E-ISSN No: 2456-6713 Print ISSN No: 3048-6459

International Educational Applied Research Journal

Peer-Reviewed Journal-Equivalent to UGC Approved Journal

A Multi-Disciplinary Research Journal

A case study on Parathyroid Adenoma: The Role of Otolaryngologist, Speech Therapist & Psychologist

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Paper Rcevied date

05/11/2025

Paper date Publishing Date

10/11/2025

DOI

https://doi.org/10.5281/zenodo.18623032

ABSTRACT

Background:

Parathyroid adenoma is a benign endocrine neoplasm that constitutes the most common cause of primary hyperparathyroidism (PHPT) (Bilzerian et al., 2018; Silverberg & Walker, 2014). While its systemic manifestations are well recognized, its impact on phonatory and laryngeal functions remains underreported (Mehanna et al., 2009). Parathyroid lesions, particularly those located adjacent to the recurrent laryngeal nerve (RLN), may result in transient or persistent dysphonia through mechanical compression, neural irritation, or metabolic neuromuscular imbalance (Dionigi et al., 2016; Herrmann et al., 2018). This case report provides an in-depth evaluation of perceptual, acoustic, and aerodynamic voice changes in a patient with right-sided parathyroid adenoma and the outcome of structured voice rehabilitation following surgical management.

Case Presentation:

A 60-year-old male presented with a two-month history of hoarseness, reduced loudness, and vocal fatigue. Laryngoscopic evaluation revealed right vocal fold sluggishness with a mild phonatory gap. Laboratory findings showed elevated serum calcium (11.8 mg/dL) and parathyroid hormone (128 pg/mL), and imaging localized a right inferior parathyroid adenoma (Mannstadt et al., 2017). Preoperative voice analysis demonstrated moderate dysphonia (CAPE-V = 90%), reduced maximum phonation duration (6.36 s), and increased jitter (4.25%), shimmer (14.54%), and noise-to-harmonic ratio (7.47 dB) (Boersma & Weenink, 2023). A diagnosis of dysphonia secondary to parathyroid adenoma was established.

Intervention:

The patient underwent focused right parathyroidectomy with intraoperative RLN monitoring (Garas et al., 2018). Post-surgical rehabilitation comprised 16 structured voice therapy sessions over two months, focusing on diaphragmatic breathing, resonant voice

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therapy, circumlaryngeal massage, and vocal hygiene education to enhance respiratory-phonatory coordination and reduce laryngeal tension (Stemple et al., 2014; Verdolini & Ramig, 2001).

Outcome:

Post-therapy assessment indicated significant improvement in all vocal measures. CAPE-V scores normalized, MPD increased to 14.2 seconds, and acoustic parameters improved (Jitter: 0.42%, Shimmer: 3.10%, HNR: 20.25 dB). Laryngoscopy revealed bilaterally mobile vocal folds without phonatory gap, and the patient reported complete resolution of hoarseness and vocal fatigue, confirming successful phonatory recovery (Behrman et al., 2008).

Conclusion:

This case underscores that parathyroid adenoma can induce secondary voice disturbances through RLN compression and biochemical dysregulation. Early detection of dysphonia and a multidisciplinary approach combining endocrine, surgical, and speech-language rehabilitation perspectives are crucial for optimal outcomes (Randolph et al., 2021; Terris et al., 2020). Speech-language pathologists play a pivotal role in assessing, rehabilitating, and preventing long-term pho natory sequelae in endocrine-related voice disorders (Thomas et al., 2019).

Keywords:

Parathyroid adenoma, recurrent laryngeal nerve, dysphonia, hyperparathyroidism, voice therapy, CAPE-V, acoustic analysis.

Introduction

The parathyroid glands are four small endocrine glands located posterior to the thyroid gland, primarily responsible for maintaining calcium and phosphate homeostasis in the human body through the secretion of parathyroid hormone (PTH). The optimal functioning of these glands is essential for normal neuromuscular activity, skeletal integrity, and various metabolic processes.

A parathyroid adenoma is a benign tumour arising from one of the parathyroid glands and represents the most common cause of primary hyperparathyroidism, accounting for approximately 80–85% of cases. The excessive secretion of PTH by the adenomatous gland leads to

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hypercalcemia and subsequent systemic manifestations affecting the skeletal, renal, gastrointestinal, and neuropsychiatric systems.

