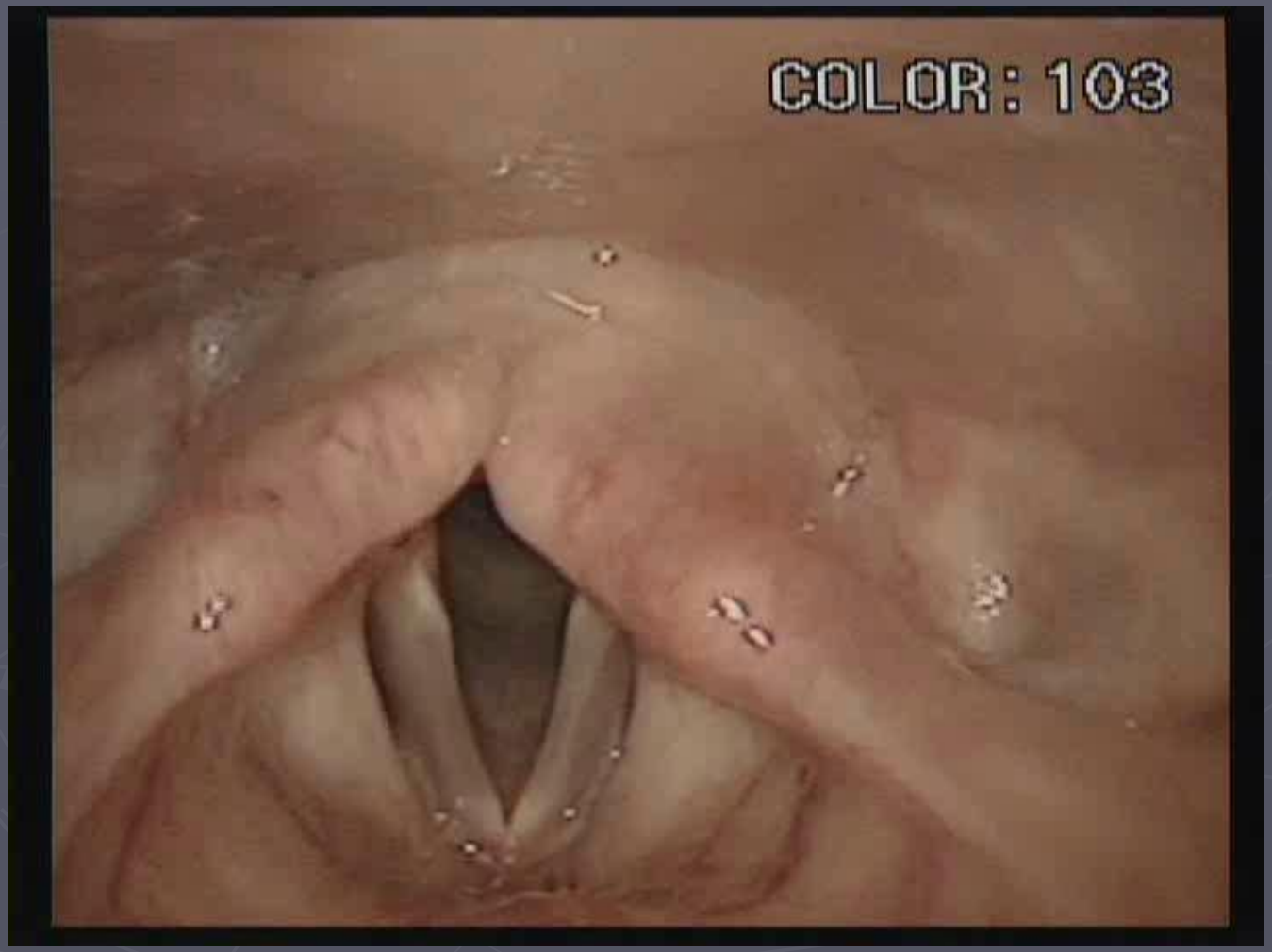
Feature and ethiology of unilateral vocal fold paralysis（UVFP） and its surgical treatment

Ryoji Tokashiki



Shinjyuku Voice Clinic
Tokyo medical university

Unilateral vocal fold paralysis (UVFP)



Indication of arytenoid adduction (AA) for unilateral vocal fold paralysis (UVFP) is considered･･･

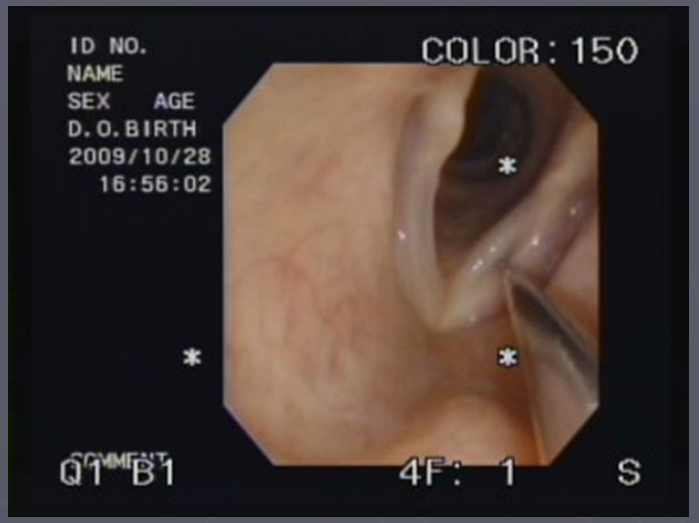
- Large posterior gap
- Unequal vocal fold levels during phonation

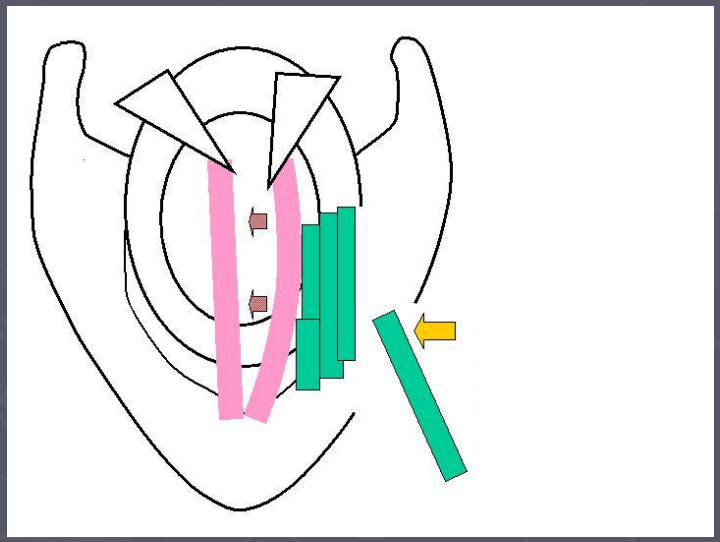
- Mild cases can be treated by medialization laryngoplasty or injection

Is it true?

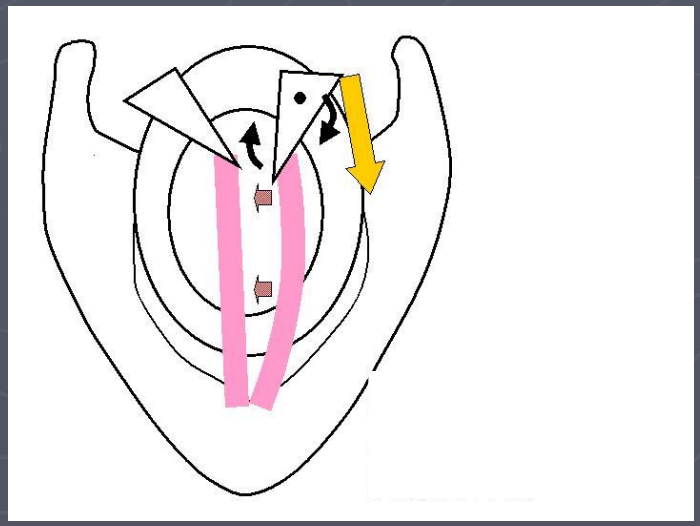
Surgery for UVFP

- Injection laryngoplasty





- Type I thyroplasty

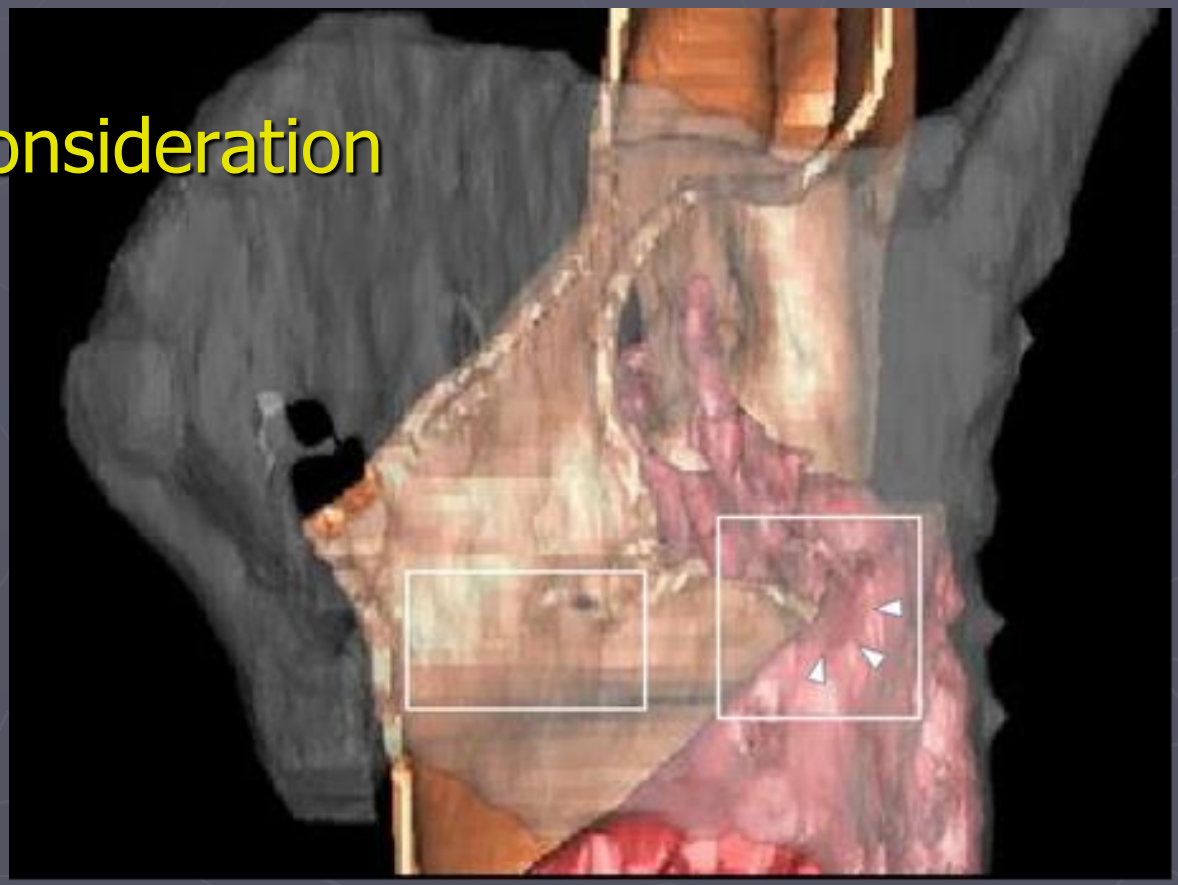


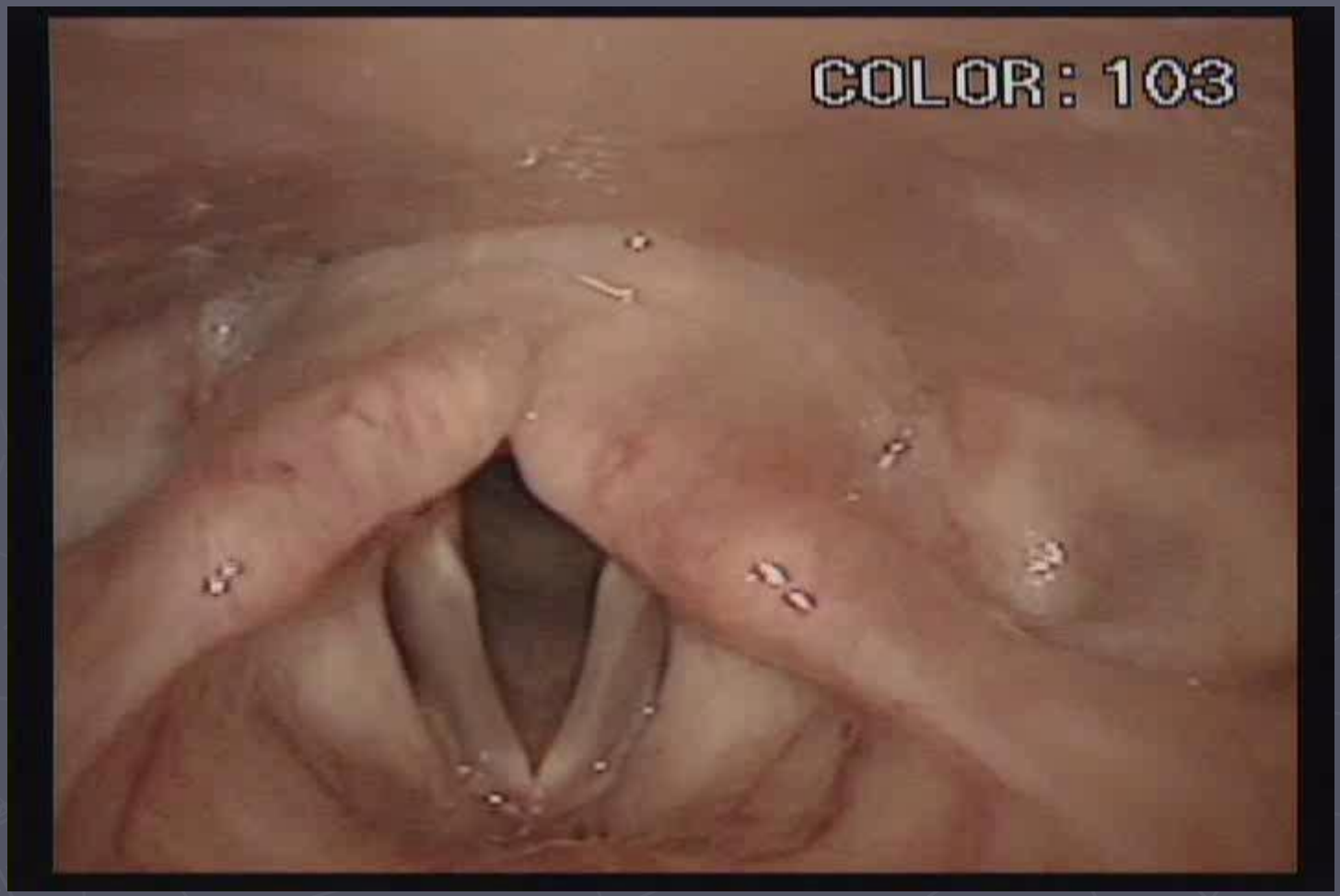
- Arytenoid adduction

Our answer is “N0”

- Why arytenoid adduction is “the best choice” for UVFP?

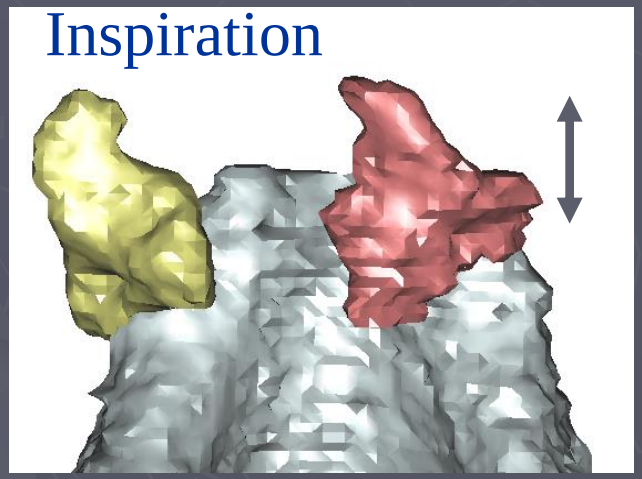
Pathological consideration using 3DCT




COLOR: 103

State of paralyzed arytenoid of unilateral vocal cord paralysis (UVFP)

- Arytenoid is passively moved up and pushed laterally by healthy side when patients phonate. (Jostle sign)



3D movement of arytenoids on the cricoid cartilage

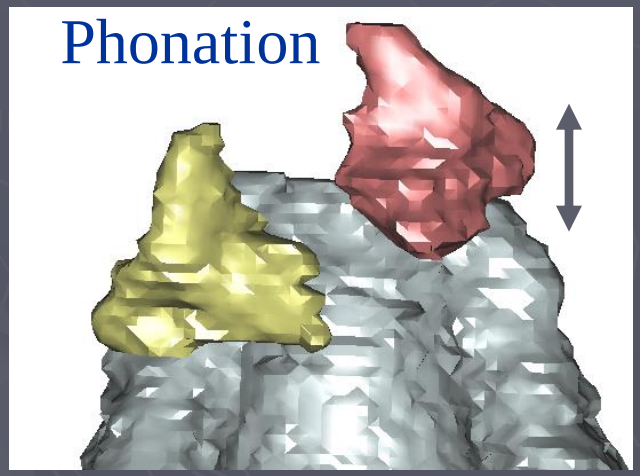


Subglottic view through tracheotomy

Hiramatsu, Tokashiki et al : Three-Dimensional Computed Tomography of the Larynx for Evaluating Unilateral Vocal Fold Paralysis European Archives of ORL 2008

State of paralyzed arytenoid of unilateral vocal cord paralysis (UVFP)

- Arytenoid is passively moved up and pushed laterally by healthy side when patients phonate. (Jostle sign)



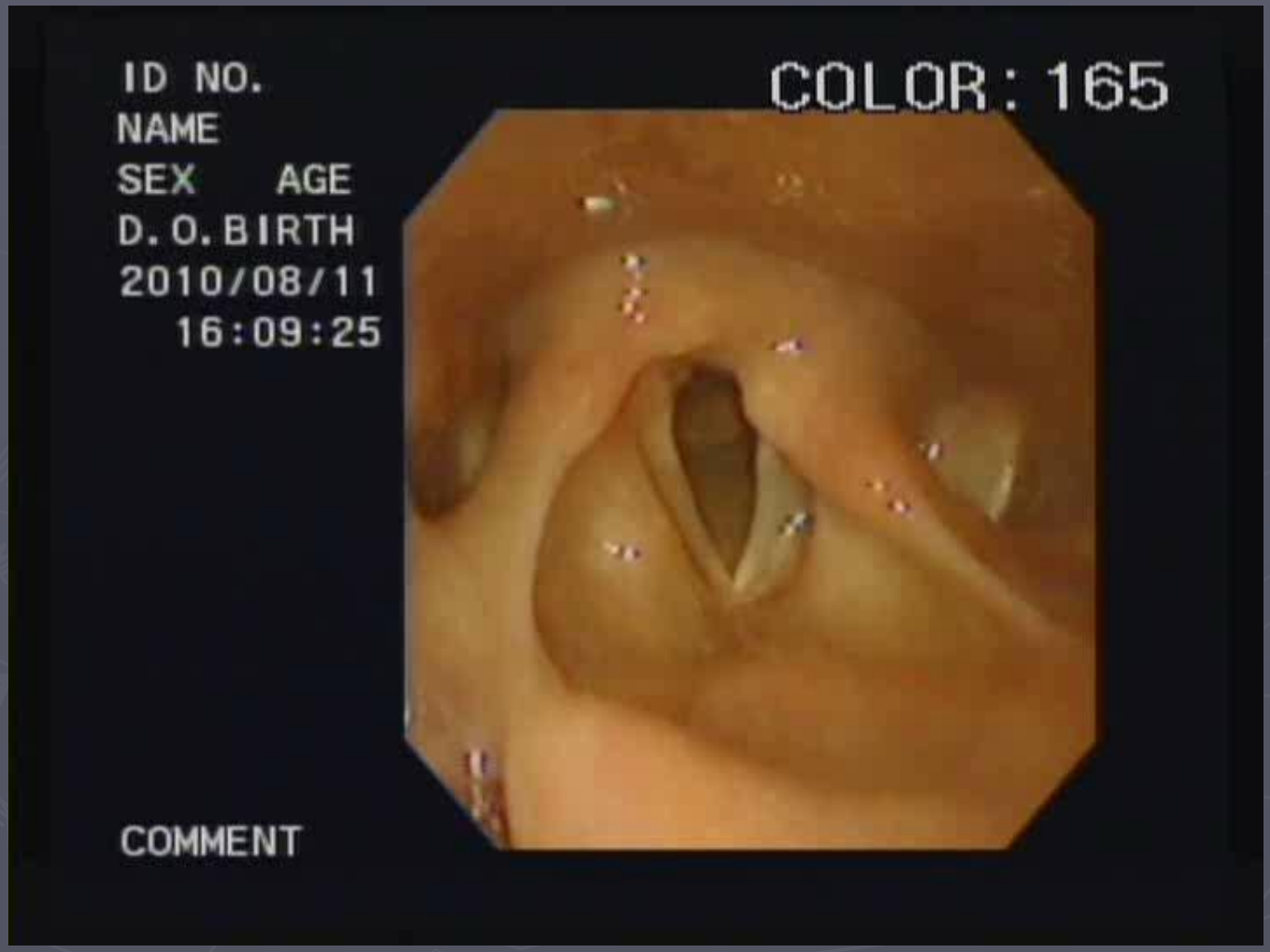
3D movement of arytenoids on the cricoid cartilage



