THE EFFECT OF MOUTH REMAINING OPEN OR CLOSE ON THE DEPTH OF MANDIBULAR ALVEOLO-BUCCAL VESTIBULE DURING IMPRESSION RECORDING.

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ABSTRACT

Objective: To examine the effect, on the depth of mandibular alveolo-buccal vestibule, of mouth remaining open or closed at the impression recording stage.

Methodology: In the first place, in each of the 5 dentate subjects, with their teeth in light occlusion and no biting force, 5 recordings of the alveolo-buccal vestibule were obtained by injecting a cartridge type VPS impression material (Exahiflex, GC, Corp, Tokyo, Japan). Impressions were made in controlled manner with the subjects performing a standard lip protrusion and retrusion exercise three time to shape the material accordingly. The procedure was then repeated in the same manner except the subjects keeping their opposing teeth apart by 10mm using a custom made bite-block fitting the central incisor teeth. For each subject, a mandibular arch stone-cast was also prepared from an alginate impression (Aroma Fine Mixer Type, GC, Corp, Tokyo, Japan). The vestibular impressions were modified by removing the portion above the gum margins so as to leave the occlusal surfaces and the coronal third of teeth uncovered when adapted to their stone-casts. Subsequently, each of the impression on its cast was carefully sectioned between reference lines drawn on the cast to connect selected points on the occlusal surfaces of second molar (M2), first molar (M1), second premolar (P2) and first premolar (P1) teeth with a corresponding point at the peripheral land around the sulcus. In all cases, these lines crossed the deepest part of the gum margin around the teeth and were made parallel to each other. After cutting, the mesial face of each impression section was scanned with Twain 32, Epson Twain Pro Version 1.5, at 400 resolution against a mm ruler . Using the Photo-Editor Software (Microsoft Co, USA) in an IBM compatible computer, the depth of the alveolo-buccal vestibule at the selected locations was determined between the deepest part of the gum margin and the peripheral-most outline of the impression section representing the sulcus. The data obtained were analyzed statistically, for significance of the within and between subjects variations, using student t-test and paired t-test respectively.

Results: In the results, the depth of the alveolo-buccal vestibule was significantly less with the close-mouth method than that with the open-mouth method. In general, a depth reduction, ranging between 11.5 to 18.6 %, was observed with the highest amounts of reduction between the first molar and second molar (M2-M1) region.

Conclusion: *Decreased vestibular depth will be recorded when using an open-mouth impression technique.*

Key Words: *Alveolo-buccal Vestibule, Sulcus depth, Open-mouth, Closed-mouth, Impression recording.*

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CLINICAL IMPLICATIONS: *Recording of impression of the buccal vestibule in dentate subjects with teeth-occluded (close-mouth) and with teeth-apart (open-mouth) have shown to affect the depth of the vestibule. Similar effects are expected to be translated when recording impression for replacement complete dentures or relining old dentures in edentulous patients, particularly in those with anticipated denture retention and stability problems. Therefore, it is emphasized that these effects should be considered when planning treatment for complete denture patients so as to maximize treatment success.*

INTRODUCTION:

There is an abundant literature pertaining to the explanation of peri-oral muscle attachments and the anatomical landmarks bordering the vestibules of mouth.[1-8] However, the methods for its recording

during impression are based on personal clinical judgment and experience.

Many features have been considered important for incorporating stability and retention in complete dentures.[9 - 22] Firstly, the denture base should be fabricated on a cast exhibiting exact reproduction of tissue details of the denture supporting tissues. Bearing in mind the dangers of encroachment on functional muscle attachments, it is also necessary that the base of the denture is maximally extended for a wider coverage, not only to minimize the concentration of functional stresses on a unit area, but also to involve a larger surface area in its retention due to physical factors. Lastly, adaptation of the denture base to the musculature of the oral cavity is required for securing both the active and passive muscular fixation, because muscle activity is a factor transcending all other factors responsible for denture retention.

