root surfaces within their layers can be seen in Figures. 5.28, 5.30 and 5.31. However the intra layer differences are clearly seen in the 3-D colour coded graph (Fig. 5.32). The red areas indicated regions of high relative calcium concentrations, while the blue areas indicated regions low relative calcium concentrations. There appeared to be a repeat in the trend of hardness and elasticity in that the mid root regions appear higher in relative Calcium content than the apical and cervical regions.

The relationship of Calcium content to both hardness and elastic modulus is shown in Figure 5.29. Hardness and elastic modulus plotted with respect to relative calcium content appeared to be linear.

Relative Calcium Content At Different Layers Along Root Between Surfaces

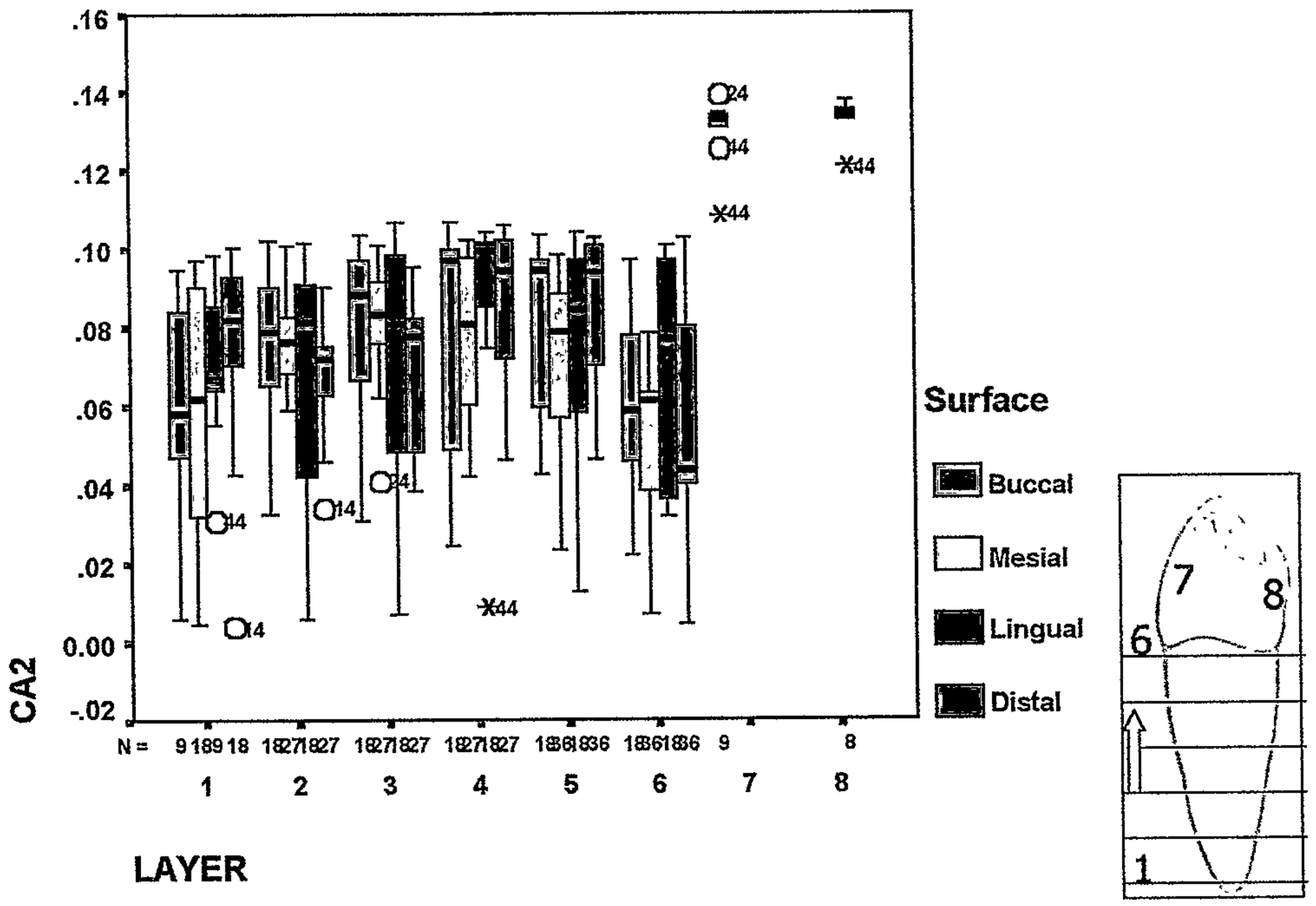


Figure 5. 28. A diagrammatic representation of the calcium content variation from the "apex" to the "CEJ" with respect to the root surfaces of all the nine teeth tested. Buccal and lingual enamel were also represented. (N = Number of tests analyzed).

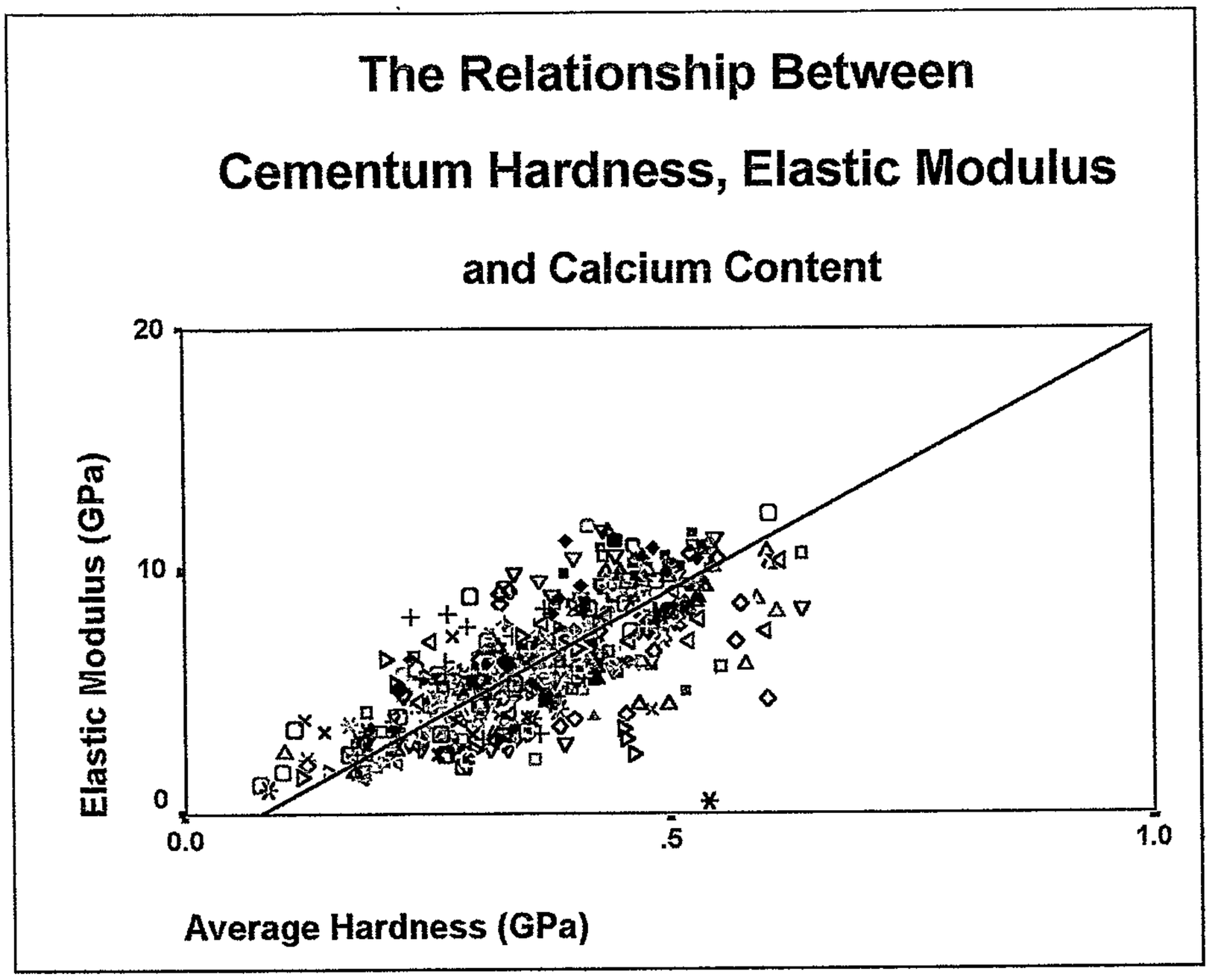


Figure 5. 29. Hardness and elasticity plotted with respect to relative calcium content. A linear relationship is seen when the averages of the 2970 points are plotted. Calcium content (coloured markers) are plotted for hardness and elasticity at the respective values. Relative calcium concentration values are set as markers in SPSS programme.

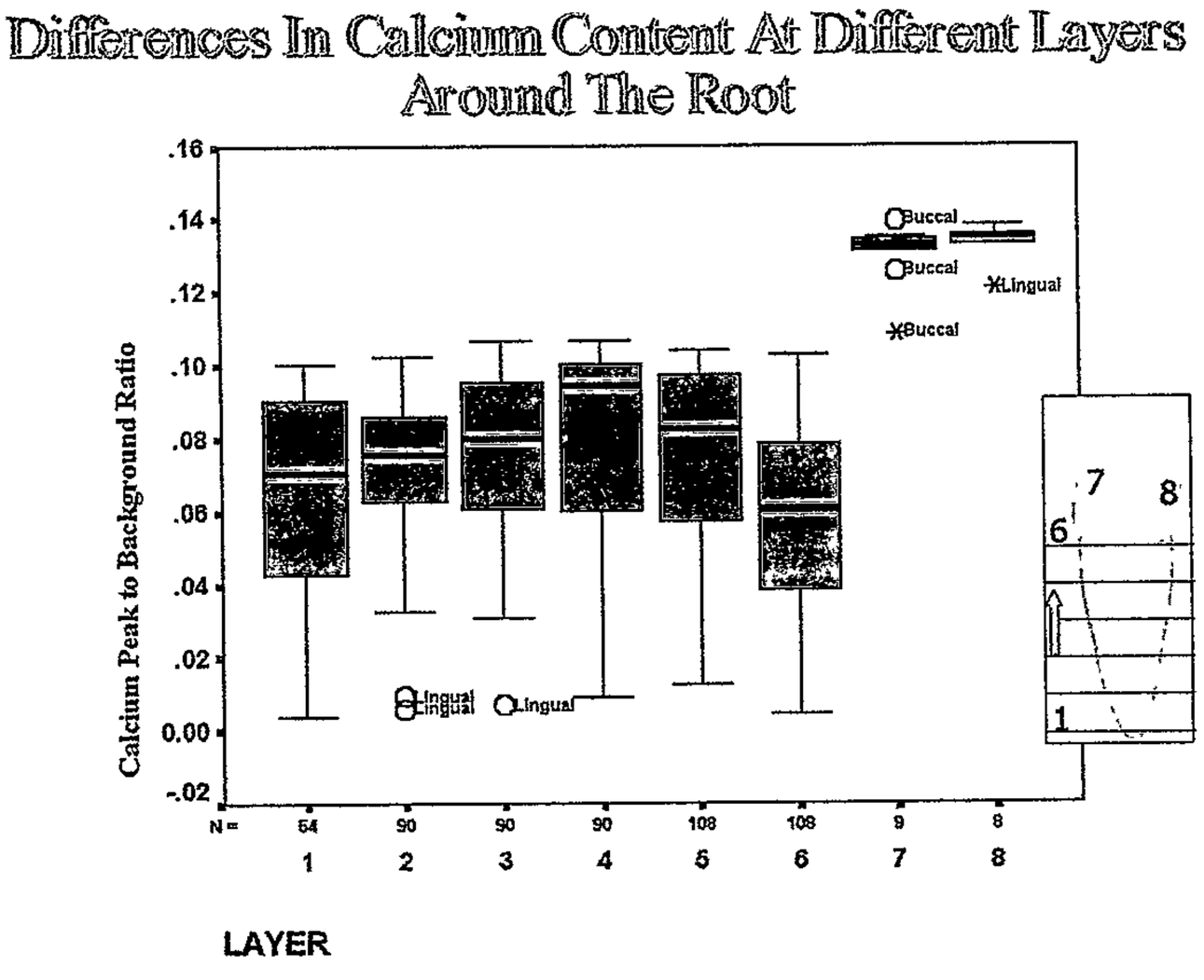


Figure 5. 30. A diagrammatic representation of the calcium content variation from the "apex" to the "CEJ" of all the nine teeth tested. Buccal and lingual enamel are also represented. There appeared to be a repeat in the trend of hardness and elasticity in that the mid root regions appear higher than the apical and cervical regions. (N = Number of tests analyzed).

Differences In Calcium Content Along Root Surfaces

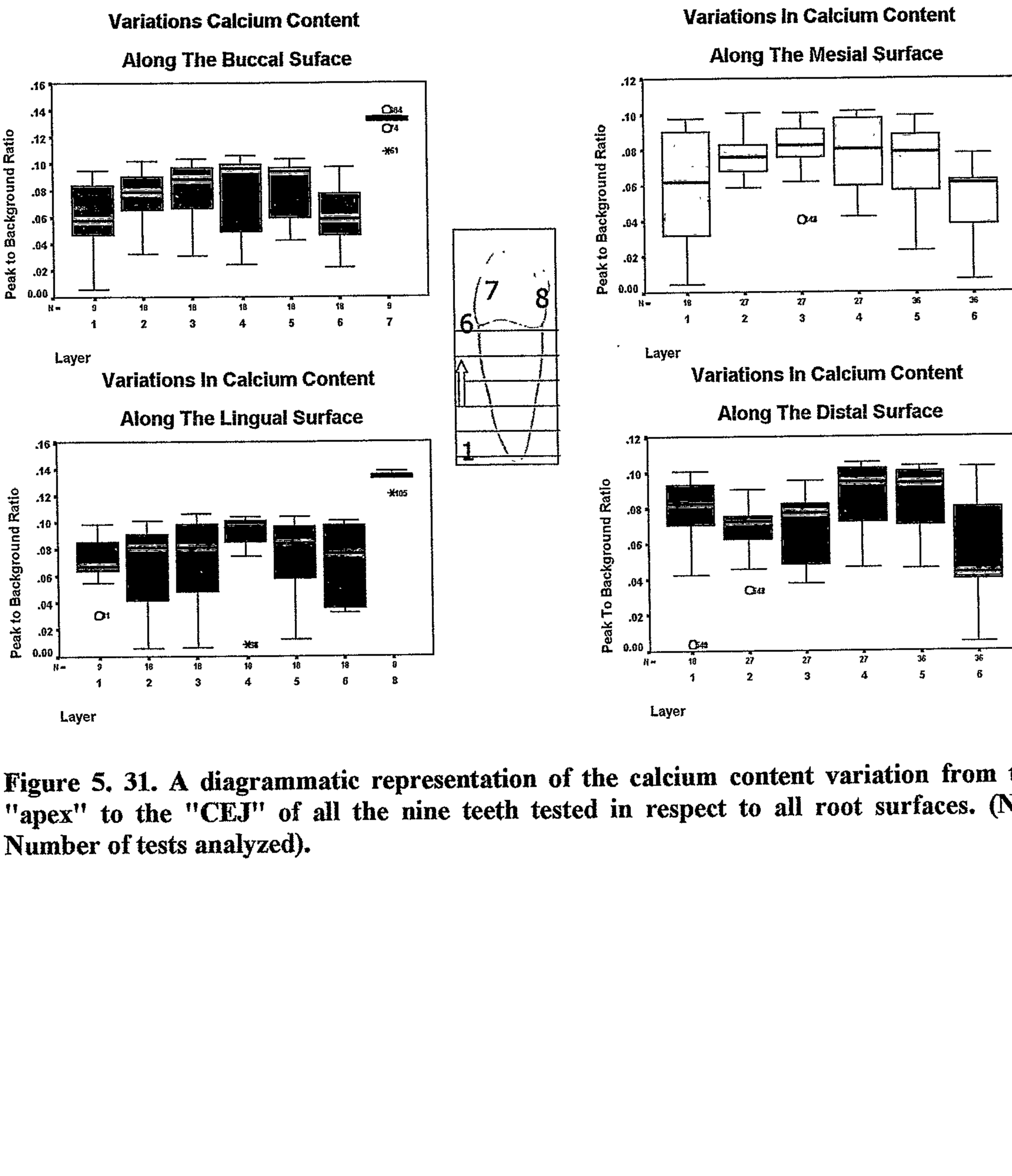
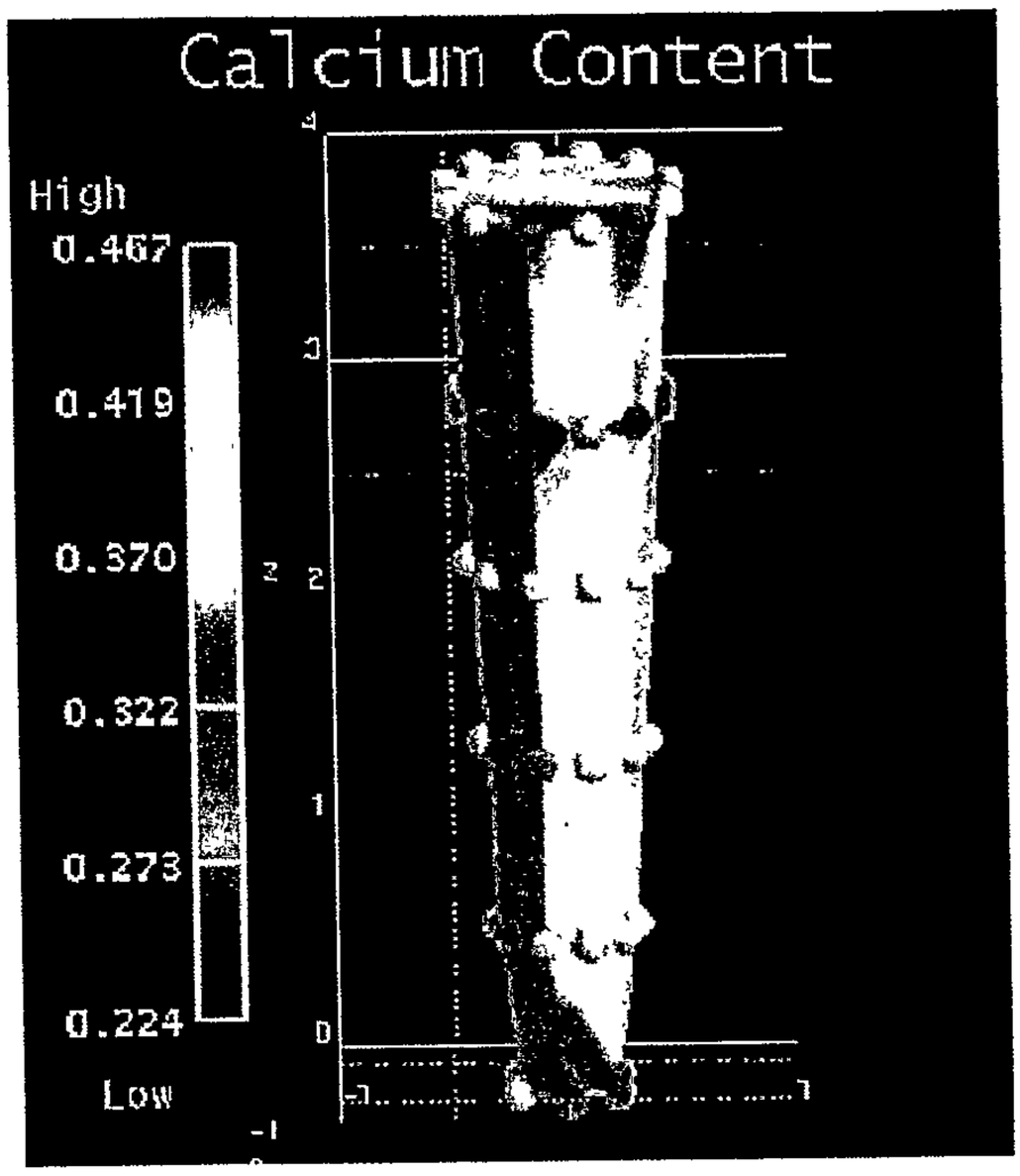
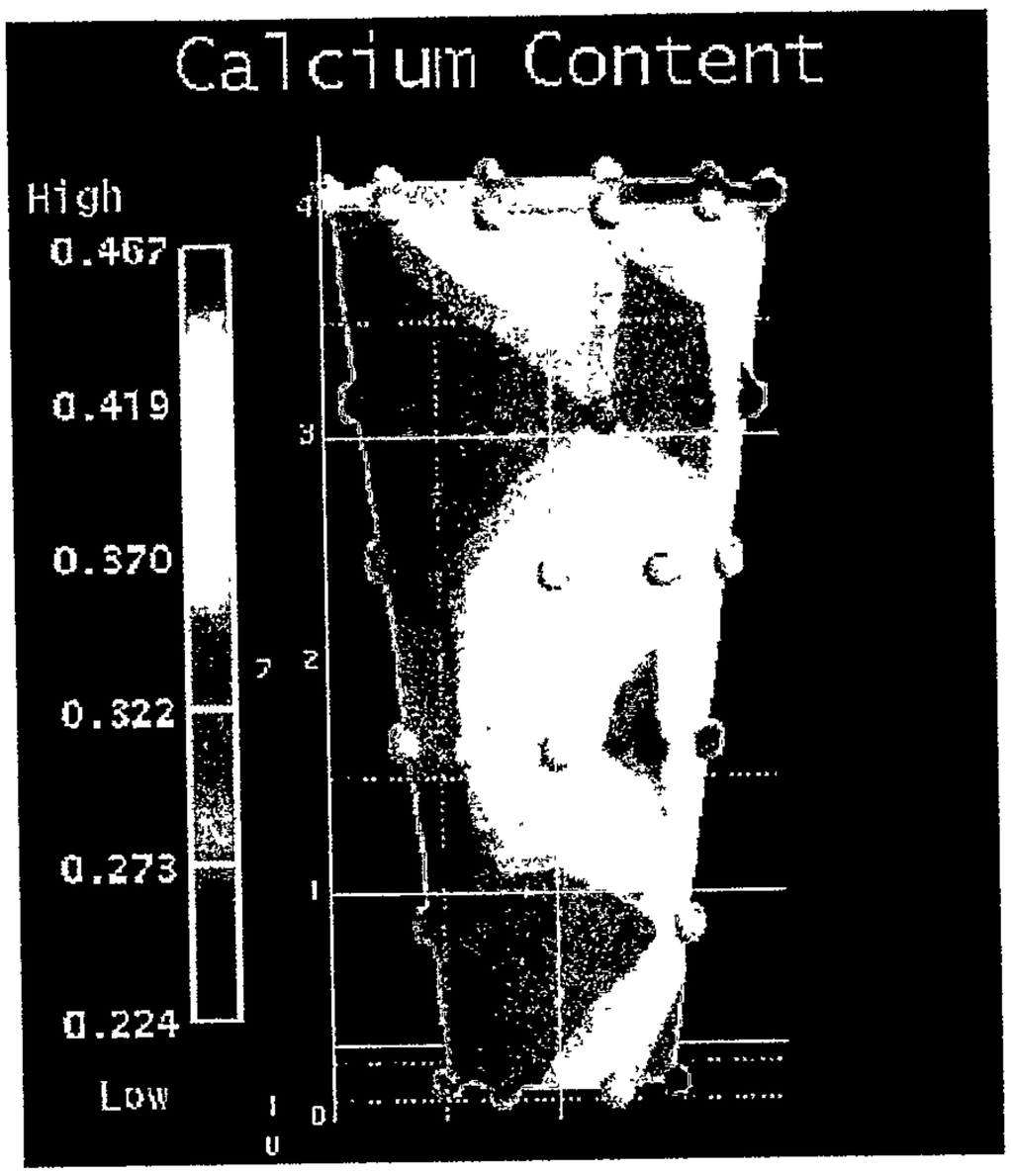


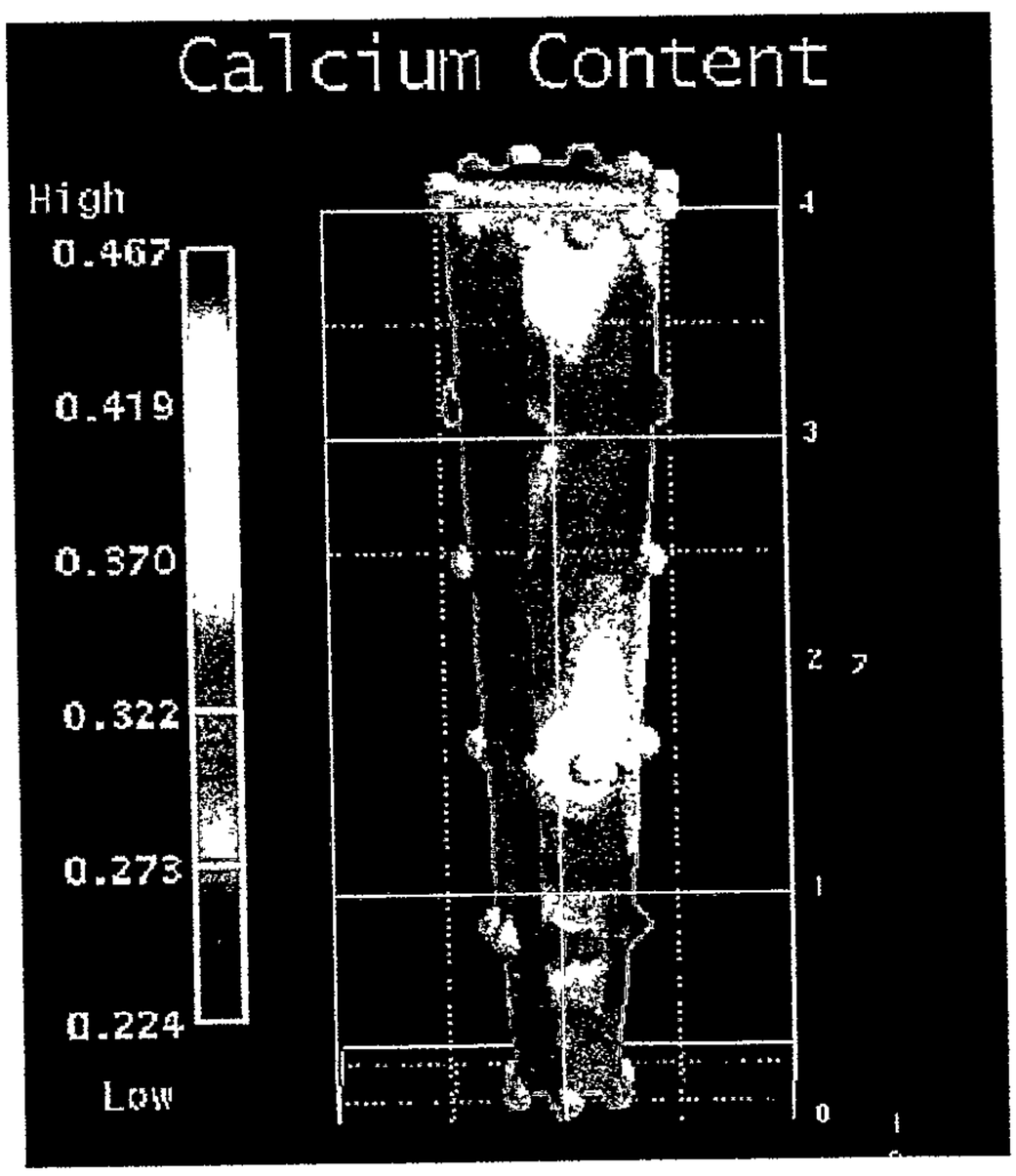
Figure 5. 31. A diagrammatic representation of the calcium content variation from the "apex" to the "CEJ" of all the nine teeth tested in respect to all root surfaces. (N = Number of tests analyzed).



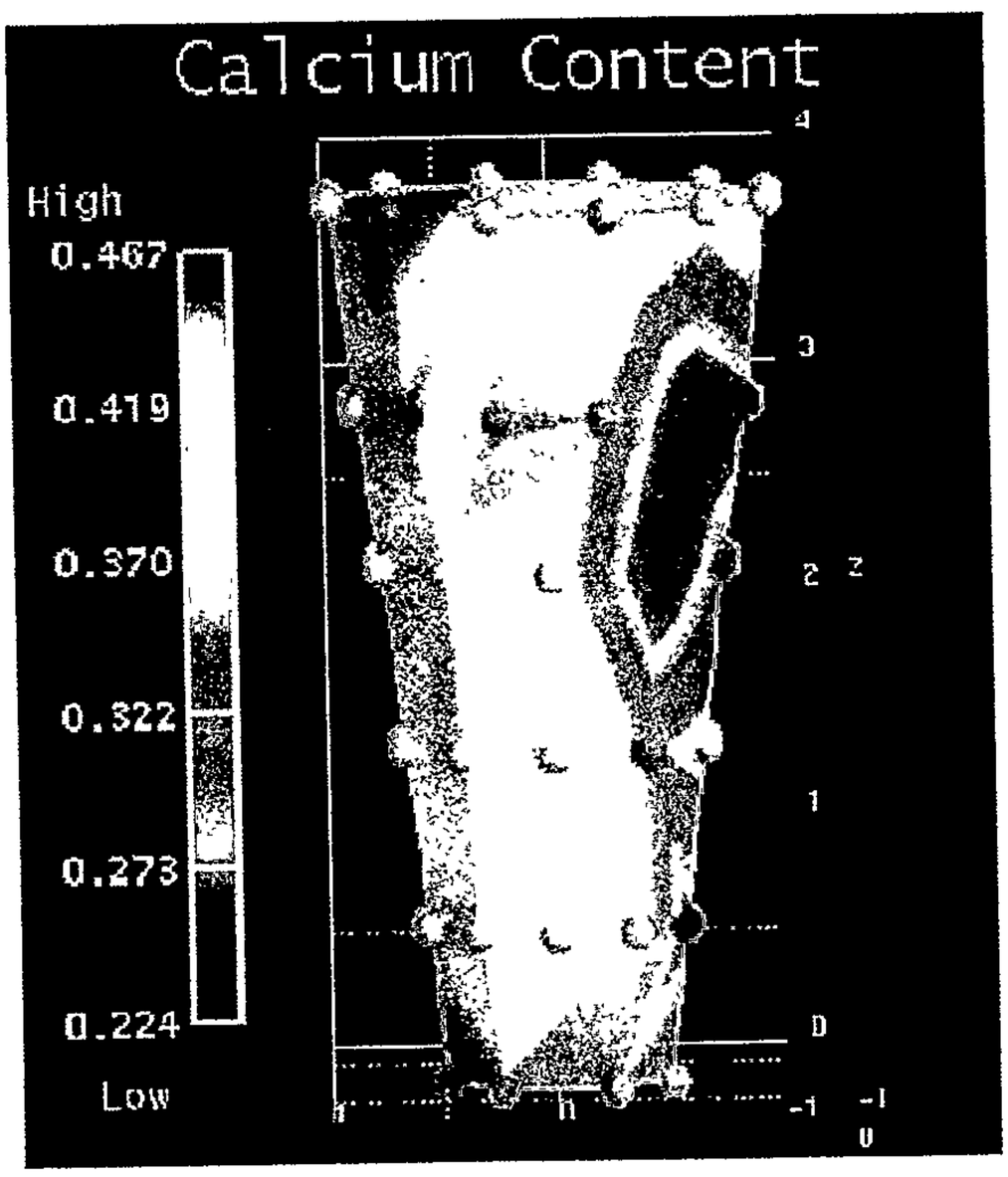
Buccal Surface



Mesial Surface



Lingual Surface



Distal Surface

Figure 5. 32. Sample 1 Calcium Content. All surfaces of the lower right first premolar teeth, divided into six layers with calcium content represented in colour. Blue is low relative values and red is high relative values. The sixty sites tested on this root are depicted by the spheres.