Subglottic view through tracheotomy

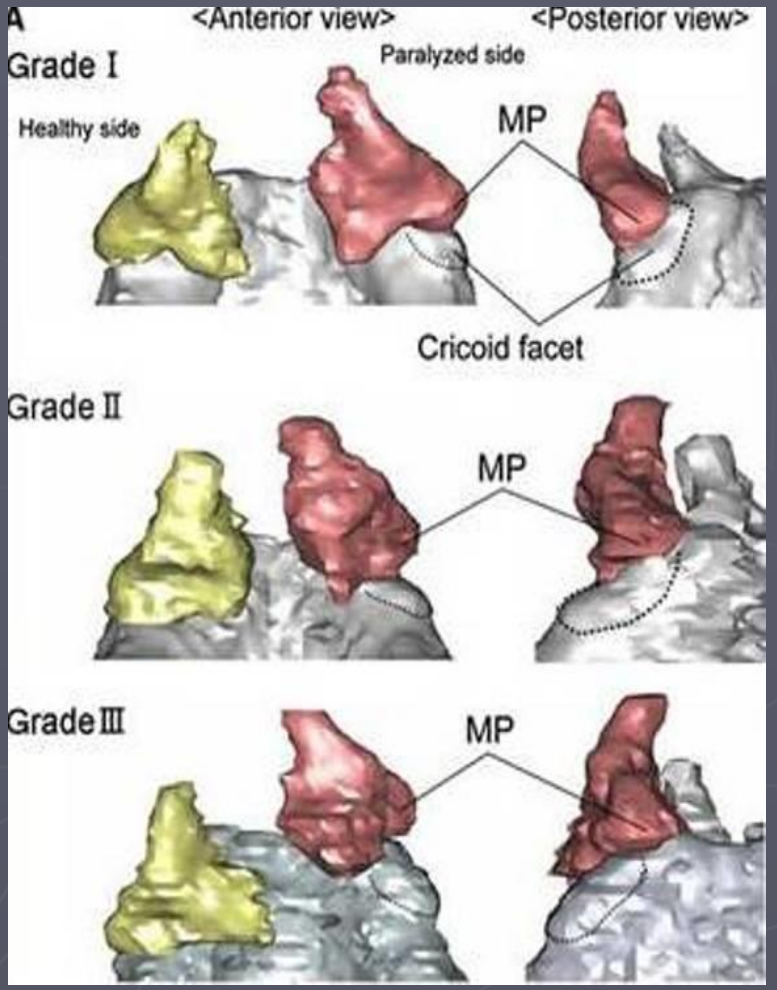
Hiramatsu, Tokashiki et al : Three-Dimensional Computed Tomography of the Larynx for Evaluating Unilateral Vocal Fold Paralysis European Archives of ORL 2008

VP level seems to be the same, but‥



Correlation between arytenoid vertical displacement and MFR

- As the grade of cranial displacement becomes more severe, the MFR worsens.
- Cranial displacement was observed in all patients even in mild cases

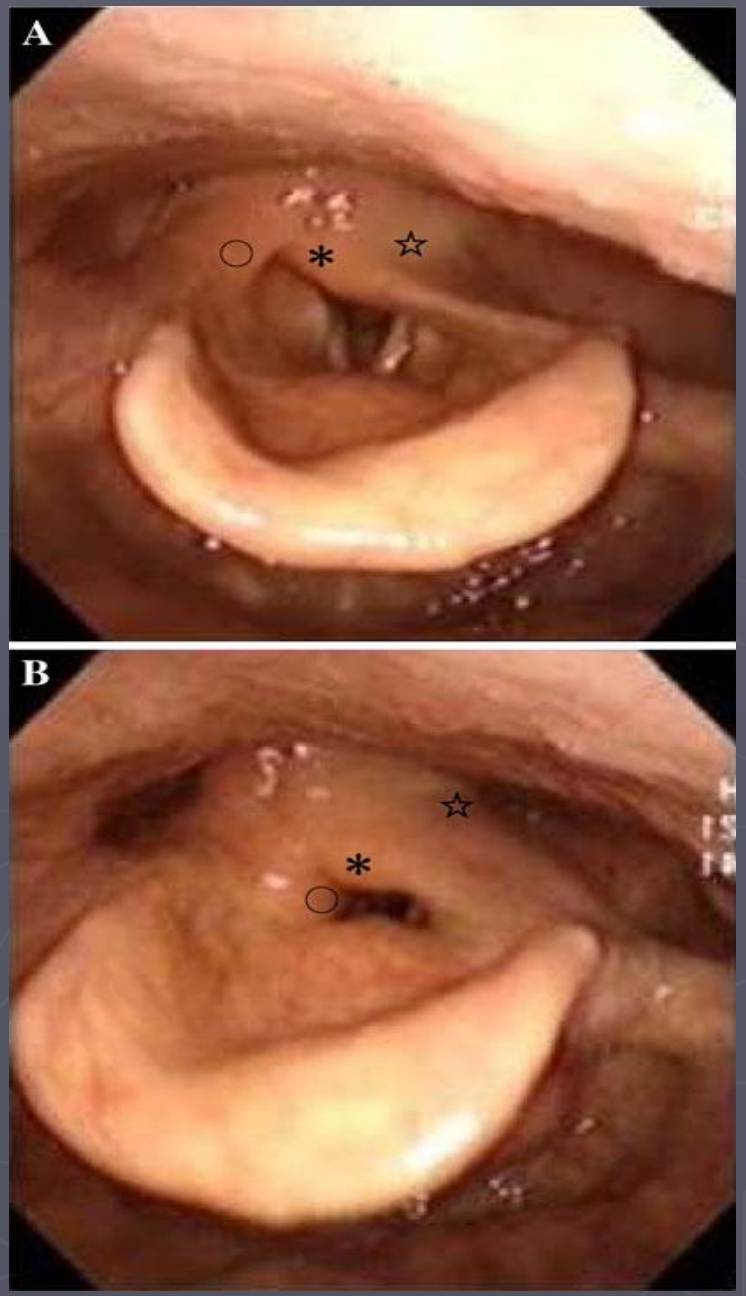


	Control	Grade Ⅰ	Grade Ⅱ	Grade Ⅲ
MFR(ml/s)	150.9 ±31.6	477.3 ±258.0	617.3 ±230.5	1074.7 ±323.3

Hiramatsu, Tokashiki et al European Archives of ORL 2009

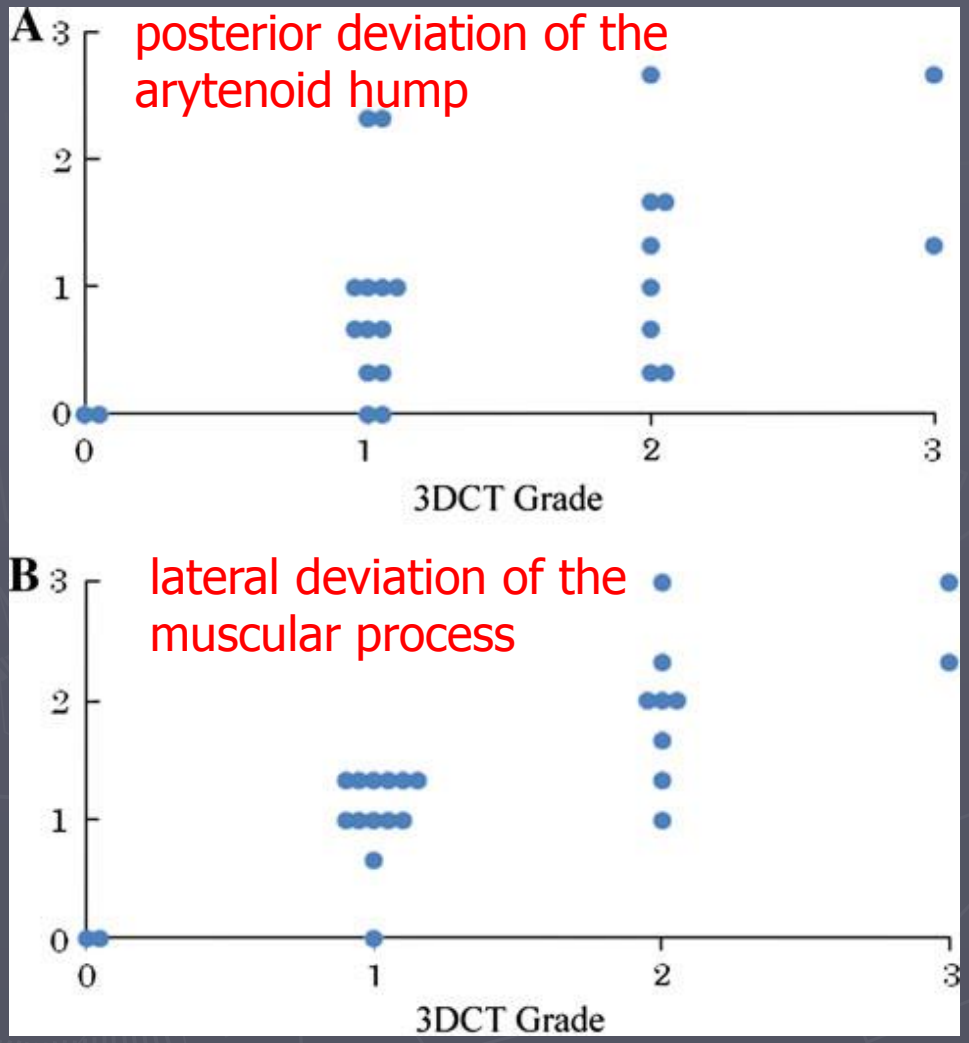
Endoscopic findings of passive movement (Jostle sign)

- The arytenoid hump moves to posteriorly during phonation
- The muscler process moves laterally and upward during phonation



Okamoto, Tokashiki et al : Detection of passive movement of the arytenoid cartilage in unilateral vocal-fold paralysis by laryngoscopic observation:useful diagnostic findings European Archives of ORL 2012

Relationship between endoscopic findings scale (0-3) and 3DCT grade (0-3)



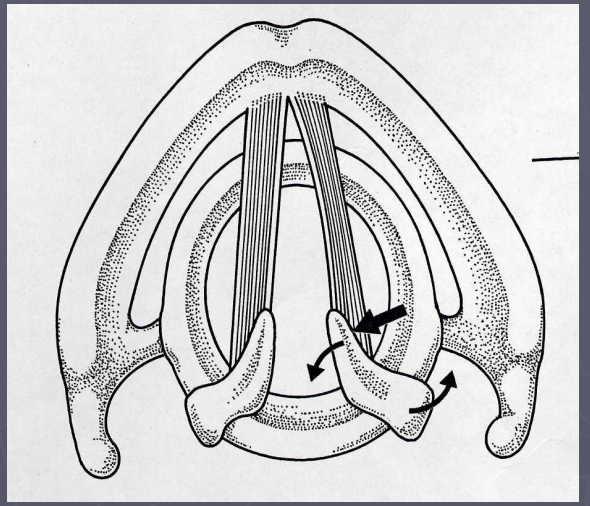
- Both findings had significant relation with 3DCT grade
- The lateral deviations of the MP was more significant with 3DCT grade
- These findings are useful to diagnose UVFP and judge severity

Okamoto, Tokashiki et al : Detection of passive movement of the arytenoid cartilage in unilateral vocal-fold paralysis European Archives of ORL 2012

According to these findings ……..

- AA reproduce natural adduction of the arytenoid
- Fixation of the arytenoid in rocking position

  resolve passive movement



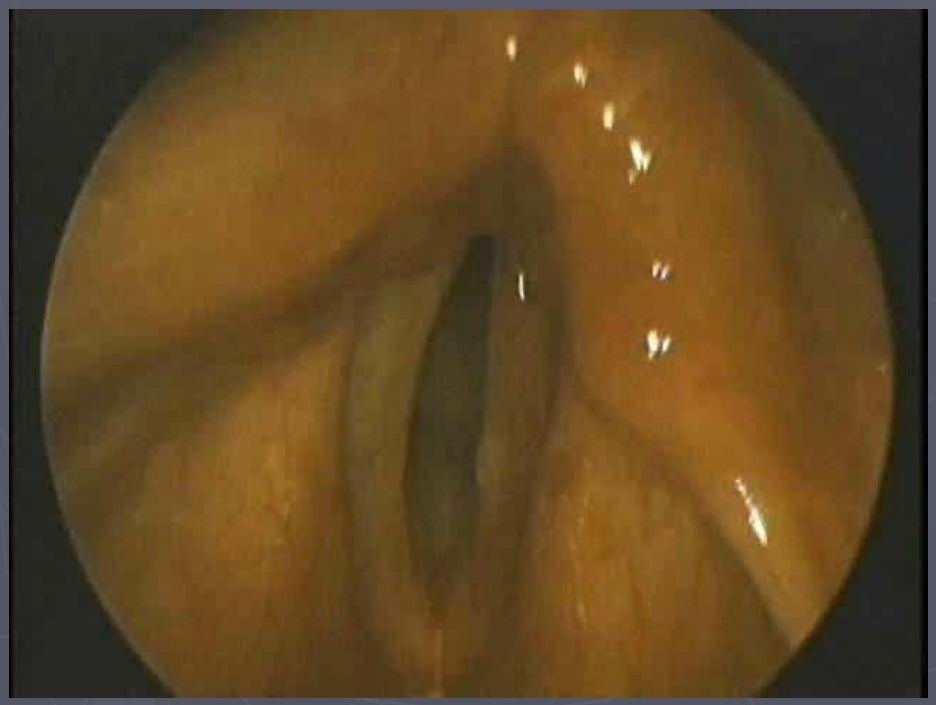
- Two point support reproduce the tension of the vocal fold
- AA stretch the vocal fold and give real tension to vocal fold.

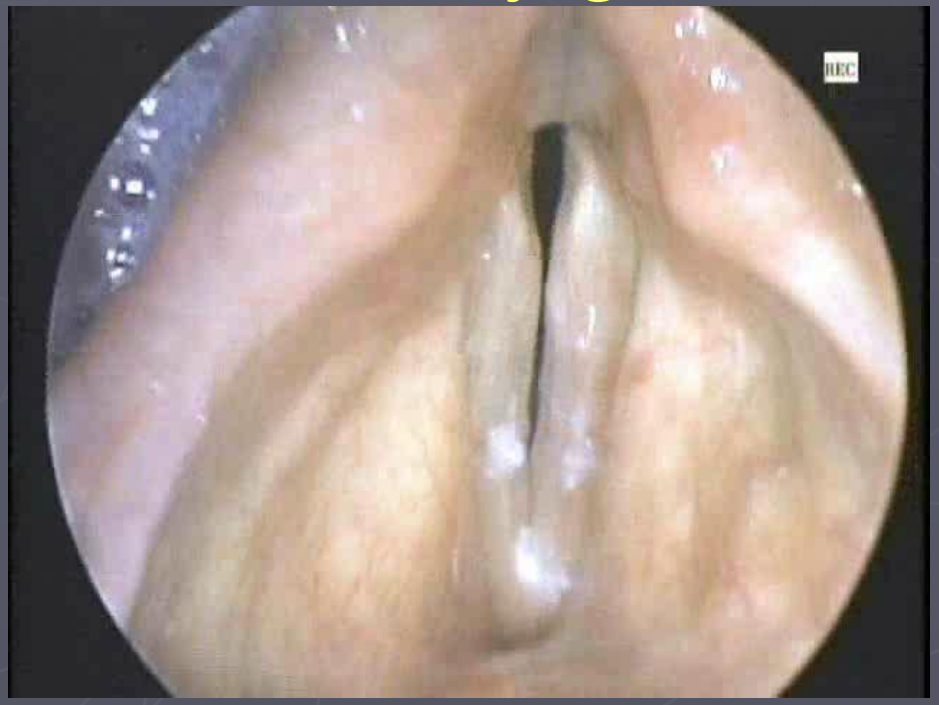
Our approach to UVFP

- AA is useful for every grade of UVFP
- Type Ⅰ or type Ⅳ thyroplasty is simulated during surgery and performed when effective.
- Mild cases could be treated by AA only???

A case of high-pitched diplophonia that was resolved by AA only

Tsukahara.K Tokashiki.R : Acta Otolaryngol 2005





Before Surgery

- MPT : 18 s　MFR : 216ml/s
- pitch range : C2-A3 (22 semitone)

After Surgery

- MPT : 33 s　MFR : 158ml/s
- pitch range : D2-G4 (34 semitone)

Possible AA (arytenoid adduction)

There have been some reports of trying to adduct the arytenoid

- by injecting materials near to the vocal process (VP)

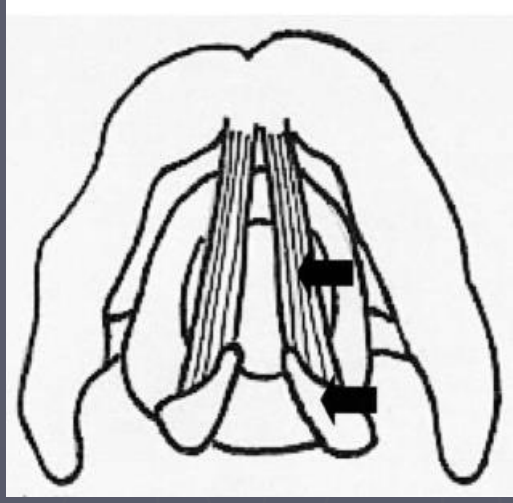
or

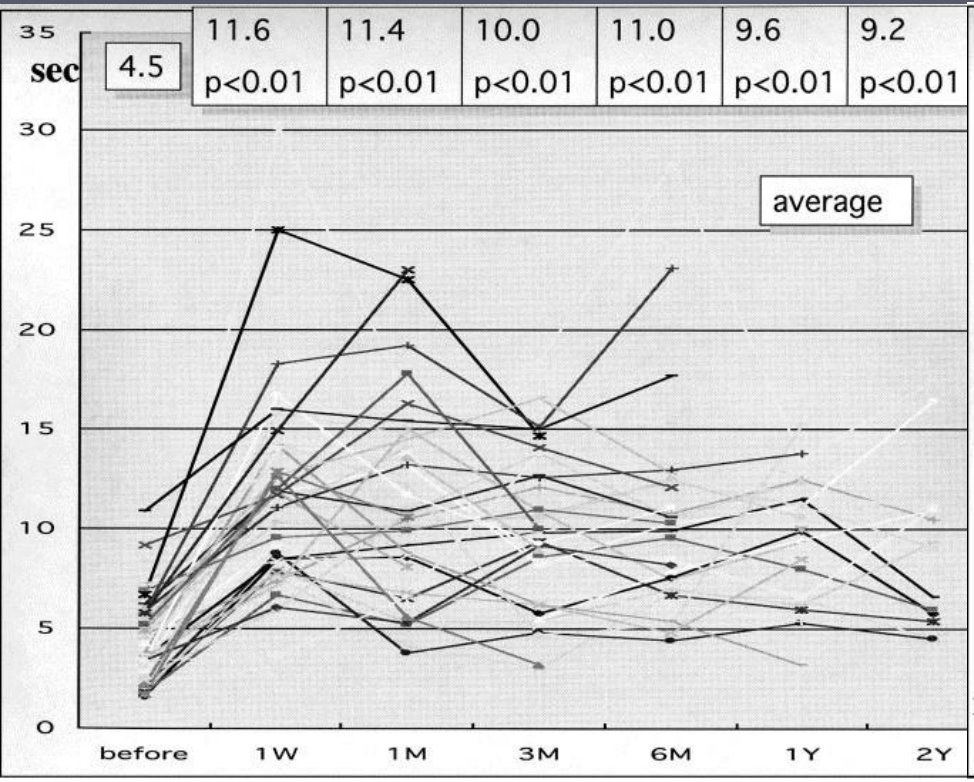
- by pushing posterior part of the vocal fold through the type I Thyroplasty window.

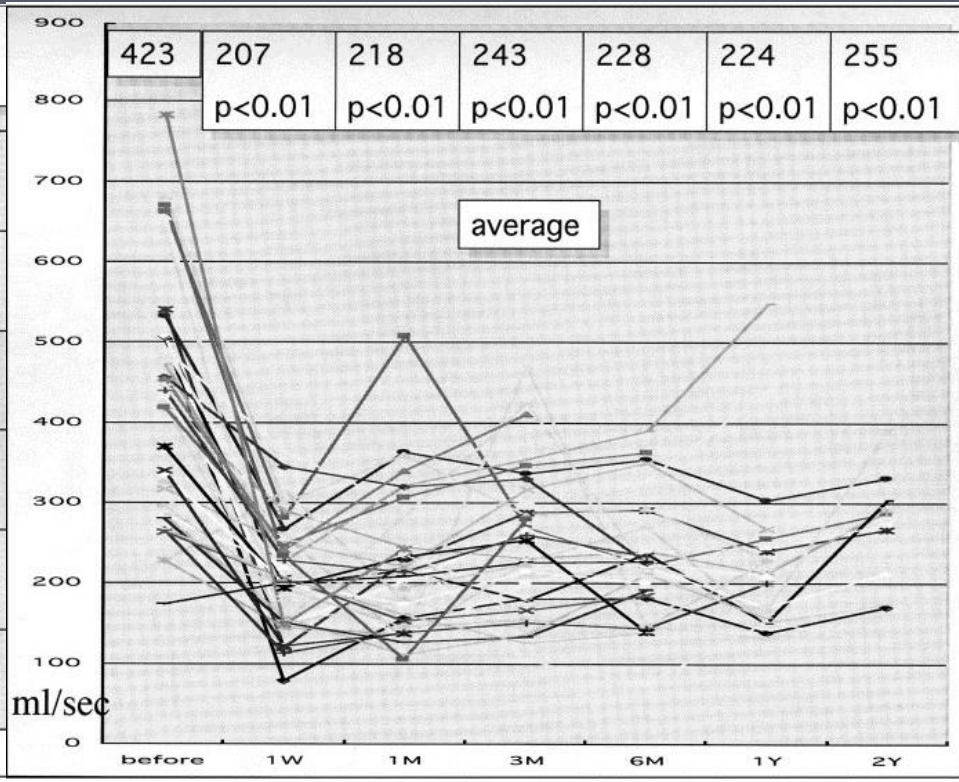
Do these procedures achieve the same outcome as usual AA?

