Original Article

# Lateral throat form re-classified using a customized gauge: A clinical study

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## Abstract

**Background:** A common problem faced by prosthodontists is achieving adequate retention and stability in the mandibular dentures. Recording the lateral throat form (LTF) correctly can aid in the retention and stability. Till date, Neil's classification has been considered as the gold standard in measuring the depth of the LTF. This is a subjective classification and varies among different operators. In this study, a customized tool was used to measure the depth of the LTF, and a classification was proposed according to the measured depths.

**Objectives:** The objective of this study is to measure the exact depth of LTF using customized gauge and to propose a classification based on the measured depth.

**Materials and Methods:** A customized gauge was made to measure the depth of the LTF. Two different observers classified the LTFs according to Neil's classification and according to the proposed classification in a total group of 50 patients. The customized gauge was inserted into the alveolo-lingual sulcus to measure the depth. The Pearson's correlation statistics was carried out to observe the inter-observer relationships of sulcus depth using this customized gauge. ANOVA test was used to compare the mean depth of the sulcus as measured by observers 1 and 2.

**Results:** There was more inter-observer variability when Neil's classification was used as compared to the one with the proposed classification using the gauge. The inter-observer agreement for the proposed new classification was assessed by Cohen's kappa value, with $P < 0.001$. The mean depth of the sulcus as calculated by observers 1 and 2 was compared with ANOVA test and found to be significant with $P < 0.001$.

**Conclusion:** The proposed new classification for LTF gave consistent results and was easier to use with less variability when compared to the Neil's classification.

**Key Words:** Alveolo-lingual sulcus, lateral throat form, Neil's classification, retention, stability

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## INTRODUCTION

Successful denture therapy is a complex process demanding technical and interpersonal expertise. The prosthodontics needs to know as much as possible about each patient's intraoral anatomy and function; expectations and experience; and likely range of physical and psychological responses to treatment;

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and a new prosthesis. For this reason, thorough collection of relevant information regarding intraoral anatomy needs to precede the initiation of fabrication of complete dentures.[1] These parameters require that patients perceive their dentures as stationary or well retained during function. In this regard in the field of prosthodontics, retention and stability are the two major concerns for complete denture therapy, especially in lower denture because of less surface area available.[2]

Geriatric patients who present with resorbed ridges, challenge the dentist in terms of achieving proper retention and stability. Retention is defined as that quality inherent in the dental prosthesis, acting to resist the forces of dislodgement along the path of placement.[3] Thomas described three distinct spaces available on the lingual side of edentulous ridge for the extension of the denture base to get adequate retention in resorbed lower ridges. These three spaces were: (1) Sublingual crescent space (2) sublingual fossa (3) retromylohyoid fossa.[4]

The retromylohyoid fossa is a region below and behind the retromolar pad and it provides an excellent area for extending the denture for positive retention, especially when extensions into the sublingual crescent and the sublingual fossa cannot be made as in the case of resorption. Neil also mentioned that the distal end of the alveolingual sulcus (i.e. lateral throat form [LTF]) [Figure 1] can be used to achieve more vertical height of dentures in this region. Lower dentures are shallow in the mylohyoid region and turn toward the tongue and then curves back again toward ridges as we go more posteriorly. Neil classified LTF as Class I, Class II, and Class III depending on the displaceability of the instrument placed in the alveolo-lingual sulcus on protrusion of the tongue. The perception of the displaceability of the instrument varies among different observers hence making this classification as subjective and prone to error.[5,6]