5.6 *Method Error*

Errors due to measurements are calculated as pooled standard deviation (Sp). The combined method error was calculated for hardness to be Sp = 0.07. The errors due to measurements for elasticity, from 3100 results were calculated to be Sp = 1.09.

5.7 *Ultra-Structural Analysis*

A fracture, which involved the longitudinal scoring of the tooth using a diamond disc, was obtained using twist of an osteotome (Fig. 5.33). Although various tooth layers can be seen such as dentine tubules and the orientation of the fibres, the overall structure remained obscure.

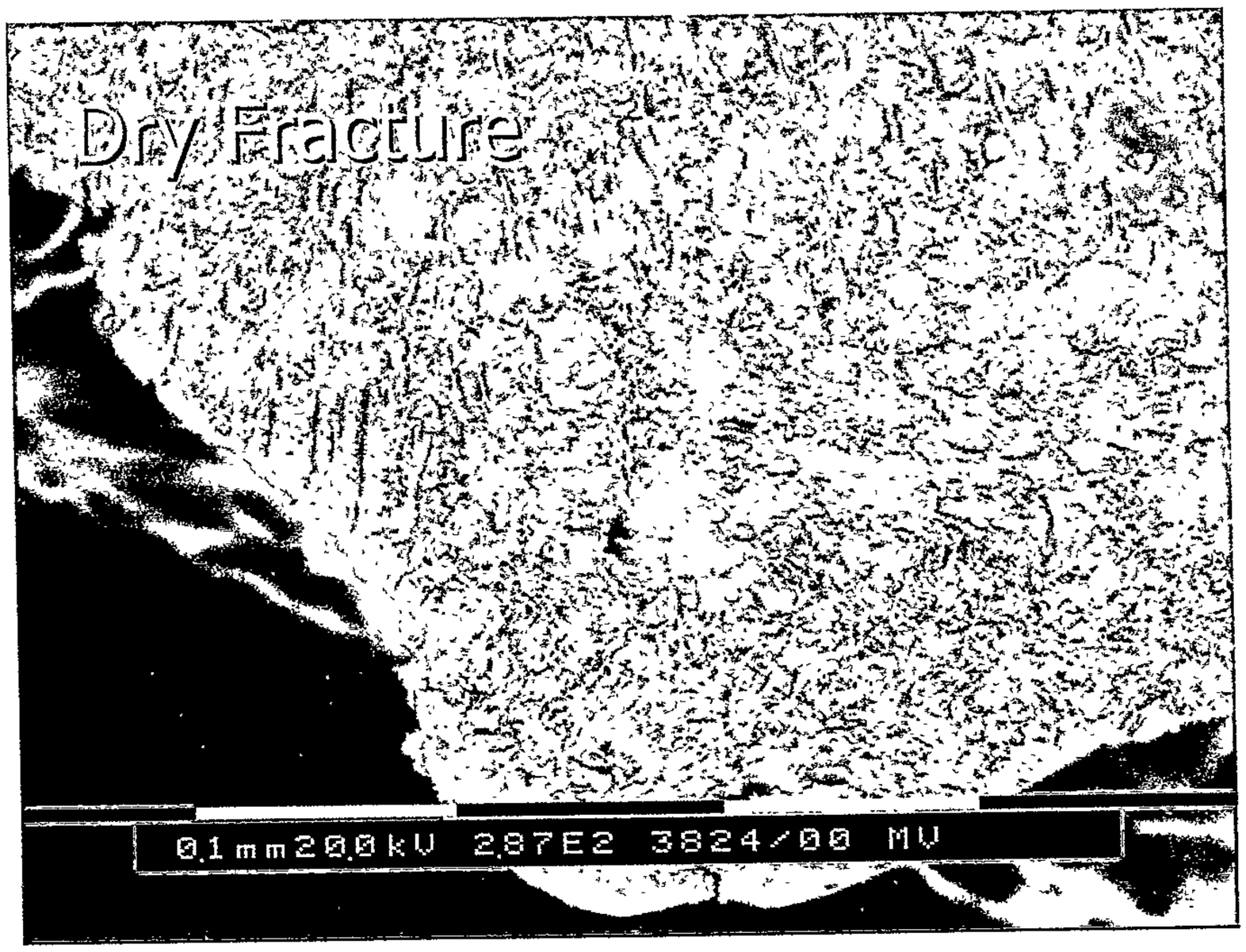


Figure 5. 33. A controlled fracture involved longitudinal scoring of the tooth with a diamond disc until the opposite surface was almost reached. A small osteotome was inserted and twisted to split the remaining surface, which included the cementum.

The use of liquid nitrogen produced a fracture pictured (Fig. 5.34). Although various tooth layers can be seen, such as the surface of cementum and the orientation of the fibres, the overall structure remains obscure.

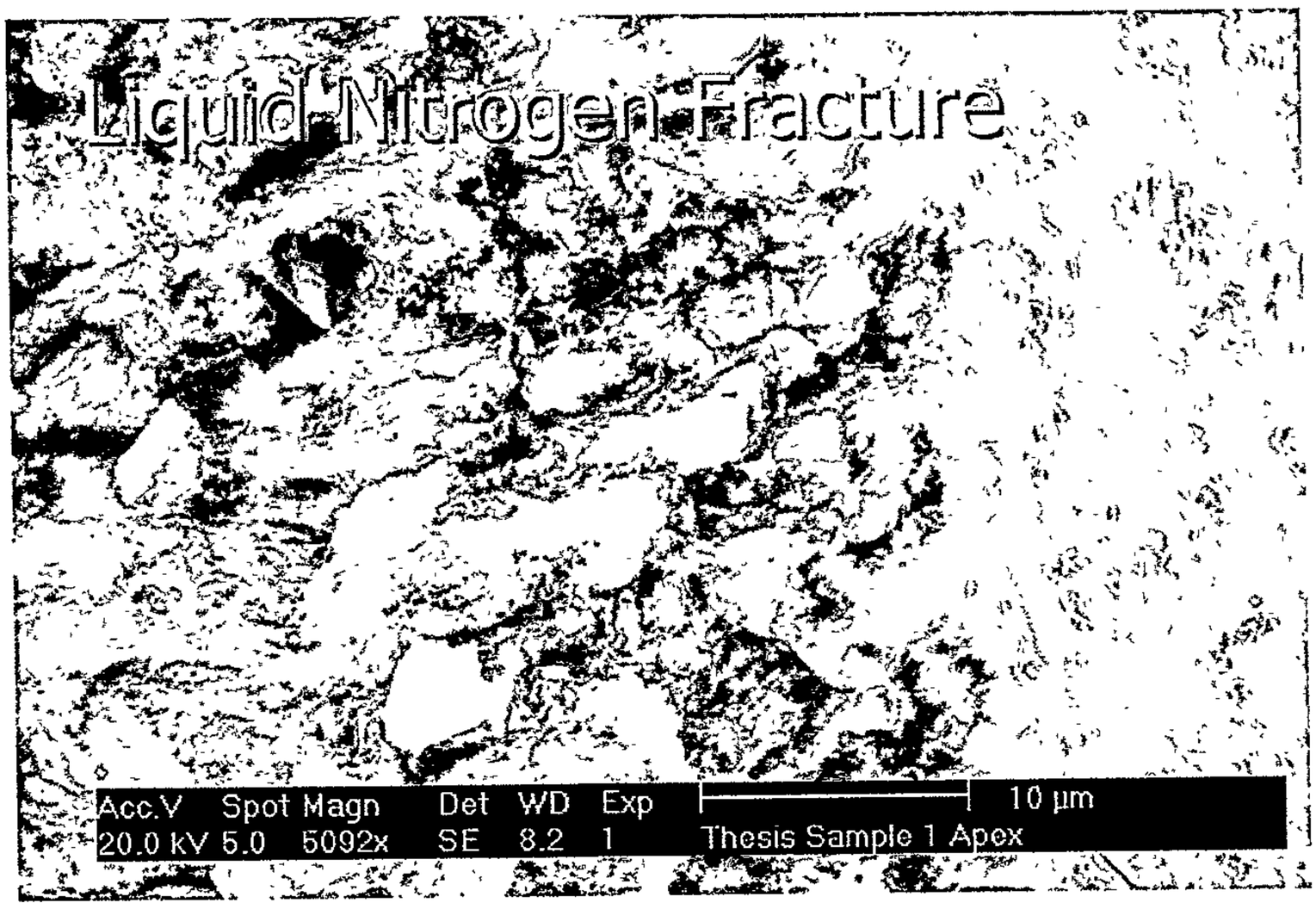


Figure 5. 34. The tooth was inserted into liquid nitrogen on a metal platform. A small household razor blade was placed on its surface in a longitudinal orientation. A firm blow with a mallet, fractured the tooth, this produced multiple pieces. The piece shown was from the apex.

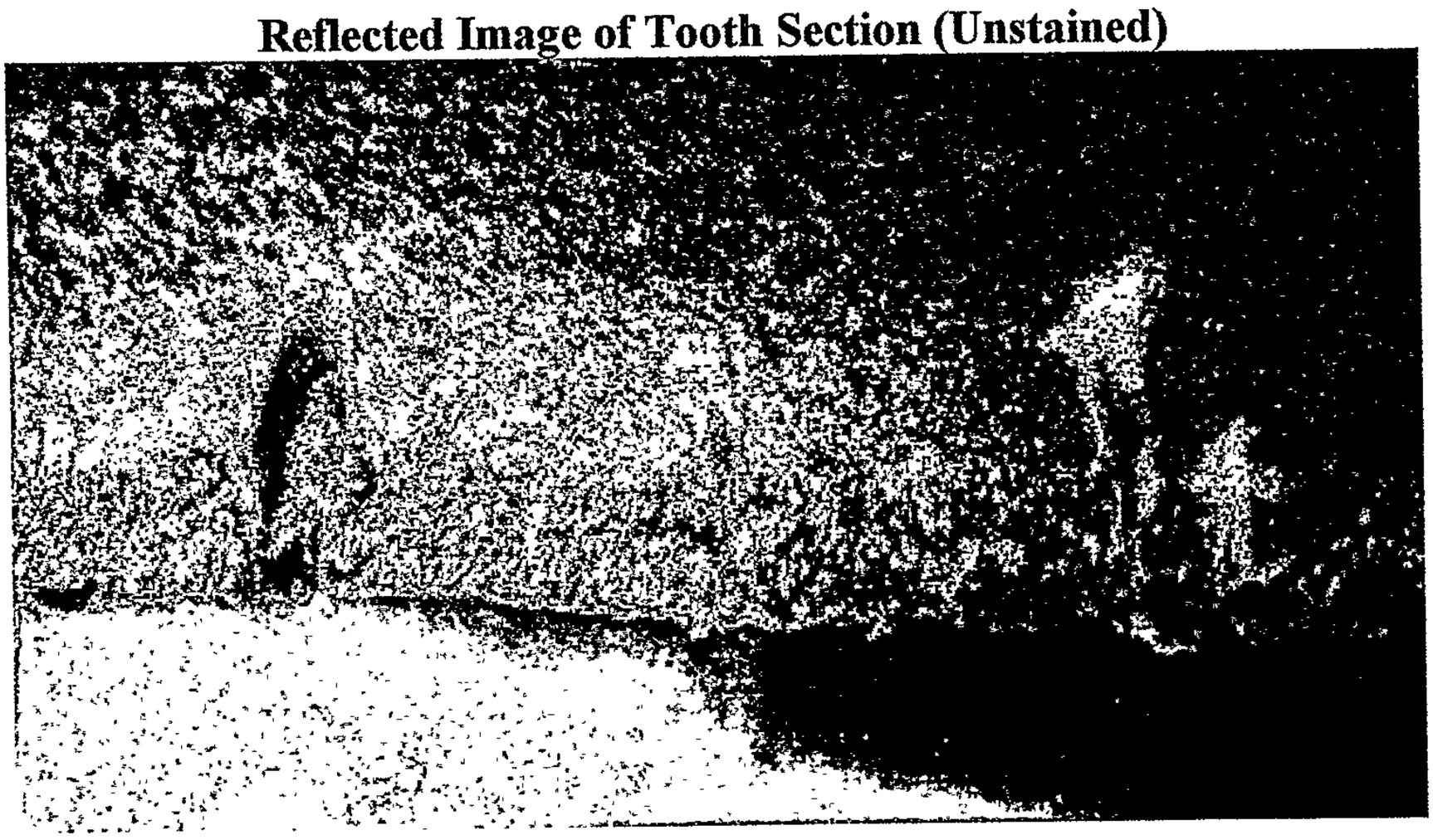


Figure 5. 35. A reflected image of a tooth sectioned from sample 1 in the layer 3 position on the buccal surface. Obscure layering can be seen in the cementum. The folds seen as artefacts are due to preparation. The unstained image is 220.8 x 220.8 µm.

Fluorescent Image of Tooth Section (Stained with eosin)

Figure 5. 36. A fluorescent image of a tooth sectioned from sample 1 in the layer 3 position on the buccal surface. Obscure layering could be seen in the cementum. The fold was seen as an artefact (dark), are due to preparation. The stained (eosin) image was excited with 488nm light and collected the fluorescence. Image size 73.6 x 73.6 μm.

The reflected and fluorescent images are pictured above (Fig. 5.35 and 5.36). The obscure cementum layers could be seen. There was insufficient time to complete this part of the study.

6. Discussion

The physical properties of hardness and elasticity of human root cementum on first premolar teeth from male and female subjects were measured by the use of micro-indentation analysis. The data showed that these properties differ both inter- and intra-sample, along the root length on all four surfaces. This novel method of analysis on unprocessed teeth has provided a 3-dimensional map of hardness and elasticity. The effects of the storage media in time on hardness and elasticity of human premolar teeth were also assessed to enable an accurate determination of these properties.

In correlating the physical properties of the different areas of cementum to the structural composition at these sites, baseline values of hardness and elasticity profiles of human premolar cementum were established. These profiles can be used for future investigations involving similar protocol to allow assessment of changes of these properties that occur, following orthodontic tooth movement. This can give a better understanding of orthodontic tooth movement and the causes of root resorption.

6.1 Sample Selection

Premolar teeth were used in this study as they are frequently extracted for orthodontic treatment purposes. As cementum is continually deposited throughout life (Zander and Hurzeler 1958), a limited window (14-18years of age) was chosen to enable meaningful sampling. This is the period at completed apical development at functional development stage of cementum formation as described by Bosshardt and Selvig (1997). This was assessed radiographically and confirmed clinically by microscopic examination that is why the age range in this study was 14-18yrs.

First premolars were identified as the tooth of choice for this analysis in order to limit the number of variables in the statistical analysis. The number of variables would

increase substantially with the inclusion of the second premolar. Factors such as function may affect the thickness and therefore composition of cementum and hence such properties as hardness and elasticity. Variables that still remained for consideration were patient, sex, side (left and right) and maxillary and mandibular teeth (upper/ lower). Intra-sample variables such as surface (buccal, mesial, lingual and distal) and layer (1-6, fig. 5.18) as well as layer within the surface and inter- and intra-patient differences were also assessed.

Tooth samples varied in length and shape between individuals and between surfaces. To standardize the root sample, the length of the root was divided into six layers and the width divided according to the surface resulting in buccal and lingual having eleven location test sites and mesial and distal having nineteen location tests sites (Fig4.7).

6.2 Surface Preparation

For pure elements and homogeneous materials, it is feasible to prepare relatively flat surfaces since the hardness will not vary greatly over the specimen (Goldstein et al 1981). This results in fairly uniform material removal during grinding and polishing. Unfortunately, most biological specimens fall outside these two categories. In cases where phases of different hardness coexist, sharp steps may occur at the phase boundaries.

A somewhat more insidious and more general problem than sharp steps is that of relief due to polishing, etching, and repolishing. This results in variable surface contours over the specimen face, that is, a hilly surface. These contours can occur in the same phase as well as across phase boundaries (Goldstein et al 1981). An associated problem is the introduction of polishing abrasive into the material of interest. One should be suspicious of anomalous inclusions containing elements used in the polishing preparation. In such cases a different preparation technique is often warranted in order to determine whether or not such inclusions are artefacts (Goldstein et al 1981).

Past studies have required embedding of the specimen cementum and sectioning and polishing. As Goldstein et al (1981) pointed out that for pure elements and homogeneous materials this is feasible, however for the complex heterogeneous connective tissue, cementum, this is not advisable. Weaver (1960) also concluded that hardness values should be obtained from unaltered samples. Thus an unembedded sample was critical for this experimental protocol.

The advantage of experimentation with the use of unembedded samples, such as cementum, is that the surface was easily visible. Poolthong et al (1996) and Poolthong (1998) used horizontal sections for testing (that is perpendicular to the long axis) and the acrylic influence on the near surface regions could not be discounted. Clark (1997) used oblique sections of cementum and therefore the amount remaining was not known. Underlying dentine as well as the infiltrating embedding material can influence the hardness and elasticity of cementum particularly if the cementum layer is thin.

6.3 Rationale for Selection of Indenter

There are a large number of hardness tests reported in the literature, however with particular reference to indentation a variety of indenters have been used. As early as 1933, Hodge and Mckay the first workers to consider cementum hardness used a Brinell Hardness test. The Knoop Hardness tester was used by Rautiola and Craig (1961). Ichiro and Nihei (1951) used the Vickers hardness test. There are basically two types of indenters: sharp diamond shape or a blunt spherical shape out of the commonly used hardness tests (Table 2.2 and Fig. 2.6).

More recent investigators using the Umis instrument as that used in this study, include Poolthong et al (1996), Poolthong (1998) and Clark (1997). Clark (1997) reported hardness and elasticity of the apical region of cementum, Poolthong et al (1996) and Poolthong (1998) also obtained enamel hardness and elasticity values. These values were obtained using the Berkovich indenter (a sharp diamond pyramid) with various loading parameters for teeth stored and embedded in acrylic.

However, a 20μm diamond spherical indenter was chosen for this study for several reasons. Firstly the use of the Berkovich diamond indenter required an extremely flat surface to allow a stable contact for testing procedures. This could only be obtained through resin embedding of the sample and therefore precluded its use in this study. However the Berkovich indenter has the advantage of unlimited depth of penetration. The spherical indenter is limited in depth by virtue of its construction constraints. To obtain a flawless diamond sphere is impossible. The tip is machined to a particular radius then a cone shape results. The software and physical limitations allowed calculation of up to only one third of the indenter radius. Therefore depths greater than one third of the 20μm radius could not be investigated. The depth of penetration in this study was therefore limited to 7000nm (7μm). However this allowed for reporting of the properties of the near surface regions of interest.

In our initial pilot study, results using the Berkovich indenter were greatly affected by the surface of the unpolished specimen. The results varied considerably (Fig. 5.1). The second limitation with Berkovich is that the software of the Berkovich analysis only measured the elasticity in the "Load / Unload" cycle at only the last point in the cycle. This reduced the accuracy of the test to a one point. However with the "Load / Partial Unload" cycle amenable to the spherical indenter, a relatively more accurate measurement of elasticity was obtained. This is due to the fact that multiple assessment of the elasticity was derived from this section of the analysis.

The fact that an unembedded sample was used provided a source of error when using the Berkovich indenter (Fig. 5.1). The surface asperities caused the indenter and the indenting shaft to literally slide down inclines as though cusp on teeth. This accounted for the inconsistencies seen in the results. The minimally prepared tooth could be better assessed with the spherical indenter that has a greater surface area of contact. The load of contact was increased to flatten the asperities (Fig. 5.4 and 5.5).

The maximum force of 500 milli-Newtons allowed assessment on all area of the root, both soft and hard, as well as to enable enamel testing using the same protocol and

therefore enabled comparison of the results more readily (Boyer 1987). Greater loads were utilized to enable the compression of the asperities and therefore compensate for the minimally prepared surface. The Umis 2000 has the ability to accept surface discrepancies of up to 25μm in a traverse without interfering with its operation (CSIRO 1993). Weaver (1966) pointed out that in selecting the proper test load, every attempt should be made to produce the largest impression within the structure under study. This is aimed at reducing technical errors. Weaver (1966) also recommended that imprints should be kept at a distance of at least twice their diagonals, therefore the 100μm² array was chosen.

The extent to which a biological material acts internally during mechanical testing is not known. The use of different indenters can produce different results more so than with non-biological samples. The Berkovich indenter is known to produce cutting at its edges, whereas in the relatively unexplored Spherical indenter may produce compression of the underlying material by virtue of the greater surface area produced by the blunt indenter geometry. The extent to which this compression of various tissue layers occurs in biological material has not been previously investigated.

In this study, the first 2000nm (2μm) of data was disregarded due to the surface irregularities. The Hardness was reported to a depth of 7000nm (7μm) due to limitations of the spherical indenter geometry.

6.4 Umis Calibration and Jig Compliance

Prior to testing procedure the Umis 2000 was calibrated by the use of a standard with known properties. The standard chosen was fused silica. A typical run using the same force and indenter was used. The poison's ratio (0.17) (Oliver and Pharr 1992) was imported into the programme and compared to the test result. The results showed a perfect elastic behaviour of the sample at the parameters used. The Umis force and depth sensors as well as the indenter were calibrated. This was needed as the diamond indenter

shape with prolonged usage, can become worn and therefore not produce the indentation that it was designed to produce. An indentation that was not perfect would then introduce errors in the computed calculations thus producing aberrant results.

Testing of the Jig assembly was required to ensure that no errors in the measurement were introduced through the Jig's design. The Umis has pre-evaluated compliance values added into the software to allow computations to include such values. To ensure no additional compliance issues needed to be taken into account, testing of the Jig's compliance was undertaken.

The compliance of the designed Jig was tested. A known sample, a highly polished piece of enamel in cross-section from a human premolar, was chosen as this particular sample has been investigated previously (Poolthong 1998). The results obtained were compared and cross-referenced to a different enamel section mounted on a jig.

The hardness and elasticity of enamel, obtained by the Berkovich indenter varied with increasing force levels. With testing at low loads (50mN) the hardness values ranged between 4.18 - 4.95 GPa and elasticity values between 77.18 - 89.0 GPa. With higher loads (150mN) the hardness values ranged between 3.95 - 3.98 GPa and elasticity values between 79.77 - 81. 77GPa. At loading with even higher loads (500mN) the hardness values dropped to between 3.20 - 3.58 GPa and elasticity values to between 67.38 - 71.35 GPa. This is thought to be due to the phenomenon of cracking. As a crack propagates, hardness and elasticity both decrease as the force increases.

While testing enamel with the Spherical indenter it was seen that the above mentioned cracking did not occur. As the force increased the hardness increased and the elastic modulus decreased. While testing at low loads the same polished standard, at (50mN) the mean hardness value was 1.80 GPa and mean elasticity value at this load was 58.62 GPa. With higher loads (150mN) the mean hardness value was 2.64 GPa and mean elastic modulus at this load was 65.6GPa. At loading with even higher loads (500mN) the hardness values increased to between 3.20 - 3.50 GPa and elastic modulus values to

between 49.35 - 50.46 GPa. No cracking was observed with the use of the spherical indenter.

When the results from Berkovich and Spherical indenters were compared there were surprising differences in the data. The Berkovich produced a higher elastic modulus value than was obtained with the spherical indentor on the polished standard. The Berkovich also produced marginally higher hardness values when compared to that of the spherical diamond indenter. The only explanation that accounted for this is the nature of the indenters being different in both geometry and method of calculation of datum. As mentioned previously, the calculation of elastic modulus occurs in the Berkovich programmed software at the last and final unloading step, however in the spherical programme this occurs continuously. This would suggest that the data on elastic modulus derived from the spherical indenter may be more accurate (Poolthong 1998). However in consideration of the hardness data the only explanation of the differences attained is that of geometry of the indenters. Hardness, as stated by Boyer (1987), is not a fundamental property, it has no quantitative value except in terms of a given load applied in relation to the contact area, generated in a specified manner for a specific duration and a specified penetration shape. Therefore with this being considered different values can be expected.

Comparison data was also generated and compared in terms of the polished enamel standard and a polished sample placed on the Jig. Comparable data were obtained with regards to the tested enamel. That is both types of indenters were used on both types of samples with similar results. This therefore enabled us to use the Jig without any additional compliance parameters needing to be considered. The Berkovich indenter on a highly polished enamel sample gave a similar result (3.20-3.58 GPa) to that of the spherical indenter (3.20-3.50 GPa) on the same enamel sample at a maximum force of 500mN, but the elastic moduli varied. The Berkovich indenter gave an elastic modulus of 67.38-71.35 GPa, while the elastic moduli of the spherical indenter gave 49.35-50.46 GPa. The Berkovich indenter on an unpolished enamel sample that was jig mounted

gave an identical result 3.20GPa to that of the spherical indenter on a polished jig mounted enamel sample at a maximum force of 500mN.

6.4.1 The Enamel Standard

The enamel of the teeth was considered as an internal standard, being a known substance with previously published data on hardness and elasticity. This therefore doubled as a Jig compliance calibrator as well as a means of testing the method used. The Berkovich indenter was also used with the developed method so as to allow direct comparison to the spherical indenter used on the same samples.

The methodology proved sound when using the Berkovich indenter on enamel. The data obtained on hardness and elasticity was within the range of previously published data. Therefore the methodology was accepted.

The Berkovich indenter however, when using heavy loads produced crack formation on the enamel surface, whereas the spherical indenter did not. The lower hardness values that where obtained using the spherical indenter was thought to be due to the size / surface area of contact generated as a consequence of the indenter shape. The greater the force produced greater hardness values, possibly due to the hardness plateau not being reached in this brittle material, using the large diameter (20μm) spherical indenter. However, given the softness of cementum this was not going to present a problem. The ability to use this indenter on an unprepared surface with little or no indenter stability problems, as well as the ability to average any given area of a heterogeneous material, is why this indenter was chosen in this study.

Enamel has been reported to behave anisotropically, ie., differently in different direction, with respect to stiffness (van Noort et al., 1991; Spears 1997 and Lees and Rollins 1972). Craig (1993) reported enamel hardness as 3.4 GPa. More recently Poolthong (1998) reported enamel hardness as 3.39 ± 0.07 GPa.

Spears (1997) used a 3-Dimensional finite element analysis model on enamel and found reason for the inconsistencies in the literature with regards to the Young's modulus. He postulates that this decrease may be in part explained by the change in mineral content found as the enamel traverses from the surface to the dentine. Another possibility claimed, is the direction of applied force. Predicted values of Young's modulus are presented to range from 19-91 GPa perpendicular to the orientation of the crystals, to 93-113 GPa parallel to the orientation of the crystals.

Craig et al., (1960) obtained a value for Young's modulus of 77.9 ± 4.8 GPa. Craig and Peyton (1960) determined the elastic modulus of cusp enamel and reported a range varying from 9.1 x 10^6 to 13.6 x 10^6 psi with an average of 12.2 x 10^6psi ± 0.9 x 10^6 psi. While Gilmore et al., (1970) obtained a value for Young's modulus of 73 GPa. Prior to this Stanford et al., (1960) obtained a value for Young's modulus as low as 9.65 ± 3.45 GPa.

The above mentioned authors did not use spherical indenters, therefore as we know that hardness is quantitative only in term of the parameters it is derived from, then it may be possible that different indenters can generate different results. The use of the hardness of enamel was solely to test the Jig's compliance and to test the quantitative values obtained by a known standard which is not affected by embedding. The results obtained fell within those values quoted previously in the literature with regards to elasticity, while the hardness values were lower than those previously published. This could be due to the high loading forces used and the possibility of crack propagation.

6.5 Storage

Storage of teeth in the past has utilized many different media. The various media that have been used range from tap Water (Van Noort 1991, Addy et al 1988, Jameson et al 1994), saline (Dippel et al 1984, Tao et al 1988, Huang et al 1992), formalin (Wenner et al 1988, Jameson 1994), to NaOCl, Thymol, Karnovsky's fixative (1965) and so on.

Different aspects of the selected storage media have been exploited for reason ranging from disinfection to fixation.

The groups of media tested in this study were chosen partly because they have been used in past experimentation involving the physical properties of cementum, and partly because of ease of access.

Desiccation as a storage media was considered because of prior experimental protocol involving the UMIS. Clark et al., (1997) maintained a dry field by storage at room temperature. His results differed between male and female hardness and this difference was attributed to the samples drying out with time. A qualification of this change was desirable to meaningfully interpret the presented results.

Another reason that desiccation was considered, was that the tooth was inevitably left to dry under the standard testing procedure. The series of indents requires approximately 1.5 hrs to produce data for 1 site of the 5 indents of the 62 points per tooth. By virtue of the test method, some indents were conducted after leaving the tooth in a dry situation for several hours. Therefore it is possible to produce different results at the beginning of the test to those occurring at the end of the test. Hence, a knowledge of the changes in the mechanical properties of a tooth specimen left in a dry condition is crucial to the meaningful interpretation of the results.

6.5.1 Analysis of Results

Rautiola and Craig (1961) were the only other authors that looked at the different storage effects on the physical property of hardness of cementum. They compared immediate casting in plastic within 20 minutes after extraction to neutral formalin storage and tap water. They could not find any difference between any of the subgroups with relation to micro-hardness. This could be due to the fact that prior to testing all teeth needed to be embedded into acrylic.

6.5.1.1 Alcohol Group

Results suggested that with 70% alcohol storage, there was no significant change in hardness and elasticity values within the first month from baseline. The range existed due to the individual variation that exists between teeth. Therefore the storage of teeth in alcohol for up to one month produced no appreciable change in physical properties. However storage for greater than one month in 70% alcohol produced a 30 - 40% increase in both hardness and elasticity.

Researchers investigating alcohol storage effects on the physical properties of bovine bone have obtained similar results (Lucksanasombool et al. 2000). Lucksanasombool et al (2000) reported that the alcohol effects the physical properties of bone in two ways. Firstly, alcohol has the effect of removing water from bone reversibly. Secondly, it has an irreversible effect on bone by lipid removal. They found that the removal of water by drying had a significant effect on the fracture properties. They concluded also that the effects of alcohol on bone could be reversed by storage of bone in saline. This showed that there was little permanent deterioration of the collagen structure of bone by alcohol storage.

