



Voice parameters change in different vocal ford motion prognosis of thyroid surgery patients with recurrent laryngeal nerve injury

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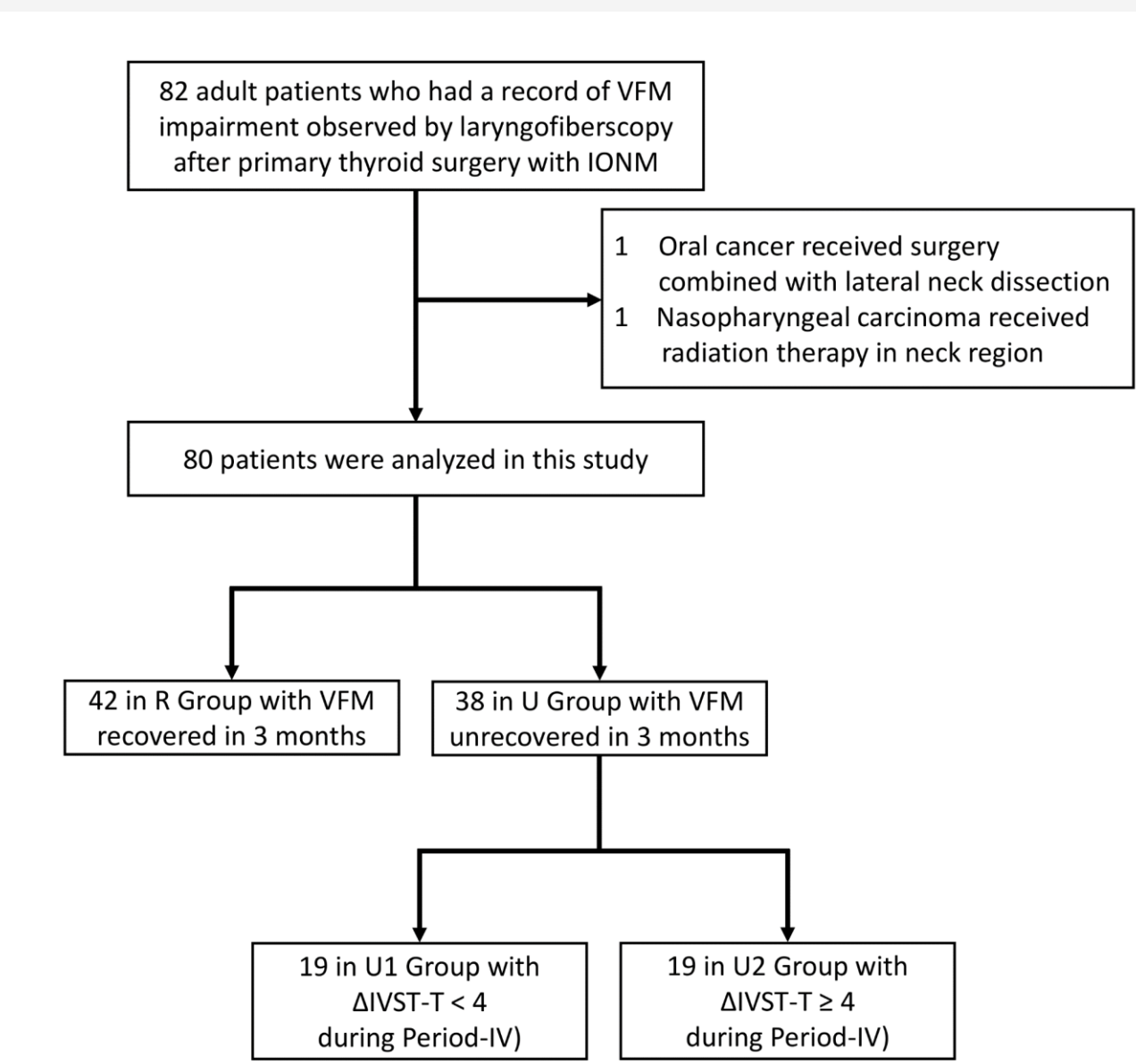


Introduction

Among patients with recurrent laryngeal nerve (RLN) injury after thyroid surgery, the unrecovered vocal fold motion (VFM) and subjective voice impairment are extremely stressful for both the patients and the surgeons. To earlier find and treat the patients with the dissatisfied surgical outcomes, this study evaluates the prognostic indicators of non-transection RLN injury and VFM impairment after thyroid surgery, and the correlation between intraoperative neuromonitoring (IONM) finding and perioperative voice parameters.

Material & Method

This study retrospectively enrolled 82 adult patients who had normal and symmetric VFM before surgery and had VFM impairment within two weeks after primary thyroid surgery with IONM. All surgeries were performed by “IONM team” at Kaohsiung Medical University Hospital from June 2013 to June 2019. **(Figure 1)** Demographic characteristics, RLN electromyography (EMG), and RLN injury mechanism were compared. Multi-dimensional voice program, voice range profile and Index of voice and swallowing handicap of thyroidectomy (IVST, **Supplemental Table 1**) were administered during at period-I (preoperative period, within 2 months before surgery), period-II (immediate postoperative period, median duration of 3 days, range of 1-7 days), period-III (short-term postoperative period, median duration of 12 days, range of 7-30 days); period-IV (long-term postoperative period, median duration of 40 days, range of 30-90 days). The patients were divided into R Group and U Group according to the VFM was recovered and unrecovered 3 months after surgery. The patients in U Group were divided into U1 Group and U2 Group according to total IVST score change was <4 and ≥4 during period-IV.



▲ **Figure 1.** Flow diagram for inclusion and exclusion of patients

Supplemental Table 1. Index of Voice and Swallowing Handicap of Thyroidectomy (IVST)				
Questions	Never (0 point)	Sometimes (1 point)	Always (2 points)	
Voice domain				
1. My overall voice quality is abnormal.	0	1	2	
2. My voice difficulties restrict personal and social life.	0	1	2	
3. I feel my voice is hoarse.	0	1	2	
4. I feel as though I have to strain to produce voice.	0	1	2	
5. The sound of my voice varies throughout the day.	0	1	2	
6. I find it difficult to make a high-pitched voice.	0	1	2	
7. I find it difficult to make a low-pitched voice.	0	1	2	
IVST-V = _____ (Range from 0-14)				
Swallowing domain				
8. I feel strained when I speak or swallow.	0	1	2	
9. I choke when I drink (water or tea).	0	1	2	
10. I choke when I eat.	0	1	2	
IVST-S = _____ (Range from 0-6)				
Total score IVST-T = _____ (Range from 0-20)				