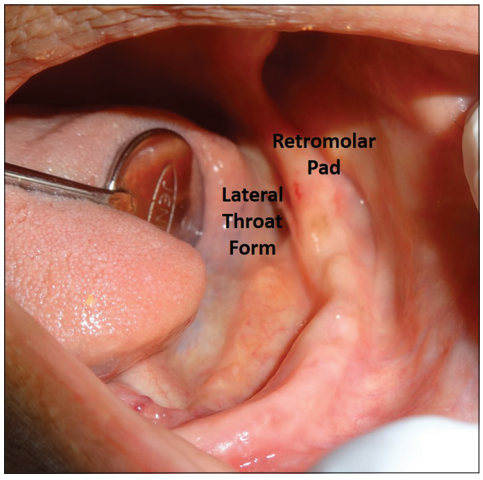


**Figure 1:** Lateral throat form (left side)

To overcome this problem, a customized gauge instrument was designed to measure the depth of the LTF and a study was conducted in the Department of Prosthodontics, Crown, and Bridge to evaluate the depth of LTF in completely edentulous patients. This instrument gives the exact depth of LTF, based on which we can classify lateral form. This measurement was then used to modify the primary impression tray in the area of interest to record the LTF more accurately during subsequent impression procedures. Keeping the above in mind, this study was conducted to measure the exact depth of the LTF using a customized gauge and propose a new classification for LTF based on the measurements obtained.

## MATERIALS AND METHODS

### Study design

A total of 50 edentulous subjects were randomly selected from the local population who fell under the inclusion criteria:

- Patients with completely edentulous mandibular arches
- Patients with good neuromuscular coordination
- Patients in whom retromolar pad can be easily distinguished.

The exclusion criteria were:

- Patient who has undergone any surgical procedure of the jaws, e.g., hemimandibulectomy and glossectomy
- Patient who is not willing to sign the consent form
- Any congenital defect in the jaw
- Any abnormality of oral structures.

This instrument was checked in patients, to measure the depth of LTF on the left side, since left side has a better access for a right-hand operator.

Two different observers classified LTF in edentulous patients using Neil's classification [Table 1].

### Instrument design (customized gauge design)

The Instrument was designed with a hollow "L" shaped copper pipe with a flexible wire within it [Figure 2]. This wire was freely movable inside the pipe and was extended on both sides of the L-shaped tube. Extension on one side would help in the measurement, and on the other side, it would move on a metal scale which is attached to the copper pipe that would accurately give us the LTF depth. A stopper

**Table 1: Neil's classification**

| Classification | Description |
|---|---|
| Class I | No movement to the clinician's finger or hand mirror when patient is protruding |
| Class II | About half as long and narrow as a Class I flange and about twice the length of a Class III |
| Class III | The entire finger/mirror is displaced. Minimum length and thickness, usually ending the flange 2-3 mm below of just at the mylohyoid ridge |

was attached to the vertical arm which was positioned on the retromolar pad [Figure 3]. The stopper was made movable horizontally so that the same instrument could be used on either side. A scale was attached on the horizontal arm so that measurement can be made directly on the patients [Figure 4]. Mouth mirror is used to retract the tongue from the area of interest.

### Method to measure the lateral throat form

Patients were instructed to open their mouth and protrude their tongue so that it was ¼ inch ahead of the lower lip. Then the instrument was placed inside the patient's mouth so that the stopper of the instrument rested on the middle third of the retromolar pad. Then the flexible wire was pushed from outside till it touches the floor of the mouth [Figure 5].

The length of wire pushed in the vertical arm was indicated on a scale attached to it and was equal to the length of wire coming out from the vertical arm which in turn reflected the LTF depth.

## RESULTS

A total of 50 patients were observed by two different observers. For each observation, depth was measured using customized gauge [Table 2]. From these measurements, a classification of the LTF was proposed according to the depth measurement [Table 3]. Hence, the values obtained were denoted with the proposed classification [Table 4].