From base line to two months there was an increase in hardness approximately 33% as found by Lucksanasombool et al. (2000). From two to three months there was no significant change in the physical property of hardness, in fact even the range that existed due to the assumed individual variation was reduced. This could be interpreted as the effect of alcohol on hardness after two months of storage reduced the samples to a similar platform removing individual variation factors.

With regard to elasticity there were no differences that were statistically significantly distinguishable between the time periods with regards to alcohol storage.

6.5.1.2 Desiccation Group

Of the three main storage groups studied the desiccation group varied the most. The drying out of the samples produced constantly changing results. Clark (1997) studied the hardness and elasticity of human premolar teeth. He found that female teeth were harder than male teeth, but suggested this may be due to the latency in testing of the female specimens. These teeth were left to air dry for a longer time and the increase in hardness was postulated to be due to the drying effect.

Kinney et al (1994) investigated dentine using an Atomic Force Microscope to study the drying induced changes to dentine in vitro. They found that dehydration caused dimensional changes and microstrains in the individual collagen fibrils as they contracted. No similar study has been done for cementum, however as the organic constituents are similar, these effects might be seen in cementum as it dehydrates.

Of the groups studied, the desiccation group was the least favoured as the storage media. Statistically this group had the largest range.

In relation to elasticity, there were no differences that were statistically significantly distinguishable between the time periods with regards to desiccation storage.

As a result of the poor performance of the desiccation group, care had to be taken not to leave the teeth in the Umis for a prolonged period. Although this would not effect the elasticity results, the hardness values could possibly be affected.

6.5.1.3 Milli Q Group

The results of the storage group, Milli Q, indicated that no significant variation existed between any of the time periods studied. Milli Q was shown to be the media which produced the least change in the hardness and elastic modulus over time, and therefore the most ideal storage media to be used in the analysis of the physical properties of

cementum. The standard deviations of hardness and elastic modulus were calculated for each tooth within each media. The standard deviations of hardness and elasticity over time were computed by means of a general linear model to determine whether the standard deviations of hardness and elasticity were significantly different over time. They were found to be different and that Milli Q was the smallest. Therefore since there were no significant differences seen between the time points and the differences were smallest in the Milli Q group, this was the media that best maintained the properties as compared to baseline values.

6.5.1.4 Miltons Effects on Cementum Physical Properties

Two minor storage groups were tested for the effects on the physical properties of cementum. These groups were Miltons 24 hours and Miltons 10 minutes. The former group was considered as this formed part of the protocol of a similar study (Poolthong 1998). The later group was considered to aid in the removal of the PDL in a qualitative fashion. Sodium hypochlorite is one of the most commonly used in dentistry as a disinfectant. It also, is known for its protein denaturing as well as its antibacterial properties, accounting for its endodontic uses (Piskin et al., 1995). For this very reason it is surprising that its use can even be considered with cementum, due to its large organic component (Mariotti 1993). It is expected that cementum exposed to Sodium hypochlorite will be eroded as seen in the low powered electro-micrograph Fig. 5.11.

The results suggested that there was minimal effect when compared to the baseline values with the Miltons 10 minutes group. However, although this aided in the removal of the PDL the residual effects were not known and were not investigated further because of time constraints. A decrease in hardness and elasticity may have been due to the alteration of surface properties (erosion of the surface).

With the Miltons 24 hour group, there was a great amount of variation when comparing data to baseline values. There was a significant decrease in hardness and elastic modulus. If the surface is altered or etched as seen in the micrograph (Fig. 5.11) and

then embedded into resin, it would be likely that the near surface properties studied would be effected by the resin infiltrate.

6.6 3-D Analysis

6.6.1 Hardness of Cementum

Hodge and McKay (1933) tested a sagittal section of a cuspid. The average hardness of cementum was found to be 85 Brinell Hardness numbers. This test is only similar in regards to the indenter is Spherical. However, even this does not allow for comparison as the parameters of the test are completely different. The indentor is a steel ball of 1.6mm diameter compared to a 20μm radius diamond spherical indenter.

Schemel et al (1984) and Rautiola and Craig (1961) obtained values for cementum hardness using a diamond Berkovich type indenter. The comparison should be made with caution because there are different parameters used (Boyer 1987). Rautiola and Craig (1961) used a 25 gram load with a contact time of 15 seconds. A total of 1640 indentations were completed spanning over 26 sections of 18 teeth. For all teeth the mean KHN was 39.6 (± 6.1) for unexposed cementum and 39.3 (±5.3) for exposed cementum. Measured in VH (Vickers hardness, with a pressure of 25 g), cementum reveals an average hardness of 49.6 kg/ mm², ranging between 38.7 and 61.3 kg /mm² (Schemel et al. 1984). Rautiola and Craig (1961) reported extremely wide variations in hardness among different locations of the same tissue of the same tooth. Some teeth, however, showed little variation in hardness among different locations. Rautiola and Craig (1961) could not explain the variation of hardness in their study, this is not unusual even if the teeth have been embedded in resin and have a polished surface. The very nature of cementum would allow for not only natural variation but intra-layer (location) differences. The standard deviation in this study is comparable to that of past studies of cementum hardness.

Poolthong et al (1996) used UMIS to measure the hardness and elasticity of human premolar teeth. They reported that the cementum in the apical third (H= 0.82 ± 0.08 GPa, E= 9.3 ± 0.23) gave lower hardness and elasticity values when compared to the cervical third (H= 1.5 ± 0.09 GPa, E= 12.3 ± 0.43). Clark (1997) suggested that these results were flawed due to protocol variations, unstable environmental conditions and calculation errors. These results varied considerably from our study.

Poolthong (1998) obtained different results to those obtained 2 years previously. In Poolthong (1998), hardness values ranged between 0.57 - 0.63 GPa (Equivalent to 52 - 58 Vickers hardness numbers). Clark, (1997) using the UMIS 2000 found that the mean value of hardness of cementum for the apical third of premolar teeth is 0.36 ± 0.08 GPa.

Clark (1997) also found a statistically significant difference between the hardness of male and female cementum, with female teeth being harder. He proposed several reasons to explain this difference, stating that the most likely was due to air storage. The female specimens were allowed to dehydrate causing an increase in the hardness value. The results of this present study suggested differences between males and females were statistically significantly different ($p<0.01$), however the relationship was not as simple as that previously reported by Clark (1997). There are variations between the sexes that reverse when considering different surfaces. For example, the buccal surface of the males in this group produced higher hardness values than those of the females. However when considering the lingual and distal surfaces the female mean hardness values were harder.

Our findings were similar to Clark's (1997) with regard to their hardness between maxillary and mandibular teeth. He found no statistical differences between the hardness of cementum from maxillary teeth when compared to those of the mandible. However with regard to inter surface differences he concluded that there where no significant differences between the buccal surface when compared to the lingual

surface. The results of this study suggested that there exists differences between the surfaces that were statistically significant ($p < 0.01$).

The results of this study show apical cementum being considerably softer than that reported by Poolthong et al (1996). Our results ranged form 0.25 GPa (± 0.08) to 0.35 GPa (± 0. 08) in the apical region (layers 1-3). The cervical cementum (layers 4-6) results also suggested a comparably softer result ranging from 0.39 GPa (± 0.10) to 0.43 (± 0.01). These results reported in this fashion are mean values of all surfaces whereas those reported previously are of one surface only.

The hardness values in this study were lower than those previously mentioned. This may be due to a number of factors. Firstly, the fact that the specimen was not embedded may account for the differences. Weaver (1961) investigated the microscopic hardness of bone. He found that storage in 10% formalin increased the hardness approximately 20%. Drying and embedding the bone in methyl methacrylate increased its hardness by 30 to 40 %. Clark (1997) reported that resin can penetrate the cementum, as is seen in the dentine bonding procedures in restorative dentistry were a Hybrid Layer is form with the exposed collagen fibrils and the resin. In previous studies, there was an effect of the resin embedding and the use of formalin as a fixative, both acting to increase the hardness reported.

Another cause for discrepancies in hardness values was due to preparation aspects other than embedding. Formalin had been reported to show dehydration and also cross-linking of proteinaceous material when used in preparation. Also commercially available formalin is generally acidic due to the formation of formic acid, which would result in the dissolution of the mineral component Waters (1980).

Yet another possibility of the variation in previous results is that the preparation procedure of the multi-layered CMSC leads to an unknown amount of cementum that has been removed in polishing or indeed what layer is being tested. In this protocol the exact depth at which the hardness and elasticity values were obtained is recorded. In this

study the first 2000nm (2μm) of data was disregarded due to the surface irregularities. The Hardness was reported to a depth of 7000nm (7μm) due to limitations of the spherical indenter geometry. Therefore because we were testing near surface regions these regions may be softer.

Polson (1984), Dastmalchi, (1990) and Melcher (1984) described differences on the distal cementum surface. Polson (1984) in his observations in rhesus monkeys, found that with orthodontic tooth movement there is more new cementum on the tension side when compared to the pressure side of the root cementum. Dastmalchi (1990) found thicker cementum on the distal surface and associated this with mesial drift. A common finding in the literature is the difference of the distal surface. This was also observed in our hardness values. The distal surface appeared softer than all other surfaces. The patch-wise deposition of cellular mixed stratified cementum resulted in great circumferential variations in cementum thickness reflected periods of accelerated deposition of cellular intrinsic fiber cementum that were probably due to functional demands in order to reposition the tooth when it was shifting in its bony socket during its post-eruptive tooth movements (Bosshardt and Selvig 1997). If this is true then distal surface may have a greater proportion of CMSC.

Growth rates are reported faster on the distal surface (4.3 μm/year) than on the mesial surface (1.4 μm/year) (Dastmalchi et al 1990). Acellular extrinsic fiber cementum has the potential to adapt to functionally dictated alterations such as mesial tooth drift (Bosshardt and Selvig 1997). Given the complexities that exist in the formation (Bosshardt and Schroeder 1991), maturation (Bosshardt and Selvig 1997), adaptive and dynamic nature (Mariotti 1993) and complex structure (Ten Cate 1994) of cementum, it is no surprise that there exists a large range of intra- and inter surface differences in the physical properties. Cementum cannot be considered as an engineering material having an absolute value for hardness, but rather a complex biological specimen that has many variables to be considered.

6.6.2 Elasticity of Cementum

Poolthong et al (1996) measured the elasticity of human premolar cementum in the apical and cervical thirds. They found elasticity to be 9.3GPa ± 0.23 and 12.3 GPa ± 0.43 in the cervical third. Poolthong (1998) obtained similar results ranging between 8.6 - 12.0 GPa. The elastic modulus of cementum was higher in the middle third than the apical third.

Clark (1997), using the UMIS 2000 found the mean value of elasticity of cementum from the apical third of premolar teeth was 12.31 ± 2.03 GPa.

The results of this study showed apical cementum having considerably lower elastic modulus than that previously reported by Poolthong et al (1996), Poolthong (1998) and Clark (1997). Our results ranged form 4.11 ± 1.47 GPa to 5.5 ± 2.02 GPa apically (layers 1-3). The cervical cementum (layers 4-6) results also suggested a comparably more elastic result ranging from 6.32 ± 2.28 GPa to 7.23 ± 2.48 GPa. These results reported in this fashion were mean values of all surfaces whereas those reported previously were of one surface only. For example if we consider the buccal surface only the values would differ slightly. The elasticity in the cervical region (layers 4-6) ranged from 7.8 ± 1.84 GPa to 8.1 ± 2.88 GPa. While the elasticity on the buccal surface in the apical region (layers 1-3) ranged from 4.16 ± 1.26 GPa to 6.6 ± 2.44 GPa.

Again the variations can be explained as for hardness, however Poolthong's lowest values are in the range of our highest values. This probably arises because Poolthong et al (1996), Poolthong (1998) and Clark (1997) used a Berkovich indenter.

6.7 Calcium Content

6.7.1 Comparison of Results

Cellular mixed stratified cementum may deposit up to 30-times faster than the more regular acellular extrinsic fiber cementum. The patch-wise deposition of cellular mixed stratified cementum results in great circumferential variations in cementum thickness and reflects periods of accelerated deposition of cellular intrinsic fiber cementum, which are probably due to functional demands in order to reposition the tooth when it is shifting in its bony socket during its post-eruptive tooth movements (Bosshardt and Selvig 1997)

The distribution of mineral within the cementum is said to show a great deal of variability (Soni et al 1962). Studies by microradiography, using a technique that reflects the distribution of calcium in cementum have shown that cellular mixed stratified cementum generally has a lower mineral content than acellular extrinsic fiber cementum (Soni et al 1962). This difference can in part be accounted for by the nonmineralized structures present in cellular intrinsic fiber cementum. These may include cementocyte lacunae as well as larger inclusions of cellular elements (Soni et al 1962). In addition, the Sharpey's fibers of cellular mixed stratified cementum generally retain an unmineralized core (Selvig 1968). The latter feature is in contrast to the intrinsic fibers and to the Sharpey's fibers in acellular extrinsic fiber cementum which exhibit a more complete degree of mineralization. When formation progresses at a rapid rate, such as during formation of cellular mixed stratified cementum there would be less opportunity for calcium deposition (Schroeder 1986).

This accounted for the relatively softer regions in the apical regions, as seen in the hardness results. These differences again, were seen within and between surfaces. The distal surface was again seen to have a different profile overall when compared to the other surfaces.

Acellular extrinsic fiber cementum is more mineralized than cellular intrinsic fiber Cementum and cellular mixed stratified cementum. The difference can in part be explained by the presence of uncalcified spaces, such as lacunae and by the uncalcified core of Sharpey's fibers. In addition, the matrix of acellular extrinsic fiber cementum may be more completely mineralized because its formation is a slow process that allows longer direct contact of tissue fluids (Soni et al 1962).

Neiders et al (1972) studied 5 teeth to determine mineral content using an electron microprobe with scanning electron microscope attachment to obtain data on the chemical composition of small selected regions of the tooth. They found that the Ca composition of the cementum in the cervical and midroot regions showed statistically significant differences in only one tooth with higher Ca composition in the midroot region. The Ca values in the hypermineralized zone did not show statistically significant differences in individual teeth, except in one, where the highest Ca level was in the cervical portion.

Calcium content has been related to enamel and bone hardness (Davidson et al., 1974; Weaver, 1966). Davidson correlated micro-hardness of enamel to calcium after slow decalcification and etching. Weaver (1966) investigated the microscopic hardness of bone and using micro-radiography found that microhardness is a direct measure of the degree of mineralization. Carlström (1954), was first to note that microhardness of bone was a direct function of the degree of osseous mineralization as determined by microradiography.

This study has shown that a direct relationship exits not only with hardness but also with elasticity. A relative value was chosen as opposed to an absolute value as the samples were not embedded and polished flat. To prevent the software interpretation of the peak to background ratio which allowed for the programme to self determine an estimation of the background, two intergration windows of the background were established to further reduce the possibility of error, which was estimated at approximately 5%.

6.8 Structural Correlation

6.8.1 Analysis of Results

Human teeth have three fundamentally different varieties of cementum. The location of these varieties shows tooth-type specific distribution patterns but may also vary along and around the surface of the same tooth. Generally on human teeth: acellular afibrillar cementum covers minor areas of the enamel, particularly at and along the cementoenamel junction. Acellular extrinsic fiber cementum is mainly found on the cervical and middle root portions. On anterior teeth, it may also cover part of the apical root portion, since the apical extension of acellular extrinsic fiber cementum on the root surface increases from posterior to anterior teeth. Cellular intrinsic fiber cementum may occur in the furcations and on the apical root portions. Cellular intrinsic fiber cementum may overgrow layers of acellular extrinsic fiber cementum, and acellular extrinsic fiber cementum, in turn, can overlay cellular intrinsic fiber cementum. The so formed mixed cementum is called cellular mixed stratified cementum and is confined to the apical root portions and to the furcations (Bosshardt and Selvig 1997).

The fracture of the teeth produced inconclusive results and there was insufficient time to develop other techniques of analysis. A method for investigating and identifying the different types of cementum at each test coordinate has not yet been developed.

6.9 Statistical Analysis·

6.9.1 Types of Errors

Errors due to measurements are calculated as pooled standard deviation (Sp). This error was calculated for hardness to be Sp = 0.07. The errors due to measurements for elasticity was calculated to be Sp = 1.09. However the standard errors of the mean are considerably lower. The standard error of the mean for hardness was calculated at 0.004,

while the standard error of the mean for elastic modulus is 0.103. This was calculated using the grand total of the 2790 indentations.

With regard to the 320 indents in the storage section of this study the standard errors of the mean are marginally higher 0.01 for hardness and 0.30 for elastic modulus.

There are generally two types of errors, Systemic errors and Random errors. Systemic errors are those derived as a result of biased or unrepresented sample (for example, measuring with the machine wrongly calibrated, or using teeth that have been taken from patients with a disease that causes teeth to soften). This is a result of the sample group being in some way not representative of the wider population.

Random errors are errors due to the nature of using a sample to estimate values from a population – they are in no way mistakes, and cannot be eliminated, only controlled. One source of random error is the error of measurement, the plus-or-minus introduced by the actual measurement process (the point you pick, the way you hold the machine, the plus-or-minus in the machine reading, etc). It is measured from the variability in repeated measurements made at a particular point and under a particular condition. These errors due to measurements are calculated as pooled standard deviation (sd).

Other sources of random errors are the variability in selecting the position on the tooth, and the sampling variability due to taking only a small number of measurements to estimate an overall average.

The random errors are measured by the standard deviations (standard errors of the mean) as reported. These are the variability due to chance. The possibility that the natural variability of these observations obscuring the real differences seen is unlikely in this study. The increase in observations, such as the five array at one point is an attempt to reduce random errors (Dixon and Massey 1983, Bulman and Osborn 1989).

6.9.2 Multivariate Analysis

A multivariate general linear model was chosen to express the inter relationships between the multiple factors. A general linear model is basically an equation that expresses values of the variable in terms of other variables. This is calculated by estimating coefficients. The "p" values check whether the coefficient is significantly different from zero. This probability is expressed as a fraction of one.

6.10 Clinical Significance

This method allowed for the detailed characterization of the physical properties of cementum namely hardness and elasticity. The developed method also enabled these basic properties to be related to the calcium composition. The clinical relevance is seen in the ongoing study of root resorption. Characterization of cementum is essential to allow further understanding of the process of root resorption. Hardness and elasticity profiles, as well as calcium content and morphology profiles, as well as the inter-relationships are important in the characterization of this complex and change connective tissue cementum.

Dale (1975) said, " The workbench of orthodontics is the occlusal plane", this is undoubtedly true in regards to orthodontic mechanics. However, when considering the biology of orthodontics the PDL is seen as the workbench. Specifically, within the PDL there are two interfaces that should be dealt with separately. These are the PDL / cementum interface and the PDL / alveolar bone interface. It is these that act as workbenches at a cellular level. Indeed, the later is responsible for favorable orthodontic responses in tooth movement through bone, while the former provides those unfavorable responses seen as root resorption. The ability to assess a tooth in 3-D and to be able to consider these properties studied enables understanding and characterization of the cement. We have now a baseline from which to expand into the study of root resorption.

7. Conclusion.

A new method was developed for the 3-Dimensional analysis of a minimally processed tooth. The results produced using the Ultra Micro-Indentation System enabled consistent and reproducible results of the physical properties of hardness and elasticity of human premolar teeth. The physical properties of cementum were shown to vary along the root surfaces and between the root surfaces as well as between the individual teeth tested. The results obtained using this novel method are presented to give a baseline comparison for further investigation. The resultant data obtained enabled a 3-Dimensional map to be presented.

With regards to storage, the 3 main groups were statistically indistinguishable with regard to elasticity but not to hardness. Milli Q was seen to vary less than other media tested that is the most stable with the smallest deviation from baseline. Milli Q was seen to be the most stable storage media in which individual teeth could be stored for up to nine months without any significant alteration in the physical properties of cementum. There was also seen a significant amount of cementum loss occurred with the use of 1% Sodium hyperchlorite for 24hrs.

On analysis of the 3100 indents, a multivariate general linear model was chosen to express the interrelationships between the multiple factors (SPSS). The variables included; Sex, Patient within sex, Side, Maxilla/ Mandible, Layer within surface, Surface and Calcium content.

Due to the biologically complex nature of cementum, 3-D analysis hardness and elasticity provided varying results. Hardness of human premolar cementum was shown to have the following relationships to the variables assessed.

1. Hardness was found to be significantly different between males and females ($p < 0.01$).
2. Different individuals show significantly different hardness ($p < 0.01$).

3. There was a significant difference between the hardness of the apex and the CEJ ($p<0.01$).
4. There was a significant difference between the hardness of the Buccal, Mesial, Lingual and Distal surfaces ($p<0.01$).
5. There was no difference between left and right premolar cementum hardness ($p= 0.18$) in relation to Hardness.
6. There was no significant difference found between maxillary and mandibular premolar teeth ($p>0.05$) in relation to Hardness.
7. Hardness of cementum significantly correlated to Calcium Content ($p= 0.01$).

Elasticity of human premolar cementum was shown to have the following relationships to the variables assessed.

1. Elasticity was significantly correlated to Sex ($p< 0.01$).
2. Elasticity was specific to the individual Patient ($p< 0.01$).
3. Side was significantly correlated to Elasticity ($p= 0.01$).
4. There was no significant difference found between maxillary and mandibular teeth ($p>0.05$) with regards to elasticity.
5. Elasticity was significantly correlated to Layer within the Surface ($p<0.01$).
6. Elasticity was significantly correlated to Surface ($p<0.01$).
7. Elasticity were significantly correlated to Calcium ($p<0.01$) more strongly than for hardness.

In conclusion, the ultra micro-indentation analysis provides an accurate method for analysis of hardness and elasticity with the newly designed 3-D location device on unprocessed teeth. Milli Q was the storage media of choice, which did not influence significantly hardness and elasticity of human teeth.

8. Future Applications

The most stirring of questions is the effect of orthodontic force on the physical properties of cementum. This study provided a novel method, which enabled the quantitative testing of hardness and elasticity on unprocessed teeth at 62 different sites. The method was successful in analysing the effect of the storage media on teeth for a period of nine months, with the most stable media being Milli Q. The testing of an unprocessed tooth eliminated errors such as imbedding, polishing and identification of cementum. Intra-dental divisions allowed comparisons within surface, and between surfaces and individual teeth. As the unprocessed teeth could be easily retrieved for further analyses and the particular coordinate could be pin-pointed using the specially designed Jig, many multi-disciplinary analyses were made possible at particular sites of the root surface.

This research had two limiting factors: time and a small sample size. The time that was required for UMIS testing was one hour per site, each site being five indentations. Sixty-two sites were investigated per tooth. The test site needed to be visually inspected for the analysis of the unprocessed sample to aid in the determination of working length. The limited sample size could not allow the comparison of extra-dental factors (sex, side and maxillary / mandibular teeth). This method has enabled investigations into the effect of orthodontic force on the physical properties of cementum to be examined.

Kinney et al (1994) developed a non-invasive procedure for accurately discriminating between naturally occurring variations in mineral concentration. This procedure called X-ray tomographic microscopy (XTM) resulted in a quantitative, three-dimensional (3D) map of mineral distributions in hard tissues. Scanning electron micrographs are converted into an X-ray microscope-microtomographs giving a third dimension of information. This is done by using the SEM beam to generate the X-rays in a thin metal foil mounted on the specimen holder and by collecting the X-rays with the detector, tomographic scanning is carried out by a mechanical rotation of the specimen holder

under computer control. It differs from other forms of micro-tomography in that the images are truly 3D, and the spatial resolution is microscopic. XTM combines the high resolution advantages of the surface techniques and the quantitative aspects of the volumetric measurements without the artifacts caused by sample preparation (Kinney and Nichols 1992). The use of this technique together with the Jig device can further examine each specific location point along the root surface from the inner most layers to the outer surface.

The resolution of XTM in three-dimensions is between one to two micrometers with an ability to detect high contrast features as small as 70 μm.

Profiles such as those generated in this study can have applications in finite element analyses that have been used in orthodontic research. This would provide comprehensive detail on near surface characteristics of cementum.

This study allowed a qualitative comparison of the calcium content to the physical properties of root cementum. Quantitative results would be readily attainable as the nine teeth have now been mounted and sectioned ready for such analysis. This will be completed in the near future.

9. Appendix

9.1 Sample 1 - Summary of Results.

Buccal Hardness and Elasticity:

Hardness Enamel:	3.1884	Elasticity Enamel:	40.2933
Standard Deviation:	0.172883	Standard Deviation:	1.439691
Hardness Apex+10:	0.228404	Elasticity Apex+10:	2.225726
Standard Deviation:	0.083159	Standard Deviation:	0.350397
Hardness Apex+8:	0.59524	Elasticity Apex+8:	9.962831
Standard Deviation:	0.00629	Standard Deviation:	0.443887
Hardness Apex+6:	0.491819	Elasticity Apex+6:	7.118074
Standard Deviation:	0.141472	Standard Deviation:	2.417666
Hardness Apex+4:	0.597029	Elasticity Apex+4:	9.031849
Standard Deviation:	0.017298	Standard Deviation:	0.647598
Hardness Apex+2:	0.294344	Elasticity Apex+2:	3.997591
Standard Deviation:	0.028618	Standard Deviation:	1.872485
Hardness Apex:	0.231468	Elasticity Apex:	4.121416
Standard Deviation:	0.068221	Standard Deviation:	0.772375

Mesial Hardness and Elasticity:

Hardness Enamel:		Elasticity Enamel:	
Standard Deviation:		Standard Deviation:	
Hardness Apex+10:	0.515805	Elasticity Apex+10:	7.25843
Standard Deviation:	0.104398	Standard Deviation:	1.603795
Hardness Apex+8:	0.53263	Elasticity Apex+8:	5.760872
Standard Deviation:	0.112381	Standard Deviation:	2.466225
Hardness Apex+6:	0.50141	Elasticity Apex+6:	6.135066
Standard Deviation:	0.03479	Standard Deviation:	2.788644
Hardness Apex+4:	0.456713	Elasticity Apex+4:	3.040729
Standard Deviation:	0.006455	Standard Deviation:	0.522287
Hardness Apex+2:	0.447449	Elasticity Apex+2:	6.475531
Standard Deviation:	0.06607	Standard Deviation:	0.582936
Hardness Apex:	0.304689	Elasticity Apex:	5.482334
Standard Deviation:	0.040276	Standard Deviation:	0.021574

Lingual Hardness and Elasticity:

Hardness Enamel:		Elasticity Enamel:	
Standard Deviation:		Standard Deviation:	
Hardness Apex+10:	0.46738	Elasticity Apex+10:	10.83662
Standard Deviation:	0.192815	Standard Deviation:	2.195594
Hardness Apex+8:	0.591382	Elasticity Apex+8:	9.901178
Standard Deviation:	0.063184	Standard Deviation:	2.10726
Hardness Apex+6:	0.59493	Elasticity Apex+6:	8.415302
Standard Deviation:	0.058989	Standard Deviation:	3.267624
Hardness Apex+4:	0.447541	Elasticity Apex+4:	5.729686
Standard Deviation:	0.065952	Standard Deviation:	2.287057
Hardness Apex+2:	0.36053	Elasticity Apex+2:	4.676802
Standard Deviation:	0.030389	Standard Deviation:	1.617362
Hardness Apex:	0.303978	Elasticity Apex:	3.640917
Standard Deviation:	0.112219	Standard Deviation:	1.878768

Distal Hardness and Elasticity:

Hardness Enamel:		Elasticity Enamel:	
Standard Deviation:		Standard Deviation:	
Hardness Apex+10:	0.556946	Elasticity Apex+10:	6.797534
Standard Deviation:	0.050684	Standard Deviation:	1.628521
Hardness Apex+8:	0.468308	Elasticity Apex+8:	6.041738
Standard Deviation:	0.158643	Standard Deviation:	1.988399
Hardness Apex+6:	0.246944	Elasticity Apex+6:	3.040195
Standard Deviation:	0.124775	Standard Deviation:	0.405593
Hardness Apex+4:	0.21888	Elasticity Apex+4:	2.54715
Standard Deviation:	0.046823	Standard Deviation:	0.774235
Hardness Apex+2:	0.284158	Elasticity Apex+2:	2.397221
Standard Deviation:	0.109597	Standard Deviation:	0.465158
Hardness Apex:	0.182877	Elasticity Apex:	1.661119
Standard Deviation:	0.002729	Standard Deviation:	0.191992

Table 9. 1. Sample 1 hardness and elasticity summary.

