Dimensional Changes in Extraction Sockets: A Pilot Study Evaluating Differences between Digital and Conventional Impressions

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The Doctoral Dissertation
submitted to the Department of Dentistry
and the Graduate School of Yonsei University
in partial fulfillment of the requirements for the degree of
Ph.D. in Dental Science

Min-Woo Baek

December 2022

This certifies that the Doctoral Dissertation
of Min-Woo Baek is approved.

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The Graduate School
Yonsei University
December 2022

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Abstract

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Traditionally, soft tissue records are obtained by dental impression using impression materials; however, accurately recording the soft tissue immediately after tooth extraction is difficult. We measured the tissue changes after tooth extraction and compared two impression modalities (digital versus conventional) by measuring the changes at the soft tissue level. In this case, 15 patients with 17 single extraction sites were enrolled. Conventional impression (CI) using vinyl polysiloxane material and digital impression (DI) using an intraoral scanner were prepared immediately after extraction (T0) and at 2 months post-extraction (T1). Standard tessellation language files were generated for superimposition of the tissue surface. The tissue changes and discrepancies were measured on the superimposed surfaces. The differences in the changes and the discrepancy between the tissue surface impression at each time point were compared. At all measuring levels, the total tissue change was significantly different between groups DI and CI ($p < 0.05$). DI exhibited a more pronounced tissue surface at both time points, and the total discrepancy was statistically significantly greater at T0 than at T1 ($p < 0.05$). The values from DI and CI demonstrated small but significantly different for the same study material. The interpretation of such differences may depend on the clinical situation or scientific value.

Keywords: alveolar bone loss; digital technology; dental impression material; gingiva; tooth extraction

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I. Introduction

Tooth extraction leads to alterations in the surrounding tissues [1,2]. To date, many researchers have evaluated changes in the alveolar ridge following tooth extraction; how ever, the recent literature is chiefly confined to hard-tissue changes. Considering that the ridge is an entity comprising hard and soft tissues, it is necessary to gather data regarding ridge changes at the soft-tissue level.

Traditionally, soft-tissue records were obtained through dental stone cast models using various impression materials [1–3]. These stone models were serially sliced to analyze tissue changes in specific regions of interest [1,2]. However, despite such extensive efforts, precise matching between stone models prepared at different time points may be difficult to obtain because it is the human eyes that inevitably determine the matching.

Scanning of the stone model using a model scanner was later introduced. Three-di mensional (3D) digital images formatted as standard tessellation language (STL) files are generated using this method [4]. Intraoral scanners have enabled impression material/stone model-free processes [5]. Superimposing STL images from different time pointscan help analyze the differences in the tissue surfaces [3,6,7]. Regarding superimposition,best-fit alignment using an iterative closest point algorithm was applied to search for thebest matching location between datasets. However, this method often causes errors in minimizing the absolute distance between datasets regardless of the clinical outcome. To overcome this limitation, we attempted to align surface areas that underwent changes below a predefined threshold on the entire surface [8,9].

The abovementioned methodological improvement might prevent errors, including those resulting from improper impression/stone material preparation, an inaccurate technique of impression-taking/stone model fabrication, and dimensional changes in the materials, prior to the scanning process [10].

Intraoral scanning technologies have proven accuracy in generating meaningful andnovel data [11]. However, specific impression materials, such as vinyl polysiloxane, are highly accurate compared with other materials [12] and have been used to evaluate the accuracy of intraoral scanners [13]. Furthermore, digital impressions using intraoral scanners exhibit deviations according to the scanning device type, scanning range, and intraoral environmental conditions, such as bleeding or mobile tissues [11,14–16].

Therefore, there is a need to compare tissue surface changes according to the impression methods (digital or conventional). Impression material/stone model-free processes using an intraoral scanner and the subsequent production of STL files have become popular for analyzing and comparing tissue changes at the soft-tissue level [14,15]. Extensivedata on tissue changes have already been obtained from conventional methods using impression materials and stone models. However, even in recent studies, conventional methods were used because of the unavailability of intraoral scanners and maintenance of the same technique employed at study initiation. By comparing the digital and conventionalmethods, the effect of the soft tissue-recording technique on the targeted outcomes and the creditability of past data could be appraised.

The aims of this study were (1) to evaluate the effect of two modalities (digital versus conventional impressions) for evaluating tissue changes at the soft-tissue level and (2) to investigate the factors affecting the recording of such tissue changes.