The most important muscles involved in the active and passive muscular control phenomenon of a lower denture include the buccinator, orbicularis oris and the intrinsic and extrinsic muscles of the tongue.[10] Using impression materials developed over the years, many impression techniques, including mucostatic, tissue displacement, functional, one-step, multiple-step border moulding, open and close-mouth and many others are being practiced for the recording to be an acceptable impression conducive to function.[8, 23 - 38] The philosophy behind the development of so many diverse impression techniques was to effectively utilize the retention-enhancing potential of the border seal and the effect of properly contoured and polished surfaces against a functioning musculature.[20, 39] As the total area of support from the mandible, anatomically, is far less than that from the maxillae, the importance of a proper determination of the outline of the mandibular foundation area is always emphasized.[40] However, despite these, confusion and lack of precision exists regarding the desired amount of pressure and the resultant tissue displacement necessary for recording an impression for a lower denture.[32,41-42] Keeping this in view, a clinical study was made to investigate if mouth opening had any effect on the depth of alveolo-buccal vestibule.

SUBJECTS AND METHODS:

A number of adult subjects from the staff and graduate students at the Department of Geriatric Dentistry, Tohoku University School of Dentistry, Sendai (Japan) participated in this study. Subject selection criteria included; subject to have an intact arch with permanent teeth on the side of impression recording and healthy gum margins. All participants were explained the scope of the study as well as the instructions they had to follow regarding the procedures set for the experimental protocol explained below.

Landmarks for measuring the depth of buccal vestibule:

For each subject, a cast in dental stone having W/P (0.2) and setting expansion upto 0.08 % (New Fuji Rock, GC, Corp, Tokyo, Japan) was prepared using a mandibular impression in alginate (Aroma Fine Mixer Type, GC, Tokyo, Japan). The base for the cast was prepared following the routine and recommended method but with an extended plaster-land around the periphery of the buccal sulcus which allowed the recorded impression to be positioned for sectioning at pre-determined locations (detailed below). On each cast, reference points on each molar and pre-molar tooth (in line with the most-concave part of the gingival margin of the tooth) were identified and marked with a sharp pencil. These points were used to scribe vertical lines connecting a corresponding point identified and marked on the border-land of the cast around the peripheral out-line of the sulcus in a manner so that the lines so drawn were in parallel relationship with each other (Figure 1).