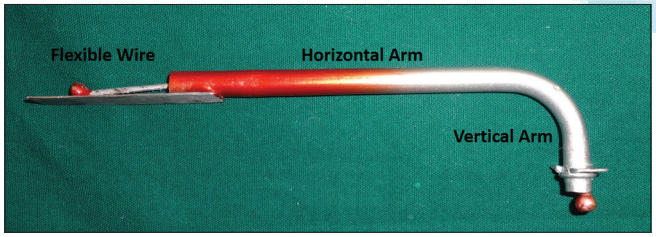


**Figure 2:** Customized instrument used to measure the depth of lateral throat form

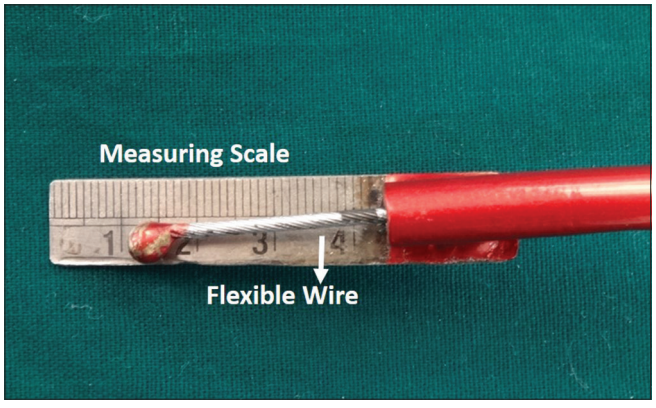


**Figure 4:** Metal scale attached to the horizontal arm of the instrument below the flexible wire

Statistical analysis was carried out to verify the significance of the proposed classification. Pearson correlation statistics to observe the relationship among the inter-observer estimations of sulcus depth using customized gauge is shown in Table 5.

Table 6 shows the comparison of mean depth of the sulcus as measured by observer 1 using customized gauze for proposing a newer classification using ANOVA test. Comparison of mean depth of the sulcus as measured by observer 2 using customized gauze for proposing a newer classification using ANOVA test is depicted in Table 7.

The results show that there is a significant inter-observer agreement in the proposed classification using a customized gauge.

## DISCUSSION

Based on the Neil's classification, percentage of Class I, Class II, and Class III LTF according to the observers I

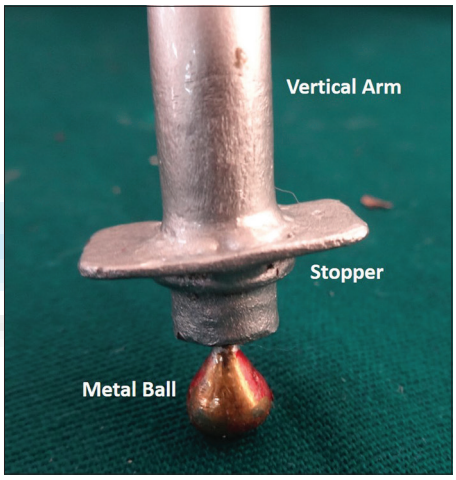


**Figure 3:** Stopper attached to the vertical arm of the instrument

**Figure 5:** Instrument placed inside the oral cavity with the stopper resting on retromolar pad and the metal ball attached to the flexible wire touching the floor of the mouth

