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LITERATURE SEARCH

"Voice Parameters in Parkinson's Disease"

Prepared by
The Royal Society of Medicine Library for

Dr M Pedersen   **22 August 2023**

Database(s) Searched

Medline (Dialog): 1946-present
Embase (Dialog): 1947-present
Embase Preprints (Dialog): 2013-present

Search Period

1 January 2013 – 22 August 2023

Summary of the Search

Voice parameters (not speech) in Parkinson's disease. Examples of voice parameters include noise-to-harmonics ratio (NHR), decibel (dB), fundamental frequency (F_0) and mean phonation time (MPT).

Search Parameters

Last 10 Years
All Languages
Human Studies

Overview

The search strategy was devised using two main concepts: (1) Voice parameters as a broad term or specific types such as fundamental frequency -AND- (2) Parkinson's disease. Both thesaurus terms (i.e. MeSH terms in Medline and EMB terms in Embase/Embase Preprints), where available and textwords (i.e. words or phrases appearing in the Title, Abstract or Author Keywords fields of references) were identified to describe each concept. It's not possible to search for these terms in the full text of articles using these databases.

To produce a tighter search strategy to minimise too many irrelevant references which can only be removed from the final results after manual scanning, thesaurus terms were majored and textwords were restricted to the Title or Author Keywords fields for the Parkinson's disease concept. Set S24 (593 references) represents the final results of this search after removing references indexed with 'Speech' search terms as part of the search strategy. These references were then manually scanned for relevancy, identifying a total of 78 references as the closest match to your search question. As a double-check, the titles of the references in set S25 (728 references) which represent the references indexed with 'Speech' search terms were manually scanned. A further 20 references were included in the final results from this set because they covered both voice and speech parameters not speech parameters only. Any animal studies were manually excluded from the final results as were references where abbreviations for some of the specific voice parameters picked up irrelevant articles (e.g. 'dB' used as an abbreviation for 'double blind' or 'deep breathing' instead of 'decibel').

Search undertaken by

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January 2022
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Search Strategy

Databases: Embase®, Embase Preprints, MEDLINE®
(search strategy run and results downloaded on 22 August 2023)

Set#	Searched for	Results
S1	MESH.EXACT("Parkinson Disease") OR EMB.EXACT("Parkinson disease") or ti,ab,if(parkinson*)	414408*
S2	MESH.EXACT("Voice") OR MESH.EXACT("Voice Quality") OR MESH.EXACT.EXPLODE("Voice Disorders") OR MESH.EXACT.EXPLODE("Vocal Cord Dysfunction") OR MESH.EXACT("Vocal Cord Paralysis") OR MESH.EXACT("Glottis") OR MESH.EXACT("Vocal Cords") OR MESH.EXACT("Phonation")	40517*
S3	EMB.EXACT("voice") OR EMB.EXACT("voice change") OR EMB.EXACT.EXPLODE("voice disorder") OR EMB.EXACT("hoarseness") OR EMB.EXACT("vocal cord") OR EMB.EXACT.EXPLODE("vocal cord disorder") OR EMB.EXACT("vocal cord paralysis") OR EMB.EXACT("glottis") OR EMB.EXACT("phonation") OR EMB.EXACT("vocalization")	108663*
S4	EMB.EXACT.EXPLODE("voice parameter")	14255*
S5	EMB.EXACT("voice analysis") OR EMB.EXACT.EXPLODE("voice disorder assessment")	1969°
S6	MESH.EXACT("Speech Acoustics") OR MESH.EXACT("Acoustics")	23999*
S7	EMB.EXACT("acoustic analysis") OR EMB.EXACT("acoustics")	28618*
S8	ti,ab,if(parameter or parameters or analys* or acoustic*)	20244748*
S9	s1 and (s2 or s3) and (s6 or s7 or s8) and pd(2013-2023)	691°
S10	s1 and s4 and pd(2013-2023)	258°
S11	s1 and s5 and pd(2013-2023)	112°
S12	ti,ab,if((vocal* or voice or phonat* or phoneme* or phonolog*) near/5 (parameter or parameters or analys* or acoustic))	22744*
S13	s1 and s12 and pd(2013-2023)	338°
S14	ti,ab,if((fundamental pre/3 frequenc*) or F0 or vF0 or "amplitude tremor intensity index" or ATRI or "degree of voice break*" or DVB or "amplitude tremor frequency" or Fatr or Fftr or "frequency tremor intensity index" or FTRI or jitter or "frequency perturbation" or "maximum phonation* time" or "mean phonation* time" or MPT or (noise near/3 harmonic*) or NHR or "N/H" or HNR or "H/N" or shimmer or "amplitude perturbation" or "intensity perturbation" or "voice turbulence index" or VTI or ("s/z" near/3 ratio) or "diadochokinetic rate" or DDK or (grade near/3 roughness near/3 breathiness near/3 asthenia near/3 strain) or GRBAS or "voice handicap index" or VHI or VHI10 or VHI30 or decibel or decibels or dB or "voice intensity variation" or "perturbation of glott* vibration" or "vocal tract length" or VTL)	248182*
S15	s1 and s14 and pd(2013-2023)	599°
S16	ti,ab,if("maximal phonation* time" or "glott* to noise excitation ratio" or GIRBAS or GRBASI or F0SD or "noise homophonic ratio" or "sound pressure level" or "sound pressure levels" or dBSPL or SPL or MSPL or "acoustic voice quality index" or AVQI or "mean estimated subglott* pressure" or MESGP or "mean phonat* power" or "mean phonat* efficiency" or MPE or "mean phonat* resistance" or MPR or "pitch perturbation quotient" or "relative average perturbation" or RAP or "pitch period perturbation quotient" or PPQ or "amplitude perturbation quotient" or APQ or "normalized noise energy" or "normalised noise energy" or NNE)	58264*

S17	s1 and s16 and pd(2013-2023)	200°
S18	ti,ab,if((vocal* or voice or phonat* or phoneme* or phonolog*) near/5 (measurement or measurements or measure or measures or assessment or assessments or testing or test or tests or indicator or indicators))	20976*
S19	s1 and s18 and pd(2013-2023)	323°
S20	s1 and (s4 or s5 or s12 or s14 or s16 or s18) and pd(2013-2023)	1189°
S21	s9 or s20	1456°
S22	MJMESH.EXACT("Parkinson Disease") OR MJEMB.EXACT("Parkinson disease") or ti,if(parkinson*)	316523*
S23	s22 and (s9 or s20)	1219°
S24	**s23 not (MESH.EXACT("Speech") OR MESH.EXACT("Speech Intelligibility") OR MESH.EXACT.EXPLODE("Speech Production Measurement") OR MESH.EXACT.EXPLODE("Speech Disorders") OR EMB.EXACT.EXPLODE("speech") OR EMB.EXACT.EXPLODE("speech analysis") OR EMB.EXACT.EXPLODE("speech disorder") or EMB.EXACT("speech intelligibility") or ti(speech))**	**593°**
S25	**s23 not s24**	**728°**

* Duplicates are removed from the search, but included in the result count.
° Duplicates are removed from the search and from the result count.

* The search strategy retrieved a number of references that were then hand searched to find the most relevant. The details of 98 references have been provided in accordance with your original request.

Search Results

The full text of any of these articles may be ordered from the Royal Society of Medicine Library by either contacting the Enquiry Desk on Tel: +44 (0)20 7290 2940 or emailing library@rsm.ac.uk

Document 1

Biomechanical parameters of voice in Parkinson's disease patients

Author: Romero Arias, Tatiana; Redondo Cortés, Inés; Pérez Del Olmo, Adrián

Abstract (summary): INTRODUCTION: Previous research on voice in Parkinson's disease (PD) has consistently demonstrated alterations in acoustic parameters, including fundamental frequency (F0), maximum phonation time, Shimmer, and Jitter. However, investigations into acoustic parameter alterations in individuals with PD are limited. METHODS: We conducted an experimental study involving twenty PD patients (six women and fourteen men). Subjective measures of voice (VHI-30 scale and GRBAS) and objective measures using the Online Lab App tool for analyzing biomechanical correlates of voice were recorded. The App analyzed a total of 22 biomechanical parameters of voice. RESULTS: The results of subjective measures were consistent with findings from previous studies. However, the results of objective measures did not align with studies that employed acoustic measures. CONCLUSIONS: The biomechanical analysis revealed alterations in various parameters according to gender. These findings open up a new avenue of research in voice analysis for patients with Parkinson's disease (PD), whether through acoustic or biomechanical analysis, aiming to determine whether the observed changes in these patients' voices are attributable to age or disease progression. This line of investigation will help elucidate the relative contribution of these factors to vocal alterations in PD patients and provide a more comprehensive understanding of the underlying mechanisms.

Document 2

Performance of the phonatory deviation diagram in monitoring voice quality before and after voice exercise in individuals with Parkinson's Disease

Author: Lima, Hellen Vasconcelos Silva Leal de 1 ; Lopes, Leonardo Wanderley 2 ; Silva, Hilton Justino da 1 ; Vieira, Ana Cláudia de Carvalho 3 ; Cruz, Thalita Vitória Silva da 3 ; Gomes, Adriana de Oliveira Camargo 1 ; Lira, Zulina Souza de 1

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Abstract (summary): PURPOSE

To assess the performance of the phonatory deviation diagram and its measurements in monitoring voice quality before and after voice exercise in individuals with Parkinson's Disease.

METHODS

Retrospective and documentary study. A sample of 30 subjects was used, 50% male, with a mean age of 62.13 ± 9.05 years. The results of the phonatory deviation diagram were analyzed, in the moments before and after vocal exercise with the pushing technique associated with plosive sounds, considering the area, density, shape and location of the diagram in the quadrants. For comparison

purposes, the acoustic parameters of jitter, shimmer, glottal to noise excitation ratio and results of the auditory-perceptual analysis, carried out in previous research, were also considered, in the pre- and post-technical moments.

RESULTS

Despite the fact that there was no difference in the distribution of samples in the diagram, after performing the vocal technique, a change in the displacement of the diagram towards the area of normality was identified in the visual qualitative analysis, and there was an association between the general degree of vocal deviation in the analysis auditory perception and the area of the diagram. There was an improvement in the shimmer values after the vocal technique.

CONCLUSION

The displacement of the phonatory deviation diagram towards the area of normality corroborated the results in relation to the general degree of dysphonia, evaluated by the auditory-perceptual analysis and the shimmer results, after the vocal technique. Thus, the diagram shows good performance in monitoring voice quality of individuals with Parkinson's.

OBJETIVO

Verificar o desempenho do diagrama de desvio fonatório e de suas medidas no monitoramento da qualidade da voz, pré e pós exercício vocal, em indivíduos com Doença de Parkinson.

MÉTODO

Estudo retrospectivo e documental. Utilizou-se uma amostra de 30 sujeitos, sendo 50% do sexo masculino, com média de idade de 62,13 ± 9,05 anos. Foram analisados os resultados do diagrama de desvio fonatório, nos momentos pré e pós exercício vocal com a técnica de empuxo associada aos sons plosivos, considerando-se a área, densidade, forma e localização do diagrama nos quadrantes. Para fins de comparação, os parâmetros acústicos de jitter, shimmer, glottal to noise excitation ratio e resultados da análise perceptivo-auditiva, realizada em pesquisa anterior, também foram considerados, nos momentos pré e pós-técnica.

RESULTADOS

A despeito de não ocorrer diferença na distribuição das amostras no diagrama, após realização da técnica vocal, foi identificada, na análise qualitativa visual, mudança no deslocamento do diagrama em direção à área de normalidade e houve associação entre o grau geral do desvio vocal da análise perceptivoauditiva e a área do diagrama. Houve melhora nos valores de shimmer, após a técnica vocal.

CONCLUSÃO

O deslocamento do diagrama de desvio fonatório em direção à área de normalidade corroborou os resultados em relação ao grau geral de disfonia avaliado pela análise perceptivoauditiva e os resultados de shimmer, após a técnica vocal empregada. Desse modo, o diagrama de desvio fonatório apresentou bom desempenho no monitoramento da qualidade vocal de indivíduos com Parkinson.

Accession number: 37466502

Alternate title: Desempenho do diagrama de desvio fonatório no monitoramento da qualidade vocal pré e pós exercício vocal em indivíduos com Doença de Parkinson

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Document 3

Acoustical and Perceptual Analysis of Voice in Individuals with Parkinson's Disease

Author: Abraham, Elsa Ann 1 ; Geetha, Arya 1

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Abstract (summary): Parkinson's disease is a neurodegenerative disorder that affects motor efficiency which is also required for voice production. Voice is part of the identity of a person, any abnormality in voice quality hampers the quality of communication, and quality of life. This study aimed to analyse the voice of individuals with Parkinson's disease objectively through acoustic analysis, and subjectively through perceptual analysis. Quasi-experimental study conducted in a tertiary health care centre. The study comprised two groups: 12 individuals with Parkinson's disease (11 males and 1 female, mean age: 72.41 years), and 12 healthy controls (10 males and 2 females, mean age: 53.83 years). The voice samples of all the participants were recorded and analyzed using the MDVP software of CSL 4500. The voice samples were analyzed for eleven acoustical parameters, and the perceptual analysis was carried out using the GRBAS scale by two experienced Speech Language Pathologists. Mann-Whitney U test was performed to compare the two groups of participants, and Cronbach's alpha test was performed to find the inter-judge reliability between the perceptual ratings of two listeners. Acoustical comparison showed significant variations in seven parameters (jitter, shimmer, PPQ, APQ, Fatr Hz, Fftr, ATRI), and the perceptual analysis between two listeners showed a fair amount of reliability.

Accession number: 37275077

Correspondence author: Abraham, Elsa Ann Kattankulathur Campus, Chennai, Tamil Nadu 603203 India Department of Audiology and Speech Language Pathology, SRM Medical College Hospital and Research Centre, SRM Institute of Science and Technology.

Document 4

Oropharyngeal geometry and acoustic parameters of voice in healthy and Parkinson's disease subjects

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Abstract (summary): PURPOSE

to verify whether there are differences in acoustic measures and oropharyngeal geometry between healthy individuals and people with Parkinson's disease, according to age and sex, and to investigate whether there are correlations between oropharyngeal geometry measures in this population.

METHODS

40 individuals participated, 20 with a diagnosis of Parkinson's disease and 20 healthy individuals, matched by age, sex, and body mass index. Acoustic variables included fundamental frequency, jitter, shimmer, glottal-to-noise excitation ratio, noise, and mean intensity. Oropharyngeal geometry variables were measured with acoustic pharyngometry.

RESULTS

geometry variables were smaller in the group with Parkinson's disease, and older adults with Parkinson's disease had a smaller oropharyngeal junction area than healthy older adults. Regarding acoustic parameters of voice, fundamental frequency values were lower in males with Parkinson's disease, and jitter values were higher in the non-elderly subjects with Parkinson's disease. There was a moderate positive correlation between oral cavity length and volume, pharyngeal cavity length and vocal tract length, and pharyngeal cavity volume and vocal tract volume.

CONCLUSION

individuals with Parkinson's disease had smaller glottal areas and oropharyngeal junction areas than healthy individuals. When distributed into sex and age groups, the fundamental frequency was lower in males with Parkinson's disease. There was a moderate positive correlation between oropharyngeal length and volume measures in the study sample.

OBJETIVO

verificar se existem diferenças nas medidas acústicas e da geometria orofaríngea entre indivíduos hígidos e pessoas com Doença de Parkinson, segundo a idade e sexo e investigar se há correlações entre as medidas geométricas orofaríngeas nessa população.

MÉTODO

participaram 40 indivíduos, sendo 20 com diagnóstico de Doença de Parkinson e 20 indivíduos hígidos, pareados por faixa etária, sexo e índice de massa corporal. As variáveis acústicas estudadas foram frequência fundamental, jitter, shimmer, glottal-to-noise excitation ratio, ruído e média da intensidade. As variáveis geométricas da orofaringe foram aferidas por faringometria acústica.

RESULTADOS

as variáveis geométricas foram menores no grupo com Doença de Parkinson e os idosos com Doença de Parkinson apresentaram menor área da junção orofaríngea que os idosos hígidos. Com relação aos parâmetros acústicos vocais, o valor da frequência fundamental foi menor no sexo

masculino, no grupo com Doença de Parkinson e os valores de jitter foram maiores no grupo não idoso dos sujeitos com Doença de Parkinson. Houve correlação positiva moderada entre o comprimento e volume da cavidade oral, comprimento da cavidade faríngea e o comprimento do trato vocal e do volume da cavidade faríngea e o volume do trato vocal.

CONCLUSÃO

indivíduos com Doença de Parkinson apresentaram menores valores de área glótica e área da junção orofaríngea, comparativamente aos hígidos. Quando distribuídos por faixa etária e sexo, a frequência fundamental foi menor no grupo com doença de Parkinson, na população masculina. Houve correlação positiva moderada entre as medidas de comprimento e volume da orofaringe, na amostra estudada.

Correspondence author: Silva, Joice Maely Souza da Programa de Pós-graduação em Saúde da Comunicação Humana, Universidade Federal de Pernambuco - UFPE - Recife (PE), Brasil.

Document 5

Perceptual and qualitative voice alterations detected by GIRBAS in patients with Parkinson's disease: is there a relation with lung function and oxygenation?

Author: Olivares, Adriana 1 ; Comini, Laura 1 ; Di Pietro, Davide Antonio 2 ; Vezzadini, Giuliana 3 ; Luisa, Alberto 2 ; Boccali, Elisa 2 ; Boccola, Sara 3 ; Vitacca, Michele 4

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Abstract (summary): BACKGROUND

Impairments in respiration, voice and speech are common in people with Parkinson's disease (PD).

AIMS

To evaluate the prevalence of dysphonia, assessed by a specific acoustic evaluation and description of the voice by the speech therapist (GIRBAS), and its relation with lung function and oxygenation, in particular cough ability and during the night or exercise desaturation.

METHODS

This is a posthoc analysis of a prospective cross-sectional observational study on PD patients collecting anthropometric and clinical data, comorbidities, PD severity, motor function and balance, respiratory function at rest, during exercise and at night, voice function with acoustic analysis and presence of speech disorders, in addition to the GIRBAS scale. Based on GIRBAS Global dysphonia ('G') score, we divided patients into dysphonic (moderate-to-severe deviance from the euphonic condition) vs. no/mild dysphonic and analyzed the relations with respiratory impairments.

RESULTS

We analyzed 55 patients and found significant impairments in both respiratory and voice/speech functions. Most patients (85.5%) presented mild-to-severe deviance from the euphonic condition in at

least one GIRBAS perceptual element (80% of cases for Global dysphonia) and only 14.5% did not show deviance in all elements simultaneously. At Odds Ratio analysis, the risk of presenting nocturnal desaturation and reduced peak cough expiratory flow was approximately 24 and 8 times higher, respectively, in dysphonic patients vs. those with no/mild dysphonia.

CONCLUSION

Perceptual and qualitative evaluation of the voice with GIRBAS showed that mild-to-severe dysphonia was highly prevalent in PD patients, and associated with nocturnal oxygen desaturation and poor cough ability.

Document 6

Acoustic Analysis of Intonation in Persons With Parkinson's Disease Receiving Transcranial Magnetic Stimulation and Intensive Voice Treatment

Author: Li, Qiang 1 ; Millard, Kelly 2 ; Tetnowski, John 2 ; Narayana, Shalini 3 ; Cannito, Michael 2

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Abstract (summary): Intonation is one of the prosodic features manifested acoustically in the fundamental frequency ($f0$). Intonation abnormality is common and prominent in the speech of persons with Parkinson's disease (PD). The current research investigated acoustically five intonational features including $f0$ declination, $f0$ resetting, sentence stress, terminal fall, and syntactic prejunctural fall in 20 PD participants, receiving Lee Silverman Voice Treatment (LSVT)-LOUD alone, or combined with transcranial magnetic stimulation delivered to the left or right primary laryngeal motor cortex. The results revealed that $f0$ declination, sentence stress, and terminal fall changed significantly from pre- to post-treatment, and the changes of declination and terminal fall were maintained at the follow-up evaluations. The observed changes in intonation were attributed to LSVT alone, which caused large changes of $f0$ magnitude. $f0$ resetting and syntactic prejunctural fall did not change significantly following treatment, probably because these intonational features need very precise fine motor control of the intrinsic laryngeal muscles to make small-range, rapid $f0$ adjustments, which were not improved by LSVT in the present PD participants. Difficulties with syntactic processing previously reported in PD may have also contributed to the lack of improvement in resetting and prejunctural fall, since these $f0$ features are used to mark syntactic boundaries within utterances.

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Document 7

Artificial Intelligence-Based Voice Assessment of Patients with Parkinson's Disease Off and On Treatment: Machine vs. Deep-Learning Comparison

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Abstract (summary): Parkinson's Disease (PD) is one of the most common non-curable neurodegenerative diseases. Diagnosis is achieved clinically on the basis of different symptoms with considerable delays from the onset of neurodegenerative processes in the central nervous system. In this study, we investigated early and full-blown PD patients based on the analysis of their voice characteristics with the aid of the most commonly employed machine learning (ML) techniques. A custom dataset was made with hi-fi quality recordings of vocal tasks gathered from Italian healthy control subjects and PD patients, divided into early diagnosed, off-medication patients on the one hand, and mid-advanced patients treated with L-Dopa on the other. Following the current state-of-the-art, several ML pipelines were compared usingdifferent feature selection and classification algorithms, and deep learning was also explored with a custom CNN architecture. Results show how feature-based ML and deep learning achieve comparable results in terms of classification, with KNN, SVM and naïve Bayes classifiers performing similarly, with a slight edge for KNN. Much more evident is the predominance of CFS as the best feature selector. The selected features act as relevant vocal biomarkers capable of differentiating healthy subjects, early untreated PD patients and mid-advanced L-Dopa treated patients.

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Document 8

Editorial: Parkinson's disease: Technological trends for diagnosis and treatment improvement

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Document 9

Community Choir Improves Vocal Production Measures in Individuals Living with Parkinson's Disease

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Abstract (summary): OBJECTIVES

Parkinson's disease (PD) is a neurodegenerative disease leading to motor impairments and dystonia across diverse muscle groups including vocal muscles. The vocal production challenges associated with PD have received considerably less research attention than the primary gross motor symptoms of the disease despite having a substantial effect on quality of life. Increasingly, people living with PD are discovering group singing as an asset-based approach to community building that is purported to strengthen vocal muscles and improve vocal quality.

