A static palatography investigation of Nkọrọọ coronal consonants

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Abstract

Linguistic field work often requires describing the sounds in the language one is investigating. Static palatography involves the use of instrumental techniques to record contact between the tongue and the roof of the mouth and is especially useful for determining the place of consonant articulation. This study employed the palatography technique in the description of the coronal consonants found in Nkọrọọ, an Eastern Ịjọ language belonging to the Niger-Congo phylum. Two kinds of data – palatograms and linguograms, collected from two competent native speakers through this process, were used to determine the place and type of articulatory contact. Based on auditory perception alone, nine coronal consonanfeats were investigated. The findings confirmed that [t], [d], [n], [ɹ], [s], and [l] are produced at the alveolar place of articulation, [dʒ] is post alveolar, while [ɲ] and [j] are palatal. Apart from corroborating the auditory perception of the place of consonant articulations, the records indicate that the plosives and liquids have central closure, the fricative and approximant lack central closure while nasals and the affricate have little central closure. Furthermore, visual inspection of the linguograms revealed [l] as apical, [t], [d], [n], and [ɹ] as apico-laminal, and [s], [dʒ], [ɲ], and [j] as laminal.

Keywords: **Nkọrọọ, Ịjọ, Static palatography, Palatograms, and Linguograms**

1. Introduction

Phonetics is the systematic study of human speech sounds. It is that branch of linguistics that involves identifying, describing, and classifying the sounds employed in speaking the world's languages. According to Miller (2010), if phonetic description of a language is not accurate, it is difficult to compare to other languages. One important aspect of phonetic fieldwork is describing the sounds of the language that one is investigating via the use of instruments. Instruments may be used to carry out articulatory and acoustic investigation of sound segments in order to verify and substantiate the perception of the hearer, and help in providing accurate analyses of speech sounds. Instrumental phonetics refers to any method of speech sound analysis that involves the use of instruments.

Static palatography (hereafter, palatography) is an articulatory phonetic technique that involves making records of contact on the roof of the mouth (that is, palatography) and records of contact on the tongue (that is, linguography). It is an instrumental method that helps one ascertain how consonant sounds that involve the tongue making contact with some part of the palate are articulated. Palatography entails using an edible paint-like mixture to paint either the tongue (for palatograms) or the palate (for linguograms) in order to record the pattern of contact during an utterance (Anderson, 2008; Ladefoged, 2003; Salffner, 2010). It allows one to ascertain the part of the tongue and the part of the palate that is used in speech production. Consonants that can be investigated via palatography include dental, alveolar, post alveolar, retroflex, palatal, dorsal, laminal, apical, and palatalized and velarized consonants. Two kinds of data are collected through this process – palatograms and linguograms. Palatograms are produced by painting the tongue with

charcoal powder mixed with olive oil so that the paint is transferred to the roof of the mouth when the sound is pronounced and the part of the palate involved can be recorded. Linguograms are produced by painting the palate in order to examine the part of the tongue that is involved in the pronunciation of a consonant sound. According to Miller (2010), linguograms help to indicate whether a sound is apical (that is, produced with the tip of the tongue), laminal (produced with the blade of the tongue), dorsal (produced with the back of the tongue) or subapical (produced with the underside of the tongue), while palatograms reveal the place of articulation. "Static palatography is a "field-friendly" technique that can provide valuable, detailed information about articulatory characteristics of speech sounds. However, the process is labor-intensive and time-consuming" (Patil et. al., 2017. p. 21).

In this study, articulatory investigations were carried out on the coronal consonants (that is, sounds produced with the alveolar, post alveolar, and palatal places of articulation) via palatography in Nkọrọọ, an Eastern Ịjọ language spoken in the Niger Delta region of Nigeria, West Africa. The objectives were to substantiate auditory perception and provide a more objective interpretation to the language data. The technique was carried out on two language consultants; one male and one female.