II. Materials & Methods

1. Study Design

In this case, 17 Patients requiring tooth (teeth) extraction (19 teeth) were initially recruited between January 2019 and August 2019 in the Department of Periodontology, Veterans Health Service Medical Center. We performed both conventional impression-making and intraoral scanning for each patient to record the soft-tissue condition. This study was approved by the institutional review board (IRB) of Veterans Health Service Medical Center (BOHUN IRB No. 2018-12-033) and conducted in accordance with the tenets of the 1975 Declaration of Helsinki and its subsequent revisions. Written informed consent was obtained from all participants before commencing the study.

2. Inclusion/ exclusion criteria

The inclusion criteria were as follows: (1) extraction of tooth (teeth) without simultaneous bone grafting, (2) application of appropriate oral hygiene for dental surgery, and (3) keratinized gingival height of > 2 mm in the mid-facial area of the tooth.

The exclusion criteria were as follows: (1) extraction of serially positioned teeth, (2) malpositioned tooth(teeth), (3) heavy smoking habit (> 10 cigarettes per day), (4) uncontrolled systemic diseases, (5) untreated periodontal disease, (6) pregnancy, (7) head and neck radiation, and (8) alcoholism and drug addiction.

3. Tooth extraction

Gentle tooth extraction was performed by a single experienced investigator using an elevator and forceps (D-W. L). The granulation tissue was carefully removed with extra care to avoid interrupting the integrity of the marginal gingival tissue. Suturing was not performed at all extraction sites. According to the clinician's preference, antibiotics and analgesics were prescribed for 3–5 days. For 7 days, The patients were recommended to perform mouth gargling using chlorhexidine (Hexamedine; Bukwang, Seoul, Korea).

4. Digital and conventional impression

Digital and conventional impressions were performed immediately after tooth extraction (T0) and two months after extraction (T1).

Intraoral scanning

To minimize the effect of the impression material on the tissue, we performed intraoral scanning prior to the conventional impression-making. Intraoral scanning covered at least two neighboring teeth or a prosthetic structure from the experimental site. Before scanning, saliva was removed from the site to be scanned using cotton rolls and an air syringe. The scanning started from the occlusal surface of the neighboring teeth antero-posteriorly (i500, Medit, Seoul, Korea) and proceeded to the facial area of the ridge. Apico-coronally, the extent of the scan was limited up to the area at least 2–3 mm below the mucogingival junction. The same procedure was performed on the oral areas of the ridges. Finally, the scanned image was carefully inspected, and areas with poor image quality and missing data were scanned again to obtain an optimal image quality. Finally, The image data were saved as STL files (group DI) (Figure 1).

Conventional impression

Following intraoral scanning, conventional impression was procured using vinyl polysiloxane impression material according to the manufacturer's instructions (Imprint II Garant, 3M ESPE, Seefeld, Germany). A partial impression tray was used. scannable type IV gypsum (Uni-base 300, Dentona, Germany) was poured on the retrieved impression and stored at a room temperature of 21–23°C for 96 h, which was necessary for the expansion of the gypsum. The gypsum model was then scanned using a scanner (i500). The obtained image data were saved as STL files (group CI) (Figure 1).

5. Superimposition of the STL files and measurement

Before the main analysis, five test sets that were not relevant to the present study were given to an investigator (M.-W.B.) for training. Superimposition and measurements using those test sets were performed under the supervision of the senior investigator (K.-T.N.). Then, the results from two investigators were compared. Those were repeated until the interclass correlation coefficient reached at least 0.85.

The STL files were superimposed using an image analysis software (Geomagic Control X; Geomagic, Morrisville, NC, USA). The initial overlap was performed using a rough best-fit alignment algorithm based on the selected points, such as the cusp of the adjacent teeth/prothesis (Figure 2A). The files were then superimposed through the best-fit alignment process using neighboring teeth/prosthesis surfaces [1].

On the superimposed images, two references were made: (1) a long axis of the extracted tooth and (2) a line perpendicular to the tangent of the dental arch at the midpoint of the extraction site. Subsequently, the total (between the facial and oral surfaces), facial (on the facial surface), and oral changes (on the oral surface) in the soft tissues were measured on each superimposed match (Figure 2B).

6. Statistical analysis

The Sample size was not calculated owing to the exploratory nature of the study.