STUDY DESIGN/METHODS

The present study investigated the impact of community choir on vocal production in people living with PD across two sites. Prior to and immediately following a 12-week community choir at each site, vocal

testing included a range of vocal-acoustic measures, including lowest and highest achievable pitch, duration of phonation, loudness, jitter, and shimmer.

RESULTS

Results showed that group singing significantly improved some, though not all, measures of vocal production. Group singing improved lowest pitch (both groups), duration (both groups), intensity (one group), and jitter (one group) and shimmer (both groups).

CONCLUSIONS

These findings support community choir as a feasible and scalable complementary approach to managing vocal production challenges associated with PD.

Document 10

An integrated biometric voice and facial features for early detection of Parkinson's disease

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Abstract (summary): Hypomimia and voice changes are soft signs preceding classical motor disability in patients with Parkinson's disease (PD). We aim to investigate whether an analysis of acoustic and facial expressions with machine-learning algorithms assist early identification of patients with PD. We recruited 371 participants, including a training cohort (112 PD patients during "on" phase, 111 controls) and a validation cohort (74 PD patients during "off" phase, 74 controls). All participants underwent a smartphone-based, simultaneous recording of voice and facial expressions, while reading an article. Nine different machine learning classifiers were applied. We observed that integrated facial and voice features could discriminate early-stage PD patients from controls with an area under the receiver operating characteristic (AUROC) diagnostic value of 0.85. In the validation cohort, the optimal diagnostic value (0.90) maintained. We concluded that integrated biometric features of voice and facial expressions could assist the identification of early-stage PD patients from aged controls.

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Subject: Embase;accuracy;acoustic analysis;adult;aged;algorithm;area under the curve;arthritis;Article;biometry (major);cerebrovascular accident;cohort analysis;controlled study;deep learning;demographics;diagnostic test accuracy study;diagnostic value;disease duration;facial expression;facies (major);Hoehn and Yahr scale;human;logistic regression analysis;machine learning;major clinical study;male;MDS-Unified Parkinson Disease Rating Scale;middle aged;motor dysfunction;Parkinson disease (major);random forest;receiver operating characteristic;training;validation process;voice analysis;voice change

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Document 11

Parkinsonics: A Randomized, Blinded, Cross-Over Trial of Group Singing for Motor and Nonmotor Symptoms in Idiopathic Parkinson Disease

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Abstract (summary): Introduction

Parkinson's disease (PD) frequently causes communication difficulties due to various voice impairments and there are few treatment options for vocal/communication complaints. We assessed the effects of weekly group singing on PD patients' objective vocal and motoric function, cognition, mood, self-efficacy, and quality of life.

Methods

Thirty-two participants were randomly assigned to either a singing group or a facilitated discussion group weekly over 12 weeks. After 12 weeks, participants crossed over for an additional 12 weeks. Evaluations were performed at baseline and every six weeks for 30 weeks. Objective voice measures included volume/loudness (decibels), held vowel duration, jitter, shimmer, and harmonic-to-noise ratio. Additional outcome measures included patient-centered quality of life, voice-related quality of life, MDS-UPDRS, Montreal Cognitive Assessment, and questionnaires assessing depression, self-efficacy, and overall well-being.

Results

Twenty-six participants (16 M/10F; Hoehn &Yahr stage 2.3 (range 2-3); and age 68.6 (55-89)) completed the study. Across participants in both groups (intention-to-treat analyses), there was significant improvement from baseline in average loudness on the Cookie Theft picture description at 24 weeks (end of interventions), corresponding with improved minimal reading volumes at 24 weeks and 30 weeks (end of study). Similarly, there were improvements in minimal loudness on Rainbow passage reading at 24 and 30 weeks. There were improvements observed in the Emotional Well-Being (mean delta -12.7 points, p = 0.037) and Body Discomfort (mean delta -18.6 points, p = 0.001) domains of the PDQ-39 from baseline to week 24 in the overall cohort and greater improvement in the Communication domain for Group S than Group D after 12 weeks of singing (delta -12.9 points, p = 0.016). Baseline differences between the participant groups (age, gender, Hoehn &Yahr stage, and several voice loudness measures) and observed improvements during the weekly discussion group

period limited our ability to attribute all of the above results specifically to singing (per-protocol <mark>analyses</mark>). No significant changes in other assessed outcome measures were found.

Conclusions

Weekly group singing may improve some aspects of conversational voice volume and quality of life in PD. Some improvements were sustained at least six weeks after interventions ended. Further investigations of the mechanism of benefit and randomized controlled studies (without crossover) to assess the longitudinal effects of singing in PD are necessary.

Document 12

Comparison of Voice, Speech, Swallowing and Drooling Problems in Parkinson's Disease Patients with Healthy Individuals

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Abstract (summary): Objective: To compare voice, speech, swallowing and drooling problems in Parkinson's disease (PD) patients with healthy individuals (HI) by using objective and subjective methods and to establish the defining characteristics of PD patients with these problems. Background: PD is associated with a number of disorders that negatively affect the quality of life of patients such as voice, speech, swallowing and drooling problems. As far as we know, there is no study directly comparing voice, speech, swallowing and drooling problems between HI and PD patients. Methods: 43 patients with PD and 43 HI matched for age and sex were included in the study. Prolonged production of /a/, /s/, and /z/ was requested to measure maximum phonation time (MPT) from each participant. Praat software and Audacity software were used for acoustic sound analysis. Each participant was asked to first produce the extended vowel /a/ for more than 3 seconds with a comfortable loudness and pitch, wait 2 seconds, and then read the first sentence of the Turkish "Diyet" passage. Voice Handicap Index (VHI), visual analog scale (VAS) for selfassessment of speech and voice, Eating Evaluation Tool (EAT-10) and the Sialorrhea Clinical Scale for PD (SCS-PD) were used. All tasks were performed during the "ON state" of all patients. Results: There was no significant difference between the two groups in terms of age and gender. MPT (/a/, /s/, /z/) was decreased in PD patients (p<0.05). Acoustic sound analysis revealed a statistically significant difference between the two groups in terms of the standard deviation of the fundamental frequency (SD F0), the maximum F0 and the acoustic sound quality index (AVQI) values (p<0.05). However, there was no significant difference between the groups in jitter, shimmer and HNR values. VAS for voice, VAS for speech, VHI, EAT-10 and SCS-PD scores were higher in PD patients (p<0.05). Conclusions: This study reveals that patients with PD have decreased MPT and have more problems with voice and speech, swallowing and drooling compared to HI. Dysphagia and sialorrhea is likely to contribute to the voice and speech problems of PD patients. Evaluation of this problems by considering different dimensions will guide future research in terms of developing and combining different treatment approaches for PD patients.

Conference title: 2022 MDS International Congress

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Document 13

An Analysis of Vocal Features for Parkinson's Disease Classification Using Evolutionary Algorithms

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National Taiwan University of Science and Technology, Taipei City 106, Taiwan, Taiwan 3 School of Electrical Engineering, International University, Vietnam National University, Ho Chi Minh City 700000, Vietnam, Vietnam

Abstract (summary): Parkinson's Disease (PD) is a brain disorder that causes uncontrollable movements. According to estimation, roughly ten million individuals worldwide have had or are developing PD. This disorder can have severe consequences that affect the patient's daily life. Therefore, several previous works have worked on PD detection. Automatic Parkinson's Disease detection in voice recordings can be an innovation compared to other costly methods of ruling out examinations since the nature of this disease is unpredictable and non-curable. Analyzing the collected vocal records will detect essential patterns, and timely recommendations on appropriate treatments will be extremely helpful. This research proposed a machine learning-based approach for classifying healthy people from people with the disease utilizing Grey Wolf Optimization (GWO) for feature selection, along with Light Gradient Boosted Machine (LGBM) to optimize the model performance. The proposed method shows highly competitive results and has the ability to be developed further and implemented in a real-world setting.

Accession number: 36010330

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Document 14

Multidimensional voice assessment after Lee Silverman Voice Therapy (LSVT®) in Parkinson's disease

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Abstract (summary): Objective

To investigate the effectiveness of Lee Silvermann Voice Treatment (LSVT®) in improving prosody in patients with Parkinson's disease over medium-term follow-up.

Methods

15 patients with Parkinson's disease were assessed before LSVT®, within one week, and 3 and 6 months after treatment. Subjective and objective evaluation included: Voice Handicap Index - 10 (VHI-10), perceptual assessment by GRBAS scale and item 18 of the Unified Parkinson's Disease Rating Scale III (UPDRS III), maximum phonation time (MPT /s/) and acoustic analysis by means the Voice Range Profile (VRP) and the "Intonation Stimulability Protocol" of the Motor Speech Profile (MSP).

Results

A significant increase of the mean values of Imax and rF0 was observed until 6 months post-therapy (p <0.001), whereas Running Speech Standard Deviation (rSTD) (p = 0.004), Amplitude Variability (rVAm) (p = 0.02) and Frequency Variability (rvF0) (p = 0-01) improved significantly after 3 months, but returned to pre-therapy levels after 6 months. The score of item 18 of the UPDRS III increased significantly early post-therapy (p = 0.03), but did not maintain the improvement at 3 and 6 months.

Median values of Grade (G), Asthenia (A) and mean values VHI-10 score significantly decreased at each post-therapy control (p <0.05).

Conclusions

In addition to the subjective and perceptual beneficial effect of LSVT®, we found a long-lasting increase of loudness and fundamental frequency. There was also improvement of acoustic parameters related to prosody, although it was temporary.

Valutazione multidimensionale della voce dopo riabilitazione vocale sec. Lee Silverman nei pazienti affetti da malattia di Parkinson.

Obiettivo

Valutare l'efficacia del LSVT® nel migliorare gli aspetti prosodici dei pazienti con malattia di Parkinson.

Metodi

Sono stati valutati 15 pazienti subito dopo il LSVT® e nei follow-up a una settimana, a 3 e a 6 mesi dal termine del trattamento attraverso la somministrazione dei seguenti strumenti: Voice Handicap Index -10 (VHI-10), scala GRBAS, item 18 dell'Unified Parkinson's Disease Rating Scale III (UPDRS III), Tempo Massimo Fonatorio (TMF/s/), Voice Range Profile (VRP) e l'Intonation Stimulability Protocol del Motor Speech Profile (MSP).

Risultati

Dopo la terapia i parametri acustici Imax e rF0 hanno mostrato un incremento significativo che si è mantenuto nel follow-up a 6 mesi (p <0,001), mentre per le variabili rSTD (p = 0,004), rVAm (p = 0,02) e rvF0 (p = 0-01) si è evidenziato un miglioramento significativo nel follow-up a 3 mesi che tuttavia non si è mantenuto nel successivo controllo a 6 mesi. Il punteggio dell'item 18 dell'UPDRS III ha mostrato un incremento significativo soltanto a una settimana dal termine del trattamento (p = 0,03). Infine si è evidenziato un miglioramento statisticamente significativo dei parametri G (Grado) e A (Astenia) della scala GRBAS così come del valore medio del VHI-10 sia subito dopo il LSVT® che nei successivi follow-up a 3 e a 6 mesi (p <0,05).

Conclusioni

I risultati hanno evidenziato, oltre ad un miglioramento soggettivo e percettivo della sintomatologia, un incremento dell'intensità e della frequenza fondamentale. Il miglioramento dei parametri acustici relativi alla prosodia è stato temporaneo e non si è mantenuto nel tempo.

Accession number: 36254651

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Document 15

Classification of Dysphonic Voices in Parkinson's Disease with Semi-Supervised Competitive Learning Algorithm

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Abstract (summary): This article proposes a novel semi-supervised competitive learning (SSCL) algorithm for vocal pattern classifications in Parkinson's disease (PD). The acoustic parameters of voice records were grouped into the families of jitter, shimmer, harmonic-to-noise, frequency, and nonlinear measures, respectively. The linear correlations were computed within each acoustic parameter family. According to the correlation matrix results, the jitter, shimmer, and harmonic-to-noise parameters presented as highly correlated in terms of Pearson's correlation coefficients. Then, the principal component analysis (PCA) technique was implemented to eliminate the redundant dimensions of the acoustic parameters for each family. The Mann−Whitney−Wilcoxon hypothesis test was used to evaluate the significant difference of the PCA-projected features between the healthy subjects and PD patients. Eight dominant PCA-projected features were selected based on the eigenvalue threshold criterion and the statistical significance level ($p < 0.05$) of the hypothesis test. The SSCL algorithm proposed in this paper included the procedures of the competitive prototype seed selection, K-means optimization, and the nearest neighbor classifications. The pattern classification experimental results showed that the proposed SSCL method can provide the excellent diagnostic performances in terms of accuracy (0.838), recall (0.825), specificity (0.85), precision (0.846), F-score (0.835), Matthews correlation coefficient (0.675), area under the receiver operating characteristic curve (0.939), and Kappa coefficient (0.675), which were consistently better than those results of conventional KNN or SVM classifiers.

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Document 16

Phonemes based detection of parkinson's disease for telehealth applications

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Abstract (summary): Dysarthria is an early symptom of Parkinson's disease (PD) which has been proposed for detection and monitoring of the disease with potential for telehealth. However, with inherent differences between voices of different people, computerized analysis have not demonstrated high performance that is consistent for different datasets. The aim of this study was to improve the performance in detecting PD voices and test this with different datasets. This study has investigated the effectiveness of three groups of phoneme parameters, i.e. voice intensity variation, perturbation of glottal vibration, and apparent vocal tract length (VTL) for differentiating people with PD from healthy subjects using two public databases. The parameters were extracted from five

sustained phonemes; /a/, /e/, /i/, /o/, and /u/, recorded from 50 PD patients and 50 healthy subjects of PC-GITA dataset. The features were statistically investigated, and then classified using Support Vector Machine (SVM). This was repeated on Viswanathan dataset with smartphone-based recordings of /a/, /o/, and /m/ of 24 PD and 22 age-matched healthy people. VTL parameters gave the highest difference between voices of people with PD and healthy subjects; classification accuracy with the five vowels of PC-GITA dataset was 84.3% while the accuracy for other features was between 54% and 69.2%. The accuracy for Viswanathan's dataset was 96.0%. This study has demonstrated that VTL obtained from the recording of phonemes using smartphone can accurately identify people with PD. The analysis was fully computerized and automated, and this has the potential for telehealth diagnosis for PD.

Document 17

Effects of Resonance Tube Voice Therapy on Parkinson's Disease: Clinical Trial

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Abstract (summary): PURPOSE

To verify the effect of resonance tube voice therapy on the vocal aspects of patients with Parkinson's Disease (PD).

METHOD

Intra-subject comparative controlled clinical trial with a single group assignment. Fourteen individuals with PD (10 men, mean age 66.1 years; four women, mean age 73.75 years) received eight 45-minute sessions of voice therapy, twice a week for 4 weeks. The therapy consisted of semi-occluded vocal tract exercises - phonation method in a resonance tube (glass, 27 cm x 9 mm) in water. Tube depth in water ranged from 2 cm to 9 cm, as the difficulty in carrying out the exercises increased (usual pitch, high pitch, low pitch, ascending/descending glissandos), followed by sentence production. The assessments were made three times: at baseline (Time0), after 30 days without intervention (Time1), and 1 day after eight intervention sessions (Time2). The following aspects were assessed: vocal intensity; acoustic parameters (Smoothed Cepstral Peak Prominence - CPPs, alpha ratio, and L1-L0 difference); auditory-perceptual analysis of the overall degree of vocal quality deviation; voice symptoms (Voice Symptom Scale protocol - VoiSS) and voice-related quality of life (Voice-Related Quality of Life Protocol - V-RQOL). The results were compared at the three times of assessment Time0/Time1/Time2 using one-way repeated measures ANOVA test and Tukey test (5% significance).

RESULTS

intervention significantly increased: vocal intensity, L1-L0 value of vowel /a/ and counting, CPP value in counting, and decreased: the overall degree of vocal quality deviation in 78% of participants, the total score of VoiSS protocol, the limitation, and emotional subscales. In addition, the intervention increased the score of all the domains of V-RQOL protocol - physical, socio-emotional, and total.

CONCLUSION

Resonance tube phonation in voice therapy was effective in increasing vocal intensity and long-term acoustic parameters, the improved overall degree of vocal quality, reducing voice symptoms, and increasing voice-related quality of life in individuals with PD.

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Document 18

Effects of Age and Parkinson's Disease on the Relationship between Vocal Fold Abductory Kinematics and Relative Fundamental Frequency

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Abstract (summary): PURPOSE

This study reports on two experiments to examine vocal fold abduction and its relationship with relative fundamental frequency (RFF), considering two attributes that have been shown to elicit group differences in RFF: age (Experiment 1) and Parkinson's disease (PD; Experiment 2).

METHODS

For both experiments, simultaneous acoustic and nasendoscopic recordings were collected as participants produced the utterance, /ifi/. RFF values were computed from the acoustic signal, whereas abduction duration and glottic angle at voicing offset were identified from the laryngoscopic images. In Experiment 1, 50 speakers with typical voices (18-83 years) were analyzed to examine (1A) the effects of speaker age on individual outcome measures (RFF, abduction duration, glottic angle) via Pearson's correlation coefficients, and (1B) the effects of abductory measures and age on RFF via an analysis of covariance. In Experiment 2, 20 speakers with PD and 20 matched controls were analyzed to examine (2A) the effects of group (with/without PD) on outcome measures via an analysis of variance, and (2B) the relationship of RFF with abduction duration, glottic angle, and age when considering group via an analysis of covariance.

RESULTS

Age demonstrated a significant, negative relationship with glottic angle (1A) but was not a significant factor when examining the relationship of vocal fold abduction and RFF (1B). Speaker group (with/without PD) demonstrated a significant effect on measures of RFF and abduction duration (2A) but was not a significant factor when examining the relationship of vocal fold abduction and RFF (2B).

CONCLUSIONS

RFF is sensitive to changes in vocal fold abductory patterns during devoicing, irrespective of speaker age or PD status.

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Document 19

Voice handicap Index in Parkinson's patients: Subthalamic versus globus pallidus deep brain stimulation

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Abstract (summary): PURCHASE

PURPOSE

Subthalamic nucleus (STN) and globus pallidus interna (GPI) are the two most common sites for deep brain stimulation (DBS) in people with Parkinson's disease (PWP). Voice impairments are a common symptom of Parkinson's disease and information about voice outcomes with DBS is limited. Most studies in speech-language pathology have focused on STN-DBS and few have examined the effects of GPI-DBS. This was an initial effort to examine the impact of DBS location on Vocal Handicap Index (VHI) scores, which assess the impact of a voice disorder on an individual.

METHOD

Twenty-four gender-matched PWP (12 STN-DBS and 12 GPI-DBS) completed the VHI post-DBS implantation. Two-tailed independent samples t-tests were used to compare each VHI scale score (physical, functional, emotional, total) and patient factors between the two groups.

RESULTS

No significant differences in total or subscale VHI scores were identified between the two DBS groups. A trend toward greater impairment in PWP with GPI-DBS was noted. An association between higher VHI scores and DBS settings was found.

CONCLUSIONS

Studies directly comparing speech outcomes for different DBS targets are lacking. The current findings provide new insights concerning voice outcomes following DBS by adding to the limited literature directly comparing speech outcomes in multiple DBS targets. Limitations and directions for future research are discussed.

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Document 20

Relationship Between Oropharyngeal Geometry and Vocal Parameters in Subjects With Parkinson's Disease

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Abstract (summary): OBJECTIVE

To verify whether the dimensions of different segments of the oropharyngeal cavity have different proportions between Parkinson's disease patients and vocally healthy subjects and investigate whether the measurements of these subjects' oropharyngeal geometry associate with their acoustic measurements of voice.

METHOD

Quantitative, descriptive, cross-sectional, and retrospective study with secondary data, approved by the Human Research Ethics Committee under no. 4.325.029. We used vocal samples and data from the oropharyngeal geometry of 40 subjects - 20 with Parkinson's disease stages I to III and 20 who formed the control group, matched for sex and age. Each group had 10 males and 10 females, mean age of 61 years (±6.0). Formant (F1, F2, and F3) and cepstral measures of the sustained vowel /ɛ/ were extracted and arranged in the database to determine their values using Praat software. The data were descriptively analyzed, with statistics generated with R software. The proportion of oropharyngeal geometry measurements was arranged by mean values and coefficients of variation. Pearson's linear correlation test was applied to relate voice parameters to oropharyngeal geometry, considering $P < 0.05$, and linear regression test, to justify F2.

RESULTS

The Parkinson's disease group showed a linear relationship between oral cavity length and F1 in males ($P = 0.04$) and between glottal area and F2 in females ($P = 0.00$); linear relationships were established according to age in both groups, and a regression model for F2 was estimated ($R2 = 0.61$). There was no difference between pathological and healthy voices; there was a difference in the proportional relationship of oropharyngeal geometry between the groups.

CONCLUSION

The proportional relationship of oropharyngeal geometry differs between the Parkinson's disease group and the control group, as well as the relationship between oropharyngeal geometry and formant and cepstral values of voice according to the subjects' sex and age.

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Document 21

Parkinson's disease patients with freezing of gait have more severe voice impairment than non-freezers during "ON state"

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Abstract (summary): BACKGROUND

Speech disorders and freezing of gait (FOG) in Parkinson's disease (PD) may have some common pathological mechanisms. The purpose of this study was to compare the acoustic parameters of PD patients with dopamine-responsive FOG (PD-FOG) and without FOG (PD-nFOG) during "ON state" and explore the ability of "ON state" voice features in distinguishing PD-FOG from PD-nFOG.

METHODS

A total of 120 subjects, including 40 PD patients with dopamine-responsive FOG, 40 PD-nFOG, and 40 healthy controls (HCs) were recruited. All subjects underwent neuropsychological tests. Speech samples were recorded through the sustained vowel pronunciation tasks during the "ON state" and then analyzed by the Praat software. A set of 27 voice features was extracted from each sample for comparison. Support vector machine (SVM) was used to build mathematical models to classify PD-FOG and PD-nFOG.