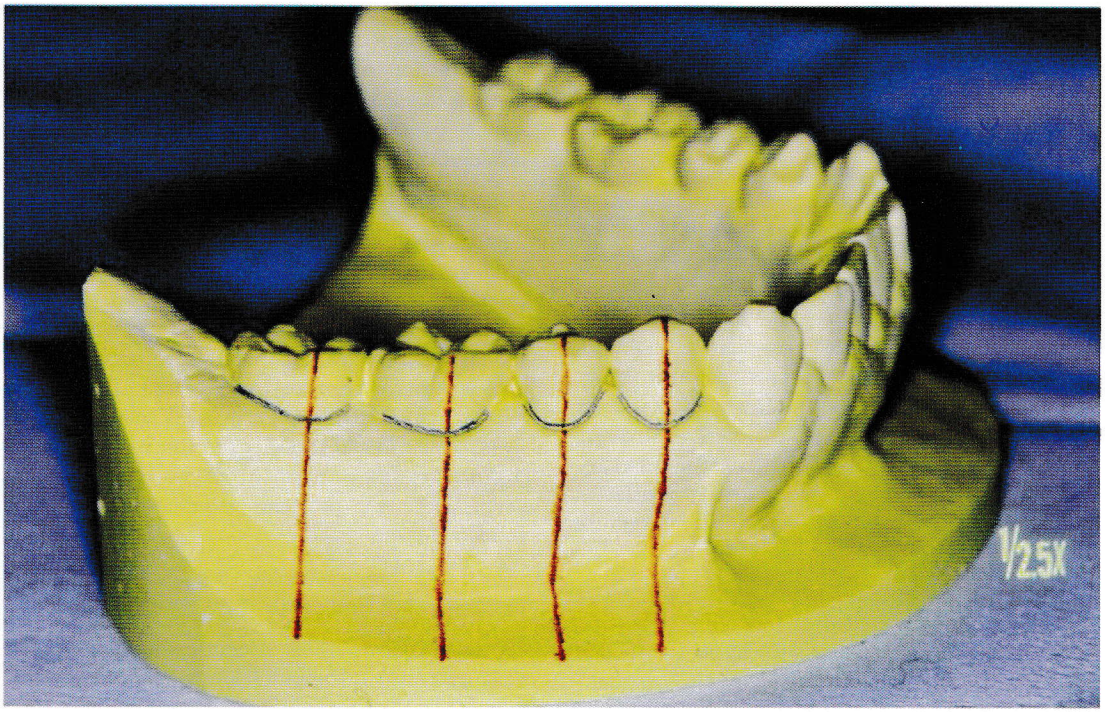

Fig. 1. A cast with reference lines drawn for sectioning the impression.

Impressions procedures:

A minimum of five recordings of the right mandibular buccal sulcus for all subjects (except one) was obtained by using a medium viscosity cartridge type vinyl-polysiloxane impression material (Exahiflex, GC, Corp, Tokyo, Japan). The cartridge containing the impression material and loaded in its gun was kept refrigerated (Medicool, Sanyo, Co, Tokyo, Japan) except when required for use. After drying the sulcus, using a jet air spray, it was directly loaded with the impression material through the tip of the cartridge in a controlled manner.

In the first instance, the subject, while keeping his teeth in light occlusion with no tension in the muscles, manipulated the peri-oral muscles three times with a controlled and standardized lip protrusion and re-trusion exercise so as to shape and adapt the impression material in place. The subject kept teeth so shut until the impressions of the vestibule were recovered from his mouth when it was completely set. The same procedure was then repeated for each subject in the same manner except the subject teeth were kept out of occlusion with a custom made bite-block allowing a 10 mm fixed mouth opening. The bite-block, made in composition impression material and positioned inter-incisally with no active bite force, facilitated the maintenance of a standardized mouth opening until the impression material packed and adapted in the sulcus, achieved its complete setting. A specimen impression, recording the buccal vestibule, is shown in Figure 2.