Postoperative MPT & MFR of possible AA by fat injection

Umeno H et al: 2005







MPT

MFR

Postoperative MPT of possible AA by Montgomery implant



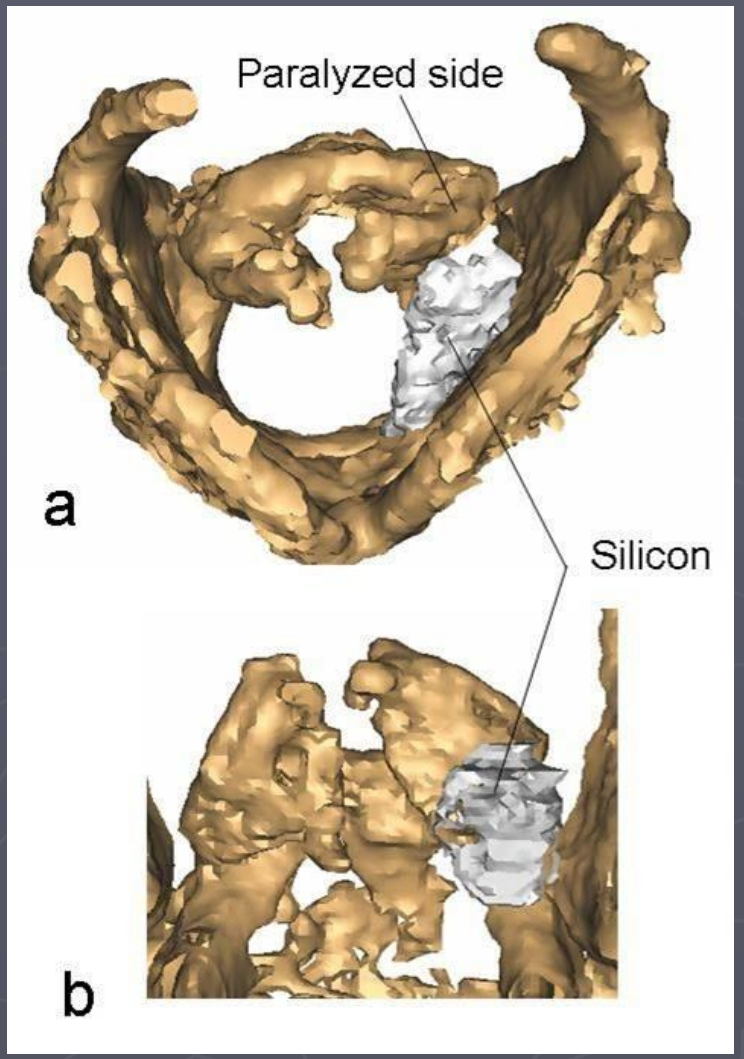
- Post-op MPT : 4~18sec
- Average : 9 sec （Nouwen 2004）

- Post-op MPT: 3~25 sec
- Average : 10.4 sec （Laccourreye 2005）

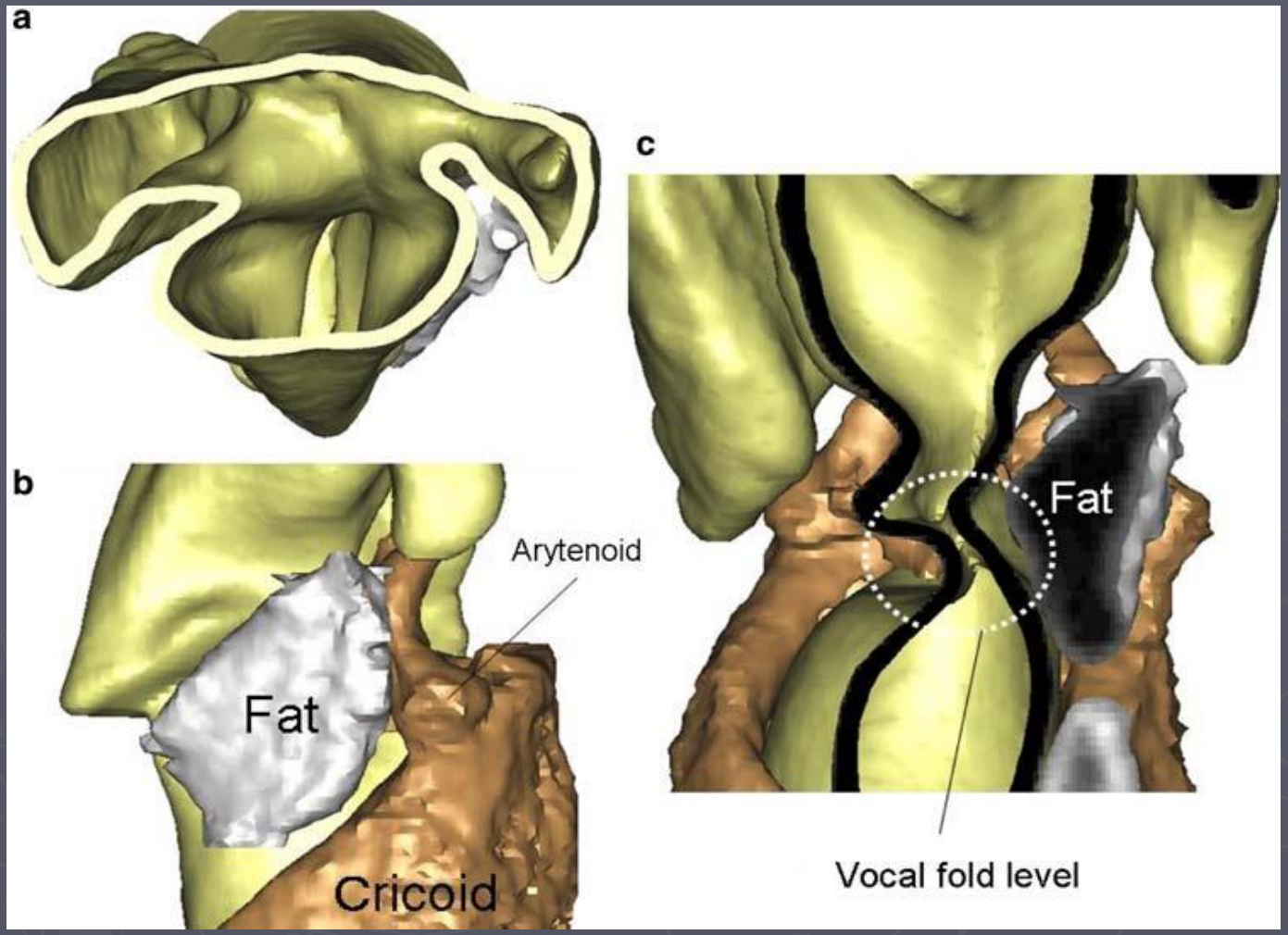
Why are there not more improved cases by possible AA?

They try to adduct the arytenoid....

- The arytenoid seems to move medially
- The arytenoid is pushed cranially and the vertical gap worsens.
- These procedures do not reproduce natural adduction



Hiramatsu, Tokashiki et al : 3DCT of the Larynx for Evaluating Unilateral Vocal Fold Paralysis European Archives of ORL 2008



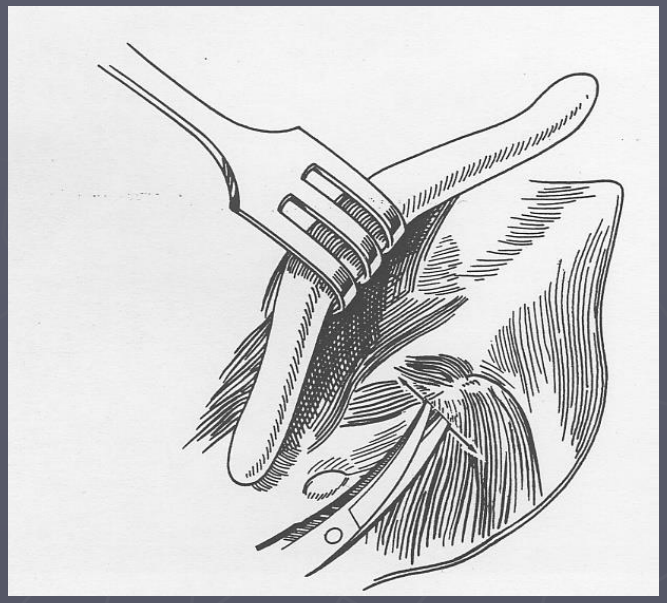
Hiramatsu, Tokashiki et al : 3DCT of the Larynx for Evaluating Unilateral Vocal Fold Paralysis European Archives of ORL 2008

Some laryngologists may think AA is difficult and may have experienced poor results.

- Our procedure of AA is simple and shows promising results.

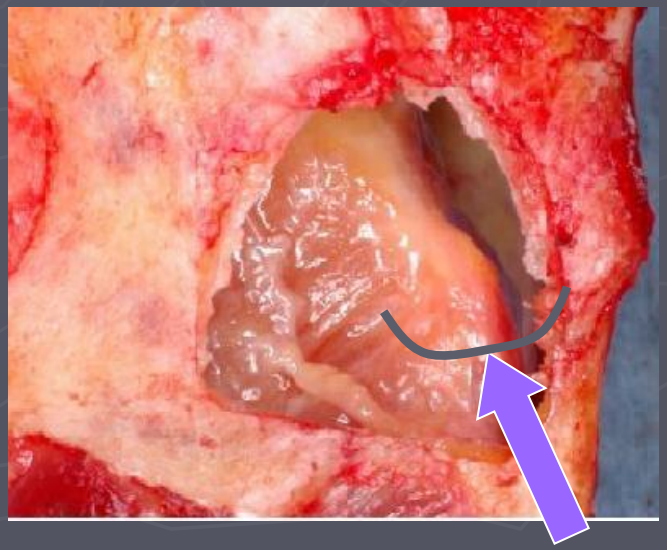
Arytenoid adduction （Isshiki 1976)

- Release the cricothyroid joint and elevated thyroid ala laterally

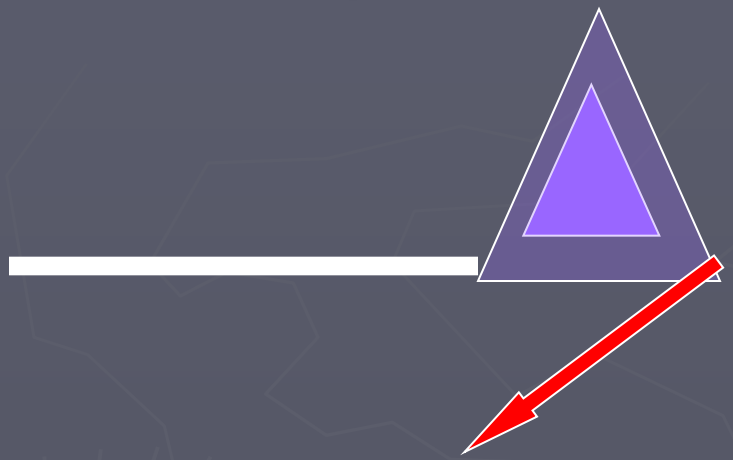


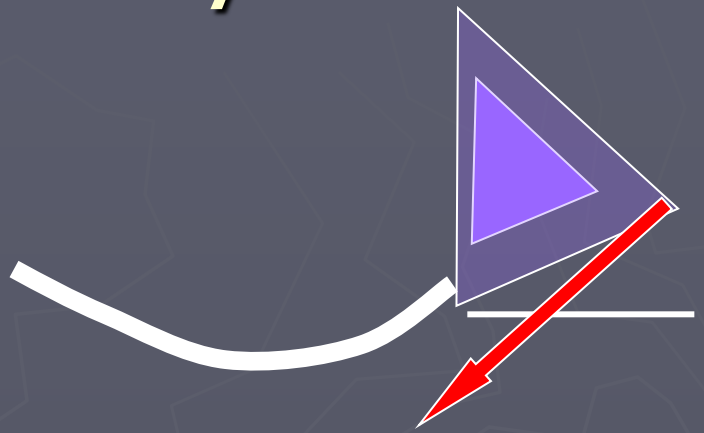
- Release the cricoarytenoid joint

and make a stitch in the direction of an arrow（ ）



If the cricoarytenoid joint is opened excessively‥‥

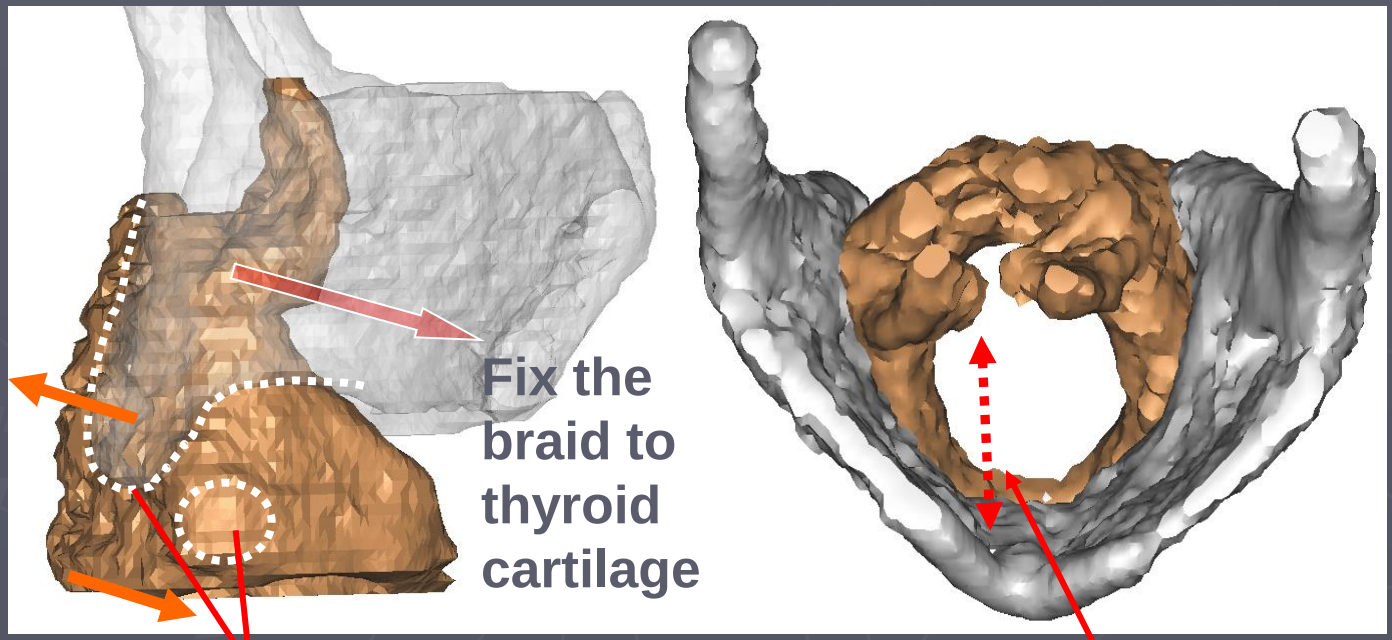






The vocal fold shortens and loses its tension.

If the thyroarytenoid joint is opened and the braid is fixed strongly to the thyrod cartilage･･･



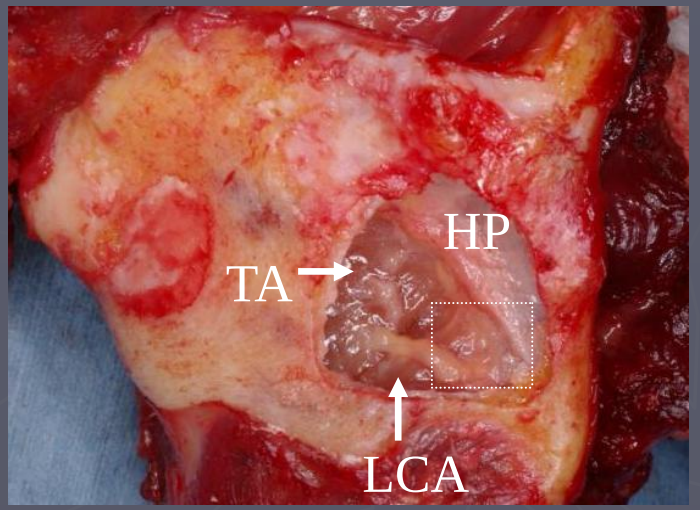
Dislocation of the thyroarytenoid joint

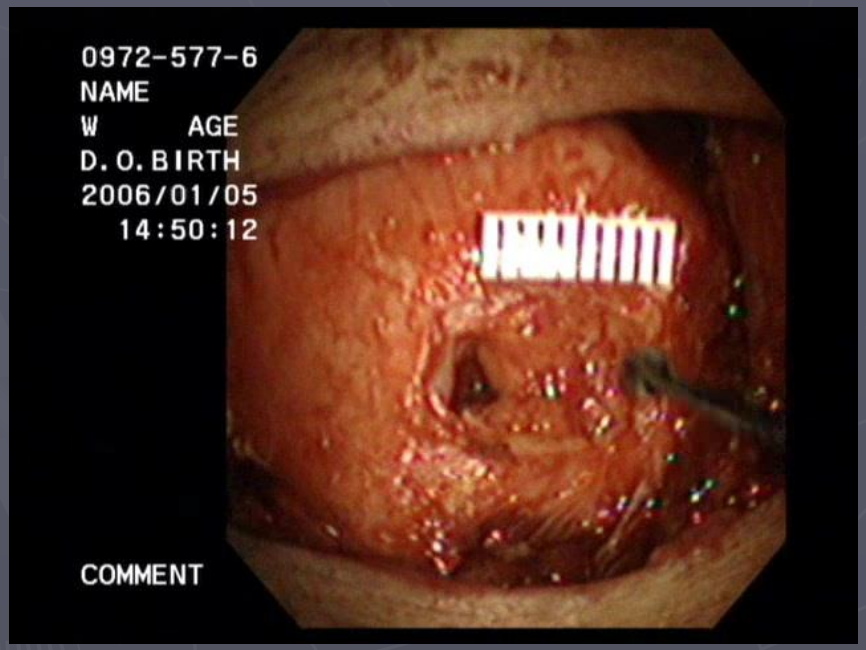
The vocal fold shortens and loses its tension

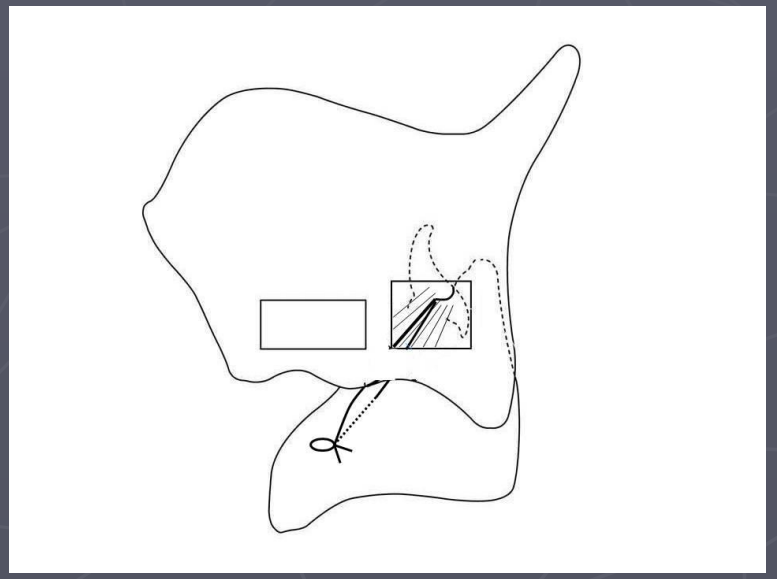
Hiramatsu, Tokashiki et al : 3DCT of the Larynx for Evaluating Unilateral Vocal Fold Paralysis European Archives of ORL 2008

To reproduce natural adduction of the arytenoid and obtain satisfactory results‥‥

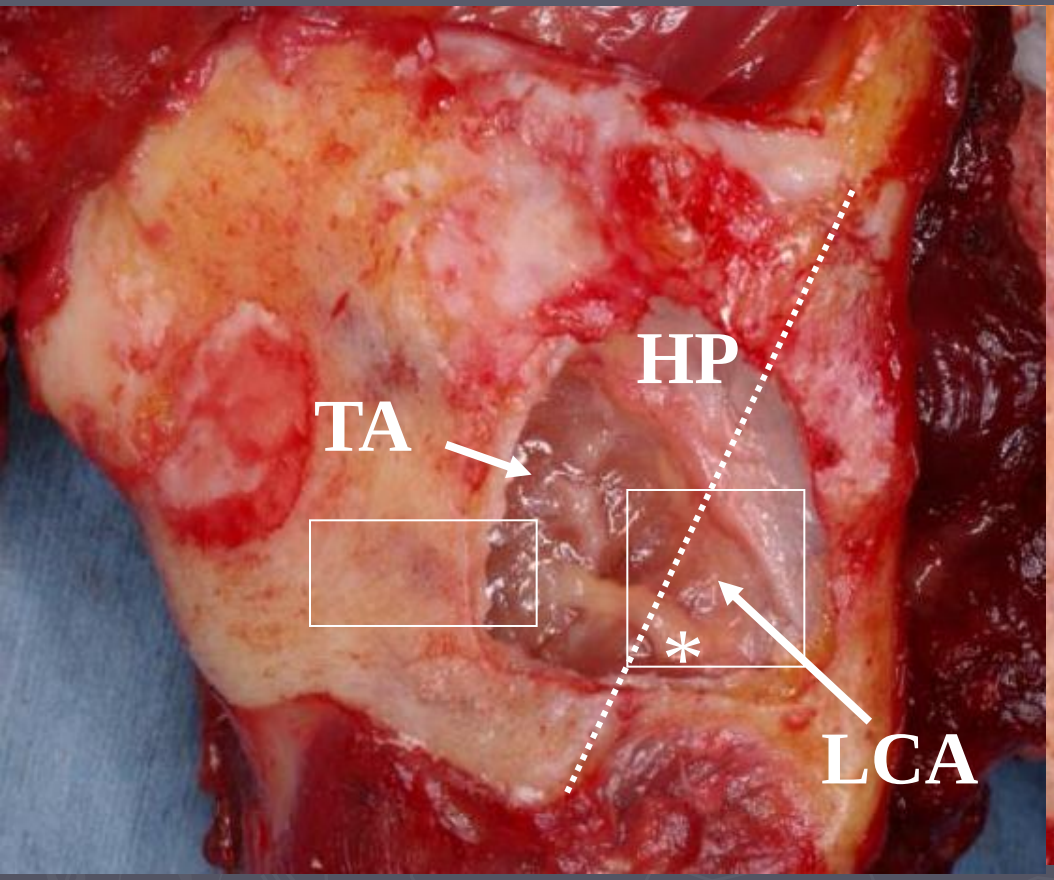
- Local anesthesia
- No release of the cricotyroid joint
- No release of the cricoarytenoid joint
- Braid pulled in the contractile direction of the LCA muscle

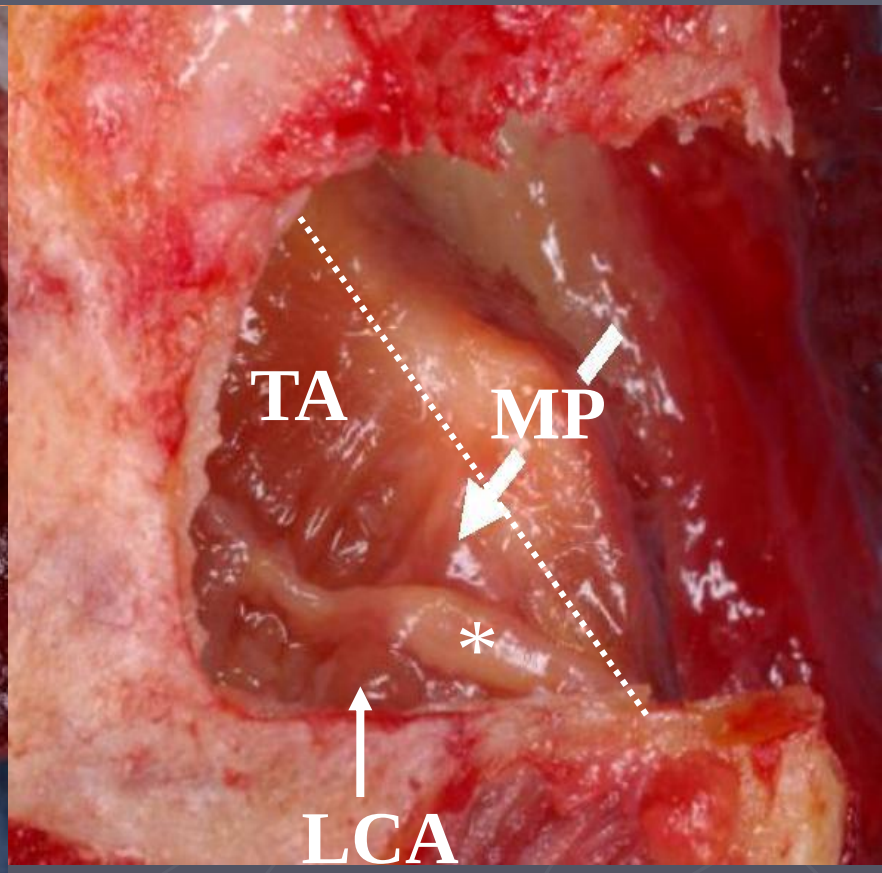






Tokashiki R, et al : A "fenestration approach" for arytenoid adduction through the thyroid ala combined with type I thyroplasty Laryngoscope 2007