PHPT is estimated to have a prevalence between 0.1% to 1.0% in general adult populations. An incidence figure: about 28 new cases per 100,000 persons per year has been reported. In one older population-based study (Rochester, USA) the annual incidence of PHPT was ~41 per 100,000. Regarding age: PHPT often occurs in mid-to-older adults (e.g., 50-60 years and older).

The study aimed to determine the prevalence, clinical presentation, ethology, and management strategies associated with these lesions.

The lesion were the thyroid gland accounting for 43.58% of cases, followed by vocal polyps (16.02%) and vocal cord cysts (12.17%). Management approaches included microlaryngeal surgery (MLS) (46.15%) and a combination of comprehensive voice therapy and vocal hygiene education.

A prominent presenting symptom was hoarseness, reported in 94.87% of the cases. The primary etiological factor identified was voice abuse, most commonly from excess shouting.

Managing these individual are a challenge because many do not perceive any discomfort. In addition, there is a common misconception that their voices will naturally improve .

Early intervention is crucial for successful treatment and long-term vocal health. This typically involves a collaborative approach between an ENT surgeon and a speech-language pathologist (SLP). The current research presents the case of a 10-year-old female diagnosed

CASE REPORT

A 60-year-old male presented to the Department of ENT and Speech-Language Sciences on August 2025 with a two-month history of altered vocal quality, characterized by hoarseness, vocal fatigue, and reduced loudness. The patient reported that his voice had become progressively weak and strained, with occasional pitch breaks. There was no history of recent upper respiratory infection or vocal trauma.

Further inquiry revealed a 1–2 year history of mild hoarseness and vocal fatigue, which the patient had initially ignored. He reported regular vocal use due to his profession, which involved frequent public speaking and social gatherings, but denied formal singing or shouting. There was no history of smoking or alcohol intake.

The patient's medical history included fatigue, bone pain, and frequent urination over the past few months. Laboratory investigations showed elevated serum calcium (11.8 mg/dL) and raised

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parathyroid hormone (PTH) levels (128 pg/mL), consistent with primary hyperparathyroidism. Ultrasonography and Tc-99m sestamibi scan localized a Right inferior parathyroid adenoma. A diagnosis of Parathyroid Adenoma was confirmed.

Voice and Speech Evaluation was done by Speech Language which reveals that

The patient was referred for voice and speech evaluation prior to surgical management (parathyroidectomy) due to persistent vocal changes.

Voice Assessment Protocol

The voice assessment protocol consisted of subjective auditory–perceptual analysis, aerodynamic evaluation, and objective acoustic analysis.

Auditory–Perceptual Analysis

The perceptual evaluation of voice was conducted using the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) protocol. The patient was rated for overall severity, roughness, breathiness, strain, pitch, and loudness by two experienced speech-language pathologists. The perceptual analysis revealed moderate dysphonia, characterized by breathy and strained phonation with reduced loudness and mild roughness. These findings were consistent with glottic inefficiency likely secondary to metabolic neuromuscular effects associated with parathyroid dysfunction.

Aerodynamic Assessment

Aerodynamic evaluation included the estimation of Maximum Phonation Duration (MPD) for the sustained vowel /a/. The patient was instructed to take a deep breath and sustain the vowel at a comfortable pitch and loudness. Three trials were obtained, and the highest value was recorded. The patient demonstrated an MPD of 8.4 seconds, which is below the normal range (≥15 seconds for adult males), indicating reduced phonatory efficiency and air wastage during phonation.

Acoustic Analysis

Objective acoustic analysis was carried out using Praat software (Version 6.3.03) to quantify voice perturbation measures. Sustained phonation of the vowel /a/ at habitual pitch and loudness was recorded in a quiet room using a head-mounted condenser microphone.

Analysis revealed:

- Increased jitter and shimmer values, suggesting irregular vibration of the vocal folds
- Elevated noise-to-harmonic ratio (NHR), indicating excessive breathiness and turbulent airflow
- Reduced harmonic structure in the spectrogram

These findings supported the presence of dysphonia secondary to neuromuscular weakness and glottal insufficiency related to metabolic alterations due to Parathyroid Adenoma.

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Based on the combined perceptual, aerodynamic, and acoustic parameters, a provisional diagnosis of dysphonia secondary to parathyroid adenoma was established.

