

SLP – P24

THE VOICE



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# Nonlinear Analysis by Phase Space Reconstruction in Voice Signals with Benign Laryngeal Lesions

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CAPES



# Phase Space Reconstruction Benign Laryngeal Lesions

## Nodules

Jiang et al. (2009), Scalassara et al. (2009), Dajer (2010) and Gonçalves (2019)

## Cyst

Gonçalves (2019)

## Sulcus

Choi et al. (2012) and Gonçalves (2019)

**Authors reported the effectiveness of the NL method  
Few studies with the nodule, cyst and sulcus population**

# Objective

Describe Phase Space Reconstruction (PSR) in voice signals with benign laryngeal lesions.

# Method

## ETHICAL CONSIDERATIONS

- Comitê de Ética e Pesquisa da Faculdade de Odontologia de Bauru (FOB-USP)
- Parecer nº2.332.833
- October 11th, 2017



# Method

## Participants

106 voice signals

### **Nodules 43**

41 women e 2 men

Average = 32 anos

### **Cyst 40**

39 women e 1 men

Average = 31 anos

### **Sulcus 23**

13 women e 10 men

Average = 34 anos

Entry to the clinic for screening between 2010 and 2019

# Method

## Procedure – Phase Space Reconstruction

*Voice Analysis* (MONTAGNOLLI, 2019)

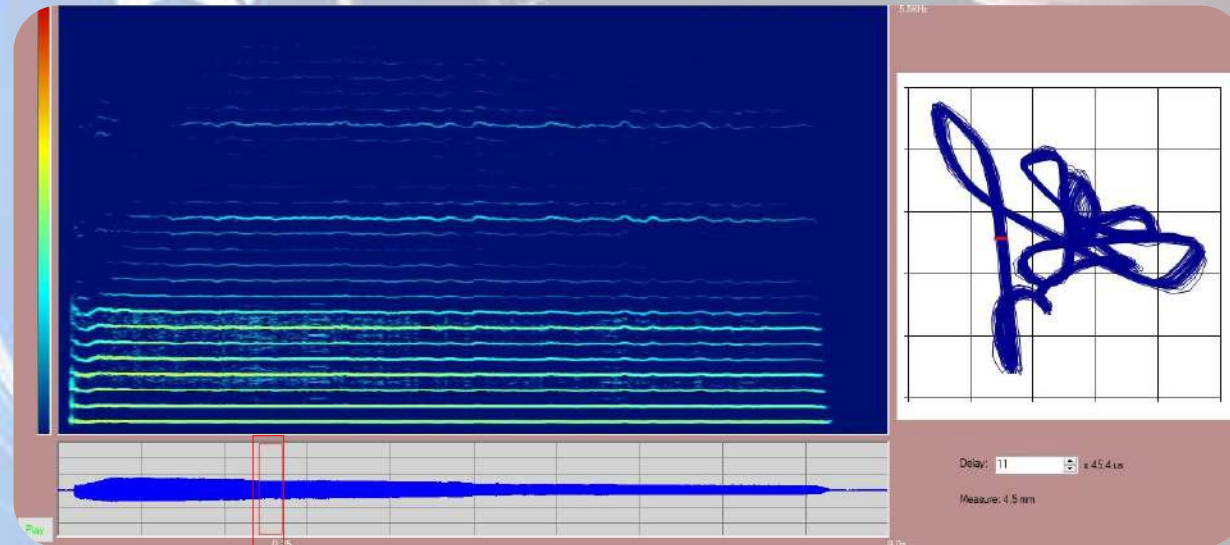


Image: Gonçalves (2019, p. 59)

# Method

## Procedimentos – Phase Space Reconstruction – Curves Scale

Galdino (2019) e Gonçalves (2019)