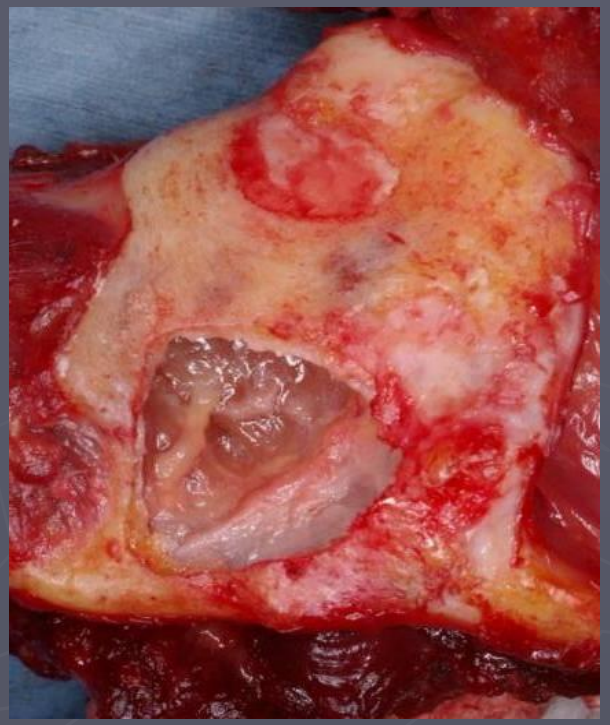




* : adductor branch of the RLN

Surgery（Lt）





cranial

Tokashiki R, Hiramatsu H et al : *A "fenestration approach" for arytenoid adduction through the thyroid ala combined with type I thyroplasty* *Laryngoscope 2007*

Surgery of Lt side



Cranial

Tokashiki R　Hiramatsu H et al: Direct pull of lateral cricoarytenoid muscle　for unilateral vocal cord paralysis. Acta-Otolaryngol 2005

Laryngeal findings and voice before and after our operation



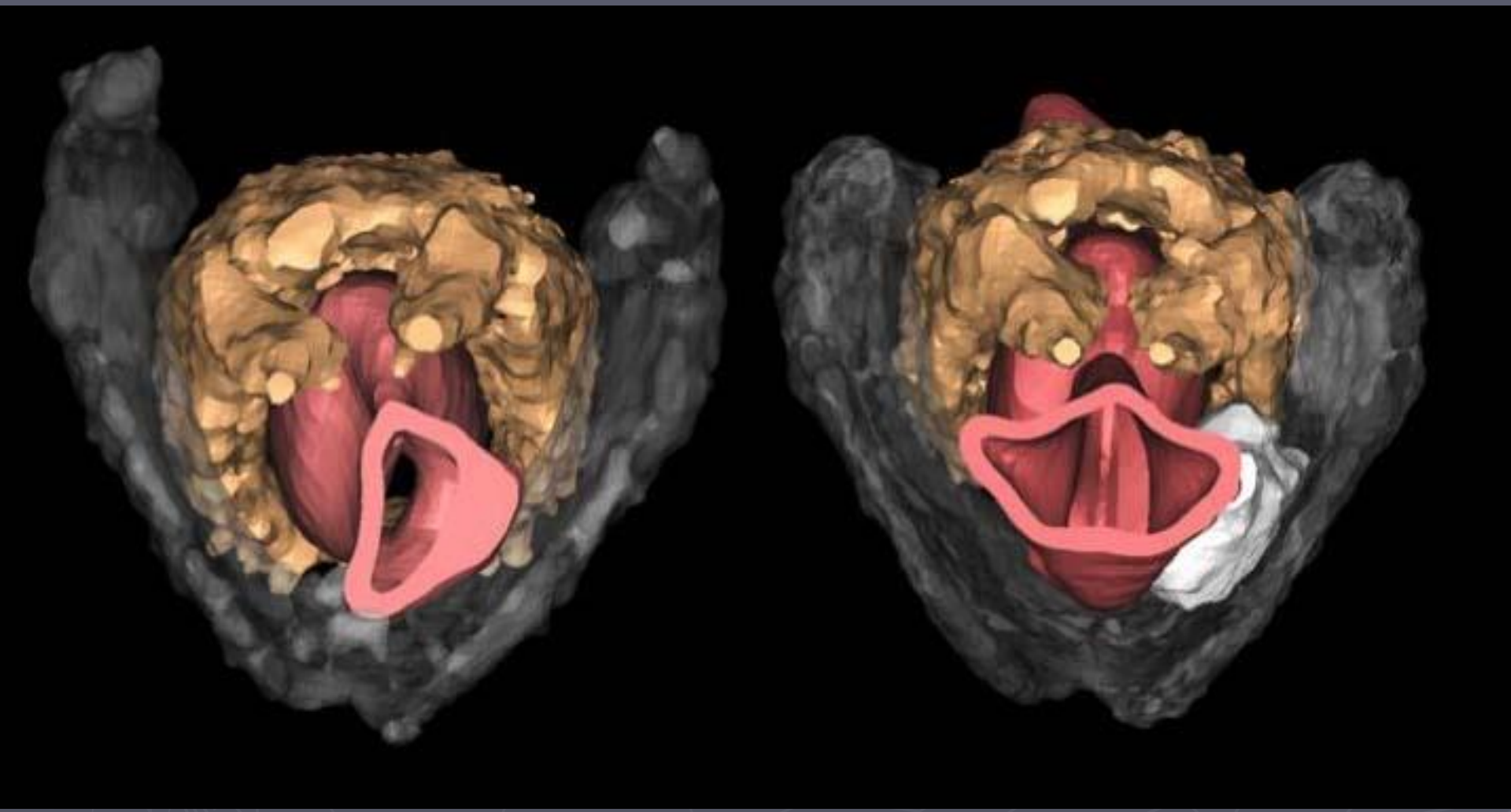


before

MPT: 4 sec

after

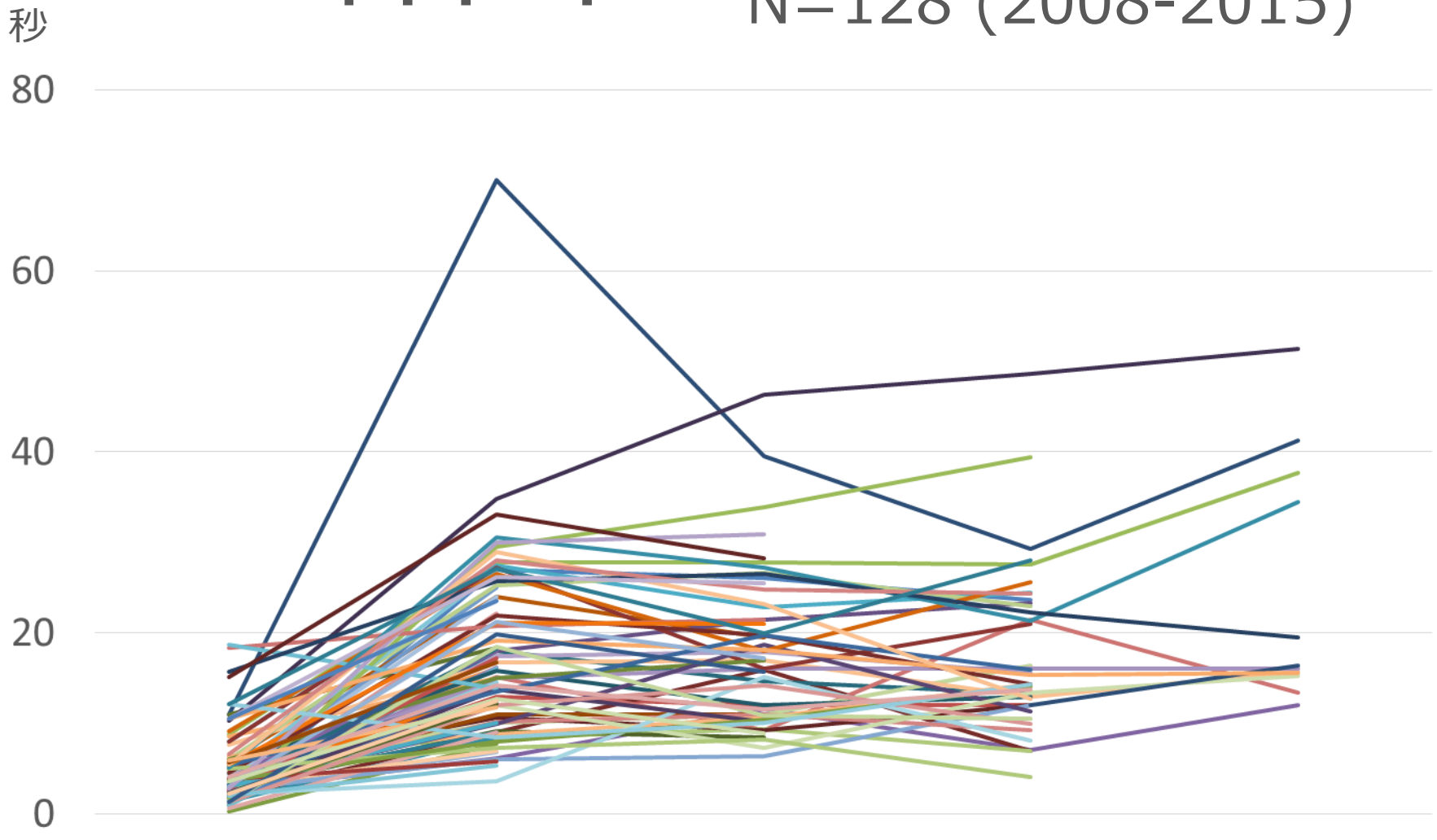
MPT : 22 sec



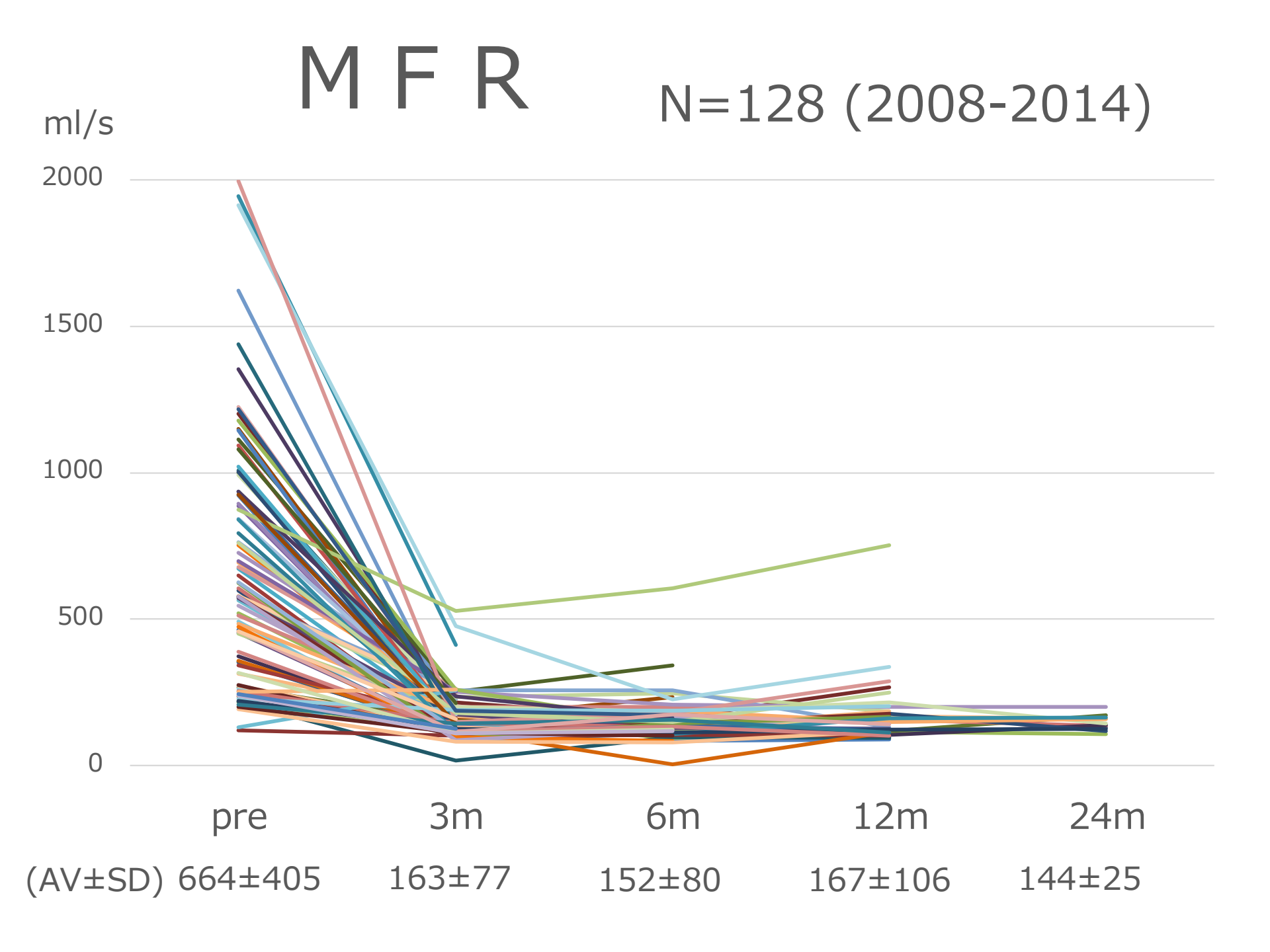
Result

M P T

N=128 (2008-2015)



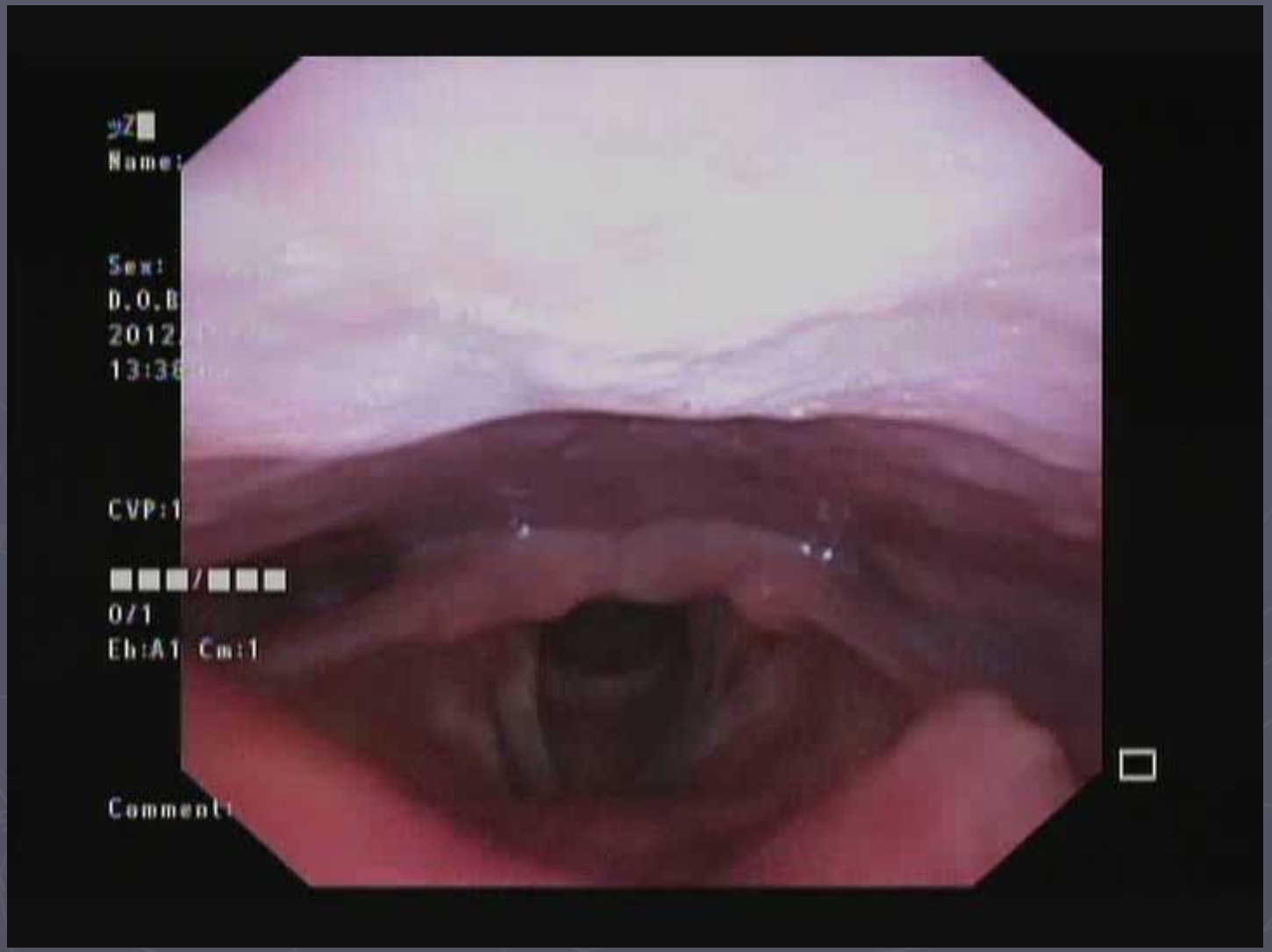
	pre	3m	6m	12m	24m
(AV±SD)	5.3±4.4	17.3±9.2	18.2±8.8	17.2±8.7	23.5±12.8


M F R
N=128 (2008-2014)
ml/s
2000
1500
1000
500
0
pre
3m
6m
12m
24m
(AV±SD) 664±405
163±77
152±80
167±106
144±25

Unilateral paralysis of the adductor branch of the recurrent laryngeal nerve

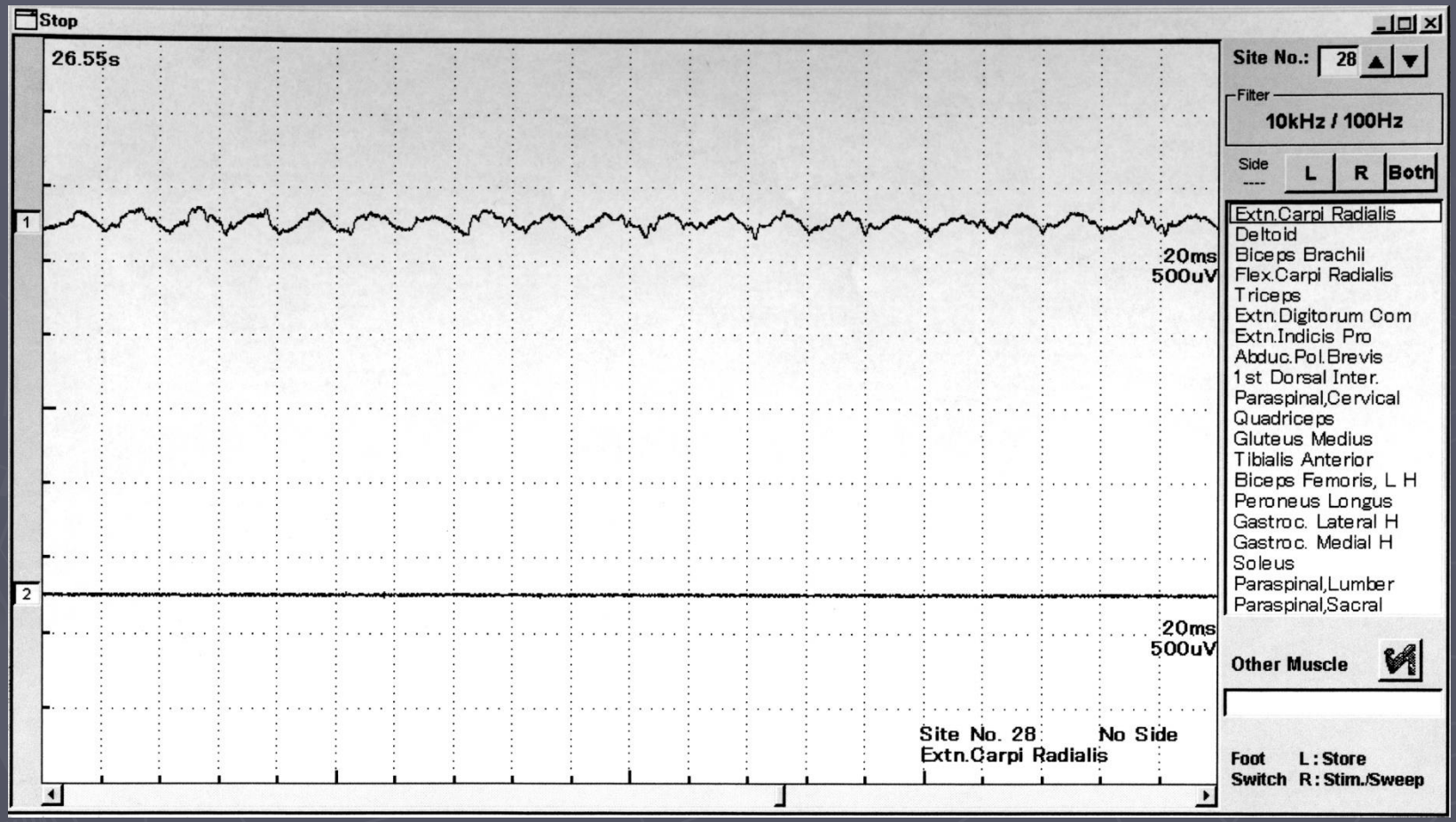
(AdBP)

Lt adductor branch paralysis (AdBP)



