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Effects of age, disease, and L-dopa on estimated subglottic pressure in parkinsonian dysarthria

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INTRODUCTION

The main objective of our study is to compare the aerodynamic performances between healthy and pathological subjects in order to identify if the aerodynamic parameters allow to characterize the parkinsonian speech and what are the parameters of variations (disease, age, sex, L-DOPA treatment).

METHODS

Our corpus consists of 40 speakers (20 parkinsonian patients + 20 control subjects) recorded in the Neurology Department of the Centre Hospitalier du Pays d'Aix in Aix-en-Provence. The speakers were native French-speaking women aged 40 to 90 years. There was no significant difference in age between the two groups. We analyzed subglottic pressure measurements estimated from the peak of intraoral pressure during the production of the consonant [p] as well as the pressure decay during the sentence "papa ne m'a pas parlé de beau papa". The pressure was measured with a tube inserted between the speakers' lips. For Parkinsonian subjects, data were analyzed in the two pharmacological states: with L-DOPA (ON-DOPA) and with withdrawal (OFF-DOPA).

Papa ne m'a pas parlé de beau papa
P1 P2 P3 P4 P5 P6

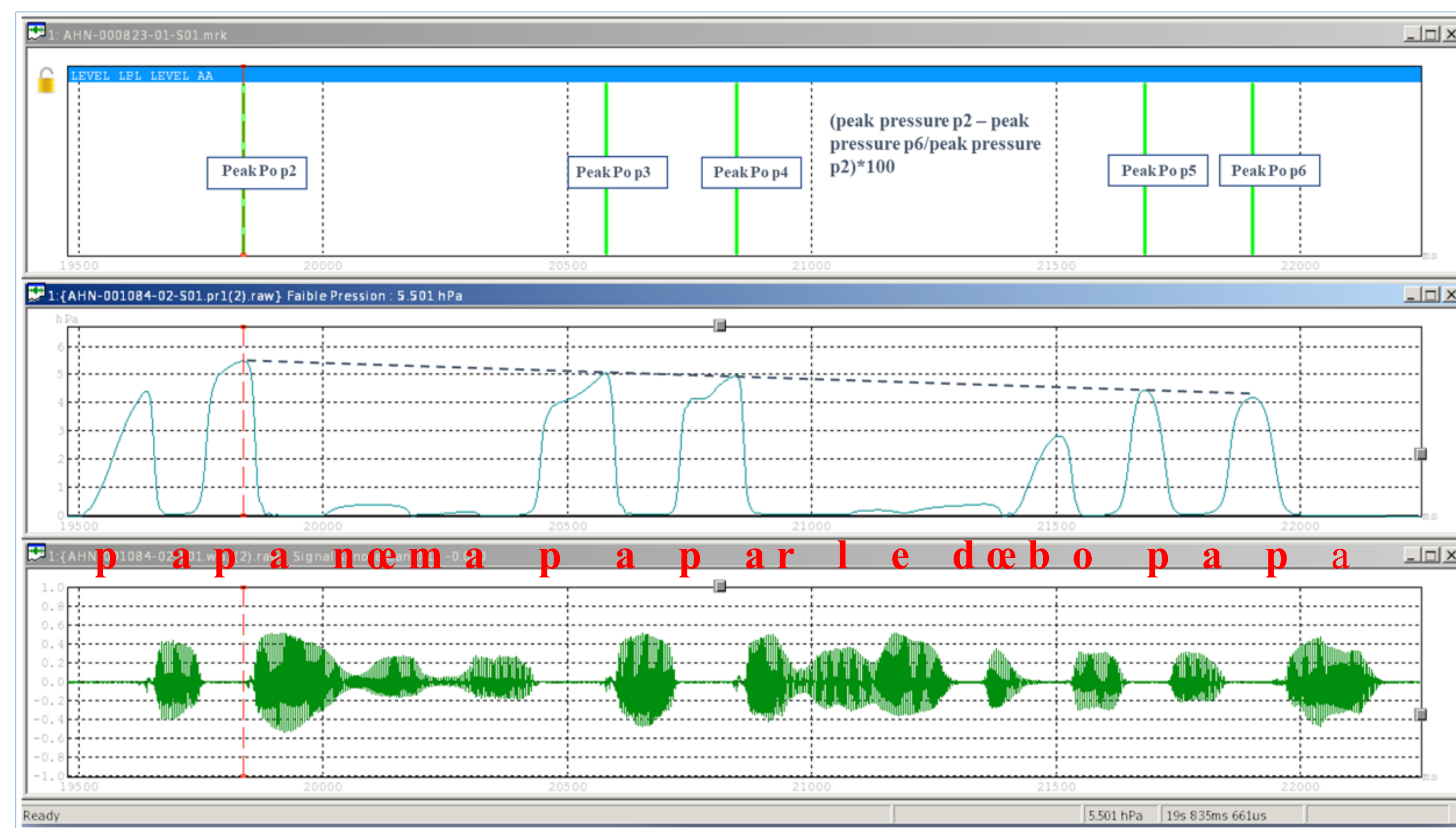


FIGURE 1: Segmentation criteria applied to Intra-oral pressure peaks to estimate subglottic pressure on all the /p/ except the first of the sentence «papa ne m'a pas parlé de beau papa». The top window shows labels corresponding to the temporal position of the peaks, the middle the intra-oral pressure curve, the acoustic signal is on the lower window. The measurements were performed with the Phonedit software.