Results

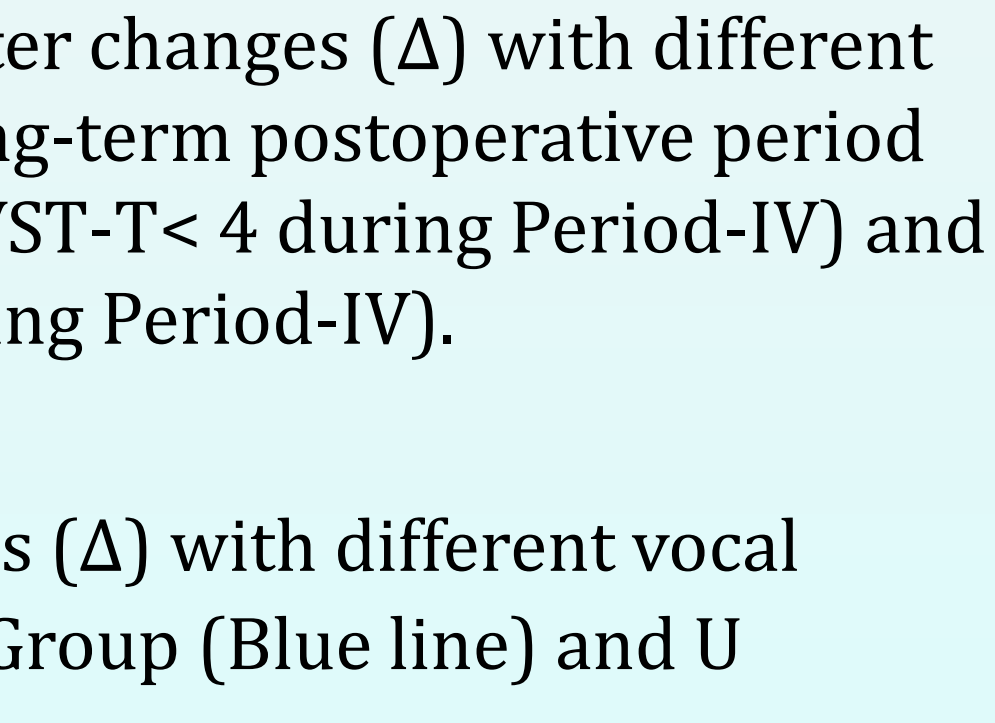
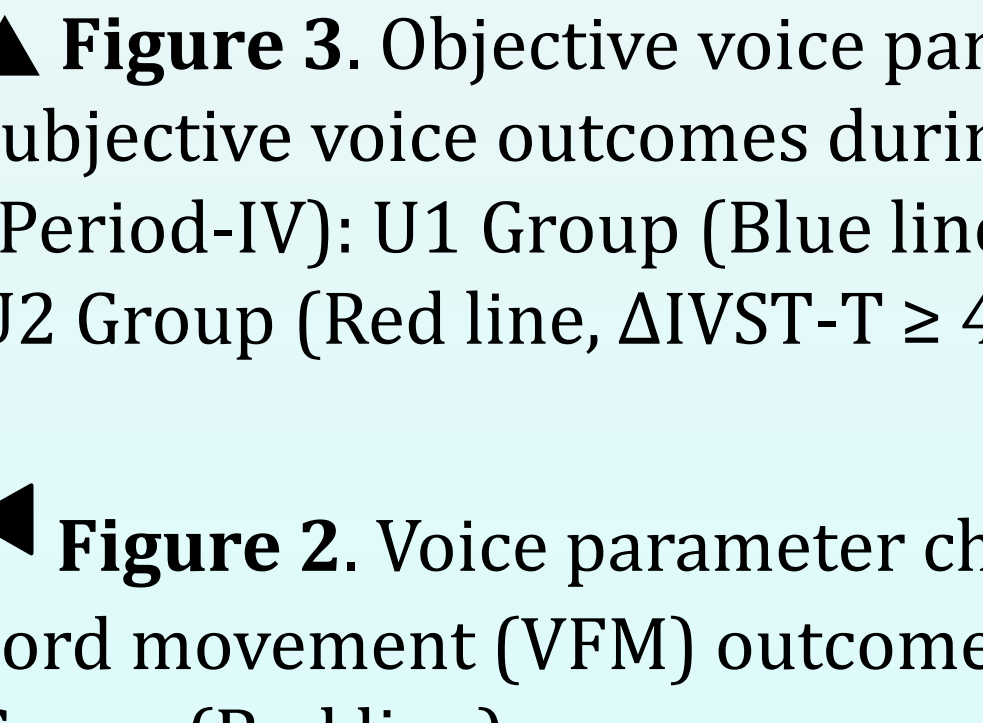
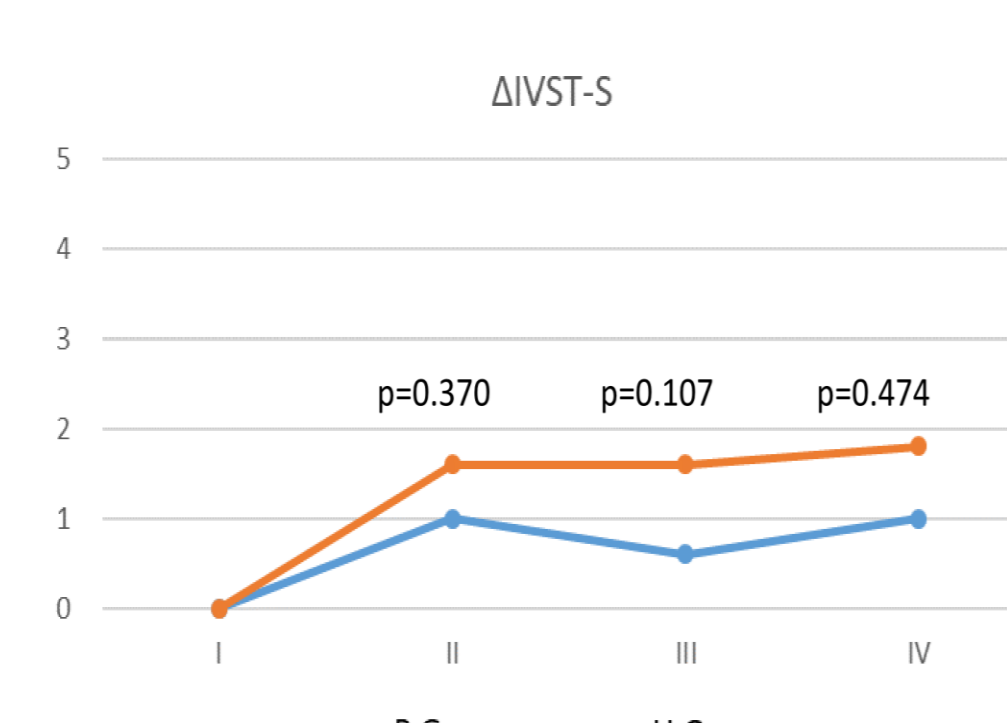
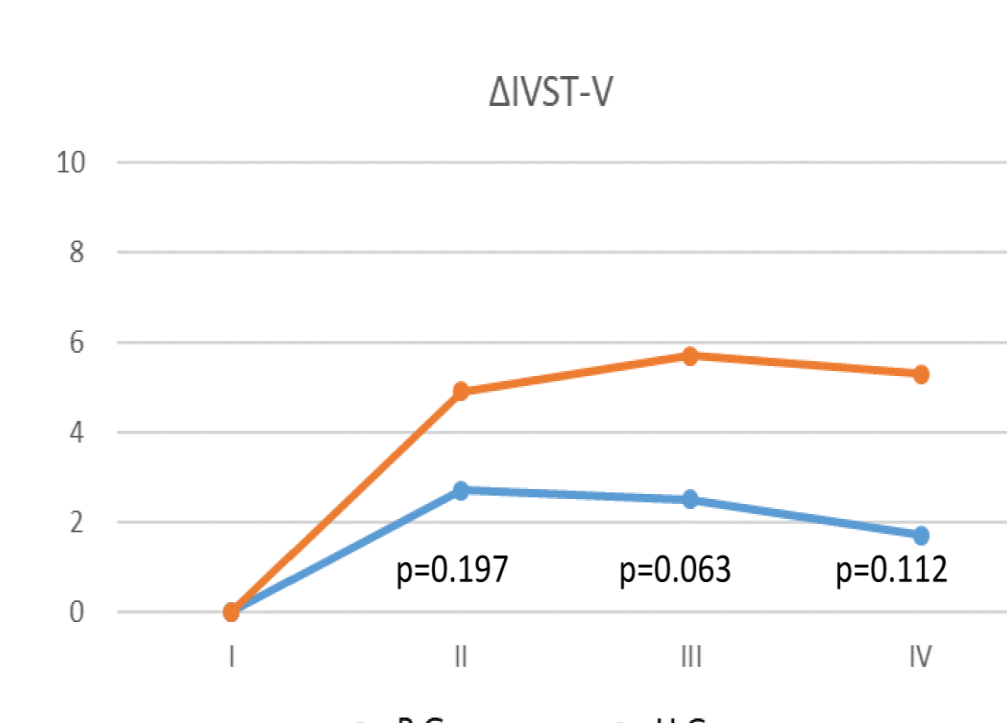
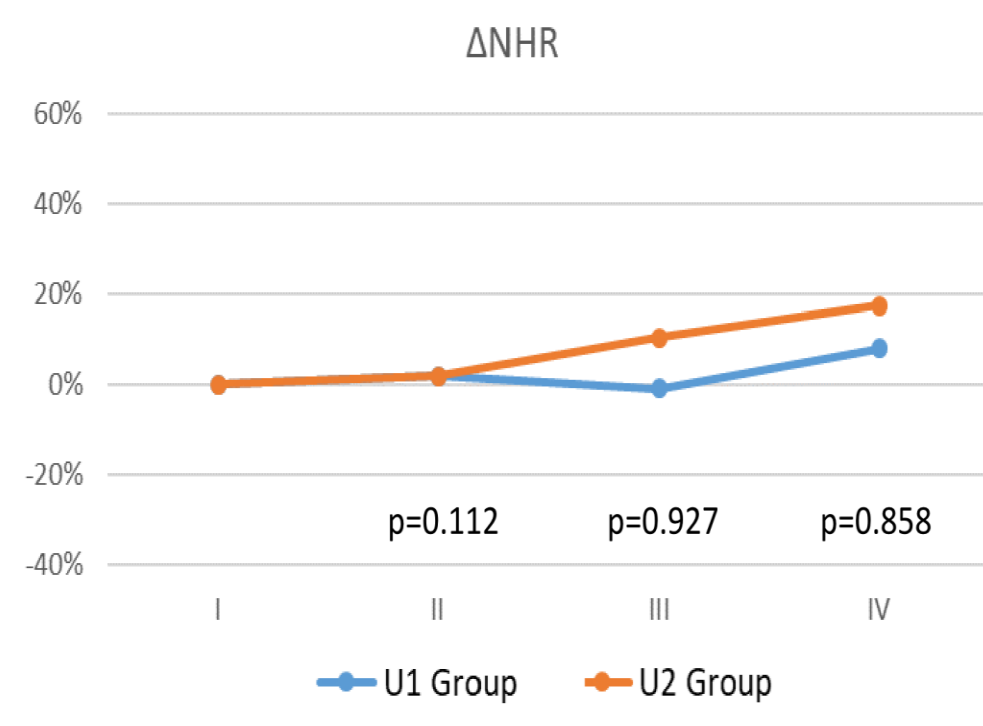
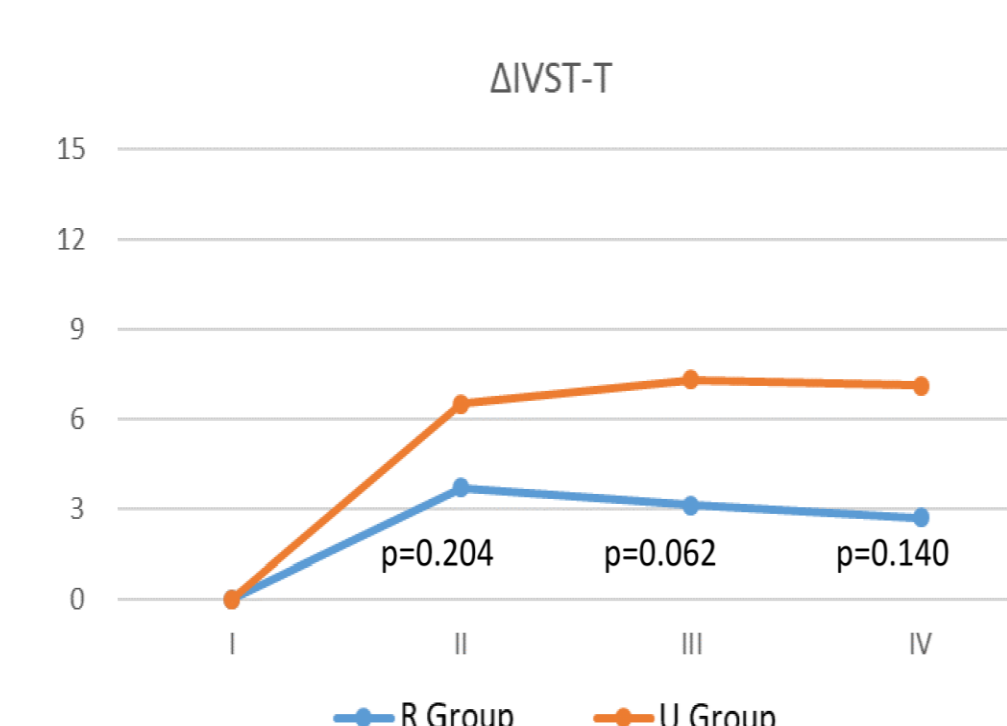
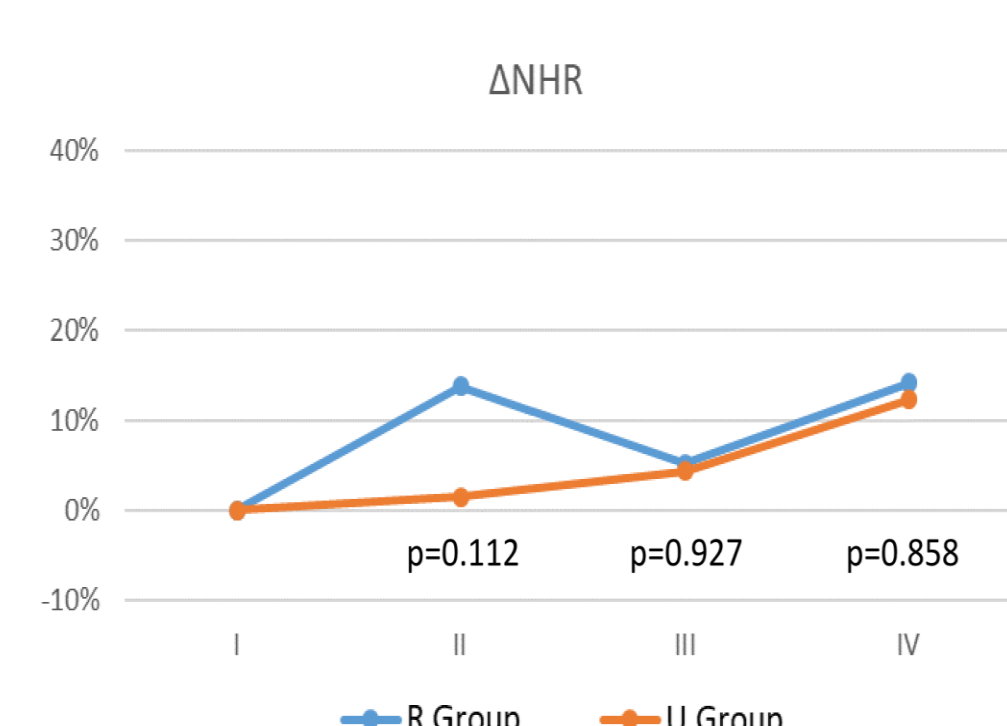