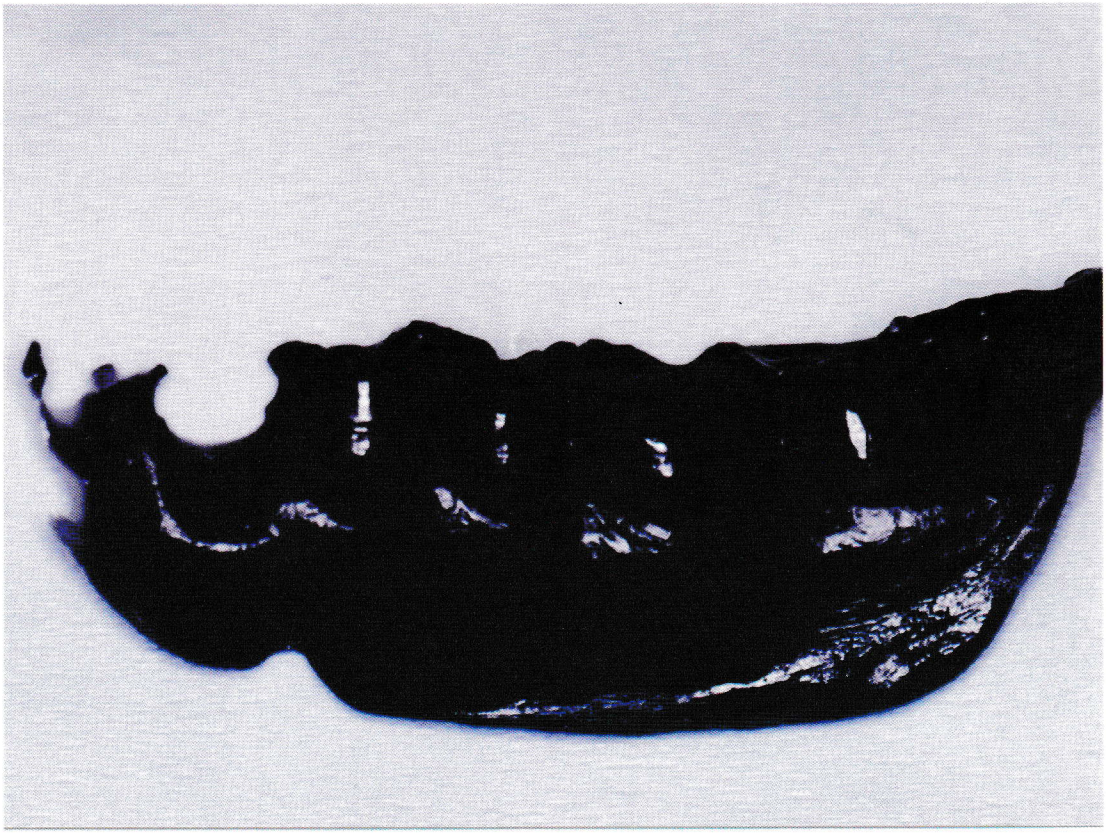

Fig. 2. An Impression recording of the buccal vestiblue.

Measurement methods:

Each of the buccal vestibular impressions for each subject was adapted to the individual cast. The occlusal portion of the impression was removed with a sharp pair of scissors to expose the lines drawn on stone teeth of the cast. Following this, each of the impression was then sectioned along its length in lines with the pre-determined lines drawn on the cast. The mesial surfaces of the sections were numbered for identification, and for measurement of their lengths to be made between the area bordered by the most-concave part of the gingival margins and the peripheral-most contour out-lines of the sulcus.

Measurements for the depth (occluso-apical length) of buccal vestibule were made at regions corresponding to molars and premolar teeth. This facilitated for obtaining measurements at the location of second molar (M2), first molar (M1), second pre-molar (P2) and first pre-molar (P1) as one proceeds in a postero-anterior direction.

To accomplish the above measurements precisely, the mesial surfaces of each of the impression sections for all subjects were scanned at a resolution of 400 against an mm ruler, using the Adobe Photo-Shop Soft-Ware Program and a scanner (Twain 32, Epson Twain Pro, Version 1.5) and an IBM compatible computer. Using the Photo-Editor software program (Micro-Soft, Co, USA), the individual scans of the impression sections (Figure 3) were subsequently magnified to 200 % on the computer screen for measurements to be made precisely. The measurements (x & y co-ordinates) for each measuring location (gingival and peripheral sulcular out-line) were obtained and calibrated against the *x* & *y* coordinates measurement for the image of a distance of 10 mm of the ruler against which the impression sections were originally scanned. This facilitated the measurement of the depth of the alveolo-buccal vestibule at the intended locations for each impression section.

Statistical analyses:

To compare the change in depth at the chosen points of the vestibule recorded under the two experimental conditions, a 2-sample Student *t* test for individual subjects and a paired *t* test for the whole group were used. Statistical significance was defined at a 5% level of significance.