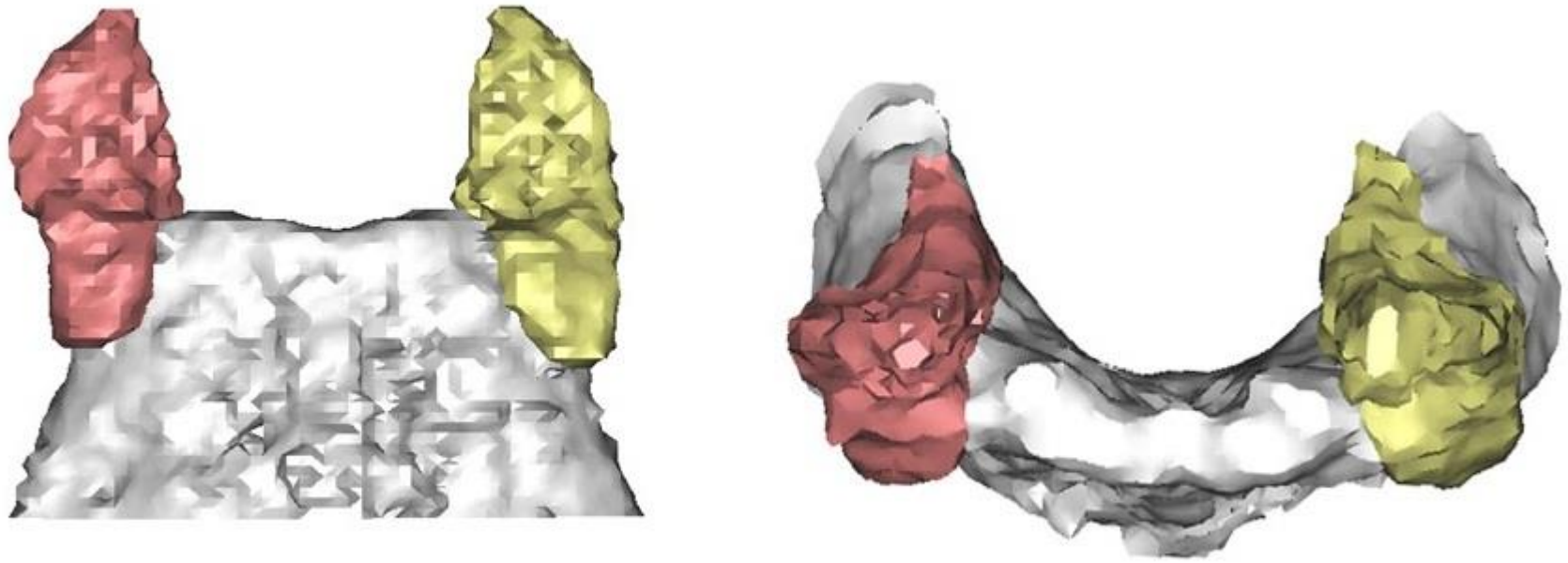
E M G

- of the left thyroarytenoid（TA）muscle



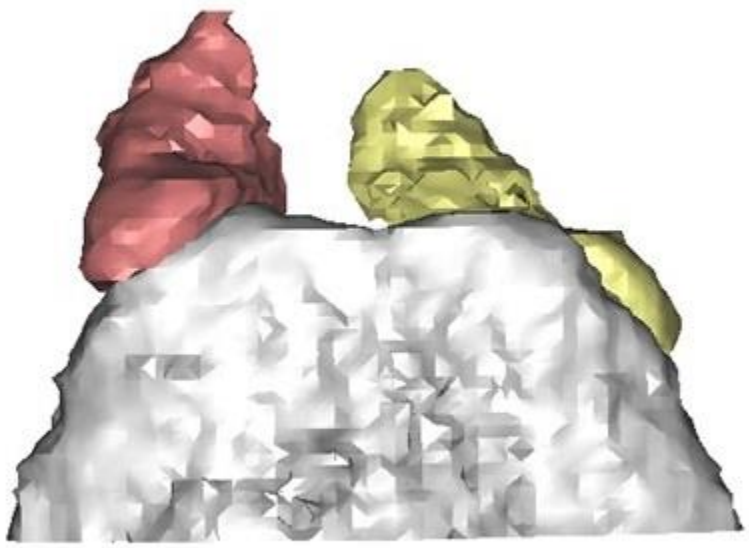
→ **silent**

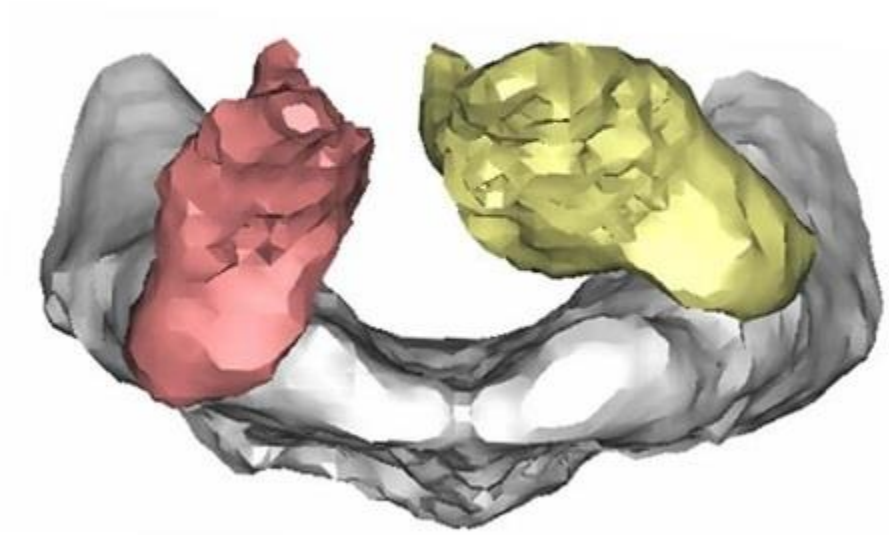
inspiration



- Both arytenoids opened normally.

phonation





- The right arytenoid (red) did not adduct during phonation.

Diagnosis

paralysis of the adductor branch of the right recurrent laryngeal nerve

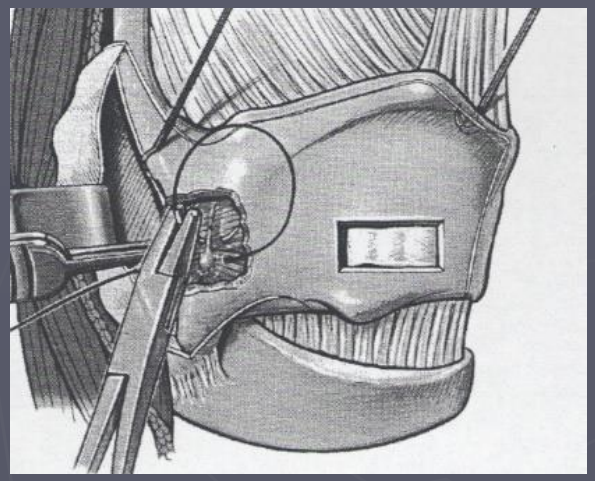
(Rt AdBP)

Operation Planning

- Arytenoid adduction combined with type 1 thyroplasty

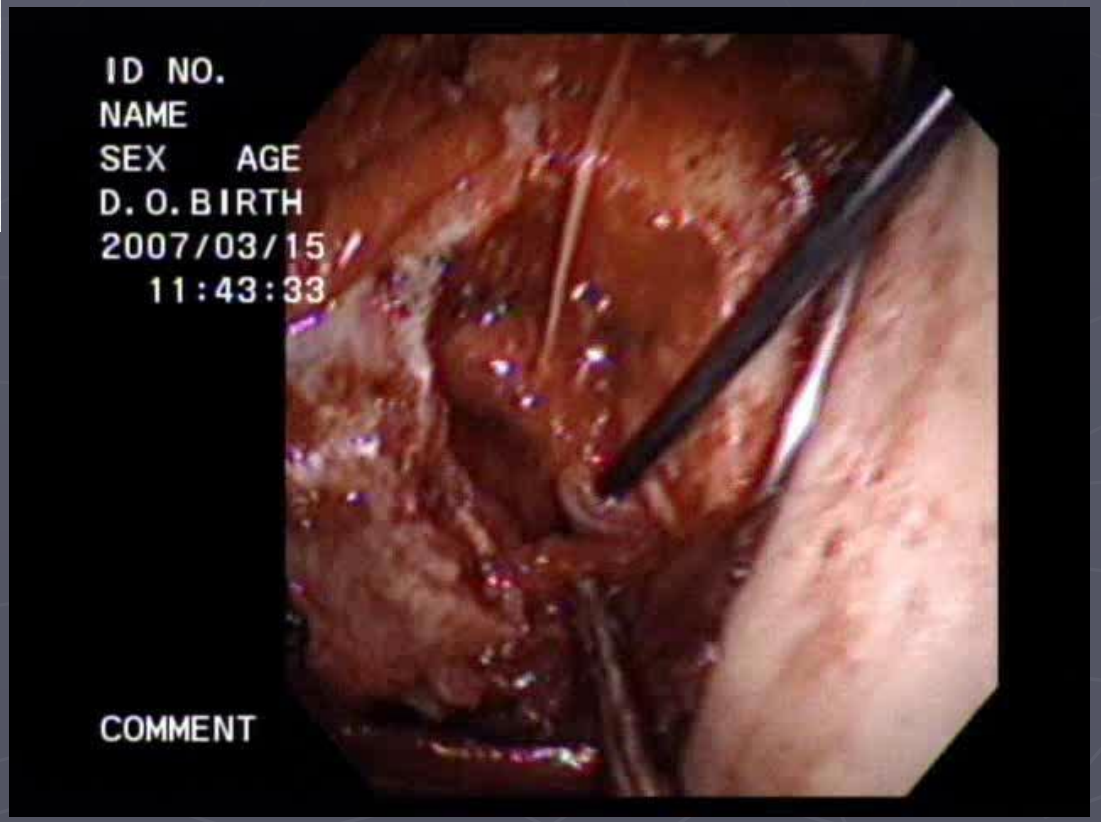
- Resection of the PCA muscle
- We supposed that Maragos approach (posterior border removal) was better to treat the PCA

Operation



anterior

cranial



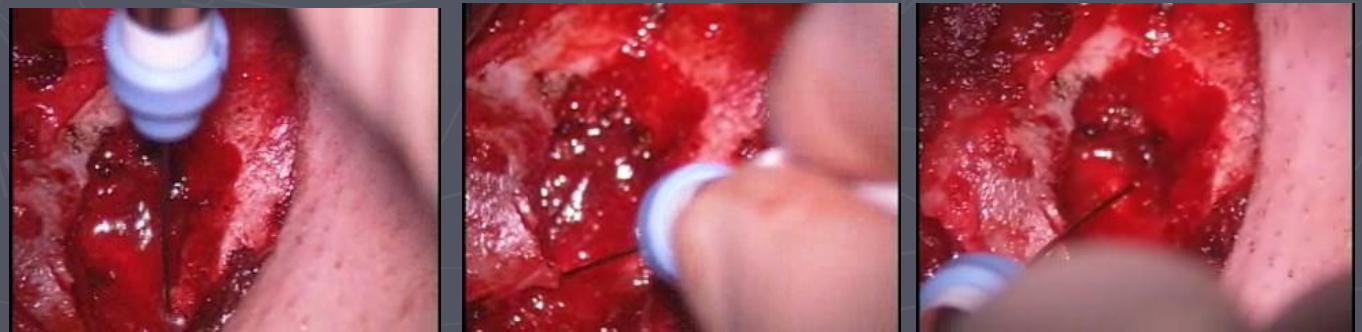
caudal

posterior

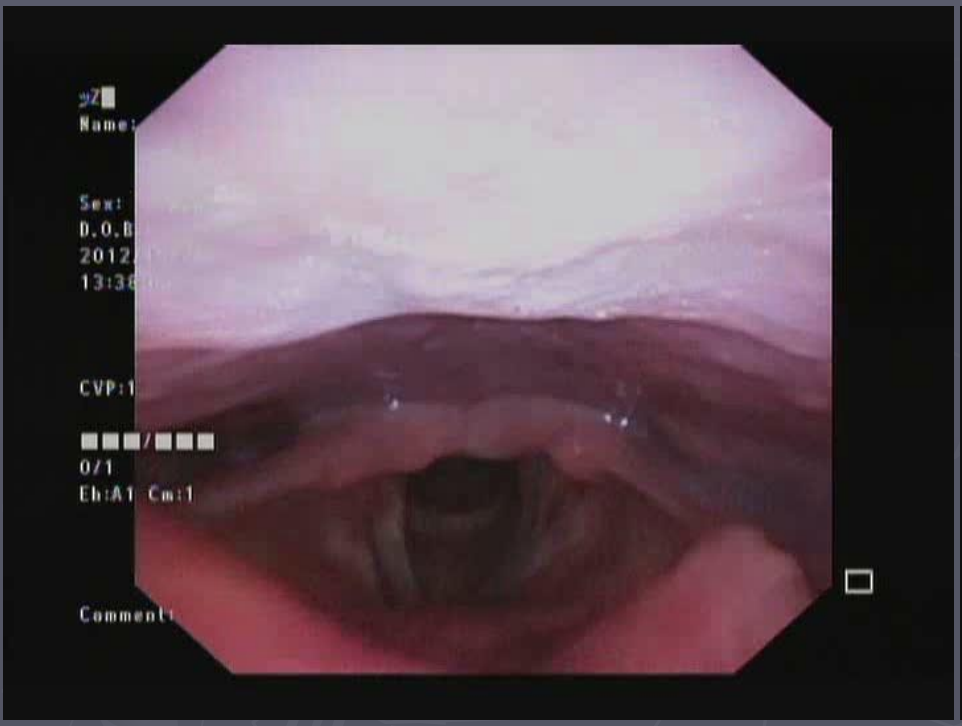
EMG during surgery

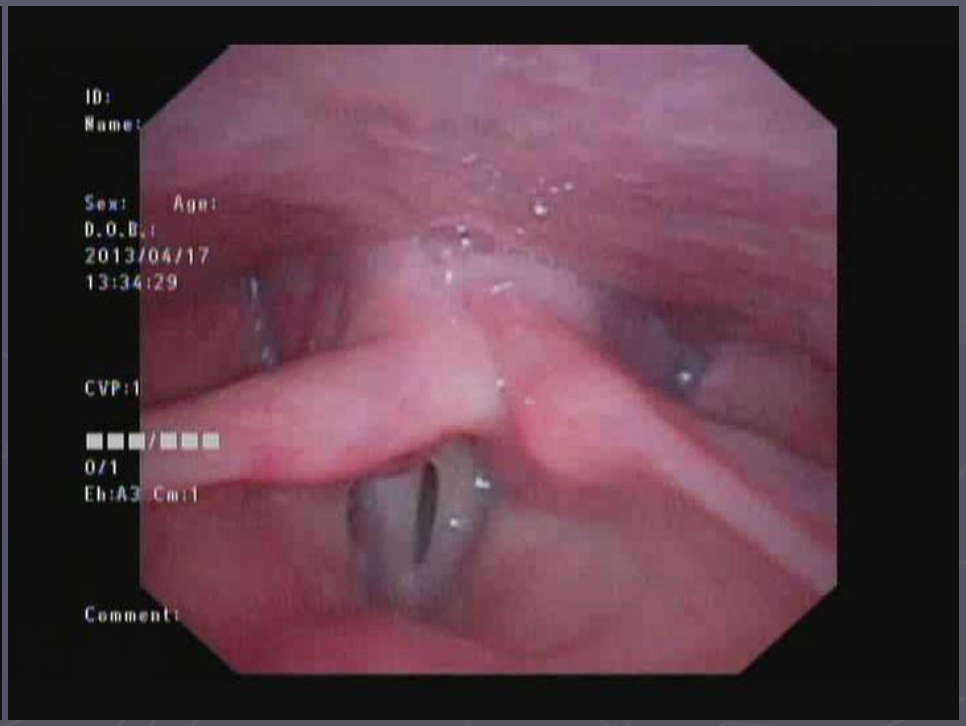
- Cricothyroid (CT) >> normal
- Posterior cricoarytenoid >> normal
- Intra arytenoid >> normal

- lateral cricoarytenoid >> silent
- Thyroarytenoid >> silent



Lt AdBP





Before surgery

After surgery

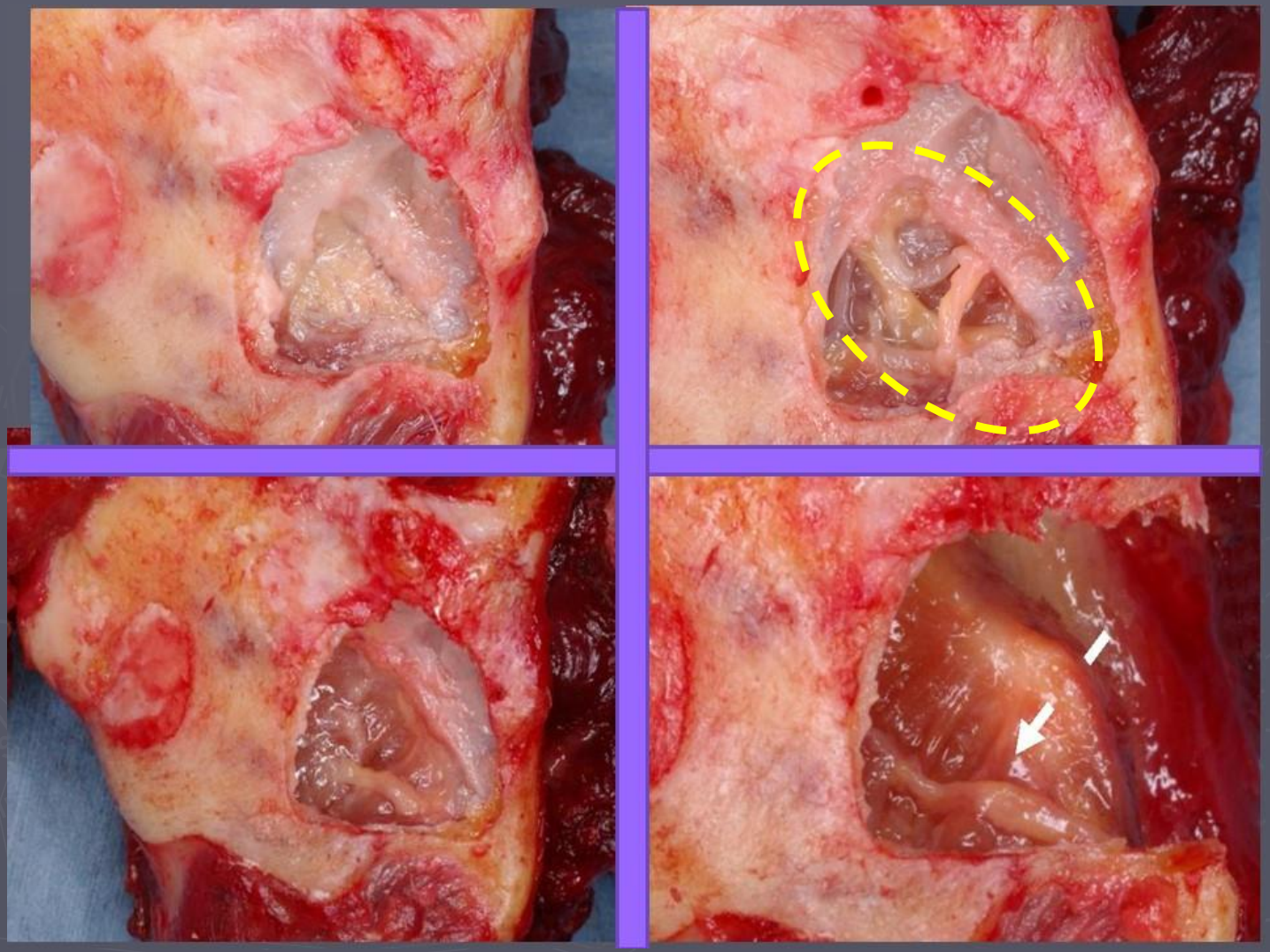
4 cases of adductor branch paralysis

case	1		2		3		4	
	pre	post	pre	post	pre	post	pre	post
MPT（sec)	2	8	5	8	2	39	8	31
MFR（ml/s）	1550	415	875	605	1202	117	501	113
Surgical procedure	AA+TP1		AA+TP1		AA+TP1		AA+TP1	
PCA resection	NO		NO		YES		YES	

Complication

Complication(2008-2015)

- Tracheotomy　2 of 125 cases　（1.6%）



Conclusion

- Only AA can reproduce natural adduction which can obtain tension of the vocal fold

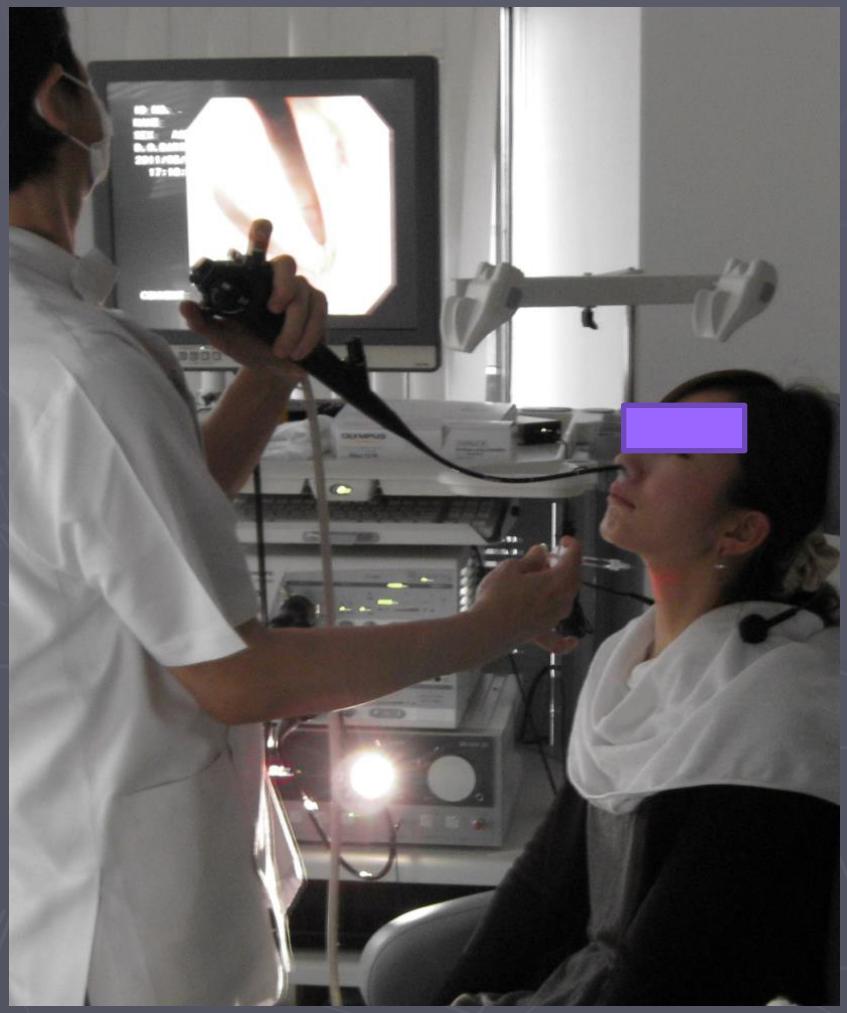
- If the structure of the laryngeal frame work is destroyed, it is sometimes difficult to keep vocal fold tension.