RESULTS

Compared with PD-nFOG, the jitter, the standard deviation of fundamental frequency (F0SD), the standard deviation of pulse period (pulse period SD) and the noise-homophonic-ratio (NHR) were increased, and the maximum phonation time (MPT) was decreased in PD-FOG. The above voice features were correlated with the freezing of gait questionnaire (FOGQ). The average accuracy, specificity, and sensitivity of SVM models based on 27 voice features for classifying PD-FOG and PD-nFOG were 73.57%, 75.71%, and 71.43%, respectively.

CONCLUSIONS

PD-FOG have more severe voice impairment than PD-nFOG during "ON state".

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Document 22

Voice in Parkinson's Disease: A Machine Learning Study

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Abstract (summary): INTRODUCTION

Parkinson's disease (PD) is characterized by specific voice disorders collectively termed hypokinetic dysarthria. We here investigated voice changes by using machine learning algorithms, in a large cohort of patients with PD in different stages of the disease, OFF and ON therapy.

METHODS

We investigated 115 patients affected by PD (mean age: 68.2 ± 9.2 years) and 108 age-matched healthy subjects (mean age: 60.2 ± 11.0 years). The PD cohort included 57 early-stage patients (Hoehn &Yahr ≤ 2) who never took L-Dopa for their disease at the time of the study, and 58 mid-advanced-stage patients (Hoehn &Yahr >2) who were chronically-treated with L-Dopa. We clinically evaluated voices using specific subitems of the Unified Parkinson's Disease Rating Scale and the Voice Handicap Index. Voice samples recorded through a high-definition audio recorder underwent machine learning analysis based on the support vector machine classifier. We also calculated the receiver operating characteristic curves to examine the diagnostic accuracy of the analysis and assessed possible clinical-instrumental correlations.

RESULTS

Voice is abnormal in early-stage PD and as the disease progresses, voice increasingly degradres as demonstrated by high accuracy in the discrimination between healthy subjects and PD patients in the early-stage and mid-advanced-stage. Also, L-dopa therapy improves but not restore voice in PD as shown by high accuracy in the comparison between patients OFF and ON therapy. Finally, for the first time we achieved significant clinical-instrumental correlations by using a new score (LR value) calculated by machine learning.

CONCLUSION

Voice is abnormal in early-stage PD, progressively degrades in mid-advanced-stage and can be improved but not restored by L-Dopa. Lastly, machine learning allows tracking disease severity and quantifying the symptomatic effect of L-Dopa on voice parameters with previously unreported high accuracy, thus representing a potential new biomarker of PD.

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Document 23

Prediction of Parkinson's disease from Voice Signals Using Machine Learning

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Abstract (summary): Parkinson's Disease(PD) is a common neurological condition related to the Central Nervous System, that influence the motion of an individual. Normally, Parkinson's Disease Patients have low voice volume with monotone quality. To automate the prediction of this neurological condition, audio signals from the UCI dataset repository had been taken. The major features like Harmonic/Noise Ratio, Jitter, Noise/Harmonic Ratio, Shimmer etc were extracted for the study. In the prior work, an accuracy of 83% was obtained by the LSTM based model on this dataset. To enhance

the model accuracy, a combination of CNN and LSTM were employed in this work. From the proposed study it was analyzed that the combination model was capable exhibited a better classification accuracy of 85% when compared to the traditional machine learning model like Support Vector Machine and Recurrent Neural Network like LSTM.

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Document 24

Effects of Subthalamic Nucleus Deep Brain Stimulation Surgery on Voice and Formant Frequencies of Vowels in Turkish

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Abstract (summary): AIM

To investigate the effects of deep brain stimulation (DBS) of the subthalamic nucleus (STN) on acoustic characteristics of voice production in Turkish patients with Parkinson's disease (PD).

MATERIAL AND METHODS

This study recruited 20 patients diagnosed with PD. Voice samples were recorded under the "stimulation on" and "stimulation off" conditions of STN-DBS. Acoustic recordings of the patients were made during the production of vowels /a/, /o/, and /i/ and repetition of the syllables /pa/-/ta/-/ka/. Acoustic analyses were performed using Praat.

RESULTS

A significant difference in the parameters was observed among groups for vowels. A positive significant difference was observed between preoperative med-on and postoperative med-on/stim-on groups for /a/ and the postoperative med-on/ stim-on and postoperative med-on/stim-off groups for /o/ and /i/ for frequency perturbation (jitter) and noise-to-harmonics ratio. No significant difference was noted between the preoperative med-on and postoperative med-on/stim-off groups for any vowels.

CONCLUSION

STN-DBS surgery has an acute positive effect on voice. Studies on formant frequency analysis in STN-DBS may be expanded with both articulation and intelligibility tests to enable us to combine patient abilities in various perspectives and to obtain precise results.

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Document 25

Effect of ketogenic diet versus regular diet on voice quality of patients with Parkinson's disease

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Abstract (summary): Diets that have effects on health problems can vary in their composition. Whilst following a regular diet (RD) a person typically consumes about 30% of calories from fat. Ketogenic diet (KD) is a form of diet whereby a person consumes as much as 90% of calories from fat. KD has been trialed as a treatment for neurological diseases and obesity. Parkinson's disease (PD) is a neurologic disease that impacts the quality of voice. Voice Handicap Index (VHI) is a test

that gives information to clinical and physiological assessment about voice. We assessed the impact of KD and RD on voice quality (VQ). Seventy-four patients with PD who reported a voice disorder related to their disease were randomly assigned to the KD or RD groups. We investigated the VHI change of subjects before and 3 months after diet. Sixty-eight PD patients completed the study. Baseline VHI values did not differ significantly between groups. All mean VHI parameters improved in KD group (p< 0.001). Currently there are different therapies that address speech and voice disorders in patients with PD. As such KD may be an alternative therapy to improve VQ of patients with PD. A larger sample size is necessary to determine the role and pathophysiology of KD on VQ of PD patients.

Document 26

Daily Phonatory Activity of Individuals With Parkinson's Disease

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Abstract (summary): PURPOSE

This study evaluated the amount of phonatory activity of Persons with Parkinson disease (PwPD) compared to adults without Parkinson's disease measured over 3 days. The relationship between the amount of phonatory activity and Voice Handicap Index (VHI) total score was assessed as were differences in voicing activity across 3 days of data collection.

METHODS

Fifteen PwPD receiving dopaminergic medication and fifteen age and sex matched adults without Parkinson's disease completed the VHI and then wore a VocaLog vocal monitor (VM) for 3 consecutive days. From the VM data, the number of 1-second windows with dB sound pressure level >0 were summed as a measure of phonatory activity (PA) and reported relative to the time the VM was worn (%PA).

RESULTS

The percentage of time the VM was worn did not differ between groups or across days. The PwPD had statistically significantly fewer minutes of PA per day than controls (F = 21.782, P <0.001) by 54 minutes on average. The %PA also differed significantly (F = 31.825, P <0.001) with a mean of 11.1% for PwPD and 18.6% for controls. Neither PA nor %PA differed across the 3 days of vocal monitoring. VHI total score was significantly correlated with PA (r = -0.436, P = 0.016) and %PA (r = -0.534, P = 0.002) for all participants.

CONCLUSIONS

The results indicate that PwPD engaged in less verbal communication in their daily environment compared to adults without <mark>Parkinson</mark>'s disease. The findings support reports in the literature indicating that PwPD often have reduced communication participation. Measures such as %PA could serve as a quantifiable metric in future studies assessing communication changes in PwPD as a function of disease progression or therapeutic interventions.

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Document 27

Effect of Resonance Tube Technique on Oropharyngeal Geometry and Voice in Individuals with <mark>Parkinson</mark>'s Disease

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Abstract (summary): Objective: To verify the immediate effect of the flexible resonance tube vocal technique on the oropharyngeal geometry and vocal acoustic parameters of individuals with Parkinson's disease (PD) and to study the correlation between oropharyngeal geometry and the intensity and fundamental frequency (f0) parameters of the voice. Methods: Forty individuals participated—20 with PD and 20 healthy individuals, with a mean age of 60.95 (± 5.69) years. There were 10 men and 10 women in each group. All underwent pharyngometric analysis of the vocal tract and voice acoustics parameters before and after use of the vocal technique with a flexible resonance tube. Results: After the technique, there was a reduction in pharyngeal cavity volume only in females in the healthy group, a reduction in shimmer values in females in both groups and males in PD group and an improvement in noise parameters in females in the PD group. There was a negative correlation between vocal tract volume and intensity, between f0 and vocal tract volume, between f0 and oropharyngeal junction area, between f0 and oral cavity volume as well as a positive correlation between oral cavity length and f0. Conclusion: The vocal technique with the flexible resonance tube applied to individuals with PD improved the subjects' voice quality in the perceptual and acoustic voice parameters. Regarding the oropharyngeal geometry, it was possible to observe its correlation with the parameters of vocal intensity and frequency in the studied population.

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Document 28

Park-AI-an AI based tool for detection of Parkinson's disease using vocal measurements

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Abstract (summary): Objective: The study aims at detecting patients affected with Parkinson's disease from their vocal measurements using Artificial Intelligence Techniques. Background: The Parkinson's Disease (PD) is a progressive nervous disorder that impairs the movement during disease progression. The symptoms include tremors, slowness of movement, poor balance and speech difficulty. Diagnosis of PD at earlier stages is of prime significance. The diagnosis is usually done by a neurologist who relays on general neurological examination, rather than a specific test. There is a dire need to develop a specific test for diagnosis of PD, to eliminate personal biases. Methods: A range of biomedical voice measurements are collected from 31 people, which includes 23 PD patients. A total of about 195 voice recordings are collected from these individuals [1]. These recordings are fed into the AI model. Various Machine learning models are used for this diagnosis. The Training : Testing dataset are in the ratio 80 : 20. Several vocal parameters like Average Vocal Fundamental Frequency, Maximum Vocal Fundamental Frequency, Minimum Vocal Fundamental Frequency, several measures of variations in Amplitude, Jitter and Shimmer are evaluated from these voice recordings. The score of 0 for healthy individual and 1 for an individual affected with PD is assigned. The performance measures like accuracy, sensitivity, specificity and F1-Score of the various models are evaluated. Results: The comparison of performance measures of the various models is listed in Table 1 [table1]. From the table, it is evident that AdaBoost classifier has given the best outcome with an accuracy, sensitivity, specificity and F1-Score of 0.9719, 0.9627, 0.9788 and 0.9753 respectively. Conclusions: From the results, it is evident that AdaBoost classifier tool serves as a suitable candidate for a PD-specific test. This tool if employed in patient care, could aid in the diagnosis of PD by neurologists. This could eliminate the false identification or mis-identification by neurologists in diagnosing PD. (Figure Presented).

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Document 29

Improved Estimation of Parkinsonian Vowel Quality through Acoustic Feature Assimilation

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Abstract (summary): This paper investigated the performance of a number of acoustic measures, both individually and in combination, in predicting the perceived quality of sustained vowels produced by people impaired with Parkinson's disease (PD). Sustained vowel recordings were collected from 51

PD patients before and after the administration of the Levodopa medication. Subjective ratings of the overall vowel quality were garnered using a visual analog scale. These ratings served to benchmark the effectiveness of the acoustic measures. Acoustic predictors of the perceived vowel quality included the harmonics-to-noise ratio (HNR), smoothed cepstral peak prominence (CPP), recurrence period density entropy (RPDE), Gammatone frequency cepstral coefficients (GFCCs), linear prediction (LP) coefficients and their variants, and modulation spectrogram features. Linear regression (LR) and support vector regression (SVR) models were employed to assimilate multiple features. Different feature dimensionality reduction methods were investigated to avoid model overfitting and enhance the prediction capabilities for the test dataset. Results showed that the RPDE measure performed the best among all individual features, while a regression model incorporating a subset of features produced the best overall correlation of 0.80 between the predicted and actual vowel quality ratings. This model may therefore serve as a surrogate for auditory-perceptual assessment of Parkinsonian vowel quality. Furthermore, the model may offer the clinician a tool to predict who may benefit from Levodopa medication in terms of enhanced voice quality.

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Document 30

Voice Analysis to Differentiate the Dopaminergic Response in People With Parkinson's Disease

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Abstract (summary): Humans' voice offers the widest variety of motor phenomena of any human activity. However, its clinical evaluation in people with movement disorders such as Parkinson's disease (PD) lags behind current knowledge on advanced analytical automatic speech processing methodology. Here, we use deep learning-based speech processing to differentially analyze voice recordings in 14 people with PD before and after dopaminergic medication using personalized Convolutional Recurrent Neural Networks (p-CRNN) and Phone Attribute Codebooks (PAC). p-CRNN yields an accuracy of 82.35% in the binary classification of ON and OFF motor states at a sensitivity/specificity of 0.86/0.78. The PAC-based approach's accuracy was slightly lower with 73.08% at a sensitivity/specificity of 0.69/0.77, but this method offers easier interpretation and understanding of the computational biomarkers. Both p-CRNN and PAC provide a differentiated view and novel insights into the distinctive components of the speech of persons with PD. Both methods detect voice qualities that are amenable to dopaminergic treatment, including active phonetic and

prosodic features. Our findings may pave the way for quantitative measurements of speech in persons with PD.

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Document 31

Are the Acoustic Measurements Reliable in the Assessment of Voice Quality? A Methodological Prospective Study

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Abstract (summary): Objective: Acoustic parameters are widely used as voice quality therapeutic outcomes in many laryngological diseases. The aim of this study is to explore the impact of changes in the nature and duration of the analyzed time interval and the vowel choice on the significance of the acoustic measurements used as therapeutic outcomes in two different diseases. Study Design: A prospective case series. Material and Methods: From September 2013 to January 2018, patients with laryngopharyngeal reflux (LPR) disease were recruited and treated with pantoprazole, diet, and behavioral changes for 3 months. The reflux symptom index and reflux finding score were used for both diagnosis and assessment of treatment effectiveness. Simultaneously, patients with early idiopathic Parkinson's disease (IPD) were enrolled and benefited from a levodopa challenge test. An Iowa Oral Performance Instrument was used for objective outcomes in the assessment of levodopa effectiveness on muscular strength of IPD patients. Acoustic measurements were performed in both groups pre- and postmedication intake at different time intervals, including the "most stable" time intervals of 1 second, 2 seconds, 3 seconds, 4 seconds, and 5 seconds and a 1 second-time interval positioned at mid-production. We also measured acoustic parameters on the entire signal of three vowels and on the signal of each vowel being taken separately. Results: A total of 80 LPR and 19 IPD patients met our inclusion criteria and completed the study protocol. LPR and IPD patients had significant clinical improvements throughout treatment, according to reflux symptom index, reflux finding score, and Iowa Oral Performance Instrument scores. The acoustic analysis revealed that acoustic parameters significantly improved from pre- to post-treatment and varied across methods used for measurement. The duration and position of the analyzed time interval in the production and

the vowel on which the acoustic measures were made yielded considerable differences in the results. Conclusion: Depending on the time interval over which the acoustic parameters are measured, the clinically demonstrated effect of the medication may or may not be statistically demonstrated irrespective of the disease. According to the results of this study and regarding the lack of standardization of acoustic measurement methods, a line of thought is proposed to bypass the interval selection problem.

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Subject: Embase;MEDLINE;levodopa -- drug therapy -- Parkinson disease;pantoprazole -- drug therapy -- laryngopharyngeal reflux;information processing device;microphone;acoustic analysis (major);acoustics;adult;amplitude perturbation quotient +;Article;assessment of humans;behavior change;clinical assessment;controlled study;diet supplementation;drug efficacy;female;human;iowa oral performance instrument +;laryngopharyngeal reflux -- drug therapy -- pantoprazole (major);major clinical study;male;middle aged;muscle strength;noise harmonic ratio +;Parkinson disease -- drug therapy -- levodopa (major);peak to peak amplitude variation +;phonatory fundamental frequency range +;pitch perturbation quotient +;prospective study;provocation test;relative average perturbation +;shimmer percent +;smoothed amplitude perturbation quotient +;smoothed pitch perturbation quotient +;soft phonation index +;software;symptom;therapy;treatment duration;treatment outcome;treatment response;voice (major);voice parameter;voice turbulence index +;vowel

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Document 32

Improved Estimation of Parkinsonian Vowel Quality through Acoustic Feature Assimilation

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Abstract (summary): This paper investigated the performance of a number of acoustic measures, both individually and in combination, in predicting the perceived quality of sustained vowels produced by people impaired with Parkinson's disease (PD). Sustained vowel recordings were collected from 51 PD patients before and after the administration of the Levodopa medication. Subjective ratings of the overall vowel quality were garnered using a visual analog scale. These ratings served to benchmark the effectiveness of the acoustic measures. Acoustic predictors of the perceived vowel quality included the harmonics-to-noise ratio (HNR), smoothed cepstral peak prominence (CPP), recurrence period density entropy (RPDE), Gammatone frequency cepstral coefficients (GFCCs), linear prediction (LP) coefficients and their variants, and modulation spectrogram features. Linear regression (LR) and support vector regression (SVR) models were employed to assimilate multiple

features. Different feature dimensionality reduction methods were investigated to avoid model overfitting and enhance the prediction capabilities for the test dataset. Results showed that the RPDE measure performed the best among all individual features, while a regression model incorporating a subset of features produced the best overall correlation of 0.80 between the predicted and actual vowel quality ratings. This model may therefore serve as a surrogate for auditory-perceptual assessment of Parkinsonian vowel quality. Furthermore, the model may offer the clinician a tool to predict who may benefit from Levodopa medication in terms of enhanced voice quality.

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Orofacial Strength and Voice Quality as Outcome of Levodopa Challenge Test in Parkinson Disease

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Abstract (summary): OBJECTIVE

To assess the usefulness of orofacial strength and voice quality as assessment of response to levodopa challenge test (LCT) used in the diagnosis of early idiopathic Parkinson disease (IPD).

STUDY DESIGN

Controlled Prospective Study.

METHODS

From January 2014 to April 2019, patients with early IPD and healthy individuals were recruited and evaluated for clinical findings (Hoehn and Yahr scale; Unified Parkinson's Disease Rating Scale); Voice Handicap Index (VHI); grade of dysphonia, roughness, breathiness, asthenia, and strain and instability (GRBASI); maximal phonation time; phonation quotient; acoustic parameters; and orofacial muscle strength Oral Performance Instrument (IOPI; IOPI Medical, Woodinville, WA, USA) t) at baseline and 45 minutes after the levodopa intake (LCT).

RESULTS

A total of 32 IPD patients and 20 healthy individuals completed the study. Healthy individuals exhibited better VHI, grade of dysphonia, breathiness, asthenia, strain, instability, and acoustic measurements (noise-related, tremor, F0 short- and mid-term and intensity short-term parameters) than healthy subjects. The mean values of muscle strength of lips, cheeks, fundamental frequency (F0), highest F0, and shimmer significantly improved from pre- to post-LCT in IPD patients. Healthy individuals did not exhibit significant changes of orofacial strength and voice quality assessment from pre- to post-LCT. Significant associations were found between clinical, orofacial strength, and some aerodynamic and acoustic measurements.

CONCLUSION

Orofacial strength and acoustic voice quality measurements may be used as objective outcomes of the LCT responsiveness in patients with early IPD.

LEVEL OF EVIDENCE

3A. Laryngoscope, 2020.

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Document 34

The Effects of Respiratory Muscle Training on Phonatory Measures in Individuals with Parkinson's Disease

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Abstract (summary): INTRODUCTION

In individuals with Parkinson's disease (PD), respiratory muscle weakness and rigidity, bradykinesia of abdominal muscles and stiffness of the chest wall, affect the respiratory component of voice intensity due to reduced pulmonary capacity and airflow needed to vibrate the vocal folds. It may be possible to improve voice production by strengthening respiratory muscles. The purpose of this study was to evaluate the effects of inspiratory and expiratory muscle training on voice production outcomes in individuals with PD.

METHOD

Thirty-one participants with PD were randomly allocated to three study groups (control group n = 10, inspiratory training group, n = 11, and expiratory training group, n = 11). The inspiratory and expiratory group performed a home-based inspiratory and expiratory muscle training program, respectively (five sets of five repetitions). Both groups trained six times a week for 2 months using a progressively increased resistance. The control group performed expiratory muscle training using the same protocol and a fixed resistance. Phonatory measures, maximum inspiratory/expiratory pressure, and spirometric indexes were assessed before and at 2 months after training.

RESULTS

Differences in peak subglottic pressure were moderate (d = 0.59) between expiratory and inspiratory groups, large between inspiratory and control groups (d = 1.32), and large between expiratory and control groups (d = 1.96). Differences in maximum phonation time were large (d = 1.26) between inspiratory and control groups, moderate (negative) between expiratory and inspiratory groups (d = -0.60), and moderate between expiratory and control groups (d = 0.72). Differences in peak sound pressure level were large (d = 1.27) between inspiratory and control groups, trivial between expiratory and inspiratory groups (d = -0.18), and large between expiratory and control groups (d = 1.10).

CONCLUSIONS

Inspiratory muscle training is effective in improving maximum phonation time, and expiratory muscle training is more effective for improving peak subglottic pressure, and peak sound pressure level in individuals with PD.

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Document 35

Investigating the effects of subthalamic Nucleus-Deep brain stimulation on the voice quality

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Abstract (summary): Introduction: Deep brain stimulation (DBS) is a standard surgical treatment method which is generally applied to subthalamic nucleus in Parkinson's patients in cases where medical treatment is insufficient in treating the motor symptoms. It is known that Subthalamic Nucleus

Deep Brain Stimulation (STN-DBS) treats many motor symptoms. However, the results of studies on speech and voice vary. The aim of the study is analysing the effect of STN-DBS on the characteristics of voice.Materials/methods: A total of 12 patients, (8 male-4 female) with an age average of 58.8 ± 9.6, who have been applied DBS surgery on STN included in the study. The voice recordings of the patients have been done prior to surgery and 6 months after the surgery. The evaluation of voice has been carried out through the instrumental method. The patients' voice recordings of the /a,e,i/ vowels have been done. The obtained recordings were evaluated by the Praat programme and the effects on jhitter, shimmer, fundamental frequency (F0) and noise harmonic rate (NHR) were analysed.Results: Numerical values of F0 of all female participants have been decreased for all of the vowels postoperatively. In the females; jhitter and fraction parameters were found to be significantly different (0.056 and 0.017, perspectively) for the vowel /e/. In addition, p values in the shimmer for vowels /e,i/ were thought to be clinically significant (.087, .079 and .076) respectively. All these changes in second measurements were found to indicate worsening vocal quality after the DBS in females. In males, there is not any significant difference observed between two measures in any of the parameters of any vowels.Conclusions: Acoustic voice quality deteriorated after STN-DBS predominantly for females however this deterioration was not prominent audio-perceptually. This finding commented as a result of the fact that that voice quality deviance of the participants was not severe.