**Table 2: Classification of lateral throat form using Neil's classification and measurement using customized gauge**

| Patients | Observer 1 | | Observer 2 | |
|---|---|---|---|---|
| | Neil's classification | Customized gauge | Neil's classification | Customized gauge |
| 1 | Class I | 3.0 | Class I | 3.0 |
| 2 | Class I | 2.5 | Class I | 2.6 |
| 3 | Class I | 3.0 | Class I | 3.1 |
| 4 | Class I | 3.9 | Class I | 4.1 |
| 5 | Class II | 2.4 | Class I | 2.4 |
| 6 | Class I | 3.5 | Class I | 3.4 |
| 7 | Class I | 3.0 | Class I | 3.2 |
| 8 | Class I | 2.8 | Class I | 2.9 |
| 9 | Class II | 2.3 | Class II | 2.4 |
| 10 | Class I | 3.0 | Class I | 3.2 |
| 11 | Class III | 1.8 | Class II | 2.0 |
| 12 | Class II | 2.0 | Class II | 2.1 |
| 13 | Class II | 1.8 | Class II | 1.6 |
| 14 | Class I | 2.6 | Class I | 2.6 |
| 15 | Class I | 2.5 | Class I | 2.5 |
| 16 | Class III | 2.2 | Class II | 2.4 |
| 17 | Class III | 2.0 | Class II | 2.0 |
| 18 | Class III | 2.1 | Class II | 2.2 |
| 19 | Class III | 2.4 | Class II | 2.4 |
| 20 | Class III | 2.2 | Class II | 2.2 |
| 21 | Class III | 0.5 | Class III | 0.5 |
| 22 | Class III | 1.0 | Class II | 1.2 |
| 23 | Class III | 1.2 | Class III | 1.1 |
| 24 | Class III | 0.6 | Class III | 0.6 |
| 25 | Class II | 1.1 | Class III | 1.0 |
| 26 | Class I | 2.9 | Class I | 2.7 |
| 27 | Class I | 3.0 | Class I | 2.9 |
| 28 | Class I | 2.5 | Class I | 2.6 |
| 29 | Class III | 1.1 | Class II | 1.2 |
| 30 | Class III | 0.3 | Class III | 0.5 |
| 31 | Class III | 1.0 | Class III | 1.1 |
| 32 | Class I | 2.8 | Class I | 2.7 |
| 33 | Class II | 2.3 | Class II | 2.4 |
| 34 | Class I | 3.1 | Class I | 3.2 |
| 35 | Class I | 2.6 | Class I | 2.8 |
| 36 | Class III | 0.8 | Class III | 0.9 |
| 37 | Class I | 2.6 | Class I | 2.8 |
| 38 | Class I | 3.5 | Class I | 3.5 |
| 39 | Class II | 0.9 | Class III | 0.8 |
| 40 | Class I | 2.5 | Class I | 2.6 |
| 41 | Class I | 2.6 | Class I | 2.5 |
| 42 | Class I | 2.5 | Class I | 2.3 |
| 43 | Class I | 2.8 | Class I | 2.9 |
| 44 | Class III | 0.6 | Class II | 0.8 |
| 45 | Class II | 1.5 | Class III | 1.4 |
| 46 | Class II | 1.9 | Class III | 1.7 |
| 47 | Class III | 1.0 | Class II | 1.2 |
| 48 | Class II | 1.5 | Class III | 1.3 |
| 49 | Class III | 1.2 | Class II | 1.2 |
| 50 | Class I | 2.6 | Class I | 2.5 |

**Table 3: Proposed classification for lateral throat form using customized gauge**

| Proposed classification | Measurement range |
|---|---|
| Class A | 2.5-4.1 cm |
| Class B | 1.5-2.4 cm |
| Class C | 0.5-1.4 cm |

and 2 was tabulated in Table 8. Based on the proposed classification, percentage of Class A, Class B, and Class C LTF according to the observers 1 and 2 was tabulated in Table 9.

LTF, area situated at the distal end of the alveolo-lingual sulcus, has profound influence on the fabrication of complete dentures. Yet its importance is not appreciated by most clinicians. The length and thickness of the flange in the space are different depending on the tonicity, activity, and anatomic attachments of the adjacent structures. Neil described the difference of this important area and divided it into three classifications.[5]

In the present cross-sectional study, according to Neil's classification, observer 1 has classified 23 patients as Class I, 10 patients as Class II, and 17 patients as Class III. Observer 2 has classified 24 patients as Class I, 15 patients Class II, and 11 patients as Class III. This proves the variability among two observers when using Neil's classification to classify LTF. Although Neil's has been the gold standard for classifying the LTF for many years, it is a subjective classification and varies from operator to operator. It also varies between experienced clinicians and beginners.

A study conducted by Huang *et al*. investigated the proportion of three classes of LTF and reported that Class I was more common than Class II or III.[7] Sadhvi *et al*. used a customized instrument to measure LTF intraorally and compare its efficacy with the conventional method.[8] Another study observed the significant differences between the vertical dimension of LTF measured in patients' mouth and that of their diagnostic casts using a customized instrument.[9] However, no attempt has been made to classify the LTF based on such measurements. This study aims to propose a classification based on the measured depth.

In the present study, the customized tool described in this report gives us the exact value of LTF depth which will be helpful in classifying it and making good preliminary impressions by selecting a proper stock tray. A good preliminary cast will ensure that the custom tray is fabricated with proper extensions, which will be reflected in the final denture. This will help us achieve better retention and stability in mandibular dentures.