2. Steps to doing palatography

The steps to carrying out a palatography investigation are listed below. These are the same steps employed in this study.
i. Choosing your wordlist
ii. Palatography and linguography tools
iii. Preparing the paint mixture
iv. Doing linguograms
v. Doing palatograms
vi. Hygiene

2.1 Choosing your wordlist

The first step in doing palatography is to choose suitable words for the investigation. The words in your list should contain the consonants you want to investigate. Any other consonant in the words chosen should preferably be either a labial or glottal sound as these do not require the tongue making contact with any part of the palate. Vowels in your chosen word should preferably not be high vowels (except you are investigating the behavior of consonants when they occur in the environment of high vowels, or no other word containing other vowels can be found). Open vowels are most suitable. It is advisable to choose bisyllabic words that have the target consonant in intervocalic position or monosyllabic/bisyllabic words with the target consonant in word-initial position. This is to ensure that the tongue does not approach the palate (Miller, 2010). If you can, create a list that contains minimal pairs with the sounds for investigation.

Following the above procedure for this study, two words were chosen for each consonant sound to be investigated. Each word contained the consonant that was being investigated. A set of bisyllabic words with the consonant in word-initial position followed by two vowels (CVV) were chosen for the palatography records while another set of bisyllabic words with the consonant in intervocalic position (VCV) were chosen for the linguography records. Minimal pairs and near minimal pairs (where minimal pairs could not be found) were used.

2.2. Palatography and linguography tools

The tools for carrying out both the palatography and linguography investigation included;
i. Activated charcoal powder (this can be bought at a pharmacy).
ii. Olive oil (vegetable oil can also be used).
iii. Dental or intraoral mirror (a mirror that is small enough to fit into the mouth comfortably).
iv. Soft paint brushes (a child's paintbrush is ideal). It is also ideal to have more than one brush especially if you are going to be carrying out the technique on more than one person. It is not hygienic to use the same brush for different persons.
v. Bowls for the mixture.
vi. Spatula/spoon (for stirring the mixture).
vii. Digital camera (for taking pictures).
viii. Fresh pineapples and oranges (any citrus fruit juice will work). This helps remove the activated charcoal and olive oil mixture from the consultant's mouth.
ix. Covering cloth (to avoid the mixture spilling on the consultant).
x. Tissue and towels for cleaning up.
xi. Soap and water for washing up tools.
xii. Warm water (for rinsing the brush after each contact).

2.3. Preparing the paint mixture

The following steps describe the procedure for preparing the mixture for creating palatograms and linguograms.

i. Pour some activated charcoal powder into a clean bowl.
ii. Pour some olive oil (or vegetable oil) into the bowl and stir with a spatula or spoon. You can pour the oil in little by little until you are satisfied with the consistency of the mixture.
iii. Ensure the mixture is not too light nor too thick. You get the right consistency by practice.

2.4. Doing linguograms

The specific instrumental technique for doing linguograms is called linguography. It may be done separately, that is, without recording palatograms. First, the charcoal mixture was prepared. Then using a brush, the consultant's palate was painted with the mixture, ensuring that the palate was well covered. The consultant was asked to pronounce a word from the word list and stick out their tongue. The picture of the tongue was quickly captured via the digital camera. It is important for the researcher to do this as fast as possible because not everyone is able to stick out their tongue for a long time without drooling. The part of the tongue covered with the mixture shows the articulatory contact. The consultant took some fruit juice after each contact to remove the charcoal mixture from the tongue. Also, after each contact, the brush was rinsed in warm water.

2.5. Doing palatograms

The specific instrumental technique for doing palatograms is called palatography. Again, it may be carried out separately without recording linguograms. After mixing the activated charcoal with olive oil, the tongue of the consultant was painted with the mixture using a brush. The consultant was asked to pronounce a word from the word list. Immediately afterwards, the intraoral mirror was put into the mouth of the consultant and a picture of the palate that is reflected on the mirror was taken with the digital camera. The part of the palate that is covered with the mixture shows the articulatory contact. After each contact, the consultant was given some fruit juice which helped rinse off the dark patches in the mouth. The brush used was rinsed with warm water and the mirror cleaned with a soft cloth or tissue before the technique could be repeated.