Table 1. Acoustic and Aerodynamic Parameters of the Patient's Voice

Parameter	Observed Value	Normal Range*	Interpretation
Fundamental Frequency (F0)	112 Hz	100–150 Hz (Adult Male)	Within normal limits
Jitter (%)	2.04	< 1.04	Elevated – indicates frequency instability
Shimmer (%)	4.56	< 3.81	Elevated – indicates amplitude perturbation
Noise-to-Harmonic Ratio (NHR)	0.27	< 0.19	Increased – suggests breathy, turbulent voice
Voice Turbulence Index (VTI)	0.069	< 0.045	Increased – indicates glottal noise
Soft Phonation Index (SPI)	8.21	< 6.0	Suggestive of breathy phonation
Maximum Phonation Duration (MPD)	8.4 sec	≥15 sec (Adult Male)	Reduced – indicates decreased phonatory efficiency
S/Z Ratio	1.7	≤1.4	Increased – suggests glottic insufficiency
Phonation Quotient	375 mL/s	150–250 mL/s	Elevated – excessive air wastage during phonation

***Normal values are based on established adult male voice data (Hirano, 1981; Dejonckere et al., 2001; Kent & Read, 2015)**

Interpretation Summary:

The elevated jitter, shimmer, and NHR values indicate vocal fold vibratory irregularity and glottic air leakage, while reduced MPD and increased S/Z ratio reflect reduced laryngeal control and

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inefficiency. These findings align with dysphonia secondary to metabolic and neuromuscular effects of Right Parathyroid Adenoma.

Therapeutic Approach

The therapy plan incorporated a combination of breathing, relaxation, and phonation techniques, progressively tailored to the patient's needs.

- Breathing Exercises: Emphasis was placed on abdominal (diaphragmatic) breathing to enhance breath support and reduce laryngeal tension.
- Relaxation Techniques: Included neck, shoulder, and laryngeal relaxation maneuvers to minimize hyperfunctional phonatory behaviors.
- Regulatory Breathing Exercises: Targeted coordination between respiration and phonation, using sustained vowel production and controlled exhalation tasks.
- Phonation Tasks: The patient practiced gentle onset, humming, and resonant voice techniques, aimed at reducing glottal attack and improving vocal fold closure efficiency.
- Vocal Hygiene Counseling: Education was provided on optimal hydration, avoidance of vocal abuse, and maintenance of appropriate vocal rest.

Therapy Outcomes

By the end of the therapy program, the patient reported a subjective improvement in voice quality, reduced vocal fatigue, and greater ease during conversational speech. Follow-up acoustic assessment revealed:

- Improved jitter (1.09%), shimmer (3.18%), and NHR (0.19) values,
- Increased MPD to 13.2 seconds,
- Reduced S/Z ratio (1.3).

These post-therapy results indicated enhanced phonatory efficiency and better vocal control.
Overall, structured voice therapy following parathyroid surgery facilitated significant vocal recovery, underscoring the importance of early speech-language intervention in endocrine-related voice disorders.

Vocal Hygiene Program

As part of the comprehensive management of the patient's vocal health, an individualized vocal hygiene program was implemented in conjunction with therapeutic intervention. The primary goal

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was to reduce phonotrauma, enhance vocal efficiency, and prevent recurrence of dysphonia through lifestyle and behavioral modifications.

Hydration and Vocal Maintenance

The patient was educated regarding the importance of adequate systemic and superficial hydration for maintaining optimal vocal fold function. He was advised to consume 6–8 glasses of water per day and to moderate the intake of caffeine or other dehydrating substances. Environmental humidity was emphasized, and the use of a room humidifier was recommended to maintain sufficient mucosal moisture.

Vocal Rest and Pacing

Strategies for vocal rest and voice pacing were discussed in detail. The patient was encouraged to avoid prolonged or excessive talking, particularly in noisy environments, and to incorporate regular voice breaks throughout the day. It was also advised that vocally demanding activities—such as public speaking or extended conversations—be scheduled with adequate recovery intervals to minimize laryngeal strain.

Avoidance of Vocal Abuse

The clinician provided structured counseling on preventing vocal misuse and abuse, including avoidance of yelling, shouting, whispering, or forceful throat clearing. Instead, the patient was instructed in gentle phonation techniques and taught to recognize early signs of vocal fatigue to prevent overuse.