The statistical analysis with the Pearson's correlation test demonstrated that there was a positive agreement between the two observers with respect to the measurement using the customized gauge. The ANOVA test gave the mean values for each class for both the observers and it was found to be roughly the same.

All these tests prove that the proposed classification is consistent with the measurements and can be used as a reliable measure for checking the LTF.

**Table 4: Values obtained denoted with the proposed classification**

| | Observer 1 | | | Observer 2 | | |
|---|---|---|---|---|---|---|
| Patients | Neil's classification | Customized gauge | Proposed classification | Neil's classification | Customized gauge | Proposed classification |
| 1 | Class I | 3.0 | Class A | Class I | 3.0 | Class A |
| 2 | Class I | 2.5 | Class A | Class I | 2.6 | Class A |
| 3 | Class I | 3.0 | Class A | Class I | 3.1 | Class A |
| 4 | Class I | 3.9 | Class A | Class I | 4.1 | Class A |
| 5 | Class II | 2.4 | Class B | Class I | 2.4 | Class B |
| 6 | Class I | 3.5 | Class A | Class I | 3.4 | Class A |
| 7 | Class I | 3.0 | Class A | Class I | 3.2 | Class A |
| 8 | Class I | 2.8 | Class A | Class I | 2.9 | Class A |
| 9 | Class II | 2.3 | Class B | Class II | 2.4 | Class B |
| 10 | Class I | 3.0 | Class A | Class I | 3.2 | Class A |
| 11 | Class III | 1.8 | Class B | Class II | 2.0 | Class B |
| 12 | Class II | 2.0 | Class B | Class II | 2.1 | Class B |
| 13 | Class II | 1.8 | Class B | Class II | 1.6 | Class B |
| 14 | Class I | 2.6 | Class A | Class I | 2.6 | Class A |
| 15 | Class I | 2.5 | Class A | Class I | 2.5 | Class A |
| 16 | Class III | 2.2 | Class B | Class II | 2.4 | Class B |
| 17 | Class III | 2.0 | Class B | Class II | 2.0 | Class B |
| 18 | Class III | 2.1 | Class B | Class II | 2.2 | Class B |
| 19 | Class III | 2.4 | Class B | Class II | 2.4 | Class B |
| 20 | Class III | 2.2 | Class B | Class II | 2.2 | Class B |
| 21 | Class III | 0.5 | Class C | Class III | 0.5 | Class C |
| 22 | Class III | 1.0 | Class C | Class II | 1.2 | Class C |
| 23 | Class III | 1.2 | Class C | Class III | 1.1 | Class C |
| 24 | Class III | 0.6 | Class C | Class III | 0.6 | Class C |
| 25 | Class II | 1.1 | Class C | Class III | 1.0 | Class C |
| 26 | Class I | 2.9 | Class A | Class I | 2.7 | Class A |
| 27 | Class I | 3.0 | Class A | Class I | 2.9 | Class A |
| 28 | Class I | 2.5 | Class A | Class I | 2.6 | Class A |
| 29 | Class III | 1.1 | Class C | Class II | 1.2 | Class C |
| 30 | Class III | 0.3 | Class C | Class III | 0.5 | Class C |
| 31 | Class III | 1.0 | Class C | Class III | 1.1 | Class C |
| 32 | Class I | 2.8 | Class A | Class I | 2.7 | Class A |
| 33 | Class II | 2.3 | Class B | Class II | 2.4 | Class B |
| 34 | Class I | 3.1 | Class A | Class I | 3.2 | Class A |
| 35 | Class I | 2.6 | Class A | Class I | 2.8 | Class A |
| 36 | Class III | 0.8 | Class C | Class III | 0.9 | Class C |
| 37 | Class I | 2.6 | Class A | Class I | 2.8 | Class A |
| 38 | Class I | 3.5 | Class A | Class I | 3.5 | Class A |
| 39 | Class II | 0.9 | Class C | Class III | 0.8 | Class C |
| 40 | Class I | 2.5 | Class A | Class I | 2.6 | Class A |
| 41 | Class I | 2.6 | Class A | Class I | 2.5 | Class A |
| 42 | Class I | 2.5 | Class A | Class I | 2.3 | Class B |
| 43 | Class I | 2.8 | Class A | Class I | 2.9 | Class A |
| 44 | Class III | 0.6 | Class C | Class II | 0.8 | Class C |
| 45 | Class II | 1.5 | Class B | Class III | 1.4 | Class C |
| 46 | Class II | 1.9 | Class B | Class III | 1.7 | Class B |
| 47 | Class III | 1.0 | Class C | Class II | 1.2 | Class C |
| 48 | Class II | 1.5 | Class B | Class III | 1.3 | Class C |
| 49 | Class III | 1.2 | Class C | Class II | 1.2 | Class C |
| 50 | Class I | 2.6 | Class A | Class I | 2.5 | Class A |

