Review Article

University J Dent Scie 2024; Vol. 10, Issue 3

The Intersection of Speech Therapy and Prosthodontics: A Comprehensive Review

Abstract:

This literature review delves into the principles and methodologies underlying speech therapy, emphasizing the integration of prosthetic devices for the treatment of speech and language disorders. It explores the design and implementation of oral prostheses, specifically for cleft palate patients, highlighting the importance of avoiding obstructions that hinder tongue movement and ensuring proper velopharyngeal function. The review outlines comprehensive speech evaluation protocols, including oral examinations, articulation tests, nasal emission tests, and overall speech intelligibility assessments. Furthermore, it discusses the impact of prosthodontics on speech, noting that changes in denture design can affect tongue position and oral cavity dimensions, thus influencing speech production. The role of speech therapy in managing congenital and acquired speech disorders through devices like palatal lifts and speech bulbs is also examined. Additionally, the review touches on the intersection of speech therapy and mental health, suggesting that speech characteristics may serve as biomarkers for psychiatric conditions. Overall, this review underscores the necessity of collaborative efforts between prosthodontists and speech therapists to optimize patient outcomes in speech rehabilitation.

Key-words: Speech Therapy, Prosthetic Devices, Cleft Palate, Speech Evaluation, Articulation Tests

Introduction:

The field of prosthodontics, which deals with the restoration and replacement of missing teeth, is closely intertwined with the principles of speech therapy. Effective communication is a crucial aspect of human interaction, and the ability to speak clearly and intelligibly is essential for a patient's overall well-being and quality of life[1].

In the rehabilitation of patients with impaired speech function, such as dysarthria or dysglossia, speech therapy plays a crucial role in helping to restore and improve their ability to communicate effectively. The main goals of speech therapy in this context are to improve the speech motor output and enhance the patient's communicative abilities, ultimately reducing the impact of the disability on their everyday life[2].

Various factors must be considered when assessing the potential for rehabilitation and establishing attainable therapeutic goals, including the nature and severity of the brain damage, the duration of the condition, and the progression or stability of the disease. In cases of tumor-related speech impairments, additional factors such as scarring or tissue changes resulting from radiation and chemotherapy must also be taken into account. Furthermore, the presence of comorbidities and unfavourable psychosocial conditions can often reduce the chances of successful therapeutic outcomes, especially in older patients[3].

It is essential that qualified speech and language therapists are readily accessible to patients in need of their services. Effective communication between the speech therapist and the

Access this article online

Website: www.ujds.in

Quick Response Code

DOI: https://doi.org/10.21276/ujds.2024.10.3.18

[1]AKASH RAJ SHARMA, [2]YASH SINGH, [3]ELIZABETH MADATHIL, [4]UTKARSH GUPTA

[1-3]Department of Prosthodontics & Crown & Bridge, Subharti Dental College & Hospital, Swami Vivekanand Subharti University Meerut.

[4]Department of Prosthodontics & Crown & Bridge, Maharana Pratap College of Dentistry & Research Centre, Gwalior

Address for Correspondence: Dr. Akash Raj Sharma
Assistant Professor,
Department of Prosthodontics & Crown & Bridge,
Subharti Dental College & Hospital,
Swami Vivekanand Subharti University Meerut
Email: _itsdocakash@gmail.com

Received : 4 July, 2024, **Published :** 30 Sept., 2024

How to cite this article: Sharma, D. A. (2024). The Intersection of Speech Therapy and Prosthodontics: A Comprehensive Review. UNIVERSITY JOURNAL OF DENTAL SCIENCES, 10(3).

prosthodontist is crucial, as the restoration of missing teeth can have a significant impact on the patient's ability to speak clearly and intelligibly.

The restoration of missing teeth through prosthodontic interventions can have a profound impact on a patient's ability to communicate effectively. By collaborating with speech therapists, prosthodontists can ensure that the design and placement of prosthetic devices optimize the patient's speech function and overall communication abilities.

Speech therapy is critical in addressing various speech and language disorders, often utilizing prosthetic devices and specific therapeutic protocols[4]. This review examines key literature on the construction and utilization of prosthetic devices for speech therapy, methodologies for speech evaluation, and the integration of speech therapy in prosthodontics[5].