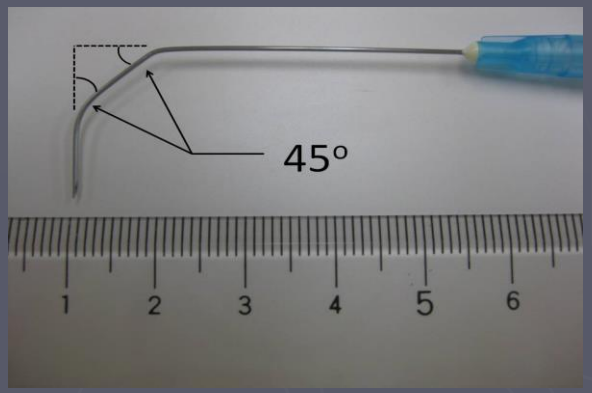
- We treated over 200 UVFP cases by AA since 2007

- Because we check patient's voice during surgery, we experienced no case whose voice worsened.

Office based injection laryngoplasty by thyrohyoid approach

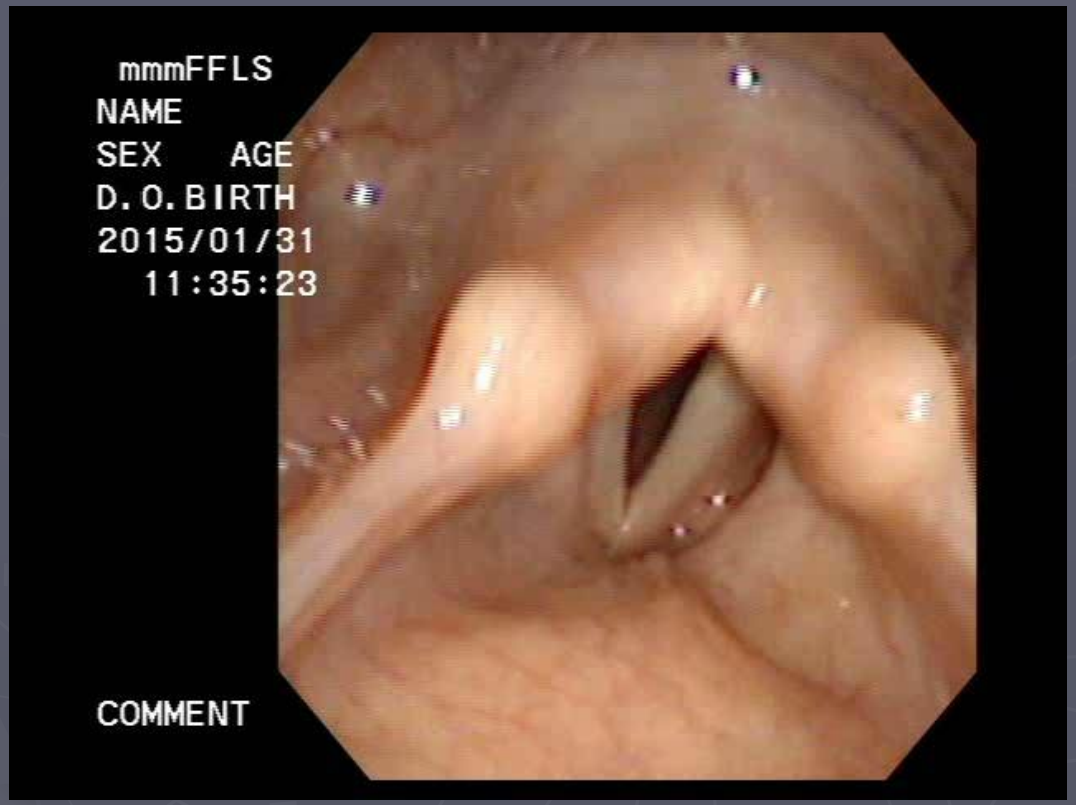
Insert the needle just above the thyroid notch by watching vocal cords through endoscopy







CaHA injection for Lt UVFP



- I will present about our office based injection laryngoplasty on Wednesday (Day 3) afternoon !

شکرا جزیلا



Shinjuku Skyscrapers

Voice Clinic Shinjuku

Thank you for your attention!

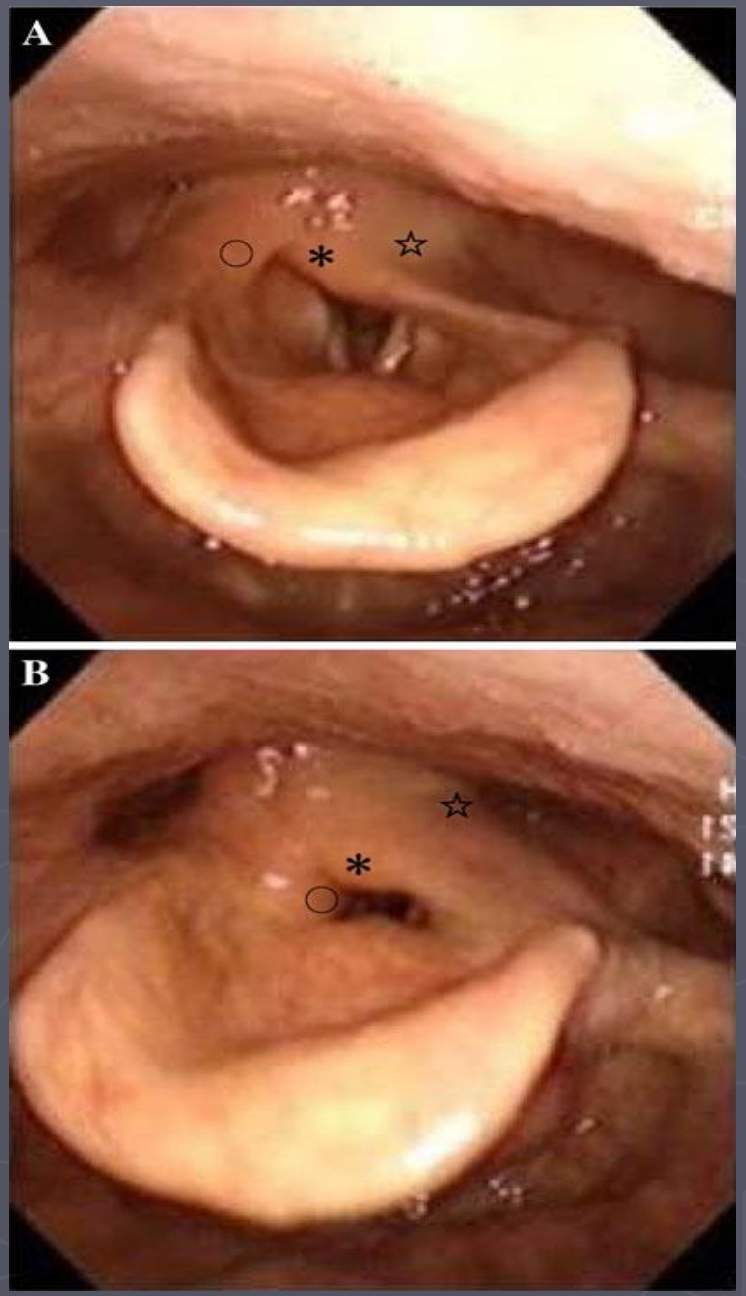


Shinjuku Skyscrapers

Voice Clinic Shinjuku

Endoscopic findings of passive movement (Jostle sign)

- The arytenoid hump moves posteriorly during phonation
- The muscular process moves laterally and upward during phonation



Okamoto, Tokashiki et al : Detection of passive movement of the arytenoid cartilage in unilateral vocal-fold paralysis by laryngoscopic observation:useful diagnostic findings European Archives of ORL 2012

In five cases, voice improvement was not satisfactory（Except AdBP）（MPT<8sec or MFR>250ml）

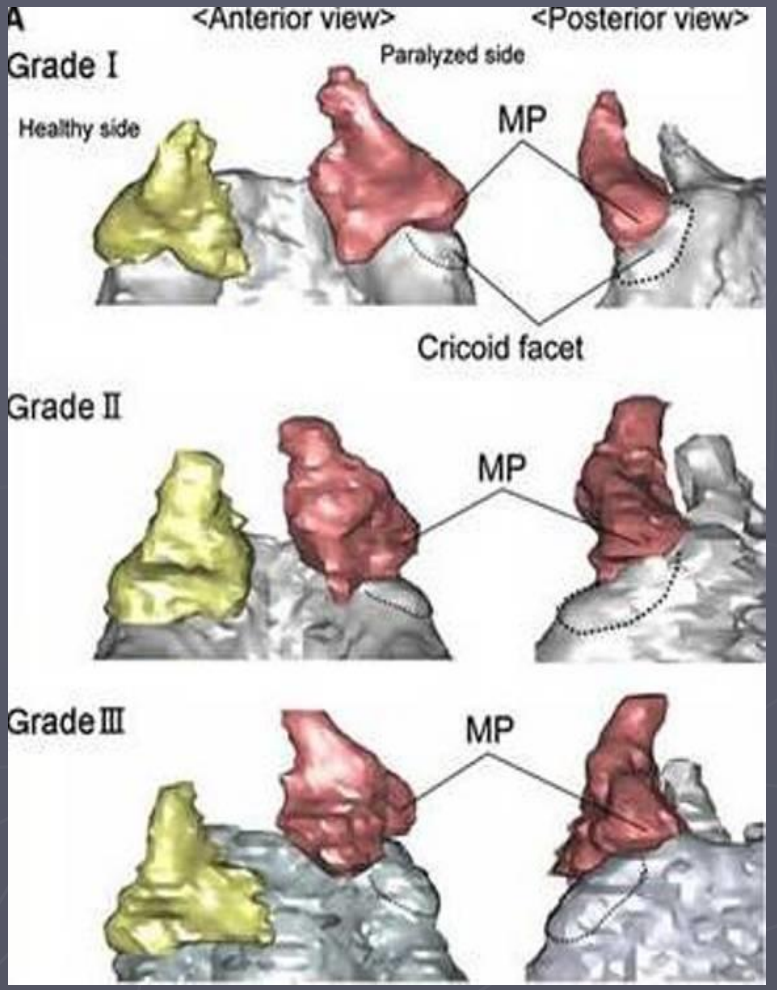
age	surgery	Pre-Op		Post-Op		reason
		MPT	MFR	MPT	MFR	
74	AA＋TP Ⅰ	1.8	1201	7	267	healthy side atrophy？
72	AA＋TP Ⅰ	2.5	764	6.8	226	insufficient type Ⅰ ？
58	AA＋TP Ⅰ	1.4	1946	8.4	411	CA joint fixation
53	AA＋TP Ⅰ	2.3	1913	8.1	336	CA joint fixation
75	AA＋TP Ⅰ ＋TPⅣ	0.3	354	7.8	118	one lung after tuberculosis operation

No case of which MFR>300ml except CA joint fixation

All patients saw improvements in their voice

Correlation between arytenoid vertical displacement and MFR

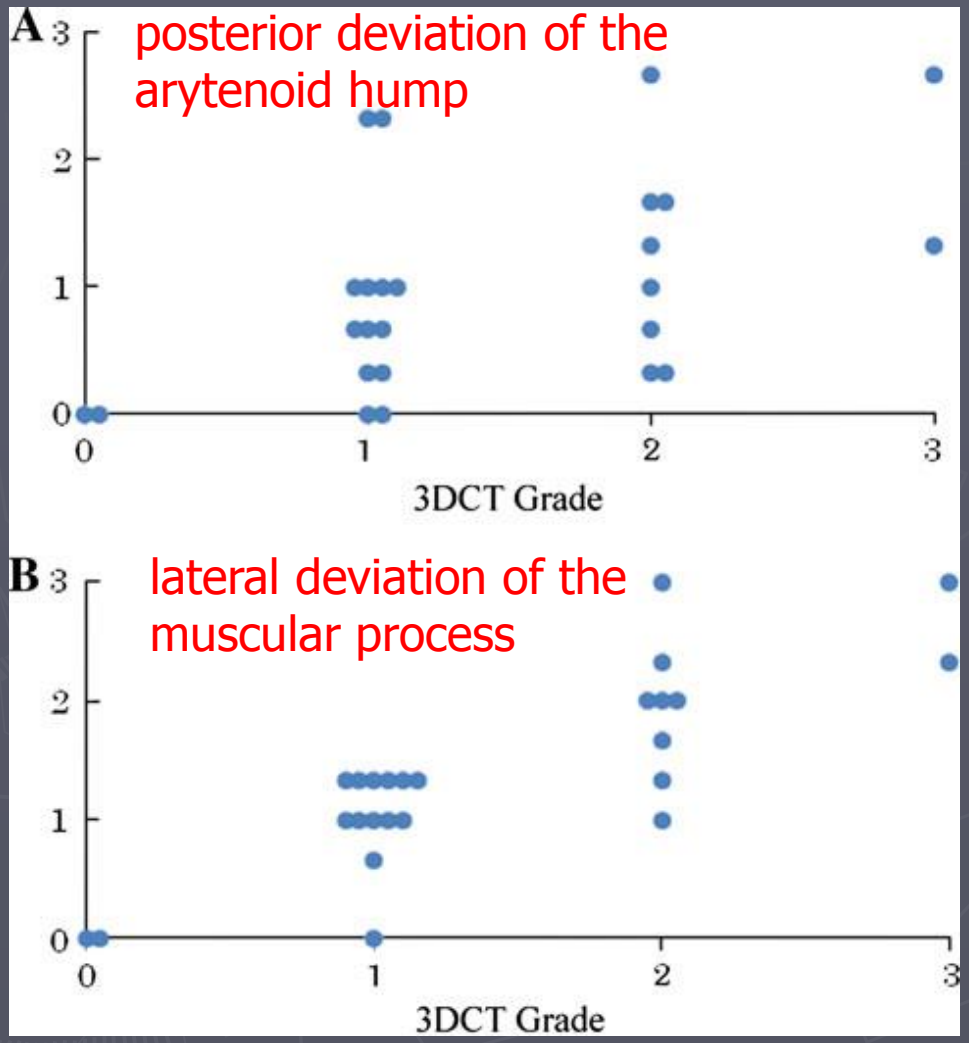
- As the grade of cranial displacement becomes more severe, the MFR worsens.
- Cranial displacement was observed in all patients even in mild cases



	Control	Grade Ⅰ	Grade Ⅱ	Grade Ⅲ
MFR(ml/s)	150.9 ±31.6	477.3 ±258.0	617.3 ±230.5	1074.7 ±323.3

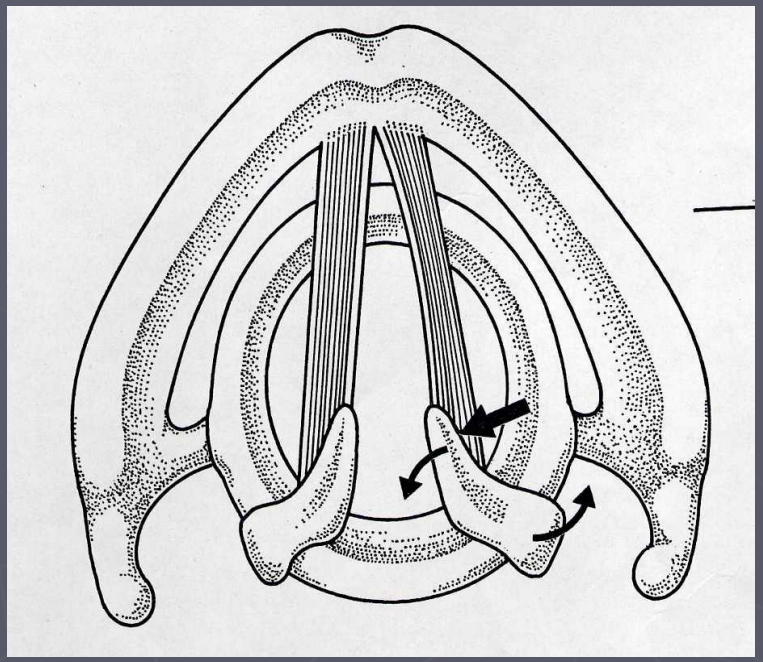
Hiramatsu, Tokashiki et al European Archives of ORL 2009

Relationship between endoscopic findings scale (0-3) and 3DCT grade (0-3)



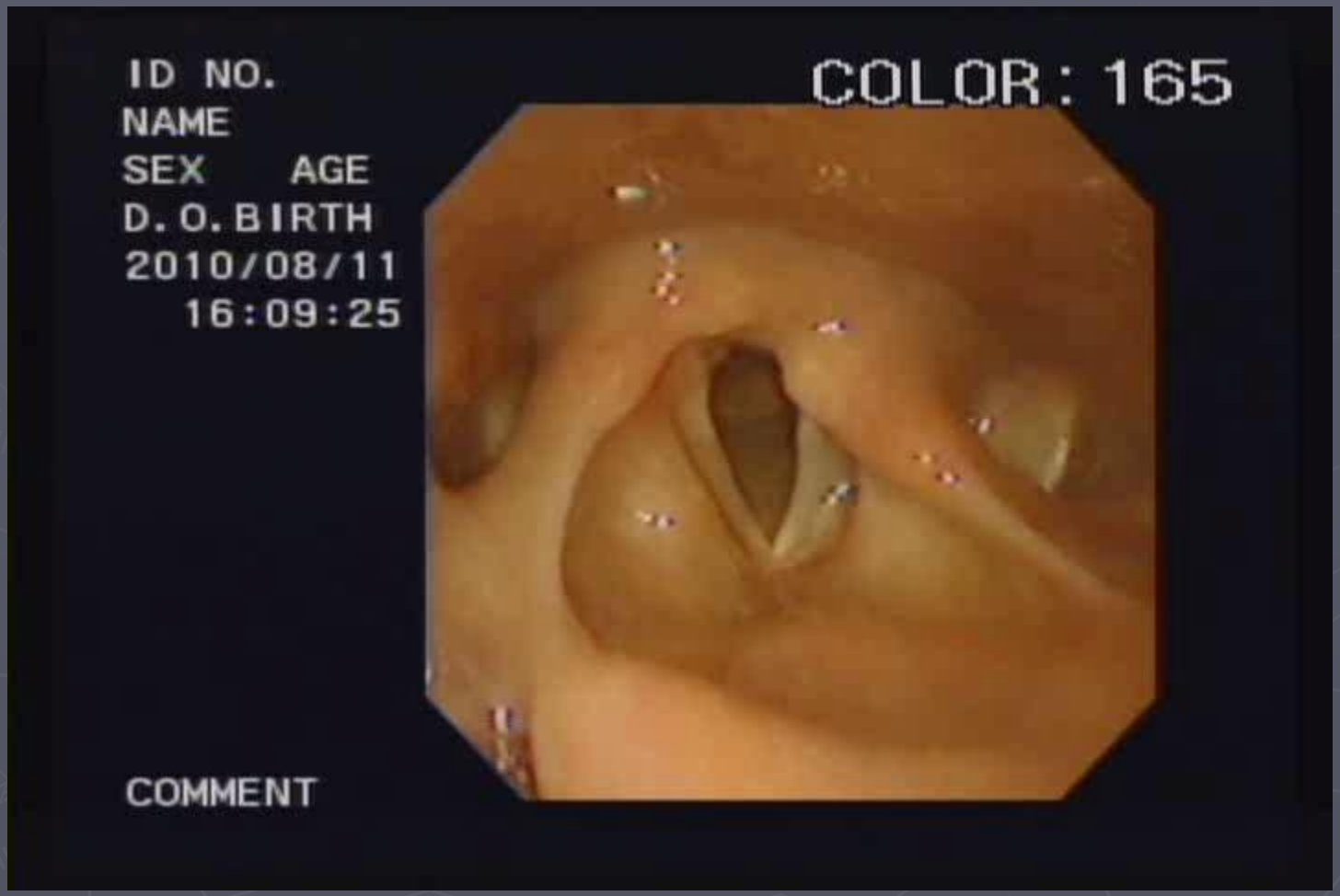
- Both findings had significant relation with 3DCT grade
- The lateral deviations of the MP was more significant with 3DCT grade
- These findings are useful to diagnose UVFP and judge severity

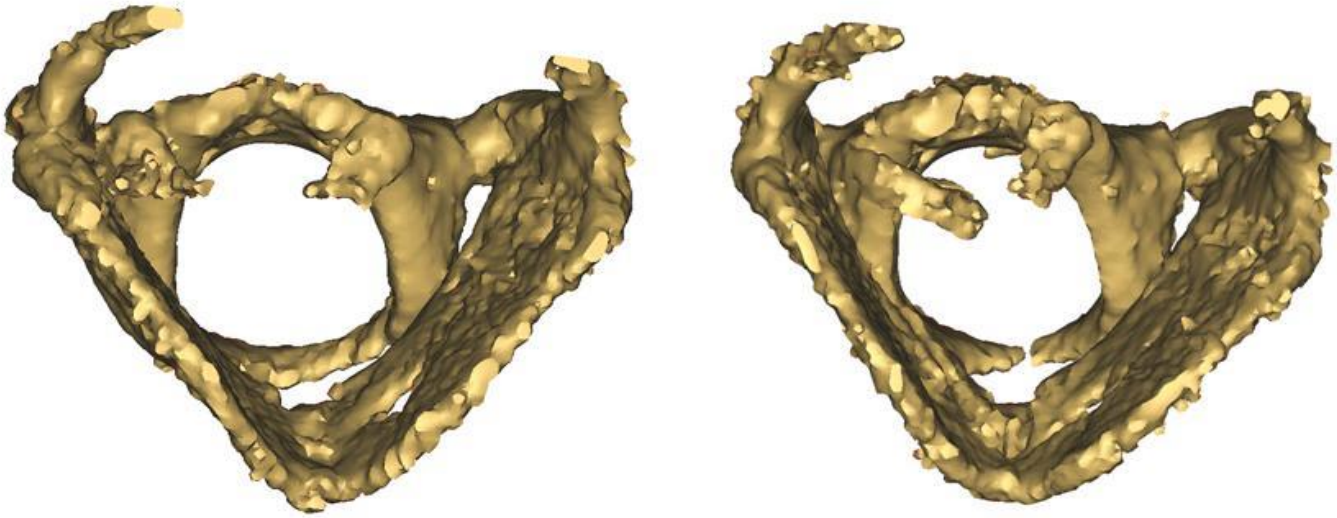
Okamoto, Tokashiki et al : Detection of passive movement of the arytenoid cartilage in unilateral vocal-fold paralysis European Archives of ORL 2012

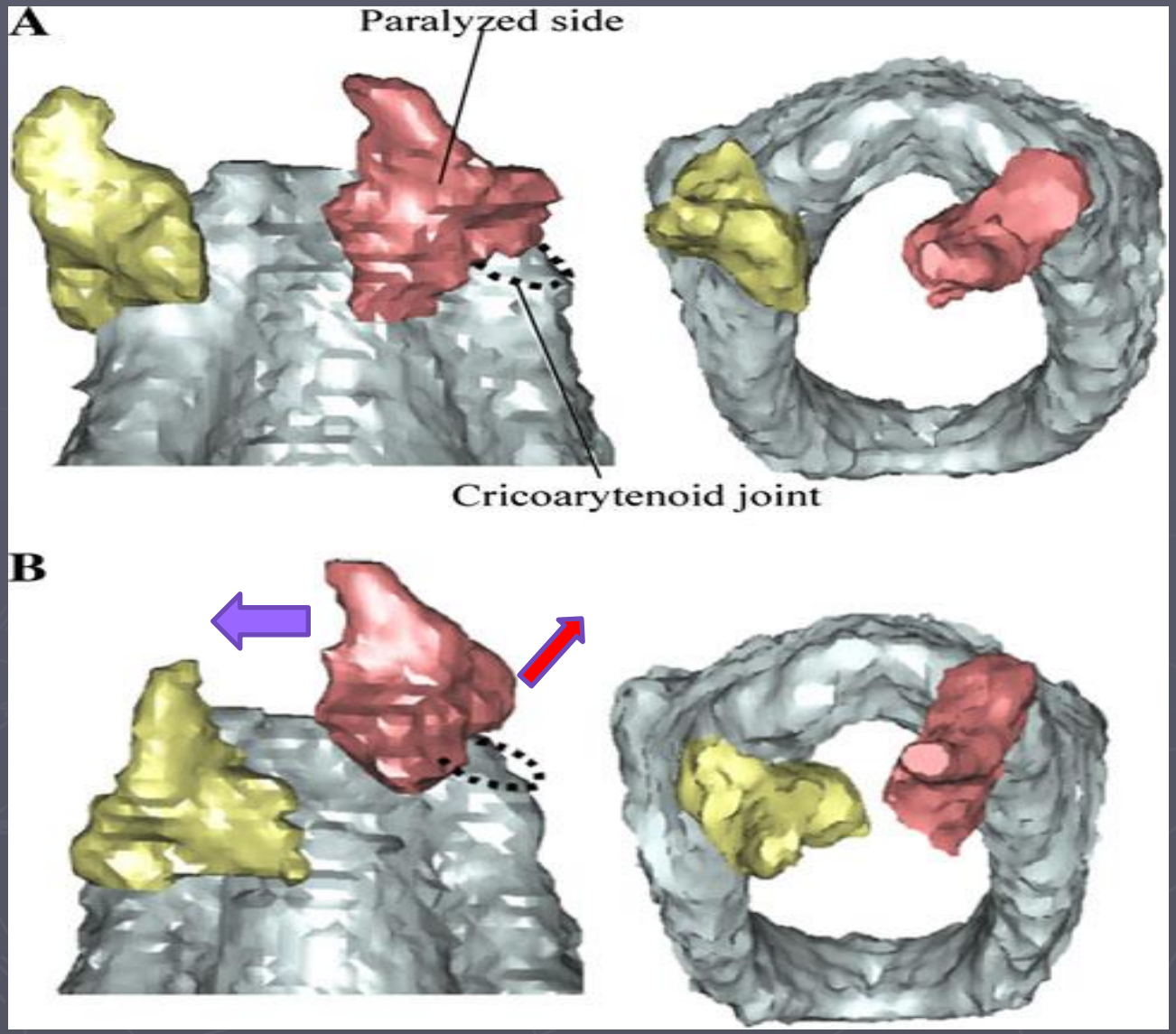


- Tension is needed for string (=Vocal fold) to produce good vibration and good sound.
- Posterior support of the vocal cord (= arytenoid) should be fixed to obtain strong tension against the healthy side.
- AA stretch the vocal fold and give real tension to vocal fold.