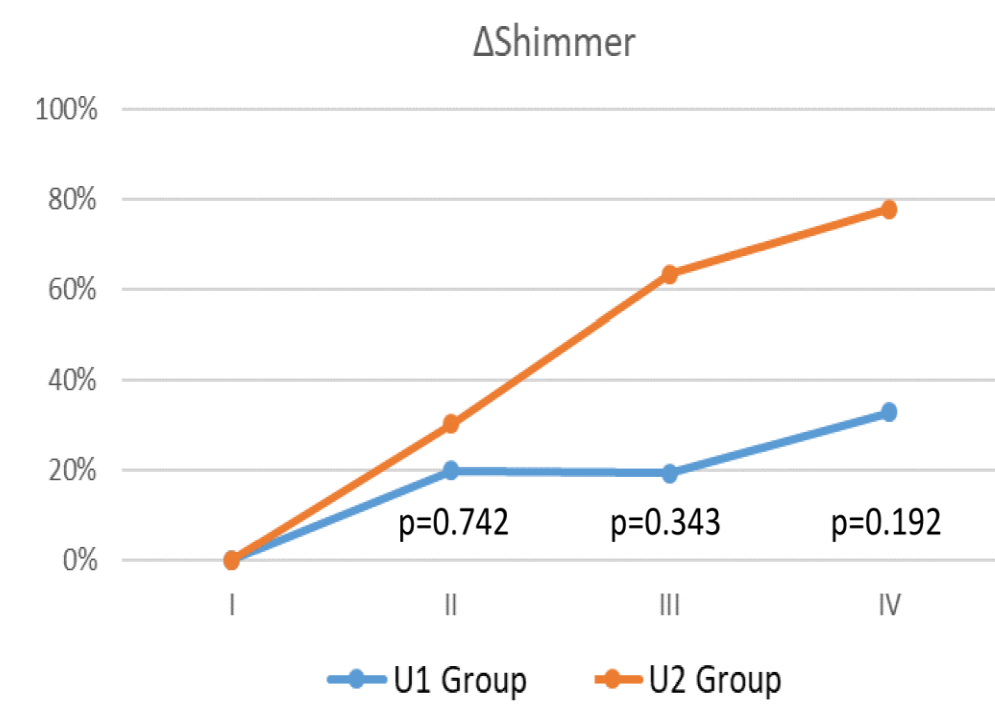
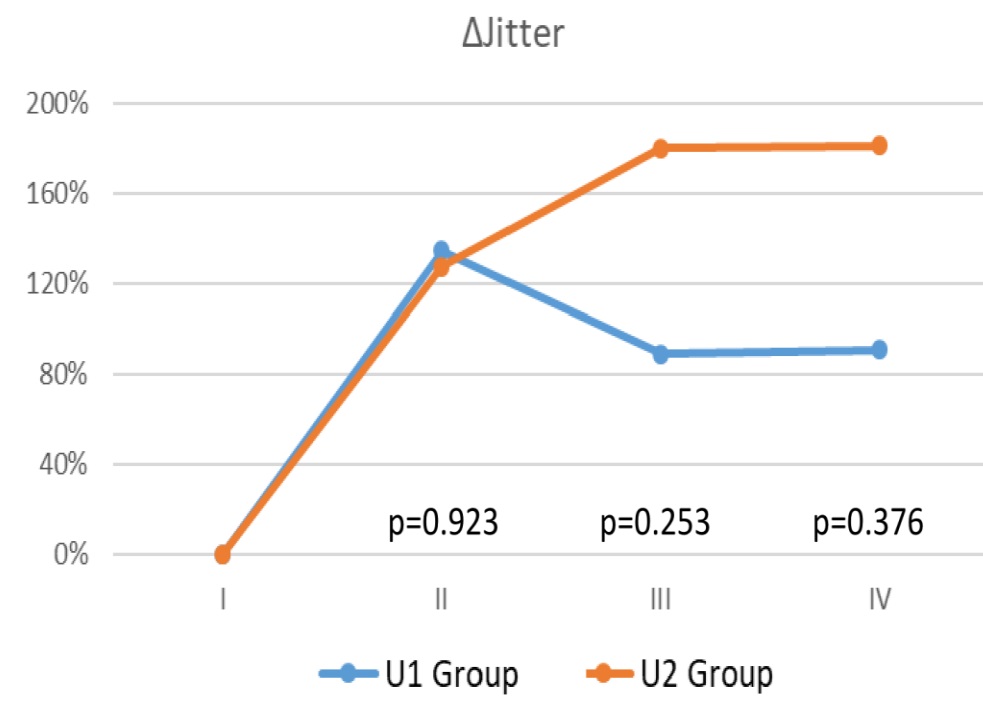
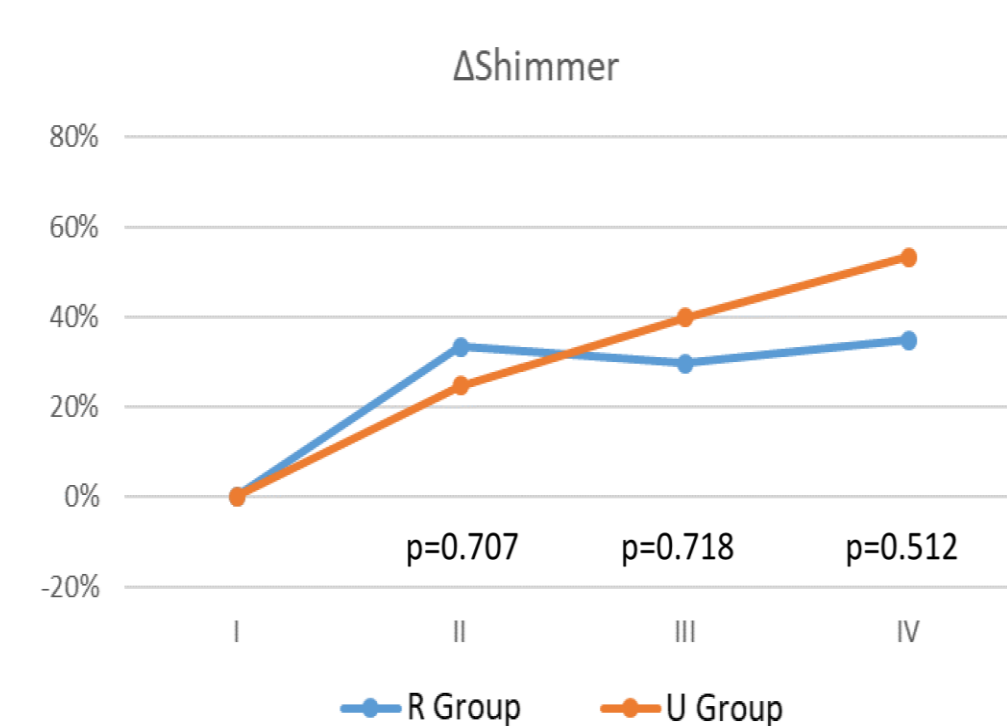
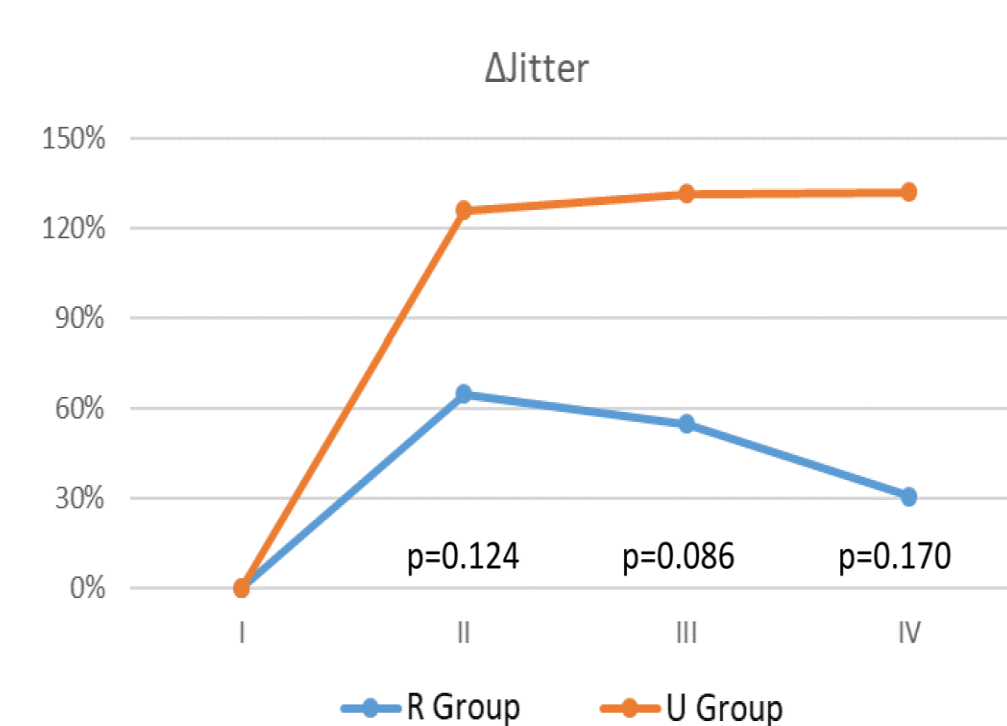
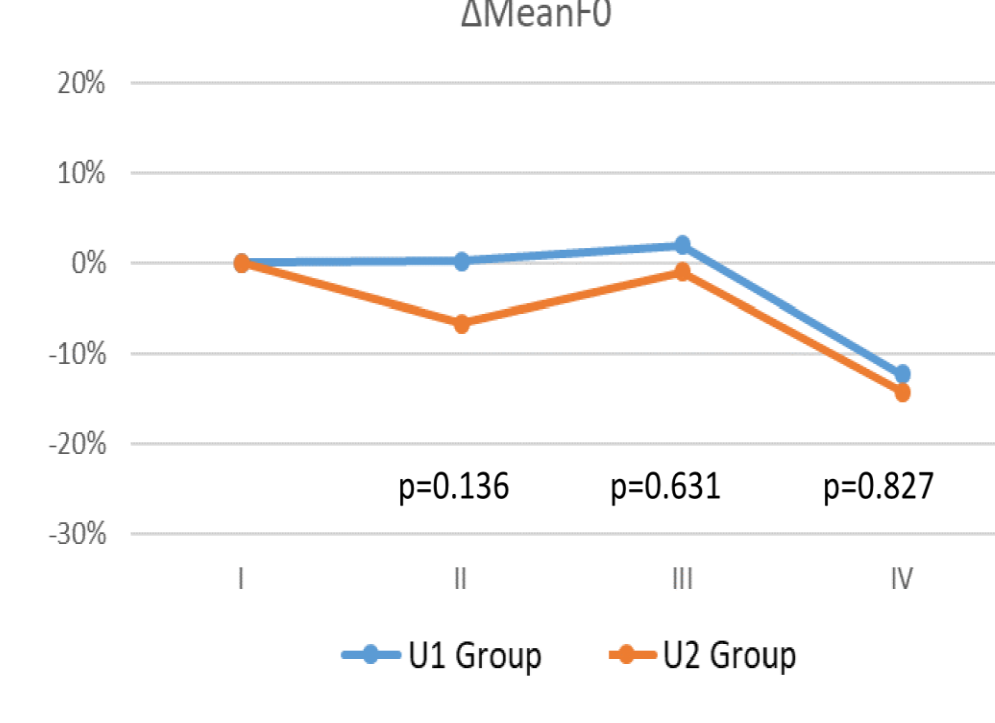
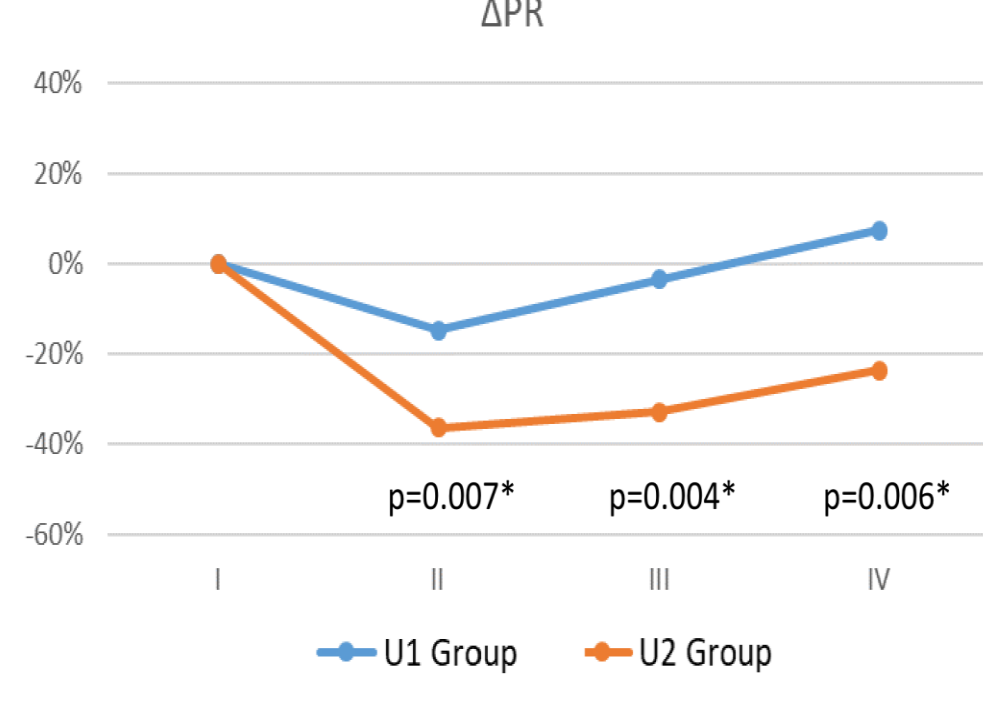
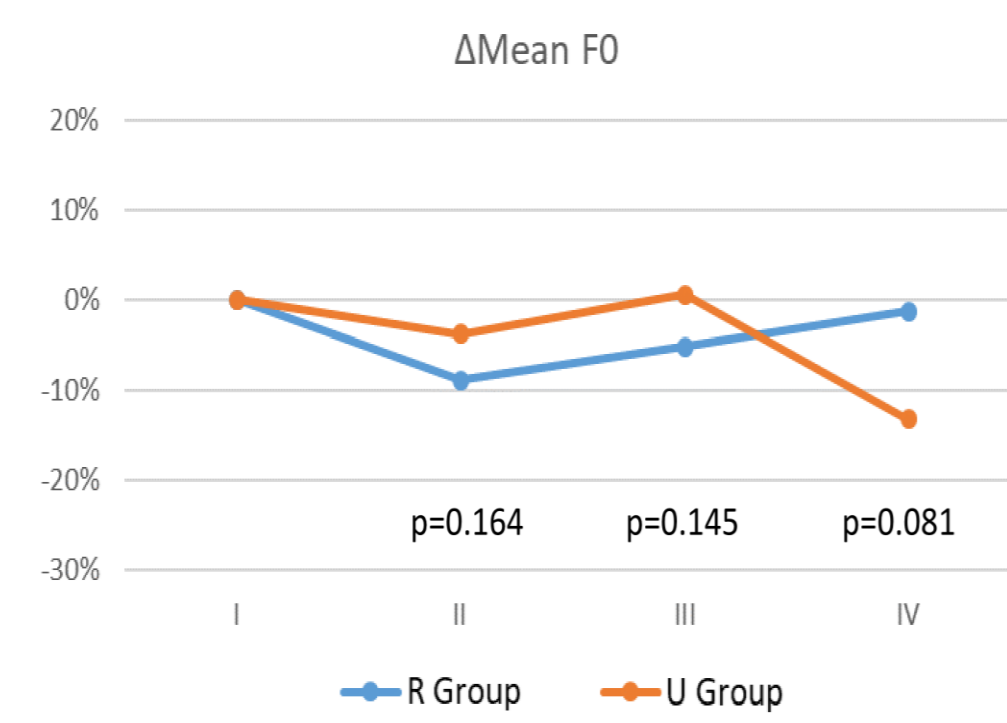