Speech Production, Perception And Repetition:

Speech production is a complex, multi-step process that transforms thoughts into spoken utterances. This process involves selecting appropriate words and their forms from the lexicon and morphology, and organizing them using syntax.

The classical model of the brain's language system highlights two key areas: Broca's area in the inferior prefrontal cortex, and Wernicke's area in the posterior superior temporal gyrus, typically on the left hemisphere for language.

In articulatory phonetics, articulation concerns how speech organs like the tongue, lips, jaw, and vocal cords produce sounds. Speech sounds are categorized by their manner and place of articulation. Place of articulation refers to where the airstream in the mouth is constricted, while manner of articulation describes how the speech organs interact, including the degree of air restriction, the type of airstream used (e.g., pulmonic, implosive, ejectives, clicks), whether the vocal cords are vibrating, and if the nasal cavity is involved in the airstream.

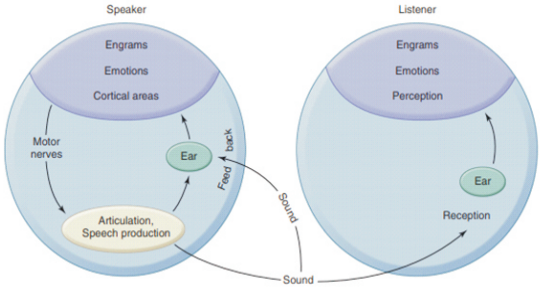

Figure 15-2 A general schema of speech production and communication.

Speech Science:

Aspects of Normal Speech Functioning:

1. **Motor System**: This system includes the lungs and associated muscles that supply the air necessary for speech production.
2. **Vibrator**: The vocal cords fall under this category, providing the pitch to the voice, which is essential for modulating speech sounds.
3. **Resonator**: This comprises the oral, nasal, and pharyngeal cavities, along with the para-nasal sinuses. These structures work together to create a unique tone for everyone, contributing to the distinctiveness of their voice.
4. **Enunciators and Articulators**: These include the lips, tongue, soft palate, hard palate, and teeth. They function as musculoskeletal valves that control the passage of air, allowing for the precise formation of speech sounds.
5. **Initiator**: The motor speech area of the brain, along with its nerve pathways, conveys motor speech impulses to the speech organs, initiating the process of speech production.

Components of Speech (Kantner and West):

1. **Respiration**: This is the process of air flowing into and out of the lungs, crucial for speech production.
   - **Inhalation**: The diaphragm lowers, increasing the volume of the thoracic cavity. This creates negative pressure, causing air to rush into the lungs.
   - **Exhalation**: The volume of the thoracic cavity decreases, creating positive pressure, and air rushes out of the lungs.
2. **Phonation**: This is the production of sound by the vibration of the vocal folds within the larynx.
   - **Constitution of Larynx**: The larynx includes unpaired cartilages (thyroid, cricoid, epiglottic) and paired cartilages (arytenoid, corniculate, cuneiform).
   - **Pitch Control**: The tension and elongation of vocal cords increase pitch, while their relaxation and shortening decrease pitch.
3. **Resonance**: This occurs when the amplitude of sound increases as its frequency matches the natural frequency of the resonating system.
   - **Resonating Chambers**: These include the vocal tract, oral cavity, pharyngeal cavity, and sinuses.
   - **Sound Modification**: The nasal cavity is used for specific sounds such as M, N, and 'ng,' while the oral cavity is used for others. This modulation is controlled by the soft palate[7].

Manner of Articulation ↓	Place of Articulation ↓									
	Bilabial		Alveolar		Palatal		Velar		Glottal	
	Vl	Vd	Vl	Vd	Vl	Vd	Vl	Vd	Vl	Vd
Aspirated Stop	p^h		t^h				k^h			
Un-aspirated		b		d				g		
Nasal	m			n				ŋ		
Fricative					s	z				h
Trill				r						
Lateral				l						
Semi-vowel	w					y				

1. **Articulation**:This involves the adjustment of the vocal tract by various articulators, such as the lips and tongue, to produce different sounds.

- **Phoneme Classification**:

- **Vowels**:These sounds involve no significant constriction in the vocal tract. They are classified by the point and degree of constriction, lip rounding, and muscle tension.
- **Diphthongs**:These are sequences of two vowel sounds that form a single syllable.[9-10]
- **Consonants**:
- **Place of Articulation**:This includes bilabial, labiodental, dental, alveolar, palatal, velar, and glottal sounds.
- **Manner of Articulation**:This encompasses stops, fricatives, nasals, glides, and liquids.
- **Voicing**:Consonants can be voiced, where the vocal cords vibrate, or voiceless, where the vocal cords remain open[8].