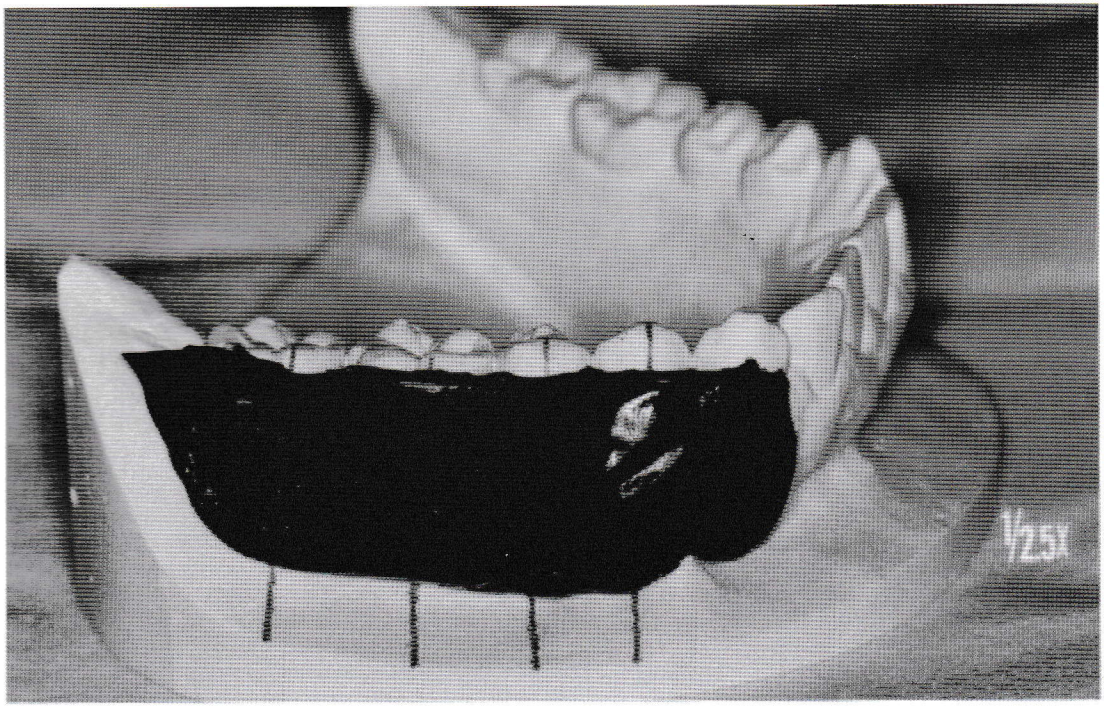

Fig. 3. A modified Impression piece adapted to the corresponding cast surface.

RESULTS:

The data collected under the two experimental conditions for the depth of the vestibule at the pre-selected sites, as determined between the most concave points of the gum margins and the peripheral-most sulcular contour outlines of the impression are presented as mean values (± SD). Table 1, details these values for the individual subjects as well as for the whole group. Mean values for the depth of the vestibule at the chosen measurement locations for the whole group, as detailed in Table 1, are depicted in Figure 4.