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Document 36

Say "AH~": Vocal Analysis in Parkinson's Disease and Essential Tremor

Author: Park, J.E. 1 ; Oh, S.W. 1 ; Shin, J.Y. 1 ; Lee, S.Y. 1 ; Hong, S.H. 1 ; Ahn, N.H. 1 ; Kim, H.J. 1 ; Lee, K.H. 1 ; Bae, J.E. 1 ; Lee, H.B. 1

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Abstract (summary): Objective: We aimed to investigate useful vocal parameters in differentiating PD and ET, using a machine-learning algorithm. Background: Correlation between Parkinson's disease (PD) and essential tremor (ET) has long been suggested, as both clinical characteristics and epidemiological factors have been found to overlap. A subset of patients with long-standing ET are found to develop subsequent PD, further suggesting an association between the two disease entities. Methods: Patients (27 PD[ON], 20 PD[OFF], 26 ET[ON] and 13 ET [OFF]) seen in the Neurology Clinic at Dongguk University Ilsan Hospital were included. Study procedures included the following: Vocal recording ("Ah~" for at least 5 seconds x 3 trials, reading a standardized sentence, and singing the Korean anthem), Brief Smell Identification Test, Unified Parkinson's Disease Rating Scale (UPDRS) Parts I, II &III and in ET patients, the Clinical Tremor Rating Scale (CTRS) was also performed. Videotaping was conducted and analysis was performed offline. Results: We applied a machine-learning algorithm to our data. Spectography was performed and binary classification of deep-learning was attempted. Simple utterance vocal data of the two patient groups in the medication-OFF state were found to have a 68% accuracy. Simple utterance vocal data of the ET group in the medication-OFF and ON state were found to have 60% LOSO accuracy. Conclusions: Vocal data obtained by simple utterance may be useful to differentiate patients with PD and ET in the medication-OFF state. Our machine-learning algorithm was capable of differentiating vocal data of patients with ET in the medication-OFF and ON state, suggesting that the vocal tremor in ET patients may be affected by medication, in contrast with findings of the PD group. We anticipate applying our algorithm to vocal data of a subset of ET patients found to have moderate UPDRS scores and/or olfactory dysfunction, which may help to shed light on the association between ET and PD.

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Document 37

Association analysis of Parkinson disease with vocal change characteristics using multi-objective metaheuristic optimization

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Abstract (summary): Parkinson's disease (PD) is a neurodegenerative disorder that has important economic and social effects influencing the quality of patient life. Diagnosis of PD is performed in terms of certain criteria depending on the clinical symptom evaluation. However, this method may be inadequate, especially during the onset of the disease. Acoustic analysis of PD is a cost-effective, easy, and non-invasive method for early diagnosis. The mining of association rules is one of the problems in data mining that aims to find valuable and interesting associations in huge data sets. Although association analysis is very popular and useful, to the best of our knowledge, there is not any study on association analysis of PD using vocal change characteristics. Automatic mining of comprehensible, interesting, and accurate association rules in PD data sets containing huge numerical processed voice data is aimed in this study. Due to the numerical characteristics of the vocal attributes in pre-processed PD data, classical association rules mining methods cannot be efficiently applied to this problem. For this reason; MOPNAR, NICGAR, and QAR_CIP_NSGAII that are artificial intelligence-based algorithms were modeled for mining of numerical association rules in order to obtain better performances without using any pre-process for numerical data for the first time. Furthermore, the problem of association analysis of PD with vocal change characteristics was modeled as a multi-objective optimization problem considering many different complementary/contradictory metrics such as support, confidence, comprehensibility, interestingness, etc. in this study. According to the obtained multi-objective rule sets, the NICGAR outperformed in terms of average confidence, average CF, average netconf, average yulesQ, and average number of attributes.

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Document 38

Estimation of <mark>Parkinson</mark>'s disease severity from voice features of vowels and consonant

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Abstract (summary): This study has investigated the efficiency of voice features in estimating the motor Unified Parkinson's Disease Rating Scale (UPDRS) score in Parkinson's disease (PD) patients. A total of 26 PD patients (mean age = 72) and 22 control subjects (mean age = 66.91) were recruited for the study. The sustained phonation /a/, /u/ and /m/ were collected in both off-state and on-state of Levodopa medication. The average motor UPDRS for PD off-state patients was 27.31, on-state was 20.42 and that of controls was 2.63. Voice features were extracted from the phonation tasks and were reduced to the most relevant 6 features for each phonation task using the Least Absolute Shrinkage and Selection Operator (LASSO) feature ranking method. The correlation between the reduced features and motor UPDRS was tested using the Spearman correlation coefficient test. AdaBoost regression learner was trained and used for automatically estimating the motor UPDRS score using the voice features. The results show that the vocal features for /m/ performed best by estimating the

motor UPDRS score for PD off-state with the mean absolute error (MAE) of 3.52 and 5.90 for PD on-state. This study shows that assessment of voice can be used for day to day remote monitoring of PD patients.

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Document 39

Acoustic analysis of voice in Parkinson's disease: a systematic review of voice disability and meta-analysis of studies

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Abstract (summary): AIM

To systematically review all the literature, focusing on instrumental quantitative assessment of voice in patients with Parkinson's disease (PD). Furthermore, a meta-analysis was performed to identify the main characteristics of voice disturbances in PD.

PATIENTS AND METHODS

Literature searches with the keywords «Parkinson» and «voice» were conducted in PubMed, EMBASE, Cochrane Library and Web of Science. Main inclusion criteria were: clinically confirmed PD and instrumented measurement of voice parameters with acoustic analysis of voice.

RESULTS

Fourteen publications met the inclusion criteria and were included in the meta-analysis. The data within the meta-analysis revealed that several voice parameters including jitter, shimmer and fundamental frequency variation presented significant variations between patients with EP and healthy controls. Significant variations of fundamental frequency, maximum phonation time, harmonic to noise ratio, standard deviation of fundamental frequency were observed, but with a high heterogeneity between the studies. On the other hand, significant variations of noise to harmonic ratio, s/z ratio, variation of amplitude were not observed.

CONCLUSION

Acoustic analysis of voice, using an electronic system, allows the identification of changes in voice parameters for predicting the worsening of disease and for targeting specific intervention. Among the voice parameters, jitter and shimmer significantly increased in patients with PD.

TITLE

Análisis acústico de la voz en la enfermedad de Parkinson: revisión sistemática de la discapacidad vocal y metaanálisis de estudios.Objetivo. Revisar de manera exhaustiva la bibliografía referente a la evaluación instrumental cuantitativa de la voz en pacientes con enfermedad de Parkinson (EP) y realizar un metaanálisis para definir las principales características de los trastornos de la voz en la EP. Pacientes y métodos. Búsquedas bibliográficas con las palabras clave «Parkinson» y «voice» en PubMed, EMBASE, Cochrane Library y Web of Science. Los principales criterios de aceptación fueron: EP con confirmación clínica y medición instrumentada de los parámetros de la voz mediante análisis acústico. Resultados. Catorce publicaciones cumplieron los criterios de aceptación y se incluyeron en el metaanálisis. De los datos incorporados al metaanálisis, se dedujo que varios parámetros vocales, como el jitter, el shimmer y la variación de la frecuencia fundamental, presentan variaciones significativas en los pacientes con EP frente a los controles sanos. Se hallaron variaciones significativas de la frecuencia fundamental y de su desviación estándar, del tiempo

máximo de fonación y de la razón armónicos-ruido, si bien con una alta heterogeneidad entre los estudios. En cambio, no se observaron variaciones sustanciales de la razón ruido-armónicos, en el índice s/z ni en la variación de la amplitud. Conclusión. El análisis acústico de la voz por medio de un sistema electrónico permite detectar los cambios de los parámetros vocales de cara a predecir el empeoramiento de la enfermedad y elegir una intervención específica. Entre dichos parámetros, el jitter y el shimmer aumentaron significativamente en los pacientes con EP.

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Document 40

Dysphonia and Dysarthria in People With Parkinson's Disease After Subthalamic Nucleus Deep Brain Stimulation: Effect of Frequency Modulation

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Abstract (summary): Purpose: Subthalamic nucleus deep brain stimulation (STN-DBS) parameters, for example the frequency of stimulation, seem to affect speech and voice aspects. However, this influence is not well understood. This study aimed to investigate the impact of low- and high-frequency STN-DBS on voice and speech for people with Parkinson's disease. Methods: Nineteen individuals with Parkinson's disease who received bilateral STN-DBS were assessed for motor performance (Unified Parkinson's Disease Rating Scale-III), perceptual evaluation of voice (grade, roughness, breathiness, asthenia, strain, and instability [GRBASI]), dysarthria assessment, and computerized acoustic analysis of voice upon receiving low-frequency (60 Hz) and high-frequency (130 Hz) STN-DBS. Results: In the GRBASI protocol, asthenia, and instability were significantly better at 130 Hz of stimulation. In the dysarthria evaluation, the phonation aspect, articulation, and grade of dysarthria showed deterioration at the same high-frequency condition. There was no significant difference for any vocal acoustic measures. Conclusion: The high-frequency of STN-DBS may affect speech and voice differently, leading to an amelioration of the vocal production, but with adverse effects in the speech control.

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Document 41

Voice changes in Parkinson's disease: What are they telling us?

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Abstract (summary): Emerging evidence suggests voice dysfunction is the earliest sign of motor impairment in Parkinson's disease (PD). The complexity and fine motor control involved in vocalization may result in dysfunction here before the limbs. The voice in PD demonstrates characteristic changes on perceptual and acoustic analyses. The physiological and anatomical correlates of these have been investigated through laryngoscopy, stroboscopy, photoglottography, laryngeal electromyography, computed-tomography, pulmonary function testing and aerodynamic assessments. These have revealed numerous abnormalities including incomplete glottic closure and vocal fold hypoadduction/bowing to account for these voice changes. Many of these phenomena are likely related to rigidity or bradykinesia of the laryngeal muscles. The early onset of voice changes is resonant with the pathophysiological insights offered by Braak's hypothesis and murine models of the disease. These physiological abnormalities and pathological models largely stand to support dopaminergic and non-dopaminergic mechanisms being implicated in the pathogenesis of voice dysfunction. This review focuses on characterizing the voice changes in PD. These stand as a promising area of enquiry to further our understanding of the pathophysiology of the disease and offer potential to be utilized as an early diagnostic biomarker or marker of disease progression.

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MeSH: Animals;Disease Progression (major);Dysphonia (major);Electromyography;Female;Humans;Male;Mice;<mark>Parkinson Disease</mark> -- diagnosis (major);<mark>Parkinson Disease</mark> -- physiopathology (major)

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Document 42

Effectiveness of Lee Silverman Voice Treatment® LOUD on Japanese-Speaking Patients with <mark>Parkinson</mark>'s Disease

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Abstract (summary): Background. Lee Silverman Voice Treatment® LOUD (LSVT®) is an intensive program devised in the United States to train patients with <mark>Parkinson</mark>'s disease (PD) to speak louder, at normal intensity, while keeping a good voice quality. Four weeks of LSVT® has been shown to increase vocal loudness and improve intelligibility among Japanese-speaking PD patients. However, the long-term effects of LSVT® have not been examined in these patients. Objective. This study aimed to investigate the long-term effects of LSVT® on Japanese-speaking PD patients. Methods. Twenty-one Japanese PD patients underwent a standardized course (four sessions over four consecutive days, for four weeks) of LSVT® at our hospital. Vocal loudness and intelligibility were assessed at the following three time-points: pretreatment (baseline), immediately after treatment, and at the end of the 12 month follow-up (12FU). Sound pressure levels (<mark>dB</mark> SPL) were measured during the following tasks: sustained phonation of /a/, reading a standardized text, and delivery of a monologue. Three experienced speech-language pathologists, who were blinded to patients' identities

and assessment points, assessed speech intelligibility based on recorded audio samples of each participant during the reading and monologue tasks. Results. Fourteen patients were evaluated at 12FU. Changes in dB SPL from baseline to immediately after treatment were +6.5 dB, +4.2 dB, and +2.8 dB, and those from baseline until 12FU were +4.7 dB, +3.5 dB, and +2.5 dB in sustained phonation of /a/, reading a passage, and delivery of a monologue, respectively. These changes were significant ($p < 0.025$) in both the baseline-to-immediately-after-treatment and baseline-to-12FU intervals. Intelligibility relative to baseline was significantly improved immediately after treatment, but not at 12FU. Conclusions. LSVT® had a long-term effect on the vocal loudness of Japanese-speaking PD patients. A short-term effect was seen in intelligibility, however, there was no significant long-term effect.

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Complexity measures of voice recordings as a discriminative tool for Parkinson's disease

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Abstract (summary): In this paper, we have investigated the differences in the voices of Parkinson's disease (PD) and age-matched control (CO) subjects when uttering three phonemes using two complexity measures: fractal dimension (FD) and normalised mutual information (NMI). Three sustained phonetic voice recordings, /a/, /u/ and /m/, from 22 CO (mean age = 66.91) and 24 PD (mean age = 71.83) participants were analysed. FD was first computed for PD and CO voice recordings, followed by the computation of NMI between the test groups: PD–CO, PD–PD and CO–CO. Four features reported in the literature—normalised pitch period entropy (Norm. PPE), glottal-to-noise excitation ratio (GNE), detrended fluctuation analysis (DFA) and glottal closing quotient (ClQ)—were also computed for comparison with the proposed complexity measures. The statistical significance of the features was tested using a one-way ANOVA test. Support vector machine (SVM) with a linear kernel was used to classify the test groups, using a leave-one-out validation method. The results showed that PD voice recordings had lower FD compared to CO ($p < 0.008$). It was also observed that the average NMI between CO voice recordings was significantly lower compared with the CO–PD and PD–PD groups ($p < 0.036$) for the three phonetic sounds. The average NMI and FD demonstrated higher accuracy (>80%) in differentiating the test groups compared with other speech feature-based classifications. This study has demonstrated that the voices of PD patients has reduced FD, and NMI between voice recordings of PD–CO and PD–PD is higher compared with CO–CO. This suggests that the use of NMI obtained from the sample voice, when paired with known groups of CO and PD, can be used to identify PD voices. These findings could have applications for population screening.

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Document 44

ParkinSong: Outcomes of a 12-Month Controlled Trial of Therapeutic Singing Groups in Parkinson's Disease

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Abstract (summary): BACKGROUND

Parkinson's disease (PD) frequently causes progressive deterioration in speech, voice and cognitive aspects of communication. These affect wellbeing and quality of life and are associated with caregiver strain and burden. Therapeutic singing groups can ameliorate PD-related communication disorders and increase social interaction and wellbeing for caregivers and care recipients.

OBJECTIVE

To analyse the effects of ParkinSong group singing sessions on Parkinson's communication and wellbeing outcomes for people with PD and caregivers over 12 months.

METHODS

A 4-armed controlled clinical trial compared ParkinSong with active non-singing control conditions over 12 months. Two dosage levels (weekly versus monthly) were available for each condition. ParkinSong comprised high-effort vocal, respiratory and speech exercises, group singing, and social interaction. PD-specific outcomes included vocal loudness, speech intelligibility, maximum phonation time, respiratory muscle strength, and voice related quality of life (QoL). Wellbeing outcomes were also measured for caregivers and care recipients.

RESULTS

We recruited 75 people with PD and 44 caregivers who attended weekly ParkinSong, monthly ParkinSong, weekly control or monthly control groups. We found significant improvements in the

primary outcome of vocal loudness (p=0.032), with weekly singers 5.13 dB louder (p=0.044) and monthly singers 5.69 dB louder (p=0.015) than monthly controls at 12 months. ParkinSong participants also showed greater improvements in voice-related QoL and anxiety. Caregivers who attended ParkinSong showed greater reductions in depression and stress scores.

CONCLUSIONS

This 12-month controlled clinical trial of ParkinSong demonstrated improvements in speech loudness and voice-related QoL for participants with PD, and enhanced wellbeing for both caregivers and care recipients. No adverse effects were reported over 12 months and improvements were sustained.

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Document 45

An ensemble method for diagnosis of Parkinson's disease based on voice measurements

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Abstract (summary): Background: Parkinson's disease (PD) is the most common destructive neurological disorder after Alzheimer's disease. Unfortunately, there is no specific test such as electroencephalography or blood test for diagnosing the disease. In accordance with the previous studies, about 90% of people with PD have some types of voice abnormalities. Therefore, voice measurements can be used to detect the disease. Methods: This study presents an ensemble-based method for identifying patients and healthy samples by class label prediction based on voice frequency characteristics. It includes three stages of data preprocessing, internal classification and ultimate classification. The outcomes of internal classifiers next to primary feature vector of samples are considered the ultimate classifier inputs. Results: According to the results, the proposed method achieved 90.6% of accuracy, 95.8% of sensitivity, and 75% of specificity, admissible compared to those of other relevant studies. Conclusion: Current experimental outcomes provide a comparative analysis of various machine learning classifiers and confirm that using ensemble-based methods has improved medical diagnostic tasks.

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Machine learning classifiers and subjective vocal perception of Parkinson's disease patients and healthy control

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Abstract (summary): Objective: To identify machine learning classifiers and to assess the acoustic differences between PD patients and healthy control (HC) and the relations between objective and subjective vocal parameters. Background: Vocal characteristics associated with Parkinson's disease (PD) are part of hypokinetic dysarthria and can be acoustically analyzed. Voice analysis is being used

to diagnose the presence and progression of different diseases, including PD. Methods: The study included 104 PD patients (30 Females) and 82 HC (47 Females). All participants underwent the Montreal Cognitive Assessment (MoCA), Voice Handicap Index (VHI), Beck Depression Inventory (BDI). PD patients underwent the PD quality of life questionnaire (PDQ8), Hoehn &Yahr scale (H&Y). All participants' voice quality was assessed using the Grade, Roughness, Breathiness, Asthenia &strain (GRBAS) score. All participants were recorded while performing speech tasks including set of vowel sounds, counting up section, a phonetically balanced text to be read aloud, picture description and a short spontaneous speech section. Acoustic analysis including pitch and Root Mean Score (RMS) was performed. A large set of dynamic and static acoustic features were developed in order to train several machine learning classifiers to measure their performance in detecting PD from speech. Results: Mean age of PD/HC 67.26±10.26/59.09±9.47 respectively. Mean H&Y 2.5±0.81; Disease duration 9.17±6.29 and PDQ8 10.58±6.32; MoCA, VHI, BDI and GRBAS mean score of PD/HC 22.39±4.90/26.54±2.63; 36.27±30.30/4.48±6.51; 3.79±4.19/0.91±1.40; 0.80±0.94/0.15±0.36 (p <0.001) respectively. Significant difference was noted in RMS MAX between PD patients 14.61±29.04 and HC 5.07±0.96. In the HC group a positive correlation was noted between pitch (1.06±0.13) and GRBAS (0±0; p <0.05) during reading. Using special feature classifiers, ~70% correct classification using single feature on \MPT\ task, and ~80% using combination of features were achieved. Classification accuracy for GRBAS among PD patients was 80%. Conclusions: The combination of acoustic analysis and subjective vocal assessment can differentiate healthy voice from dysarthric voice of PD. Machine learning may be useful in the early detection of PD.

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Document 47

Voice Quality and Orofacial Strength as Outcome of Levodopa Effectiveness in Patients with Early Idiopathic Parkinson Disease: A Preliminary Report

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Abstract (summary): INTRODUCTION

Sixty to 90% of patients with idiopathic Parkinson disease (IPD) developed early dysphonia and subtle speech impairment, which is usually related to orofacial muscular dysfunctions. The aim of this preliminary study is to assess the usefulness of voice quality and orofacial strength (involved in speech) as outcome of levodopa challenge test used for the IPD diagnosis.

MATERIAL AND METHODS

A total of 20 patients with early IPD were recruited and evaluated for clinical findings (Hoehn and Yahr scale), voice handicap index, maximal phonation time, phonation quotient, percent jitter, percent shimmer, noise-to-harmonic ratio, and orofacial muscular strength (Iowa Oral Performance Instrument) at baseline, throughout the levodopa challenge test and after therapeutic stabilization.

RESULTS

The intake of a standardized dose of levodopa (levodopa challenge test) significantly improved phonation quotient and percent shimmer. We did not find similar improvement after medical stabilization of patients (based on levodopa medication) despite an improvement of Hoehn and Yahr mean score. The intake of levodopa significantly improved cheeks and lips strength involved in speech quality both along the challenge test and after the therapeutic stabilization.

CONCLUSIONS

These preliminary findings support a differential impact of levodopa on voice and speech functions in early diagnosed IPD and a mismatch between the clinical examination, orofacial strength, and voice quality improvements once the patient is medically stabilized.

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Document 48

Voice Tremor Outcomes of Subthalamic Nucleus and Zona Incerta Deep Brain Stimulation in Patients With Parkinson Disease

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Abstract (summary): OBJECTIVES

We aimed to study the effect of deep brain stimulation (DBS) in the subthalamic nucleus (STN) and caudal zona incerta (cZi) on level of perceived voice tremor in patients with Parkinson disease (PD).

STUDY DESIGN

This is a prospective nonrandomized design with consecutive patients.

METHODS

Perceived voice tremor was assessed in patients with PD having received either STN-DBS (8 patients, 5 bilateral and 3 unilateral, aged 43.1-73.6 years; median = 61.2 years) or cZi-DBS (14 bilateral patients, aged 39.0-71.9 years; median = 56.6 years) 12 months before the assessment. Sustained vowels that were produced OFF and ON stimulation (with simultaneous l-DOPA medication) were assessed perceptually in terms of voice tremor by two raters on a four-point rating scale. The assessments were repeated five times per sample and rated in a blinded and randomized procedure.