VP level seems to be same, but‥



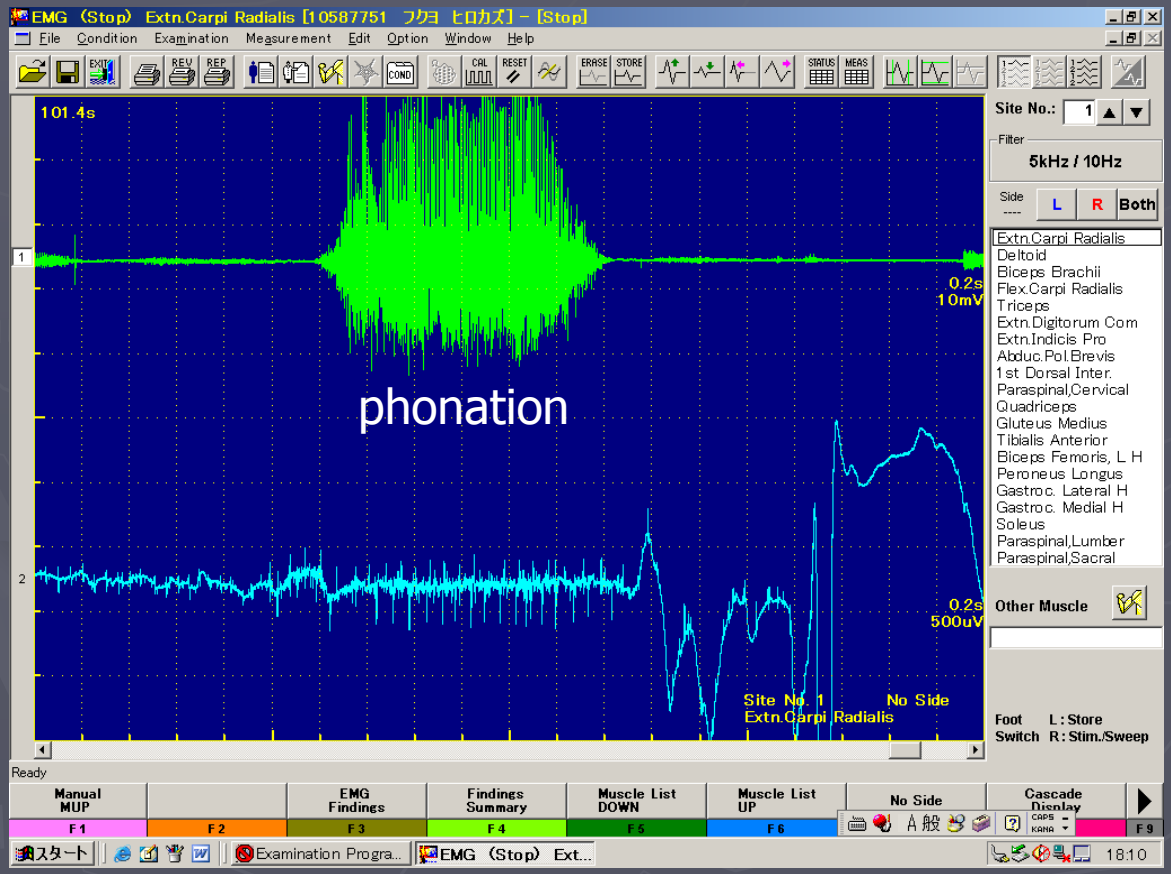




Hiramatsu, Tokashiki et al : European Archives of ORL 2008

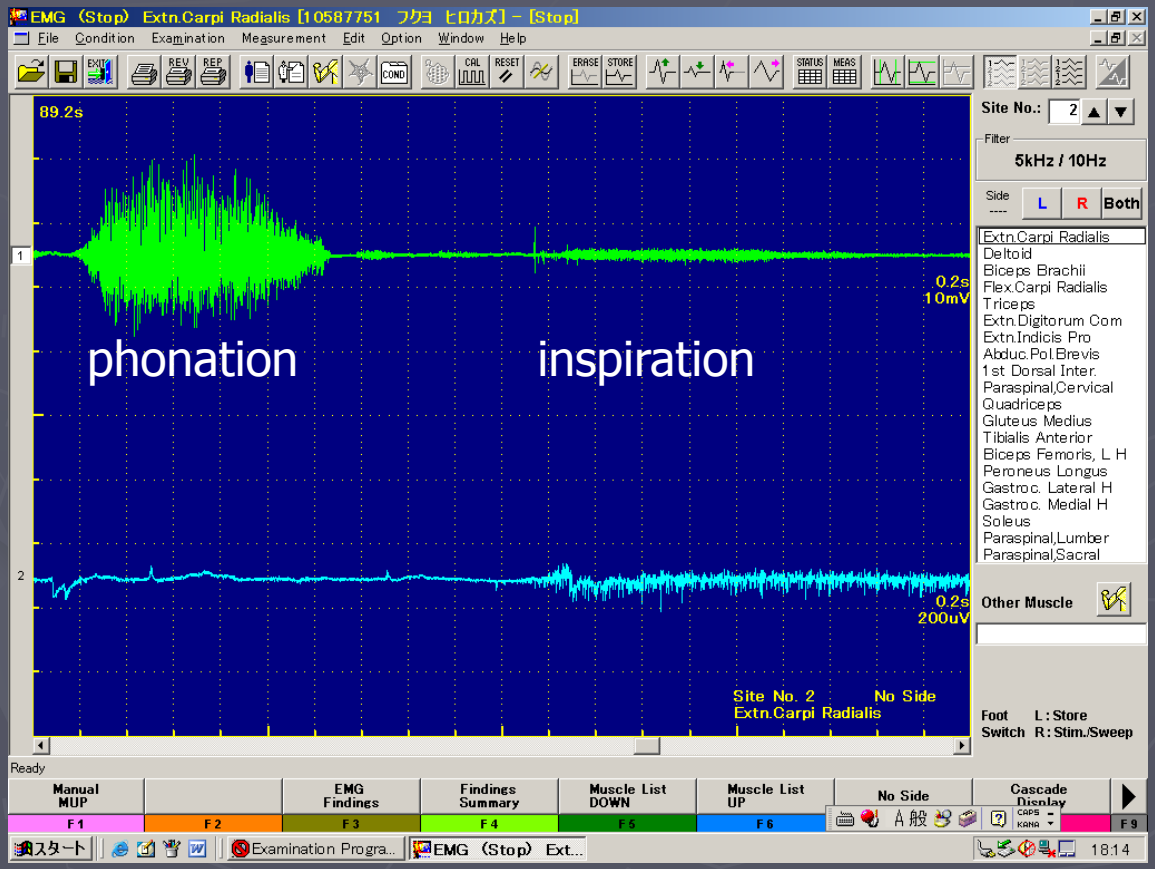
EMG during surgery

- Crcothyroid (CT) >> normal



EMG during surgery

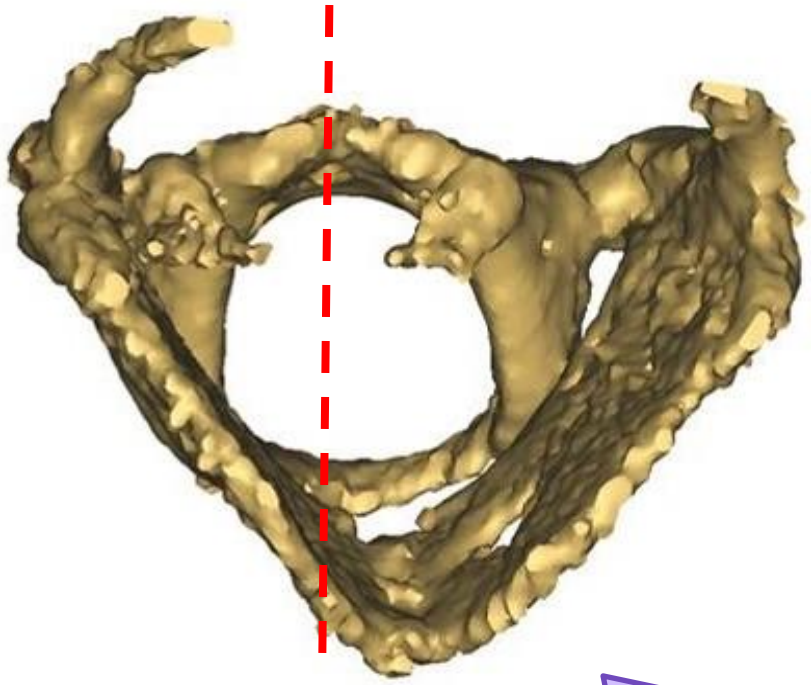
- Posterior cricoarytenoid >> normal



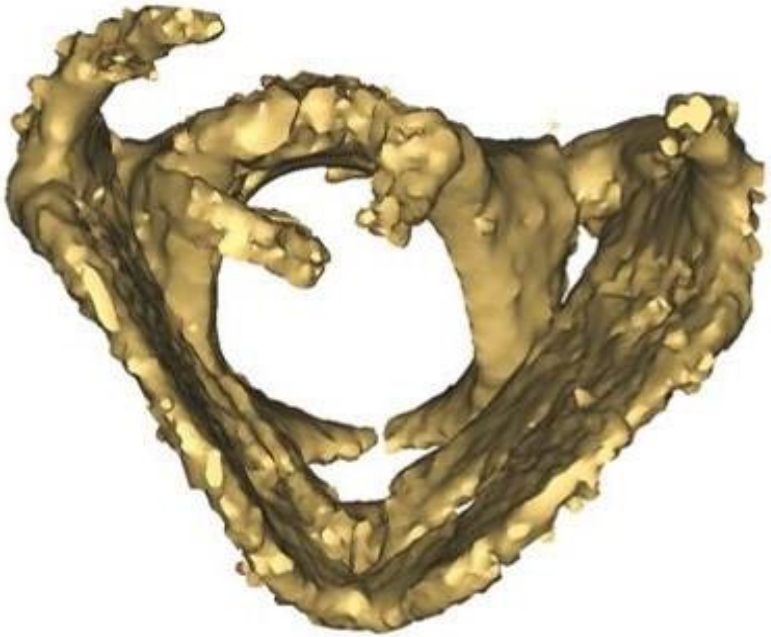


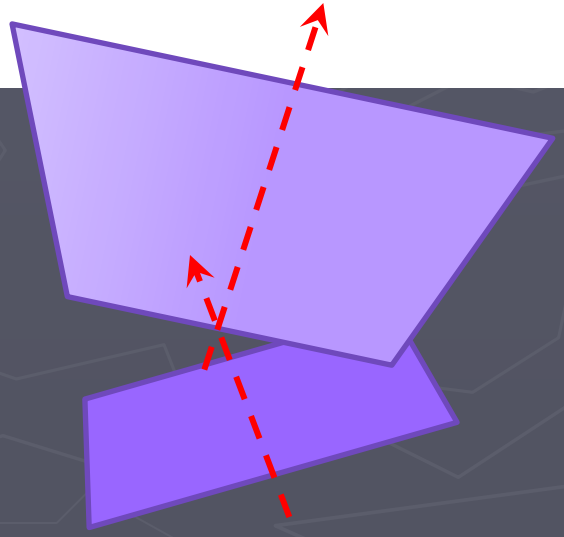
喉頭の枠組みのバリエーションについて

Inspiration



Phonation

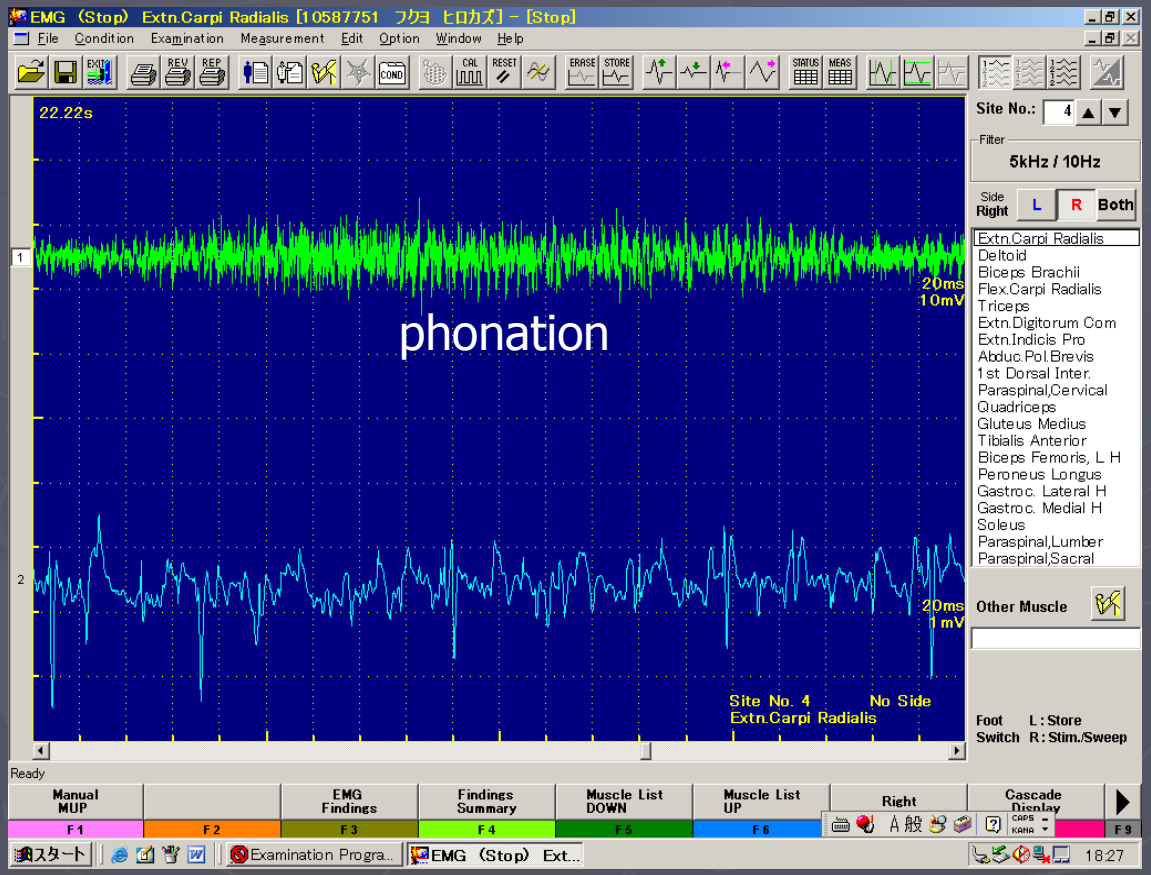


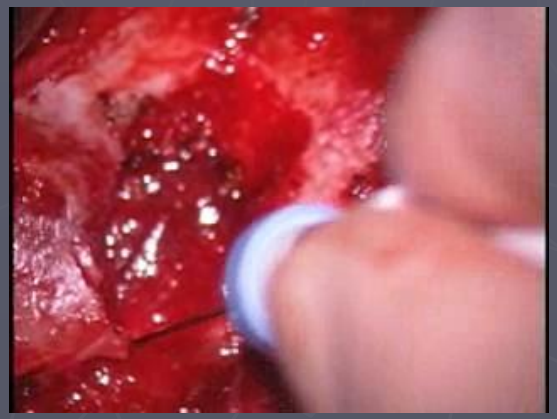


- 術後の喉頭浮腫による呼吸困難は創部の出血によるもので、手術当日に起こる
- 一般的な術後の浮腫は3日目から5日目にみられるが呼吸困難は生じない
- 手術中には声帯の浮腫は起こらない

EMG during surgery

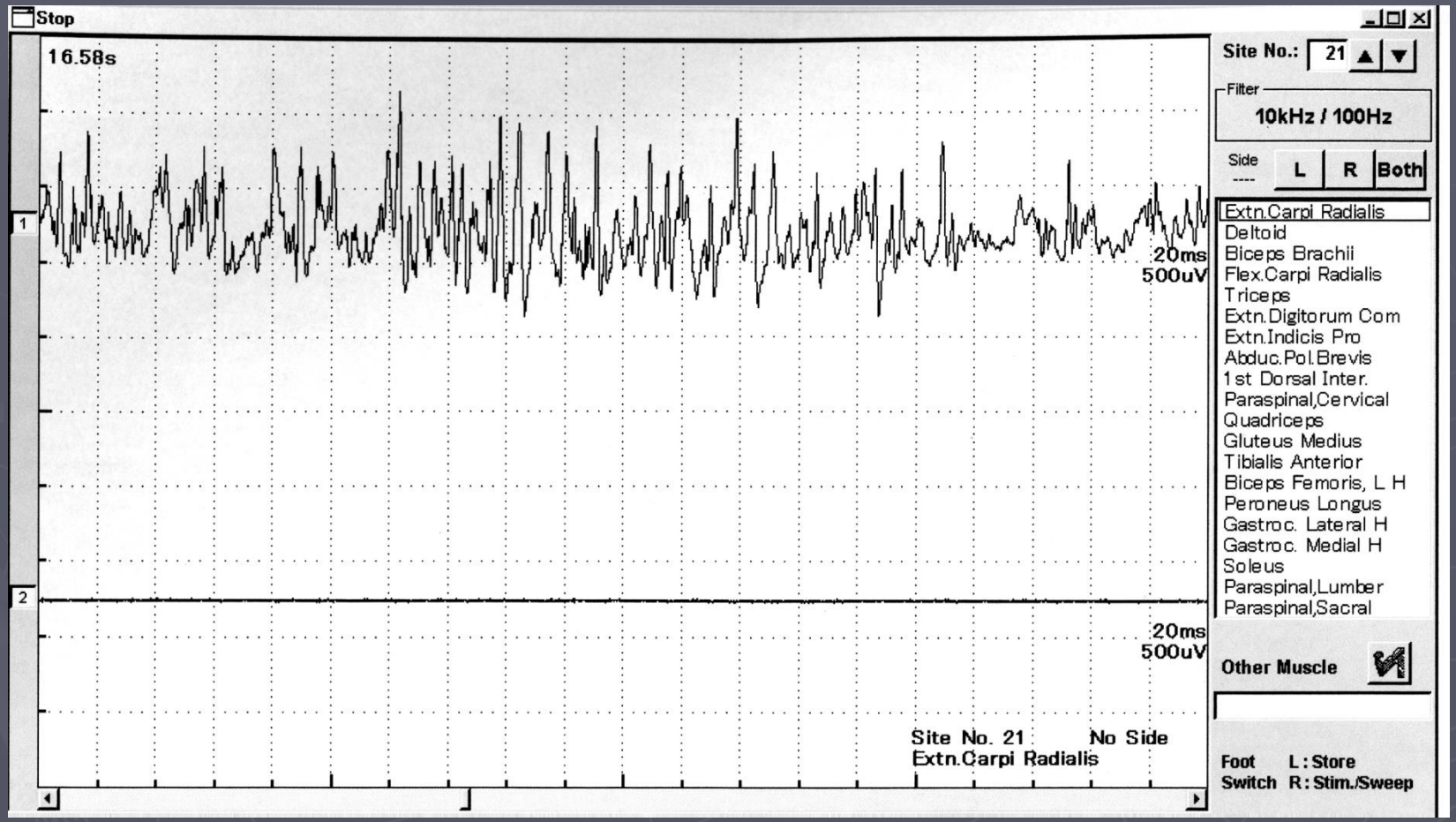
- Intra arytenoid >> normal





E M G (electro myography)