The Shapiro-Wilk test was performed to determine the normal distribution of the data. Thereafter, a paired t-test or Mann-Whiteney U test was performed to evaluate the statistical differences between the ridge changes recorded in the digital and conventional impressions and the discrepancies between the digital and conventional impressions at T0 and T1. Bland-Altman plots were used to compare the ridge changes measured on the digital and conventional impressions. Additionally, potential factors affecting the ridge changes or discrepancies in relation to the impression methods were evaluated (sex, periodontal destruction and molar/non-molar, maxilla/mandible, time points). For this purpose, a linear mixed model was applied. Statistical significance was set at $p < 0.05$.

III. Result

Among the recruited patients, two patients exhibited a lack of keratinized tissue on the extraction sites (one site for each patient) at two months after extraction. Due to the mobility of the non-keratinized tissue, those patients were excluded, leaving 17 extraction sites in 15 patients (mean age: 67.07 ± 3.44 years). Site-wise, 13 maxillary teeth (non-molar: n = 8, molar: n = 5) and 4 mandibular teeth (non-molar: n = 0, molar: n = 4) were included.

1. Clinical healing

All extraction sites exhibited uneventful healing. No patient showed adverse signs, such as pus discharge, persistent bleeding, bone exposure, or prolonged pain.

2. Digital versus conventional impressions

At most experimental sites, the gingival margins moved apically over time, resulting in five sites presenting a gingival margin at the 1 mm level at T1 (the levels for measurement were established on the images obtained at T0). In this case, 17 sites were available for measurement at the 2- and 3-mm levels and 14 sites at the 4 mm level (owing to mu cogingival junction). However, statistical analysis was not performed for the 1 mm level owing to the small sample size

Difference between digital and conventional impressions in terms of tissue change over time

Group DI exhibited greater tissue changes at all levels in terms of the total, facial, and oral changes than did group CI. In both groups, the total, facial, and oral changes were the greatest at the 2 mm level, followed by the 3- and 4-mm levels. At all levels, the facial tissue changes were greater than the oral tissue changes (Table 1).

The tissue change at each level is presented in Table 1. Significant differences were present at all levels regarding the total tissue changes, at the 3- and 4-mm levels for the facial tissue changes, and at the 2 mm level for the oral tissue changes ($p < 0.05$) (Figure 3A).

Figure 4 (Bland–Altman plots) shows the agreement of the ridge changes measured on the digital and conventional impressions. In these plots, the x-axes indicate the average value of the ridge changes, and the y-axes represent the difference in the values on the digital and conventional impressions. The values were 0.13, 0.1, and 0.09 mm greater in group DI than in group CI at the 2-, 3-, and 4-mm levels.

Discrepancies between digital and conventional impressions in terms of recording tissue status at each time point

At all levels on all analyzed aspects, the discrepancy between digital and conventional impressions was generally greater at T0 than at T1 (Table 2).

The discrepancies in the total ridge width were between 0.41 ± 0.24 and 0.48 ± 0.23 mm at T0 and between 0.31 ± 0.21 and 0.35 ± 0.19 mm at T1. In terms of the facial and oral tissue changes, the corresponding values were between 0.18 ± 0.12 and 0.23 ± 0.12 mm (facial) and between 0.21 ± 0.18 and 0.24 ± 0.18 mm (oral) at T0, respectively, and between 0.12 ± 0.10 and 0.16 ± 0.10 mm (facial) and between 0.18 ± 0.14 and 0.19 ± 0.14 mm (oral) at T1, respectively. For the discrepancies noted between T0 and T1, significant differences were present at all levels at both time points ($p < 0.05$), except for the 2- and 3-mm levels for the oral tissue changes (Figure 3B).

Factors affecting tissue changes over time and discrepancies according to the time points

We included several factors that could potentially influence the tissue changes over time and discrepancies according to the time points. Among them, sex, periodontal destruction, and molar/non-molar were not significant factors in the initial screening statistical analysis, leaving maxilla/mandible, digital/conventional impressions, or T0/T1. Maxilla/mandible, digital/conventional impressions, and T0/T1 were then included in the statistical models. The following presented significant influences: (1) tissue change over time: digital/conventional impressions at the 2- and 3-mm levels for the total ridge width and at the 3 mm level for the facial tissue change and maxilla/mandible at the 2 and 3 mm levels for the total ridge width and at the 3 mm level for the oral tissue change; (2) discrepancy according to the time points: maxilla/mandible and T0/T1 at the 3 mm level for the facial tissue change ($p < 0.05$).

