Changes in Tooth Mobility and Position in an Established Dentition Following Placement of a New Restoration

Keywords

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ABSTRACT

The aim of this study is to examine and evaluate physiologic tooth mobility and movement in different groups of patients. Four groups of patients were examined and recordings were taken. Group A1 consisted of 12 undergraduate students under the age of 30, A2 consisted of 11 members of staff over the age of 30 and A3 consisted of 9 patients with periodontal disease between the ages of 40-65 years old. The fourth Group B, 14 patients between 30-70 years old, received single-tooth restorations and recordings were taken immediately after, a month and four months following the cementation of the restoration. Patients in the first 3 groups showed no significant change in tooth mobility and movement between appointments. The fourth group demonstrated a non-statistically significant increase in tooth mobility following the cementation of the restoration due to the force applied on the occlusal surface of the tooth during the cementation process, while tooth movement was not observed beyond that of physiological tooth migration. Regardless of the age or the restorations a patient receives over the years, with careful occlusal consideration, no significant changes in tooth mobility and movement should be observed.

INTRODUCTION

Occlusion is each static contact between one or more lower teeth and one or more upper teeth.[1] Masticatory loads are absorbed by the periodontal ligaments (PDL), whose purpose is not only the attachment of the teeth to the bone, but most importantly the transmission of the occlusal forces to the bone and the resistance to the impact of the occlusal forces[2] (shock absorption).

Tooth movement does not end with the end of the eruption of the permanent dentition. During occlusal activity there is the tendency of displacement of the tooth further into the bone socket. The supporting structures of the tooth, the bone and connective tissue provide the bio-elastic and bio-plastic foundation upon which the dentition functions. It is a shock-absorbing system, designed to protect the tooth structure with the help of the elastic fibers of the ligaments. They protect the tooth by absorbing irreversibly harmful occlusal forces or loads and dispersing them within the jaw and adjoining structures.[3,4,5]

Tooth movement also activates the periodontal mechanoreceptors (Ruffini type II) which limit jaw closing forces and reduce the risk of tooth damage.[6] Although the periodontal ligaments can withstand quite heavy occlusal forces, if they exceed the normal limits then the bone tissue remodels, allowing the teeth to move away from the occlusal loading to a position where the occlusal equilibrium is once more reached.[7]

During any type of movement, the teeth experience some mobility which is considered physiologic.[8,9] Physiologic tooth mobility seems to depend mainly on the quality or elastic properties of the periodontal ligaments,[10] and on anatomical characteristics such as the amount of supporting alveolar bone and the width of the periodontal ligament space.[11] Other factors such as the number, shape and length of the roots or the intrinsic elasticity of the tooth itself may also be taken into consideration. It should also be noted that the degree of mobility recorded on teeth is directly associated with previous loading like chewing, clenching and more.[10]

In the United Kingdom over 1.2 million crowns are cemented each year (NHS estimate). Crowns, are constructed by different practitioners using different techniques to prepare the abutment teeth, different materials to take the impressions and different laboratory technicians to finally fabricate them. However, when placed on posterior teeth, they should be adjusted to remove any occlusal interferences or high contacts before final cementation, and re-evaluated following cementation to make sure there has been no unexpected increase in vertical dimension.[12] Excessive premature contacts can be one of the reasons for failure. However, it should be stressed that altering the occlusion intra-orally without introducing further errors is a difficult undertaking.

Regrettably, the importance of harmony in occlusion is overshadowed by the need for expediency and patient satisfaction. Aesthetics are often the determining factor of the type of restoration to be used, regardless of the space or height available in the oral cavity. Patient discomfort and evaluation of the recently developed occlusal situation is dealt with by grinding the occlusal surface of the newly cemented restorations. This method solves the problem of high or premature contacts but may take the tooth out of occlusion with the opposing teeth.

Since the presence of high occlusal contacts have been identified it is essential for the clinician to take the necessary steps to protect the integrity of the occlusion. Adjustment of the occlusal contacts interfering with normal function could prevent any irreversible damage to the tooth's pulp and the crown and could also prevent unwanted symptoms. Only high contacts ought to be removed.

This process should be repeated as many times as necessary until all interferences are eliminated. Care must also be taken while grinding the crown not to over adjust the occlusal surface and the vertical height. Once the crown is polished and cemented, the above process with the articulating paper needs to be repeated and the occlusion re-evaluated to make sure there has been no unexpected increase in the vertical dimension due to the thickness of the cement.