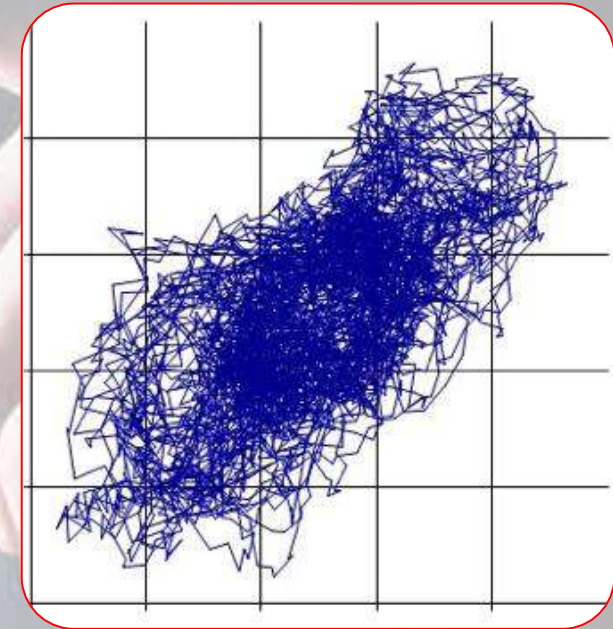
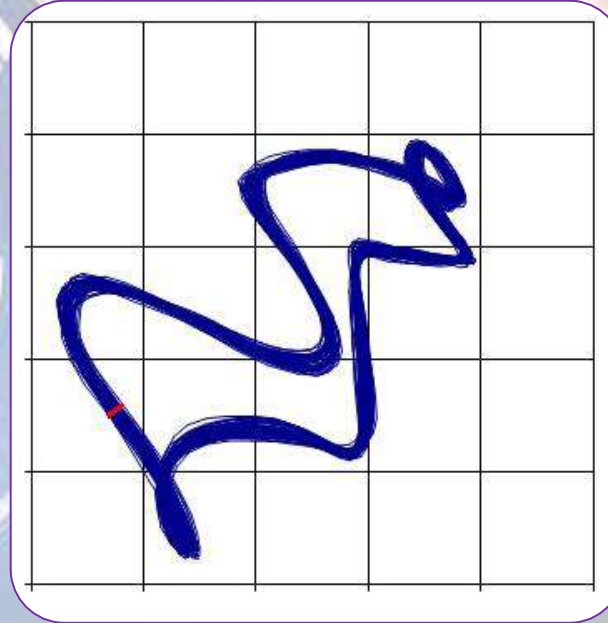