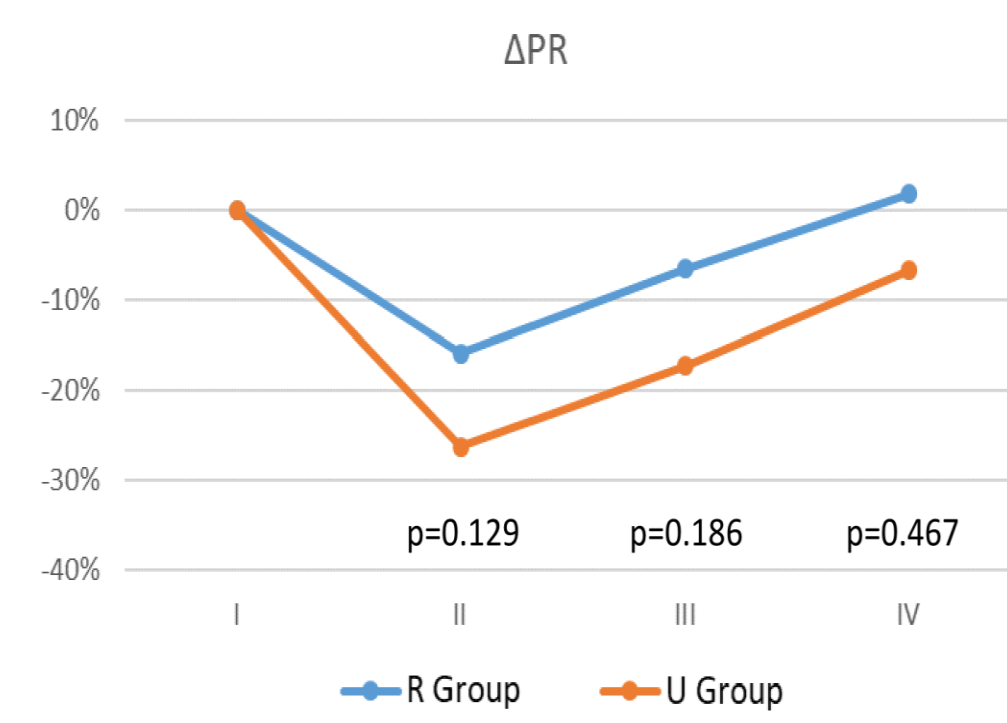
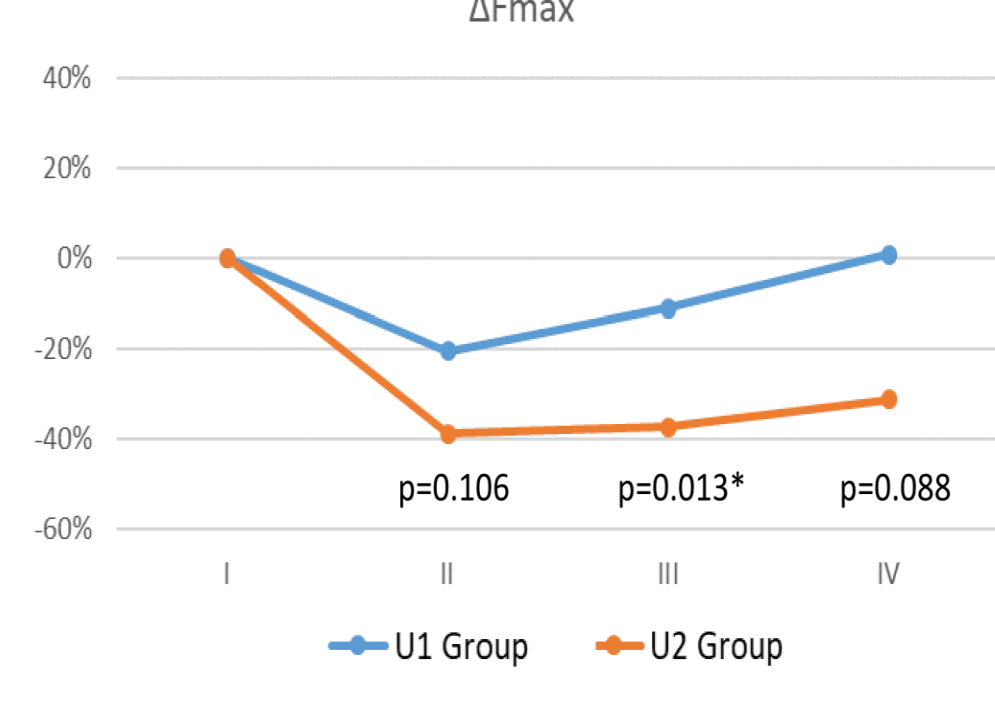
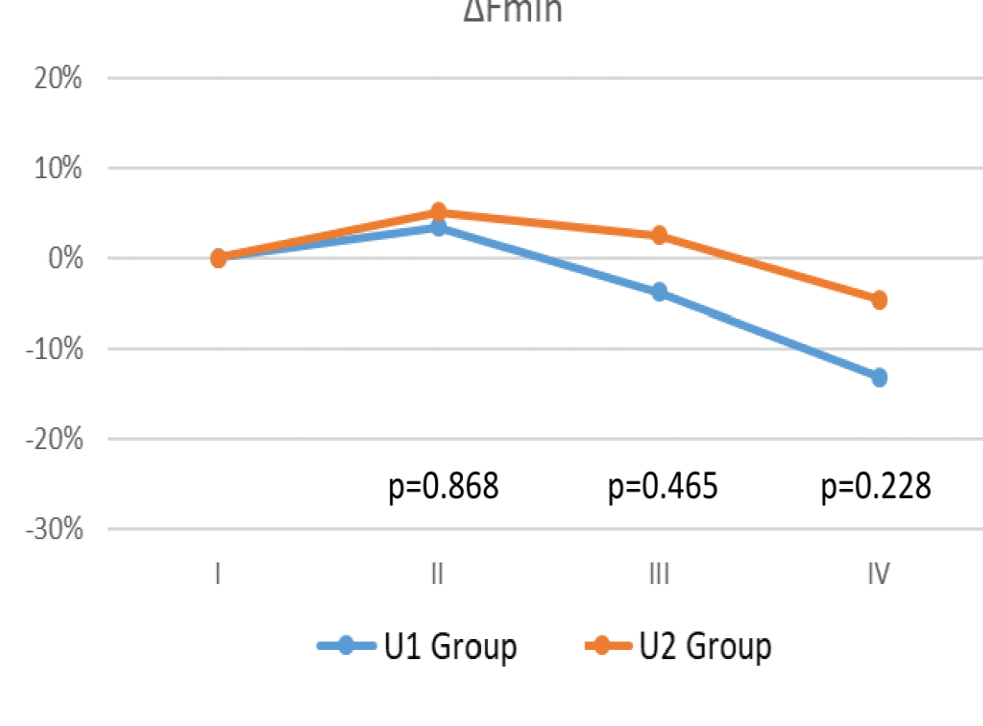
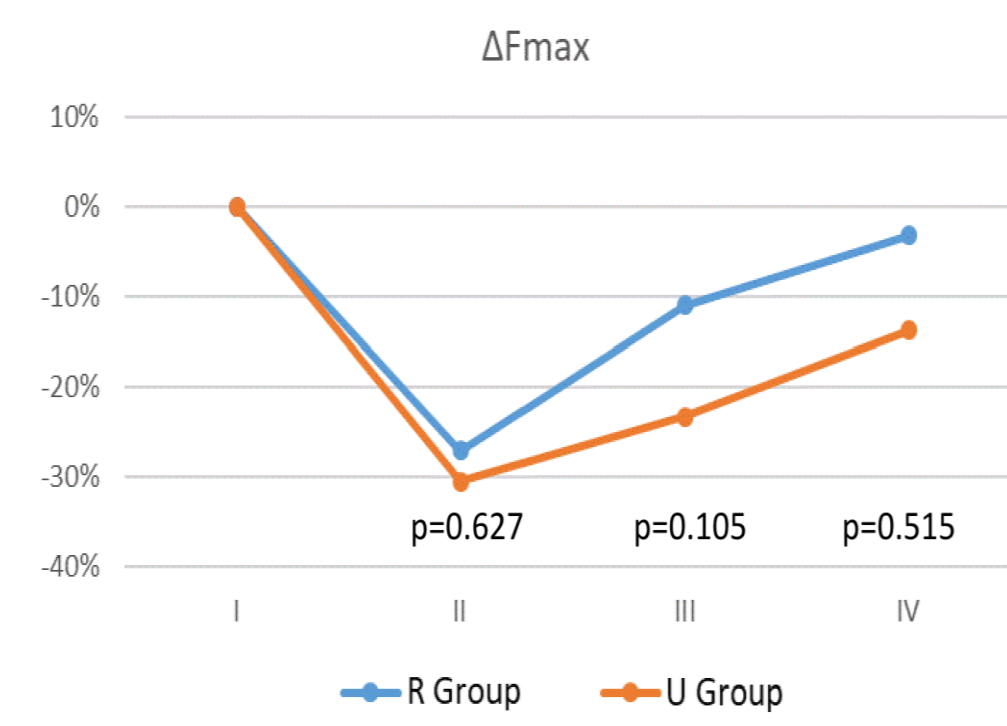
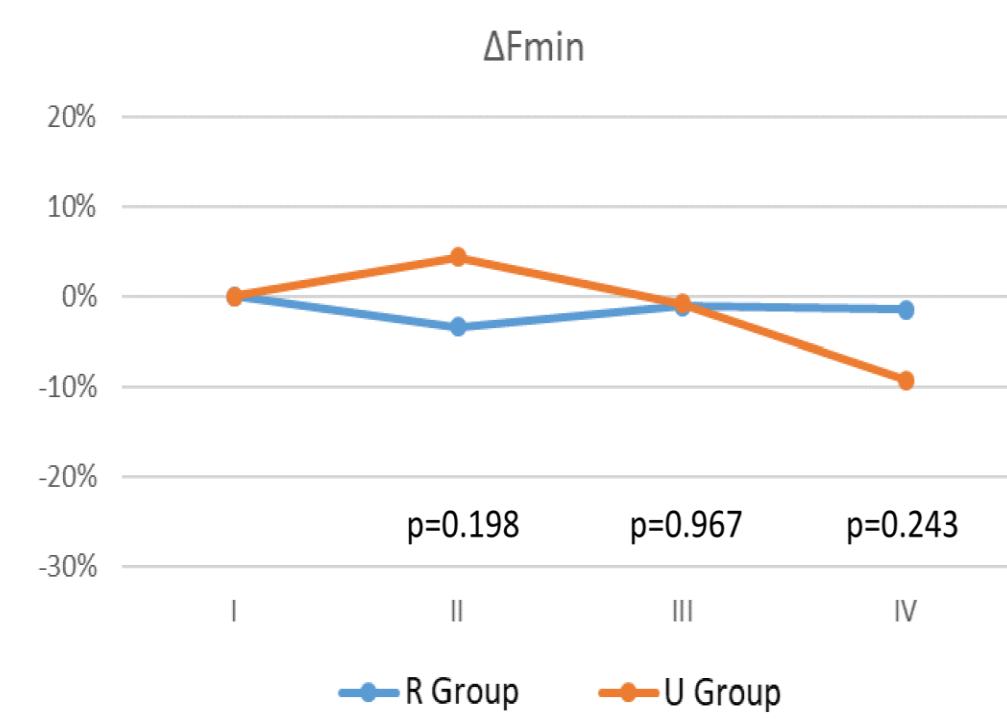
38 patients in U Group had more EMG >90% decrease of injured RLN ($p<0.001$), and had more thermal injury as RLN injury mechanism ($p=0.002$) compared to 42 patients in R Group. (**Table 1**) The U Group showed much impaired voice parameters than R Group without significant difference. (**Figure 2**) 19 patients in U2 Group had significant higher proportion of patients had EMG decrease >90% of injured RLN ($p=0.022$), and had thermal injury as RLN injury mechanism ($p=0.017$) than 19 patients in U1 Group. (**Table 2**) More pitch range decrease during period-II is a prognostic indicator for a moderate/severe long-term postoperative subjective voice impairment. (**Figure 3**)