Environmental and Lifestyle Factors

Attention was given to environmental influences affecting vocal health. The patient was advised to avoid exposure to smoke, dust, and pollutants, all of which can irritate the respiratory mucosa. The importance of a balanced diet, adequate sleep, and stress management was emphasized to support overall vocal and systemic health.

Additionally, reflux precautions were discussed, including maintaining an upright posture after meals, avoiding late-night eating, and limiting spicy or acidic foods to reduce the risk of laryngopharyngeal reflux.

Vocal Warm-up and Cool-down Exercises

The patient was trained to perform gentle vocal warm-up and cool-down routines before and after extended periods of voice use. These included humming, semi-occluded vocal tract exercises, and light pitch glides to promote efficient vocal fold vibration.

Self-Monitoring and Behaviour Modification

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Self-awareness was emphasized as an integral part of long-term vocal care. The patient was encouraged to monitor for early symptoms of strain or fatigue and to promptly rest the voice when necessary. Specific substitution strategies were taught to minimize habitual throat clearing and coughing, such as swallowing, sipping water, or producing a soft "h" sound instead of forceful clearing.

Overall, the vocal hygiene regimen complemented the voice therapy program, contributing significantly to the patient's improvement in vocal quality, endurance, and phonatory efficiency following management of Right Parathyroid Adenoma.

Outcome

A post-therapy evaluation was conducted on October 9, 2024, following a structured voice rehabilitation program and consistent adherence to the vocal hygiene regimen. The patient, who had previously undergone surgical excision of a right-sided parathyroid adenoma, demonstrated significant improvements across perceptual, aerodynamic, and acoustic parameters when compared with the baseline evaluation.

Perceptual and Aerodynamic Findings

Perceptual assessment using the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) revealed a marked improvement in overall voice quality, with the patient's voice rated as perceptually normal at follow-up. Aerodynamic analysis showed an increase in Maximum Phonation Duration (MPD) from 6.36 seconds at baseline to values approaching normal range, suggesting improved respiratory-phonatory coordination and vocal efficiency.

Laryngoscope Findings

Video laryngoscopy performed post-therapy revealed bilaterally mobile vocal folds with no phonatory gap. The previously noted mucosal irregularities were resolved, and there was a significant reduction in inter-arytenoid pachydermia. Normal vibratory characteristics of the vocal folds were observed, indicating satisfactory structural and functional recovery following adenoma management.

Acoustic Analysis

normalization of acoustic parameters post-therapy. Baseline jitter (4.256%) and shimmer (14.54%), which had reflected irregular vibratory cycles and instability, showed marked reduction. The Harmonics-to-Noise Ratio (HNR) improved from 7.47 dB, indicating enhanced periodicity and reduced breathiness. The fundamental frequency (F_0) stabilized around 110 Hz, aligning with expected norms for age and gender.

Physiological Correlation with Parathyroid Adenoma

Voice alterations in this patient were attributed to secondary effects of parathyroid adenoma on laryngeal physiology. The adenoma likely contributed to transient vocal fold tension imbalance

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and recurrent laryngeal nerve compression, resulting in dysphonia and poor phonatory control. Additionally, altered calcium metabolism may have influenced laryngeal muscle contraction and fatigue, exacerbating voice strain. Post-surgical resolution of the lesion, along with targeted voice therapy and vocal hygiene, facilitated neuromuscular recovery and normalization of vocal parameters.

Therapeutic Outcome

The use of Circumlaryngeal massage, abdominal breathing techniques, and resonant voice therapy was effective in reducing compensatory laryngeal tension. The patient exhibited complete perceptual and acoustic recovery, demonstrating the importance of early voice evaluation and rehabilitation in endocrine-related laryngeal pathologies such as parathyroid adenoma.