RESULTS

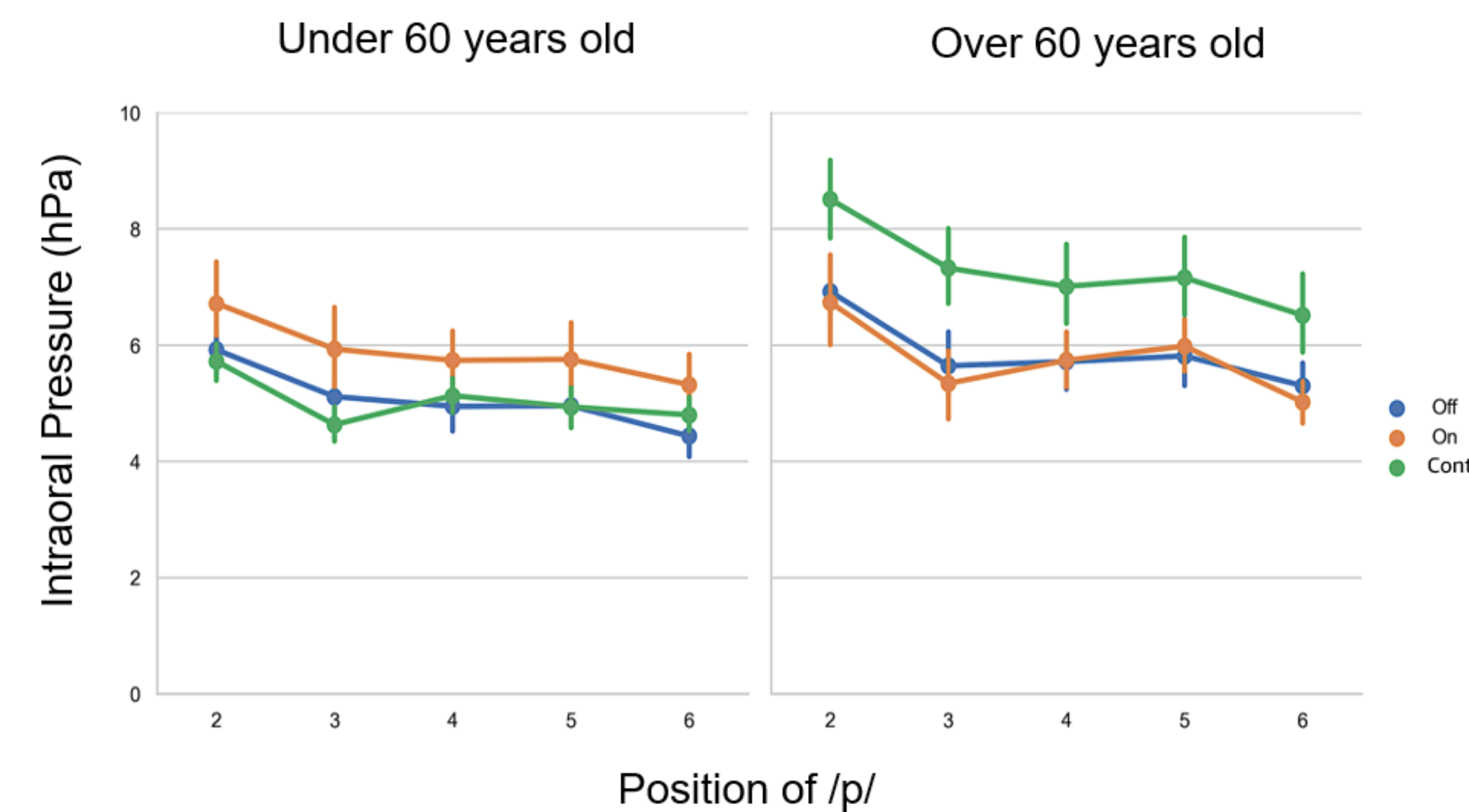
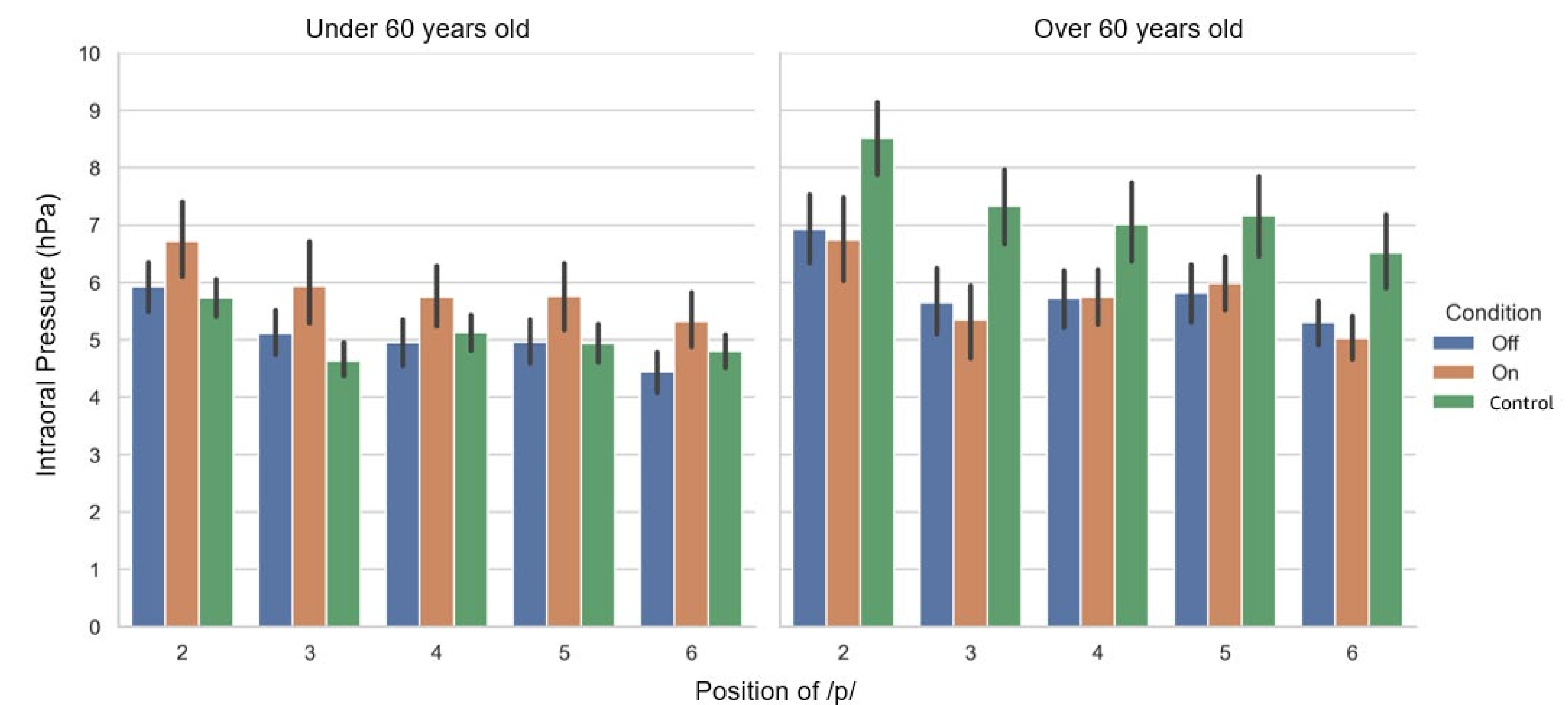


FIGURE 2: Visualization of the evolution of intra-oral pressure during the realization of the different [p] produced in the sentence "papa ne m'a pas parlé de beau papa". The sentence was repeated 6 times by the subjects, the colored dots represent the 6 occurrences of [p] in the different positions (p2, p3, p4, p5, p6). In blue, the parkinsonian subjects in OFF condition, in orange the parkinsonian subjects in ON condition and in green the control subjects.