The aim of this paper is to examine teeth in established dentitions and evaluate their physiological movement and mobility up to 4 months, as well as the mobility and movement of teeth that have recently received single- tooth restorations (crowns or onlays) by a variety of practitioners.

METHODS AND MATERIALS

Three groups of patients were seen a total of 3 times in 4 weeks, with 2 weeks intervals between each appointment. The first group (Group A1) consisted of 12 undergraduate students under the age of 30 (6 females and 6 males) who volunteered to take part in the study. The second group (Group A2) consisted of 11 members of staff over the age of 30 (5 females and 6 males) and the third group (Group A3) consisted of 9 patients with an evaluated periodontal disease (3 females and 6 males) between the ages of 40 to 65 years old. The patients of Group A3 were diagnosed with periodontitis, received full periodontal treatment and their condition was considered inactive in follow-up examinations.

A fourth group (Group B) of 14 patients (8 females and 6 males) were seen a total of 3 times in 4 months, with a one-month interval between the first and the second appointment and 3 months between the second and the third. Their age varied between 30 and 70 years old, with complete upper and lower dentitions, healthy periodontium and no undergoing orthodontic treatment. Patients received crowns or onlays prepared and constructed in the KCL Dental Institute restorative clinics by undergraduate students under the supervision of their clinical demonstrators. The type of restoration used for each patient was either a metal-ceramic crown, or a gold onlay.

Before entering the study, all participants signed a consent form in accordance with the Ethical Committee approval: King's College London Dental Institute Research Ethics Committee approval 04/Q0704/57, stating that they fully understood and agreed to participate in clinical research, reserving the right to withdraw at any point if they wished to. Patients who were invited to participate in the study were about to have crowns or onlays constructed on an upper or lower first molar. The researcher was not in any way involved in the preparation, construction or cementation of the crown which was fully undertaken by the undergraduate student in charge of the patient and supervised by clinical staff unrelated to this study. No recordings were taken on the day of the tooth preparation because preliminary work showed that the results were not comparable to those after the placement of the restoration.

PILOT STUDY

Prior to the study, pilot tests were carried out to examine the reproducibility of the methods, techniques and devices that were going to be used. This particular study will look into aspects of tooth mobility and movement and attempt to identify and calculate changes during a period of time using devices such as the *Periotest* (Medizintechnik Gulden, Eschenweg 3, 64397 Modautal, Germany) and the Renishaw Cyclone (Renishaw plc, New Mills, Wotton-under-Edge, Gloucestershire, GL12 8JR, UK) contact scanner and 3D-imaging software such as the 3dd SurfScan (ScanSurf 3D Digital Corporation CT USA) and the Cloud UCL (©1996 Robin Richards, Medical Physics, U.C.L. All rights reserved). It was important to understand the limitations of the devices and the methods selected to record any changes in order to obtain accurate results that could withstand scrutiny. The results obtained confirmed the reproducibility of the recording for all methods and devices used in the study. It also confirmed the long-term accuracy and error provided by the manufacturers. The subjects used in the reproducibility pilot tests were not part of the main study and did not receive any restorative work in the clinics before or after recordings for tooth mobility and movement were taken.

DATA RECORDING & ANALYSIS

The same clinical procedures to measure tooth mobility and tooth movement took place for all patients in all 4 groups at each session. Tooth mobility was recorded using the *Periotest* Device *(Figure 1)* which measures the damping characteristics of the periodontium[13,14] and consists of a micro-computerized measuring device that connects to a handpiece with a built-in metal rod in the head of the handpiece.[15] The metal rod taps the surface of the tooth *(Figure 2)* at a rate of four times per second, for four seconds (16 taps). The tapping procedure with the *Periotest* was repeated three times. The recording produced by the device is a value (*Periotest* value or PTV), based on a numerical scale from -8 to +50. The average of the three recordings was noted as the mean value of mobility of the tooth. The *Periotest* was calibrated with the calibration sleeve provided by the manufacturer before any recordings were taken. Long term accuracy of the device was ±1 to ±2 PTV units for anterior teeth and premolars but for the molars the variation is greater to about ±3.

In Group B, following cementation of the restoration, the patients were asked to wait for 30 minutes as a standardized time before any recordings were taken; no instructions were given while waiting. The force applied on the crown during cementation could stretch the periodontal ligaments which are trying to absorb the applied load and mobility could potentially increase temporarily. Also, vibrations from the fast handpiece during occlusal adjustments carried out by the students could temporarily affect mobility.[16]

Figure 1: The Periotest Device.