2.6. Hygiene

Hygiene is very important while recording linguograms and palatograms. Your hands should be washed before you begin the instrumental investigation. You can also wash your hands in between the investigation, when necessary. It is advisable to sterilize all equipment before use. In this study, sterilization was done by washing the tools such as the bowls, mirror, and brush with soap and water. After which, they were soaked in warm water (which was allowed to boil and cool a little) and salt for about ten minutes before rinsing them for use. After the investigation, all the tools used were washed again with soap and water.

3. Results and discussion

Based on auditory perception, Harry (1987) and Obikudo (2013, 2022) identify nine coronal consonants in Nkọrọọ whose articulation involve the tongue and the palate or the roof of the mouth. The production of these consonants involve the alveolar, post alveolar, and palatal places of articulation. They include [t], [d], [n], [s], [r], [l], [dʒ], [ɲ], and [j]. Palatograms and linguograms were recorded for each consonant sound.

On the palatograms, the dark patches on the roof of the mouth (as reflected on the mirror), represent the contact made by the tongue (that was painted with the activated charcoal and olive oil mixture) on the palate and indicate the place of articulation of the consonant. The linguograms show dark patches on the tongue that also represent the contact made between the tongue and the palate (which was painted with the activated charcoal and olive oil mixture), and indicate the part of the tongue that was involved in the consonant articulation. The palatograms and linguograms for the nine consonants investigated are presented in the figures below.

1. [t] voiceless alveolar plosive

[tàà] 'wife' [átí] 'fish hook'

Fig. 1: Palatogram for [t]

Fig. 2: Linguogram for [t]

The palatogram shows contact between the tongue and the alveolar ridge while the linguogram record shows [t] to be an apico-laminal stop. The dark patches indicate contact on the tip of the tongue and a little further back. There is evidence of central closure. This means that there is no gap between the dark patches in the center of the mouth.

2. [d] voiced alveolar plosive

[dàà] 'father' [ídó] 'tribe'

Fig. 3: Palatogram for [d]

Fig. 4: Linguogram for [d]

The records for [d] are similar to [t]. The palatogram and linguogram reveal that [d] is produced at the alveolar place of articulation and is an apico-laminal stop. There is also evidence of central closure.

3. [n] voiced alveolar nasal

[nàà] 'hear' [òní] '3rd person plural pronoun'

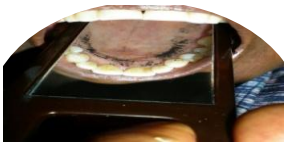

Fig. 5: Palatogram for [n]

Fig. 6: Linguogram for [n]

The dark patches on the alveolar ridge (also known as the teeth ridge) in figure 5 show that the tongue makes contact with the alveolar ridge in the production of [n], while the linguogram in figure 6 shows an apico-laminal contact. The records indicate little central closure which is seen more clearly on the linguogram.

4. [s] voiceless alveolar fricative
[sa̰a̰] 'urinate' [àsì] 'blood'

Fig. 7: Palatogram for [s] Fig. 8: Linguogram for [s]

The palatogram in figure 7 shows an alveolar contact that lacks a central closure. In other words, the dark patches do not extend to the center of the palate. This opening at the center is characteristic of fricatives. The dark patches on the tongue also lack a central closure and do not begin from the tip of the tongue. The linguogram represents contact made with the blade of the tongue, indicating that [s] is a laminal fricative.

5. [ɹ] voiced alveolar central approximant
[ɹàà] 'shine, be bright' [àɹì] 'medicine, poison, witchcraft'

Fig. 9: Palatogram for [ɹ] Fig. 10: Linguogram for [ɹ]

The dark patches on the alveolar ridge in figure 9 indicate that [ɹ] is an alveolar consonant, while the dark patches in figure 10 begin from the tip of the tongue and move further back indicating that [ɹ] is apico-laminal. The records also show central closure.

6. [l] voiced alveolar lateral approximant
[lá□á] 'arrive, reach' [áló] 'print wrapper'

Fig. 11: Palatogram for [l] Fig. 12: Linguogram for [l]

The palatogram in figure 11 reveals that [l] is an alveolar articulation, while the linguogram in figure 12 shows dark patches on the tip of the tongue indicating that [l] is articulated with the tip of the tongue and is apical. The records indicate central closure.