RESULTS

Three out of the 22 patients (13%) were concluded to have voice tremor OFF stimulation. Patients with PD with STN-DBS showed mild levels of perceived voice tremor OFF stimulation and a group level improvement. Patients with moderate/severe perceived voice tremor and cZi-DBS showed marked improvements, but there was no overall group effect. Six patients with cZi-DBS showed small increases in perceived voice tremor severity.

CONCLUSIONS

STN-DBS decreased perceived voice tremor on a group level. cZi-DBS decreased perceived voice tremor in patients with PD with moderate to severe preoperative levels of the symptom.

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Document 49

Analysis of the prevalence and onset of dysphonia and dysphagia symptoms in movement disorders at an academic medical center

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Abstract (summary): Voice and swallowing impairments are common in movement disorders, but their effect on patients' quality of life is not well known. This study was conducted to determine the onset and prevalence of patient-reported dysphonia and dysphagia symptoms in Parkinson's disease (PD), dystonia, Atypical Parkinsonian Syndromes (APS), and Essential Tremor (ET). Patients referred to a movement disorders clinic in a tertiary care academic medical center completed validated voice and swallowing specific Quality of Life (QOL) questionnaires: Voice Handicap Index-10 (VHI-10) and Eating Assessment Tool-10 (EAT-10). Patient demographics and clinical data were also collected. Two hundred and sixty-eight patients (males = 150, females = 118) completed the questionnaires (n was PD = 103, APS = 30, ET = 56, dystonia = 32, other = 47). Prevalence of patient-reported dysphagia symptoms was significantly higher in APS (63%) than PD (26%), ET (25%), and dystonia (31%). Prevalence of patient-reported dysphonia symptoms was significantly lower in ET (14%) compared to PD (34%) and APS (43%). Disease duration was shorter in PD and APS compared to ET and dystonia (p < 0.05) before reporting clinically significant dysphonia and dysphagia symptoms indicating an earlier onset of these symptoms. There were significant positive correlations between VHI-10 and EAT-10 scores and disease severity, as indicated by Unified Parkinson's Disease motor scores (p < 0.0001) and modified Fahn-Tolosa-Marin Tremor Rating sub-scores (p = 0.0013). Patient-reported dysphonia and dysphagia symptoms were present in one fourth of patients with PD, ET, dystonia, and almost two thirds in APS. Patient-reported QOL measures, such as VHI-10 and EAT-10, can help screen movement disorder patients for dysphonia and dysphagia symptoms.

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Effect of deep brain stimulation on vocal motor control mechanisms in Parkinson's disease

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Abstract (summary): INTRODUCTION

Deep brain stimulation (DBS) of the subthalamic nucleus (STN) is an effective treatment for limb motor symptoms in Parkinson's disease (PD); however, its effect on vocal motor function has yielded conflicted and highly variable results. The present study investigated the effects of STN-DBS on the mechanisms of vocal production and motor control.

METHODS

A total of 10 PD subjects with bilateral STN-DBS implantation were tested with DBS ON and OFF while they performed steady vowel vocalizations and received randomized upward or downward pitch-shift stimuli (±100 cents) in their voice auditory feedback.

RESULTS

Data showed that the magnitude of vocal compensation responses to pitch-shift stimuli was significantly attenuated during DBS ON vs. OFF (p = 0.012). This effect was direction-specific and was only observed when subjects raised their voice fundamental frequency (F0) in the opposite direction to downward stimuli (p = 0.019). In addition, we found that voice F0 perturbation (i.e. jitter) was significantly reduced during DBS ON vs. OFF (p = 0.022), and this DBS-induced modulation was positively correlated with the attenuation of vocal compensation responses to downward pitch-shift stimuli (r = +0.57, p = 0.028).

CONCLUSIONS

These findings provide the first data supporting the role of STN in vocal F0 motor control in response to altered auditory feedback. The DBS-induced attenuation of vocal compensation responses may result from increased inhibitory effects of the subcortical hyperdirect (fronto-subthalamic) pathways on the vocal motor cortex, which can help stabilize voice F0 and ameliorate vocal motor symptoms by impeding PD subjects' abnormal (i.e. overshooting) vocal responses to alterations in the auditory feedback.

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Developing a large scale population screening tool for the assessment of Parkinson's disease using telephone-quality voice

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Abstract (summary): Recent studies have demonstrated that analysis of laboratory-quality voice recordings can be used to accurately differentiate people diagnosed with Parkinson's disease (PD) from healthy controls (HCs). These findings could help facilitate the development of remote screening and monitoring tools for PD. In this study, 2759 telephone-quality voice recordings from 1483 PD and 15 321 recordings from 8300 HC participants were analyzed. To account for variations in phonetic backgrounds, data were acquired from seven countries. A statistical framework for analyzing voice was developed, whereby 307 dysphonia measures that quantify different properties of voice impairment, such as breathiness, roughness, monopitch, hoarse voice quality, and exaggerated vocal tremor, were computed. Feature selection algorithms were used to identify robust parsimonious feature subsets, which were used in combination with a random forests (RFs) classifier to accurately distinguish PD from HC. The best tenfold cross-validation performance was obtained using Gram-Schmidt orthogonalization and RF, leading to mean sensitivity of 64.90% (standard deviation, SD, 2.90%) and mean specificity of 67.96% (SD 2.90%). This large scale study is a step forward toward assessing the development of a reliable, cost-effective, and practical clinical decision support tool for screening the population at large for PD using telephone-quality voice.

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Document 52

Acoustic voice modifications in individuals with Parkinson disease submitted to deep brain stimulation

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Abstract (summary): Introduction Subthalamic nucleus deep brain stimulation (STN-DBS) improves motor function in individuals with Parkinson disease (PD). The evidence about the effects of STN-DBS on the voice is still inconclusive. Objective To verify the effect of STN-DBS on the voice of Brazilian individuals with PD. Methods Sixteen participants were evaluated on the Unified Parkinson Disease Rating Scale—Part III, and by the measurement of the acoustic modifications in on and off conditions of stimulation. Results The motor symptoms showed significant improvement with STN-DBS on. Regarding the acoustic measures of the voice, only the maximum fundamental frequency (fhi) showed a statistical difference between on- and off-conditions, with reduction in off-condition. Conclusion Changes in computerized acoustic measures are more valuable when interpreted in conjunction with changes in other measures. The single finding in fhi suggests that DBS-STN

increases vocal instability. The interpretation of this result should be done carefully, since it may not be of great value if other measures that also indicate instability are not significantly different.

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Lee Silverman voice treatment (LSVT) mitigates voice difficulties in mild Parkinson's disease

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Abstract (summary): Background: Parkinson's disease (PD) is a progressive neurological disorder and many PD patients experience some type of voice and speech disorders during the course of illness. In this study, the aim was to investigate the effect of Lee Silverman voice treatment (LSVT) on improving voice difficulties in patients with mild PD using voice handicap index (VHI). Methods: This interventional study was conducted on 23 PD patients who were randomly divided into 2 groups: a treatment group (PD-T) (n=13) and a no-treatment group (PD-NT) (n=10). Neurologically healthy control (NNC) group consisted of 13 healthy participants who did not suffer from voice and speech problems and were matched with PD group by age (50-65 years), sex, and education. VHI questionnaire was completed a day before the start of LSVT and a day after the treatment fulfillment for the PD-T group; the same time spots were applied for the PD-NT and NNC groups. Statistical analyses were performed using SPSS Statistics 22.0 and significance level was set at 0.05. The multivariate analysis of variance and repeated measure analysis of variance were used for data analysis. Results: PD groups showed a significant weakness in VHI scores before treatment compared to NNC group (p≤ 0.001). The mean of VHI scores for PD-T, PD-NT, and NNC groups before treatment was 44.31±11.23, 43.54±6.10, and 8.15±4.27, respectively. LSVT was successful in improving VHI scores in PD-T group (17.23±5.35, p≤ 0.001). However, no improvement was observed in PD-NT group (44.00±5.88). Conclusion: Improvement in VHI score could be the result of ameliorated self-monitoring and self-regulation created by LSVT.

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Study of voice disorder based on acoustic assessment in Parkinson 's disease

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Abstract (summary): Objective: To analyze the acoustic features of patients with Parkinson's disease (PD), and to explore the correlation between the acoustic features and the severity and

course of disease. Methods: Fifty-two patients with PD from the Tongji Hospital Affiliated to Tongji Medical University and the Ninth People's Hospital Affiliated to the Medical College of Shanghai Jiaotong University from August to December 2015 were enrolled into this study. Thirty-two age-matched healthy people served as control group. PD patients were tested with Unified Parkinson's Disease Rating Scale (UPDRS) and Hoehn-Yahr (H-Y) staging. And all the patients were tested with Mini-Mental State Examiantion (MMSE) and Voice Handicap Index (VHI). The voice samples of all subjects were collected and the frequency perturbation (jitter), amplitude perturbation (shimmer), and harmonic-to-noise ratio (NHR) were analyzed using a vocal assessment. Fundamental frequency (F0), standard deviation of fundamental frequency (SDF0) and formant ratio (F2i/F2u) were analyzed using a real-time speech measuring instrument. The acoustic parameters of the two groups were compared and the correlation between the parameters of the patients and the disease and course of disease was analyzed. Results: Subjective assessment using VHI showed a total of 24 VHI abnormalities (46%) in the PD group, including 13 males (54%), 11 females (46%). No VHI abnormalities were found in the control group. Among the parameters analyzed by objective acoustic method, compared with the control group (female/a/1.43(1.19, 1.92),/i/3.39(1.49,9.85),/u/1.46(1.23,3.85); male/a/1.06 (0.92, 1.89),/u/1.30(1.07,1.64)), the SDF0 of the three vowels of the female patients in the PD group (/a/2.99(1.81, 4.12), Z=5.429, P<0.01; /i/10.89(5.47, 22.20), Z=8.487, P<0.01; /u/5.16(3.75, 7.80), Z=7.138, P<0.01) and /a/and/u/of the male patients in the PD group (/a/2.16 (1.73, 2.94), Z=4.858, P=0.002; /u/3.70(2.41, 5.43), Z=7.664, P<0.01) were significantly increased, and the F2i/F2u in the PD group (male 1.96±0.84, female 1.81±1.14) was lower than that in the control group (male 3.48±0.70, female 4.14±1.08), and the difference was statistically significant (t=-6.669,-6.844, P<0.01). There were no statistically significant differences in frequency perturbation, amplitude perturbation, harmonic noise ratio and fundamental frequency. Only the fundamental frequency standard deviation of the sound parameters used in the study was correlated with the disease course of PD patients. After the severity of the disease was assessed by H-Y staging, the frequency perturbation (jitter), amplitude perturbation (shimmer) in the middle and late stage patients were higher than those in the early stage patients, and the difference of frequency perturbation in the three vowels was statistically significant, and the difference of amplitude perturbation in the vowels/i/and/u/was statistically significant. No correlation was found between the acoustic parameters and UPDRS score. Conclusions: Consonance disorders are common in PD patients, and the changes in acoustic parameters are mainly manifested as the increase in the SDF0 and the decrease in the F2i/F2u. Acoustic parameters can be used as an effective indicator to evaluate the condition and course of PD patients, and further language tasks need to be added to clarify.

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Voice Tremor in Parkinson's Disease: An Acoustic Study

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Abstract (summary): Background: Voice tremor associated with Parkinson disease (PD) has not been characterized. Its relationship with voice disability and disease variables is unknown. Objectives: This study aimed to evaluate voice tremor in people with PD (pwPD) and a matched control group using acoustic analysis, and to examine correlations with voice disability and disease variables. Methods: Acoustic voice tremor analysis was completed on 30 pwPD and 28 age-gender matched controls. Voice disability (Voice Handicap Index), and disease variables of disease duration, Activities of Daily Living (Unified Parkinson's Disease Rating Scale [UPDRS II]), and motor symptoms related to PD (UPDRS III) were examined for relationship with voice tremor measures. Results: Voice tremor was detected acoustically in pwPD and controls with similar frequency. PwPD had a statistically significantly higher rate of amplitude tremor (Hz) than controls (P = 0.001). Rate of amplitude tremor was negatively and significantly correlated with UPDRS III total score (rho −0.509). For pwPD, the magnitude and periodicity of acoustic tremor was higher than for controls without statistical significance. The magnitude of frequency tremor (Mftr%) was positively and significantly correlated with disease duration (rho 0.463). PwPD had higher Voice Handicap Index total, functional, emotional, and physical subscale scores than matched controls (P <0.001). Voice disability did not correlate significantly with acoustic voice tremor measures. Conclusion: Acoustic analysis enhances understanding of PD voice tremor characteristics, its pathophysiology, and its relationship with voice disability and disease symptomatology.

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Impact of levodopa treatment in the voice pattern of Parkinson's disease patients: a systematic review and meta-analysis

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Abstract (summary): PURPOSE: Investigate the association between levodopa therapy and vocal characteristics in Parkinson's disease patients. SEARCH STRATEGY: Studies published at MEDLINE, LILACS, and SciELO, from 1960 to December 2016. A systematic review and meta-analysis was performed using the following keywords: Parkinson's disease; levodopa; L-dopa; voice; speech disorders; dysphonia; dysarthria. After analyzing titles and abstracts, two independent reviewers selected all clinical trials that met the eligibility criteria and selected the articles and the data recorded in a previously standardized table. SELECTION CRITERIA: Trials published in English between 1960 and December 2016 individuals with clinical diagnosis of Parkinson's disease; use of levodopa therapy in stable doses; acoustic analysis combined or not with auditory-perceptual analysis to evaluate the vocal parameters under investigation. DATA ANALYSIS: The following vocal parameters were analyzed: fundamental frequency (F 0), jitter, and vocal intensity. Standardized mean differences (SMD) were calculated using the Comprehensive Meta-analysis V2 software. RESULTS: Nine articles met the eligibility criteria and were selected, with a total of 119 individuals. From these, six articles with 83 individuals were included in the meta-analysis. During the levodopa therapy "on" state, modifications in F 0 (SMD=0.39; 95% CI - 0.21-0.57) and jitter (SMD=0.23; 95% CI - 0.02-0.45) were observed. Vocal intensity was not affected (SMD=0.09; 95% CI - 0.22-0.39) by levodopa ingestion. Data of the included studies were controversial in the auditory-perceptual analysis of voice. CONCLUSION: Levodopa therapy modifies F0 and jitter. No changes in vocal intensity were observed in either the "on" or "off" states of levodopa therapy.

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Acoustic analysis and subjective vocal perception of Parkinson's disease patients and healthy control and the relation to depression and quality of life

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Abstract (summary): Objective: To assess the acoustic differences between PD patients and healthy control (HC), the participants' perception of their vocal characteristics and the relation of the acoustic characteristics to depression and quality of life (QOL). Background: Vocal characteristics associated with Parkinson's disease (PD) are part of hypokinetic dysarthria. Acoustic correlates of PD have a potential to provide biomarkers for depression. Methods: The study included 26 PD patients (8 females) and 13 HC. All participants underwent the Montreal Cognitive Assessment (MoCA), the voice handicapped index (VHI) and the Beck depression inventory (BDI). The PD patients underwent the Parkinson's disease quality of life questionnaire (PDQ8), Hoehn &Yahr scale (H&Y), and the researchers assessed the participants' voice quality using the Grade, Roughness, Breathiness, Asthenia &strain (GRBAS) score. All participants were recorded while performing a long /A/, reading a phonetically balanced paragraph and during spontaneous speech. An acoustic analysis that included pitch and Root Mean Score (RMS) was performed using digital signal processing. Results: PD patients' mean Hoehn&Yahr 2.8±0.97; disease duration 7.84±5.36 and PDQ8 11.5±6.55. Mean age of PD/HC 67.26±11.28/ 68.70 ±4.47 respectively; MoCA, VHI, BDI and GRBAS mean score of PD/HC 20.73±5.76/ 27.15±1.95; 37.07± 32.8/5.07±3.87; 4.46±4.32/ 0.69±1.06 1.38±0.92/0±0 (p<0.001) respectively. Significant difference was noted in RMS MAX between PD patients 29.04±14.61 and HC 5.07±0.96. A positive correlation was noted between PD patients' BDI, PDQ8 and VHI scores (p<0.05). A positive tendency was observed between PDQ8 score and RMS 378.68 ±346.85 in spontaneous speech (p=0.06). No correlation was noted between BDI and acoustic measurements. In the HC group a positive correlation was noted between pitch (1.06±0.13) and GRBAS (0±0; p<0.05) score during reading. Conclusions: The vocal characteristics of PD patients perceived by the patients

and examiners was worse than the HC. Patients with greater variability in <mark>acoustic</mark> energy seemed to have better QOL. <mark>Acoustic</mark> characteristics were not correlated with depression scale in this pilot study.

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Individual Therapeutic Singing Program for Vocal Quality and Depression in Parkinson's Disease

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Abstract (summary): OBJECTIVE

Patients with Parkinson's disease (PD) frequently experience depression associated with voice problems. Singing involves the use of similar muscles and the neural networks associated with vocal function and emotional response. The purpose of this study is to enhance vocal quality and depressive symptoms of patients with PD using individual singing program.

METHODS

The Individual Therapeutic Singing Program for PD (ITSP-PD) was conducted by a certified music therapist. In total, nine PD patients with a subjective voice problem or depression participated in 6 sessions over 2 weeks. We measured the Maximum Phonation Time (MPT) via the Praat test, the Voice Handicap Index (VHI), the Voice-Related Quality of Life (V-RQOL) and the Geriatric Depression Scale (GDS).

RESULTS

In total, 8 out of 9 patients completed all the sessions; 6 out of 8 patients participated in the follow-up test after 6 months. A statistically significant change in MPT (p = 0.011) was observed between the pre- and post-tests. The VHI (p = 0.035) and the GDS (p = 0.018) were significantly lower in the post-test. In the pre-, post-, and follow-up tests, the MPT (p = 0.030), V-RQOL (p = 0.008), and GDS (p = 0.009) were significantly changed.

CONCLUSION

The ITSP-PD based on neurological singing therapy for PD showed therapeutic possibility for vocal function and depression in patients with PD. Our findings suggest the need for a randomized study to examine the continuing positive effects of the ITSP-PD over a longer period of time.

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Relationship Between Swallowing Function and Maximum Phonation Time in Patients With Parkinsonism

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Abstract (summary): OBJECTIVE

To identify the relationship between maximum phonation time (MPT) and swallowing function, as well as the elements of swallowing, in order to provide a rationale for speech therapy in patients with Parkinsonism manifesting dysphagia.

METHODS

Thirty patients with Parkinsonism who underwent speech evaluation and videofluoroscopic swallowing study (VFSS) were recruited. The MPT, the longest periods of sustained pronunciation of /aa/, was evaluated. The VFSS was evaluated using Penetration Aspiration Scale (PAS), National Institutes of Health-Swallowing Safety Scale (NIH-SSS), and Videofluoroscopic Dysphagia Scale (VDS). The relationship between dysphagia scales and MPT was analyzed using Pearson correlation. The difference in VDS variables between subgroups (Parkinson disease or Parkinsonian syndrome, independent or dependent ambulation, and normal or abnormal MPT) and the difference in MPT between subgroups based on the VDS variables were analyzed using the independent t-test.

RESULTS

Bolus formation and laryngeal elevation functions were significantly higher in the normal MPT group compared with the impaired group. In the VDS variables, patients with intact bolus formation, oral transit time, pharyngeal swallow triggering, and laryngeal elevation showed significantly longer MPTs compared with the impaired groups. In addition, MPT was significantly correlated with the VDS and modestly correlated with the NIH-SSS, but not the PAS, suggesting that phonatory function is related to the oropharyngeal swallowing function, but not directly to the aspiration itself.

CONCLUSION

The correlation between MPT and several swallowing-related elements was identified, indicating an interactive correlation between swallowing and phonation. This result justifies voice therapy as a treatment for dysphagia in patients with Parkinsonism.

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Document 60

Loudness Perception of Pure Tones in Parkinson's Disease

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Abstract (summary): Purpose: Reduced intensity is a hallmark of speech production in Parkinson's disease (PD). Previous work has examined the perception of intensity in PD to explain these speech deficits. This study reports loudness ratings of pure tones by individuals with PD and controls, all with normal thesholds for older adults. Method: Twenty individuals with PD and 23 age- and sex-matched

controls rated the loudness of pure tones from 1 (very soft) to 7 (uncomfortably loud). Tones at 500, 750, 1000, 2000, and 4000 Hz were presented from 35 to 80 dB HL (or until a rating of 7 was given). A mixed-model analysis of variance was performed on ratings to assess the effects of group, frequency, sound intensity, and ear. Loudness growth slopes were determined for each participant and analyzed by group. Results: The mean loudness growth slopes of the control and PD groups did not significantly differ. Conclusions: No difference was found in loudness growth slopes in response to externally generated tones in PD. This is in contrast with the findings of previous studies of self-generated speech and externally presented speech. The underlying causes for impaired perception and production of loudness in PD require further investigation.

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Voice quality outcomes of idiopathic <mark>Parkinson</mark>'s disease medical treatment: A systematic review

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Abstract (summary): INTRODUCTION

To investigate voice quality (VQ) impairments in idiopathic <mark>Parkinson</mark>'s disease (IPD) and to explore the impact of medical treatments and L-Dopa challenge testing on voice.

METHODS

Relevant studies published between January 1980 and June 2017 describing VQ evaluations in IPD were retrieved using PubMed, Scopus, Biological Abstracts, BioMed Central and Cochrane databases. Issues of clinical relevance, including IPD treatment efficiency and voice quality outcomes, were evaluated for each study. The grade of recommendation for each publication was determined according to the Oxford Centre for Evidence-Based Medicine evidence levels.