Figure 2: Correct placement of the Periotest handpiece against the buccal surface of an Upper Right 1.

A polyvinylsiloxane addition-type silicone elastomer (Affinis Monobody, Coltène Whaladent Ltd, The President Suite-A, Kendal House, Burgess Hill, Victoria Way, West Sussex, RH15 9NF, UK) of medium viscosity was finally used to take impressions of the dental arch in all 4 groups at each session to identify tooth movement. Precision study models were constructed 24 to 48 hours later using a Type 4 dental die stone (FujiRock, GC Europe N.V., Interleuvenlaan 13, B - 3001 Leuven.) for high-definition precision and edge hardness.

The model casts were mounted - at least 24 hours after casting and trimming - on the Renishaw Cyclone Surface Contact Scanner table and three 3D-true model images *(Figure 3)* were produced for each patient. The files were imported in the 3DD SurfScan software in sets of two (the first with the second & the first with the third) in order to superimpose one on top of the second *(Figure 4)* and identify any movement of the teeth between appointments. For this to happen, the software requests the operator to select and mark exactly the same points in both images in order to have standard points of reference. The sets

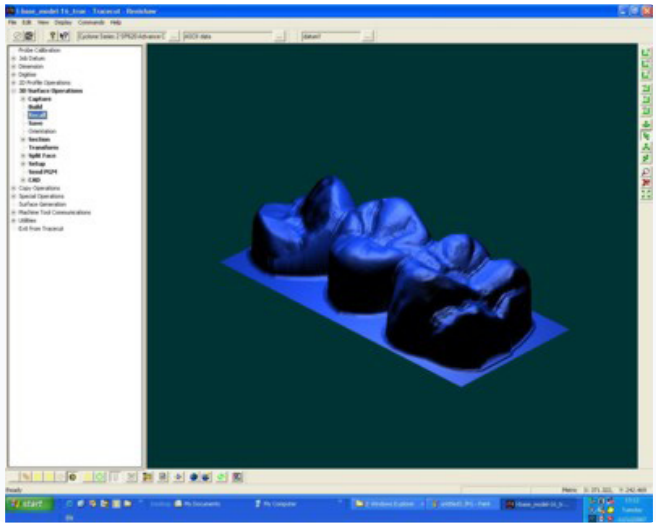

Figure 3: 3D-true model images created following scanning of a model cast by Renishaw's Cyclone Machine.

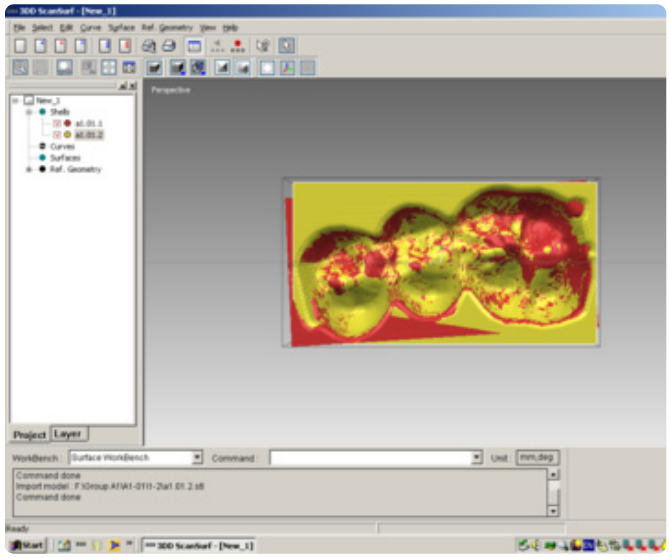

Figure 4: 3DD ScanSurf Software- Two superimposed shells, the first on top of the second, after the selected points were registered.

of 3D images were then imported in the Cloud UCL software *(Figure 5*) which calculates the shortest distance of each point on one object surface from a second object surface. The results appear in the form of an image with bright colours *(Figure 6*), each representing a numerical difference. The software provides the operator with the option of saving the results in a numerical form using Microsoft Office Excel to facilitate statistical analysis. Tables 5 & 7 provide the mean measurements between appointments across all groups.