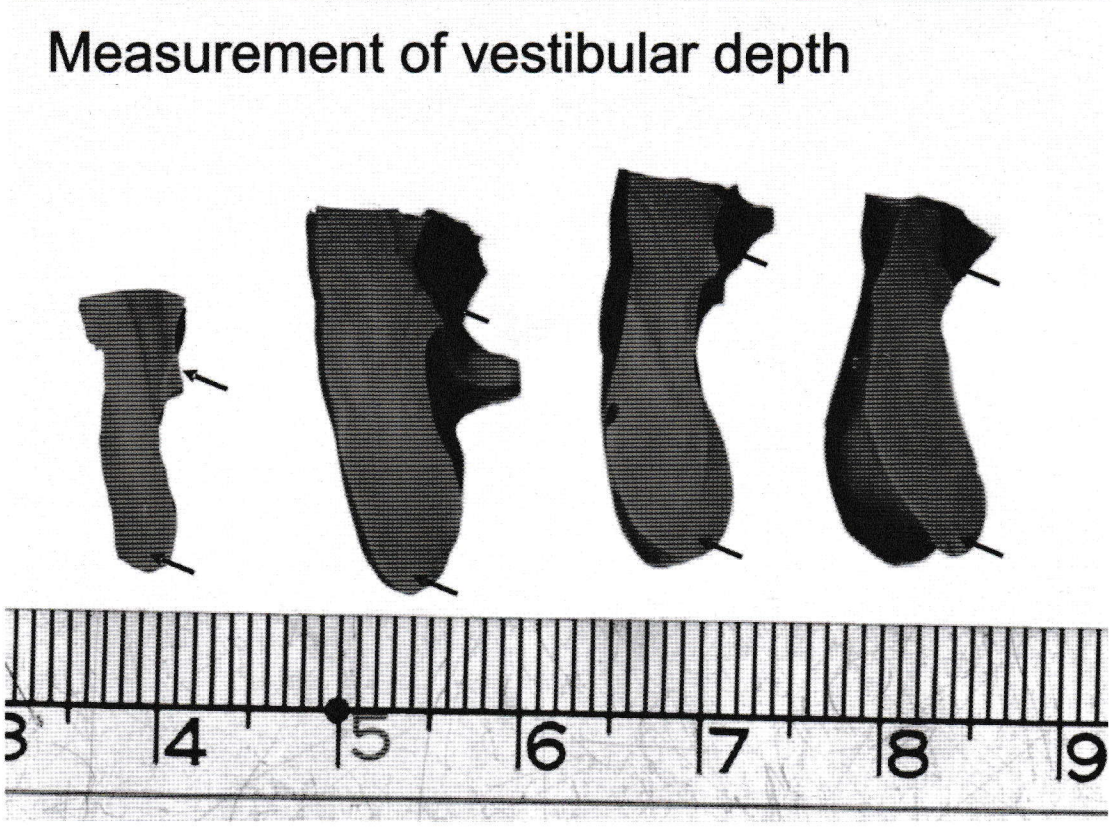

Fig. 4. A scanned image showing cross-section of the impression and a ruler. The depth of the vestiblue was defined as the distance between two arrows for each cross-section.

There were substantial variations both between and within subjects for the data of the depth of the vestibule at all the chosen measurement locations under the same experimental condition and between the two experimental conditions. Notwithstanding these variations, the depth of the vestibule appeared to be greater when it was recorded with the closed-mouth method. The values for range of vestibular depth, at all measurement locations and under the two experimental conditions, for the whole group are shown in Table 1.

Table 1: Close-mouth

Value	M2*	M1*	P2*	P1*
Mean	8.2	11.5	11.9	10.6
Standard Deviation (SD)	2.6	2.0	1.5	1.8
Maximum	12.7	14.6	13.6	13.3
Minimum	4.7	8.0	8.5	8.1

*M2, M1, P2 & P1 refer to measurement locations at 2nd molar, 1st molar, 2nd premolar & 1st premolar regions

