Changes in the sound articulation of Bulgarian speech following non-removable prosthetic restoration of frontal maxillary defects

Nedelchev D., Konstantinova K.

Abstract: Human speech is a complex process that requires coordinated action of various articulatory organs. The formation of sounds in speech, both vowels and consonants, is achieved through the use of the articulatory apparatus. It is important to note that the place and manner of articulation are crucial for producing different sounds in speech. Specifically, over 46% of the frequency of sound occurrence in speech is related to the frontal teeth, including their shape, size, and spatial arrangement. These observations can be used for a more in-depth analysis of phonetic changes that occur after the prosthetic restoration of frontal maxillary defects.

Introduction

Human speech is an articulatory process through which coordinated action of all speech organs is carried out. The articulatory apparatus includes the throat, nasal, and oral cavities. Its main purpose is to produce vowels and consonants. The articulatory characteristics of each consonant involve the place and manner of articulation. Each consonant has an articulatory place in the vocal tract. In this process, the tongue plays an active role, along with its position relative to the hard palate and teeth.

According to the place of articulation, several groups of consonants can be distinguished:

- **LabialConsonants:** Articulated with the movement of the lips, with the lower lip being the active organ.
  - *Bilabial:* The lower lip contacts the upper lip (p, b, m).
  - *Labiodental:* The lower lip approaches the upper incisors (f, v).
- **Alveolar Consonants: A**rticulated on the alveoli with the involvement of the front part of the tongue.
  - *Alveolodental:* The front part of the tongue creates a barrier with the lower part of the alveoli and adjacent parts of the upper incisors (t, d, s, z, c, dz, l).
  - *Alveolar*: The front part of the tongue creates a barrier with the central and upper parts of the alveoli (n, r).
- **Palatal Consonants:** The front part of the tongue contacts the upper edge of the alveoli and the front part of the hard palate (sh, zh, ch, dzh).
- **Velar Consonants:** The back part of the tongue contacts the soft palate (k, g, h).

According to the manner of articulation, consonants can be categorized as:

- **Stops:** Formed with a complete blockage of the vocal tract, achieved by tightly closing the lips or pressing the tongue against the alveoli and palate (p, b, t, d, k, g).
- **Fricatives:** Consonants formed with a narrowed passage in the vocal tract, produced by bringing the lower lip close to the upper incisors or bringing the tongue close to the alveoli or different parts of the palate (f, v, s, z, sh, zh, h).
- **Affricates:** Consonants that combine the articulatory and acoustic qualities of stops and fricatives (ts, dz, ch, dzh).

- **Laterals:** Consonants that combine features of stops and fricatives, but unlike affricates, the stop and the fricative occur simultaneously (l). [1, 2, 3]

From the perspective of sound articulation, the difference between vowels and consonants lies in whether there is a barrier along the vocal tract. For the pronunciation of vowels, this barrier does not play a role. The airstream exits smoothly from the oral cavity and is not affected by the shape and positioning of the palatal and incisal surfaces of the teeth. Therefore, functional changes that occur due to tooth loss can impact speech function, specifically the pronunciation of consonants. [1, 2, 3].

Objective

To conduct a study based on available scientific literature sources, investigating the changes in sound articulation following the application of non-removable prosthetic restoration for frontal maxillary defects.

Materials and method

Based on key terms such as sound articulation, prosthetic treatment, sound formation, speech disorders, non-removable frontal restorations, a total of 35 literary sources in Bulgarian and English were identified over a 15-year period. English sources were selected from the "Science Direct" database. Information in Bulgarian was gathered from speech therapy textbooks as well as specialized dental literature . After introducing additional criteria—full-text publications and a time frame of up to 10 years—17 literary sources were selected.

Results

The data analysis reveals that over 46% of the frequency of sound occurrence in speech articulation, in terms of place and manner of articulation, is related to the frontal teeth—specifically, their shape, size, and spatial arrangement [1,2]. Various prosthetic constructions influence speech function [4,5,6]. In one-third of the studied sources, it is described that prosthetic constructions need to be both strong enough to resist fracture during masticatory function and thin enough not to impact the patient's speech function [7,8,11,13,14].

The lingual surfaces of the teeth, with their anatomical characteristics and spatial arrangement in dental arches, create optimal passages for the articulation of consonant sounds like s, z, sh, zh, f, v, t, d, ch. Therefore, any changes in lingual surfaces, anatomical forms, and spatial arrangement of teeth in dental arches may lead to alterations in the pronunciation of these sounds, consequently affecting speech [1,2,10,11,16,17].

Any change in the length, inclination, and shape of frontal maxillary teeth, whether intact, restored, or prosthetically replaced, has an impact on the patient's speech function [4,15,16,17]. The mechanism of speech disturbances influenced by veneer crowns lies in the fact that the passage created for f, v, s, z, zh is altered by the new forms and inclinations of frontal maxillary teeth. This affects the necessary barrier for t, d, as well as the passage for c, ch, sh. The flow of Bulgarian speech is realized through the articulatory chain in a complex physiological process, where the articulation of sounds is interconnected. Hence, some authors argue that changes in certain sounds alter the pronunciation of others, influencing the entire speech articulation [1,2,4,5].

Sterenborg AMM et al. found a significant improvement in speech articulation after the rehabilitation of worn and missing teeth [4]. Wan J et al. reported minimal differences in the pronunciation of vowels but noticeable improvement in the articulation of consonant sounds after prosthetic restoration of frontal maxillary defects [5]. Lu, H et al. discovered that increasing the inclination of maxillary incisors up to 30° does not change the articulation of the alveolodental sound "s". However, increasing the inclination beyond these values significantly reduces the amplitude of the sound frequency [16].

Conclusion

Speech function is biologically determined by the anatomical forms and spatial arrangement of dental arches. Frontal maxillary defects, such as missing

teeth, diastemas, and attrition, as well as crown destruction, negatively impact sound articulation. Alongside all preventive, functional, and aesthetic requirements, their prosthetic treatment should aim to preserve or restore speech function.

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