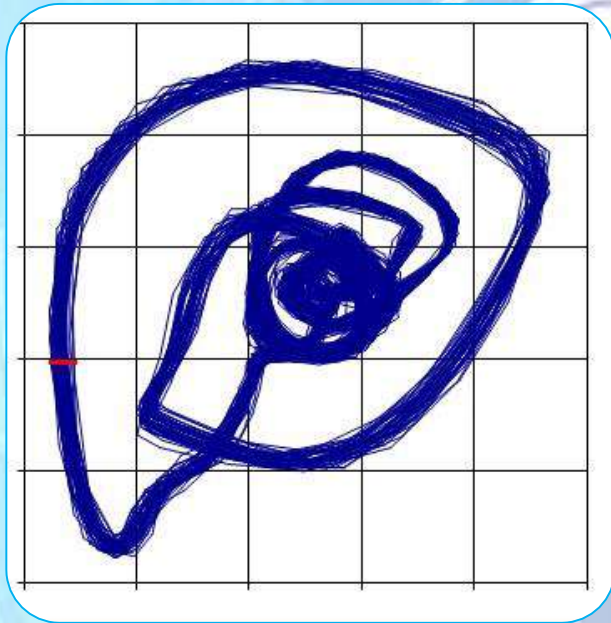
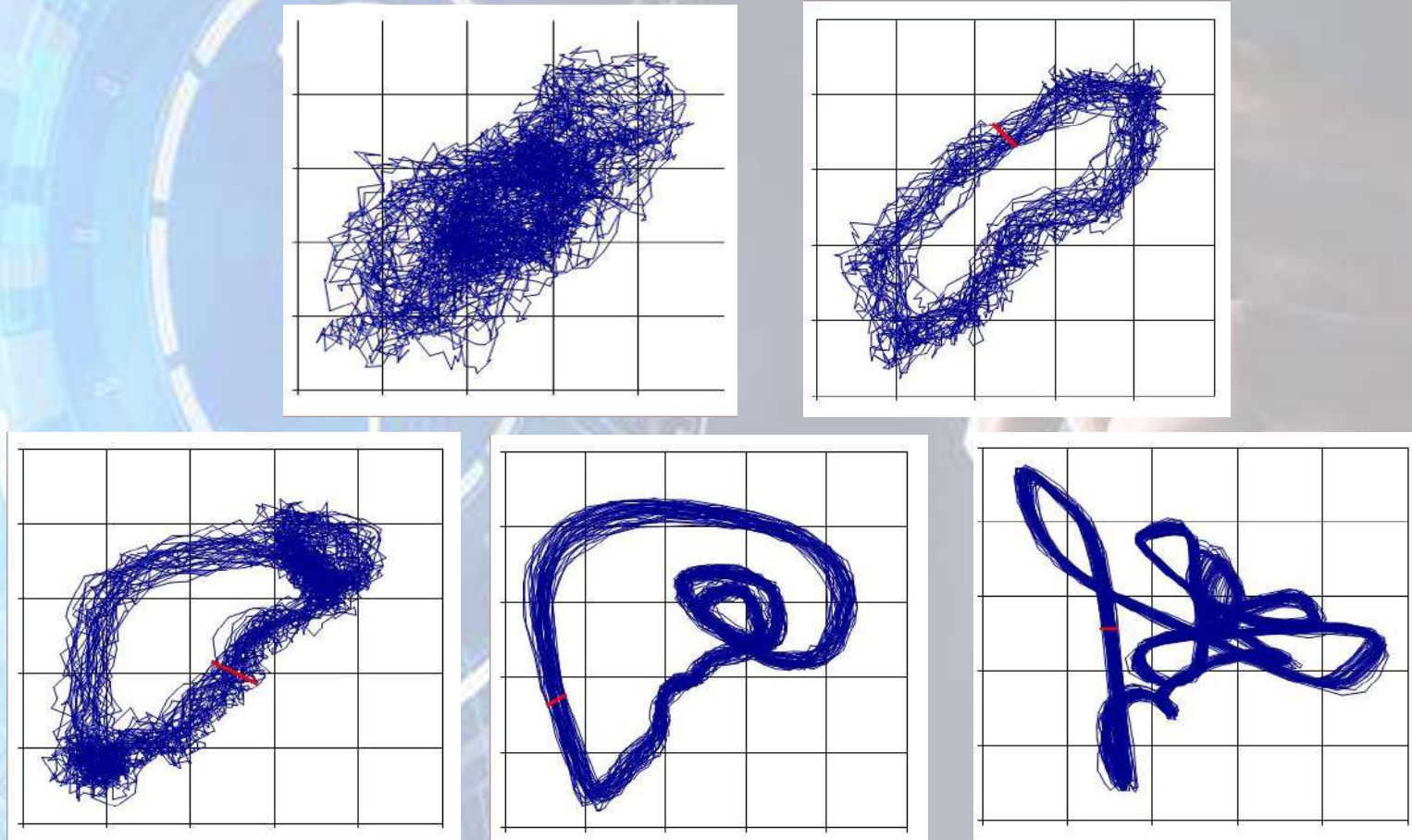