IV. Discussion

This study revealed the effects of impression modalities (digital vs. conventional impressions) on evaluating tissue changes at the soft-tissue level and potential factors affecting these tissue changes. We found that (1) the total tissue changes were significantly greater with digital impression than with conventional impression, and (2) the discrepancy between the two modalities was significantly greater immediately after tooth extraction than at two months after extraction.

Information regarding tissue changes is currently a major research interest, especially in implant dentistry. Until recently, hard-tissue changes were primarily investigated via cone-beam computed tomography and the resultant acquisition of DICOM files [16]. However, there was methodological difficulty in measuring soft-tissue changes. Previously, dental impressions were taken for soft-tissue analysis. [1–3] Much of the data we referred to were produced using this method. However, digital impressions using the intraoral scanning technology have been propagated, excluding some steps in previous methods and seemingly enhancing the accuracy of the soft-tissue analysis.

Some studies compared digital and conventional impressions for palatal soft tissue registration [13,17]. In one study, a digital impression was compared with a vinyl polysiloxane impression, resulting in 130.54 ± 33.95 μm difference between them [13]. Of note, this difference was greater than the value from the area of full dentitions (80.01 ± 17.78 μm) even though the difference between digital and conventional impressions appeared to be minor. In the other study, the digital impression was compared with an irreversible hydrocolloid impression, exhibiting that the difference between them was 0.02 ± 0.07 mm [17]. Those studies are limited to the evaluation performed at a one-time point. More recently, the interest regarding soft tissue seems to be focused on the change following a specific treatment or over time. In line with this, one study compared digital and conventional impressions in periodontally healthy patients to test accuracy between the two methods and then investigated soft tissue change after periodontal treatment for periodontitis patients using digital impression [15]. In that study, the difference between digital and conventional impressions in periodontally healthy patients was 70.71 ± 25.58 μm. The change of the gingival volume in periodontitis patients was 433.43 ± 227.55 mm3.

Our study selected the post-extraction ridge change to compare tissue changes measured using conventional and digital impression methods. Herein, groups DI and CI presented significantly different ridge changes for the same study material, with greater values in group DI (total ridge change, 3.53 ± 1.00 vs. 3.40 ± 1.02 mm at the 2 mm level, 2.75 ± 0.97 vs. 2.65 ± 0.97 mm at the 3 mm level, and 2.08 ± 0.87 vs. 1.64 ± 1.12 mm at the 4 mm level). Such discrepancies should be interpreted carefully. According to some clinicians, these discrepancies might be clinically negligible based on the findings of studies that used an arbitrary 1 mm threshold value as an esthetic criterion. According to other clinicians, such differences should be treated more discretely because studies on the investigation of soft-tissue changes showed that the changes in the designated level of interest were measured to the first decimal place (mm). For example, the following findings were previously obtained: less than 1 mm of soft-tissue gain in the majority of the points of interest for root coverage outcomes in the study by Gil and colleagues [18]; 0.22 ± 0.48 and 0.83 ± 0.61 mm of soft-tissue volume gains around the implants with specific tissue grafts in the study by Rojo and colleagues [19]; and 0.15–0.32 mm of soft-tissue volume changes at one year and 0.45–0.66 mm at five years after implant treatment in the study by Sapata and colleagues [20].

The discrepancy in the values of ridge changes between groups DI and CI was derived from the inter-group difference in the STL images at each time point (T0 and T1). At both T0 and T1, the total ridge width for the same material was greater in group DI than in group CI, and the values were not disproportionate in one aspect, either in the facial or oral aspect. This inherent discrepancy between the groups was not offset when calculating the change in the tissue surface for each modality. It should be also noted that the differences between groups DI and CI were greater at T0 than at T1. Tissue conditions might affect the recording. Gingival tissues unsupported by the bone or tooth might be susceptible to pressure from the impression material. In particular, the gingival tissue might have suboptimal tissue consistency immediately after tooth extraction.