Table 1. Demographic characteristics of Recovered VFM Group (R Group) and Unrecovered VFM Group (U Group)

	R Group	U Group	p value
Number (%)	42 (52.5%)	38 (47.5%)	
Age (mean±SD)	50.7±13.7	52.7±12.4	0.497
Gender			0.073
Male (%)	11 (26.2%)	5 (13.2%)	
Female (%)	31 (73.8%)	33 (86.8%)	
Surgical extent			0.086
Unilateral (%)	7 (16.7%)	1 (2.6%)	
Bilateral (%)	35 (83.3%)	37 (97.4%)	
Pathology			0.069
Benign (%)	24 (57.1%)	14 (36.8%)	
Malignant (%)	18 (42.9%)	24 (73.2%)	
EMG decrease of injured RLN			<0.001
<50% decreased (%)	0 (0.0%)	0 (0.0%)	
50-90% decreased (%)	35 (83.3%)	17 (44.7%)	
>90% decreased(%)	7 (16.7%)	21 (55.3%)	
RLN Injury mechanism and type			0.002
Transection (%)	0 (0.0%)	0 (0.0%)	
Mechanical (%)	42 (100.0%)	30 (78.9%)	
Type 1	33	27	
Type 2	9	3	
Thermal (%)	0 (0.0%)	8 (21.1%)	
Subjective voice impairment during period IV			0.028*
No/Mild (ΔIVST-T <4) (%)	31 (73.8%)	19 (50.0%)	
Moderate/Severe (ΔIVST-T ≥4) (%)	11 (26.2%)	19 (50.0%)	
RLN reinnervation or nerve grafting	0 (0.0%)	0 (0.0%)	