7. [dʒ] voiced post alveolar affricate
[dʒáì] 'be calm' [ìdʒì] 'give birth'

Fig. 13: Palatogram for [dʒ] Fig. 14: Linguogram for [dʒ]

The dark patches in figure 13 appear a little beyond the alveolar ridge indicating that [dʒ] is produced at the post alveolar place of articulation. There is also little central closure, which is characteristic of an affricate being a stop with a fricative release. The linguogram in figure 14 indicates contact made with the blade of the tongue, that is, a laminal articulation.

8. [ɲ] voiced palatal nasal
[àɲì] 'egg'

Fig. 15: Linguogram for [ɲ]

Note that at the time of data collection, the informants could not find a word in which [ɲ] occurred word-initially in order to create a minimal pair for the palatography investigation. Howbeit, the linguogram indicates contact made with the blade of the tongue and little central closure. [ɲ] is thus a laminal consonant.

9. [j] voiced palatal nasal
[jàà] 'marry' [á□jó] 'onion'

Fig. 16: Palatogram for [j] Fig. 17: Linguogram for [j]

The palatogram in figure 16 show dark patches that start well beyond the alveolar ridge indicating that [j] is produced at the palatal place of articulation. The linguogram in figure 17 indicates a laminal articulation. There is also a lack of central closure as seen in the gap between the dark patches.

Visual inspection of the palatograms and linguograms show that [t], [d], [l], and [ɹ] involve central closure, [dʒ], [n], and [ɲ] involve little central closure, while [s] and [j] lack central closure.

The gap between the dark patches in the center of the mouth was widest for [j], followed by [s], and least for [n], [ɲ] and [dʒ]. These findings are corroborated by the linguograms.

4. Conclusion

This paper employed the palatography technique in the investigation and description of the coronal consonants in Nkọrọọ, an Eastern Ịjọ language belonging to the Niger-Congo phylum. Nine consonants consisting of two plosives [t] and [d], two nasals [n] and [ɲ], two liquids [ɹ] and [l], one affricate [dʒ], one fricative [s], and one approximant [j] were identified for the study. These are all the consonants that are produced with the alveolar, post alveolar, and palatal places of articulation based on auditory perception. Palatograms and linguograms were created using a word list that was carefully prepared with the aid of two competent language consultants.

Concerning the place of articulation of the consonants, the records indicated that [t], [d], [n], [s], [ɹ], [l] are alveolar consonants, [ɲ] and [j] are palatal, and [dʒ] is post alveolar. This confirmed the impressionistic perceptions stated in the literature (Harry, 1989; Obikudo, 2013, 2022). Concerning the part of the tongue involved in the consonant articulations, the linguograms indicated [l] as apical, [t], [d], [n], [ɹ] as apico-laminal, and [s], [dʒ], [ɲ], and [j] as laminal. Furthermore, the findings revealed that the plosives and liquids (l-like and r-like sounds) exhibit central closure, the affricate and nasals have little closure, while the fricative and approximant lack central closure.

In employing an instrumental analysis, this study corroborated the auditory perception of the consonant qualities and also provided a more objective interpretation to the language data. Based on auditory perception, only the consonant place of articulation was identified. With the palatography technique, observations concerning the part of the tongue used in the consonant articulation as well as the presence or absence of central closure were provided. This new information has enhanced our understanding of the phonetic features of the coronal consonants in Nkọrọọ by providing a more accurate phonetic description of the consonants being studied. The use of instrumental techniques to evaluate the auditory perceptions of speech sounds is thus necessary to aid our understanding of linguistic typology.

Finally, the study recommends further instrumental investigation via acoustic techniques into the nature of [r] in the Nkọrọọ language, as the sound as been identified perceptually as a trill (Harry, 1989) and also as an approximant (Obikudo, 2013, 2022). Although palatography is an instrumental method, it is an articulatory technique and best suited for identifying the place of articulation. An acoustic investigation is a more adequate method to distinguish sounds based on their manner of articulation.

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