STATISTICAL ANALYSIS

Statistical analysis of the data for all 4 groups (Group A1, A2, A3 & B) to determine if there was significant difference in tooth mobility and tooth movement between the baseline and the following visits was performed using the Wilcoxon Signed Ranks Test through the statistical software SPSS v.15 (© 2008 SPSS Inc. All rights reserved. SPSS Inc. Headquarters, 233 S.

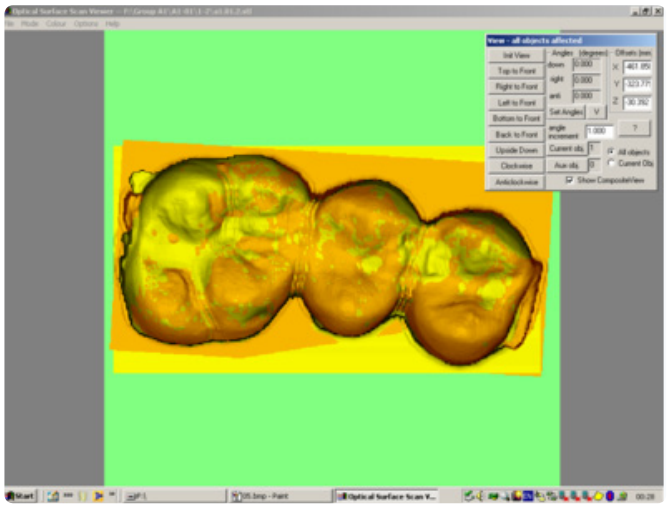

Figure 5: Cloud Data Analysis Software- Imported 3D images in composite view.

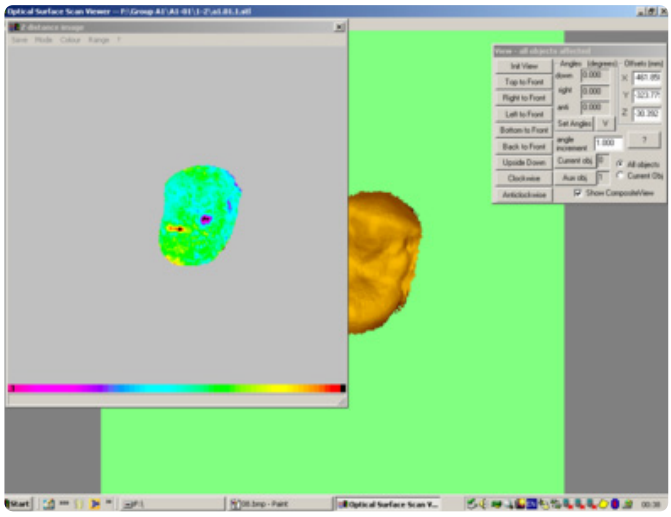

Figure 6: The selected areas of the 3D images placed in composite view and analysed for surface differences.

Wacker Drive, 11th floor Chicago, Illinois 60606) for Microsoft Windows OS. This is a non-parametric test equivalent to the parametric Paired Sample t-test and is mostly used in cases where the statistical sample is either too small, has a wide variance or does not follow normal distribution.

Due to the limited sample size, there is a lack of certainty that the data follows a normal distribution. Therefore, non-parametric analysis was carried out. Non-parametric analysis tests do not require the same assumptions regarding the distribution of the data and are more suitable for small samples. Contrary to the t-tests, the Wilcoxon test examines Median values with the null hypothesis stating that both samples are the same and have zero median value.

To consider that there is strong indication of dependence between the variables, the value of significance or p-value must be lower than the predetermined significance level which is set to 0.05. The p-value is a Type II error that expresses the possibility of an error in the null hypothesis stating that there is dependence between the variables. The lower its value, there is a lesser possibility of such an error.

RESULTS

TOOTH MOBILITY

All patients participating in study Groups A1, A2, A3 and B agreed to the recordings and were happy to cooperate. None complained of any pain during the measurements' procedure or for any residual discomfort left subsequently. Three consecutive *Periotest* recording were taken for each tooth and the average of the three recordings was noted as the mean value of mobility for the tooth.