9.2 Storage Results

Tooth	Media	Time	H1	H2	H3	H4	H5	Aver. H	E1	E2	E3	E4	E5	Aver. E.
1	Alcohol	0	0.23	0.1	0.12	0.07	0.25	0.16	4.03	2.64	3.01	2.25	4.7	3.32
1	Alcohol	1	0.4	0.3	0.24	0.27	0.23	0.29	10.6	8.31	6.97	6.98	6.98	7.97
1	Alcohol	2	0.51	.	0.34	0.37	0.45	0.42	5.33	.	4.75	4.94	5.02	5.01
1	Alcohol	3	0.38	0.28	.	0.37	0.33	0.34	9.16	7.38	.	9.02	7.95	8.38
2	Alcohol	0	0.51	0.35	0.32	0.24	0.34	0.35	6.39	4.65	4.15	4.46	5.14	4.96
2	Alcohol	1	0.1	0.3	0.11	0.23	0.15	0.18	.	4.99	3.14	4.62	3.45	4.05
2	Alcohol	2	0.37	0.26	0.29	0.29	0.83	0.41	11	8.14	9	8.95	15.7	10.58
2	Alcohol	3	0.5	0.38	0.39	0.66	0.63	0.51	10.6	8.74	8.98	8.67	8.46	9.1
2	Alcohol	4	0.47	0.23	0.4	0.32	0.59	0.4	14.1	8.67	12.9	10.6	13.9	12.02
3	Alcohol	0	.	0.27	0.14	0.34	0.39	0.28	.	4.89	2.99	5.25	5.39	4.63
3	Alcohol	1	0.65	0.5	0.5	0.46	0.46	0.51	12.6	10.9	10.7	10.3	10.2	10.92
3	Alcohol	2	0.67	0.45	0.47	0.26	0.45	0.46	10.8	9.44	9.32	6.88	9.46	9.18
3	Alcohol	3	0.5	0.19	0.43	0.4	0.45	0.4	11.2	5.54	10.1	9.89	10.9	9.53
3	Alcohol	4	0.52	0.37	0.48	0.5	0.44	0.46	13.4	9.98	11.7	11.8	11	11.57
4	Alcohol	0	0.42	0.38	0.41	0.4	0.48	0.42	10.2	9.54	10	9.91	10.5	10.04
4	Alcohol	1	0.56	0.34	0.22	0.27	0.35	0.35	4.3	3.95	3.13	3.29	3.96	3.72
4	Alcohol	2	0.42	0.33	0.4	0.5	0.35	0.4	4.92	4.32	4.63	4.95	4.43	4.65
4	Alcohol	3	0.48	0.43	.	0.44	0.44	0.45	4.74	4.56	.	4.56	4.56	4.6
5	Desiccation	0	0.52	0.15	0.08	0.22	0.19	0.23	9.62	3.64	2.22	5.61	4.8	5.18
5	Desiccation	1	0.18	0.34	0.11	0.33	0.27	0.25	2.98	7.28	3.54	7.72	5.35	5.37
5	Desiccation	2	0.38	0.24	0.47	0.51	0.3	0.38	4.25	3.55	4.68	4.8	3.87	4.23
5	Desiccation	3	0.41	0.41	0.5	0.47	0.29	0.41	8.05	8.05	9.03	8.78	6.87	8.15
6	Desiccation	0	.	.	0.29	0.35	0.3	0.31	.	.	5.31	6.11	5.63	5.69
6	Desiccation	1	0.4	0.39	0.41	0.3	0.39	0.38	8.26	7.8	9.7	7.16	8.75	8.33
6	Desiccation	2	0.63	0.6	0.25	0.32	0.4	0.44	10.9	10.2	6.04	6.99	8.27	8.47
6	Desiccation	3	0.42	0.38	0.33	.	0.35	0.37	8.19	8.12	7.26	.	8.27	7.96
7	Desiccation	0	0.27	0.32	0.27	0.38	0.3	0.31	5.08	5.68	4.03	6.44	4.9	5.23
7	Desiccation	1	.	0.5	0.45	0.42	0.33	0.43	13.4	9.08	8.57	8.29	5.99	9.07
7	Desiccation	2	0.63	0.54	0.65	0.6	0.6	0.6	13.1	11.6	13.1	12.3	12.3	12.47
7	Desiccation	3	0.81	0.6	0.63	0.64	0.34	0.61	16.1	13.4	13.8	13.7	8.93	13.19
8	Desiccation	0	.	0.09	0.19	0.15	.	0.14	.	1.24	1.24	1.09	.	1.19
8	Desiccation	1	0.55	0.61	0.55	0.56	0.47	0.55	9.31	10	9.56	9.65	8.88	9.48
8	Desiccation	2	0.85	0.34	0.32	0.48	0.34	0.47	7.71	5.51	5.42	6.27	5.66	6.11
8	Desiccation	3	0.5	0.37	0.3	0.46	0.32	0.39	8.21	7.42	6.1	8.31	6.45	7.3
9	Milli Q	0	0.3	0.23	0.07	0.17	0.29	0.21	5.82	5.58	2.13	5.21	6.05	4.96
9	Milli Q	1	0.29	0.16	0.19	0.2	0.19	0.21	5.85	5.58	5.06	5.18	5.01	5.34
9	Milli Q	2	0.37	.	.	.	.	0.37	6.11	.	.	.	.	6.11
9	Milli Q	3	0.19	.	0.17	0.2	0.22	0.19	5.58	.	6.54	7.43	8.09	6.91
9	Milli Q	9	0.29	0.18	0.19	.	.	0.22	5.89	3.19	3.36	.	.	4.15
10	Milli Q	0	0.77	0.43	0.39	0.31	0.31	0.44	11.6	8.67	8.55	8.28	8.28	9.08
10	Milli Q	1	0.41	0.31	0.3	0.32	0.37	0.34	9.35	8.09	9.07	8.75	8.94	8.84
10	Milli Q	2	0.74	0.32	0.38	0.34	0.32	0.42	.	11.3	12.6	11.6	10.6	11.52
10	Milli Q	3	0.71	0.29	0.39	0.28	0.44	0.42	10.9	7.84	9.2	8.62	9.59	9.23
10	Milli Q	9	0.41	0.32	0.35	.	.	0.36	8.62	6.76	7.27	.	.	7.55
11	Milli Q	0	.	0.41	0.34	0.45	0.36	0.39	.	8.51	8.25	9.32	8.59	8.67
11	Milli Q	1	0.53	0.3	0.29	0.25	0.29	0.33	11.1	9.2	9.31	8.9	9.67	9.63
11	Milli Q	2	0.53	0.25	0.27	0.25	0.3	0.32	11.7	9.27	9.76	9.9	11.9	10.51
11	Milli Q	3	0.48	0.21	0.21	0.23	0.27	0.28	5.54	4.24	4.3	4.87	5.21	4.83
11	Milli Q	9	0.32	0.32	0.31	.	.	0.31	8.98	8.8	7.5	.	.	8.43
12	Milli Q	0	0.52	0.22	0.3	0.28	0.3	0.32	7.52	5.13	5.24	4.66	4.36	5.38
12	Milli Q	1	0.4	0.2	0.19	0.2	0.18	0.23	9.85	9.24	7.64	7.43	6.73	8.18
12	Milli Q	2	0.5	0.22	0.18	0.32	0.25	0.29	10.3	7.78	8.23	9.9	9.11	9.06
12	Milli Q	3	0.49	0.16	0.16	0.22	0.22	0.25	10.9	7.86	7.96	8.98	9.24	8.99
12	Milli Q	9	0.35	0.22	0.26	.	.	0.28	6.73	4.41	5.42	.	.	5.52
13	Miltons 24Hrs	0	0.48	0.69	0.34	0.14	0.31	0.39	7.38	7.82	5.72	3.7	5.56	6.03
13	Miltons 24Hrs	1	0.44	0.21	0.21	0.22	0.5	0.31	9.96	6.95	7.11	7.02	10.2	8.24
14	Miltons 24Hrs	0	0.49	0.48	0.49	0.34	0.53	0.47	7.66	8.23	8.22	5.56	8.33	7.6
14	Miltons 24Hrs	1	0.44	0.21	0.21	0.22	0.5	0.31	9.96	6.95	7.11	7.02	10.2	8.24
15	Miltons 24Hrs	0	0.54	0.48	0.55	0.51	0.51	0.52	12.3	9.61	11.4	10.4	10.4	10.8
15	Miltons 24Hrs	1	0.39	0.21	0.2	0.15	0.15	0.22	13.4	8.62	8.41	7.66	7.21	9.06
16	Miltons 24Hrs	0	0.33	0.48	0.51	0.49	0.45	0.45	11.6	10.9	11.7	10.4	9.63	10.85
16	Miltons 24Hrs	1	0.48	0.2	0.21	0.23	0.27	0.28	9.49	6.63	6.36	6.36	6.44	7.06
17	Miltons 10 mins	0	0.55	0.45	0.45	0.56	0.51	0.5	10	8.67	7.75	10	9.43	9.18
17	Miltons 10 mins	1	0.55	0.47	0.61	0.5	0.44	0.51	4.78	4.4	4.89	4.34	4.11	4.5
18	Miltons 10 mins	0	0.41	0.41	0.46	0.41	0.5	0.44	8.04	8.28	8.67	7.85	9.03	8.37
18	Miltons 10 mins	1	0.5	0.5	0.51	0.51	0.59	0.52	11.7	10.9	10.8	11.2	12.1	11.33
19	Miltons 10 mins	0	.	0.5	0.54	0.46	0.46	0.49	.	4.71	4.86	4.57	4.64	4.7
19	Miltons 10 mins	1	0.46	0.45	0.42	0.46	0.46	0.45	8.43	8.31	7.31	8.2	8.24	8.1
20	Miltons 10 mins	0	0.47	0.55	0.32	0.47	0.49	0.46	8.93	9.81	5.59	8.36	9.45	8.43
20	Miltons 10 mins	1	0.54	0.51	0.48	0.6	0.47	0.52	9.8	9.84	9.34	11	9.21	9.85

Table 9. 2. Storage Data Summarized.

9.2.1 Storage Statistics

A summary of the storage tests

Between-Subjects Factors

		Value Label	N
Media	1.00	Alcohol	18
	2.00	Desiccation	16
	3.00	Milli Q	20
	4.00	Miltons 24Hrs	8
	5.00	Miltons 10 mins	8
TIME	.00		20
	1.00		20
	2.00		12
	3.00		12
	4.00		2
	9.00		4

Table 9. 3.Table 9.5.2. Model 1. A summary of the storage tests, where media and time (in months) are analyzed (N= number of tests analyzed).

A Summary Of The Interrelationships And Statistical Significance

Multivariate Tests[c]

Effect		Value	F	df	Error df	Sig.
Intercept	Pillai's Trace	.973	652.16[a]	2.000	36.000	.000
	Wilks' Lambda	.027	652.16[a]	2.000	36.000	.000
	Hotelling's Trace	36.231	652.16[a]	2.000	36.000	.000
	Roy's Largest Root	36.231	652.16[a]	2.000	36.000	.000
MEDIA	Pillai's Trace	.756	5.626	8.000	74.000	.000
	Wilks' Lambda	.339	6.468[a]	8.000	72.000	.000
	Hotelling's Trace	1.673	7.321	8.000	70.000	.000
	Roy's Largest Root	1.484	13.729[b]	4.000	37.000	.000
TOOTH(MEDIA)	Pillai's Trace	.779	1.572	30.000	74.000	.060
	Wilks' Lambda	.367	1.563[a]	30.000	72.000	.063
	Hotelling's Trace	1.331	1.553	30.000	70.000	.067
	Roy's Largest Root	.881	2.174[b]	15.000	37.000	.028
TIME	Pillai's Trace	.552	2.822	10.000	74.000	.005
	Wilks' Lambda	.521	2.775[a]	10.000	72.000	.006
	Hotelling's Trace	.779	2.726	10.000	70.000	.007
	Roy's Largest Root	.495	3.665[b]	5.000	37.000	.009
MEDIA * TIME	Pillai's Trace	.544	1.729	16.000	74.000	.060
	Wilks' Lambda	.494	1.899[a]	16.000	72.000	.034
	Hotelling's Trace	.944	2.066	16.000	70.000	.020
	Roy's Largest Root	.853	3.944[b]	8.000	37.000	.002

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c. Design: Intercept+MEDIA+TOOTH(MEDIA)+TIME+MEDIA * TIME

Table 9. 4. Table 9.5.3. A summary of the interrelationships and statistical significance between the different variables investigated. The intercept is the relationship between hardness and elasticity.

The Statistical Significance And Breakdown Between Factors

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Sqs	df	ms	F	Sig.
Corrected Model	AVER.H	.604[a]	32	.019	3.637	.000
	AVER.E	264.09[b]	32	8.253	1.688	.063
Intercept	AVER.H	6.798	1	6.798	1310.9	.000
	AVER.E	2905.6	1	2905.6	594.38	.000
MEDIA	AVER.H	.224	4	.056	10.817	.000
	AVER.E	35.136	4	8.784	1.797	.150
TOOTH(MEDIA)	AVER.H	.161	15	.011	2.076	.036
	AVER.E	128.36	15	8.557	1.750	.083
TIME	AVER.H	.092	5	.018	3.534	.010
	AVER.E	73.737	5	14.747	3.017	.022
MEDIA * TIME	AVER.H	.158	8	.020	3.802	.002
	AVER.E	35.244	8	4.405	.901	.526
Error	AVER.H	.192	37	.005		
	AVER.E	180.88	37	4.889		
Total	AVER.H	10.533	70			
	AVER.E	4562.2	70			
Corrected Total	AVER.H	.795	69			
	AVER.E	444.97	69			

a. R Squared = .759 (Adjusted R Squared = .550)

b. R Squared = .594 (Adjusted R Squared = .242)

Table 9. 5. Table 9.5.4. The statistical significance and breakdown of the factors hardness and elasticity with respect to the different variables.

A Summary Of The Storage Tests

Between-Subjects Factors

		Value Label	N
MEDIA Media	1.00	Alcohol	16
	2.00	Desiccation	16
	3.00	Milli Q	16
TIME	.00		12
	1.00		12
	2.00		12
	3.00		12

Table 9. 6. Table 9.5.5. A summary of the storage tests, where media and time (in months) are analyzed (N= number of tests analyzed). Note time 4.00 and time 9.00 are excluded.

Multivariate Tests[c]

Effect		Value	F	df	Error df	Sig.
Intercept	Pillai's Trace	.979	739.27[a]	2.000	32.000	.000
	Wilks' Lambda	.021	739.27[a]	2.000	32.000	.000
	Hotelling's Trace	46.204	739.27[a]	2.000	32.000	.000
	Roy's Largest Root	46.204	739.27[a]	2.000	32.000	.000
MEDIA	Pillai's Trace	.764	5.095	8.000	66.000	.000
	Wilks' Lambda	.334	5.842[a]	8.000	64.000	.000
	Hotelling's Trace	1.702	6.594	8.000	62.000	.000
	Roy's Largest Root	1.508	12.439[b]	4.000	33.000	.000
TOOTH(MEDIA)	Pillai's Trace	.768	1.373	30.000	66.000	.143
	Wilks' Lambda	.375	1.351[a]	30.000	64.000	.156
	Hotelling's Trace	1.286	1.329	30.000	62.000	.171
	Roy's Largest Root	.820	1.805[b]	15.000	33.000	.077
TIME	Pillai's Trace	.438	3.084	6.000	66.000	.010
	Wilks' Lambda	.601	3.092[a]	6.000	64.000	.010
	Hotelling's Trace	.599	3.093	6.000	62.000	.010
	Roy's Largest Root	.456	5.021[b]	3.000	33.000	.006
MEDIA * TIME	Pillai's Trace	.549	1.559	16.000	66.000	.106
	Wilks' Lambda	.491	1.706[a]	16.000	64.000	.068
	Hotelling's Trace	.954	1.848	16.000	62.000	.044
	Roy's Largest Root	.859	3.544[b]	8.000	33.000	.005

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c. Design: Intercept+MEDIA+TOOTH(MEDIA)+TIME+MEDIA * TIME

Table 9. 7. Table. 9.5.6. A summary of the interrelationships and statistical significance between the different variables investigated.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Sqs	df	ms	F	Sig.
Corrected Model	AVER.H	.560[a]	30	.019	3.223	.001
	AVER.E	216.37[b]	30	7.212	1.347	.202
Intercept	AVER.H	8.687	1	8.687	1501.1	.000
	AVER.E	3501.9	1	3501.9	653.94	.000
MEDIA	AVER.H	.224	4	.056	9.693	.000
	AVER.E	35.136	4	8.784	1.640	.188
TOOTH(MEDIA)	AVER.H	.150	15	.010	1.729	.093
	AVER.E	121.14	15	8.076	1.508	.159
TIME	AVER.H	.087	3	.029	5.020	.006
	AVER.E	41.485	3	13.828	2.582	.070
MEDIA * TIME	AVER.H	.158	8	.020	3.407	.006
	AVER.E	35.244	8	4.405	.823	.589
Error	AVER.H	.191	33	.006		
	AVER.E	176.72	33	5.355		
Total	AVER.H	9.803	64			
	AVER.E	4108.3	64			
Corrected Total	AVER.H	.750	63			
	AVER.E	393.09	63			

a. R Squared = .746 (Adjusted R Squared = .514)

b. R Squared = .550 (Adjusted R Squared = .142)

Table 9. 8. Table 9.5.7. The statistical significance and breakdown of the factors hardness and elasticity with respect to the different variables.

Standard Deviations for All Media

General linear Model SD's

Multivariate Tests[c]

Effect		Value	F	df	Error df	Sig.
Intercept	Pillai's Trace	.923	71.963[a]	2.000	12.000	.000
	Wilks' Lambda	.077	71.963[a]	2.000	12.000	.000
	Hotelling's Trace	11.994	71.963[a]	2.000	12.000	.000
	Roy's Largest Root	11.994	71.963[a]	2.000	12.000	.000
MED	Pillai's Trace	.544	2.427	4.000	26.000	.073
	Wilks' Lambda	.479	2.674[a]	4.000	24.000	.056
	Hotelling's Trace	1.043	2.869	4.000	22.000	.047
	Roy's Largest Root	.997	6.479[b]	2.000	13.000	.011

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c. Design: Intercept+MED

Table 9. 9. Table. 9.5.8. The significance of the standard deviations for all media studied.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Sqs	df	ms	F	Sig.
Corrected Model	SDH	.016[a]	2	.008	6.083	.014
	SDE	2.541[b]	2	1.271	1.708	.220
Intercept	SDH	.106	1	.106	79.93	.000
	SDE	83.62	1	83.62	112.4	.000
MED	SDH	.016	2	.008	6.083	.014
	SDE	2.541	2	1.271	1.708	.220
Error	SDH	.017	13	.001		
	SDE	9.672	13	.744		
Total	SDH	.125	16			
	SDE	95.43	16			
Corrected Total	SDH	.033	15			
	SDE	12.21	15			

a. R Squared = .483 (Adjusted R Squared = .404)

b. R Squared = .208 (Adjusted R Squared = .086)

Table 9. 10. Table 9.5.9. The statistical significance and breakdown of the factors hardness and elasticity with respect to the standard deviations.

9.3 3-D Data

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
G, Mr M	44	.	0.16	0.31	0.19	0.27	0.23
G, Mr M	44	.	0.47	0.36	0.27	0.17	0.31
G, Mr M	44	.	0.56	0.15	0.11	.	0.27
G, Mr M	44	.	0.56	.	0.6	0.6	0.58
G, Mr M	44	.	0.59	0.62	0.63	0.57	0.6
G, Mr M	44	.	0.8	0.63	0.6	0.34	0.59
G, Mr M	44	0.38	0.33	0.31	0.43	0.52	0.39
G, Mr M	44	0.64	0.58	0.68	0.36	0.7	0.59
G, Mr M	44	.	0.52	0.64	0.63	0.61	0.6
G, Mr M	44	.	0.4	0.07	0.38	.	0.29
G, Mr M	44	.	0.2	0.2	0.11	.	0.17
G, Mr M	44	0.2	0.16	0.48	0.26	0.29	0.28
G, Mr M	44	.	0.26	0.34	0.4	.	0.33
G, Mr M	44	.	0.54	0.49	0.54	0.5	0.52
G, Mr M	44	.	0.39	.	0.38	0.39	0.39
G, Mr M	44	.	0.29	0.43	0.49	0.39	0.4
G, Mr M	44	.	0.47	0.45	0.43	0.5	0.46
G, Mr M	44	.	0.49	0.47	0.43	0.43	0.45
G, Mr M	44	0.45	0.51	0.41	0.43	0.45	0.45
G, Mr M	44	0.43	0.51	0.52	0.4	0.47	0.47
G, Mr M	44	.	0.56	0.54	0.51	0.55	0.54
G, Mr M	44	.	0.52	0.49	0.43	0.55	0.5
G, Mr M	44	.	0.54	0.17	0.29	0.48	0.37
G, Mr M	44	.	0.64	0.6	0.66	0.63	0.63
G, Mr M	44	.	0.59	0.56	0.54	0.56	0.56
G, Mr M	44	0.57	0.56	0.56	0.56	0.58	0.57
G, Mr M	44	.	0.43	0.4	0.5	0.5	0.46
G, Mr M	44	.	0.63	0.62	0.6	0.61	0.61
G, Mr M	44	.	0.55	0.61	0.6	0.63	0.6
G, Mr M	44	.	.	0.45	0.34	.	0.39
G, Mr M	44	.	0.14	0.38	0.33	0.37	0.3
G, Mr M	44	.	0.31	0.43	0.42	0.36	0.38
G, Mr M	44	.	0.27	0.34	0.4	0.35	0.34
G, Mr M	44	.	0.54	0.31	0.59	0.54	0.49
G, Mr M	44	.	0.34	0.29	0.62	0.29	0.39
G, Mr M	44	.	0.6	0.68	0.66	0.61	0.64
G, Mr M	44	.	0.52	0.62	0.56	0.52	0.55
G, Mr M	44	.	0.32	0.7	0.6	0.57	0.55
G, Mr M	44	.	0.6	0.7	0.6	0.64	0.64
G, Mr M	44	.	0.57	0.66	0.58	0.61	0.6
G, Mr M	44	.	0.33	0.37	0.29	0.34	0.33
G, Mr M	44	0.19	0.21	0.13	0.2	0.17	0.18
G, Mr M	44	0.2	0.22	0.19	0.16	0.16	0.18
G, Mr M	44	0.3	0.25	0.27	0.3	0.31	0.29
G, Mr M	44	0.37	0.54	.	0.32	0.33	0.39
G, Mr M	44	.	0.19	0.18	0.18	0.16	0.18
G, Mr M	44	.	0.24	0.28	0.15	0.2	0.22
G, Mr M	44	.	0.28	0.3	0.24	0.25	0.27
G, Mr M	44	.	0.13	0.2	0.2	0.16	0.17
G, Mr M	44	0.23	0.28	0.34	0.42	0.31	0.32

Table 9. 11. 3-D Hardness Data Summary.

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
G, Mr M	44	.	0.34	0.34	0.37	0.24	0.32
G, Mr M	44	.	0.1	0.1	0.11	0.11	0.1
G, Mr M	44	.	0.38	0.24	0.13	0.32	0.27
G, Mr M	44	.	.	0.61	0.57	0.55	0.58
G, Mr M	44	.	0.41	0.57	0.3	0.39	0.42
G, Mr M	44	.	0.62	0.62	0.6	0.61	0.61
G, Mr M	44	.	0.51	0.45	0.48	0.49	0.48
G, Mr M	44	.	0.57	0.55	.	0.6	0.57
G, Mr M	44	.	0.56	0.55	0.56	0.6	0.57
G, Mr M	44	.	0.6	0.58	0.61	0.62	0.6
G, Mr M	44	3	3	3.3	3.3	3.3	3.19
G, Mr M	44	.	.	.	.	.	.
G, Miss Si Y	44	0.29	0.21	0.11	0.23	0.16	0.2
G, Miss Si Y	44	.	0.19	0.27	0.35	0.23	0.26
G, Miss Si Y	44	.	0.28	0.26	0.28	0.34	0.29
G, Miss Si Y	44	.	0.3	0.3	0.33	0.32	0.31
G, Miss Si Y	44	0.3	0.19	0.24	0.22	0.13	0.22
G, Miss Si Y	44	.	0.26	0.28	0.26	0.25	0.26
G, Miss Si Y	44	0.49	0.28	0.3	0.26	0.37	0.34
G, Miss Si Y	44	.	0.33	0.39	0.37	0.41	0.37
G, Miss Si Y	44	0.41	0.31	0.28	0.28	0.29	0.31
G, Miss Si Y	44	0.44	.	0.54	0.36	0.39	0.43
G, Miss Si Y	44	0.53	0.41	0.37	0.47	0.55	0.46
G, Miss Si Y	44	.	.	.	.	.	.
G, Miss Si Y	44	.	.	.	.	.	.
G, Miss Si Y	44	.	0.13	0.2	0.2	0.23	0.19
G, Miss Si Y	44	0.34	0.26	0.2	0.28	0.24	0.26
G, Miss Si Y	44	.	0.24	0.22	0.27	0.17	0.22
G, Miss Si Y	44	0.46	0.27	0.27	0.3	0.31	0.32
G, Miss Si Y	44	0.28	0.23	0.24	0.23	0.24	0.24
G, Miss Si Y	44	.	0.22	0.2	0.31	0.23	0.24
G, Miss Si Y	44	0.39	0.3	0.3	0.27	0.27	0.31
G, Miss Si Y	44	0.4	0.34	0.35	0.37	0.37	0.37
G, Miss Si Y	44	.	0.37	0.4	0.41	0.36	0.39
G, Miss Si Y	44	0.26	0.15	0.17	0.17	0.17	0.18
G, Miss Si Y	44	0.19	0.17	0.13	0.16	0.18	0.17
G, Miss Si Y	44	.	0.28	0.23	.	0.33	0.28
G, Miss Si Y	44	0.42	0.39	0.44	0.38	0.36	0.4
G, Miss Si Y	44	0.36	0.37	0.4	0.42	0.41	0.39
G, Miss Si Y	44	0.42	0.41	0.37	0.41	0.32	0.39
G, Miss Si Y	44	0.37	.	.	.	.	0.37
G, Miss Si Y	44	0.55	0.24	0.24	0.23	0.28	0.31
G, Miss Si Y	44	0.18	0.11	0.13	0.13	0.08	0.13
G, Miss Si Y	44	0.44	0.18	0.2	0.21	0.2	0.25
G, Miss Si Y	44	.	0.12	0.13	0.13	0.1	0.12
G, Miss Si Y	44	0.3	0.24	0.19	0.3	0.27	0.26
G, Miss Si Y	44	.	.	.	.	.	.
G, Miss Si Y	44	0.41	0.34	0.27	0.31	0.3	0.33
G, Miss Si Y	44	.	.	.	0.26	0.27	0.27
G, Miss Si Y	44	0.57	0.35	0.36	0.37	0.4	0.41
G, Miss Si Y	44	0.31	0.35	0.32	0.24	0.26	0.3

Table 9. 12. 3-D Hardness Data Summary.

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
G, Miss Si Y	44	0.51	0.41	0.39	0.4	0.41	0.42
G, Miss Si Y	44	0.56	0.29	0.3	0.53	0.37	0.41
G, Miss Si Y	44	0.51	0.37	0.42	0.37	0.38	0.41
G, Miss Si Y	44	0.73	0.33	0.37	0.34	0.41	0.44
G, Miss Si Y	44	.	.	.	.	.	.
G, Miss Si Y	44	0.1	0.05	0.11	0.13	.	0.1
G, Miss Si Y	44	0.16	0.07	0.19	0.17	0.11	0.14
G, Miss Si Y	44	.	0.31	0.29	0.3	0.26	0.29
G, Miss Si Y	44	.	0.28	0.31	0.33	0.28	0.3
G, Miss Si Y	44	.	0.19	0.22	0.22	0.19	0.21
G, Miss Si Y	44	.	0.17	0.24	0.26	0.3	0.24
G, Miss Si Y	44	.	0.23	0.32	0.28	0.24	0.27
G, Miss Si Y	44	0.39	0.36	0.39	0.32	0.31	0.35
G, Miss Si Y	44	.	0.24	0.44	0.23	.	0.3
G, Miss Si Y	44	.	0.32	0.28	0.27	0.29	0.29
G, Miss Si Y	44	.	0.33	0.37	0.37	0.36	0.35
G, Miss Si Y	44	.	0.37	0.36	0.43	0.37	0.38
G, Miss Si Y	44	.	0.2	0.2	0.24	0.28	0.23
G, Miss Si Y	44	.	0.29	0.36	0.24	0.28	0.29
G, Miss Si Y	44	.	0.3	0.3	0.36	0.36	0.33
G, Miss Si Y	44	.	0.26	0.19	0.2	0.23	0.22
G, Miss Si Y	44	.	0.33	0.32	0.31	0.33	0.32
G, Miss Si Y	44	.	0.32	0.32	0.34	0.32	0.32
G, Miss Si Y	44	.	0.31	0.33	0.36	0.34	0.34
E, Mr	24	0.11	0.12	0.11	.	.	0.11
E, Mr	24	0.35	0.32	0.41	0.25	0.22	0.31
E, Mr	24	0.44	0.45	0.16	0.54	0.37	0.39
E, Mr	24	.	0.47	0.49	0.45	0.49	0.48
E, Mr	24	0.3	0.3	0.3	0.28	0.34	0.3
E, Mr	24	.	0.53	0.52	0.53	0.52	0.53
E, Mr	24	.	.	.	.	.	.
E, Mr	24	.	0.52	0.52	0.52	0.52	0.52
E, Mr	24	.	0.37	0.33	0.33	0.35	0.34
E, Mr	24	0.62	0.58	0.63	0.58	0.61	0.6
E, Mr	24	.	0.42	0.44	0.44	0.39	0.42
E, Mr	24	1.8	2	2	2.3	2.3	2.07
E, Mr	24	0.32	0.39	0.32	0.32	0.32	0.33
E, Mr	24	0.28	0.34	0.2	0.32	0.31	0.29
E, Mr	24	.	0.37	0.3	0.32	0.34	0.33
E, Mr	24	0.22	0.19	0.27	0.24	0.23	0.23
E, Mr	24	0.39	0.24	0.31	0.31	0.32	0.31
E, Mr	24	.	0.23	0.28	0.28	0.32	0.28
E, Mr	24	.	0.31	0.31	0.35	0.32	0.32
E, Mr	24	0.33	0.33	0.32	0.32	0.34	0.33
E, Mr	24	0.33	0.34	0.32	0.34	.	0.33
E, Mr	24	0.46	0.3	0.33	0.33	0.35	0.35
E, Mr	24	.	0.32	0.3	0.33	0.34	0.32
E, Mr	24	.	0.37	0.37	0.39	0.37	0.37
E, Mr	24	.	0.32	0.39	0.36	0.37	0.36
E, Mr	24	.	0.32	0.32	0.34	0.33	0.33

Table 9. 13. 3-D Hardness Data Summary.

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
E, Mr	24	0.34	0.34	0.35	0.33	0.32	0.34
E, Mr	24	.	0.32	0.34	0.33	0.35	0.33
E, Mr	24	.	0.42	0.34	0.36	0.4	0.38
E, Mr	24	.	0.32	0.34	0.37	0.3	0.33
E, Mr	24	.	0.39	0.32	0.42	0.37	0.37
E, Mr	24	.	0.22	0.26	0.26	0.28	0.25
E, Mr	24	0.37	0.26	0.32	0.37	0.37	0.34
E, Mr	24	0.31	0.28	0.2	0.28	0.3	0.27
E, Mr	24	.	0.4	0.39	0.39	0.36	0.39
E, Mr	24	0.35	0.32	0.34	0.32	0.34	0.33
E, Mr	24	.	0.28	0.28	0.26	0.26	0.27
E, Mr	24	.	0.32	0.34	0.34	0.32	0.33
E, Mr	24	.	0.3	0.3	0.28	0.34	0.31
E, Mr	24	.	0.29	0.3	0.33	0.37	0.32
E, Mr	24	0.23	0.21	0.24	0.24	0.19	0.22
E, Mr	24	0.24	0.26	0.42	0.28	0.36	0.31
E, Mr	24	2.3	.	.	2.3	.	2.3
E, Mr	24	.	0.3	0.2	0.2	0.22	0.23
E, Mr	24	0.34	0.26	0.24	0.3	0.37	0.3
E, Mr	24	.	0.2	0.26	0.23	0.32	0.25
E, Mr	24	.	0.27	0.26	0.26	0.24	0.26
E, Mr	24	0.45	0.35	0.33	0.33	0.33	0.36
E, Mr	24	.	0.26	0.26	0.26	0.25	0.26
E, Mr	24	.	0.25	0.3	0.23	0.19	0.24
E, Mr	24	.	0.29	0.3	0.3	0.28	0.29
E, Mr	24	.	0.35	0.33	0.28	0.3	0.32
E, Mr	24	0.39	0.15	0.22	0.23	0.25	0.25
E, Mr	24	0.29	0.25	0.24	0.28	0.29	0.27
E, Mr	24	.	0.34	0.44	0.33	0.35	0.36
E, Mr	24	0.35	0.28	0.34	0.32	0.34	0.32
E, Mr	24	.	0.34	0.36	0.34	0.32	0.34
E, Mr	24	.	0.22	0.29	0.35	0.27	0.28
E, Mr	24	.	0.47	0.31	0.31	0.29	0.35
E, Mr	24	.	0.42	0.37	0.42	0.4	0.4
E, Mr	24	.	0.25	0.26	0.23	0.31	0.26
E, Mr	24	.	0.32	0.3	0.44	0.33	0.35
G, Miss M	44	0.2	0.12	0.12	0.21	0.27	0.18
G, Miss M	44	.	0.39	0.36	0.37	0.37	0.37
G, Miss M	44	0.16	0.2	0.21	0.17	0.16	0.18
G, Miss M	44	.	0.42	0.39	0.39	0.42	0.4
G, Miss M	44	0.35	0.22	0.3	0.29	0.19	0.27
G, Miss M	44	.	0.41	0.4	0.41	0.36	0.39
G, Miss M	44	.	0.44	0.32	0.43	0.4	0.4
G, Miss M	44	.	0.44	0.46	0.48	0.47	0.46
G, Miss M	44	.	0.55	0.51	0.57	0.52	0.54
G, Miss M	44	0.57	0.57	0.52	0.53	0.55	0.55
G, Miss M	44	.	0.52	0.56	0.53	0.47	0.52
G, Miss M	44	2	1.9	2.3	2.2	2.3	2.16
G, Miss M	44	.	0.24	0.19	0.21	0.33	0.24
G, Miss M	44	.	0.2	0.26	0.16	0.24	0.22

Table 9. 14. 3-D Hardness Data Summary.