In many studies, the accuracy of intraoral scanning has been evaluated by measuring the discrepancies among different models [10,12,21]. Accuracy involves “precision” and “trueness”. In the study context, precision is defined as the difference between digital impressions from different intraoral scanners and trueness as the difference between digital impressions from the test scanner and the reference impression. Herein, we did not evaluate the precision because it was not suitable for our study. However, given that the vinyl polysiloxane impression was regarded as a reference, comparing the groups can be considered an evaluation of trueness [15]. With such definition, the trueness of the gingiva on a full arch scale was 83.65 ± 14.43 μm in periodontally healthy patients. In the study involving only the upper jaw, the trueness of the palatal tissue was 130.54 ± 33.95 μm. By referring to the trueness of this previous literature, we tried to evaluate the discrepancy between the two modalities of our study. The discrepancy was more prominent in our study than in these previous studies (between 0.41 ± 0.24 and 0.48 ± 0.23 mm at T0 and between 0.31 ± 0.21 and 0.35 ± 0.19 mm at T1). However, the following should be considered: (1) In other studies, digital impression obtained using an industry-grade scanning device was used as a reference [13,22]. Again, an issue regarding the accuracy of the impression concerning the actual tissue situation may be posed. Thus, the use of the term "trueness" here may leave room for further speculation. Moreover, this term in this study was utilized only to manifest the difference between the two modalities, not to attest to the superiority or inferiority of the modalities. (2) Bleeding from the extraction socket (at T1) may reflect light from the scanning device and obscure the boundaries of the extraction socket. These cause inaccuracy in some areas [11].

Despite the issues mentioned, the values measured in our study are in line with those reported in a systematic review [23], demonstrating 3.79 ± 0.23 mm of horizontal reduction in the ridge width. However, the study also showed that ridge resorption could continue for over three months after tooth extraction. Thus, some changes in the values from this study may be expected if more extended observation periods are established.

We investigate several factors that could influence the tissue change over time and discrepancies according to the time points. Among the factors (except the impression modalities and time points), the jaw (maxilla or mandible) significantly affected the tissue changes and discrepancies, which is in line with previous findings [1]. Such an effect might be related to bone morphology and tissue thickness. Areas with a flat ridge morphology, such as the maxillary palatal area and mandibular buccal shelf, have low pressure, and where the ridge morphology is sharp, the pressure is high. The thicker the tissue, the lesser influence it has on bone morphology, and the lesser the discrepancy in the maxilla with thick tissue [24–26].

Our study has some limitations. First, the sample size was small. Second, the effects of intraoral scanning devices were not investigated. Third, the baseline was set immediately after tooth extraction. Inconsistencies in some tissue parts at this stage might have affected the study results. Based on the results of this preliminary study, further research is needed in a larger sample.

V. Conclusion

Within the limits of this study, the total tissue change after tooth extraction was significantly greater with digital impressions than with conventional impressions, even though the numerical difference was clinically negligible. Depending on tissue status, the tissue recording can be affected by impression modalities.

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Figure legends

Figure 1. Flow and design of the study. T0: immediately after tooth extraction, T1: 2 months after extraction.

Figure 2. Superimposition and measurement. (A) Standard tessellation language file acquisition and superimposition using the best-fit alignment process, (B) measurement on the superimposed tissue surfaces.

Figure 3. Box plots represent the discrepancies between the ridge changes measured in groups DI and CI and between the time-wise intergroup differences. (A) Total tissue changes in group DI and CI, (B) difference between the groups at T0 and T1. H2: 2mm below the ridge crest, H3: 3mm below the ridge crest, H4: 4mm below the ridge crest, T0: immediately after tooth extraction, T1: at 2 months after extraction, group CI: conventional impression using vinyl polysiloxane impression material, group DI: digital impression using an intraoral scanner, $^{*}p < 0.05$

Figure 4. Bland-Altman plots. (A) At the 2-mm level, (B) At the 3-mm level, and (C) At the 4-mm level. H2: 2mm below the ridge crest, H3: 3mm below the ridge crest, H4: 4mm below the ridge crest.