The teeth that were used to take mobility measurements with the *Periotest* device for Groups A1, A2 and A3 were the Upper Right 1 (UR1), the Upper Right 3 (UR3) and the Upper Right 6 (UR6). For Group A1, the mean PTV values for all 3 teeth were approximately the same between the 3 consecutive visits and their standard deviation well within the limits of error of the device. Statistical analysis of the *Periotest* recordings showed no significant difference in *Periotest* values and tooth mobility between the three visits in all 3 teeth with the exception of one occasion between the baseline and third visits for the UR6 *(Table 1 and 2*). For Group A2, the mean PTV values for all 3 teeth were approximately the same between the 3 consecutive visits and their standard deviation edged above the limits of error of the device only for the first two visits of the UR1. Statistical analysis showed no significant difference in *Periotest* values and tooth mobility between the three visits in all 3 teeth with the exceptions of the UR3 and the UR6 between the first - second and the first - third visit four weeks later *(Table 1 and* 2). Finally, for Group A3, the mean PTV values for all 3 teeth were approximately the same between the 3 consecutive visits, except for the second visit of UR6, while their standard deviation was in all cases above the limits of error for the device. Statistical analysis showed once again no significant difference in *Periotest* values and no tooth mobility between the three visits in all 3 teeth with the exception of UR6 between the baseline and second visits *(Table 1 and 2*).

In Group B, patients had single-tooth restorations cemented on their upper or lower, left or right first molars. The restorations were occlusally adjusted by the practitioner in charge, if it was deemed necessary. The patients reported no discomfort or pain due to high occlusal contacts a month after the restorations were cemented.

For Group B, the mean *Periotest* values between the 3 consecutive visits are approximately the same and their standard deviation is well within the limits of error for the device. Statistical analysis of the *Periotest* recordings showed no significant difference in tooth mobility following the cementation of a single-tooth restoration between the 3 visits *(Table 3 and 4*).

Table 1. Tooth mobility mean values, standard deviation, median and IQR for the 3 consecutive visits for Groups A1, A2 & A3 and for teeth UR1, UR3 & UR6.

Group A1		N	Baseline	2 weeks	4 weeks
UR1	Mean	12	1.00	0.83	1.17
	Std Deviation		2.045	1.642	1.267
	Median		0.50	0.50	1.00
	IQR		4	3	2
UR3	Mean	12	-1.50	-1.83	-1.75
	Std Deviation		2.111	1.749	1.545
	Median		-1.50	-2.00	-2.00
	IQR		2	3	2
UR6	Mean	12	0.17	-0.50	-1.08
	Std Deviation		2.329	2.067	2.021
	Median		0.00	-0.50	-1.50
	IQR		3	3	3
Group A2		**N**	**Baseline**	**2 weeks**	**4 weeks**
UR1	Mean	11	1.18	1.00	0.91
	Std Deviation		2.089	2.646	1.868
	Median		1.00	1.00	1.00
	IQR		4	4	3
UR3	Mean	11	-0.64	-1.36	-1.45
	Std Deviation		1.859	1.859	2.067
	Median		-1.00	-1.00	-2.00
	IQR		2	3	3
UR6	Mean	11	1.09	0.27	-0.55
	Std Deviation		2.914	2.867	2.382
	Median		0.00	-1.00	-1.00
	IQR		4	5	1
Group A3		**N**	**Baseline**	**2 weeks**	**4 weeks**
UR1	Mean	9	3.56	3.33	3.44
	Std Deviation		3.127	3.428	3.812
	Median		3.00	3.00	3.00
	IQR		5	6	8
UR3	Mean	9	0.56	0.11	-0.33
	Std Deviation		3.283	2.713	2.915
	Median		0.00	0.00	0.00
	IQR		3	3	4
UR6	Mean	9	1.89	3.78	2.00
	Std Deviation		5.036	4.868	5.244
	Median		0.00	4.00	0.00
	IQR		5	5	6

Table 2. Tooth mobility p-value results for the UR1, UR3 & UR6 teeth of Groups A1, A& A3 between 0-2 weeks, 0-4 weeks and 2-4 weeks.

Group		N	Asymp. Sig. (2-tailed)		
			0 – 2 weeks	0 – 4 weeks	2 – 4 weeks
A1	UR1	12	0.516	0.608	0.157
	UR3	12	0.391	0.490	0.860
	UR6	12	0.146	0.012	0.096
A2	UR1	11	0.527	0.180	0.739
	UR3	11	0.070	0.021	0.785
	UR6	11	0.024	0.011	0.107
A3	UR1	9	0.589	0.785	0.655
	UR3	9	0.336	0.168	1.000
	UR6	9	0.016	0.892	0.125

Table 3. Tooth mobility mean values, standard deviation, median and IQR for the 3 consecutive visits of Group B.