TABLE 15-1 ENGLISH CONSONANTS: THEIR VALVE POSITIONS AND MODES OF PRODUCTION

	Mode of Production											
	Plosives (Stops)		Fricatives		Affricatives		Nasals		Liquids		Glides	
Valve Position	Breathed	Voiced	Breathed	Voiced	Breathed	Voiced	Breathed	Voiced	Breathed	Voiced	Breathed	Voiced
Bilabial	*p* (pay)	*b* (bay)						*m* (man)				*w* (witch)
Labiodental			*f* (fan)	*v* (van)								
Linguodental			*th* (thumb)	*th* (there)								
Linguoalveolar	*t* (to)	*d* (dot)	*s* (so)	*z* (zoo)				*n* (name)				
Linguopalatal			*sh* (shoe)	*z* (vision)	*ch* (chin)	*j* (jar)				*r* (rose)		*y* (you)
Linguovelar	*k* (back)	*g* (bag)	*h* (who)					*ng* (bang)				

1. **Neural Integration**:Various brain regions and neural pathways are critical for speech production.

- **Broca's Area**:This region controls the motor functions necessary for speech production.
- **Wernicke's Area**: This area is involved in language comprehension.

2. **Audition**: The ability to hear sounds, essential for monitoring and controlling speech output.[12]

Categories of Speech Sounds:

1. **Voicing**: The vibration of the vocal cords.
2. **Frication**: Turbulence due to constriction in the vocal tract.
3. **Plosion**: The release of built-up air pressure.
4. **Silence**: Pauses in speech.

Sonority and Speech Sound Categories:

1. **Vowels**:These are produced with no significant constriction in the vocal tract and usually with periodic excitation[13].

2. Consonants:

- **Plosive**:Produced by releasing built-up air pressure (e.g., P, B, T, D).
- **Fricative**:Created by nearly obstructed airflow, resulting in sharp sounds (e.g., S, Z).
- **Affricative**:A combination of plosive and fricative sounds (e.g., Ch, J).
- **Nasal**:Produced with resonance through the nasal cavity (e.g., M, N, NG).
- **Liquid**:Produced without significant friction (e.g., R, L).

3. Glides:

Produced by gradually changing the shape of the articulators (e.g., W, Y).

The 'S' Sound:

- **Articulatory Properties**:The tongue is placed near the upper front incisors, creating a narrow groove.
- **Acoustic Properties**:This sound has strong energy concentrated in high frequencies.
- **Auditory Properties**:It is loud and sibilant, and its quality can be affected by dental and palatal structures, especially in prosthetics[14].

Prosthetic Devices in Speech Therapy:

McDonald (1951)[15] emphasized the construction of oral prostheses for cleft palate patients, focusing on speech considerations. The prosthesis should facilitate occlusion between anterior teeth, be free from obstructions that hinder tongue movement, and provide adequate retention to avoid interference during speech. The velar section must prevent air leakage into nasal cavities, and the pharyngeal section should be positioned at the point of maximum constriction to support speech production.

Shyammohan and Sreenivasulu (2010) highlighted the importance of a protocol for speech therapy with obturators, involving a thorough speech evaluation encompassing oral examinations, articulation tests, nasal emission tests, and overall speech intelligibility[16].

Speech Evaluation and Therapy Protocols:

Speech evaluation is multifaceted, involving several tests to measure clarity and nasal resonance. The articulation tests include phrases loaded with pressure-sensitive phonemes and counting sequences. Nasal emission tests and tests for overall speech intelligibility are also critical.

Impact of Speech Therapy on Prosthodontics:

Kessler (1957) discussed phonetics in denture construction, noting that dentures' design can influence speech due to changes in tongue position and oral cavity dimensions. Patients typically adapt to these changes, but prolonged adaptation may be needed for those with hearing impairments[5].

Aboloyoun et al. (2013) and McDonald (1951) stressed the significance of speech considerations in prosthetic design, particularly for velopharyngeal insufficiency cases where surgical intervention is not viable[14-15]. The integration of speech therapy and prosthodontics ensures comprehensive patient care and optimal speech outcomes.