Table

Table 1. Linear tissue change over time according to impression technique

		Group CI	Group DI	
		Mean ± SD (mm) **median (IQR) (mm)**	**Mean ± SD (mm)** **median (IQR) (mm)**	**P-value**
Total	H2	3.40 ± 1.02 3.45 (2.77, 4.21)	3.53 ± 1.00 3.65 (2.97, 4.02)	<0.001* 0.002*
	H3	2.65 ± 0.97 3.15 (1.91, 3.37)	2.75 ± 0.97 3.29 (2.04, 3.45)	<0.001* <0.001*
	H4	1.99 ± 0.88 2.12 (1.40, 2.63)	2.08 ± 0.87 2.20 (1.43, 2.80)	0.033* 0.019*
Facial	H2	2.21 ± 0.57 2.29 (2.08, 2.72)	2.29 ± 0.59 2.40 (2.08, 2.76)	<0.001* <0.001*
	H3	1.78 ± 0.58 1.87 (1.36, 2.22)	1.86 ± 0.62 1.92 (1.43, 2.29)	0.001* 0.001*
	H4	1.44 ± 0.61 1.54 (1.05, 1.76)	1.50 ± 0.62 1.60 (1.10, 1.87)	0.005* 0.003*
Oral	H2	1.19 ± 0.56 1.13 (0.88, 1.50)	1.25 ± 0.56 1.15 (0.97, 1.67)	0.139 0.020*
	H3	0.87 ± 0.56 0.93 (0.56, 1.33)	0.90 ± 0.56 0.94 (0.56, 1.43)	0.277 0.060
	H4	0.55 ± 0.43 0.58 (0.12, 0.95)	0.57 ± 0.41 0.64 (0.18, 0.89)	0.347 0.139

Group CI: conventional impression using vinyl polysiloxane impression material, group DI: digital impression using an intraoral scanner, SD: standard deviation, IQR: interquartile range, H2: 2 mm below the ridge crest, H3: 3 mm below the ridge crest, H4: 4 mm below the ridge crest. *Statistically significant difference ($p < 0.05$).

Table 2. Discrepancy between two impression techniques at each time point.

		T0	T1	
		Mean ± SD (mm) **median (IQR) (mm)**	**Mean ± SD (mm)** **median (IQR) (mm)**	**P-value**
Total	H2	0.48 ± 0.23 0.42 (0.33, 0.53)	0.35 ± 0.19 0.33 (0.22, 0.55)	<0.001* 0.003*
	H3	0.41 ± 0.24 0.35 (0.23, 0.55)	0.31 ± 0.21 0.22 (0.15, 0.46)	<0.001* <0.001*
	H4	0.42 ± 0.26 0.45 (0.24, 0.61)	0.31 ± 0.23 0.28 (0.15, 0.44)	0.002* 0.002*
Facial	H2	0.23 ± 0.12 0.23 (0.15, 0.32)	0.16 ± 0.10 0.15 (0.11, 0.23)	<0.001* <0.001*
	H3	0.20 ± 0.10 0.22 (0.13, 0.27)	0.13 ± 0.11 0.11 (0.06, 0.18)	0.001* 0.001*
	H4	0.18 ± 0.12 0.24 (0.07, 0.28)	0.12 ± 0.10 0.11 (0.01, 0.22)	0.005* 0.003*
Oral	H2	0.24 ± 0.18 0.18 (0.14, 0.32)	0.19 ± 0.12 0.18 (0.11, 0.23)	0.139 0.017*
	H3	0.21 ± 0.18 0.17 (0.12, 0.33)	0.18 ± 0.14 0.18 (0.11, 0.23)	0.277 0.055
	H4	0.24 ± 0.18 0.22 (0.12, 0.37)	0.19 ± 0.14 0.20 (0.11, 0.27)	0.015* 0.011*

H2: 2 mm below the ridge crest, H3: 3 mm below the ridge crest, H4: 4 mm below the ridge crest, T0: immediately after tooth extraction, T1: 2 months after extraction, SD: standard deviation, IQR: interquartile range *Statistically significant difference ($p < 0.05$).