		N	Baseline	1 month	4 months
Group B	Mean	14	-0.29	-0.43	-0.43
	Std Deviation		1.773	2.441	2.277
	Median		0.00	-0.50	0.00
	IQR		2	2	2

Table 4. Tooth mobility p-value results of the pairs between the 3 visits for Group B.

	0 – 1 month	0 – 4 months	1 – 4 months
Asymp. Sig. (2-tailed)	0.717	0.944	0.483

TOOTH MOVEMENT

The tooth that was used to examine, identify and calculate tooth movement for Groups A1, A2 and A3 was the Upper Right 6 (UR6). The mean values of movement between the first visit and the second visit 2 weeks later and the first and third visit 4 weeks later, for all 3 groups (Group A1, A2 and A3), were approximately the same regardless of age or periodontal health. Statistical analysis showed no significant difference in tooth movement for Groups A1 and A2 but some indication of dependence for Group A3 *(Table 5 and 6*).

The mean values of movement for Group B between the day of the cementation of the restoration and 1 month later and the day of cementation and 4 months later are approximately the same, while the standard deviation is almost double the mean value between the day of the cementation and 4 months later. Statistical analysis showed no significant dependence and difference in tooth movement *(Table 7 and 8*).

DISCUSSION

TOOTH MOBILITY

The current literature on the *Periotest* Device regards it as a valuable, objective and a more sensitive tool at detecting periodontal damage which can be used in everyday clinical situations in practice, as well as clinical dental research.[17,18] It can measure tooth mobility very quickly, in a non-invasive way and without causing the patient any discomfort or pain. The tapping on the surface of the teeth is very light and doesn't increase the mobility in already periodontally compromised dentitions.

The success of the *Periotest* device as a diagnostic tool depends on various factors, such as the manipulation of the handpiece and the position of the head. Incorrect manipulation of the handpiece, results in erroneous readings. The ability also to reproduce the same readings over a period of time depends to a degree on the location of the tooth in the arches.

Table 5. Mean values, standard deviation, median and IQR in mm of the differences in movement between pairs of 3 consecutive visits for groups A1, A2 and A3.

		N	0-2 weeks	0-4 weeks
Group A1	Mean	12	0.044	0.047
	Std Deviation		0.023	0.041
	Median		0,040	0.035
	IQR		0.026	0.051
Group A2	Mean	11	0.073	0.048
	Std Deviation		0.083	0.061
	Median		0.031	0.030
	IQR		0.096	0.013
Group A3	Mean	9	0.041	0.033
	Std Deviation		0.011	0.016
	Median		0.038	0.032
	IQR		0.018	0.023

Table 6. Tooth movement p-value results for Groups A1, A2 and A3 between 0-2 weeks and 0-4 weeks.

	Asymp. Sig. (2-tailed) 0-2 weeks - 0-4 weeks
Group A1	0.480
Group A2	0.424
Group A3	0.051

Table 7. Mean values, standard deviation, median and IQR of tooth movement between pairs of the 3 consecutive visits for Group B.

		N	0-1 month	0-4 months
Group B	Mean	14	0.14	0.29
	Std Deviation		3.592	2.894
	Median		0.50	0.00
	IQR		2	2

Table 8. Tooth movement p-value results between baseline visit - 1 month and baseline visit - 4 months later for Group B.

	0-1 month - 0-4 months
Asymp. Sig. (2-tailed)	0.433

Anterior teeth are easier to access and correct manipulation of the handpiece is easier achievable. But in the case of posterior teeth and especially molars, the presence of lips and cheeks prevent the handpiece from being positioned horizontally and at a 90-degree angle to the buccal surface of the teeth.

Taking a closer look at the results *(Table 4)*, it is clear that tooth mobility was minutely affected by the placement of the new restoration. However, it was not significant enough to become apparent or cause any irreversible harm to the teeth[19] or discomfort to the participants. It was perceived as an increase in functional loading by the periodontal ligaments and it was dealt in the same way as any other force applied on the occlusal surface of a posterior tooth. The ligaments stretched to absorb the increased loading until the socket around the tooth adjusted to the new situation.

This inconsequential increase in tooth mobility can be attributed to the minor changes introduced to the occlusal surface of the new restoration. The morphology of the previous occlusal surface cannot be exactly reproduced. The new restoration fitted was assessed and adjusted according to the opposing teeth in order to avoid causing the patients any discomfort and in an attempt to match the formerly well-established occlusion. Once the occlusion was re-established through the new occlusal contacts, mobility returned to the prior normal levels and continued with the same values in all subsequent sessions.