Image: Gonçalves (2019, p. 59)

# Method

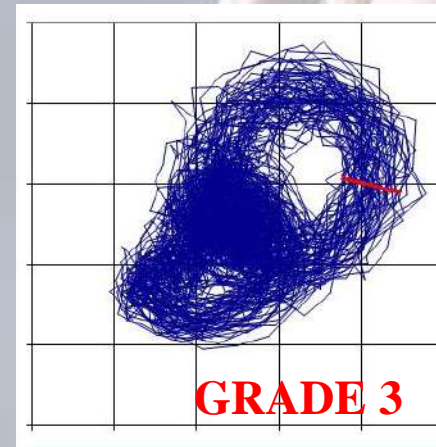
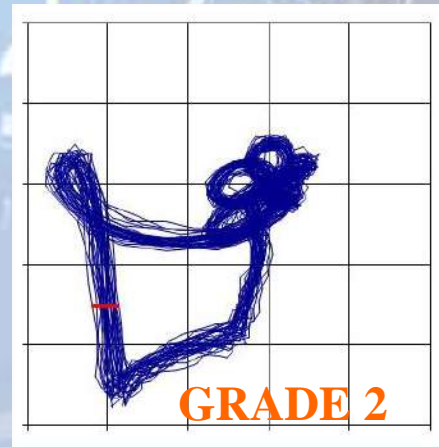
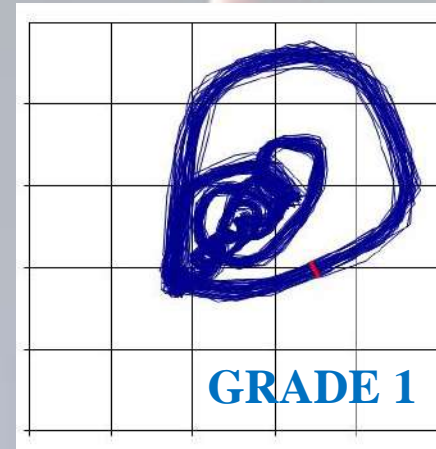
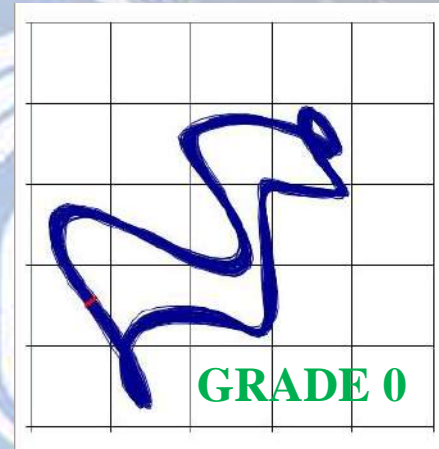
## Procedure – Phase Space Reconstruction – Curves scale





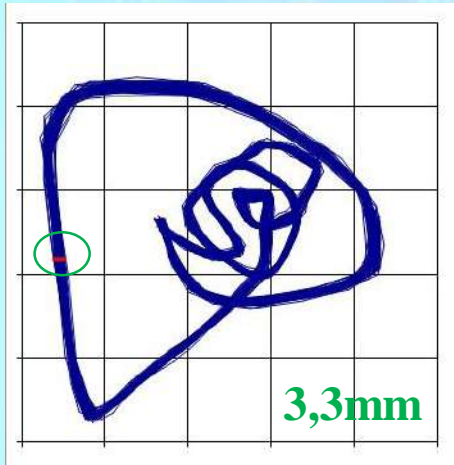
# Method

## Procedure – Phase Space Reconstruction – Irregularity scale

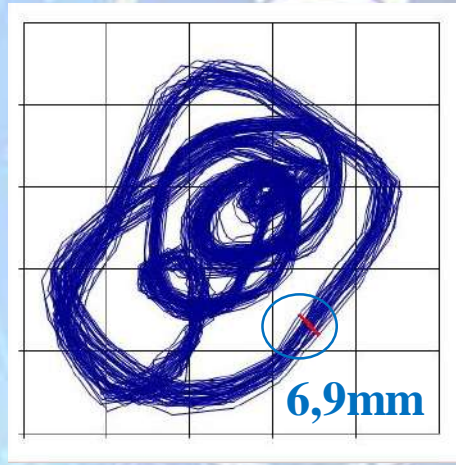


# Method

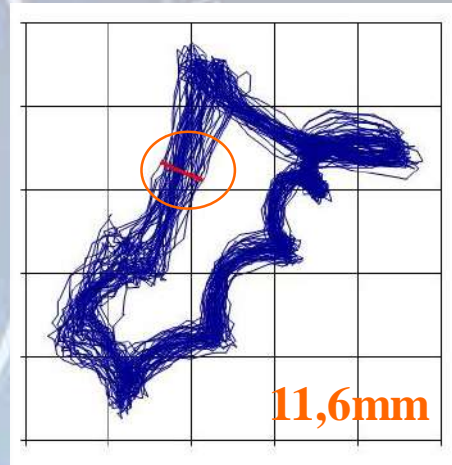
## Procedure – Phase Space Reconstruction – Spacing scale