RESULTS

The database research yielded 106 relevant publications, of which 33 studies met the inclusion criteria, for a total of 964 patients with IPD. Data were extracted by 3 independent physicians who identified 21, 11 and 1 trials with IIIb, IIb and IIa evidence levels, respectively. The main VQ assessment tools used were <mark>acoustic</mark> testing (N = 27), aerodynamic testing (N = 10), subjective measurements (N = 8) and videolaryngostroboscopy (N = 3). The majority of trials (N = 32/33) identified subjective or objective VQ improvements after medical treatment (N = 10) or better VQ evaluations in healthy subjects compared to patients with IPD (N = 22). Especially, our <mark>analysis</mark> supports that VQ overall improves during the L-Dopa challenge testing, making the VQ evaluation an additional tool for the IPD diagnosis. The methodology used to assess subjective and objective VQ

substantially varied from 1 study to another. All of the included studies took into consideration the patient's clinical profile in the VQ analysis.

CONCLUSION

The majority of studies supported that VQ assessments remain useful as outcome measures of the effectiveness of medical treatment and could be helpful for the IPD diagnosis based on L-Dopa challenge testing. Further controlled studies using standardised and transparent methodology for measuring acoustic parameters are necessary to confirm the place of each tool in both IPD diagnosis and treatment evaluation.

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Aerodynamic findings and Voice Handicap Index in Parkinson's disease

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Abstract (summary): OBJECTIVE

To verify possible relations between vocal disability and aerodynamic measures in selected Parkinson's disease (PD) patients with low/moderate-grade dysphonia.

METHODS

Fifteen idiopathic dysphonic PD male patients were examined and compared with 15 euphonic subjects. Testing included the following measures: Voice Handicap Index (VHI), maximum phonation time (MPT), mean estimated subglottal pressure (MESGP), mean sound pressure level (MSPL), mean phonatory power (MPP), mean phonatory efficiency (MPE) and mean phonatory resistance (MPR).

RESULTS

Statistical analysis showed: a significant reduction in MPR and MSPL in PD subjects compared to the healthy ones; a significant positive correlation between VHI score and MSPL, MPR, MPP, MESGP and a significant negative correlation between VHI and MTP within PD subjects. Test for multiple linear regression showed a significant correlation between VHI score, MPT, MPR and MSPL.

CONCLUSIONS

A relationship between VHI and aerodynamic measures was shown in the present study. Compensatory mechanisms may aggravate vocal disability in PD subjects.

Document 63

Interaction between vowel lengthening and tonal alignment in Parkinson's disease

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Abstract (summary): Objective: To assess the vowel lengthening in Parkinson's Disease (PD)1 and the alignment of the rising prenuclear accent (RPA) in Brazilian Portuguese (BP). BP speakers often realized it as an f0 rise in the stressed syllable of a phonological word2. Background: RPA peak reportedly occurs in stressed or poststressed syllable vocoids. The alignment of RPA with the syllable (Table presented) boundaries may be affected by temporal constraints. How vowel lengthening affects RPA in PD is currently unknown. Methods: 20 healthy (CNT) participants (M513, 60 yo; F57, 55 yo) and 23 PD participants (M514, 59 yo; F 59, 55 yo) were recorded reading a 93-words text. We selected three sentences for analysis. For each one, we measured the duration of the vocoids of the stressed syllables bearing an RPA. We also measured the distance from f0 valley and f0 peak to the left and right boundaries of the stressed syllable respectively. We used Linear Mixed Models to statistical analysis. Random variables were the participant, stressed syllable and sentence. Gender, clinical condition, voicing status and manner of articulation of the consonant were fixed variables. The PD impairment was assessed using UPDRS and FDA. Results: PD participants presented mild bilateral impairment as shown in the analyses of UPRDS and FDA (table 1 and 2). We found longer vowels in PD than in CNT, but this difference is less pronounced when the syllable begins with a voiced consonant. Regarding the f0 peak, it occurs earlier in PD than in CNT. In both groups, the longer the vowel, the later the peak will occur. Similarly, the f0 peak will occur later if the onset is voiced. However, this shift is always smaller in PD. As for f0 valley, it occurs later in both groups when the syllable begins with a voiced consonant, but in PD the shift is smaller. In sum, in PD, both f0 peak and f0 valley occur earlier than in CNT. Conclusions: Even patients with mild impairment present vowel lengthening, probably due to bradykinesia. Vowel lengthening generates an environment with less temporal constraints. Temporal constraints are a well-known factor that affects tonal alignment- an important feature of intonation grammar. The shift to the right of the f0 peak and f0 valley can be interpreted as a use of more time available to better accommodate RPA. When the vowels are longer, and the consonant is voiced, there is more voiced space in which to produce the f0 movement. This shift is smaller in PD since there is already more time available because the vowel is longer. However, although the phonetic implementation is different, the phonological representation is preserved in PD.

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Document 64

Sensorimotor adaptation of voice fundamental frequency in Parkinson's disease

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Abstract (summary): Objective This study examined adaptive responses to auditory perturbation of fundamental frequency (f_o) in speakers with Parkinson's disease (PD) and control speakers. Method Sixteen speakers with PD and nineteen control speakers produced sustained vowels while they received perturbed auditory feedback (i.e., f_o shifted upward or downward). Speakers' pitch acuity was quantified using a just-noticeable-difference (JND) paradigm. Twelve listeners provided estimates of the speech intelligibility for speakers with PD. Results Fifteen responses from each speaker group for each shift direction were included in analyses. While control speakers generally showed consistent adaptive responses opposing the perturbation, speakers with PD showed no compensation on average, with individual PD speakers showing highly variable responses. In the PD group, the degree of compensation was not significantly correlated with age, disease progression, pitch acuity, or intelligibility. Conclusions These findings indicate reduced adaptation to sustained f_o perturbation and higher variability in PD compared to control participants. No significant differences were seen in pitch acuity between groups, suggesting that the f_o adaptation deficit in PD is not the result of purely perceptual mechanisms. Significance These results suggest there is an impairment in vocal motor control in PD. Building on these results, contributions can be made to developing targeted voice treatments for PD.

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Document 65

Voice quality and orofacial strength in patients with early idiopathic Parkinson disease: A controlled study

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Abstract (summary): Introduction: Ninety percent of patients with idiopathic Parkinson's disease (IPD) developed early dysphonia, and subtle speech impairment, which is usually related to orofacial muscular dysfunctions. The aim of this study is to assess the usefulness of voice and speech qualities as outcome of Levodopa challenge test used for the IPD diagnosis. Material and methods: 20 patients with early IPD and 10 healthy subjects were recruited and evaluated for clinical findings (Hoehn &Yahr scale), voice handicap index, maximal phonation time, phonatory quotient, percent jitter, percent shimmer, noise-to-harmonic ratio, and orofacial muscular strength (Iowa Oral Performance Instrument) at baseline, throughout the Levodopa challenge test, and after therapeutic stabilization. Results: The intake of a standardized dose of L-Dopa (levodopa challenge test) significantly improved aerodynamic (phonatory quotient) and acoustic (percent jitter) measurements depending on the subglottic airflow. We did not found similar improvement after medical stabilization of patients despite an improvement of Hoen &Yahr mean score. The intake of levodopa significantly improved cheeks and lips strength involved in speech quality during the challenge test and after the therapeutic stabilization. We did not found substantial improvement in all evaluations in healthy subjects. Conclusions: These findings support a differential impact of levodopa on voice and speech functions in early diagnosed IPD and a mismatch between the clinical, speech, and voice quality improvements once the patient is medically stabilized. Voice and orofacial muscular strength can be used as outcomes of levodopa efficiency in IPD.

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Document 66

On the harmonic-to-noise ratio as an acoustic cue of vocal timbre of Parkinson speakers

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Abstract (summary): The relevance of the harmonic-to-noise ratio (HNR) and glottal cycle length jitter as cues of the vocal timbre of Parkinson speakers is investigated. HNR and vocal cycle length jitter are known to be suitable cues for the evaluation of the vocal timbre of dysphonic speakers. However, the question whether they are relevant descriptors of the voice quality of Parkinson

speakers is still unanswered. Empirical mode decomposition (EMD) has been used to estimate the HNR by decomposing the log-magnitude spectrum of the speech signal into its harmonic, contour and noise components. Cycle length jitter has been estimated via the break-up by empirical mode decomposition of the cycle length time series into the intonation contour as well as the perturbations owing to tremor and jitter. HNR and cycle length jitter values of vowels [a] sustained by 205 Parkinson and 74 control speakers are in the same interval respectively and the differences are not statistically significant. Also, the standard deviations of the per-frame HNR values of an utterance do not differ statistically significantly between control and Parkinson speakers.

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Document 67

Immediate effect of expiratory strengthening training in swallowing and voice in patients with parkinson disease

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Abstract (summary): Introduction: Parkinson is a neurodegenerative disease that can progress with dysphagia and dysphonia. The expiratory strengthening training has been widely used as a strategy for rehabilitation. Objectives: to describe the immediate effect of the expiratory strengthening exercise in patients with Parkinson's disease. Methods: data from the anamnesis, staging (Hoehn&Yahr scale) and acoustic records (pre and post exercise) of 5mL and comfort swallowing of liquid, of sustained vowel/e/and counting from 1 to 20. Compared flexible tube in container (300mL of water, 3cm from the bottom) and respiratory incentive device Respiron (classic, charge0). Results/Conclusion: 10 patients (7 male), average age 75.2±11.15, staging 2.85±1.1. Means and standard deviation, pre and post exercise with flexible tube and Respiron, to 5mL respectively: fundamental frequency (650.5±94.88; 652.5±51.83; 662±48.71 Hz), intensity (95±6; 94.3±19.9; 94.5±9.65 dB) and number of deglutition (1±1.06; 2±0.67; 1±0.71). Comfort swallowing: fundamental frequency (630.5±59.04; 710±107; 638.5±188.36 Hz), intensity (94.5±11.84; 94.5±8.43; 93.95±8.81 dB) and number of deglutition (1.5±1.3; 1.5±0.7; 1.5±0.82). Vowel/e/: deviation diagram (2.1±1; 2.4±0.7; 1.9±0.74), jitter (0.79±1.16; 1.21±1.39; 0.8±0.98), shimmer (8.7±3.67; 10.97±6.31; 8.7±3.67), irregularity (4.88±1.18; 5.34±1.15; 4.81±1.06), Glottal Noise Excitation (0.61±0.25; 0.57±0.27; 0.63±0.23) and noise (1.76±1.09; 1.98±1.08; 1.7±0.93). Count: fundamental frequency (160.5±36.1; 146.97±35.62; 154.4±39.3 Hz), intensity (50.3±5.8; 48.7±4; 47.6±4.5 dB), variability (129.5±57.9; 113.6±42.9; 121.3±52.8) and semitones (13.9±3.9; 14.2±5.6; 14.2±4.6). According to the results, the two models of exercises generate impacts on swallowing and voice. It is suggested to be considered individual issues in the analysis of the effect of exercise in the intervention process. dysphonia, rehabilitation.

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Document 68

Parkinsonics-a prospective, randomized, blinded, cross-over trial of group singing for motor and non-motor symptoms in idiopathic parkinson's disease (PD)

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Abstract (summary): Objective: To assess the effects of weekly group singing on PD patients' objective vocal and motoric function, cognition, mood, self-efficacy and quality of life. Background: PD frequently causes communication difficulties due to several voice impairments. There are few treatment options for vocal/communication complaints. Accessible rehabilitative therapies that encourage active participation and promote socialization may be self-reinforcing, potentially improving voice volume and quality of life. Methods: In a randomized controlled comparative effectiveness study, 32 participants were assigned to either a singing group or facilitated discussion weekly over 12 weeks. After 12 weeks, participants crossed over for an additional 12 weeks. Evaluations were performed at baseline and every 6 weeks for 30 weeks. Objective voice measures included loudness (decibels), held vowel duration, jitter, shimmer, and harmonic-to-noise ratio. Additional outcome measures included patient-centered quality of life, voice-related quality of life, MDS-UPDRS scores, Montreal Cognitive Assessment, and subjective scales of depression, self-efficacy and overall well-being. Group means were compared using repeated measures ANOVA, and linear mixed models were used to assess changes in variables over time controlling for age, gender and PD stage. Results: Twenty-six patients (16M/10F; Hoehn&Yahr stage 2.3(2-3); Age 68.6(55-89)) completed the study. There was significant improvement from baseline in average loudness on the Cookie theft picture description(2.06 dB) at 24 weeks as well as decreased volume range at 30 weeks(7.7 dB), corresponding with improved minimal reading volumes at 24 weeks (4.4 dB) and 30 weeks (8.1dB). Similarly, there were significant decreases in the volume range (4.9dB at 24 weeks, 8.8dB at 30 weeks) and improvements in minimal loudness on Rainbow passage reading at 24 (4.3dB) and 30 weeks (7.2dB) for both). Participants also improved on the MDS-UPDRS Motor scale between baseline and 24 (5.9 points) and 30-week visits(8.4), regardless of intervention order. Conclusions: Weekly group singing is a feasible intervention that may improve some aspects of conversational voice volume in PD. Some improvements were sustained at least 6 weeks after interventions ended. Further investigations of the mechanism of benefit and longitudinal effects of singing in PD are necessary.

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Document 69

Comparison of self and proxy ratings for voice handicap index and motor-related quality-of-life of individuals with Parkinson's disease

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Abstract (summary): PURPOSE: Quality-of-life (QoL) consists of health, psychological well-being and communication-related domains. Due to the heterogeneous nature of Parkinson disease (PD), it

is important to examine effects of different domains including motor and cognitive performance or motor and speech performance among the same set of individuals. Existing studies indicate mixed findings due to use of different QoL measures and lack of general consensus regarding QoL components.

METHOD: The present study examined self and proxy ratings for 20 individuals with PD on Voice Handicap Index (VHI) and PDQ-39 mobility to determine effects on speech and motor-related QoL, respectively.

RESULT: There was good level of agreement between self and proxy ratings for PDQ-39 mobility ratings alone. In addition, no overall group differences were found for self and proxy ratings of VHI and PDQ-39 mobility ratings, thus indicating similar perceptions by individuals with PD and their communication partners for speech and motor-related changes associated with PD. Further, no significant correlations between speech and motor-related QoL were found, thereby suggesting these domains to be independent of each other.

CONCLUSION: The present study indicates the need to consider both self and proxy reports to understand the impact of PD on a person's overall functioning.

Document 70

Effects of singing on voice, respiratory control and quality of life in persons with Parkinson's disease

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Abstract (summary): Purpose Interventions focused on singing may provide additional benefits to established voice and respiratory therapies, due to their greater emphasis on the respiratory muscle control system in those with Parkinson's disease (PD) progresses. The purpose of this study was to examine if singing can improve voice, respiratory pressure and quality of life (QOL) in persons with PD. Methods This pilot study measured the effects of a singing intervention in 27 participants with PD. Participants were assigned to a high (met twice weekly) or low (met once weekly) dosage group. Voice, respiratory and QOL measures were recorded before and after an 8-week singing intervention. Sessions were led by board-certified music therapists and included a series of vocal and articulation exercises and group singing. Results Both groups demonstrated significant improvements in maximum inspiratory and expiratory pressure, as well as phonation time. While other voice measures improved, they did not reach statistical significance. Voice QOL and whole health QOL also significantly improved. Conclusion These results suggest singing may be a beneficial and engaging treatment choice for improving and maintaining vocal function and respiratory pressure in persons with PD. Implications for Rehabilitation In a small sample, group singing proved beneficial for improving voice and respiratory impairment in persons with Parkinson's disease. Completing group singing one time per week for 8 weeks was as effective as completing group singing two times per week for 8 weeks in persons with Parkinson's disease. Group singing is an effective means of improving overall quality of life in persons with Parkinson's disease.

Document 71

Dysphonic Voice Pattern Analysis of Patients in Parkinson's Disease Using Minimum Interclass Probability Risk Feature Selection and Bagging Ensemble Learning Methods

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Abstract (summary): Analysis of quantified voice patterns is useful in the detection and assessment of dysphonia and related phonation disorders. In this paper, we first study the linear correlations between 22 voice parameters of fundamental frequency variability, amplitude variations, and nonlinear measures. The highly correlated vocal parameters are combined by using the linear discriminant analysis method. Based on the probability density functions estimated by the Parzen-window technique, we propose an interclass probability risk (ICPR) method to select the vocal parameters with small ICPR values as dominant features and compare with the modified Kullback-Leibler divergence (MKLD) feature selection approach. The experimental results show that the

generalized logistic regression <mark>analysis</mark> (GLRA), support vector machine (SVM), and Bagging ensemble algorithm input with the ICPR features can provide better classification results than the same classifiers with the MKLD selected features. The SVM is much better at distinguishing normal vocal patterns with a specificity of 0.8542. Among the three classification methods, the Bagging ensemble algorithm with ICPR features can identify 90.77% vocal patterns, with the highest sensitivity of 0.9796 and largest area value of 0.9558 under the receiver operating characteristic curve. The classification results demonstrate the effectiveness of our feature selection and pattern <mark>analysis</mark> methods for dysphonic <mark>voice</mark> detection and measurement.

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Document 72

Subcortical Effects on Voice and Fluency in Dysarthria: Observations from Subthalamic Nucleus Stimulation

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Abstract (summary): OBJECTIVE

Parkinson's disease (PD), caused by basal ganglia dysfunction, is associated with motor disturbances including dysarthria. Stimulation of the subthalamic nucleus, a preferred treatment targeting basal ganglia function, improves features of the motor disorder, but has uncertain effects on speech. We studied speech during contrasting stimulation states to reveal subcortical effects on voice and articulation. Measures were made on selected samples of spontaneous and repeated speech.

METHODS

Persons with Parkinson's disease (PWP) who had undergone bilateral deep brain stimulation of the subthalamic nucleus (DBS-STN) provided spontaneous speech samples and then repeated portions of their monologue both on and off stimulation. Excerpts were presented in a listening protocol probing intelligibility. Also analysed were a continuous phrase repetition task and a second spontaneous speech sample. Fundamental frequency (F0), harmonic-to-noise ratio (HNR), jitter, shimmer and fluency were measured in these three speech samples performed with DBS stimulation on and off.

RESULTS

During subcortical stimulation, spontaneous excerpts were less intelligible than repeated excerpts. F0 and HNR were higher and shimmer was decreased in repetition and stimulation. Articulatory dysfluencies were increased for spontaneous speech and during stimulation in all three speech samples.

CONCLUSION

Deep brain stimulation disrupts fluency and improves voice in spontaneous speech, reflecting an inverse influence of subcortical systems on articulatory posturing and laryngeal mechanisms. Better voice and less dysfluency in repetition may occur because an external model reduces the speech planning burden, as seen for gait and arm reach. These orthogonal results for fluency versus

phonatory competence may account for ambivalent reports from dysarthric speakers and reveal the complexity of subcortical control of motor speech.

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Document 73

Reduction of Parkinson's-related dysphonia by thyroplasty

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Abstract (summary): Parkinson's-related dysphonia has a negative impact on the quality of speech by increasing the effects of the associated dysarthria. When this dysphonia is related to vocal fold adduction defect, constituting a real glottic insufficiency, vocal fold medialization can be proposed after failure of intensive voice and speech therapy. Acoustic and aerodynamic voice and speech analysis techniques, perceptual evaluation and estimation of vocal handicap, associated with fiberoptic laryngoscopy were performed to determine the indication for vocal fold medialization in these patients with glottic insufficiency. Vocal fold medialization by Montgomery thyroplasty implant was performed under local anesthesia and neuroanalgesia in two patients with Parkinson's disease presenting a dysphonia refractory to speech therapy. Postoperative evaluation showed improvement of voice quality with an increased number of harmonics and improvement of aerodynamic parameters. Vocal fold medialization by Montgomery thyroplasty implant effectively improved voice quality in these two patients allowing a more effective vocal fold adduction. The reducing of the hypophonia has a positive effect on the quality of oral communication. The medialization thyroplasty technique, under local anesthesia, allows intraoperative control of the voice as well as removal of the implant when necessary.

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Document 74

Relationship Between Voice and Motor Disabilities of Parkinson's Disease

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Abstract (summary): To evaluate voice of Iranian patients with Parkinson's disease (PD) and find any relationship between motor disabilities and acoustic voice parameters as speech motor components. We evaluated 27 Farsi-speaking PD patients and 21 age- and sex-matched healthy persons as control. Motor performance was assessed by the Unified Parkinson's Disease Rating Scale part III and Hoehn and Yahr rating scale in the "on" state. Acoustic voice evaluation, including fundamental frequency (f0), standard deviation of f0, minimum of f0, maximum of f0, shimmer, jitter, and harmonic to noise ratio, was done using the Praat software via /a/ prolongation. No difference was seen between the voice of the patients and the voice of the controls. f0 and its variation had a significant correlation with the duration of the disease, but did not have any relationships with the Unified Parkinson's Disease Rating Scale part III. Only limited relationship was observed between voice and motor disabilities. Tremor is an important main feature of PD that affects motor and

phonation systems. Females had an older age at onset, more prolonged disease, and more severe motor disabilities (not statistically significant), but phonation disorders were more frequent in males and showed more relationship with severity of motor disabilities. Voice is affected by PD earlier than many other motor components and is more sensitive to disease progression. Tremor is the most effective part of PD that impacts voice. PD has more effect on voice of male versus female patients.

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Hypernasality associated with basal ganglia dysfunction: evidence from Parkinson's disease and Huntington's disease

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Abstract (summary): BACKGROUND

Although increased nasality can originate from basal ganglia dysfunction, data regarding hypernasality in Parkinson's disease (PD) and Huntington's disease (HD) are very sparse. The aim of the current study was to analyze acoustic and perceptual correlates of velopharyngeal seal closure in 37 PD and 37 HD participants in comparison to 37 healthy control speakers.

METHODS

Acoustical analysis was based on sustained phonation of the vowel /i/ and perceptual analysis was based on monologue. Perceptual analysis was performed by 10 raters using The Great Ormond Street Speech Assessment '98. Acoustic parameters related to changes in a 1/3-octave band centered on 1 kHz were proposed to reflect nasality level and behavior through utterance.

RESULTS

Perceptual analysis showed the occurrence of mild to moderate hypernasality in 65% of PD, 89% of HD and 22% of control speakers. Based on acoustic analyses, 27% of PD, 54% of HD and 19% of control speakers showed an increased occurrence of hypernasality. In addition, 78% of HD patients demonstrated a high occurrence of intermittent hypernasality. Further results indicated relationships between the acoustic parameter representing fluctuation of nasality and perceptual assessment (r = 0.51, p <0.001) as well as the Unified Huntington Disease Rating Scale chorea composite subscore (r = 0.42, p = 0.01).

