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REVIEW ARTICLE

A COLLABORATIVE APPROACH TOWARDS SPEECH ANALYSIS IN PATIENTS REHABILITATED WITH MAXILLARY OBTURATOR PROSTHESIS

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ABSTRACT

Maxillofacial defects whether acquired or hereditary have always had a significant effect on the functional as well as social aspect of life. Various parts of palate and maxillary ridge resection have had different effect on the speech. After prosthetically restoring such defects there is a need for analysing the outcome of the prosthesis through speech function; it should consist of some form of objective clinical measurements, like resonance balance, determining palatopharyngeal orifice (PPO) opening and speech intelligibility with the help of instruments like Nasometer & PERCI-SARS. These tests have provided a deep insight into what is required while restoring the maxillary defects and what kind of modifications will help restoring back the anatomy as close to as normal. This article was aimed at reviewing the articles which have used these tests to evaluate the speech outcome after restoring the maxillary defects with obturator prosthesis.

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INTRODUCTION

- For assessing the maxillary insufficiency after resection, planning and fabrication of the final prosthesis can be successfully guided with the help of various speech analysis test. (Rieger *et al*., 2002)
- The ones which affect speech majorly are the resection in the maxillofacial region, perhaps the most detrimental to speech are those affecting maxillary alveolar ridge, hard palate, and soft palate. (Rieger *et al*., 2002)
- For categorially assessing the speech outcome throughout prosthetic rehabilitation, it should consist of some form of objective clinical measurements, including analysis of the patient's resonance balance, aeromechanical evaluation to evaluate palatopharyngeal orifice (PPO) opening, and perceptual evaluation of speech intelligibility. (Rieger *et al*., 2002)
- For obtaining the acoustic data, a Nasometer is used, PERCI-SARS helps in collecting the aeromechanical data, and listener analysis is used as an aid to study the perceptual ratings of speech intelligibility.
- Using these three measurements are useful because they provide insight into the disharmony created after the maxillary resection, along with the resultant speech signal, the physiologic functioning of the palatopharyngeal system, and the grievous impact of the speech disorder. (Rieger *et al*., 2002)
- The purpose of the current article is to understand the speech analysis test which can help us in analysing the quality & effect of obturator post operatively.

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Speech analysis test

Speech analysis is done to check for these three parameters

1. Articulation
2. Speech intelligibility
3. Nasality

Articulation

- Articulation is assessed by a test given by Pandit *et al,* an Indian researcher. (Kumar *et al*., 2012)
- A speech pathologist assess the speech under these parameters or error patterns (substitution, distortion, omission or addition), number of sounds misarticulated (sum of distortion, substitution, addition and omission), most frequent position of error, and consistency of error. (Kumar *et al*., 2012)
- Using the articulation test and calculating the number of errors, the speech is analysed with careful listening. (Kumar *et al*., 2012)

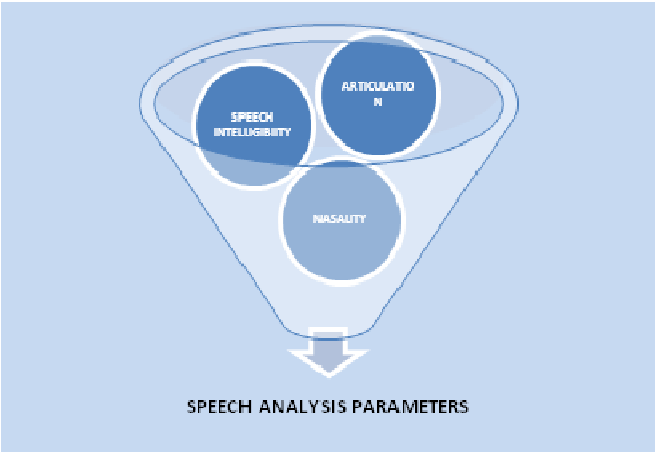

Fig. 1.

- A *zoo* passage or a set of spoken words is presented and a listener or group of listeners writes down what they hear. The percentage of words correctly heard is called the articulation score.
- Articulation scores depend upon the test words used. One type of word list consists of single syllable words selected so that speech sounds in the lists occur with the same relative frequency as they do in spoken English. These are the so-called *phonetically* balanced orpblists.
- Another type of word list is made up of two-syllable words like "armchair," "shotgun," or "railroad" in which each word is pronounced with equal stress on both syllables.
- Various articles have used this test to analyze obturator adaptation role in speech. (Kumar *et al*., 2012. Islam *et al*., 2014)

Speech intelligibility

- Abnormal change of the oronasal resonance and balance and tongue to palate contacts, post maxillectomy leads to speech disorders. (Kumar *et al*., 2012)
- Rehabilitation of the maxillectomy patients with obturators, improves the speech intelligibility which is attributed to the palate, which helps in articulation, but the tongue takes time to get adapted to a new palate. (Kumar *et al*., 2012)
- Due to obturators the speech becomes partially intelligible in most of the cases but certain cases found it hard to adjust to the obturator. (Kumar *et al*., 2012)
- Sites concerning articulation revealed that speech is majorly affected because of either poor oronasal separation in the non-reconstructed group and from inadequately replicatedlinguopalatal contact in the reconstructed group, especially for linguodentoalveolar and lingua-velar sounds. (Kumar *et al*., 2012)
- The dentoalveolar and palatal contours of the maxilla must be restored as closely as possible to normal shape, for higher speech function. (Kumar *et al*., 2012)
- This test was used for analysing the prosthetic treatment after the maxillectomy. (Kumar *et al*., 2012; Bohle *et al*., 2005; Hattori *et al*., 2013; Dholam *et al*., 2013; Kim *et al*., 2016; Rieger *et al*., 2011)