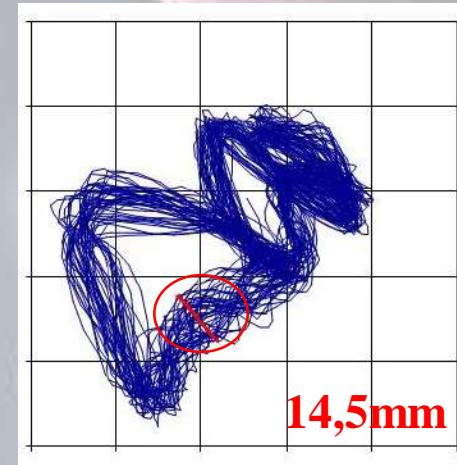
Minimum



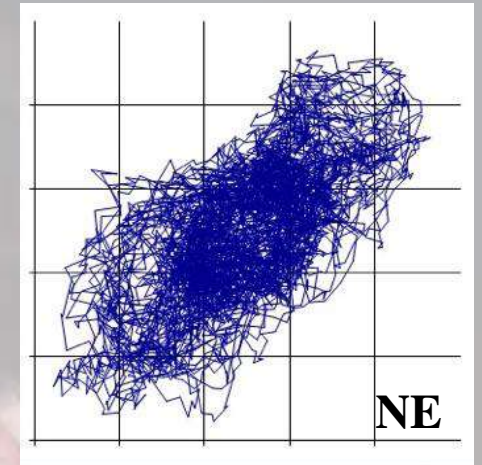
Small



Medium



Large



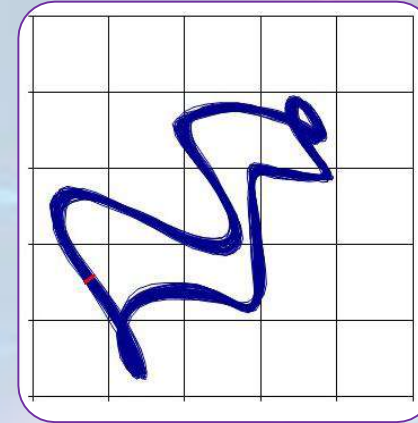
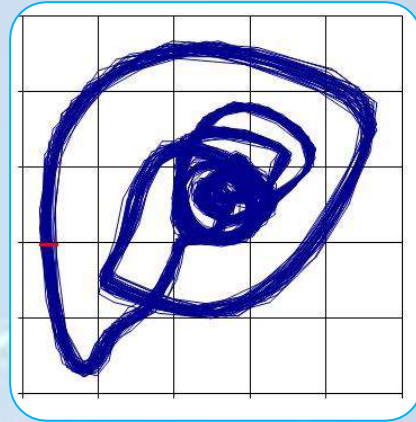
Not Evaluable

# Method

## Procedure – Statistical analysis

Statistical analysis consisted of the Mann-Whitney Test with significance of 5%.

# Results



**Table 1. Percentage of the number of curves in the PSR in the nodule, cyst and sulcus groups.**

Nodules (N 43) Curves				Cyst (N 40) Curves				Sulcus (N 23) Curves			
4	3	2	1	4	3	2	1	4	3	2	1
N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
<b>27 (63)</b>	12 (29)	3 (9)	1 (7)	<b>24 (60)</b>	13 (33)	3 (8)	0 (0)	<b>13 (53)</b>	5 (22)	5 (22)	0 (0)

# Results

Table 2. Percentage of the grade of irregularity in the PSR in the nodule, cyst and sulcus groups.