CONCLUSIONS

In conclusion the ==acoustic== assessment showed that abnormal nasality was not a common feature of PD, whereas patients with HD manifested intermittent hypernasality associated with chorea.

Document 76

Immediate effect of semi occluded vocal tract exercise (high resistance tube) in ==parkinson=='s disease

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Abstract (summary): Introduction: Vocal exercises are used in the rehabilitation of individuals with Parkinson's disease in order to improve voice quality. Objective: To evaluate the immediate effect of high resistance tube exercise in the voice of these individuals. Method: Observational study, which analyzed the record of the vowel /a/ and counting (1-20) pre and post exercise. Vocal evaluation: perceptual (GRBAS, wet voice, instability, pitch, loudness and breathing-speaking coordination), acoustic (VoxMetria and Praat softwares) and selfassessment. The effect of exercise was analyzed with interference of age, time of disease and staging (Hoehn &Yahr scale). Statistical Analysis: numeric data, paired t-test or Wilcoxon; and for categorical, the marginal homogeneity test. Results: 46 patients (28 men), age 70 ± 9.6 years, staging 2.9 ± 0.9 and time of diagnosis 8.2 ± 5.7 years. Pre and post averages, respectively, were: irregularity (4.9 ± 1.4 / 4.7 ± 1.6); glottal noise excitation (0.71 ± 0.2 / 0.72 ± 0.2); noise (1.5 ± 0.8 / 1.4 ± 0.7); intensity (53.1 ± 5.8 / 53.7 ± 5); noise-to-harmonics ratio (0.1 ± 0.2/0.1 ± 0.2); harmonicsto-noise-ratio (16.3 ± 7.6 / 17.7 ± 7.9); jitter (0.8 ± 1 / 0.7 ± 0.9); shimmer (4.8 ± 5.1 / 4.2 ± 4.5); fundamental frequency: 184.81 ± 31.78 / 187.01 ± 32.43 (female), and 130.8 ± 27.6 / 135.6 ± 30.4 (male). Exhibited improvement of higher frequencies of post-exercise: deviation diagram, global level of dysphonia, roughness, loudness, soprosity and breathing-speaking coordination. 25 patients reported improvement in voice after the exercise. There was an association between vocal self-evaluation and staging (p = 0.045). There was statistical significance when comparing pre and post exercise: global level of dysphonia (p = 0.003), coordination between breathing and speaking (p = 0.004), harmonicsto-noise-ratio (p = 0.005), noise-to-harmonics ratio (p = 0.014), relative average perturbation (p = 0.049), pitch (p = 0.045) and irregularity (p = 0.03). Conclusion: The semi occluded vocal tract exercise promotes positive changes in vocal noise parameters, vocal quality and breathing-speaking coordination in this population.

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Conference country: Brazil

Conference end date: 2016-08-20

Conference location: Campos do Jordao - SP

Conference start date: 2016-08-18

Conference title: 15th Congress of Otorhinolaryngology Foundation

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Publication date: Aug 2016

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Publisher: Georg Thieme Verlag

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Subject: Embase;aged;breathing;clinical article;conference abstract +;controlled study;coordination;diagnosis;dysphonia (major);excitation;exercise (major);female;human;loudness;male;noise;observational study;Parkinson disease (major);pitch;self evaluation;software;speech (major);staging;statistical significance;voice (major);vowel

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Document 77

Lee silverman voice treatment in parkinson's disease: A systematic review of clinical trials

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Abstract (summary): Introduction: Parkinson's disease (PD) is a neurodegenerative disorder with specific vocal and speech impairments that afflict this population. Therefore, it is necessary to use specific methodologies for these problems, as the Lee Silverman Voice Treatment (LSVT), a vocal treatment method developed especially for people with PD. Objective: To systematically review the effects of LSVT in PD patients. Data Synthesis: It was conducted an exploratory systematic review in the databases Medline (via PubMed), SCOPUS, LILACS, Cochrane Library and EMBASE using the

following search strategy: 'Parkinson's disease' AND 'Voice' and its synonyms. Studies were included without date or language restrictions to assess the effect of LSVT in PD patients. The titles, abstracts, and full text were analyzed by three independent and blinded reviewers. The initial electronic search showed 186 publications, which were analyzed by their title and abstract. 23 studieswere fully read and, after selection by predetermined inclusion /exclusion criteria, six studies remained. Although the included studies are heterogeneous as to the methods and evaluation groups, it is possible to identify promising overall results. Conclusion: It was observed increase in the vocal sound pressure levels, in the maximum f0 extension and an improvement in roughness and breathiness parameters, as well as benefits in speech tasks. There is a lack of studies using this method, being necessary more researches about it.

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Conference title: 15th Congress of Otorhinolaryngology Foundation

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Document 78

Voice harmonic amplitude differences before and after LSVT LOUDTM in Parkinson's disease

Author: Cannito, M.P. 1 ; Ramig, L.O. 1 ; Halpern, A.E. 1 ; Spielman, J.L. 1

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Abstract (summary): Objective: To evaluate voice harmonic amplitudes from acoustic spectra of speech produced by subjects with Parkinson's disease (PD) before and after voice treatment, in order to quantify voice change associated with behavioral voice treatment. Background: Differences in harmonic amplitudes found at H1, H2, and at harmonics located at the third formant frequency (HF3) have been shown to be significant acoustic indicators of voice quality in normal and disordered speakers. Methods: This retrospective study employed two existing data sets (Halpern et al, 2012; Cannito et al, 2012) to examine harmonic amplitude differences (HADs) in acoustic spectra of vowels produced by speakers with PD before and after voice treatment targeting increased vocal loudness, specifically LSVT LOUD™. Halpern et al's data set included 16 speakers with Parkinson's disease before and after LSVT® , as supplemented with the LSVT® Companion™ system. An immediate treatment onset group was compared with a delayed treatment onset control group. Cannito et al's data set examined 8 speakers with PD before and after LSVT LOUD and demonstrated significant pre-to-post treatment changes in H1-H2 and H1-F3. Results: Overall dB levels increased from pre-to-post treatment for both groups of patients. HADs (H1-H2, H1-F3) did not differ between treatment groups in the pre-treatment condition. HADs decreased significantly from pre-to-post treatment, and remained so at follow up, for both treatment groups. There was no significant interaction of treatment condition with specific vowels for either harmonic amplitude difference measure. Post-treatment changes in H1-F3 were associated with a general upward redistribution of vowel spectral energy (decreased spectral tilt) that is indicative of increased glottal closure and improved periodicity of vocal fold vibration. Cannito et al's data set included sentence intelligibility data from a rigorously controlled listening study. Change in sentence intelligibility was found to be significantly correlated with change in harmonic amplitude difference for H1-F3, r=-.845 ($r^2$5.714). Conclusions: Results indicate that as spectral tilt decreased, sentence intelligibility increased. Such changes have significant implications for both improved voice quality and speech intelligibility following voice treatment.

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Conference country: Germany

Conference end date: 2016-06-23

Conference location: Berlin

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Conference title: 20th International Congress of Parkinson's Disease and Movement Disorders

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Correspondence author: Cannito, M.P. , Lafayette, LA, United States.

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Subject: Embase;control group;controlled study;fatigue;follow up;genetic polymorphism;human;human experiment;loudness;Parkinson disease (major);periodicity;retrospective study;speech intelligibility;vibration;vocal cord;voice (major);vowel

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Document 79

Swallowing and voice assessment by manofluorography in patients with Parkinson's disease

Author: Abrahao, Luiz J.; Marques, Charles H.; Lemme, Eponina M.

Abstract (summary): INTRODUCTION: Swallowing is a function that involves transport of food from the mouth to the stomach. In Parkinsons disease (PD), deglutition may undergo changes in any one of its phases, increasing the risk of other complications, such as aspiration pneumonia. The interface between voice and swallowing may assist in the evaluation and rehabilitation of swallowing disorders. OBJECTIVE: Study by manofluorography the movements of hyolaryngeal complex with traditional vocal exercises. Furthermore, describe changes in the pharynx and the upper esophageal sphincter. METHODS: Swallowing videofluoroscopy was performed synchronized with the high-resolution manometry together with acoustic record (Praat Software). Used high-pitch /a/ and /i/ sounds and Swedish technique of prolonged / b /. In addition, two barium swallows were evaluated (5 and 10ml). All images were calibrated to quantify and describe displacements of the hyolaryngeal complex both in voice exercises as swallowing function. RESULTS: 15 patients with PD (8 women), mean age 79.4 ± 9, staging average (Hoen Yarh Scale) 3.4 ± 1.2 compared with 5 asymptomatic volunteers mean age 43 ± 18 years. PD disease patients had a significant impairment in hyoid vertical incursion in all vocal maneuvers compared to controls but normal horizontal incursion. (table 1). Regarding upper esophageal sphincter (UES) both length and pressures increased with all vocal maneuvers being higher with /i/ (length) and /b/ (pressure). There was no difference between controls and PD (table 2). There was a moderate correlation between fundamental frequency (f0) of the vowel / i / and staging of disease (0.5) and f0 of the vowel / i / and pressure of the EES (0.6), with average emission rate (/ i / = 272.5 ± 66,4Hz, / a / = 257 ± 98,7Hz). For the swallows were observed a lower average pharynx pressure in PD group (5ml = 155.7 ± 30,6mmHg, 10ml = 161.8 ± 31mmHg) and higher intrabolus pressure (5ml = 33.2 ± 8,6mmHg, 10ml = 35.8 ± 6,5mmHg), compared to asymptomatic volunteers pharynx pressures (5ml = 187,33±68 mmHg, 10ml = 198,6±48,1 mmHg), and intrabolus pressure (5ml = 13,6±3 mmHg, 10ml = 15,26±1,6 mmHg). CONCLUSION: The combination of three instrumental models for evaluation of swallowing demonstrated better description of the physiological events of the pharyngeal phase in PD disease patients. It is also concluded that increased f0 techniques affect both movement and size of the larynx, position and pressure of the UES and can help in the evaluation and treatment of swallowing disorders. (Table Presented).

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Conference title: Digestive Disease Week 2016, DDW 2016

Correspondence author: Abrahao, L.J.

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Subject: Embase;human (major);swallowing (major);voice (major);gastrointestinal disease (major);patient (major);Parkinson disease (major);pharynx;upper esophagus sphincter;staging;vowel;exercise;dysphagia;volunteer;aspiration pneumonia;esophagography;computer program;manometry;food;risk;rehabilitation;larynx;model;stomach;female

Updates: 2016-06-08

Document 80

Vocal tract tremor in parkinsons disease

Author: Gillivan-Murphy, P. 1 ; Colreavy, M. 1

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Abstract (summary): Objective: Voice impairment is salient in people with Parkinson's disease (pwPD) and leads to voice disability. Tremulous voice quality is associated with PD. Although studies have identified laryngeal tremor in PD, none have systematically evaluated tremor in the vocal tract during different speech tasks. The aim of the study was to identify, and rate severity of vocal tract tremor in pwPD. Methods: Using flexible nasendoscopy, thirty consecutive pwPD (22 males; mean age ± standard deviation (SD), 61.40 (10.31); mean disease duration ± SD 5.23 (3.17), and twenty eight healthy agesex matched controls were evaluated for tremor movement in the palate, tongue base, and larynx during tasks (rest breathing, /s/, /a/, /i/). On a rating scale of 0-3 (0 = absent, 1 = mild/intermittent tremulous movement, 2 = moderate tremulous movement, 3 = severe tremulous

movement), raters independently rated tremor movement from silent digital video files. The Voice Handicap Index (VHI) measured voice disability. Results: Inter rater reliability (ICC) ranged from good (0.8) to moderate (0.5) for tremor rating. PwPD had a greater amount of tremor in the palate, tongue, and larynx relative to controls ($p<0.05$). The palate achieved the highest tremor severity rating relative to the tongue and larynx. VHI scores were higher in pwPD than controls ($p<0.05$). Conclusions: This is the first study to take a 'vocal tract' perspective on PD voice tremor and to show that palatal tremor is a feature of PD. Flexible endoscopic evaluation of the vocal tract during different speech tasks results in greater understanding of phonatory dysfunction in pwPD.

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Voice changes in prodromal Parkinson's disease: Is a new biomarker within earshot?

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(major);pattern recognition;priority journal;prodromal symptom (major);sensitivity and specificity;Shy Drager syndrome;<mark>voice analysis</mark>

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Document 82

A retrospective study of long-term treatment outcomes for reduced vocal intensity in hypokinetic dysarthria

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Abstract (summary): BACKGROUND

Reduced vocal intensity is a core impairment of hypokinetic dysarthria in <mark>Parkinson</mark>'s disease (PD). Speech treatments have been developed to rehabilitate the vocal subsystems underlying this impairment. Intensive treatment programs requiring high-intensity voice and speech exercises with clinician-guided prompting and feedback have been established as effective for improving vocal function. Less is known, however, regarding long-term outcomes of clinical benefit in speakers with PD who receive these treatments.

METHODS

A retrospective cohort design was utilized. Data from 78 patient files across a three year period were analyzed. All patients received a structured, intensive program of voice therapy focusing on speaking intent and loudness. The dependent variable for all <mark>analyses</mark> was <mark>vocal</mark> intensity in <mark>decibels</mark> (dBSPL). Vocal intensity during sustained vowel production, reading, and novel conversational speech was compared at pre-treatment, post-treatment, six month follow-up, and twelve month follow-up periods.

RESULTS

Statistically significant increases in vocal intensity were found at post-treatment, 6 months, and 12 month follow-up periods with intensity gains ranging from 5 to 17 <mark>dB</mark> depending on speaking condition and measurement period. Significant treatment effects were found in all three speaking conditions. Effect sizes for all outcome measures were large, suggesting a strong degree of practical significance.

CONCLUSIONS

Significant increases in vocal intensity measured at 6 and 12 moth follow-up periods suggested that the sample of patients maintained treatment benefit for up to a year. These findings are supported by outcome studies reporting treatment outcomes within a few months post-treatment, in addition to prior studies that have reported long-term outcome results. The positive treatment outcomes experienced by the PD cohort in this study are consistent with treatment responses subsequent to other treatment approaches which focus on high-intensity, clinician guided motor learning for voice and speech production in PD. Theories regarding the underlying neurophysiological response to treatment will be discussed.

Document 83

Characteristics associated with voice handicap in Parkinson's disease

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Abstract (summary): Individuals with Parkinson's Disease (PD) often present with a variety of communication symptoms that are characterized within the domain of hypokinetic dysarthria, frequently resulting in voice handicap. Voice handicap is defined as the self-perceived impact of a voice disorder on an individual's ability to interact with others and perform everyday activities. The Voice Handicap Index (VHI) has been shown to be a reliable assessment of an individual's selfperceived handicap and to be valid for a wide range of voice disorders. Researchers have attempted to investigate the relationship between PD severity and voice symptoms. In some studies, associations have been reported between PD severity and voice handicap, but others have found no relationship at all. Using the World Health Organization's International Classification of Functioning, Disability and Health (ICF) as a framework, this study was conducted to better understand the relationship between voice handicap and other characteristics in individuals with PD; including, demographic characteristics, disease-related characteristics, acoustic voice measures, clinician-rated perceptual voice measures, and self-perceived communication disability. Records of eligible individuals with PD seen for a voice evaluation at Oregon Health and Science University over a 2-year period were reviewed. Higher voice handicap was found in women and those who were unmarried. These findings are consistent with research on gender differences and also may reflect the role of a partner in facilitating communication. Longer duration since PD onset and having undergone deep brain stimulation (DBS) was also associated with higher levels of voice handicap. Both of these finding may reflect the progressive nature of PD since DBS is typically performed in later stage disease. Only one acoustic variable was found to be associated with VHI, namely maximum phonation time (MPT). This is a novel finding and may reflect the fact that MPT is a test of both the phonatory and respiratory systems. Like other global health measures, the VHI appears to be influenced by disease-related as well as demographic factors. Further research is merited with regard to its sensitivity to change as a treatment outcome measure in PD.

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Conference start date: 2016-09-20

Conference title: 4th World Parkinson Congress, WPC 2016

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Document 84

Characteristic laryngoscopic findings in Parkinson's disease patients after subthalamic nucleus deep brain stimulation and its correlation with voice disorder

Author: Tsuboi, Takashi 1 ; Watanabe, Hirohisa 1 ; Tanaka, Yasuhiro 1 ; Ohdake, Reiko 1 ; Yoneyama, Noritaka 1 ; Hara, Kazuhiro 1 ; Ito, Mizuki 1 ; Hirayama, Masaaki 1 ; Yamamoto, Masahiko 2 ; Fujimoto, Yasushi 3 ; Kajita, Yasukazu 4 ; Wakabayashi, Toshihiko 4 ; Sobue, Gen 1

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Otorhinolaryngology, Nagoya University Graduate School of Medicine, Nagoya, 466-8550, Japan, Japan 4 Department of Neurosurgery, Nagoya University Graduate School of Medicine, Nagoya, 466-8550, Japan, Japan

Abstract (summary): Speech and voice disorders are one of the most common adverse effects in Parkinson's disease (PD) patients treated with subthalamic nucleus deep brain stimulation (STN-DBS). However, the pathophysiology of voice and laryngeal dysfunction after STN-DBS remains unclear. We assessed 47 PD patients (22 treated with bilateral STN-DBS (PD-DBS) and 25 treated medically (PD-Med); all patients in both groups matched by age, sex, disease duration, and motor and cognitive function) using the objective and subjective voice assessment batteries (GRBAS scale and Voice Handicap Index), and laryngoscopy. Laryngoscopic examinations revealed that PD-DBS patients showed a significantly higher incidence of incomplete glottal closure (77 vs 48 %; $p = 0.039$), hyperadduction of the false vocal folds (73 vs 44 %; $p = 0.047$), anteroposterior hypercompression (50 vs 20 %; $p = 0.030$) and asymmetrical glottal movement (50 vs 16 %; $p = 0.002$) than PD-Med patients. On- and off-stimulation assessment revealed that STN-DBS could induce or aggravate incomplete glottal closure, hyperadduction of the false vocal folds, anteroposterior hypercompression, and asymmetrical glottal movement. Incomplete glottal closure and hyperadduction of the false vocal folds significantly correlated with breathiness and strained voice, respectively ($r = 0.590$ and 0.539). We should adjust patients' DBS settings in consideration of voice and laryngeal functions as well as motor function.

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Medline document status: MEDLINE

MeSH: Aged;Deep Brain Stimulation -- adverse effects (major);Female;Follow-Up Studies;Humans;Laryngoscopy;Larynx -- pathology;Larynx -- physiopathology (major);Male;Parkinson Disease -- complications;Parkinson Disease -- pathology;Parkinson Disease -- physiopathology (major);Parkinson Disease -- therapy (major);Severity of Illness Index;Subthalamic Nucleus -- physiopathology (major);Voice -- physiology;Voice Disorders -- complications;Voice Disorders -- pathology;Voice Disorders -- physiopathology (major)

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Document 85

Acoustic analysis of voice and speech of advanced Parkinson's disease patients compared to early Parkinson's disease patients and first degree relatives

Author: Manor, Y. 1 ; Shpunt, D. 1 ; Ben Asher, I. 1 ; Tsvion, A. 1 ; Horev, N. 1 ; Ezra, A. 1 ; Megirov, A. 1 ; Hilel, A. 1 ; Gurevich, T. 1

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Abstract (summary): Objective: To assess the acoustic differences of the speech and voice characteristics among early PD (EPD) patients compared to advanced PD (APD) and first degree relatives (FDR). Background: Hypophonia and dysphonia are dominant vocal disturbances, characterizing the speech in Parkinson's disease (PD). These vocal disturbances affect the speech intelligibility in different phases of PD. Methods: The study included 31 participants mean age 55.56±18.19 (18 males) that were divided into 3 groups: 10 EPD patients, 11 APD patients and 11 FDR. All participants underwent the Montreal Cognitive Assessment (MoCA), they were recorded while performing maximum phonation time (MPT) prolong/a/, diadokinetick task (7X PAPAPA), reading 5 words from the speech reception threshold list, reading two sentences from CUNNY and retelling a story that was read to them. Five naïve judges listened to the recordings and scored their ability to identify the words, sentences and the level of intelligibility of the story (1intelligible 25 unintelligible). An acoustic analysis was performed using the Praat software. Results: Mean age of

EPD/APD/FDR 60.5±13.94/ 62.27±15.32/43.5±20.1 respectively; Hoenh &Yahr 1.67±0.73/ 2.07±0.47 respectively; disease duration 1.15±0.63/6.09±3.05 respectively; MoCA 26.20±2.35/27.45±2.54/28.50±1.35 respectively. A significant difference in vocal intensity was observed between EPD, APD and FDR during: MPT 64.91dB±11.89/ 63.22dB±8.74/74.7dB±8.53 (p<0.05) respectively and during story retelling 57.32dB±2.11/49.73dB±2.8/63.38dB±2.4 (p<0.05) respectively. A significant difference was observed in the ability to repeat/ PA/in terms of fluency and clarity, EPD 81%, APD 50% and FDR 100% of the patients (p<0.05). Nonsignificant differences in MPT duration, pitch, shimmer and jitter during vowel prolongation were observed between the 3 groups. Conclusions: Vocal intensity is the major vocal characteristic that is significantly reduced in APD when compared to EPD. A prospective follow up on FDR vocal characteristics may help to determine if voice disturbances can be a diagnostic sign for PD.