Figures

Figure 1

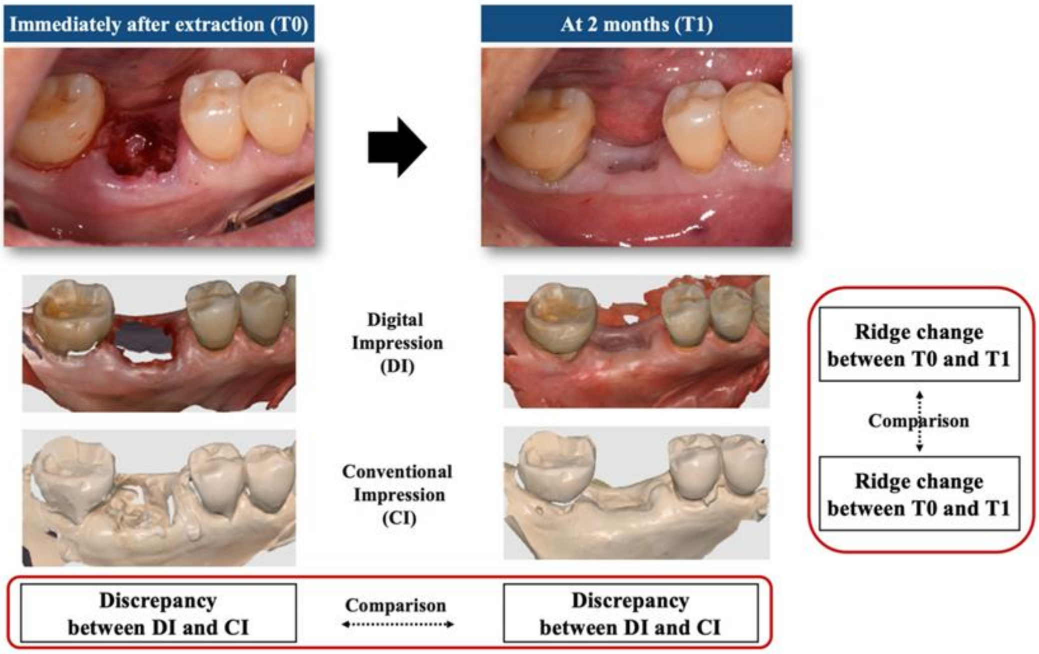


Figure 2

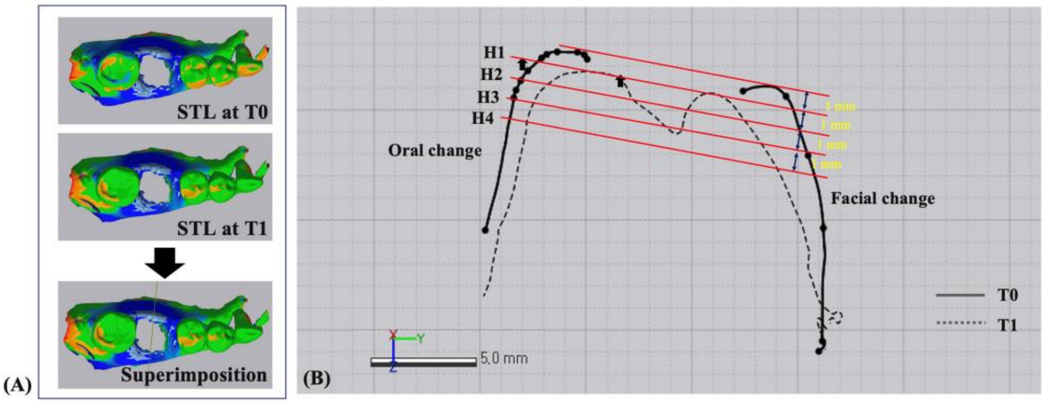

STL at T0
STL at T1
Superimposition
(A)
H1
H2
H3
H4
Oral change
Facial change
1 mm
1 mm
1 mm
1 mm
T0
T1
5,0 mm
(B)

Figure 3

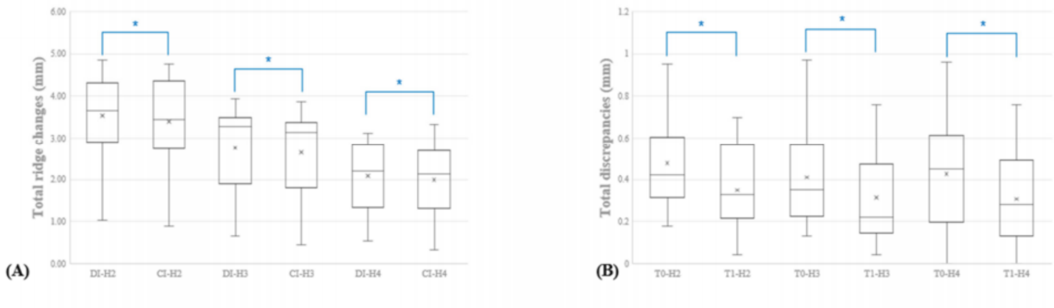
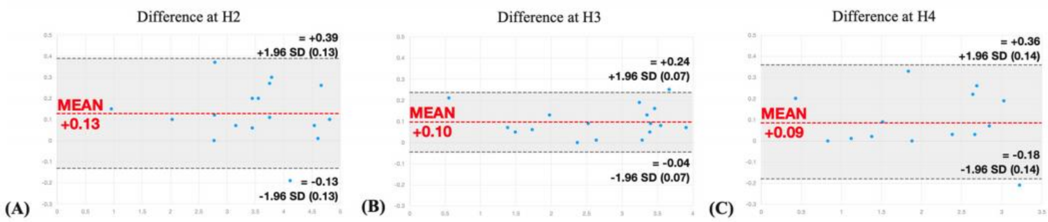