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
G, Miss M	44	.	0.37	0.34	0.37	0.36	0.36
G, Miss M	44	.	0.43	0.31	0.36	0.24	0.34
G, Miss M	44	0.46	0.4	0.27	0.34	0.23	0.34
G, Miss M	44	.	0.36	0.44	0.43	0.49	0.43
G, Miss M	44	.	0.43	0.44	0.41	0.39	0.42
G, Miss M	44	.	0.31	0.31	0.31	0.29	0.3
G, Miss M	44	.	0.13	0.14	0.17	0.23	0.17
G, Miss M	44	0.57	0.44	0.29	0.36	0.24	0.38
G, Miss M	44	.	0.44	0.46	0.4	0.47	0.44
G, Miss M	44	.	0.49	0.38	0.31	0.39	0.39
G, Miss M	44	.	0.15	0.16	0.23	0.18	0.18
G, Miss M	44	.	0.51	0.46	0.51	0.52	0.5
G, Miss M	44	.	0.48	0.54	0.46	0.49	0.49
G, Miss M	44	.	0.47	0.45	0.51	0.42	0.46
G, Miss M	44	.	0.47	0.51	0.51	0.51	0.5
G, Miss M	44	.	0.47	0.5	0.49	0.49	0.49
G, Miss M	44	0.48	0.49	0.42	0.42	0.47	0.46
G, Miss M	44	.	0.08	0.18	0.13	0.09	0.12
G, Miss M	44	.	0.35	0.28	0.38	0.35	0.34
G, Miss M	44	.	0.35	0.28	0.36	0.31	0.33
G, Miss M	44	.	0.39	0.42	0.42	0.44	0.42
G, Miss M	44	0.55	0.42	0.39	0.4	0.46	0.45
G, Miss M	44	.	0.51	0.5	0.46	0.45	0.48
G, Miss M	44	.	0.47	0.47	0.52	0.51	0.49
G, Miss M	44	0.54	0.42	0.56	0.5	0.57	0.52
G, Miss M	44	.	0.48	0.57	0.52	0.56	0.53
G, Miss M	44	0.63	0.45	0.42	0.41	0.47	0.47
G, Miss M	44	.	0.51	0.43	0.47	0.46	0.47
G, Miss M	44	2	2.2	2.3	.	2.4	2.23
G, Miss M	44	.	0.27	0.06	0.08	0.1	0.13
G, Miss M	44	.	0.17	0.1	0.22	0.19	0.17
G, Miss M	44	0.2	0.15	0.31	0.17	0.26	0.22
G, Miss M	44	.	0.08	0.18	0.23	0.23	0.18
G, Miss M	44	0.2	0.24	0.17	0.24	0.23	0.22
G, Miss M	44	0.39	0.37	0.39	0.34	0.42	0.38
G, Miss M	44	.	0.35	0.37	0.27	.	0.33
G, Miss M	44	0.37	0.31	0.2	0.27	0.34	0.3
G, Miss M	44	.	0.42	0.37	0.41	0.41	0.4
G, Miss M	44	0.45	0.37	0.24	0.39	0.4	0.37
G, Miss M	44	.	0.42	0.47	0.46	0.42	0.44
G, Miss M	44	0.52	0.47	0.52	.	.	0.5
G, Miss M	44	.	0.37	0.37	0.37	.	0.37
G, Miss M	44	.	0.41	0.28	0.36	.	0.35
G, Miss M	44	0.63	0.4	0.53	.	.	0.52
G, Miss M	44	0.32	0.35	0.31	.	.	0.33
G, Miss M	44	0.63	0.41	0.4	.	.	0.48
G, Miss M	44	.	0.41	0.41	.	.	0.41
G, Miss M	44	.	0.37	.	.	.	0.37
G, Miss M	34	0.26	0.26	.	.	.	0.26
G, Miss M	34	0.43	0.33	0.29	.	.	0.35

Table 9. 15. 3-D Hardness Data Summary.

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
G, Miss M	34	0.36	0.35	0.35	.	.	0.36
G, Miss M	34	0.46	0.35	0.31	.	.	0.37
G, Miss M	34	0.37	0.37	0.35	.	.	0.36
G, Miss M	34	0.53	0.36	0.42	.	.	0.44
G, Miss M	34	0.63	0.41	0.38	.	.	0.47
G, Miss M	34	0.52	0.5	0.49	.	.	0.5
G, Miss M	34	0.63	0.46	0.52	.	.	0.54
G, Miss M	34	0.23	0.24	.	.	.	0.24
G, Miss M	34	0.5	0.36	0.28	.	.	0.38
G, Miss M	34	1	1.2	.	.	.	1.12
G, Miss M	34	0.28	0.19	0.19	.	.	0.22
G, Miss M	34	.	0.17	0.21	.	.	0.19
G, Miss M	34	.	0.22	0.22	.	.	0.22
G, Miss M	34	0.35	0.38	0.35	.	.	0.36
G, Miss M	34	0.41	0.35	0.4	.	.	0.39
G, Miss M	34	.	0.4	0.35	.	.	0.38
G, Miss M	34	0.5	0.34	0.41	.	.	0.41
G, Miss M	34	.	0.37	0.38	.	.	0.38
G, Miss M	34	.	0.44	0.42	.	.	0.43
G, Miss M	34	.	0.39	0.41	.	.	0.4
G, Miss M	34	.	0.45	0.44	.	.	0.45
G, Miss M	34	.	0.39	0.37	.	.	0.38
G, Miss M	34	.	0.41	0.41	.	.	0.41
G, Miss M	34	.	0.5	0.41	.	.	0.46
G, Miss M	34	.	0.49	0.48	.	.	0.48
G, Miss M	34	0.66	0.52	0.41	.	.	0.53
G, Miss M	34	.	0.34	0.31	.	.	0.33
G, Miss M	34	.	0.38	0.27	.	.	0.32
G, Miss M	34	.	0.29	0.28	.	.	0.28
G, Miss M	34	0.11	0.08	0.06	.	.	0.08
G, Miss M	34	0.23	0.24	0.17	.	.	0.21
G, Miss M	34	0.37	0.28	0.35	.	.	0.33
G, Miss M	34	0.34	0.25	0.27	.	.	0.29
G, Miss M	34	0.4	0.37	0.32	.	.	0.36
G, Miss M	34	.	0.35	0.32	.	.	0.34
G, Miss M	34	0.52	0.45	0.4	.	.	0.45
G, Miss M	34	0.48	0.38	0.41	.	.	0.42
G, Miss M	34	0.61	0.43	0.52	.	.	0.52
G, Miss M	34	.	0.33	0.32	.	.	0.32
G, Miss M	34	.	0.37	0.38	.	.	0.37
G, Miss M	34	2.2	2.5	1.7	.	.	2.13
G, Miss M	34	0.4	0.16	0.2	.	.	0.25
G, Miss M	34	0.26	0.09	0.07	.	.	0.14
G, Miss M	34	0.3	0.23	0.24	.	.	0.26
G, Miss M	34	0.29	0.28	0.23	.	.	0.27
G, Miss M	34	0.32	0.31	0.28	.	.	0.3
G, Miss M	34	0.4	0.35	0.26	.	.	0.33
G, Miss M	34	0.3	0.25	0.2	.	.	0.25
G, Miss M	34	0.32	0.27	0.33	.	.	0.31
G, Miss M	34	0.39	0.36	0.37	.	.	0.37

Table 9. 16. 3-D Hardness Data Summary.

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
G, Miss M	34	0.29	0.2	0.15	.	.	0.21
G, Miss M	34	0.4	0.26	0.23	.	.	0.3
G, Miss M	34	0.58	0.45	0.42	.	.	0.48
G, Miss M	34	0.39	0.32	0.46	.	.	0.39
G, Miss M	34	.	0.4	0.42	.	.	0.41
G, Miss M	34	0.37	0.41	0.36	.	.	0.38
G, Miss M	34	0.64	0.45	0.42	.	.	0.5
G, Miss M	34	0.41	0.38	0.31	.	.	0.37
G, Miss M	34	.	0.27	0.28	.	.	0.28
G, Miss M	34	0.22	0.22	0.27	.	.	0.24
L, Miss Yi Mei	34	0.2	0.35	0.23	.	.	0.26
L, Miss Yi Mei	34	0.52	0.32	0.42	.	.	0.42
L, Miss Yi Mei	34	0.41	0.16	0.16	.	.	0.24
L, Miss Yi Mei	34	0.44	0.42	0.3	.	.	0.39
L, Miss Yi Mei	34	0.52	0.42	0.37	.	.	0.44
L, Miss Yi Mei	34	0.64	0.45	0.4	.	.	0.5
L, Miss Yi Mei	34	0.34	0.24	0.36	.	.	0.32
L, Miss Yi Mei	34	0.51	0.36	0.23	.	.	0.37
L, Miss Yi Mei	34	0.52	0.43	0.47	.	.	0.47
L, Miss Yi Mei	34	0.3	0.19	0.17	.	.	0.22
L, Miss Yi Mei	34	0.23	0.27	.	.	.	0.25
L, Miss Yi Mei	34	1.2	2.6	1.3	.	.	1.71
L, Miss Yi Mei	34	0.24	0.19	0.13	.	.	0.19
L, Miss Yi Mei	34	0.36	0.16	0.36	.	.	0.29
L, Miss Yi Mei	34	0.37	0.31	0.31	.	.	0.33
L, Miss Yi Mei	34	0.41	0.32	0.31	.	.	0.34
L, Miss Yi Mei	34	0.31	0.19	0.31	.	.	0.27
L, Miss Yi Mei	34	0.44	0.36	0.31	.	.	0.37
L, Miss Yi Mei	34	0.41	0.33	0.37	.	.	0.37
L, Miss Yi Mei	34	0.45	0.19	0.2	.	.	0.28
L, Miss Yi Mei	34	0.37	0.35	.	.	.	0.36
L, Miss Yi Mei	34	0.36	0.36	0.35	.	.	0.36
L, Miss Yi Mei	34	0.59	0.32	0.37	.	.	0.43
L, Miss Yi Mei	34	0.27	0.17	0.27	.	.	0.24
L, Miss Yi Mei	34	0.11	0.11	0.08	.	.	0.1
L, Miss Yi Mei	34	0.32	0.17	0.14	.	.	0.21
L, Miss Yi Mei	34	0.44	0.31	0.31	.	.	0.35
L, Miss Yi Mei	34	0.47	0.46	0.28	.	.	0.4
L, Miss Yi Mei	34	0.2	0.14	0.11	.	.	0.15
L, Miss Yi Mei	34	0.26	0.16	0.11	.	.	0.18
L, Miss Yi Mei	34	0.31	0.16	0.16	.	.	0.21
L, Miss Yi Mei	34	0.37	0.32	0.28	.	.	0.32
L, Miss Yi Mei	34	.	0.41	0.36	.	.	0.39
L, Miss Yi Mei	34	0.42	0.31	0.28	.	.	0.34
L, Miss Yi Mei	34	.	0.42	0.4	.	.	0.41
L, Miss Yi Mei	34	0.53	0.41	0.33	.	.	0.42
L, Miss Yi Mei	34	.	0.38	0.39	.	.	0.38
L, Miss Yi Mei	34	0.66	0.54	0.35	.	.	0.52
L, Miss Yi Mei	34	0.4	0.34	0.42	.	.	0.39
L, Miss Yi Mei	34	0.4	0.42	0.37	.	.	0.4

Table 9. 17. 3-D Hardness Data Summary.

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
L, Miss Yi Mei	34	0.31	0.2	0.32	.	.	0.28
L, Miss Yi Mei	34	0.23	0.24	0.28	.	.	0.25
L, Miss Yi Mei	34	3.2	2.7	2.6	.	.	2.85
L, Miss Yi Mei	34	0.23	0.48	0.37	.	.	0.36
L, Miss Yi Mei	34	0.42	0.33	0.36	.	.	0.37
L, Miss Yi Mei	34	.	0.28	0.31	.	.	0.3
L, Miss Yi Mei	34	0.35	0.32	0.4	.	.	0.36
L, Miss Yi Mei	34	.	0.24	0.37	.	.	0.3
L, Miss Yi Mei	34	0.6	0.24	0.44	.	.	0.43
L, Miss Yi Mei	34	.	0.28	0.31	.	.	0.3
L, Miss Yi Mei	34	0.36	0.28	0.28	.	.	0.3
L, Miss Yi Mei	34	.	0.33	0.24	.	.	0.29
L, Miss Yi Mei	34	0.37	0.28	0.2	.	.	0.28
L, Miss Yi Mei	34	0.35	0.24	0.28	.	.	0.29
L, Miss Yi Mei	34	0.41	0.35	0.28	.	.	0.35
L, Miss Yi Mei	34	0.51	0.37	0.37	.	.	0.42
L, Miss Yi Mei	34	0.61	0.36	0.45	.	.	0.47
L, Miss Yi Mei	34	0.6	0.32	0.5	.	.	0.48
L, Miss Yi Mei	34	.	0.24	0.28	.	.	0.26
L, Miss Yi Mei	34	0.44	0.42	0.42	.	.	0.43
L, Miss Yi Mei	34	0.37	0.24	0.31	.	.	0.31
L, Miss Yi Mei	34	0.53	0.24	0.52	.	.	0.43
L, Miss Yi Mei	24	.	.	.	.	.	.
L, Miss Yi Mei	24	0.52	0.5	0.28	.	.	0.43
L, Miss Yi Mei	24	0.46	0.36	.	.	.	0.41
L, Miss Yi Mei	24	0.24	0.24	0.31	.	.	0.26
L, Miss Yi Mei	24	0.24	0.27	0.21	.	.	0.24
L, Miss Yi Mei	24	.	0.28	0.31	.	.	0.3
L, Miss Yi Mei	24	0.5	0.42	0.45	.	.	0.46
L, Miss Yi Mei	24	.	0.41	0.43	.	.	0.42
L, Miss Yi Mei	24	.	0.23	0.22	.	.	0.23
L, Miss Yi Mei	24	0.4	0.27	0.35	.	.	0.34
L, Miss Yi Mei	24	0.51	0.33	0.46	.	.	0.43
L, Miss Yi Mei	24	2	2	1.6	.	.	1.86
L, Miss Yi Mei	24	0.22	0.11	0.19	.	.	0.18
L, Miss Yi Mei	24	0.36	0.31	0.24	.	.	0.3
L, Miss Yi Mei	24	0.26	0.3	0.44	.	.	0.33
L, Miss Yi Mei	24	0.19	0.24	0.11	.	.	0.18
L, Miss Yi Mei	24	0.28	0.33	0.27	.	.	0.29
L, Miss Yi Mei	24	0.41	0.37	0.37	.	.	0.38
L, Miss Yi Mei	24	0.48	0.37	0.27	.	.	0.37
L, Miss Yi Mei	24	0.62	0.23	0.41	.	.	0.42
L, Miss Yi Mei	24	0.45	0.37	0.42	.	.	0.41
L, Miss Yi Mei	24	0.39	0.31	0.37	.	.	0.36
L, Miss Yi Mei	24	0.45	0.33	0.35	.	.	0.37
L, Miss Yi Mei	24	0.49	0.42	0.42	.	.	0.44
L, Miss Yi Mei	24	0.61	0.36	0.32	.	.	0.43
L, Miss Yi Mei	24	0.46	0.28	0.33	.	.	0.35
L, Miss Yi Mei	24	0.56	0.44	0.45	.	.	0.48
L, Miss Yi Mei	24	0.4	0.23	0.23	.	.	0.29

Table 9. 18. 3-D Hardness Data Summary.

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
L, Miss Yi Mei	24	0.42	0.33	0.35	.	.	0.37
L, Miss Yi Mei	24	0.69	0.42	0.32	.	.	0.48
L, Miss Yi Mei	24	0.6	0.4	0.41	.	.	0.47
L, Miss Yi Mei	24	0.51	0.27	0.27	.	.	0.35
L, Miss Yi Mei	24	0.31	0.2	0.24	.	.	0.25
L, Miss Yi Mei	24	0.48	0.37	0.32	.	.	0.39
L, Miss Yi Mei	24	0.41	0.36	0.32	.	.	0.36
L, Miss Yi Mei	24	0.64	0.37	0.42	.	.	0.48
L, Miss Yi Mei	24	0.64	0.46	0.52	.	.	0.54
L, Miss Yi Mei	24	0.52	0.52	0.49	.	.	0.51
L, Miss Yi Mei	24	0.46	0.31	0.32	.	.	0.36
L, Miss Yi Mei	24	0.53	0.36	0.32	.	.	0.4
L, Miss Yi Mei	24	0.13	0.09	0.07	.	.	0.1
L, Miss Yi Mei	24	0.08	0.1	0.05	.	.	0.08
L, Miss Yi Mei	24	1.5	2.3	2	.	.	1.91
L, Miss Yi Mei	24	0.35	0.23	0.19	.	.	0.25
L, Miss Yi Mei	24	0.53	0.22	0.13	.	.	0.3
L, Miss Yi Mei	24	0.46	0.37	0.32	.	.	0.38
L, Miss Yi Mei	24	0.54	0.28	0.39	.	.	0.4
L, Miss Yi Mei	24	0.58	0.32	0.23	.	.	0.38
L, Miss Yi Mei	24	0.44	0.32	0.3	.	.	0.35
L, Miss Yi Mei	24	0.41	0.35	0.32	.	.	0.36
L, Miss Yi Mei	24	0.44	0.37	0.32	.	.	0.37
L, Miss Yi Mei	24	0.61	0.28	0.42	.	.	0.44
L, Miss Yi Mei	24	0.29	0.32	0.36	.	.	0.32
L, Miss Yi Mei	24	0.56	0.41	0.42	.	.	0.47
L, Miss Yi Mei	24	0.36	0.37	0.29	.	.	0.34
L, Miss Yi Mei	24	0.42	0.27	0.37	.	.	0.35
L, Miss Yi Mei	24	0.56	0.33	0.32	.	.	0.4
L, Miss Yi Mei	24	0.58	0.37	0.42	.	.	0.45
L, Miss Yi Mei	24	0.36	.	.	.	.	0.36
L, Miss Yi Mei	24	0.19	0.23	0.19	.	.	0.2
L, Miss Yi Mei	24	0.28	0.18	0.13	.	.	0.2
L, Miss Yi Mei	24	0.55	0.11	0.24	.	.	0.3
V, Miss M	24	0.32	0.23	0.3	.	.	0.28
V, Miss M	24	0.36	0.28	0.31	.	.	0.32
V, Miss M	24	0.41	0.36	0.37	.	.	0.38
V, Miss M	24	.	0.27	0.36	.	.	0.31
V, Miss M	24	0.5	0.36	0.38	.	.	0.41
V, Miss M	24	0.56	0.37	0.32	.	.	0.42
V, Miss M	24	0.55	0.46	0.4	.	.	0.47
V, Miss M	24	0.55	0.44	0.42	.	.	0.47
V, Miss M	24	0.46	0.42	0.42	.	.	0.44
V, Miss M	24	0.6	0.36	0.37	.	.	0.45
V, Miss M	24	0.36	0.24	0.37	.	.	0.32
V, Miss M	24	1.3	2.5	1.2	.	.	1.66
V, Miss M	24	0.48	0.31	0.4	.	.	0.4
V, Miss M	24	0.41	0.31	0.24	.	.	0.32
V, Miss M	24	0.64	0.42	0.47	.	.	0.51
V, Miss M	24	0.32	0.19	0.28	.	.	0.27

Table 9. 19. 3-D Hardness Data Summary.

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
V, Miss M	24	0.51	0.51	.	.	.	0.51
V, Miss M	24	0.62	0.37	0.42	.	.	0.47
V, Miss M	24	.	.	.	.	.	.
V, Miss M	24	0.46	0.31	0.32	.	.	0.36
V, Miss M	24	0.65	0.44	0.46	.	.	0.52
V, Miss M	24	.	.	.	.	.	.
V, Miss M	24	0.36	0.23	0.23	.	.	0.27
V, Miss M	24	0.57	0.46	0.46	.	.	0.5
V, Miss M	24	0.52	0.46	0.45	.	.	0.48
V, Miss M	24	.	0.45	0.42	.	.	0.44
V, Miss M	24	0.62	0.51	0.45	.	.	0.53
V, Miss M	24	0.53	0.37	0.4	.	.	0.43
V, Miss M	24	0.59	0.36	0.36	.	.	0.44
V, Miss M	24	0.69	0.33	0.41	.	.	0.48
V, Miss M	24	0.7	0.45	0.42	.	.	0.52
V, Miss M	24	0.27	0.17	0.24	.	.	0.23
V, Miss M	24	0.26	0.2	0.1	.	.	0.19
V, Miss M	24	0.36	0.27	0.28	.	.	0.3
V, Miss M	24	0.23	0.17	0.23	.	.	0.21
V, Miss M	24	0.47	0.4	0.35	.	.	0.41
V, Miss M	24	0.47	0.4	0.42	.	.	0.43
V, Miss M	24	0.55	0.36	0.27	.	.	0.39
V, Miss M	24	0.5	0.37	0.45	.	.	0.44
V, Miss M	24	0.48	0.42	0.4	.	.	0.43
V, Miss M	24	0.39	0.31	0.29	.	.	0.33
V, Miss M	24	0.45	0.32	0.37	.	.	0.38
V, Miss M	24	1.1	1.1	2.2	.	.	1.43
V, Miss M	24	0.31	0.2	0.24	.	.	0.25
V, Miss M	24	0.51	0.21	0.19	.	.	0.3
V, Miss M	24	0.28	0.26	0.24	.	.	0.26
V, Miss M	24	.	.	.	.	.	.
V, Miss M	24	0.86	0.23	0.35	.	.	0.48
V, Miss M	24	0.54	0.32	0.24	.	.	0.37
V, Miss M	24	.	.	.	.	.	.
V, Miss M	24	0.37	0.32	0.36	.	.	0.35
V, Miss M	24	0.6	0.4	0.37	.	.	0.46
V, Miss M	24	.	.	.	.	.	.
V, Miss M	24	0.62	0.35	0.5	.	.	0.49
V, Miss M	24	0.7	0.37	0.4	.	.	0.49
V, Miss M	24	0.51	0.43	0.41	.	.	0.45
V, Miss M	24	0.55	0.45	0.53	.	.	0.51
V, Miss M	24	0.54	0.36	0.32	.	.	0.41
V, Miss M	24	0.59	0.36	0.46	.	.	0.47
V, Miss M	24	0.52	0.46	0.45	.	.	0.48
V, Miss M	24	0.56	0.42	0.51	.	.	0.5
V, Miss M	24	0.73	0.42	0.45	.	.	0.53
V, Miss M	14	0.32	0.28	0.23	.	.	0.28
V, Miss M	14	0.28	0.19	0.23	.	.	0.23
V, Miss M	14	0.13	0.28	0.17	.	.	0.19
V, Miss M	14	0.5	0.32	0.36	.	.	0.39

Table 9. 20. 3-D Hardness Data Summary.

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
V, Miss M	14	.	0.36	0.35	.	.	0.36
V, Miss M	14	0.47	0.45	0.42	.	.	0.45
V, Miss M	14	0.41	0.37	0.41	.	.	0.4
V, Miss M	14	0.52	0.42	0.4	.	.	0.45
V, Miss M	14	0.56	0.42	0.45	.	.	0.48
V, Miss M	14	0.56	0.38	0.4	.	.	0.44
V, Miss M	14	0.5	0.36	0.27	.	.	0.38
V, Miss M	14	2.4	1.6	2	.	.	2.01
V, Miss M	14	0.41	0.35	0.4	.	.	0.39
V, Miss M	14	0.27	0.27	0.32	.	.	0.29
V, Miss M	14	0.34	0.14	0.17	.	.	0.21
V, Miss M	14	.	.	.	.	.	.
V, Miss M	14	0.22	0.27	0.33	.	.	0.27
V, Miss M	14	0.2	0.2	0.13	.	.	0.18
V, Miss M	14	.	.	.	.	.	.
V, Miss M	14	0.42	0.33	0.46	.	.	0.4
V, Miss M	14	0.51	0.4	0.37	.	.	0.43
V, Miss M	14	.	.	.	.	.	.
V, Miss M	14	.	0.37	0.56	.	.	0.46
V, Miss M	14	.	0.46	0.41	.	.	0.44
V, Miss M	14	0.7	0.41	0.52	.	.	0.54
V, Miss M	14	0.7	0.61	0.5	.	.	0.6
V, Miss M	14	0.69	0.47	0.47	.	.	0.54
V, Miss M	14	0.49	0.42	0.32	.	.	0.41
V, Miss M	14	0.53	0.42	0.42	.	.	0.45
V, Miss M	14	0.63	0.42	0.47	.	.	0.51
V, Miss M	14	0.63	0.37	0.42	.	.	0.47
V, Miss M	14	0.44	0.32	0.35	.	.	0.37
V, Miss M	14	0.72	0.36	0.36	.	.	0.48
V, Miss M	14	0.44	0.39	0.39	.	.	0.41
V, Miss M	14	0.5	0.37	0.39	.	.	0.42
V, Miss M	14	0.46	0.27	0.37	.	.	0.37
V, Miss M	14	0.5	0.32	0.39	.	.	0.4
V, Miss M	14	0.79	0.3	0.51	.	.	0.53
V, Miss M	14	0.53	0.51	0.49	.	.	0.51
V, Miss M	14	0.63	0.41	0.39	.	.	0.48
V, Miss M	14	0.56	0.38	0.46	.	.	0.47
V, Miss M	14	0.52	0.45	0.36	.	.	0.44
V, Miss M	14	4.1	3.2	3.2	.	.	3.51
V, Miss M	14	0.21	0.11	0.36	.	.	0.23
V, Miss M	14	0.48	0.28	0.33	.	.	0.36
V, Miss M	14	0.63	0.33	0.3	.	.	0.42
V, Miss M	14	.	.	.	.	.	.
V, Miss M	14	0.41	0.25	0.36	.	.	0.34
V, Miss M	14	0.39	0.24	0.33	.	.	0.32
V, Miss M	14	.	.	.	.	.	.
V, Miss M	14	0.32	0.28	0.26	.	.	0.29
V, Miss M	14	0.65	0.36	0.39	.	.	0.47
V, Miss M	14	.	.	.	.	.	.
V, Miss M	14	0.56	0.37	0.42	.	.	0.45

Table 9. 21. 3-D Hardness Data Summary.