(major);reading;<mark>phonation</mark>;APD50;<mark>dysphonia</mark>;diagnosis;follow up;Montreal cognitive assessment;speech intelligibility;vowel;disease duration;computer program;recording;male

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Document 86

Voice features of <mark>Parkinson</mark>'s disease patients with subthalamic nucleus deep brain stimulation

Author: Tanaka, Yasuhiro 1 ; Tsuboi, Takashi; Watanabe, Hirohisa; Kajita, Yasukazu; Fujimoto, Yasushi; Ohdake, Reiko; Yoneyama, Noritaka; Masuda, Michihito; Hara, Kazuhiro; Senda, Joe; Ito, Mizuki; Atsuta, Naoki; Horiguchi, Satoshi; Yamamoto, Masahiko; Wakabayashi, Toshihiko; Sobue, Gen

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Abstract (summary): Voice and speech disorders are one of the most important issues after subthalamic nucleus deep brain stimulation (STN-DBS) in <mark>Parkinson</mark>'s disease patients; however, their characteristics remain unclear. We performed a comprehensive voice evaluation including the multi-dimensional <mark>voice</mark> program for <mark>acoustic</mark> <mark>analysis</mark>, the <mark>GRBAS</mark> scale for perceptual <mark>analysis</mark>, and the evaluation of the <mark>voice handicap index</mark> (<mark>VHI</mark>) for psychosocial <mark>analysis</mark>. In total, 68 patients who had undergone STN-DBS (37 assessed in the on- and off-stimulation conditions) and 40 who had been treated with medical therapy alone were evaluated. Further, we performed laryngoscopic examinations in 13 STN-DBS and 19 medical-therapy-alone patients. The STN-DBS group, especially females, showed widespread impairment of <mark>voice parameters</mark> and significantly poorer <mark>VHI</mark> scores than the medical-therapy-alone group. The degree of voiceless (DUV) and strained voice were the most impaired factors in the STN-DBS group; and DUV significantly improved after stopping stimulation. Furthermore strained voice, breathiness, and asthenia improved after stopping stimulation. Laryngoscopic examination showed that abnormal laryngeal muscle contraction and incomplete glottal closure were more prominent in the STN-DBS group than in the medical-therapy-alone group. We demonstrated that (1) more widespread voice impairment in females, (2) poorer voice-related QOL, (3) worse DUV and strained voice, and (4) abnormal laryngeal muscle contraction were the characteristic voice and laryngeal findings in the STN-DBS group compared with those in the medical-therapy-alone group.

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Document 87

Vocal complaints and voice characteristics in individuals with parkinson disease: A preliminary study

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Abstract (summary): Introduction: The voice alterations most commonly found in Parkinson's disease are decreased prosody, low vocal intensity, hoarseness, breathness and vocal tremor. Objectives: To verify the voice complaints reported and to analyze the vocal characteristics found in this population. Methods: Cross-clinical study of 19 adults diagnosed with Parkinson Disease, 10 men and 09women, aged between 57 and 85 years old (mean 73,1). A questionnaire was applied to raise voice complaints for each participant and was held recording sustained vowel /a/ in acoustically isolated room. The recordings ware edited, eliminating the start and the end of emission. The Multi-Dimensional Voice Program and PRAAT softwares analyzed acoustic parameters. Results: The most frequently reported vocal complaints were low intensity (50% by women and 37,5% by men) and hoarseness (37,5% by women and 50% by men). The acoustic parameters analyzed for men about mean fundamental frequency, F0 frequency jitter, absolute jitter, jitter percent, fundamental frequency variation, shimmer in dB, shimmer percent, peak-to-peak amplitude variation, noiseto-harmonic ratio and soft phonation indexwere subsequently: 126,853Hz; 5,445Hz; 109,003us; 1.038%; 2.215%; 0,329dB; 3.731%; 17.308%; 0.125; 22.760 and 76,568dB; and forwomen were: 195,755Hz; 4,373Hz; 186,812us; 4.048%; 13.030%; 22,430dB; 7.783%; 27.829%; 0.272; 15.303 and 76,091dB. Conclusion: The individual with Parkinson Disease present vocal complaints and the acoustic analysis measures showed in vocal quality to be able to justify their complaints.

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Correspondence author: Spazzapan, Evelyn Alves Faculdade de Filosofia e Ciências-Universidade Estadual Paulista-Unesp/Marília, Brazil.

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Document 88

Vocal characteristics in subjects with parkinson's disease

Author: De Paula Soares, Maria Francisca 1 ; Santos, Luana Andrade 1

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Abstract (summary): Introduction: Parkinson's disease is a neurologic pathology characterized by motors symptoms like tremor, rigidity and bradykinesia. Difficulties on respiratory, phonatory and articulatory subsystems may impair the speech negatively. Hypophonia is perceived as breathy, tremulous voice and reduced in loudness. Objective: To describe the acoustics characteristics of phonatory production of Brazilian Parkinsonian's speakers. Methods: 22 individuals diagnosed with Parkinson's disease, 16 men and 6 women, mean age 68 years old (standard deviation = 8.4), treated with Levodopa participated in this study. The acoustics analysiswas performed and the following parameterswere considered: fundamental frequency, intensity, jitter, shimmer, harmonics to noise ratio and tremor. Only fundamental frequencywas analyzed isolated by gender group. Results: Males mean frequency was 133.8 Hz (standard deviation = 2.4, n = 16) and females were 168.1Hz (standard deviation = 19.3, n = 6), intensity (mean = 63.5, standard deviation = 1.60) and jitter (mean = 0.6, standard deviation = 0.2). These values are compatible with the literature. However, standard deviation of fundamental frequency on the female group was increased. The values of shimmer (mean = 5 %, standard deviation = 1.5), harmonics to noise ratio (mean = 19.4, standard deviation = 0.7), frequency of tremor (mean = 5.2, standard deviation = 2.7) and amplitude of tremor (mean = 24.7, standard deviation = 6.6) showed high values. Conclusion: Although there are evidences in the literature of reduced loudness on parkinsonian, the findings of this study do not corroborate this assumption. The values of standard deviation, shimmer and noise found in women's participants,

indicates variability in cycle-to-cycle and the values of tremor suggests difficulties to keep stable the phonatory system, in both short-term and long-term.

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Correspondence author: De Paula Soares, Maria Francisca Universidade Federal da Bahia, Brazil.

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Subject: Embase;levodopa;acoustics (major);aged;clinical article;conference abstract +;controlled study;diagnosis;drug therapy;dysphonia (major);female;gender;human;loudness;male;noise;Parkinson disease (major);parkinsonism;tremor

Substance: Substance Substance: levodopa; CAS: 59-92-7;

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Document 89

Quantitative Analysis of Voice in Parkinson Disease Compared to Motor Performance: A Pilot Study

Author: Silbergleit, Alice K 1 ; LeWitt, Peter A 2 ; Peterson, Edward L 3 ; Gardner, Glendon M 4

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Abstract (summary): BACKGROUND

Characteristic features of hypokinetic dysarthria develop in Parkinson disease (PD). We hypothesized that quantified acoustic changes of voice might provide a correlate of disease severity.

OBJECTIVE

To determine if there are significant differences in acoustic measures of voice between mild and moderate PD; 2) To evaluate correlations between acoustic parameters of voice and subtests of the UPDRS in mild and moderate PD.

METHODS

Twenty six participants with PD underwent vocal acoustic testing while off PD medication, for comparison to 22 healthy controls. Participants with PD were divided into two groups based upon UPDRS activities of daily living (ADL) ratings: summed scores were used to define mild and moderate PD. Participants voiced /i/ ("ee") at comfort, high, and low pitch (3 trials/pitch). The CSpeech Waveform Analysis Program was used to analyze cycle-to-cycle frequency ("jitter") and amplitude ("shimmer") irregularities of the vocal signal, signal-to-noise ratio, and maximum phonation frequency range converted to semitones. Sections of UPDRS scores were correlated to acoustic variables of voice.

RESULTS

Key findings included a significant difference between the semitone range of the control subjects and the moderate PD group (p=0.036). Further analyses revealed significant differences in semitone range for males between the controls vs. mild PD (p=0.014), and controls vs. moderate PD (p=0.005). Significant correlations were also found between acoustic findings and both the ADL and motor portions of the UPDRS.

CONCLUSIONS

Acoustic analysis of voice, particularly frequency range, may provide a quantifiable correlate of disease progression in PD.

Document 90

Effective dysphonia detection using feature dimension reduction and kernel density estimation for patients with Parkinson's disease

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Abstract (summary): Detection of dysphonia is useful for monitoring the progression of phonatory impairment for patients with Parkinson's disease (PD), and also helps assess the disease severity. This paper describes the statistical pattern analysis methods to study different vocal measurements of sustained phonations. The feature dimension reduction procedure was implemented by using the sequential forward selection (SFS) and kernel principal component analysis (KPCA) methods. Four selected vocal measures were projected by the KPCA onto the bivariate feature space, in which the class-conditional feature densities can be approximated with the nonparametric kernel density estimation technique. In the vocal pattern classification experiments, Fisher's linear discriminant analysis (FLDA) was applied to perform the linear classification of voice records for healthy control subjects and PD patients, and the maximum a posteriori (MAP) decision rule and support vector machine (SVM) with radial basis function kernels were employed for the nonlinear classification tasks. Based on the KPCA-mapped feature densities, the MAP classifier successfully distinguished 91.8% voice records, with a sensitivity rate of 0.986, a specificity rate of 0.708, and an area value of 0.94 under the receiver operating characteristic (ROC) curve. The diagnostic performance provided by the MAP classifier was superior to those of the FLDA and SVM classifiers. In addition, the classification results indicated that gender is insensitive to dysphonia detection, and the sustained phonations of PD patients with minimal functional disability are more difficult to be correctly identified.

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Correspondence author: Yang, Shanshan School of Information Science and Technology, Xiamen University, Xiamen, Fujian, China.

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Document 91

Long-time average spectrum in individuals with Parkinson disease

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Abstract (summary): BACKGROUND

Various methods of acoustic analysis have been used to describe phonatory deficits in Parkinson disease (PD), including long-time average spectrum (LTAS) analysis.

OBJECTIVE

The aim of this study was to utilize the LTAS to investigate laryngeal deficits in individuals with PD.

METHODS

Twenty-eight individuals with idiopathic PD and 10 controls were participants for this study. An LTAS was generated from a standard reading sample and analyzed using the following measurements: Mean spectral energy (MSE), first spectral peak, spectral tilt (ST), three spectral slope (SS) measures (i.e., SSF0-1kHz, SS1-5kHz, and SS ratio) and four spectral moments (mean, standard deviation, skewness, and kurtosis).

RESULTS

Individuals with PD were found to demonstrate significantly lower MSE, spectral mean and spectral SD, along with higher spectral skewness compared to control speakers. Furthermore, ST was positively correlated with self-rated symptom severity and self-rated medication effectiveness for individuals with PD.

CONCLUSIONS

The LTAS findings were consistent with either reduced vocal fold adduction or vocal fold bowing in individuals with PD compared to control speakers. Additionally, vocal fold adductory changes were one possible explanation for correlations between LTAS and self-ratings of medication effectiveness and disease severity.

MeSH: Adult;Aged;Aged, 80 and over;Female;Humans;Male;Middle Aged;<mark>Parkinson Disease</mark> -- diagnosis (major);<mark>Parkinson Disease</mark> -- physiopathology;<mark>Phonation</mark> (major) -- physiology;<mark>Speech Acoustics</mark> (major);Time Factors;<mark>Voice Quality</mark> (major) -- physiology

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Document 92

Classification of <mark>parkinson</mark>'s disease patients using nonlinear phonetic features and mel-frequency cepstral <mark>analysis</mark>

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Abstract (summary): This paper presents a combinational feature extraction approach using voice utterances for discriminating <mark>Parkinson</mark>'s disease (PD) patients from healthy people. The proposed feature set consists of seven nonlinear phonetic features and 13 usual Mel-frequency cepstral coefficients (MFCCs). In this research, two new features-EDC-PIS (energy distribution coefficient of peak index series) and EDC-PMS (energy distribution coefficient of peak magnitude series)-were introduced, which are robust to many uncontrollable confounding effects such as noisy environments. The nonlinear phonetic features comprise recurrent period density entropy (RPDE), detrended fluctuation <mark>analysis</mark> (DFA), <mark>noise</mark>-to-<mark>harmonic</mark> ratio (<mark>NHR</mark>), fractal dimension (FD), pitch period entropy (PPE), EDC-PIS, and EDC-PMS. MFCC features have been widely used in voice processing tasks and therefore are good candidates to be used for the voice processing of PD subjects. The dataset used was composed of a range of 200 voice utterances from 25 PD subjects with different severity levels, and 10 normal persons. Using voice utterances from healthy and PD subjects, a 20-dimensional final feature set using MFCCs and nonlinear features is composed. Finally, a multilayer perceptron (MLP) neural network classifier with one hidden layer was used to discriminate PD subjects. Also, the proposed system was used for classification of mild and severe PD subjects. We obtained 97.5% overall correct classification performance for the discrimination of PD. In addition, we

obtained 95.5% overall accuracy for the discrimination of mild and severe PD subjects. © 2013
National Taiwan University.

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Qazvin Branch, Qazvin, Iran.

Document 93

Acoustic analysis of voice in Parkinson's disease and amyotrophic lateral sclerosis

Author: Silbergleit, A.K. 1 ; LeWitt, P.A. 1 ; Gardner, G. 1 ; Peterson, E. 1

1 , West Bloomfield, United States

Abstract (summary): Objective: 1) To assess differences in vocal acoustics of Parkinson's disease (PD), Amyotrophic Lateral Sclerosis (ALS) and controls; 2) to determine if there are significant differences in vocal acoustics at different stages of PD. Background: Previous studies have indicated that acoustic analysis of voice is one method of identifying sensitive vocal differences between neurological diseases. How subjects with ALS and PD differ on selected acoustic measures of voice is unclear. It is also unclear how vocal acoustics change in the PD voice as the disease progresses. Methods: Eleven subjects with early PD (Hoehn and Yahr stage I) and 16 individuals with mid-stage PD (Hoehn and Yahr stage II-III) underwent acoustic analysis of voice testing while off-medication. Results were compared to 11 subjects with ALS with perceptually normal voices and 22 controls. All subjects phonated /i/ at comfort, high and low pitch, three trials per pitch. The CSpeech Waveform Analysis Program was used to analyze cycle-to-cycle frequency (jitter) and amplitude (shimmer) irregularities of the vocal signal, signal-tonoise ratio and maximum phonation frequency range (MPFR). Results: There was a significant difference between the MPFR of the moderate PD group and the control group, (p = 0.007) and the ALS group and the control group (p = 0.030). Subjects with ALS were unable to achieve as high a pitch as the control group. Subjects with mid-stage PD were unable to achieve as high and as low a pitch as the control group, maintaining a mid-pitch range. Conclusions: Laryngeal motoneuron loss limiting cricothyroid function to raise pitch may be present early in ALS. As PD progresses, laryngeal rigidity may occur also limiting cricothyroid muscle movement and pitch variation. Results indicate that MPFR may be a sensitive marker of vocal instability in ALS and PD. Acoustic analysis of voice may be able to identify vocal differences between neurological diseases and identify subtle vocal changes in disease progression. Results support early voice therapy in PD to maintain vocal flexibility.

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Correspondence author: Silbergleit, A.K. , West Bloomfield, United States.

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Document 94

An acoustic and perceptual investigation of speech and voice in Parkinson's and in depression

Author: Teixeira, Erica G. 1 ; Howard, David 1 ; Moffatt, Suzanne 1 ; Miller, Nick 1

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Abstract (summary): Objective: Most people with Parkinson's experience changes in their speech and voice. The purpose of this study was to establish why people with Parkinson's sound depressed when they are not. Methods: Participants were 30 people with Parkinson's and no depression, 30 with Parkinson's and depression; 18 with depression without Parkinson's, 30 without Parkinson's or depression. Speech and voice samples were acquired employing standard clinical tasks: reading a passage, monologue, sustained vowel, diadochokinetic repetitions (DDK). Based on these acoustic and auditory perceptual measures were derived: speech and articulation rate, pause number and duration, mean fundamental frequency (F0) and variability, mean intensity and variability, duration of sustained vowel, and DDK rate; loudness/pitch level and consistency, rate of speech and voice

quality. Sixty-six listeners transcribed low-predictability sentences to gain a measure of intelligibility. Results: Three blind speech-language pathologists judged the groups with Parkinson's as significantly more 'depressed' than the groups without Parkinson's, with the group with Parkinson's and depression perceived as significantly more 'depressed' than the others. Based on acoustic analyses, pause duration in reading was significantly longer in both groups with Parkinson's compared to those without. For the perceptual analyses, significant reduced loudness level and loudness/pitch consistency during reading and monologue tasks was reported for both groups with Parkinson's compared to the groups without Parkinson's. Regarding intelligibility people with Parkinson's produced significantly more impaired speech than those without, with those with Parkinson's and depression being most impaired. No differences were found for both groups with Parkinson's according to Hoehn and Yahr stage and disease duration. These findings suggest that people with Parkinson's sound depressed because their speech features do not differ significantly from people with depression, whereas on these key elements they do differ from people without Parkinson's or depression. Some features of speech and voice are uniquely linked to depression.

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Correspondence author: Teixeira, E.G. Newcastle University, Newcastle, United Kingdom.

Document 95

Acoustic characteristics of vowel sounds in patients with Parkinson disease

Author: Bang, Young-Im 1 ; Min, Kyunghoon; Sohn, Young H; Cho, Sung-Rae

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Abstract (summary): The purpose of this study was to define the acoustic voice and speech characteristics of patients with Parkinson disease (PD). Seven female patients with PD and seven female healthy controls participated in this study. Each subject was instructed to vocalize extended corner vowels (/a/, /e/, /i/, /u/) three times for at least 5 seconds at a comfortable voice loudness and tone. The voice was analyzed using the Praat program. As a result, female patients with PD showed a significant increase in jitter and noise-to-harmonics ratio (NHR). In addition, F1 and F2 among the PD patients demonstrated asymmetric centralization of unrounded vowels (/a/, /e/, /i/) in high/low/front/back positions of the tongue, consequently leading to a significant decrease in vowel space area, compared to healthy controls. This study showed the acoustic characteristics of vowel sounds not only by laryngeal variables such as abnormal jitter and NHR, but also by articulatory variables such as asymmetric centralization and reduced vowel space area in female patients with PD. Therefore, it is important to use these objective and sensitive variables to evaluate the status or severity of hypokinetic dysarthria in patients with PD.

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Correspondence author: Bang, Young-Im Department and Research Institute of Rehabilitation Medicine, Yonsei University College of Medicine, Seoul, Korea.

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Document 96

Influence of the relevant acoustic features on the recognition of emotional prosody following subthalamic nucleus deep brain stimulation in Parkinson's disease

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Abstract (summary): This study focus on the impact of several acoustical features known to be important for the recognition of emotional prosody following subthalamic nucleus (STN) deep brain stimulation (DBS) in Parkinson's disease (PD) and how STN DBS might impact at different levels of emotional auditory processing. The demonstration of the emotional effects of STN DBS in PD pointed for the first time to the involvement of the STN in the cerebral network subtending emotions and

notably the recognition of emotion from voices i.e., emotional prosody (see Péron, Frühholz et al. in press for a review). Nevertheless, the exact contribution of the STN in emotional prosody remains to be clarified, and the question of the influence of acoustic features in the recognition of emotional prosody of STN DBS PD has not been adequately accounted for to date. We re-analyzed the performances in the recognition of emotional prosody in the PD patients in a pre and in a post-operative conditions and matched healthy controls (Péron, Grandjean et al. 2010) including relevant acoustic features as dependent variables in our statistical modelisation (GLM zero inflated method). We focused the analyses on the significant results that we initially found to be specifically impaired in the postoperative group compared to the pre-operative and control groups. Results revealed that the biased ratings in the postoperative condition compared to the two other groups were correlated to the maximum of loudness for fear recognitionwhile the biases for anger recognitionwere correlated to the standard deviation of intensity, the mean, maximum, minimum, and SD of pitch. There is a significant influence of the relevant acoustic features on the disturbed emotional prosody recognition following STN DBS in PD. Nevertheless, this influence is not sufficient to explain the emotional prosody disturbances observed following STN DBS and suggest that higher levels of emotional prosody processing are also impaired by this surgery.

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Document 97

Voice assessment in parkinson disease and multiple sclerosis patients

Author: Bauer, V. 1 ; Aleric, Z. 1 ; Jancic, E. 2

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Abstract (summary): Introduction: The aim of study is to evaluate and to compare the subjective perception of the voice quality in patients with Parkinson disease (PD) and patients with Multiple Sclerosis (MS) by Voice Handicap Index (VHI). Materials and methods: Patients with mild-to-moderate form of the PD (N = 22) and patients with relapse remitting form of the MS (N = 31) were included. The voice quality was assessed by VHI. Results were compared between patients groups and with control groups (CG). All participants were native speakers of Croatian. Results: Average VHI in PD group was 19.1 ± 17.5 (CG:4.04, p<0.05), and in MS group 16.6 ± 14. 7 (CG:4,6, p<0.001). The comparative analysis between the PD and MS showed similar subscores for emotional and functional subitems of the VHI and different subscore for physical subitem, higher for PD (10.8 vs. 7.4). In both groups male patients rated all three subitems higher, but with no significant difference.

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Document 98

Voice handicap in essential tremor: A comparison with normal controls and Parkinson's disease

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Abstract (summary): Background: Although voice tremor is one of the most commonly noted clinical features of essential tremor (ET), there are nearly no published data on the handicap associated with it. Methods: The Voice Handicap Index (VHI) was self-administered by participants enrolled in a research study at Columbia University Medical Center. The VHI quantifies patients' perceptions of handicap due to voice difficulties. Data from 98 ET cases were compared with data from 100 controls and 85 patients with another movement disorder (Parkinson's disease, PD). Results: Voice tremor was present on examination in 25 (25.5%) ET cases; 12 had mild voice tremor ($ET_{Mild\ VT}$) and 13 had marked voice tremor (ET_{Marked} VT). VHI scores were higher in ET cases than controls (p50.02). VHI scores among ET_{Marked} VT were similar to those of PD cases; both were significantly higher than controls (p,0.001). The three VHI subscale scores (physical, functional, emotional) were highest in ETMarked VT, with values that were similar to those observed in PD. Discussion: The voice handicap associated with ET had multiple (i.e., physical, functional, and emotional) dimensions. Moreover, ET cases with marked voice tremor on examination had a level of self-reported voice handicap that was similar to that observed in patients with PD. © 2013 Louis et al.

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*END OF DOCUMENTS IN LIST