Total ridge changes (mm)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
(A)
DI-H2
CI-H2
DI-H3
CI-H3
DI-H4
CI-H4
Total discrepancies (mm)
1.2
1
0.8
0.6
0.4
0.2
0
(B)
T0-H2
T1-H2
T0-H3
T1-H3
T0-H4
T1-H4

Figure 4


Difference at H2
= +0.39
+1.96 SD (0.13)
MEAN
+0.13
= -0.13
-1.96 SD (0.13)
(A)
Difference at H3
= +0.24
+1.96 SD (0.07)
MEAN
+0.10
= -0.04
-1.96 SD (0.07)
(B)
Difference at H4
= +0.36
+1.96 SD (0.14)
MEAN
+0.09
= -0.18
-1.96 SD (0.14)
(C)

국문요약

발치와의 체적변화 : 디지털 인상법과 기존 인상법의 차이를 평가하는 선행연구

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백 민 우

발치 후 발생하는 연조직 변화는 인상채득과 석고모형을 이용하는 방법으로 기록되어왔다. 하지만 이러한 방법을 이용했을 때, 인상재로 인한 오류와 서로 다른 시점에서의 모형에 대한 주관적인 비교 등으로 인한 오류가 생길 수 있다. 구내스캐너를 이용하여 연조직의 디지털 이미지를 생성하고, 디지털 이미지를 이용하여 주관적인 비교를 피할 수 있다면 이러한 오류가 줄어들 수 있을 것이다.

본 연구의 목적은 연조직의 발치 후 변화량을 평가하는데 구내스캐너를 이용하는 방법과 기존의 인상채득과 석고모형을 이용하는 방법을 비교하여 두 방법이 기록에 미치는 영향을 평가하고, 연조직 변화량을 측정하는데 영향을 줄 수 있는

요소를 분석하는 것이다.

15명의 환자, 17개의 발치와를 대상으로 연구를 진행하였다. 발치 직후와 발치 후 2개월 지난 시점에서 구내스캐너와 실리콘 인상재를 이용하여 인상 채득하고 디지털 이미지를 생성하였다. 디지털 이미지를 중첩하여 발치 후 발생한 연조직 변화량을 측정하고 각 시점에서, 두 방법 이용했을 때의 차이를 측정하였다. 발치 후 연조직의 총 변화량은 치은 변연을 기준으로 2mm 하방에서 3.53 ± 1.00 mm vs. 3.40 ± 1.02 mm, 3mm 하방에서 2.75 ± 0.97 mm vs. 2.65 ± 0.97 mm, 4mm 하방에서 2.08 ± 0.87 mm vs. 1.64 ± 1.12 mm로 측정되었다. 구내스캐너를 이용했을 때 변화량이 더 크게 측정되었고, 이는 유의한 차이를 보였다. ($p<0.05$) 각 시점에서 구내스캐너를 이용하였을 때 연조직이 더 크게 측정되었고, 발치 후 2개월이 지난시점에 비해 발치 직후에서 그 차이값이 컸다.($p<0.05$) 또한 상악/하악의 요소가 연조직의 변화량과 두 방법간 차이에 영향을 주었다. ($p<0.05$)

연조직 인상채득 및 연조직의 변화량 평가시 구내스캐너를 이용하는 방법과 인상재를 이용하는 방법사이 유의한 차이가 있었고 그 값이 비록 작지만, 임상적 상황 등에 따라 유의한 차이값이 될 수 있을 것이다.

핵심되는 말 : 치조골 소실; 치은; 디지털 기술; 치과 인상; 치아 발치