Patient	Tooth	H1	H2	H3	H4	H5	Aver. H
V, Miss M	14	0.71	0.44	0.44	.	.	0.53
V, Miss M	14	.	0.37	0.42	.	.	0.4
V, Miss M	14	0.53	0.46	0.46	.	.	0.48
V, Miss M	14	0.36	0.41	0.46	.	.	0.41
V, Miss M	14	.	0.38	0.41	.	.	0.39
V, Miss M	14	0.51	0.41	0.37	.	.	0.43
V, Miss M	14	0.51	0.51	0.47	.	.	0.5
V, Miss M	14	0.68	0.37	0.52	.	.	0.52

Table 9. 22. 3-D Hardness Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
G, Mr M	.	3.36	4.89	3.56	4.68	4.12	0.00056	.	0.06
G, Mr M	.	6.84	5.81	4.83	3.8	5.32	0	.	0.04
G, Mr M	1.37	7.17	2.89	1.3	.	3.18	0	.	0.04
G, Mr M	.	8.5	.	8.64	8.57	8.57	0.000645	.	0.05
G, Mr M	.	9.43	9.73	9.58	9.22	9.49	0.000645	.	0.05
G, Mr M	9.54	8.85	9.79	9.66	6.31	8.83	0	.	0.05
G, Mr M	5.35	3.17	3.03	6.88	8.62	5.41	0	.	0.05
G, Mr M	9.51	9.58	10.7	7.24	11.2	9.65	0	.	0.04
G, Mr M	.	9.37	10.6	10.6	10.5	10.28	0	.	0.04
G, Mr M	.	2.51	1.25	2.18	.	1.98	0	.	0.04
G, Mr M	.	3.7	3.7	1.35	1.16	2.47	0	.	0.04
G, Mr M	.	2.3	8.28	4.89	6.59	5.51	0.00016	.	0.03
G, Mr M	.	4.75	5.34	6.26	.	5.45	0.00016	.	0.03
G, Mr M	.	7.17	6.79	7.37	7.17	7.13	0	.	0.07
G, Mr M	.	.	.	5.91	6.69	6.3	0	.	0.07
G, Mr M	6.1	4.32	6.54	7.27	5.78	6	0	.	0.07
G, Mr M	3.04	3.09	2.95	0.38	3.05	2.5	0	.	0.08
G, Mr M	.	3.18	3.1	2.92	3.08	3.07	0	.	0.08
G, Mr M	3.63	3.76	3.43	3.42	3.5	3.55	0	.	0.08
G, Mr M	4.29	4.83	4.96	4.1	4.53	4.54	0	.	0.06
G, Mr M	.	9.85	9.36	9.36	8.86	9.36	0	.	0.06
G, Mr M	.	4.87	4.49	4.16	.	4.51	0	.	0.06
G, Mr M	.	7.59	3.42	4.42	6.58	5.5	0.000237	.	0.06
G, Mr M	11.8	10.6	9.94	10.4	10.7	10.68	0.000237	.	0.06
G, Mr M	.	6.08	5.89	5.88	5.85	5.93	0.000237	.	0.06
G, Mr M	.	5.89	5.79	5.76	5.97	5.86	0.000237	.	0.06
G, Mr M	.	7.05	6.67	7.25	7.31	7.07	0	.	0.06
G, Mr M	11.2	10.5	10.2	10.2	10.3	10.45	0	.	0.06
G, Mr M	.	7.1	7.6	7.33	7.94	7.49	0	.	0.06
G, Mr M	7.27	10.1	6.15	5.32	.	7.22	0	.	0.06
G, Mr M	.	.	4.64	4.31	4.77	4.58	0.000435	.	0.03
G, Mr M	.	4.98	6.37	6.59	5.34	5.82	0.000236	.	0.04
G, Mr M	.	3.05	3.63	3.83	3.61	3.53	0.000236	.	0.04
G, Mr M	.	7.77	4.99	8.75	7.88	7.35	0.0002	.	0.05
G, Mr M	.	3.69	3.51	5.63	3.62	4.11	0.0002	.	0.05
G, Mr M	.	10.7	11	10.7	10.6	10.73	0.000531	.	0.01
G, Mr M	.	5.9	6.65	6.06	5.81	6.1	0.000531	.	0.01
G, Mr M	.	.	12.1	11.1	10.9	11.39	0.002829	.	0.06
G, Mr M	.	8.18	8.94	7.95	8.57	8.41	0.002829	.	0.06
G, Mr M	.	11.9	13.1	11.6	12.9	12.39	0.000383	.	0.03
G, Mr M	.	8.44	10.2	.	9.2	9.28	0.000383	.	0.03
G, Mr M	1.66	1.55	1.32	1.55	1.54	1.53	0.000198	.	0.07
G, Mr M	1.6	2.06	1.9	1.61	1.81	1.8	0.000198	.	0.07
G, Mr M	2.38	2.13	2.45	2.77	0.25	2	0	.	0.06
G, Mr M	2.95	3.28	.	2.72	2.68	2.91	0	.	0.06
G, Mr M	3.05	1.94	2.38	2.08	1.99	2.29	0	.	0.06
G, Mr M	4.28	2.24	2.61	1.7	2.51	2.67	0.000199	.	0.05
G, Mr M	3.4	3.25	3.36	3.14	3.13	3.25	0.000199	.	0.05
G, Mr M	2.43	1.09	2.04	1.84	1.2	1.72	0.000199	.	0.05
G, Mr M	2.23	3.17	3.5	4.22	3.38	3.3	0	.	0.05

Table 9. 23. 3-D Elasticity and Calcium Content Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
G, Mr M	3.36	3.4	3.37	3.54	2.57	3.25	0	.	0.05
G, Mr M	2.57	.	.	.	.	2.57	0	.	0.05
G, Mr M	4.2	4.35	3.32	2.1	3.57	3.51	0.000156	.	0.06
G, Mr M	.	7.26	6.14	5.76	5.77	6.23	0.000156	.	0.06
G, Mr M	8.6	5.6	6.92	4.64	5.54	6.26	0.000156	.	0.06
G, Mr M	12	7.23	7.41	7.51	7.64	8.36	0.000156	.	0.06
G, Mr M	5.21	7.84	6.73	7.12	6.81	6.74	0.000135	.	0.04
G, Mr M	10.1	7.69	7.62	9.94	7.87	8.65	0.000135	.	0.04
G, Mr M	6.06	7.26	7.1	7.45	7.67	7.11	0.000135	.	0.04
G, Mr M	2.2	6.69	0.5	6.96	7.11	4.69	0.000135	.	0.04
G, Mr M	58.4	52.7	55.7	56.9	57.5	56.26	0.000983	.	0.11
G, Mr M	.	.	.	.	.	.	.	.	.
G, Miss Si Y	4.29	3.47	1.95	4.01	3.12	3.37	0.000501	0	0.01
G, Miss Si Y	.	4.28	5.9	6.8	5.26	5.56	0.002148	0.06	0.08
G, Miss Si Y	.	5.25	5.35	5.39	6.06	5.51	0.002148	0.06	0.08
G, Miss Si Y	.	6.99	7.14	7.45	7.74	7.33	0.0014	0.05	0.07
G, Miss Si Y	2.5	2.11	2.28	2.32	1.76	2.19	0.0014	0.05	0.07
G, Miss Si Y	.	3.12	3.41	3.31	3.2	3.26	0.000243	0.02	0.02
G, Miss Si Y	6.79	4.91	5.04	4.43	5.7	5.38	0.000243	0.02	0.02
G, Miss Si Y	.	6.18	6.64	6.54	6.51	6.47	0.001265	0.05	0.06
G, Miss Si Y	4.88	4.41	4.21	4.25	4.27	4.41	0.001265	0.05	0.06
G, Miss Si Y	8.5	.	8.71	7.39	7.81	8.1	0.002255	0.07	0.1
G, Miss Si Y	12.4	10.6	9.93	10.7	11.3	11	0.002255	0.07	0.1
G, Miss Si Y	.	.	.	.	.	.	0.000292	0.08	0.13
G, Miss Si Y	.	3.12	4.51	4.44	4.86	4.23	0.000928	0.01	0.01
G, Miss Si Y	6.98	4.25	4.44	5.68	5.11	5.29	0.000928	0.01	0.01
G, Miss Si Y	.	5.2	4.77	5.44	3.83	4.81	0.001359	0.05	0.06
G, Miss Si Y	9.36	5.97	6.12	6.3	6.34	6.82	0.001359	0.05	0.06
G, Miss Si Y	3.02	2.8	2.58	2.55	2.59	2.71	0.001359	0.05	0.06
G, Miss Si Y	.	2.68	2.55	2.98	2.7	2.73	0.001968	0.06	0.08
G, Miss Si Y	3.41	3.13	3.01	3.02	2.89	3.09	0.001968	0.06	0.08
G, Miss Si Y	3.49	3.19	3.17	3.29	3.25	3.28	0.001968	0.06	0.08
G, Miss Si Y	3.84	3.46	3.62	3.61	3.43	3.59	0.00028	0.03	0.04
G, Miss Si Y	3.01	.	.	.	.	3.01	0.00028	0.03	0.04
G, Miss Si Y	.	.	.	.	.	.	0.00028	0.03	0.04
G, Miss Si Y	.	4.41	3.54	4.53	4.56	4.26	0.001391	0.06	0.08
G, Miss Si Y	5.39	5.22	5.45	5.18	4.82	5.21	0.001391	0.06	0.08
G, Miss Si Y	5.23	5.26	5.38	5.31	5.16	5.27	0.001391	0.06	0.08
G, Miss Si Y	6.04	5.59	5.63	5.8	5.48	5.71	0.001391	0.06	0.08
G, Miss Si Y	5.7	.	.	.	.	5.7	0.000302	0.03	0.04
G, Miss Si Y	9.88	5.7	4.34	4.26	4.8	5.79	0.000302	0.03	0.04
G, Miss Si Y	2.72	1.86	2.01	2.16	1.45	2.04	0.000302	0.03	0.04
G, Miss Si Y	4.39	2.59	2.85	2.79	2.79	3.08	0.000302	0.03	0.04
G, Miss Si Y	.	1.32	1.77	1.38	1.52	1.5	0.002853	0.06	0.07
G, Miss Si Y	2.61	2.54	2.28	2.62	2.49	2.51	0.002922	0.07	0.09
G, Miss Si Y	.	.	.	.	.	.	0.002922	0.07	0.09
G, Miss Si Y	.	3.22	3.11	3.27	3.17	3.19	0.000981	0.03	0.04
G, Miss Si Y	.	.	.	2.47	2.54	2.51	0.000981	0.03	0.04
G, Miss Si Y	.	6.06	5.98	5.99	6.06	6.02	0.002315	0.06	0.09
G, Miss Si Y	3.21	3.48	3.48	3.01	3.13	3.27	0.002315	0.06	0.09

Table 9. 24. 3-D Elasticity and Calcium Content Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
G, Miss Si Y	.	7.95	7.45	7.72	7.94	7.77	0.003388	0.06	0.08
G, Miss Si Y	8.35	6.15	6.58	8.38	7.27	7.35	0.003388	0.06	0.08
G, Miss Si Y	.	8.14	9.02	7.85	8.88	8.47	0.001874	0.05	0.07
G, Miss Si Y	10.7	6.86	8.04	7.44	7.72	8.15	0.001874	0.05	0.07
G, Miss Si Y	.	.	.	.	.	.	0.000873	0.08	0.12
G, Miss Si Y	2.43	.	1.6	1.47	.	1.83	0.000545	0.05	0.07
G, Miss Si Y	1.61	0.84	2.01	2.12	1.02	1.52	0.000545	0.05	0.07
G, Miss Si Y	2.84	2.55	2.52	2.49	2.39	2.56	0.000917	0.05	0.07
G, Miss Si Y	2.76	2.55	2.74	2.74	2.58	2.67	0.000917	0.05	0.07
G, Miss Si Y	9.05	6.2	6.31	5.66	4.53	6.35	0.000917	0.05	0.07
G, Miss Si Y	5.35	4.36	5.53	5.64	6.72	5.52	0.002984	0.06	0.08
G, Miss Si Y	8.87	4.7	6.23	6.15	5.52	6.29	0.002984	0.06	0.08
G, Miss Si Y	7.14	6.88	7.29	6.35	6.09	6.75	0.002984	0.06	0.08
G, Miss Si Y	6.3	3.62	4.27	3.27	.	4.36	0.003933	0.07	0.09
G, Miss Si Y	4.73	3.93	3.71	3.84	3.91	4.02	0.003933	0.07	0.09
G, Miss Si Y	.	3.98	4.16	4.05	4.02	4.05	0.003933	0.07	0.09
G, Miss Si Y	5.39	4.65	4.73	4.87	4.57	4.84	0.003717	0.06	0.08
G, Miss Si Y	11.9	7.14	6.69	7.35	7.86	8.19	0.003717	0.06	0.08
G, Miss Si Y	10.2	7.41	8.43	6.16	6.47	7.74	0.003717	0.06	0.08
G, Miss Si Y	11.2	6.57	5.98	7.95	7.62	7.86	0.003717	0.06	0.08
G, Miss Si Y	7.52	6.77	3.45	3.52	4.73	5.2	0.000828	0.03	0.04
G, Miss Si Y	10.8	7.9	8.12	8.25	8.45	8.69	0.000828	0.03	0.04
G, Miss Si Y	10.8	.	8.04	8.23	9.23	9.08	0.000828	0.03	0.04
G, Miss Si Y	12.7	7.83	8.16	9.16	8.15	9.2	0.000828	0.03	0.04
E, Mr	3.91	3.62	2.46	3.87	.	3.46	0.000931	0.02	0.03
E, Mr	7.14	6.88	6.79	5.58	4.52	6.18	0.001531	0.03	0.03
E, Mr	6.57	6.34	2.94	13.6	5.99	7.1	0.001531	0.03	0.03
E, Mr	.	8.31	8.42	8.34	8.43	8.37	0.003972	0.06	0.07
E, Mr	6.74	6.69	6.76	5.95	6.66	6.56	0.003972	0.06	0.07
E, Mr	.	8.77	8.88	8.95	8.52	8.78	0.001538	0.04	0.05
E, Mr	.	.	.	.	.	.	0.001538	0.04	0.05
E, Mr	.	9.52	9.57	9.46	9.39	9.48	0.002262	0.05	0.06
E, Mr	.	5.65	5.01	5.03	5.09	5.19	0.002262	0.05	0.06
E, Mr	10.6	9.88	10.6	10.1	10.4	10.34	0.001581	0.04	0.06
E, Mr	.	5.66	5.65	5.55	5.35	5.55	0.001581	0.04	0.06
E, Mr	58.3	61.6	52	57.9	53	56.58	0.000493	0.09	0.13
E, Mr	.	2.7	2.46	2.51	2.51	2.55	0.001269	0.03	0.03
E, Mr	2.34	2.39	2.05	2.36	2.37	2.3	0.001269	0.03	0.03
E, Mr	.	2.72	2.5	2.65	2.65	2.63	0.001472	0.05	0.06
E, Mr	2.78	2.44	3.68	2.83	2.76	2.9	0.001472	0.05	0.06
E, Mr	.	2.47	2.74	2.86	2.76	2.71	0.001472	0.05	0.06
E, Mr	.	2.68	2.72	2.8	2.96	2.79	0.000589	0.04	0.04
E, Mr	3.16	3.06	3.03	3.22	3.03	3.1	0.000589	0.04	0.04
E, Mr	2.94	2.9	2.93	2.86	3	2.92	0.000589	0.04	0.04
E, Mr	3.21	3.27	3.17	.	.	3.22	0.002455	0.06	0.07
E, Mr	.	3.49	3.51	3.53	3.72	3.56	0.002455	0.06	0.07
E, Mr	.	4.33	4.43	4.4	4.37	4.38	0.002455	0.06	0.07
E, Mr	.	3.93	3.92	4.08	3.92	3.96	0.004229	0.06	0.08
E, Mr	.	6.94	7.91	7.55	7.56	7.49	0.004229	0.06	0.08
E, Mr	.	6.86	7.12	7.03	6.9	6.98	0.004229	0.06	0.08

Table 9. 25. 3-D Elasticity and Calcium Content Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
E, Mr	5.28	4.83	4.85	0.25	4.73	3.99	0.004229	0.06	0.08
E, Mr	.	3.98	4.23	4.06	4.23	4.12	0.001642	0.05	0.07
E, Mr	.	4.83	4.56	4.46	4.73	4.65	0.001642	0.05	0.07
E, Mr	.	5.04	5.33	5.4	4.87	5.16	0.001642	0.05	0.07
E, Mr	.	4.85	4.5	4.54	4.74	4.66	0.001642	0.05	0.07
E, Mr	.	6.92	7.12	6.97	7.54	7.14	0.002198	0.05	0.06
E, Mr	.	6.44	7.38	7.7	7.71	7.3	0.004101	0.07	0.08
E, Mr	.	2.63	2.27	2.62	2.71	2.56	0.004101	0.07	0.08
E, Mr	.	7.57	7.71	7.81	7.22	7.58	0.002911	0.06	0.07
E, Mr	.	3.33	3.35	3.36	3.36	3.35	0.002911	0.06	0.07
E, Mr	.	3.94	3.97	3.83	3.88	3.91	0.00278	0.06	0.07
E, Mr	.	3.86	3.87	3.95	3.85	3.88	0.00278	0.06	0.07
E, Mr	5.39	4.84	4.64	4.39	5.88	5.03	0.001806	0.05	0.06
E, Mr	7.95	5.87	5.86	6.4	8.2	6.86	0.001806	0.05	0.06
E, Mr	4.07	3.71	4.17	4.11	3.87	3.98	0.002904	0.02	0.03
E, Mr	6.44	6.41	7.95	5.56	8.97	7.07	0.002904	0.02	0.03
E, Mr	37.5	.	.	38.7	.	38.07	0.000879	0.09	0.14
E, Mr	.	5.01	3.63	4.05	4.06	4.18	0.002895	0.07	0.08
E, Mr	.	4.88	4.94	5.22	5.81	5.21	0.002895	0.07	0.08
E, Mr	.	5.59	6.84	5.84	8.51	6.69	0.002193	0.06	0.08
E, Mr	.	6.35	6.36	6.25	6.25	6.3	0.002193	0.06	0.08
E, Mr	.	6.83	6.48	6.81	6.88	6.75	0.002193	0.06	0.08
E, Mr	.	6.09	5.36	4.32	4.01	4.94	0.000848	0.05	0.06
E, Mr	.	4.14	4.31	3.92	3.27	3.91	0.000848	0.05	0.06
E, Mr	4.35	4.4	4.14	4.25	3.98	4.22	0.000848	0.05	0.06
E, Mr	4.77	4.99	4.66	4.15	4.26	4.56	0.002943	0.06	0.07
E, Mr	.	2.79	3.66	4.19	3.48	3.53	0.002943	0.06	0.07
E, Mr	.	3.7	3.65	4.01	3.97	3.83	0.002943	0.06	0.07
E, Mr	.	5.15	6.17	5	5.13	5.36	0.003702	0.06	0.07
E, Mr	.	5.79	6.4	6.09	6.41	6.17	0.003702	0.06	0.07
E, Mr	.	5.52	5.55	5.26	4.85	5.3	0.003702	0.06	0.07
E, Mr	.	3.32	3.93	4.56	3.66	3.87	0.003702	0.06	0.07
E, Mr	6.61	7.05	5.35	5.22	5.24	5.89	0.002601	0.03	0.04
E, Mr	.	7.62	7.23	7.83	7.45	7.53	0.002601	0.03	0.04
E, Mr	.	4.61	4.96	4.51	5.57	4.91	0.002601	0.03	0.04
E, Mr	7.28	6	5.27	7.71	6.2	6.49	0.002601	0.03	0.04
G, Miss M	1.92	1.33	1.45	1.76	2.33	1.76	0.000589	0.06	0.09
G, Miss M	.	3.05	2.83	2.9	2.91	2.92	0.000914	0.06	0.09
G, Miss M	.	.	.	.	.	.	0.000914	0.06	0.09
G, Miss M	.	3.44	3.29	3.33	3.37	3.36	0.001176	0.07	0.09
G, Miss M	.	1.06	1.13	1.14	.	1.11	0.001176	0.07	0.09
G, Miss M	.	7.48	7.49	7.84	6.91	7.43	0.001513	0.07	0.1
G, Miss M	9.19	9.3	7.34	9.14	8.28	8.65	0.001513	0.07	0.1
G, Miss M	.	8.22	8.71	9.09	9.06	8.77	0.001259	0.07	0.09
G, Miss M	.	0.55	0.51	0.57	0.52	0.54	0.001259	0.07	0.09
G, Miss M	10.7	10.8	9.94	10.5	10.4	10.47	0.001013	0.03	0.05
G, Miss M	.	10.3	11.8	11.3	9.48	10.72	0.001013	0.03	0.05
G, Miss M	56.1	48.4	45.3	48.9	55.4	50.81	0.000464	0.08	0.13
G, Miss M	.	4.85	4.38	4.36	5.77	4.84	0.00143	0.07	0.1
G, Miss M	.	3.86	4.52	2.91	3.77	3.77	0.00143	0.07	0.1

Table 9. 26. 3-D Elasticity and Calcium Content Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
G, Miss M	.	5.98	5.84	6.32	5.93	6.02	0.000987	0.05	0.08
G, Miss M	.	6.55	5.33	5.88	3.82	5.39	0.000987	0.05	0.08
G, Miss M	.	5.68	4.5	5.15	4.24	4.89	0.000987	0.05	0.08
G, Miss M	7.89	6	7.39	7.11	7.95	7.27	0.000626	0.07	0.09
G, Miss M	.	6.8	7.27	6.78	6.33	6.8	0.000626	0.07	0.09
G, Miss M	.	4.46	4.12	4.08	3.91	4.14	0.000626	0.07	0.09
G, Miss M	.	2.03	2.33	2.75	3.24	2.59	0.000356	0.05	0.06
G, Miss M	.	7.4	4.47	5.5	3.55	5.23	0.000356	0.05	0.06
G, Miss M	.	5.84	5.88	5.64	6.26	5.91	0.000356	0.05	0.06
G, Miss M	.	6.66	5.43	4.2	5.88	5.54	0.002068	0.07	0.09
G, Miss M	.	2.19	2.41	3.18	2.72	2.62	0.002068	0.07	0.09
G, Miss M	.	7.84	7.45	8.03	7.96	7.82	0.002068	0.07	0.09
G, Miss M	.	6.95	7.64	6.97	7.26	7.21	0.002068	0.07	0.09
G, Miss M	.	7.54	7.39	8	7.01	7.48	0.000801	0.03	0.04
G, Miss M	.	8.11	8.51	8.41	8.4	8.36	0.000801	0.03	0.04
G, Miss M	.	9.34	9.6	9.58	9.7	9.55	0.000801	0.03	0.04
G, Miss M	8.91	9.03	8.27	8.07	9.27	8.71	0.000801	0.03	0.04
G, Miss M	.	4.2	5.5	3.49	2.48	3.92	0.000607	0.06	0.09
G, Miss M	.	5.72	4.93	5.99	5.72	5.59	0.000884	0.06	0.09
G, Miss M	.	4.35	4.05	4.54	4.16	4.28	0.000884	0.06	0.09
G, Miss M	.	7.02	7.28	7.35	7.39	7.26	0.00079	0.07	0.1
G, Miss M	.	5.83	5.37	5.67	6.32	5.8	0.00079	0.07	0.1
G, Miss M	.	8.87	8.5	8.04	7.98	8.35	0.000753	0.07	0.09
G, Miss M	.	7.94	7.97	8.65	8.47	8.26	0.000753	0.07	0.09
G, Miss M	9.93	7.96	10.2	9.35	10	9.49	0.001112	0.07	0.1
G, Miss M	.	8.57	10.2	9.39	9.98	9.54	0.001112	0.07	0.1
G, Miss M	.	9.11	8.42	9.24	9.42	9.05	0.001189	0.07	0.1
G, Miss M	.	11.2	10.2	10.6	10.6	10.63	0.001189	0.07	0.1
G, Miss M	49.7	51.5	49.8	38	52	48.21	0	0.08	0.13
G, Miss M	.	3.74	.	1.36	1.73	2.28	0.001132	0.06	0.09
G, Miss M	.	3.84	2.69	4.57	3.75	3.71	0.001132	0.06	0.09
G, Miss M	2.99	2.47	4.05	3.18	4.28	3.4	0.000728	0.06	0.09
G, Miss M	.	1.24	3.19	3.63	4	3.01	0.000728	0.06	0.09
G, Miss M	3.87	3.88	3.62	4.06	3.82	3.85	0.000728	0.06	0.09
G, Miss M	5.54	5.45	5.78	5.44	6.25	5.69	0.000783	0.07	0.09
G, Miss M	5.74	5.71	5.58	4.14	.	5.29	0.000783	0.07	0.09
G, Miss M	5.28	5.44	4.23	4.99	5.48	5.08	0.000783	0.07	0.09
G, Miss M	.	6.07	5.58	5.86	5.76	5.82	0.001067	0.07	0.09
G, Miss M	.	5.67	4.35	5.84	5.94	5.45	0.001067	0.07	0.09
G, Miss M	.	6.26	6.8	6.5	6.31	6.47	0.001067	0.07	0.09
G, Miss M	7.69	7.89	9.36	.	.	8.31	0.000524	0.07	0.09
G, Miss M	.	7.12	7.03	7.14	.	7.1	0.000524	0.07	0.09
G, Miss M	8.83	7.94	0.21	7.33	.	6.08	0.000524	0.07	0.09
G, Miss M	9.05	7.1	8.74	.	.	8.3	0.000524	0.07	0.09
G, Miss M	5.87	6.85	6.05	.	.	6.25	0.00087	0.06	0.08
G, Miss M	.	8.62	8.11	.	.	8.36	0.00087	0.06	0.08
G, Miss M	.	8.53	8.27	.	.	8.4	0.00087	0.06	0.08
G, Miss M	.	8.41	.	.	.	8.41	0.00087	0.06	0.08
G, Miss M	4.81	4.95	.	.	.	4.88	0.000883	0.06	0.08
G, Miss M	7.28	6.14	.	.	.	6.71	0.001581	0.07	0.1

Table 9. 27. 3-D Elasticity and Calcium Content Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
G, Miss M	.	6.76	6.81	.	.	6.78	0.001581	0.07	0.1
G, Miss M	.	7.26	6.5	.	.	6.88	0.000523	0.06	0.09
G, Miss M	7.24	7.27	.	.	.	7.26	0.000523	0.06	0.09
G, Miss M	9.78	.	.	.	.	9.78	0.001546	0.07	0.1
G, Miss M	11	8.26	7.61	.	.	8.95	0.001546	0.07	0.1
G, Miss M	10.3	.	10.1	.	.	10.18	0.001158	0.07	0.1
G, Miss M	12.2	9.84	10.7	.	.	10.92	0.001158	0.07	0.1
G, Miss M	6.92	6.14	.	.	.	6.53	0.001378	0.02	0.02
G, Miss M	11	8.62	6.43	.	.	8.68	0.001378	0.02	0.02
G, Miss M	32.5	39.9	.	.	.	36.18	0.000718	0.09	0.13
G, Miss M	.	2.96	2.98	.	.	2.97	0	0.04	0.06
G, Miss M	.	2.94	3.01	.	.	2.98	0	0.04	0.06
G, Miss M	2.51	5.03	2.94	.	.	3.5	0	0.05	0.08
G, Miss M	4.96	5.16	5.02	.	.	5.05	0	0.05	0.08
G, Miss M	5.52	5.13	5.44	.	.	5.36	0	0.05	0.08
G, Miss M	6.24	5.45	4.83	.	.	5.51	0.000516	0.06	0.08
G, Miss M	6.34	4.98	5.66	.	.	5.66	0.000516	0.06	0.08
G, Miss M	5.98	5.07	5.25	.	.	5.43	0.000516	0.06	0.08
G, Miss M	6.97	5.67	5.44	.	.	6.03	0.000905	0.07	0.1
G, Miss M	7.19	6.09	6.33	.	.	6.54	0.000905	0.07	0.1
G, Miss M	6.89	5.91	5.93	.	.	6.24	0.000905	0.07	0.1
G, Miss M	7.28	5.87	5.94	.	.	6.36	0.000907	0.07	0.1
G, Miss M	7.72	6.32	6.26	.	.	6.77	0.000907	0.07	0.1
G, Miss M	7.35	6.76	6.06	.	.	6.72	0.000907	0.07	0.1
G, Miss M	7.21	6.3	6.26	.	.	6.59	0.000907	0.07	0.1
G, Miss M	8.67	8.63	6.91	.	.	8.07	0.000558	0.05	0.06
G, Miss M	7.7	5.46	5.73	.	.	6.29	0.000558	0.05	0.06
G, Miss M	7.71	6.01	4.06	.	.	5.93	0.000558	0.05	0.06
G, Miss M	6.8	4.95	4.65	.	.	5.47	0.000558	0.05	0.06
G, Miss M	1.09	1.17	0.9	.	.	1.05	0.000216	0.06	0.09
G, Miss M	2.51	2.34	1.97	.	.	2.27	0.001182	0.06	0.09
G, Miss M	4.61	3.96	4.23	.	.	4.27	0.001182	0.06	0.09
G, Miss M	2.81	2.58	2.76	.	.	2.72	0.000271	0.07	0.1
G, Miss M	5.73	5.36	5.09	.	.	5.39	0.000271	0.07	0.1
G, Miss M	5.18	4.29	4.09	.	.	4.52	0.000855	0.07	0.1
G, Miss M	7.38	6.95	6.23	.	.	6.85	0.000855	0.07	0.1
G, Miss M	5.96	5.27	5.55	.	.	5.59	0.00089	0.07	0.1
G, Miss M	9.23	7.56	8.57	.	.	8.45	0.00089	0.07	0.1
G, Miss M	7.32	5.98	4.86	.	.	6.05	0.001152	0.06	0.08
G, Miss M	.	7.16	7.19	.	.	7.17	0.001152	0.06	0.08
G, Miss M	39.5	39.7	35.5	.	.	38.22	0.000405	0.09	0.13
G, Miss M	6.15	3.31	5.26	.	.	4.91	0.000579	0.06	0.09
G, Miss M	5.12	2.1	2.97	.	.	3.4	0.000579	0.06	0.09
G, Miss M	5.24	4.22	4.48	.	.	4.65	0.000604	0.05	0.08
G, Miss M	4.91	4.67	4.29	.	.	4.62	0.000604	0.05	0.08
G, Miss M	5.12	4.67	4.55	.	.	4.78	0.000604	0.05	0.08
G, Miss M	6.87	6.51	5.08	.	.	6.15	0.000379	0.07	0.1
G, Miss M	5.09	4.42	3.93	.	.	4.48	0.000379	0.07	0.1
G, Miss M	6.23	5.38	6.31	.	.	5.97	0.000379	0.07	0.1
G, Miss M	7.3	6.44	0.29	.	.	4.68	0.000518	0.07	0.1

Table 9. 28. 3-D Elasticity and Calcium Content Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
G, Miss M	4.07	4.29	4	.	.	4.12	0.000518	0.07	0.1
G, Miss M	6.4	4.86	4.51	.	.	5.26	0.000518	0.07	0.1
G, Miss M	8.82	7.33	7.21	.	.	7.78	0.000779	0.06	0.1
G, Miss M	7.58	6.71	8.1	.	.	7.46	0.000779	0.06	0.1
G, Miss M	10.1	7.76	8.05	.	.	8.65	0.000779	0.06	0.1
G, Miss M	6.89	7.34	6.73	.	.	6.99	0.000779	0.06	0.1
G, Miss M	10.4	8.7	8.35	.	.	9.16	0	0.05	0.07
G, Miss M	8.61	8.07	6.91	.	.	7.86	0	0.05	0.07
G, Miss M	7.54	4.83	5.34	.	.	5.9	0	0.05	0.07
G, Miss M	3.74	4.55	5.59	.	.	4.63	0	0.05	0.07
L, Miss Yi Mei	3.98	5.97	4.82	.	.	4.92	0.001218	0.06	0.09
L, Miss Yi Mei	8.2	6.32	7.24	.	.	7.25	0.000229	0.04	0.07
L, Miss Yi Mei	5.32	2.56	2.42	.	.	3.43	0.000229	0.04	0.07
L, Miss Yi Mei	6.62	6.49	5.43	.	.	6.18	0.001878	0.07	0.1
L, Miss Yi Mei	9.05	8.28	7.34	.	.	8.22	0.001878	0.07	0.1
L, Miss Yi Mei	10.1	7.71	7.38	.	.	8.4	0.001232	0.07	0.1
L, Miss Yi Mei	7.35	6.09	6.79	.	.	6.74	0.001232	0.07	0.1
L, Miss Yi Mei	9.15	6.83	4.06	.	.	6.68	0.000532	0.03	0.04
L, Miss Yi Mei	10.6	9.51	9.62	.	.	9.91	0.000532	0.03	0.04
L, Miss Yi Mei	.	5.16	5.65	.	.	5.4	0.000883	0.05	0.08
L, Miss Yi Mei	5.46	5.95	.	.	.	5.71	0.000883	0.05	0.08
L, Miss Yi Mei	30.4	52.4	31.4	.	.	38.06	0.000459	0.08	0.13
L, Miss Yi Mei	4.17	3.47	2.68	.	.	3.44	0.001393	0.06	0.09
L, Miss Yi Mei	5.13	3.41	5.38	.	.	4.64	0.001393	0.06	0.09
L, Miss Yi Mei	6.45	5.27	5.22	.	.	5.65	0.000854	0.06	0.09
L, Miss Yi Mei	5.56	4.9	5.03	.	.	5.16	0.000854	0.06	0.09
L, Miss Yi Mei	3.87	2.49	3.9	.	.	3.42	0.000854	0.06	0.09
L, Miss Yi Mei	6.98	6.36	5.64	.	.	6.33	0.000188	0.06	0.1
L, Miss Yi Mei	5.64	5.62	5.93	.	.	5.73	0.000188	0.06	0.1
L, Miss Yi Mei	4.27	2.47	2.49	.	.	3.08	0.000188	0.06	0.1
L, Miss Yi Mei	3.86	4.03	.	.	.	3.95	0.000261	0.06	0.09
L, Miss Yi Mei	6.22	5.86	6.73	.	.	6.27	0.000261	0.06	0.09
L, Miss Yi Mei	7.54	5.4	5.77	.	.	6.24	0.000261	0.06	0.09
L, Miss Yi Mei	3.76	2.5	3.78	.	.	3.35	0.000371	0.02	0.02
L, Miss Yi Mei	0.8	1.02	0.98	.	.	0.94	0.000371	0.02	0.02
L, Miss Yi Mei	2.64	1.71	1.62	.	.	1.99	0.000371	0.02	0.02
L, Miss Yi Mei	3.81	3.22	3.3	.	.	3.44	0.000371	0.02	0.02
L, Miss Yi Mei	5.86	5.61	4.89	.	.	5.45	0	0.05	0.08
L, Miss Yi Mei	2.19	1.71	1.34	.	.	1.74	0	0.05	0.08
L, Miss Yi Mei	2.32	1.59	1.46	.	.	1.79	0	0.05	0.08
L, Miss Yi Mei	3.11	2.06	2.11	.	.	2.43	0	0.05	0.08
L, Miss Yi Mei	5.87	5.59	5.22	.	.	5.56	0.000692	0.04	0.06
L, Miss Yi Mei	11	8.31	7.41	.	.	8.92	0.00097	0.07	0.1
L, Miss Yi Mei	3.7	3.25	3.22	.	.	3.39	0.00097	0.07	0.1
L, Miss Yi Mei	10.7	8.29	8.3	.	.	9.1	0.001606	0.07	0.11
L, Miss Yi Mei	4.42	3.94	3.73	.	.	4.03	0.001606	0.07	0.11
L, Miss Yi Mei	10.2	7.73	8.33	.	.	8.74	0.002011	0.07	0.1
L, Miss Yi Mei	5.53	5.29	4.24	.	.	5.02	0.002011	0.07	0.1
L, Miss Yi Mei	6.33	6.33	6.23	.	.	6.3	0.000337	0.01	0.01
L, Miss Yi Mei	5.17	5.19	5.07	.	.	5.14	0.000337	0.01	0.01