Speech Disorders and Prosthetic Interventions:

Speech disorders can arise from congenital and acquired conditions, including cleft palate, cerebral palsy, and neurological diseases[16]. Prosthetic devices like palatal lifts and speech bulbs are effective for managing velopharyngeal incompetence. These devices help achieve closure of the velopharyngeal port, improving speech clarity.

Role of Speech Therapy in Mental Health:

Psychiatric disorders can influence speech acoustic features. Studies indicate that speech characteristics, such as pitch, may serve as biomarkers for mental health conditions like major depressive disorder, making speech therapy a valuable tool in psychiatric assessment and intervention[17-21].

Conclusion:

Speech therapy, intertwined with prosthodontics, plays a crucial role in managing speech disorders through the use of specialized prosthetic devices and tailored therapeutic protocols. Continuous collaboration between prosthodontists and speech therapists is essential for achieving optimal patient outcomes in speech rehabilitation.

References:

1. Sharry, John J. Complete Denture Prosthodontics. First Edition.
2. ASHA : American Speech-Language-Hearing Association.
3. Catford, J.C.; Esling, J.H. (2006). "Articulatory Phonetics". In Brown, Keith (ed.). *Encyclopedia of Language & Linguistics* (2nd ed.). Amsteram: Elsevier Science. pp. 425–42.
4. Kennison, Shelia (2013). *Introduction to Language Development*. Los Angeles: Sage.
5. Kessler H.E., 1957. Phonetics in denture construction, Journal of American Dental Association, 54: 347-351.
6. Behrman, Alison. (2013). *Speech and Voice Science*. San diego, Calif.: Plural publishing.
7. BD Chaurasia. Human Anatomy. 6th Editon.
8. Prosthodontic Treatment for Edentulous Patients. Complete Dentures and Implant supported prosthesis. South Asia Edition.2017
9. Jain CD, Bhaskar DJ, Agali CR, Singh H, Gandhi R.Phonetics in Dentistry. Int J Dent Med Res 2014;1(1):31-37.
10. Surekha Godbole et al. Prosthodontic Considerations of Speech in Complete Denture. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS).Vol 15, 2016.
11. Clinical Dental Prosthetics.H R B Fenn. 2nd Edition
12. Low DM, Bentley KH, Ghosh, SS (2020). "Automated assessment of psychiatric disorders using speech: A systematic review". Laryngoscope Investigative Otolaryngology. 5 (1): 96–116.
13. Robert Rothman. Phonetic considerations in denture prosthesis.Vol 11.JPD 1961
14. Aboloyoun AI, Ghorab S, Farooq MU. Palatal lifting prosthesis and velopharyngeal insufficiency: preliminary report. Acta Med. Acad. 2013; 42(1):55-60
15. McDonald, E. T. (1951). Speech considerations in cleft palate prosthesis. The Journal of Prosthetic Dentistry, 1(5), 629–637.
16. A. Shyammohan and D. Sreenivasulu. Speech Therapy with Obturator. J Indian Prosthodont Soc (Oct-Dec 2010) 10(4):197–9.
17. Shukla S, Sharma A, Dubey S, Arya G, Sharma A.R, Yadav B. Rule The Rugae: A Case Report. Journal of Dental College Azamgarh (Official publication of Purvanchal University), 2018; 4(1):24-7.
18. Lekhi R, Singh K, Shukla S, Sharma A.R. Partial Overdenture – A Case Report. Int. J Sci Res July 2018: 7(6):12-3.
19. Sha R.K, Kumar S, Bhayana R, Shill M, Sharma A.R. Full Mouth Reconstruction- Malo Implant Bridge: A Case Report. Int. J Sci Res July 2020: 9(11).

20. Sharma A. R, Saxena D, Shivani, Raj R. Maxillary submerged implants: from error to innovation. Int J of All Res Edu & Sci Methods Jun 2022:10(6);1612-8.
21. Sharma A.R, Kumar N, Gupta R.K, Gupta U, Shivani, Raj R. Clinical success of the fiber reinforced composite fixed partial denture (FRC FPD) in anterior region for missing one or two missing teeth in anterior region. An original study.J Pharmaceutical Negative Results J Pharmaceutical Negative Results Sep 2023:14(02);1856-66.