**Table 5: Pearson correlation statistics to observe relationship between the inter-observer estimation of sulcus depth using customized gauge**

| | Values | Observer 1 | Observer 2 |
|---|---|---|---|
| Observer 1 | *r* | 1 | 0.989** |
| | *P* | | <0.001 |
| | *n* | 50 | 50 |
| Observer 2 | *r* | 0.989** | 1 |
| | *P* | <0.001 | |
| | *n* | 50 | 50 |

**Correlation is significant at the 0.01 level

There are a few limitations with using the instrument. Less experienced clinicians might not be able to correctly position the instrument. The metal ball might not be visible in case of an excessively large tongue. There are chances of over extending the metal ball into the alveolo-lingual sulcus.

## CONCLUSION

Instrument which was customized to measure LTF depth gave consistent results when compared against the conventional method.

**Table 6: Comparative analysis (observer 1) using ANOVA test**

| Proposed classification | *n* | Mean | SD | SE | 95% CI for mean | | Minimum | Maximum | *P* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lower | Upper | | | |
| Class A | 23 | 2.86 | 0.37 | 0.08 | 2.70 | 3.02 | 2.5 | 3.9 | <0.001* |
| Class B | 14 | 2.04 | 0.31 | 0.08 | 1.86 | 2.22 | 1.5 | 2.4 | |
| Class C | 13 | 0.87 | 0.29 | 0.08 | 0.70 | 1.04 | 0.3 | 1.2 | |

*Statistically significant. SE: Standard error, SD: Standard deviation, CI: Confidence interval

**Table 7: Comparative analysis (observer 2) using ANOVA test**

| Proposed classification | *n* | Mean | SD | SE | 95% CI for mean | | Minimum | Maximum | *P* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lower | Upper | | | |
| Class A | 22 | 2.92 | 0.40 | 0.08 | 2.75 | 3.10 | 2.5 | 4.1 | <0.001* |
| Class B | 13 | 2.16 | 0.27 | 0.08 | 2.00 | 2.33 | 1.6 | 2.4 | |
| Class C | 15 | 0.99 | 0.29 | 0.07 | 0.83 | 1.15 | 0.5 | 1.4 | |

*Statistically significant. SE: Standard error, SD: Standard deviation, CI: Confidence interval

**Table 8: Percentage of each class of lateral throat form according to Neil's classification**

| | Observer 1 (%) | Observer 2 (%) |
|---|---|---|
| Class I | 46 | 48 |
| Class II | 20 | 30 |
| Class III | 34 | 22 |

**Table 9: Percentage of each class of lateral throat form according to proposed classification**

| | Observer 1 (%) | Observer 2 (%) |
|---|---|---|
| Class A | 46 | 44 |
| Class B | 28 | 26 |
| Class C | 26 | 30 |

Based on the above study, the proposed classification is Class A: 2.5–4.1 cm, Class B: 1.5–2.4 cm, and Class C: 0.5–1.4 cm.

Our intention is that this particular classification will help us to judge the expected retention property of the lower denture from the existing LTF and help in doing the treatment planning in order to improve the retention of mandibular denture.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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