To measure speech intelligibility following scale is used:

Nasalance

Description of speech sample	Point scale
Normal	0
Can understand without difficulty; however feel speech is not normal	1
Can understand with little effort occasionally need to ask for repetition	2
Can understand with concentration and effort specially by sympathetic listener	3
Can understand with difficulty and concentration by family but not others	4
Can understand with effort if content is known	5
Cannot understand at all even content is known	6

- Nasalance is typically high proportion of nasal sound pressure, as in nasal consonants, for example, /m/,/n/, and/ng/. This signifies that nasalance of voice depends on the integrity of various resonating cavities. (Kumar *et al*., 2012)
- As the patient undergoes maxillectomy, it causes hypernasality of voice as the air escapes through the defect. Adequate oronasal separation is required for proper intelligible sounds; which improves resonance. Therefore, in maxillectomy cases after rehabilitation, nasalance is eliminated and can be as low as in normal individuals. (Kumar *et al*., 2012) A Nasometer is used to collect nasalance data. The Nasometer, with the help of two unidirectional microphonesside by side records the oral and nasal acoustic speech energy. These two microphones are separated by a metal plate placed between the mouth and nose. (Kumar *et al*., 2012) As shown in Fig. 2.

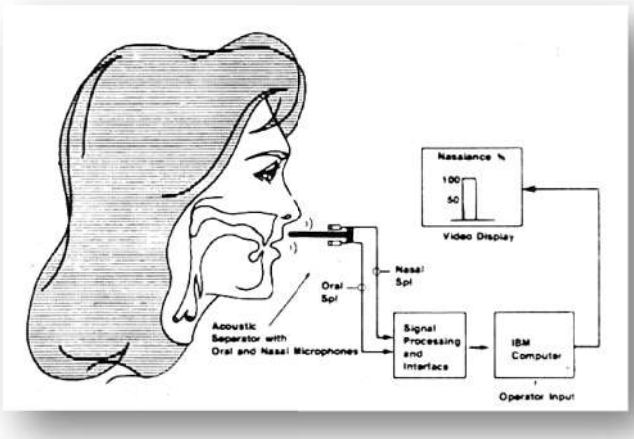

Fig. 2.

- This tool helps us in calculating the nasalance, which can be summarised as nasal acoustic energy (N) divided by nasal-plus-oral acoustic energy (N + O) and is expressed as a percentage. (Rieger *et al*., 2002)
- {[(N)/(N + O)] * 100}
- Patients were asked to read the Zoo Passage, in the collection of nasalance data. (Rieger *et al*., 2002)
- A Nasometer is used to collect nasalance data. The simultaneously sampling of the oral and nasal acoustic energy is collected with the help of two unidirectional

microphones, separated by a metal plate forming the Nasometer. (Rieger *et al*., 2002)

- The PERCI-SARS (Microtronics) was used to estimate the size of the opening between the oral and nasal cavities. The ability of this system to estimate the size of the opening between the two cavities is based on fluid mechanics and the laws of hydrodynamics. (Rieger *et al*., 2002)
- Oral and nasal pressures were converted to an electrical analogue by two differential pressure transducers. (Rieger *et al*., 2002)
- The three measures needed in the calculation of PPO area are collected in the following manner:
- A polyethylene catheter is placed behind the maxillary incisrs on the tongue, to record the oral air pressure. (Rieger *et al*., 2002)
- A polyethylene catheter along with a foam cork is fitted into one of the nare to record the nasal air pressure; (Rieger *et al*., 2002)
- Similarly nasal air flow was collected through a polyethylene tube sized to fit securely in the other nare of the patient. (Rieger *et al*., 2002)
- Nasal airflow was converted to an electrical analogue via a Fleischpneumotachometer and a third differential pressure transducer. Patients were asked to repeatedly pronounce two different stimulus words (/papa/, /hamper/) used in routine clinical practice when collecting aeromechanical data. (Rieger *et al*., 2002)
- PPO area was calculated by means of the PERCI-SARS software. The /p/ sounds produces a spike in the pressure which are than marked by cursors to obtain the mean PPO area. (Rieger *et al*., 2002)
- Speech utterances for intelligibility measures are collected via a head-mounted unidirectional microphone and recorded onto digital voice recorder through a Digital Voice Recorder. (Rieger *et al*., 2002)
- C-AIDS (Computerized Assessment of Intelligibility of Dysarthric Speech) program produces random 22 sentences which include 50 words to produce the speech stimuli. (Rieger *et al*., 2002)
- For the analysis of all these speech parameters there are companies which produce softwares and machines. (Rieger *et al*., 2002)
- With so many resonating cavities in the head and neck region, few authors have considered using this test for the assessment of the treatment outcome of maxillectomy cases.
- There are reported cases where author has used occlusal analysis with the help of T – scan to study occluso – articulatory relations after restoring the maxillary defects. (Gerdzhikov *et al*., 2016)

Conclusion

- In the era of microvascular reconstructive surgery in head and neck cancer, a role exists for speech aid– obturator prosthetic intervention for maximum functional outcomes regarding restoration of speech.
- Speech aid or obturator prostheses intervention should be considered as an integral component of soft palate resection resulting in excellent restoration of velopharyngeal insufficiency, thus providing patients an acceptable and functional speech outcome.
- With such advanced technology in hand we can try to achieve better post operative outcome in patients of maxillectomy.

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