Table 9. 29. 3-D Elasticity and Calcium Content Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
L, Miss Yi Mei	8.19	5.7	8.19	.	.	7.36	0.001563	0.06	0.09
L, Miss Yi Mei	4.39	4.01	4.81	.	.	4.4	0.001563	0.06	0.09
L, Miss Yi Mei	64	51.3	47.8	.	.	54.37	0.000333	0.09	0.14
L, Miss Yi Mei	5.05	8.69	6.54	.	.	6.76	0.002347	0.07	0.1
L, Miss Yi Mei	6.81	5.66	6.18	.	.	6.22	0.002347	0.07	0.1
L, Miss Yi Mei	.	5.74	5.92	.	.	5.83	0	0.03	0.05
L, Miss Yi Mei	6.32	5.77	6.75	.	.	6.28	0	0.03	0.05
L, Miss Yi Mei	8.14	4.74	6.21	.	.	6.36	0	0.03	0.05
L, Miss Yi Mei	9.54	4.7	8.22	.	.	7.49	0	0.03	0.04
L, Miss Yi Mei	6.81	5.24	5.72	.	.	5.93	0	0.03	0.04
L, Miss Yi Mei	6.19	5.55	4.97	.	.	5.57	0	0.03	0.04
L, Miss Yi Mei	6.56	6.19	4.63	.	.	5.79	0.001521	0.07	0.11
L, Miss Yi Mei	5.9	5.5	3.44	.	.	4.94	0.001521	0.07	0.11
L, Miss Yi Mei	4.93	4.35	4.2	.	.	4.49	0.001521	0.07	0.11
L, Miss Yi Mei	7.01	6.49	5.04	.	.	6.18	0.001683	0.07	0.1
L, Miss Yi Mei	7.11	6.26	6.47	.	.	6.62	0.001683	0.07	0.1
L, Miss Yi Mei	8.02	7.25	7.58	.	.	7.62	0.001683	0.07	0.1
L, Miss Yi Mei	7.72	6.88	7.75	.	.	7.45	0.001683	0.07	0.1
L, Miss Yi Mei	.	4.91	6.13	.	.	5.52	0.000878	0	0
L, Miss Yi Mei	8.24	7.32	7.98	.	.	7.85	0.000878	0	0
L, Miss Yi Mei	5.73	3.8	5.33	.	.	4.95	0.000878	0	0
L, Miss Yi Mei	9.86	.	11.3	.	.	10.57	0.000878	0	0
L, Miss Yi Mei	.	.	.	.	.	.	0.000796	0.05	0.08
L, Miss Yi Mei	8.18	8.09	5.51	.	.	7.26	0.001121	0.05	0.08
L, Miss Yi Mei	9.61	7.59	3.36	.	.	6.85	0.001121	0.05	0.08
L, Miss Yi Mei	4.79	5.29	7.16	.	.	5.75	0.000591	0.02	0.03
L, Miss Yi Mei	5.95	6.97	5.1	.	.	6.01	0.000591	0.02	0.03
L, Miss Yi Mei	11.2	7.15	8.41	.	.	8.93	0.000835	0.02	0.03
L, Miss Yi Mei	9.53	9.27	9.89	.	.	9.57	0.000835	0.02	0.03
L, Miss Yi Mei	14.1	10.7	10.8	.	.	11.84	0.00247	0.07	0.1
L, Miss Yi Mei	7.52	4.68	5.2	.	.	5.8	0.00247	0.07	0.1
L, Miss Yi Mei	11.3	7.98	10.5	.	.	9.94	0.002624	0.04	0.06
L, Miss Yi Mei	12.2	11	11.8	.	.	11.67	0.002624	0.04	0.06
L, Miss Yi Mei	51.4	49	39.5	.	.	46.62	0.000222	0.09	0.14
L, Miss Yi Mei	3.46	2.09	3	.	.	2.85	0.000478	0	0
L, Miss Yi Mei	4.56	4.31	3.48	.	.	4.12	0.000478	0	0
L, Miss Yi Mei	4.46	5.15	5.82	.	.	5.14	0.000116	0.05	0.08
L, Miss Yi Mei	2.67	3.48	2.03	.	.	2.73	0.000116	0.05	0.08
L, Miss Yi Mei	4.27	5.24	4.65	.	.	4.72	0.000116	0.05	0.08
L, Miss Yi Mei	5.81	5.39	5.42	.	.	5.54	0.000708	0.05	0.06
L, Miss Yi Mei	5.88	5.13	3.92	.	.	4.97	0.000708	0.05	0.06
L, Miss Yi Mei	7.98	4	6.47	.	.	6.15	0.000708	0.05	0.06
L, Miss Yi Mei	5.93	5.25	5.48	.	.	5.55	0.001567	0.06	0.08
L, Miss Yi Mei	5.58	4.63	5.44	.	.	5.22	0.001567	0.06	0.08
L, Miss Yi Mei	5.79	4.81	5.15	.	.	5.25	0.001567	0.06	0.08
L, Miss Yi Mei	6.49	5.9	5.9	.	.	6.1	0.001548	0.06	0.09
L, Miss Yi Mei	8.58	6.05	5.99	.	.	6.87	0.001548	0.06	0.09
L, Miss Yi Mei	7.46	5	5.63	.	.	6.03	0.001548	0.06	0.09
L, Miss Yi Mei	6.84	0.38	5.81	.	.	4.35	0.001548	0.06	0.09
L, Miss Yi Mei	4.09	2.62	2.61	.	.	3.11	0.001486	0	0.01

Table 9. 30. 3-D Elasticity and Calcium Content Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
L, Miss Yi Mei	7.12	5.2	6.36	.	.	6.23	0.001486	0	0.01
L, Miss Yi Mei	10.8	8.44	6.65	.	.	8.63	0.001486	0	0.01
L, Miss Yi Mei	7.43	5.4	5.97	.	.	6.27	0.001486	0	0.01
L, Miss Yi Mei	8.17	5.39	2.36	.	.	5.31	0	0.04	0.06
L, Miss Yi Mei	4.96	3.61	4.85	.	.	4.47	0.000821	0.06	0.08
L, Miss Yi Mei	8.6	6.24	6.36	.	.	7.07	0.000821	0.06	0.08
L, Miss Yi Mei	8.89	7.37	6.8	.	.	7.68	0.001838	0.06	0.08
L, Miss Yi Mei	7.94	7.53	7.72	.	.	7.73	0.001838	0.06	0.08
L, Miss Yi Mei	11.4	9.13	9.66	.	.	10.07	0.002306	0.07	0.1
L, Miss Yi Mei	10.4	9.96	.	.	.	10.18	0.002306	0.07	0.1
L, Miss Yi Mei	11.3	8.02	9.3	.	.	9.54	0.000837	0.05	0.06
L, Miss Yi Mei	12.9	9.39	9.09	.	.	10.47	0.000837	0.05	0.06
L, Miss Yi Mei	2.22	1.76	1.37	.	.	1.79	0.000293	0.03	0.04
L, Miss Yi Mei	1.31	1.51	0.98	.	.	1.27	0.000293	0.03	0.04
L, Miss Yi Mei	51.6	54.5	57.7	.	.	54.61	0.000304	0.08	0.13
L, Miss Yi Mei	.	4.21	3	.	.	3.6	0.001409	0.03	0.04
L, Miss Yi Mei	6.98	4.32	1.95	.	.	4.42	0.001409	0.03	0.04
L, Miss Yi Mei	7.71	6.24	5.63	.	.	6.53	0.00195	0.05	0.07
L, Miss Yi Mei	7.8	4.96	7.59	.	.	6.78	0.00195	0.05	0.07
L, Miss Yi Mei	8.12	5.2	4.38	.	.	5.9	0.00195	0.05	0.07
L, Miss Yi Mei	6.6	5.65	5.39	.	.	5.88	0.001388	0.06	0.08
L, Miss Yi Mei	7.07	5.98	5.7	.	.	6.25	0.001388	0.06	0.08
L, Miss Yi Mei	6.8	5.9	5.35	.	.	6.02	0.001388	0.06	0.08
L, Miss Yi Mei	10	4.88	7.21	.	.	7.38	0.000336	0.03	0.05
L, Miss Yi Mei	4.91	6.25	6.53	.	.	5.9	0.000336	0.03	0.05
L, Miss Yi Mei	9.42	7.48	7.78	.	.	8.23	0.000336	0.03	0.05
L, Miss Yi Mei	3.37	3.34	2.65	.	.	3.12	0	0.03	0.05
L, Miss Yi Mei	3.73	2.81	3.43	.	.	3.32	0	0.03	0.05
L, Miss Yi Mei	4.66	3.74	3.33	.	.	3.91	0	0.03	0.05
L, Miss Yi Mei	4.44	3.77	4.06	.	.	4.09	0	0.03	0.05
L, Miss Yi Mei	3.1	.	1.38	.	.	2.24	0.00041	0	0.01
L, Miss Yi Mei	1.99	2.31	2.06	.	.	2.12	0.00041	0	0.01
L, Miss Yi Mei	2.5	1.82	1.42	.	.	1.91	0.00041	0	0.01
L, Miss Yi Mei	5.62	2.26	3.71	.	.	3.86	0.00041	0	0.01
V, Miss M	5.26	4.3	5.8	.	.	5.12	0.00047	0.03	0.05
V, Miss M	8.2	6.43	7.17	.	.	7.27	0.000711	0.05	0.08
V, Miss M	4.81	4.29	4.36	.	.	4.49	0.000711	0.05	0.08
V, Miss M	9.99	5.42	7.29	.	.	7.57	0.001183	0.07	0.1
V, Miss M	5.52	4.69	4.8	.	.	5	0.001183	0.07	0.1
V, Miss M	9.66	7.22	6.48	.	.	7.79	0.0003	0.07	0.1
V, Miss M	6.79	5.91	5.73	.	.	6.14	0.0003	0.07	0.1
V, Miss M	11.8	9.58	10.1	.	.	10.47	0.00114	0.07	0.1
V, Miss M	6.74	6.6	6.67	.	.	6.67	0.00114	0.07	0.1
V, Miss M	13.6	9.71	10.4	.	.	11.23	0.000306	0.07	0.1
V, Miss M	6.6	5.01	6.74	.	.	6.12	0.000306	0.07	0.1
V, Miss M	22	48.1	27.2	.	.	32.47	0.000281	0.09	0.13
V, Miss M	4.72	5.81	7.37	.	.	5.97	0.000232	0.06	0.08
V, Miss M	5.74	4.81	3.94	.	.	4.83	0.000232	0.06	0.08
V, Miss M	10.1	7.79	8.21	.	.	8.69	0.001226	0.07	0.1
V, Miss M	4.19	2.45	4.45	.	.	3.69	0.001226	0.07	0.1

Table 9. 31. 3-D Elasticity and Calcium Content Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
V, Miss M	7.77	7.77	.	.	.	7.77	0.001226	0.07	0.1
V, Miss M	9.82	7.12	7.57	.	.	8.17	0.001495	0.07	0.1
V, Miss M	.	.	.	.	.	.	0.001495	0.07	0.1
V, Miss M	7.18	5.62	5.9	.	.	6.23	0.001495	0.07	0.1
V, Miss M	9.99	7.88	8.46	.	.	8.78	0.001344	0.07	0.1
V, Miss M	.	.	.	.	.	.	0.001344	0.07	0.1
V, Miss M	4.08	3.14	2.69	.	.	3.3	0.001344	0.07	0.1
V, Miss M	11	9.02	9.24	.	.	9.75	0.000657	0.03	0.05
V, Miss M	10.4	10.1	9.43	.	.	9.98	0.000657	0.03	0.05
V, Miss M	13.5	8.5	8.11	.	.	10.03	0.000657	0.03	0.05
V, Miss M	10.4	9.18	8.44	.	.	9.36	0.000657	0.03	0.05
V, Miss M	10.8	8.69	8.39	.	.	9.29	0.000818	0.01	0.01
V, Miss M	7.03	6.1	6.85	.	.	6.66	0.000818	0.01	0.01
V, Miss M	12.9	8.03	9.38	.	.	10.11	0.000818	0.01	0.01
V, Miss M	12.8	10.1	10	.	.	11	0.000818	0.01	0.01
V, Miss M	4.78	2.93	3.7	.	.	3.81	0.001443	0.05	0.07
V, Miss M	2.81	3.22	1.41	.	.	2.48	0.000273	0	0.01
V, Miss M	4.75	3.98	4.78	.	.	4.5	0.000273	0	0.01
V, Miss M	3.05	2.18	3.31	.	.	2.85	0.000757	0	0.01
V, Miss M	6.62	5.69	5.47	.	.	5.93	0.000757	0	0.01
V, Miss M	9.98	8.97	8.98	.	.	9.31	0.001715	0.07	0.1
V, Miss M	8.65	6.94	5.27	.	.	6.95	0.001715	0.07	0.1
V, Miss M	9.65	8.1	9.14	.	.	8.96	0.000617	0.07	0.1
V, Miss M	8.45	7.79	7.62	.	.	7.95	0.000617	0.07	0.1
V, Miss M	8.89	7.03	7.56	.	.	7.83	0.001251	0.07	0.1
V, Miss M	9.09	7.57	8.05	.	.	8.24	0.001251	0.07	0.1
V, Miss M	27.7	.	46.4	.	.	37.07	0.000575	0.08	0.13
V, Miss M	3.44	2.72	3	.	.	3.05	0.00083	0.07	0.1
V, Miss M	7.53	4.32	4.4	.	.	5.42	0.00083	0.07	0.1
V, Miss M	3.98	3.79	3.53	.	.	3.77	0.001042	0.05	0.06
V, Miss M	.	.	.	.	.	.	0.001042	0.05	0.06
V, Miss M	8.7	4.44	5.71	.	.	6.28	0.001042	0.05	0.06
V, Miss M	5.61	4.75	3.96	.	.	4.77	0.00064	0.06	0.08
V, Miss M	.	.	.	.	.	.	0.00064	0.06	0.08
V, Miss M	7.93	7.08	7.06	.	.	7.36	0.00064	0.06	0.08
V, Miss M	.	6.39	6.28	.	.	6.33	0.001402	0.07	0.1
V, Miss M	.	.	.	.	.	.	0.001402	0.07	0.1
V, Miss M	8.63	6.78	8.36	.	.	7.92	0.001402	0.07	0.1
V, Miss M	8.19	6.37	6.4	.	.	6.99	0.000528	0.07	0.1
V, Miss M	7.56	7.05	6.88	.	.	7.16	0.000528	0.07	0.1
V, Miss M	.	9.07	10.2	.	.	9.64	0.000528	0.07	0.1
V, Miss M	10.6	8	7.61	.	.	8.73	0.000528	0.07	0.1
V, Miss M	8.42	6.48	7.37	.	.	7.42	0.001522	0.07	0.1
V, Miss M	8.39	7.9	7.44	.	.	7.91	0.001522	0.07	0.1
V, Miss M	10.9	8.36	10.7	.	.	9.99	0.001522	0.07	0.1
V, Miss M	11.4	8.4	8.93	.	.	9.59	0.001522	0.07	0.1
V, Miss M	4.85	5.42	6.83	.	.	5.7	0.000452	0.03	0.05
V, Miss M	4.89	6.84	7.44	.	.	6.39	0.000349	0.07	0.1
V, Miss M	1.86	5.48	3.23	.	.	3.52	0.000349	0.07	0.1
V, Miss M	10.5	8.62	8.14	.	.	9.09	0	0.07	0.1

Table 9. 32. 3-D Elasticity and Calcium Content Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
V, Miss M	13.9	8	7.91	.	.	9.95	0	0.07	0.1
V, Miss M	9.93	9.59	9.49	.	.	9.67	0.000783	0.07	0.11
V, Miss M	9.72	8.34	9.56	.	.	9.21	0.000783	0.07	0.11
V, Miss M	10.7	9.63	8.97	.	.	9.78	0.001131	0.07	0.1
V, Miss M	11.2	8.85	9.11	.	.	9.71	0.001131	0.07	0.1
V, Miss M	12	9.58	10.1	.	.	10.57	0.000663	0.04	0.06
V, Miss M	10.8	9.17	6.89	.	.	8.96	0.000663	0.04	0.06
V, Miss M	76	48	56.9	.	.	60.32	0	0.09	0.13
V, Miss M	4.39	4.28	4.34	.	.	4.34	0.00046	0.06	0.09
V, Miss M	.	4.37	5.97	.	.	5.17	0.00046	0.06	0.09
V, Miss M	3.81	3.17	3.37	.	.	3.45	0.00036	0.06	0.08
V, Miss M	.	.	.	.	.	.	0.00036	0.06	0.08
V, Miss M	8.23	8.31	8.13	.	.	8.22	0.00036	0.06	0.08
V, Miss M	1.75	4.02	1.52	.	.	2.43	0	0.06	0.09
V, Miss M	.	.	.	.	.	.	0	0.06	0.09
V, Miss M	8.86	7.6	9.01	.	.	8.49	0	0.06	0.09
V, Miss M	10.6	9.34	8.5	.	.	9.48	0	0.07	0.1
V, Miss M	.	.	.	.	.	.	0	0.07	0.1
V, Miss M	13.1	8.14	9.81	.	.	10.34	0	0.07	0.1
V, Miss M	16.3	9.89	8.82	.	.	11.68	0.000225	0.04	0.06
V, Miss M	13.1	9.55	10.6	.	.	11.09	0.000225	0.04	0.06
V, Miss M	11.8	10.6	10.2	.	.	10.87	0.000225	0.04	0.06
V, Miss M	11.6	9.37	9.71	.	.	10.22	0.000225	0.04	0.06
V, Miss M	10.6	9.19	6.88	.	.	8.89	0	0.04	0.06
V, Miss M	10.1	8.53	9.13	.	.	9.27	0	0.04	0.06
V, Miss M	10.9	9.29	9.25	.	.	9.82	0	0.04	0.06
V, Miss M	11	7.66	8.63	.	.	9.1	0	0.04	0.06
V, Miss M	5.57	4.57	5.29	.	.	5.14	0.00087	0.07	0.1
V, Miss M	7.68	5.5	5.45	.	.	6.21	0.000522	0.01	0.01
V, Miss M	6.49	5.91	5.54	.	.	5.98	0.000522	0.01	0.01
V, Miss M	7.66	6.42	7.1	.	.	7.06	0	0.07	0.1
V, Miss M	7.17	6.13	6.44	.	.	6.58	0	0.07	0.1
V, Miss M	9.53	7.12	8.44	.	.	8.36	0.000621	0.07	0.1
V, Miss M	10.8	6.86	8.85	.	.	8.85	0.000621	0.07	0.1
V, Miss M	9.81	9.77	9.57	.	.	9.72	0.000556	0.07	0.1
V, Miss M	10.6	7.75	8.11	.	.	8.82	0.000556	0.07	0.1
V, Miss M	10.7	8.42	10.1	.	.	9.75	0.000797	0.07	0.1
V, Miss M	10.6	9.04	7.12	.	.	8.91	0.000797	0.07	0.1
V, Miss M	67.1	67.1	67.1	.	.	67.12	0.000222	0.09	0.14
V, Miss M	5	2.37	7.44	.	.	4.94	0.000454	0	0
V, Miss M	7.85	5.23	5.88	.	.	6.32	0.000454	0	0
V, Miss M	11.5	6.98	6.83	.	.	8.43	0	0.02	0.03
V, Miss M	.	.	.	.	.	.	0	0.02	0.03
V, Miss M	6.93	4.62	6.6	.	.	6.05	0	0.02	0.03
V, Miss M	9.73	6.62	7.65	.	.	8	0	0.03	0.04
V, Miss M	.	.	.	.	.	.	0	0.03	0.04
V, Miss M	6.64	5.99	5.57	.	.	6.07	0	0.03	0.04
V, Miss M	11.5	8.56	8.5	.	.	9.51	0.000565	0.07	0.1
V, Miss M	.	.	.	.	.	.	0.000565	0.07	0.1
V, Miss M	11.6	8.76	9.9	.	.	10.09	0.000565	0.07	0.1

Table 9. 33. 3-D Elasticity and Calcium Content Data Summary.

Patient	E1	E2	E3	E4	E5	Aver. E.	F	PO4	Ca2
V, Miss M	12.6	9.9	8.9	.	.	10.48	0.001099	0.07	0.1
V, Miss M	15.1	8.95	9.67	.	.	11.25	0.001099	0.07	0.1
V, Miss M	12	10.5	10.2	.	.	10.91	0.001099	0.07	0.1
V, Miss M	8.43	9.04	10.7	.	.	9.39	0.001099	0.07	0.1
V, Miss M	.	9.7	10.2	.	.	9.94	0.001377	0.06	0.1
V, Miss M	12.6	10.5	9.72	.	.	10.96	0.001377	0.06	0.1
V, Miss M	10.8	10.8	10.3	.	.	10.63	0.001377	0.06	0.1
V, Miss M	13.3	9.6	11.8	.	.	11.55	0.001377	0.06	0.1

Table 9. 34. 3-D Elasticity and Calcium Content Data Summary.

9.4 3-D Statistics

Between-Subjects Factors

		Value Label	N
Sex	1.00	Male	119
	2.00	Female	405
Patient	1.00	Genc, Mr M	60
	2.00	Guo, Miss Si Y	58
	3.00	Edlbi, Mr	59
	4.00	Gahli, Miss M	119
	5.00	Lin, Miss Yi Mei	119
	6.00	Vernon, Miss M	109
Side	1.00	Right	231
	2.00	Left	293
Top/Bottom	1.00	Upper	227
	2.00	Lower	297
LAYER	1		53
	2		85
	3		86
	4		84
	5		108
	6		108
Surface	1.00	Buccal	96
	2.00	Mesial	165
	3.00	Lingual	98
	4.00	Distal	165

Table 9. 35. Table 9.5.11. A summary of the variables tested in the 3-D analysis. (N= number of tests analyzed).

Multivariate Tests[c]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.607	378.9[a]	2.000	491.0	.000
	Wilks' Lambda	.393	378.9[a]	2.000	491.0	.000
	Hotelling's Trace	1.543	378.9[a]	2.000	491.0	.000
	Roy's Largest Root	1.543	378.9[a]	2.000	491.0	.000
SEX	Pillai's Trace	.083	22.32[a]	2.000	491.0	.000
	Wilks' Lambda	.917	22.32[a]	2.000	491.0	.000
	Hotelling's Trace	.091	22.32[a]	2.000	491.0	.000
	Roy's Largest Root	.091	22.32[a]	2.000	491.0	.000
PATIENT(SEX)	Pillai's Trace	.166	11.12	8.000	984.0	.000
	Wilks' Lambda	.838	11.38[a]	8.000	982.0	.000
	Hotelling's Trace	.190	11.63	8.000	980.0	.000
	Roy's Largest Root	.166	20.37[b]	4.000	492.0	.000
SIDE	Pillai's Trace	.014	3.445[a]	2.000	491.0	.033
	Wilks' Lambda	.986	3.445[a]	2.000	491.0	.033
	Hotelling's Trace	.014	3.445[a]	2.000	491.0	.033
	Roy's Largest Root	.014	3.445[a]	2.000	491.0	.033
TOP.BOT	Pillai's Trace	.004	1.089[a]	2.000	491.0	.337
	Wilks' Lambda	.996	1.089[a]	2.000	491.0	.337
	Hotelling's Trace	.004	1.089[a]	2.000	491.0	.337
	Roy's Largest Root	.004	1.089[a]	2.000	491.0	.337
LAYER(SURFACE)	Pillai's Trace	.412	6.385	40.000	984.0	.000
	Wilks' Lambda	.620	6.618[a]	40.000	982.0	.000
	Hotelling's Trace	.559	6.853	40.000	980.0	.000
	Roy's Largest Root	.440	10.83[b]	20.000	492.0	.000
SURFACE	Pillai's Trace	.102	8.805	6.000	984.0	.000
	Wilks' Lambda	.900	8.859[a]	6.000	982.0	.000
	Hotelling's Trace	.109	8.912	6.000	980.0	.000
	Roy's Largest Root	.085	13.93[b]	3.000	492.0	.000
CA2	Pillai's Trace	.016	4.008[a]	2.000	491.0	.019
	Wilks' Lambda	.984	4.008[a]	2.000	491.0	.019
	Hotelling's Trace	.016	4.008[a]	2.000	491.0	.019
	Roy's Largest Root	.016	4.008[a]	2.000	491.0	.019

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c. Design: Intercept+SEX+PATIENT(SEX)+SIDE+TOP.BOT+LAYER(SURFACE)+SURFACE+CA2

Table 9. 36. Table 9.5.12. A summary of the interrelationships and statistical significance between the different variables investigated.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	ave.h	2.529[a]	31	.082	10.98	.000
	AVE.E	1262[b]	31	40.70	10.35	.000
Intercept	ave.h	5.640	1	5.640	759.3	.000
	AVE.E	1365	1	1365	347.2	.000
SEX	ave.h	.065	1	.065	8.780	.003
	AVE.E	23.147	1	23.15	5.888	.016
PATIENT(SEX)	ave.h	.605	4	.151	20.36	.000
	AVE.E	164.4	4	41.09	10.45	.000
SIDE	ave.h	.013	1	.013	1.795	.181
	AVE.E	26.011	1	26.01	6.617	.010
TOP.BOT	ave.h	.016	1	.016	2.110	.147
	AVE.E	5.463	1	5.463	1.390	.239
LAYER(SURFACE)	ave.h	1.536	20	.077	10.34	.000
	AVE.E	666.2	20	33.31	8.473	.000
SURFACE	ave.h	.092	3	.031	4.127	.007
	AVE.E	96.022	3	32.01	8.142	.000
CA2	ave.h	.046	1	.046	6.227	.013
	AVE.E	28.140	1	28.14	7.158	.008
Error	ave.h	3.655	492	.007		
	AVE.E	1934	492	3.931		
Total	ave.h	75.689	524			
	AVE.E	22869	524			
Corrected Total	ave.h	6.183	523			
	AVE.E	3196	523			

a. R Squared = .409 (Adjusted R Squared = .372)

b. R Squared = .395 (Adjusted R Squared = .357)

Table 9. 37. Table 9.5.13. The statistical significance and breakdown of the factors hardness and elasticity with respect to the different variables.

Paired Samples Statistics

		Mean	N	sd	sem
Pair 1	ave.h	.4137	539	.3281	.0141
	AVE.E	7.283	539	7.45	.3211
Pair 2	ave.h	.4128	541	.3278	.0141
	CA2	.0722	541	.029	.0012
Pair 3	PO4	.0531	496	.019	.0009
	CA2	.0750	496	.029	.0013
Pair 4	AVE.E	7.283	539	7.45	.3211
	CA2	.0722	539	.029	.0012

Table 9. 38. Paired T-Test show simple linear correlations between Hardness, Elasticity and Calcium.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	ave.h & AVE.E	539	.946	.000
Pair 2	ave.h & CA2	541	.348	.000
Pair 3	PO4 & CA2	496	.983	.000
Pair 4	AVE.E & CA2	539	.371	.000

Table 9. 39. Tables. 9.5.21 and 9.5.22. Paired T-Test show simple linear correlations between Hardness, Elasticity and Calcium.