Table 2. Demographic characteristic of patients in U Group with different subjective voice outcomes during long-term postoperative period (Period-IV)

	U1 Group (ΔIVST-T < 4 during Period-IV)	U2 Group (ΔIVST-T ≥ 4 during Period-IV)	p value
Case number	19 patients (50.0%)	19 patients (50.0%)	
Age	50.5 ± 10.9	54.9 ± 11.8	0.240
Gender			0.150
Male (%)	4 (21.1%)	1 (5.3%)	
Female (%)	15 (78.8%)	18 (94.7%)	
Surgical extent			0.311
Unilateral (%)	1 (5.3%)	0 (0.0%)	
Bilateral (%)	18 (94.7%)	19 (100.0%)	
Pathology			0.179
Benign (%)	5 (26.3%)	9 (47.4%)	
Malignant (%)	14 (73.7%)	10 (52.6%)	
EMG decrease of injured RLN			0.022*
50-90% decreased (%)	12 (63.2%)	5 (26.3%)	
>90% decreased (%)	7 (36.8%)	14 (73.7%)	
RLN injury mechanism			0.017*
Mechanical (%)	18 (94.7%)	12 (63.2%)	
Thermal (%)	1 (5.3%)	7 (36.8%)	



▲ **Figure 3.** Objective voice parameter changes (Δ) with different subjective voice outcomes during long-term postoperative period (Period-IV): U1 Group (Blue line, ΔIVST-T < 4 during Period-IV) and U2 Group (Red line, ΔIVST-T ≥ 4 during Period-IV).

◀ **Figure 2.** Voice parameter changes (Δ) with different vocal cord movement (VFM) outcomes: R Group (Blue line) and U Group (Red line).

Conclusions

This study is the first to evaluate the correlation between IONM finding and voice outcome in patients with VFM impairment after thyroid surgery. Thyroid surgeons should try every effort to avoid severe type (EMG >90% decrease, thermal-related) RLN injury, which caused higher risk of unrecovered VFM, and higher risk of moderate/severe long-term postoperative subjective voice impairment. Using objective voice parameter (e.g. pitch range) as the prognostic indicator make surgeons can not only identify patients who suffered from stress due to the unsatisfied surgical outcome earlier, but initiate intervention therapy earlier to remain patients’ quality of life.