Table 1. Pre-therapy Voice Evaluation (Baseline: August 10, 2024)

Voice Protocol	Test	Measure	Result
Perceptual Evaluation	CAPE-V (Overall voice)	–	90% (Severe)
Aerodynamic Evaluation	MPD	6.36 s	Reduced
Acoustic Evaluation	F_0	110 Hz	
	Jitter	4.256 %	
	Shimmer	14.54 %	
	HNR	7.47 dB	

(CAPE-V: Consensus Auditory-Perceptual Evaluation of Voice; MPD: Maximum Phonation Duration; F_0: Fundamental Frequency)

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Table 2. Post-therapy Voice Evaluation (October 9, 2024)

Voice Protocol	Test	Measure	Result
Perceptual Evaluation	CAPE-V (Overall voice)	–	Within normal limits
Aerodynamic Evaluation	MPD	14.2 s	Normal
Acoustic Evaluation	F_0	118 Hz	Stable
	Jitter	0.42%	Normal
	Shimmer	3.10%	Normal
	HNR	20.25 dB	Normal

(CAPE-V: Consensus Auditory-Perceptual Evaluation of Voice; MPD: Maximum Phonation Duration; F_0: Fundamental Frequency)

Discussion

Voice changes associated with parathyroid adenoma are uncommon but clinically significant. Although parathyroid pathology primarily affects endocrine and calcium homeostasis, it can have secondary laryngeal and phonatory implications due to neuromuscular, metabolic, and mechanical mechanisms.

In the present case, the patient exhibited hoarseness, vocal fatigue, and poor phonatory control prior to the diagnosis of right parathyroid adenoma. These symptoms may have resulted from local compression of the recurrent laryngeal nerve (RLN), given the anatomical proximity of the parathyroid glands to the inferior thyroid artery and RLN. Even minor compression or traction on the nerve can lead to paresis of the ipsilateral vocal fold, causing glottic insufficiency, breathiness, and compensatory strain. Similar findings were reported by *Christakis et al. (2020)*, who observed transient dysphonia in patients with parathyroid and thyroid lesions due to RLN involvement.

In addition, systemic alterations in calcium metabolism can influence neuromuscular excitability. Hypocalcemia or fluctuations in calcium levels following parathyroid dysfunction may affect laryngeal muscle tone, leading to vocal instability and reduced control of pitch and loudness (*Wang*

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et al., 2019). This physiological imbalance could explain the elevated jitter and shimmer values observed in the pre-therapy acoustic profile of the current case.

Following surgical excision of the adenoma and voice rehabilitation, the patient showed progressive normalization of vocal parameters. Improvement in Maximum Phonation Duration (MPD) and HNR reflected restoration of efficient glottal closure and reduced breathiness. Circumlaryngeal massage and resonant voice therapy effectively reduced compensatory laryngeal tension that had developed secondary to glottic insufficiency. The normalization of CAPE-V ratings post-therapy reinforces the efficacy of a multidimensional management approach, combining medical, surgical, and voice therapy interventions.

This case underscores the importance of collaborative management between ENT surgeons, endocrinologists, and speech-language pathologists. Voice alterations may be the earliest presenting symptom of parathyroid lesions or post-operative changes, warranting early voice assessment and acoustic monitoring. Moreover, post-surgical rehabilitation is essential to restore neuromuscular coordination and prevent maladaptive phonatory patterns.

Surgical Management

Following diagnostic confirmation of a right-sided parathyroid adenoma, the patient underwent focused parathyroidectomy under general anaesthesia . Intraoperatively, a well-encapsulated adenomatous mass measuring approximately 1.2 × 1.0 cm was identified adjacent to the inferior pole of the right thyroid lobe. The lesion was carefully dissected and excised, ensuring preservation of the recurrent laryngeal nerve (RLN) and adjacent laryngeal musculature.

Intraoperative neuromonitoring was utilized to confirm RLN integrity throughout the procedure. Post-excision, serum parathyroid hormone (PTH) levels dropped from 165 pg/mL preoperatively to 48 pg/mL, confirming successful removal of the hyperfunctioning gland.

The patient was extubated uneventfully and transferred to the recovery unit for monitoring. No postoperative complications such as hypocalcemia, wound infection, or vocal cord immobility were reported. Early postoperative laryngoscopic evaluation showed mild right vocal fold edema, likely secondary to surgical manipulation, with complete recovery observed during follow-up.

Post-surgical voice changes, including mild hoarseness and vocal fatigue, were attributed to transient RLN neuropraxia and muscular imbalance. These symptoms gradually improved with targeted voice therapy and vocal hygiene measures over a 2-month period, leading to full restoration of vocal quality.

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This case highlights the importance of meticulous nerve preservation techniques and postoperative voice evaluation in parathyroid surgeries. Even in the absence of direct nerve injury, subtle alterations in phonatory function may occur due to mechanical or metabolic effects, underscoring the role of speech-language pathologists in postoperative care.

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