TOOTH MOVEMENT

Teeth continue to move and reposition within the dental arch even after active eruption of the permanent dentition is completed. Through time and loading in a functioning occlusion, they wear and have a tendency to move mesially which is considered a physiological migration of the teeth. The alveolar bone follows this move and remodels itself constantly.[2]

The results of this study in different age groups and a group of periodontally compromised patients *(Table 5*) support the presence of this migration as part of the dynamic relationship of the stomatognathic system. Nevertheless, when examined closely they show no significant movement beyond that. The final position of the teeth between visits was found to be only few microns away from the previous one.

In the young adult population, the dentition is usually comprised of all their permanent teeth with the exception of teeth removed for orthodontic reasons or congenitally missing. In most cases these teeth are still intact and unrestored. Movement, therefore, of the teeth due to functional loading was only minimal between the three visits and on a daily basis.

In the older population, over the age of 30 years old, the dentition is not always complete. Factors such as poor oral hygiene, physiological wear due to age, pathological wear due to nutrition, stress, bruxism or harmful habits, missing teeth and restorations, all contribute in altering the occlusion and the relationship between the teeth year after year.

In addition to the variables mentioned above affecting the occlusion of older participants, diagnosed periodontal disease is detrimental to the relationship between opposing teeth over the years. This can be explained due to the loss of supporting hard bone tissue and the softer tissue surrounding them. The force of everyday functional loading is now absorbed easier, without significant stretching of the periodontal ligament or compression of the tooth in the socket. Inflammation of the periodontal soft tissues causes the fibers to be loose and as a result physiological tooth movement is not properly achieved.

One more variable that needs to be taken into account for all groups of patients is the compression created due to the force applied during impression procedures which can be manifested as tooth movement. This compression should be minimal and should not affect the final value of tooth movement more than a few microns at best.

The movement of the teeth in the arch is a combination of intrusion and extrusion [Dahl and Krogstad.[20-22] It is a constant changing balance that is influenced by the functional loads applied on the surface of the teeth on a daily basis. The occlusion establishes harmony between the two arches by maintaining occlusal contacts present between the opposing teeth. This fragile balance can be disrupted with the introduction of a new restoration but just as before, the occlusion will attempt to incorporate the new change and obtain harmony yet again.

Since the crowns for this study were constructed in the clinics by undergraduate dental students under the continuous supervision of their demonstrator, the proper occlusal examinations were performed before the crowns were ground and ultimately changed. This is the reason behind this more balanced and uneventful move between the 3 visits which closely resembles that of the physiological migration. Their inexperience was also a decisive factor for the operator students who were cautious with adjustments, evading the possibility of an over-adjusted crown.

Unfortunately, in general practice proper occlusal examination, such as the use of plain articulating paper, is not always offered nor is it at all times able to identify the presence or not of premature contacts and practitioners may opt to adjust the entire occlusal surface of the crowns blind. The patient's feedback, which is typically used, can also be misleading. All tooth contacts with the opposing teeth are removed and the surface is often flattened. The newly fitted crown is lacking contacts with the opposing arch and tooth movement is likely.

Moreover, during the impression taking process, the periodontal fibers connecting the teeth and the alveolar bone are slightly compressed, something that cannot be detected on the cast. A subsequent slight increase of the occlusal vertical dimension can be observed on the resulting restoration in the form of higher occlusal contacts. This increase, depending on the quality of the constructed crown, should be minimal and the occlusion should be able to adapt to it within few days.[22] Otherwise, it can be carefully adjusted by the practitioner, always taking into consideration not to over-adjust it, or a new restoration should be constructed

CONCLUSIONS

Within the limitations of this study the following conclusions can be reached:

1. There is no statistically significant change in tooth mobility due to masticatory and functional forces applied on the occlusal surfaces of the teeth
2. There is a non-statistically significant increase in tooth mobility following the cementation of a fixed restoration which is perceived as an increase in functional loading during the cementation process by the periodontal ligaments.
3. No statistically significant movement of the teeth that did not receive a new restoration, beyond the expected physiological migration.
4. Occlusion should be allowed to self-adjust to minor discrepancies following impression recordings through tooth movement without having to adjust the occlusal surface of the new restoration.
5. Reproducibility of the *Periotest* device recordings can be achieved for patients of all ages with or without healthy periodontium.

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