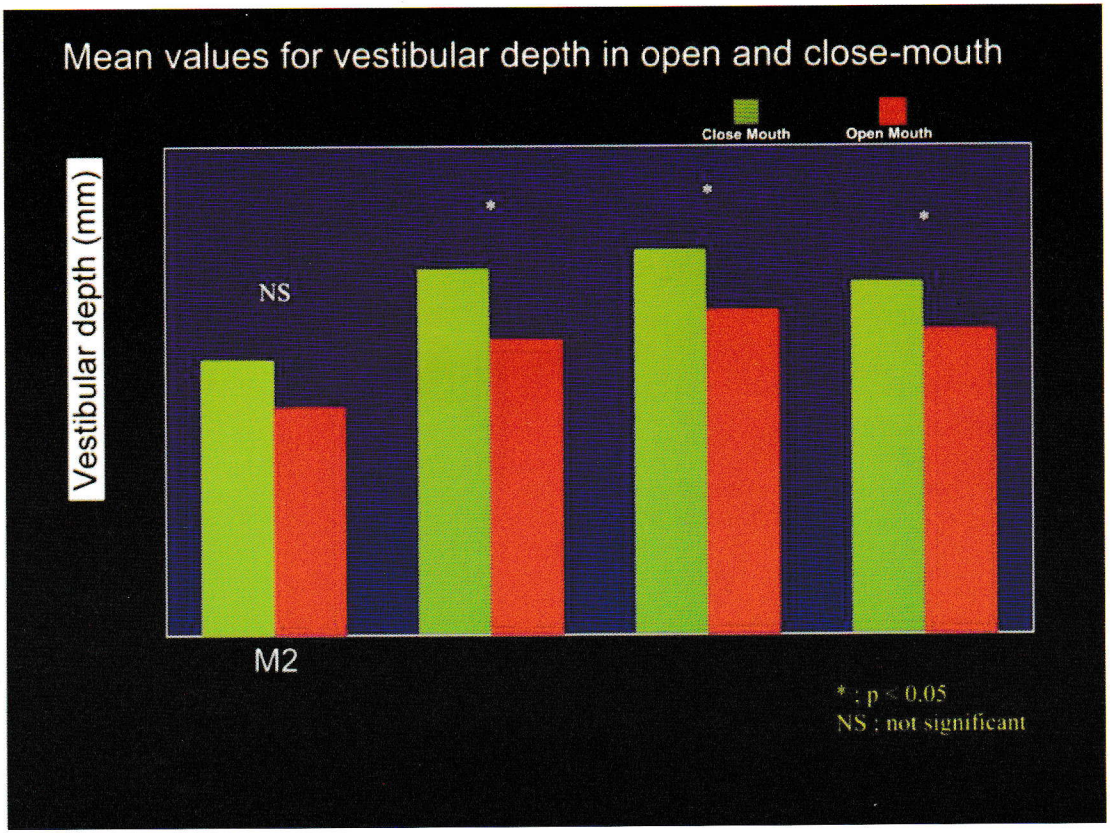

Fig. 5. Mean values of the depth of the vestiblue recorded at open and close-mouth impression recording at the chosen measurement locations for the whole group.

Statistical analyses of the individual subjects as well as the combined group data of the specified locations for the close-mouth and open-mouth showed that mouth opening significantly reduced the depth of the buccal vestibule both within and between subjects. (Table1). The values indicating the percentage proportional reduction in the depth of the vestibule at the measured locations as induced by mouth opening are detailed in Table 2 and graphically shown in Figure 5. In general, the extent of reduction in the depth of vestibule ranged between 11.46 to 18.59 % with the highest reduction values in the area between first molar and second premolars.

DISCUSSION:

This study has important clinical implications. The recording of impression of the buccal vestibule in dentate subjects with teeth-occluded (close-mouth) and with teeth-apart (open-mouth) have shown to affect the depth of the vestibule. Similar effects are expected to be translated when recording impression for replacement complete dentures or relining old dentures in edentulous patients, particularly in those with anticipated denture retention and stability problems. Therefore, it is emphasized that these effects should be considered when planning treatment for complete denture patients so as to maximize treatment success.

Table 2: Open-mouth

Value	M2*	M1*	P2*	P1*
Mean	7.1	9.3	10.3	10.3
Standard Deviation (SD)	2.1	1.6	1.8	1.8
Maximum	11.9	12.3	13.4	13.4
Minimum	4.4	6.3	7.5	7.5
% Change	- 13.4	- 18.6	- 13.6	- 13.6
P-Value	0.1	0.0	0.0	0.0

*M2, M1, P2 & P1 refer to measurement locations at 2nd molar, 1st molar, 2nd premolar & 1st premolar regions

This being the first of its kind study on the effect of mouth remaining open or closed on the depth of the sulcus has given a useful evidence on the topic. Being the first of its kind, however, the findings of the study could not be compared because of absence of such data. It has involved young dentate subject. For similar effect to occur in elderly / aged edentulous patients and in patients with muscle wasting conditions and loss of muscle tone need further investigations. Similar investigations of the change in the depth of the lingual sulcus during various functional maneuvers affecting the functional level of the floor of the mouth will also give new and interesting information. The extent of reduction ranging from 12 to 19% is, however, a considerable amount requires serious consideration when planning treatment of patients requiring prosthodontic therapies, particularly, those with removable design.

CONCLUSION:

Decreased vestibular depth will be recorded when using an open-mouth impression technique.

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