Nodules (N 43)				Cyst (N 40)				Sulcus (N 23)			
Grade of Irregularity				Grade of Irregularity				Grade of Irregularity			
0	1	2	3	0	1	2	3	0	1	2	3
N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
7 (16)	<b>18 (42)</b>	11 (26)	7 (16)	7 (18)	<b>17 (43)</b>	10 (25)	6 (15)	2 (9)	<b>13 (52)</b>	3 (13)	5 (22)

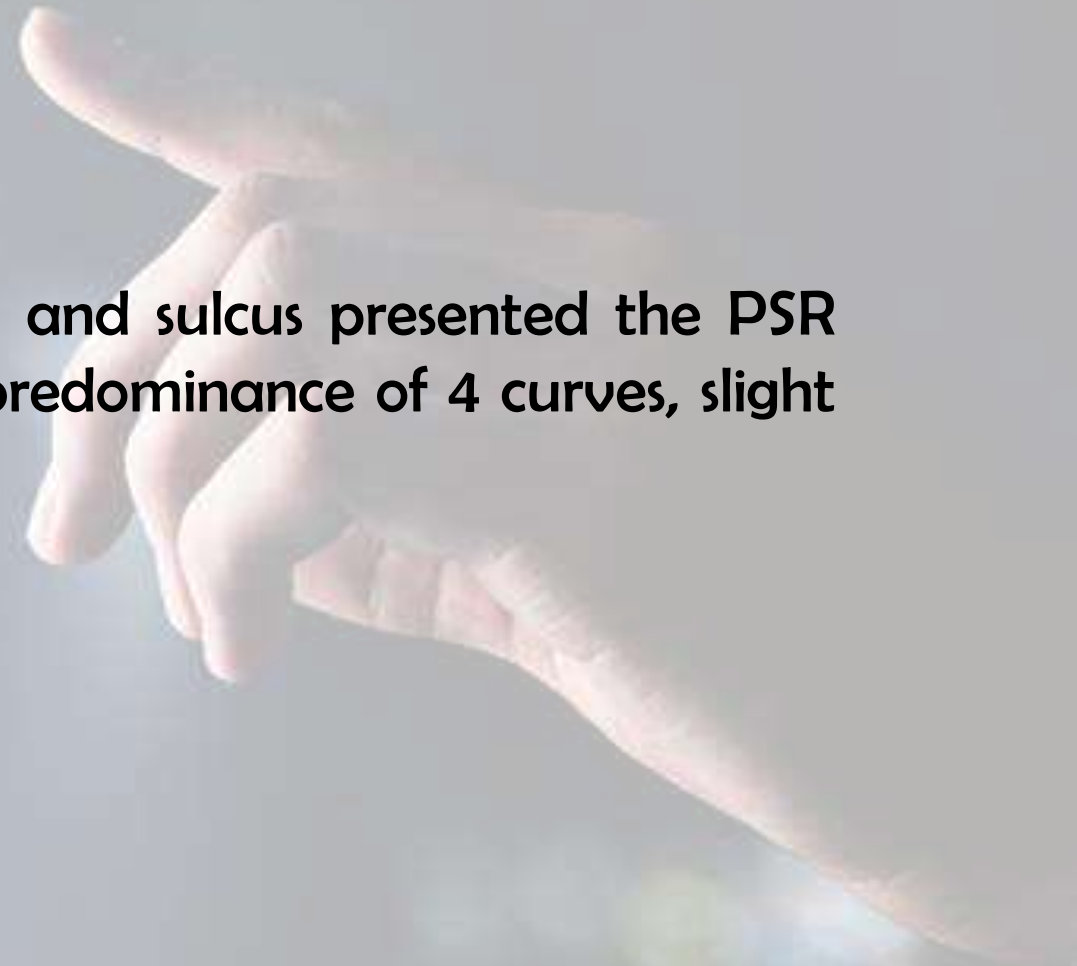
Table 3. Percentage of the grade of spacing in the PSR in the nodule, cyst and sulcus groups.

Nodules (N 43)				Cyst (N 40)				Sulcus (N 23)			
Grade of Spacing				Grade of Spacing				Grade of Spacing			
0	1	2	3	0	1	2	3	0	1	2	3
N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
12 (30)	<b>19 (46)</b>	11 (26)	1 (4)	8 (20)	<b>20 (48)</b>	8 (20)	4 (10)	2 (9)	9 (39)	<b>12 (52)</b>	0 (0)

There was no significant difference ( $p > 0.05$ ) between laryngeal lesions on the C-IS scale.

# Conclusion

Benign lesions of the larynx, nodules, cyst and sulcus presented the PSR graph with open and closed trajectories, predominance of 4 curves, slight irregularity and small to medium spacing.



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**Thank You!**