Report

ave.h

position	Mean	N	SD
1.00	.1721	2	.0840
2.00	.3132	2	.0020
3.00	.3325	2	.0825
4.00	.5306	2	.0767
5.00	.4545	2	.2124
6.00	.5591	2	.0463
7.00	.3918	1	.
8.00	.5545	2	.0513
9.00	.4718	2	.1808
10.00	.4455	2	.2239
11.00	.2987	2	.1797
12.00	.3050	2	.0406
13.00	.3129	2	.0287
14.00	.4252	2	.1315
15.00	3088	2	.1111
16.00	.3568	2	.0615
17.00	.3703	2	.1325
18.00	.3873	2	.0948
19.00	.3900	2	.0874
20.00	.4014	2	.0947
21.00	.4457	2	.1302
22.00	.4093	2	.1255
23.00	.3720	2	.0014
24 00	.4951	2	.1933
25.00	.4449	2	.1656
26.00	.4511	2	.1621
27.00	.3959	2	.0874
28.00	.4973	2	.1638
29.00	.4654	2	.1878
30.00	.3834	2	.0153
31.00	.2785	2	.0360
32.00	.3604	2	.0306
33.00	.3069	2	.0455
34.00	.4400	2	.0766
35.00	.3593	2	.0367
36.00	.4536	2	.2588
37.00	.4411	2	.1586
38.00	.4267	2	.1698
39.00	.4796	2	.2213
40.00	.4117	2	.2716
41.00	.3219	2	.0129
42.00	.2066	2	.0363
43 00	.2425	2	.0817
44.00	.2698	2	.0259
45.00	.3248	2	.0946
46.00	.2659	2	.1265
47.00	.2370	2	.0283
48 00	.2549	2	.0166
49.00	.2325	2	.0841
50.00	.3161	2	.0007
51.00	.2847	2	.0519
52.00	.1879	2	.1203
53.00	.3149	2	.0678
54,00	.4504	2	.1794
55.00	.3783	2	.0553
56.00	.4475	2	.2320
57.00	.4147	2	.0985
58.00	.4881	2	.1215
59.00	.4152	2	.2152
60.00	.4740	2	.1811
Buccal Enamel	2.6301	2	.7896
Lingual Enamel	2.3014	1	.
Total	.4297	122	.3648

Report

ave.h

position	Mean	N	SD
1.00	.2441	6	.0425
2.00	.3403	7	.0763
3.00	.2932	7	.0920
4.00	.3491	7	.0532
5.00	.3278	7	.0866
6.00	.3935	7	.0847
7.00	.4069	7	.0626
8.00	.4347	7	.0499
9.00	.4290	7	.1180
10.00	.3813	7	.1214
11.00	.3928	7	.0898
12.00	.2558	7	.0952
13.00	.2674	7	.0483
14 00	.3123	7	.1064
15.00	.3014	6	.0672
16.00	.3307	7	.0932
17.00	.3498	7	.1044
18.00	.3770	5	.0449
19.00	.3590	7	.0513
20.00	.3855	7	.1072
21.00	.3372	5	.0876
22 00	.3708	7	.1106
23.00	.3815	7	.0939
24.00	.3627	7	.1608
25.00	.4211	7	.1237
26.00	.4671	7	.0713
27.00	.4135	7	.0749
28.00	.3632	7	.1179
29.00	.3673	7	.1603
30.00	.3808	7	1284
31.00	.2285	7	.1210
32.00	.3027	7	.1052
33.00	.3493	6	.0398
34.00	.3469	7	.0789
35.00	.3931	7	.0686
36.00	.4259	7	.0673
37.00	.4566	7	.0850
38.00	.4377	7	.0575
39.00	.4527	7	.0566
40.00	.3399	7	.1296
41.00	.3465	7	.1392
42.00	.2245	7	.0893
43.00	.2552	7	.1014
44.00	.3036	7	.0722
45.00	.3025	5	.0857
46.00	.3178	7	.0949
47.00	.3475	7	.0577
48 00	.3027	5	.0437
49.00	.3249	7	.0337
50.00	.3892	7	.0735
51.00	.2954	5	.0569
52.00	.3982	7	.0823
53.00	.4385	7	.0792
54.00	.3730	7	.0691
55.00	.4176	7	.0782
56.00	.4256	7	.0633
57.00	.3620	7	.1025
58.00	.3875	7	.0991
59.00	.3591	7	.1133
60.00	.3912	7	.1108
Buccal Enamel	1.7528	6	.3619
Lingual Enamel	2.3420	6	.7356
Total	.4079	419	.3165

Report

AVE.E

position	Mean	N	SD
1.00	3.6087	3	1.980
2.00	4.9588	3	1.808
3.00	4.5172	2	1.408
4.00	6.5927	3	2.937
5.00	4.4171	3	4 819
6.00	6.7873	3	3.252
7.00	7.7441	3	2.070
8.00	8.3388	3	1.698
9.00	4.8867	3	4.606
10.00	9.7147	3	1.397
11.00	10.2277	3	1.102
12.00	4.4698	3	.3252
13.00	4.7432	3	.8489
14.00	4.7587	3	1.286
15.00	6.1053	2	1.009
16.00	5.2743	3	2.778
17.00	4.1412	3	2.712
18 00	4.9447	2	2.618
19.00	5.3043	3	2.793
20.00	5.2191	3	3.721
21.00	4.1204	2	1.569
22.00	8.1243	2	3.135
23.00	7.1635	3	3.966
24.00	6.3078	3	4.337
25.00	7.9845	3	2.805
26.00	7.7112	3	2.298
27.00	7.3574	3	1.600
28.00	7.8080	3	1.802
29.00	7.1386	3	4.418
30.00	6.9624	3	3.365
31.00	3.5185	3	1.854
32 00	4.7691	3	1.984
33.00	5.1280	2	1.204
34.00	5.8392	3	2.294
35.00	4.9605	3	2.161
36.00	7.5787	3	1.346
37.00	6.7913	3	3.068
38.00	8 9909	3	1.067
39.00	8.5698	3	1.119
40.00	9.0893	3	.6380
41.00	9.2317	3	1.273
42.00	3.0154	3	1.678
43.00	3.8519	3	2.402
44.00	4.7967	3	3.178
45.00	2.8443	2	.2411
46.00	5.4177	3	1.365
47.00	6.4049	3	1.386
48.00	5.7932	2	.7089
49.00	5.9668	3	.8384
50.00	6 5629	3	2.653
51.00	4.7366	2	1.008
52.00	6.8698	3	3.039
53.00	7.8776	3	2.845
54.00	8.8439	3	2.152
55.00	8 2417	3	2.455
56.00	8.5182	3	.7874
57.00	7.1320	3	2 491
58.00	9.3401	3	1.414
59.00	9.3673	3	1.143
60.00	9.7189	3	1.632
Buccal Enamel	55.5624	2	6.726
Lingual Enamel	57.6605	2	13.37
Total	7.6670	175	8.054

Report

AVE.E

position	Mean	N	SD
1	4.9721	3	.1290
2	7.1230	4	.2733
3	5.3880	4	1.7046
4	6.5939	4	.7984
5	6.6217	4	1.4094
6	8.7234	4	.8448
7	7.8499	4	1.6627
8	9.7924	4	2.1968
9	8.3262	4	2.4745
10	8.2771	4	2.7580
11	8.0451	4	2.7537
12	3.8068	4	1.4620
13	4.1412	4	.8322
14	5.7431	4	2.1669
15	4.1577	4	1.1643
16	5.3180	4	1.8238
17	6.3850	4	1.2492
18	5.4548	3	.4170
19	5.2225	4	1.4750
20	6.0756	4	2.0078
21	6.0082	3	.6986
22	5.2565	4	1.3850
23	6.3894	4	2.6213
24	6.1373	4	3.7740
25	6.1932	4	3.3008
26	5.9330	4	2.6380
27	6.4811	4	2.7613
28	5.2314	4	2.3321
29	6.6126	4	3.6516
30	6.2906	4	3.5477
31	3.9319	4	2.0692
32	4.5349	4	3.0844
33	4.8052	4	1.5815
34	5.5865	4	3.2890
35	5.7715	4	1.5336
36	8.1606	4	2.4901
37	7.2504	4	2.1433
38	7.5980	4	1.9436
39	8.0038	4	2.1952
40	5.7560	4	2.7517
41	5.2701	4	3.1205
42	4.5815	4	1.6490
43	4.8626	4	1.2236
44	5.1929	4	1.2273
45	5.8948	3	1.1313
46	5.8324	4	.7305
47	6.0738	4	1.1160
48	5 5523	3	.9447
49	6.2299	4	.7773
50	6.0453	4	1.1262
51	4 9870	3	.8891
52	6.4743	4	1.8789
53	6.0174	4	2.0408
54	6.1405	4	1.9103
55	7.4561	4	2.5024
56	6.6143	4	1.9632
57	6.0880	4	2.9637
58	6.4351	4	2.8764
59	5.6907	4	3.3350
60	7.1629	4	3.4084
Buccal Enamel	38.334	4	5.9922
Lingual Enamel	46.065	4	9.7380
Total	7.3543	242	6.9771

Male Hardness

Female Hardness

Female Elasticity Right

Female Elasticity Left

Table 9. 40. Tables 9.5.23, 9.5.24, 9.5.25, 9.5.26. Showing mean average results of hardness and elasticity at the sixty-two points tested with respect to sex and side.

9.5 Calcium Determination Data

	Net Inte.			Window 1	Window 2	Correction	Actual Content After		
				Baseline Intsensity		Factor	Baseline Correction		
Samples	F K	P K	CaK				F K	P K	CaK
apexbucc.	1.44	84.24	148.76	559	2011	2570	0.00056	0.032778	0.057883
apebbuc2.	0	59.84	98.22	511	1764	2275	0	0.026303	0.043174
apebbuc4.	2.12	105.19	169.42	697	2589	3286	0.000645	0.032012	0.051558
apebbu_6.	0	106.79	181.64	741	2601	3342	0	0.031954	0.054351
apebbu_8.	0	90.49	162.6	890	2932	3822	0	0.023676	0.042543
apebb_10.	0	48.49	80.7	526	1664	2190	0	0.022142	0.036849
buc_enam	2.74	181.57	302.62	534	2252	2786	0.000983	0.065172	0.108622
apexdis1.s	1.46	283.03	518.22	1625	5758	7383	0.000198	0.038335	0.070191
apdis1_2.s	0	245.15	435.08	1564	5383	6947	0	0.035289	0.062628
apdis1_4.s	1.2	167.59	292.9	1413	4613	6026	0.000199	0.027811	0.048606
apdis1_6.s	0	137.03	259.98	1218	4061	5279	0	0.025958	0.049248
apdis1_8.s	1.08	219.47	383.24	1572	5353	6925	0.000156	0.031692	0.055342
apdi1_10.s	0.62	102.54	184.84	1072	3508	4580	0.000135	0.022389	0.040358
aplin1.spc	2.56	91.86	181.9	1476	4414	5890	0.000435	0.015596	0.030883
aplin1_2.s	1.46	150.81	259.72	1455	4719	6174	0.000236	0.024427	0.042067
aplin1_4.s	1.28	178.09	310.02	1471	4927	6398	0.0002	0.027835	0.048456
aplin1_6.s	2.7	3.94	43.42	1316	3766	5082	0.000531	0.000775	0.008544
aplin1_8.s	18.64	237.32	383.22	1471	5118	6589	0.002829	0.036018	0.058161
apli1_10.s	1.86	97.14	159.12	1155	3705	4860	0.000383	0.019988	0.032741
mesialap.s	0.82	93.25	178.44	1212	3916	5128	0.00016	0.018184	0.034797
mesapx_2	0	105.21	166.78	539	1906	2445	0	0.043031	0.068213
mesapx_4	0	133.4	220.76	599	2316	2915	0	0.045763	0.075732
mesapx_6	0	85.3	146.24	594	2027	2621	0	0.032545	0.055795
mesap_8.s	0.46	72.92	122.26	463	1481	1944	0.000237	0.03751	0.062891
mesap_10	0	83.96	132.32	456	1642	2098	0	0.040019	0.06307
2bapex.sp	0.6	3.54	7.18	256	942	1198	0.000501	0.002955	0.005993
2b_2.spc	4.52	132.86	178.02	445	1659	2104	0.002148	0.063146	0.08461
2b_4.spc	2.96	109.32	142.9	447	1667	2114	0.0014	0.051712	0.067597
2b_6.spc	0.34	26.32	34.32	333	1066	1399	0.000243	0.018813	0.024532
2b8.spc	5.38	198.36	259.48	923	3330	4253	0.001265	0.04664	0.061011
2b_10.spc	5.54	166.78	237.74	515	1942	2457	0.002255	0.06788	0.09676
2benam.sp	0.92	264.52	395.8	601	2551	3152	0.000292	0.083921	0.125571
2dapex.sp	1.1	97.62	142.74	423	1595	2018	0.000545	0.048375	0.070733
2d2.spc	1.78	104.82	142.98	433	1509	1942	0.000917	0.053975	0.073625
2d4.spc	5.66	120.1	156.58	399	1498	1897	0.002984	0.06331	0.082541
2d6.spc	7.52	131.14	172.44	437	1475	1912	0.003933	0.068588	0.090188
2d8.spc	7.68	128.7	170.38	454	1612	2066	0.003717	0.062294	0.082469
2d10.spc	1.18	44.5	61.24	336	1089	1425	0.000828	0.031228	0.042975
2lapex.spc	5.78	112.12	149.02	441	1585	2026	0.002853	0.055341	0.073554
2l2.spc	4.24	95.54	127.34	334	1117	1451	0.002922	0.065844	0.08776
2l4.spc	5.46	155.68	211.28	518	5046	5564	0.000981	0.02798	0.037973
2l6.spc	5.64	150.5	207.52	512	1924	2436	0.002315	0.061782	0.085189
2l8.spc	8.22	156.72	204.66	512	1914	2426	0.003388	0.0646	0.084361
2l10.spc	3.52	101.9	132.2	422	1456	1878	0.001874	0.05426	0.070394
2lenam.sp	2.94	269.2	407	673	2696	3369	0.000873	0.079905	0.120807
2mapex.sp	0	20.72	30.7	269	903	1172	0	0.017679	0.026195
2mbapex.s	1.86	14.08	19.3	489	1515	2004	0.000928	0.007026	0.009631
2m2.spc	2.04	69.64	88.14	340	1161	1501	0.001359	0.046396	0.058721
2m4.spc	6.3	193.14	256.16	676	2526	3202	0.001968	0.060319	0.08
2m6.spc	0.84	102.02	126.3	714	2282	2996	0.00028	0.034052	0.042156
2m8.spc	5.14	221.02	303.78	795	2899	3694	0.001391	0.059832	0.082236
2m10.spc	0.58	58.22	82.42	435	1484	1919	0.000302	0.030339	0.042949

Table 9. 41. Calcium determination Data.

3bapex.sp	1.54	37.9	46.22	350	1304	1654	0.000931	0.022914	0.027944
3b2.spc	2.36	42.28	50.26	343	1198	1541	0.001531	0.027437	0.032615
3b4.spc	9.56	135.12	160.38	516	1891	2407	0.003972	0.056136	0.066631
3b6.spc	2.96	78.68	94.28	443	1482	1925	0.001538	0.040873	0.048977
3b8.spc	3.94	88.16	103.56	387	1355	1742	0.002262	0.050608	0.059449
3b10.spc	2.86	79.94	101.48	389	1420	1809	0.001581	0.04419	0.056097
3benam.sp	2	346.1	538.46	803	3252	4055	0.000493	0.085351	0.132789
3dapex.sp	5.7	130.04	161.58	390	1579	1969	0.002895	0.066044	0.082062
3d2.spc	4.28	116.26	157.42	401	1551	1952	0.002193	0.059559	0.080645
3d4.spc	1.96	114	140.56	480	1831	2311	0.000848	0.049329	0.060822
3d6.spc	5	103.5	122.94	355	1344	1699	0.002943	0.060918	0.07236
3d8.spc	10.94	172.46	208.04	675	2280	2955	0.003702	0.058362	0.070403
3d10.spc	5.78	76.58	96.8	506	1716	2222	0.002601	0.034464	0.043564
3lapex.spc	4.16	99.54	120.8	380	1513	1893	0.002198	0.052583	0.063814
3l2.spc	8.46	135.98	167.08	444	1619	2063	0.004101	0.065914	0.080989
3l4.spc	5.76	123.3	144.54	432	1547	1979	0.002911	0.062304	0.073037
3l6.spc	5.66	127.1	151.74	413	1623	2036	0.00278	0.062426	0.074528
3l8.spc	2.74	71.42	83.58	324	1193	1517	0.001806	0.04708	0.055096
3l10.spc	4.24	34.22	46.9	318	1142	1460	0.002904	0.023438	0.032123
3lenam.sp	2.24	220.1	345.2	526	2023	2549	0.000879	0.086348	0.135426
3mapex.sp	1.92	41.86	48.64	341	1172	1513	0.001269	0.027667	0.032148
3m2.spc	2.9	105.44	122.8	403	1567	1970	0.001472	0.053523	0.062335
3m4.spc	0.8	48.56	55.66	312	1047	1359	0.000589	0.035732	0.040957
3m6.spc	4.32	100.96	122.92	360	1400	1760	0.002455	0.057364	0.069841
3m8.spc	8.78	129.1	163.7	433	1643	2076	0.004229	0.062187	0.078854
3m10.spc	2.98	99.02	125.3	360	1455	1815	0.001642	0.054556	0.069036
4bapex.sp	1.44	157.96	231.96	491	1953	2444	0.000589	0.064632	0.09491
4b2.spc	2.38	163.5	235.38	614	1990	2604	0.000914	0.062788	0.090392
4b4.spc	3.3	194.96	260.16	569	2237	2806	0.001176	0.06948	0.092716
4b6.spc	3.16	145.24	205.92	454	1634	2088	0.001513	0.069559	0.098621
4b8.spc	2.52	137.92	188.78	426	1576	2002	0.001259	0.068891	0.094296
4b10.spc	1.26	41.44	57.12	294	950	1244	0.001013	0.033312	0.045916
4benam.sp	1.5	271.76	428.16	668	2566	3234	0.000464	0.084032	0.132393
4dapex.sp	2.12	121.18	173.66	409	1463	1872	0.001132	0.064733	0.092767
4d2.spc	1.86	164.66	231.18	513	2043	2556	0.000728	0.064421	0.090446
4d4.spc	1.64	146.8	196.94	445	1649	2094	0.000783	0.070105	0.09405
4d6.spc	1.76	112	155.78	369	1281	1650	0.001067	0.067879	0.094412
4d8.spc	1.08	137.94	192.98	454	1608	2062	0.000524	0.066896	0.093589
4d10.spc	1.68	112.58	155.22	413	1519	1932	0.00087	0.058271	0.080342
4lapex.spc	0.78	73.74	109.6	249	1036	1285	0.000607	0.057385	0.085292
4l2.spc	1.68	122.1	172.42	400	1500	1900	0.000884	0.064263	0.090747
4l4.spc	1.92	168.52	239.66	511	1920	2431	0.00079	0.069321	0.098585
4l6.spc	1.64	141.84	203.08	420	1757	2177	0.000753	0.065154	0.093284
4l8.spc	2.18	135.12	194.92	416	1545	1961	0.001112	0.068904	0.099398
4l10.spc	2.58	142.3	211.32	416	1753	2169	0.001189	0.065606	0.097427
4lenam.sp	0	253.56	396.9	561	2426	2987	0	0.084888	0.132876
4mapex.sp	3.22	149.44	219.62	476	1776	2252	0.00143	0.066359	0.097522
4m2.spc	2.12	116.98	162.44	488	1659	2147	0.000987	0.054485	0.075659
4m4.spc	1.28	139.4	187.88	422	1623	2045	0.000626	0.068166	0.091873
4m6.spc	0.52	66.48	87.72	304	1158	1462	0.000356	0.045472	0.06
4m8.spc	2.92	99.52	131.24	277	1135	1412	0.002068	0.070482	0.092946
4m10.spc	1.56	52.68	74.2	480	1468	1948	0.000801	0.027043	0.03809

Table 9. 42. Calcium determination Data.

5bapex.sp	1.9	132.3	180.68	465	1686	2151	0.000883	0.061506	0.083998
5b2.spc	3.52	151.34	212.06	449	1778	2227	0.001581	0.067957	0.095222
5b4.spc	1.22	149.04	205.74	510	1823	2333	0.000523	0.063883	0.088187
5b6.spc	3.88	181.46	250.84	533	1977	2510	0.001546	0.072295	0.099936
5b8.spc	3.32	197.54	278.18	603	2264	2867	0.001158	0.068901	0.097028
5b10.spc	2.94	38.36	46.92	511	1622	2133	0.001378	0.017984	0.021997
5benam.sp	2.02	240.04	369.4	568	2244	2812	0.000718	0.085363	0.131366
5dapex.sp	1.1	116.72	169	395	1505	1900	0.000579	0.061432	0.088947
5d2.spc	1.28	110.44	159.5	452	1667	2119	0.000604	0.052119	0.075271
5d4.spc	0.96	175.34	241.76	523	2011	2534	0.000379	0.069195	0.095406
5d6.spc	1.46	186.36	282.38	571	2247	2818	0.000518	0.066132	0.100206
5d8.spc	3.16	260.96	385.86	775	3283	4058	0.000779	0.064308	0.095086
5d10.spc	0	171.66	242.16	732	2701	3433	0	0.050003	0.070539
5lapex.spc	0.42	124.62	177.12	397	1546	1943	0.000216	0.064138	0.091158
5l2.spc	2.8	153.12	219.44	464	1905	2369	0.001182	0.064635	0.09263
5l4.spc	0.62	161.14	238.7	445	1843	2288	0.000271	0.070428	0.104327
5l6.spc	1.98	159.94	235.1	475	1841	2316	0.000855	0.069059	0.101511
5l8.spc	2.26	179.92	246.8	510	2028	2538	0.00089	0.07089	0.097242
5l10.spc	2.74	143.1	182.62	533	1845	2378	0.001152	0.060177	0.076796
5lenam.sp	1.4	296.38	465.82	660	2793	3453	0.000405	0.085833	0.134903
5mapex.sp	0	73.62	109.94	375	1407	1782	0	0.041313	0.061695
5m2.spc	0	91.48	127.22	374	1297	1671	0	0.054746	0.076134
5m4.spc	1.16	130.02	186.56	474	1774	2248	0.000516	0.057838	0.082989
5m6.spc	1.88	144.26	206.54	415	1663	2078	0.000905	0.069423	0.099394
5m8.spc	3.2	240.58	348.66	730	2798	3528	0.000907	0.068192	0.098827
5m10.spc	1.52	128.48	173.18	576	2150	2726	0.000558	0.047131	0.063529
6bapex.sp	2.7	136.76	196.9	492	1724	2216	0.001218	0.061715	0.088854
6b2.spc	0.46	89.16	131.18	443	1568	2011	0.000229	0.044336	0.065231
6b4.spc	3.12	110.62	161.34	361	1300	1661	0.001878	0.066598	0.097134
6b6.spc	3.4	186.9	267.18	575	2184	2759	0.001232	0.067742	0.096839
6b8.spc	0.6	34.6	47.84	245	882	1127	0.000532	0.030701	0.042449
6b10.spc	1.3	74.04	114.24	319	1153	1472	0.000883	0.050299	0.077609
6benam.sp	1.34	247.68	393.32	576	2341	2917	0.000459	0.084909	0.134837
6dapex.sp	6	173.66	244.68	529	2027	2556	0.002347	0.067942	0.095728
6d2.spc	0	50.76	67.58	346	1127	1473	0	0.03446	0.045879
6d4.spc	0	47.9	68.28	340	1272	1612	0	0.029715	0.042357
6d6.spc	3.4	160.46	236.78	496	1739	2235	0.001521	0.071794	0.105942
6d8.spc	3.6	146.34	215.76	468	1671	2139	0.001683	0.068415	0.10087
6d10.spc	1.24	3.94	6.68	348	1065	1413	0.000878	0.002788	0.004728
6lapex.spc	2.98	161.66	238	490	3814	4304	0.000692	0.03756	0.055297
6l2.spc	2.88	195.64	301.04	579	2389	2968	0.00097	0.065916	0.101429
6l4.spc	2.4	105.58	159.08	345	1149	1494	0.001606	0.070669	0.106479
6l6.spc	6.32	219.84	313.3	667	2476	3143	0.002011	0.069946	0.099682
6l8.spc	0.48	13.56	18.02	340	1083	1423	0.000337	0.009529	0.012663
6l10.spc	2.38	89.7	132.44	285	1238	1523	0.001563	0.058897	0.08696
6lenam.sp	1.28	328.96	520.18	773	3070	3843	0.000333	0.0856	0.135358
6mapex.sp	3.6	161.74	243.82	545	2039	2584	0.001393	0.062593	0.094358
6m2.spc	1.76	120.96	177.46	386	1675	2061	0.000854	0.05869	0.086104
6m4.spc	0.54	178.04	275.36	576	2293	2869	0.000188	0.062056	0.095978
6m6.spc	0.56	130.96	202.28	410	1737	2147	0.000261	0.060997	0.094215
6m8.spc	0.54	24.16	33.52	345	1112	1457	0.000371	0.016582	0.023006
6m10.spc	0	75.7	118.7	303	1212	1515	0	0.049967	0.07835

Table 9. 43. Calcium determination Data.

7bapex.sp	1.86	126.28	180.48	481	1856	2337	0.000796	0.054035	0.077227
7b2.spc	2.32	109.54	155.5	415	1655	2070	0.001121	0.052918	0.075121
7b4.spc	0.8	27	41.3	319	1035	1354	0.000591	0.019941	0.030502
7b6.spc	1.16	31.92	44.26	314	1076	1390	0.000835	0.022964	0.031842
7b8.spc	6.04	164	235.36	516	1929	2445	0.00247	0.067076	0.096262
7b10.spc	4.4	75	98.14	393	1284	1677	0.002624	0.044723	0.058521
7benam.sp	0.4	160.92	251.22	353	1449	1802	0.000222	0.089301	0.139412
7dapex.sp	2.88	65.42	86.98	466	1578	2044	0.001409	0.032006	0.042554
7d2.spc	3.84	105.62	142.02	460	1509	1969	0.00195	0.053641	0.072128
7d4.spc	2.52	100.88	145.42	380	1436	1816	0.001388	0.055551	0.080077
7d6.spc	0.5	48.74	69.66	362	1128	1490	0.000336	0.032711	0.046752
7d8.spc	0	50.26	68.86	337	1151	1488	0	0.033777	0.046277
7d10.spc	0.46	2.68	7.56	258	865	1123	0.00041	0.002386	0.006732
7lapex.spc	0	72.02	105.94	359	1278	1637	0	0.043995	0.064716
7l2.spc	1.94	136.86	190.36	509	1854	2363	0.000821	0.057918	0.080559
7l4.spc	3.62	114.08	159.32	405	1565	1970	0.001838	0.057909	0.080873
7l6.spc	4.48	132.32	195.16	401	1542	1943	0.002306	0.068101	0.100443
7l8.spc	1.36	73.66	101.36	331	1294	1625	0.000837	0.045329	0.062375
7l10.spc	0.3	26.04	37.16	234	789	1023	0.000293	0.025455	0.036325
7lenam.sp	0.86	238.3	380.9	568	2265	2833	0.000304	0.084116	0.134451
7mapex.sp	0.64	3.08	5.76	349	989	1338	0.000478	0.002302	0.004305
7m2.spc	0.36	166.78	256.86	593	2504	3097	0.000116	0.053852	0.082938
7m4.spc	0.98	65.52	86.5	275	1110	1385	0.000708	0.047307	0.062455
7m6.spc	2.94	108.32	150.82	429	1447	1876	0.001567	0.05774	0.080394
7m8.spc	3.62	142.24	207.24	476	1863	2339	0.001548	0.060812	0.088602
7m10.spc	3.68	9.28	17.28	582	1895	2477	0.001486	0.003746	0.006976
8bapex.sp	0.82	57.22	81.88	365	1380	1745	0.00047	0.032791	0.046923
8b2.spc	1.62	125.22	179.98	462	1818	2280	0.000711	0.054921	0.078939
8b4.spc	2.96	169.3	248.56	452	2050	2502	0.001183	0.067666	0.099345
8b6.spc	0.92	216.08	312.64	614	2452	3066	0.0003	0.070476	0.10197
8b8.spc	2.2	134.5	197.42	392	1538	1930	0.00114	0.069689	0.10229
8b10.spc	0.66	142.44	209.72	432	1722	2154	0.000306	0.066128	0.097363
8benam.sp	0.8	248.16	379.58	560	2292	2852	0.000281	0.087013	0.133093
8dapex.sp	1.64	134.24	198.96	437	1540	1977	0.00083	0.067901	0.100637
8d2.spc	2.5	109.28	150.68	568	1832	2400	0.001042	0.045533	0.062783
8d4.spc	1.28	111	154.4	400	1599	1999	0.00064	0.055528	0.077239
8d6.spc	3.62	177.6	264.04	562	2020	2582	0.001402	0.068784	0.102262
8d8.spc	1.08	142.14	207.84	397	1649	2046	0.000528	0.069472	0.101584
8d10.spc	3.78	176.78	255.38	544	1940	2484	0.001522	0.071167	0.10281
8lapex.spc	2.74	88.26	127.28	392	1507	1899	0.001443	0.046477	0.067025
8l2.spc	0.42	7.28	9.04	349	1188	1537	0.000273	0.004736	0.005882
8l4.spc	1.02	5.56	9.06	313	1035	1348	0.000757	0.004125	0.006721
8l6.spc	4.48	185.4	270.06	516	2096	2612	0.001715	0.07098	0.103392
8l8.spc	1.72	181.5	265.36	565	2222	2787	0.000617	0.065124	0.095213
8l10.spc	3.42	187.5	276.54	560	2174	2734	0.001251	0.068581	0.101149
8lenam.sp	1.54	224.8	357.14	516	2164	2680	0.000575	0.083881	0.133261
8mapex.sp	0.5	128	181.32	445	1707	2152	0.000232	0.05948	0.084257
8m2.spc	2.38	133	196.12	418	1524	1942	0.001226	0.068486	0.100989
8m4.spc	3.38	157.5	228.3	463	1798	2261	0.001495	0.069659	0.100973
8m6.spc	2.42	126.86	183.74	351	1450	1801	0.001344	0.070439	0.102021
8m8.spc	2.26	107.84	161.84	313	3127	3440	0.000657	0.031349	0.047047
8m10.spc	0.86	5.94	9.34	239	812	1051	0.000818	0.005652	0.008887

Table 9. 44. Calcium determination Data.

9bapex.sp	0.62	47.3	72.32	297	1074	1371	0.000452	0.0345	0.05275
9b2.spc	0.6	114.62	175.4	316	1403	1719	0.000349	0.066678	0.102036
9b4.spc	0	139.36	204.08	389	1584	1973	0	0.070634	0.103436
9b6.spc	1.54	140.22	209.42	406	1561	1967	0.000783	0.071286	0.106467
9b8.spc	1.98	116.1	181.14	381	1369	1750	0.001131	0.066343	0.103509
9b10.spc	0.7	41.72	62.46	207	849	1056	0.000663	0.039508	0.059148
9benam.sp	0	238.28	371.46	557	2214	2771	0	0.085991	0.134053
9dapex.sp	0.46	2.54	3.7	244	769	1013	0.000454	0.002507	0.003653
9d2.spc	0	35.22	51.72	333	1187	1520	0	0.023171	0.034026
9d4.spc	0	45.88	62.46	351	1287	1638	0	0.02801	0.038132
9d6.spc	1.32	157.98	242.12	450	1886	2336	0.000565	0.067628	0.103647
9d8.spc	2.6	155	244.2	467	1899	2366	0.001099	0.065511	0.103212
9d10.spc	3.38	155.4	241.38	503	1952	2455	0.001377	0.063299	0.098322
9lapex.spc	2.46	190.16	277.98	570	2258	2828	0.00087	0.067242	0.098296
9l2.spc	0.76	8.08	13.7	357	1099	1456	0.000522	0.005549	0.009409
9l4.spc	0	148.9	216.46	437	1764	2201	0	0.067651	0.098346
9l6.spc	1.54	172.24	258.74	507	1972	2479	0.000621	0.06948	0.104373
9l8.spc	1.36	171.18	254.18	492	1955	2447	0.000556	0.069955	0.103874
9l10.spc	1.48	125.28	186.04	383	1473	1856	0.000797	0.0675	0.100237
9lenam.sp	0.52	202.68	323.4	475	1869	2344	0.000222	0.086468	0.137969
9mapex.sp	1.1	150.76	216.2	489	1902	2391	0.00046	0.063053	0.090422
9m2.spc	0.72	117.34	165.8	435	1567	2002	0.00036	0.058611	0.082817
9m4.spc	0	100.1	146.18	369	1343	1712	0	0.05847	0.085386
9m6.spc	0	149.02	217.54	469	1749	2218	0	0.067187	0.098079
9m8.spc	0.4	68.12	101.82	360	1414	1774	0.000225	0.038399	0.057396
9m10.spc	0	91.2	130.38	439	1683	2122	0	0.042978	0.061442

Table 9. 45. Calcium determination Data.

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