	OFF	ON	P-value		OFF	ON	P-value
p2	5.92	6.72	0.04*	p2	6.92	6.74	0.69
p3	5.11	5.93	0.04*	p3	5.64	5.34	0.49
p4	4.94	5.73	0.02*	p4	5.1	5.73	0.95
p5	4.95	5.75	0.03*	p5	5.81	5.98	0.63
P6	4.43	5.32	0.003**	P6	5.30	5.02	0.31
	OFF	Témoin	P-value		OFF	Témoin	P-value
p2	5.92	5.72	0.47	p2	6.92	8.51	0.0005***
p3	5.11	4.63	0.05	p3	5.64	7.32	0.0002***
p4	4.94	5.13	0.49	p4	5.71	7.01	0.003**
p5	4.95	4.93	0.93	p5	5.81	7.16	0.002**
P6	4.43	4.80	0.12	P6	5.30	6.51	0.002**
	ON	Témoin	P-value		ON	Témoin	P-value
p2	6.72	5.72	0.007**	p2	6.74	8.51	0.0004***
p3	5.93	4.63	0.0009***	p3	5.34	7.32	<0.001***
p4	5.73	5.13	0.05	p4	5.73	7.01	0.004**
p5	5.75	4.93	0.02*	p5	5.98	7.16	0.006**
P6	5.32	4.80	0.06	P6	5.02	6.51	0.0002***

TAB 1: Result of Student's t test with mean intraoral pressure measurements. The p-values are shown with the significance level (*p < 0.05; **p < 0.01; ***p < 0.001). Left shows results for the under 60 age group and right results for the over 60, (N=120).



	P2	P3	P4	P5	P6	Difference (P2-P6)	% Decrease		P2	P3	P4	P5	P6	Difference (P2-P6)	% Decrease
CTRL	5.72	4.63	5.13	4.93	4.80	0.92	16.08%		8.51	7.32	7.01	7.16	6.51	2	23.50%
OFF	5.92	5.11	4.94	4.95	4.43	1.49	25.16%		6.92	5.64	5.1	5.81	5.30	1.62	23.41%
ON	6.72	5.93	5.73	5.75	5.32	1.42	20.83%		6.74	5.34	5.73	5.98	5.02	1.72	25.51%

Figure 3: Percentage decrease of the intra-oral curve from the first pressure peak to the last one by applying the following formula: (pressure peak p2 - pressure peak p6/pressure peak p2)*100. The colored bar are occurrences of [p] in p2,p3,p4,p5 et p6 positions. In blue, the parkinsonian subjects in OFF condition, in orange the parkinsonian subjects in ON and in green the control subjects.

DISCUSSION

OFF-DOPA patients have a significantly lower subglottic pressure than controls showing that PD has an impact on the sound pressure level which is significantly lower. In ON-DOPA, the values are similar to those of the controls but only in subjects under 60 years old, after which the pressure is lower. Thus, L-DOPA treatment increases the sound pressure level in subjects under 60 years old but would not improve it consistently. The drop in pressure is greater in the OFF-DOPA condition, particularly at the end of production, indicating a lesser control of pneumo-phonetic coordination.

Older healthy subjects produce higher pressure levels than younger healthy subjects with a mean difference of 2 hPa. This increase may be due to two factors: (1) a decrease in lung elasticity that may result in an increase in the value of the pressure measured in the lung volume, (2) higher subglottic pressures due to changes in laryngeal airway resistance and vocal fold closure. This increase is not present in ON-DOPA subjects. In contrast, in OFF-DOPA there is an average increase of 0.8 hPa which suggests that people with PD are still able to compensate in vocal efficiency but at much lower levels than control subjects.