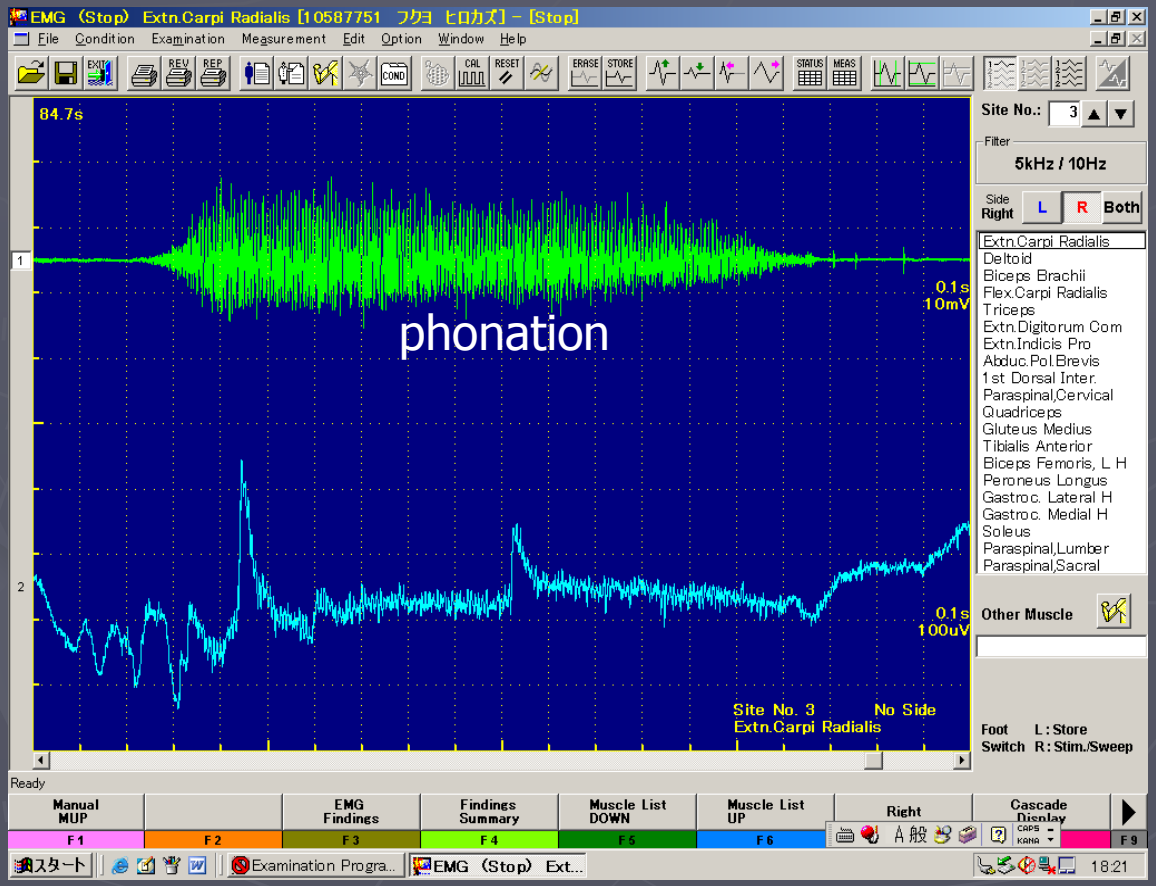
- of the right cricothyroid（CT）muscle



→ **normal image**

EMG during surgery

- lateral cricoarytenoid >> silent



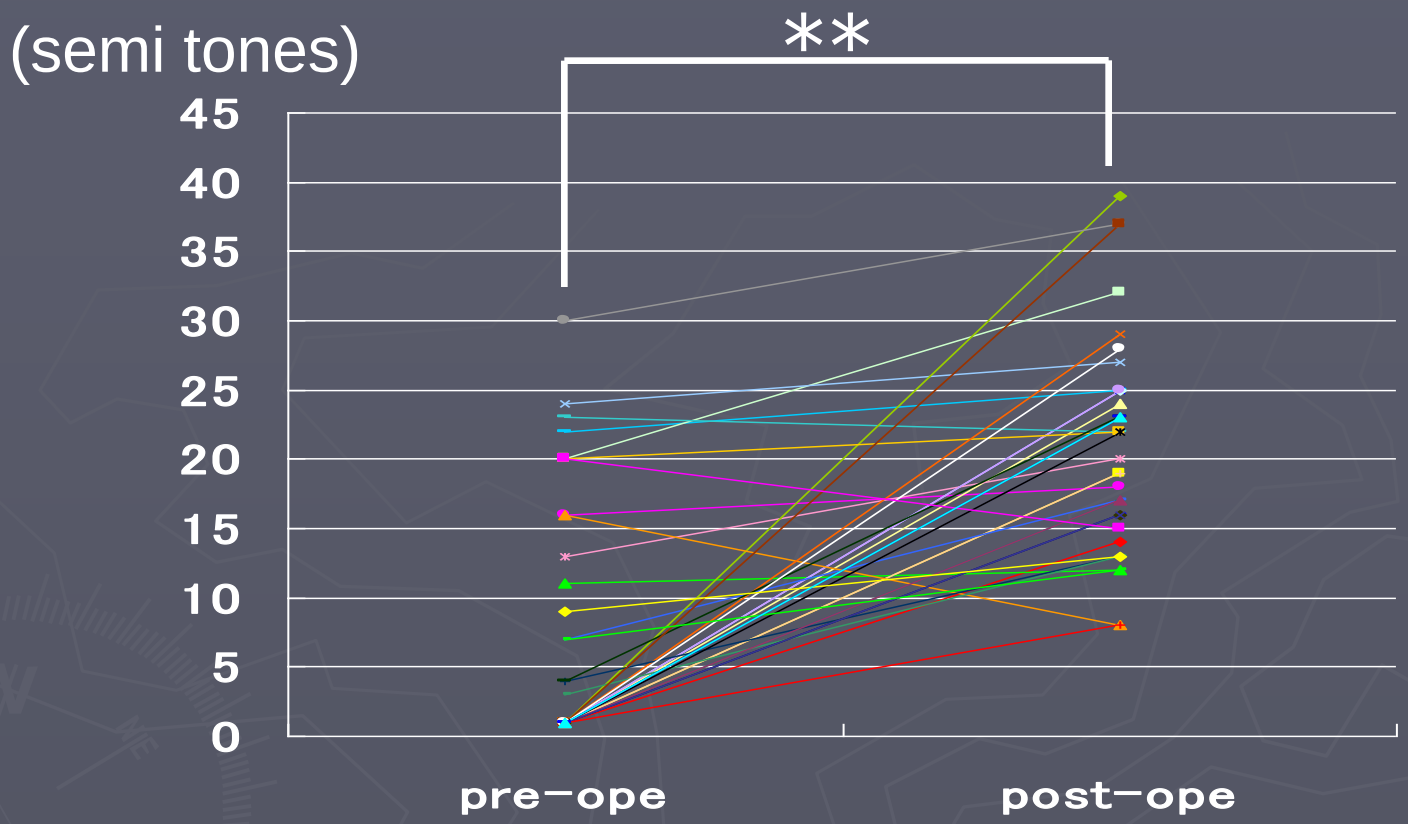


結　論

片側声帯麻痺の手術の中で

- 披裂軟骨内転術のみが生理的な内転を再現することができる
- 披裂軟骨が内転位で固定されることにより声帯は張力を獲得し術後の音声は良好となる
- 喉頭の枠組みが破壊されると時に声帯は張力を失う

pre & postoperative MFR (n=39)



- There were cases in which the pitch range was not improved or even diminished after surgery.
- Some aphonic cases improved their ranges dramatically

Correlation between postoperative pitch range and other vocal functions

	Pre ope			Post ope	
	MPT	MFR	Pitch range	MPT	MFR
Post operative pitch range	0.064	0.138	0.987	0.037 *	0.627

- Preoperative MPT, MFR, and pitch range did not correlate with postoperative pitch range.
- Postoperatively, only MPT correlated with postoperative pitch range.

Conclusion

- The combination of AA and type I thyroplasty enabled a wide pitch range even in clinically severe cases but not in all cases.

Sataroff mentioned that ‘jostle sign’ occurs because of the bilateral innervation of the interarytenoid musculature and, therefore, partial medializationof the affected arytenoid during adduction [5]. But he didn’t point the MP movement. Lateral deviation of theMP is thought to occur as a result of the paralysed arytenoidcartilage being drown to the median by constriction of the arytenoid muscle which control both Sides. In our clinical experience, we have occasionally encountered patients with a clear lateral deviation of the MP even in theabsence of any obvious posterior deviation of the arytenoidhump.

- For selective paralysis of the adductor branch of the RLN, AA with PCA dissection achieve good voice outcome.

Conclusion

術後経過

■後筋を十分切除し、術中音声も改善

■通常の内転術後と同様で、経過は良好

■十分に内転している

■ 音声検査も十分に改善

MPT 8 秒 → 31 秒

MFR 501 ml/s → 113 ml/s

十分な後筋の切断により、外転はみられない

Discussion 1

- We assumed that a wide postoperative pitch range would be achievable in cases of which auditory function was not severe.
- However our results showed that preoperative values could not predict postoperative pitch range.
- What affects postoperative pitch range?

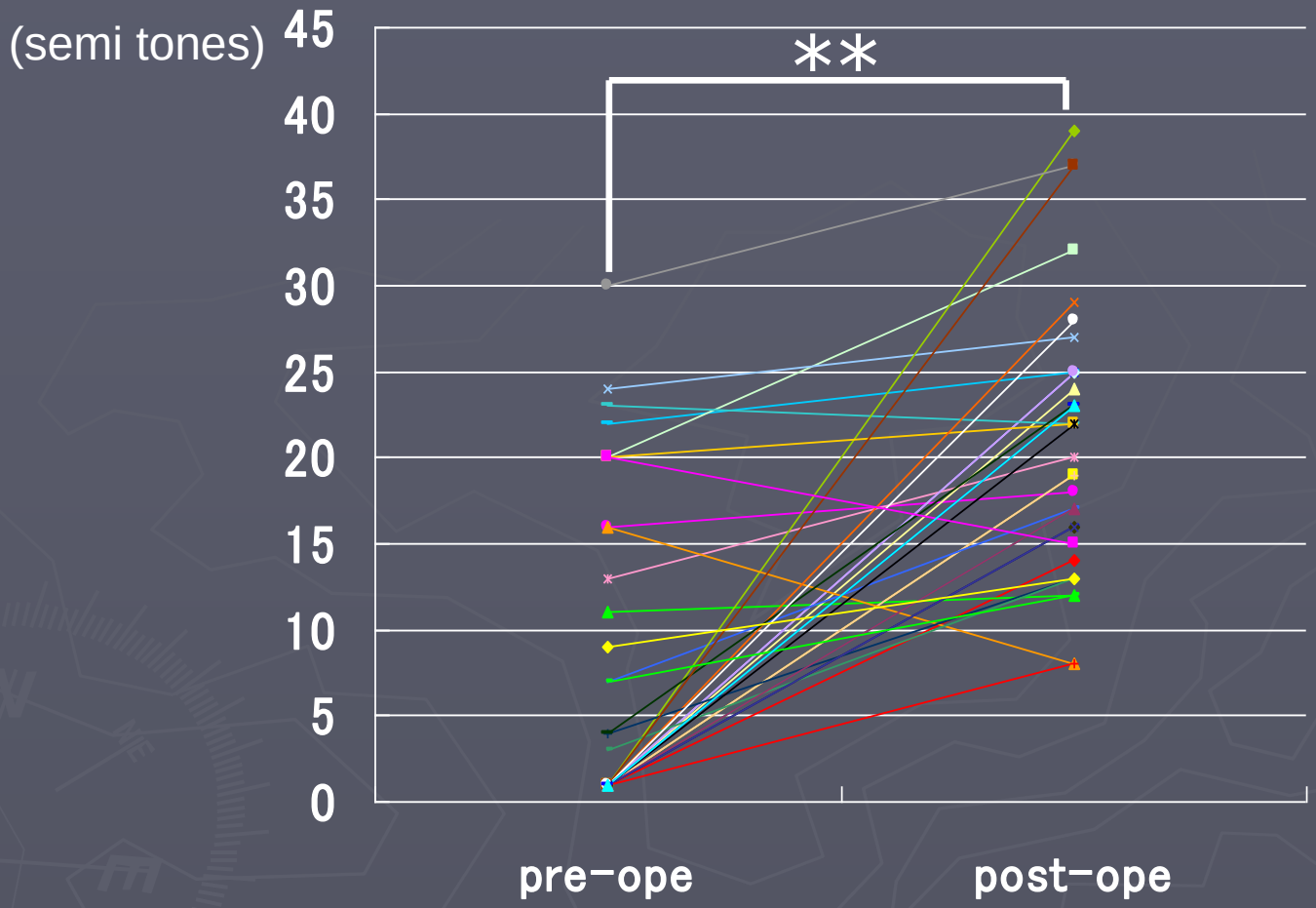
Discussion

- I t may be due to surgical procedure.
- Excessive vocal cords medialization would reduces voice quality and narrows pitch range.
- Over adduction of the arytenoid would limit the vocal fold stretch and narrows pitch range.
- Acquiring wide pitch range is difficult compare to MPT or MFR.

Case

- 47 y.o Male who had been complained of severe hoarseness since November 2005.
- He consulted three different hospital and was diagnosed as incomplete unilateral vocal cord paralysis (UVFP) in each institute and was treated medically.
- He consulted our hospital in March 2007 searching for other opinion or treatment.

Pitch ranges



59% patients answered they are able to sing!

Tokashiki R: Analysis of Pitch Range after Arytenoid Adduction by fenestration approach . J voice 2012

Relationship between post operative pitch range and other pre and post operative data

	Pre ope			Post ope	
	MPT	MFR	Pitch range	MPT	MFR
Post operative pitch range	0.064	0.138	0.987	0.037 *	0.627

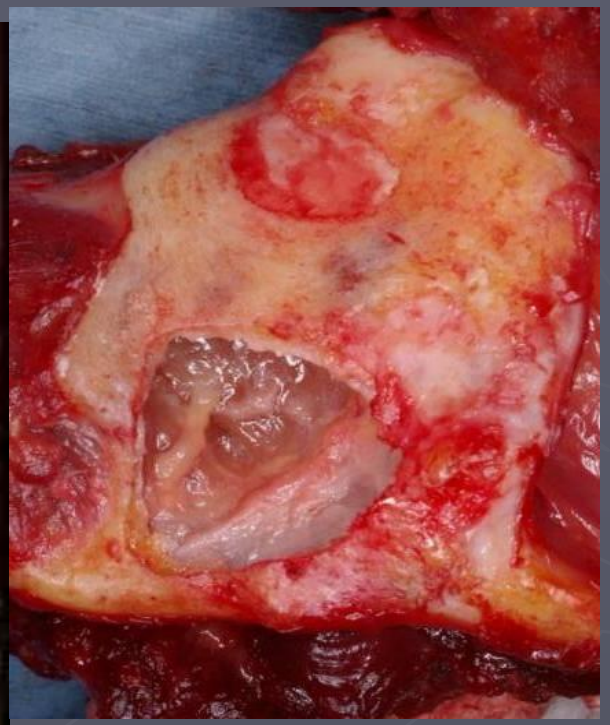
Any pre operative datas didn't affect post operative pitch ranges



Even severe case can acquire wide pitch ranges by this operation !!

手術の実際（左）





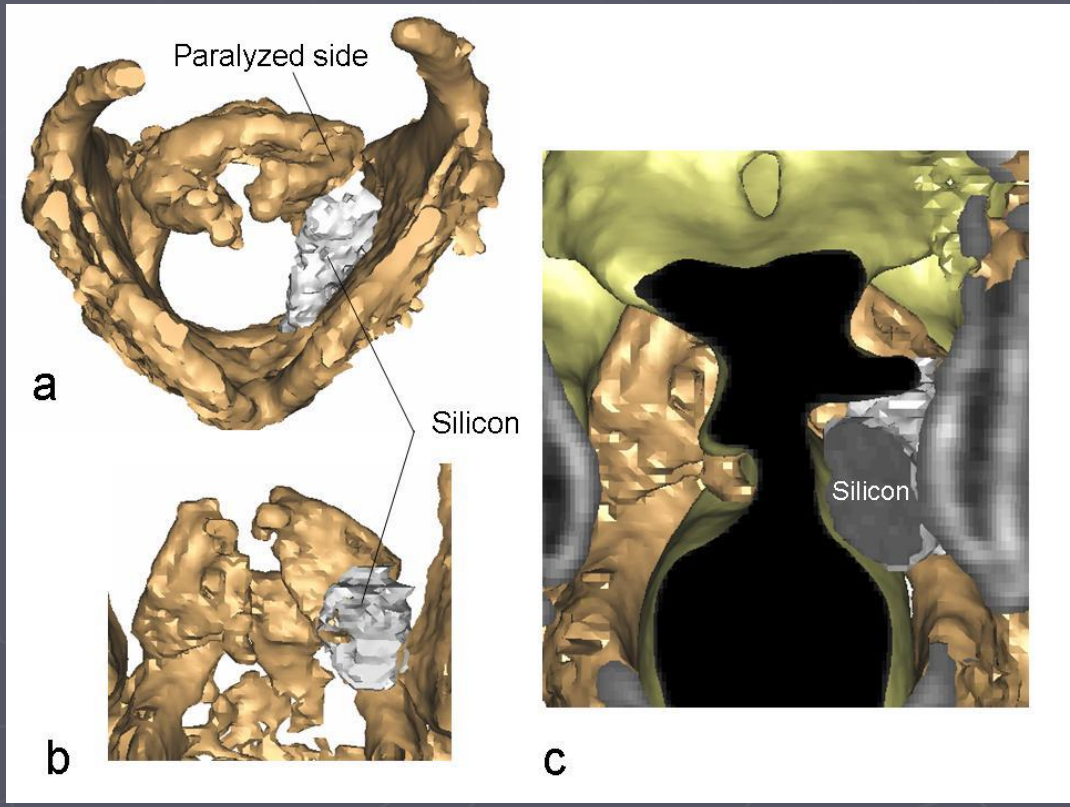
頭側

Tokashiki R, Hiramatsu H et al : A "fenestration approach" for arytenoid adduction through the thyroid ala combined with type I thyroplasty *Laryngoscope 2007*

Comparison of voice outcomes between our AA and other possible AAs

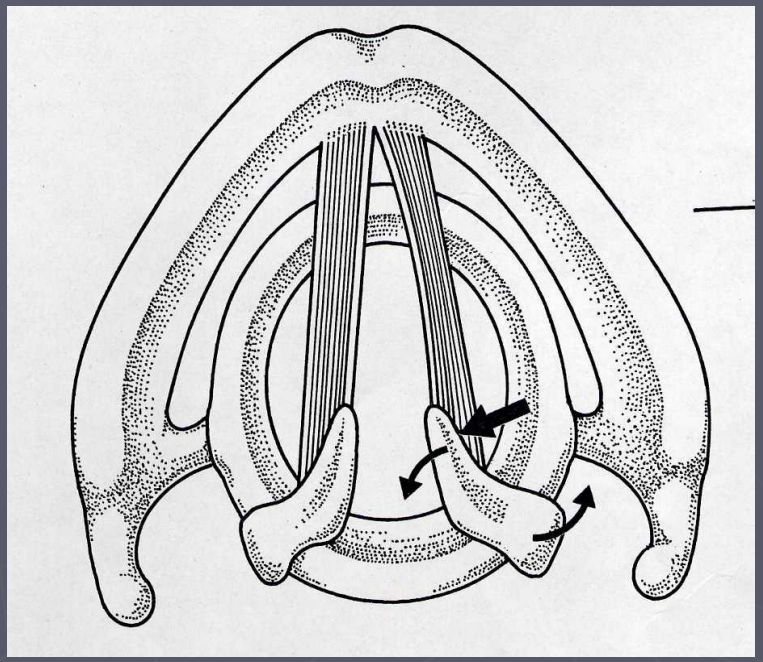
If materials are injected 0r inserted near the VP of severe UVFP ····

- Arytenoid moves medially.
- However the arytenoid is pushed cranially and the vertical gap worsens.

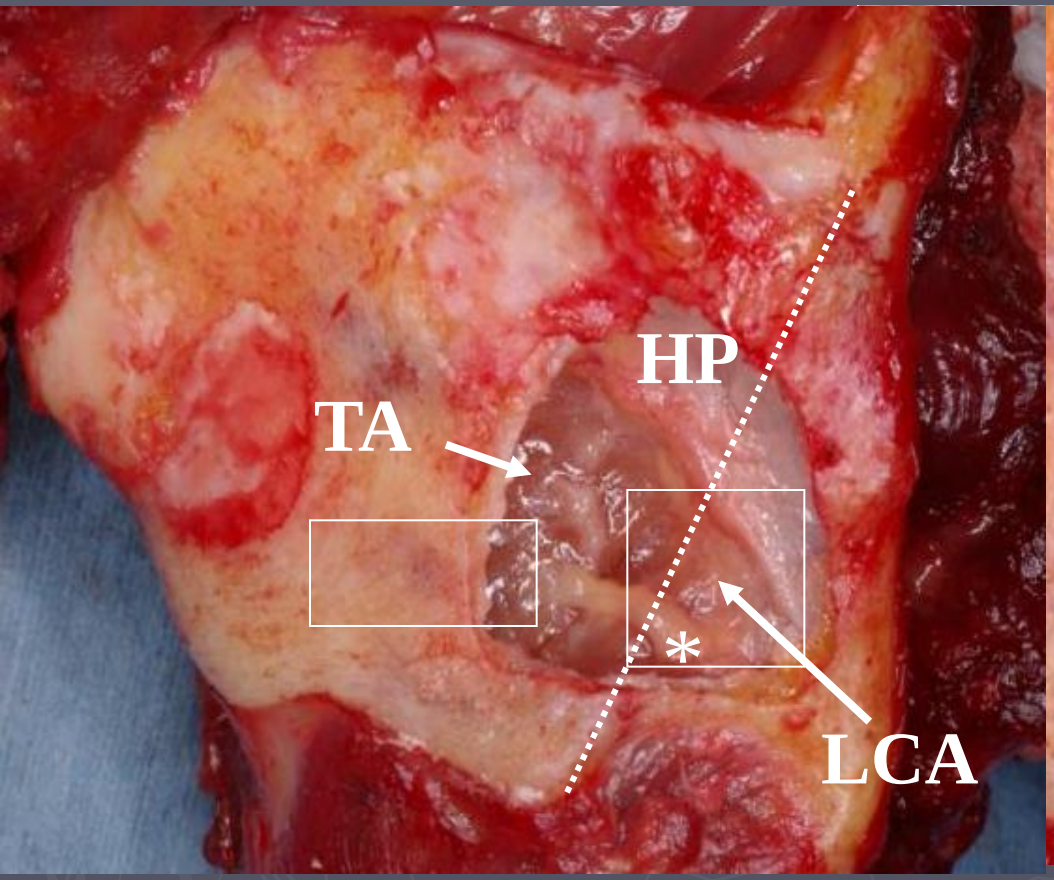


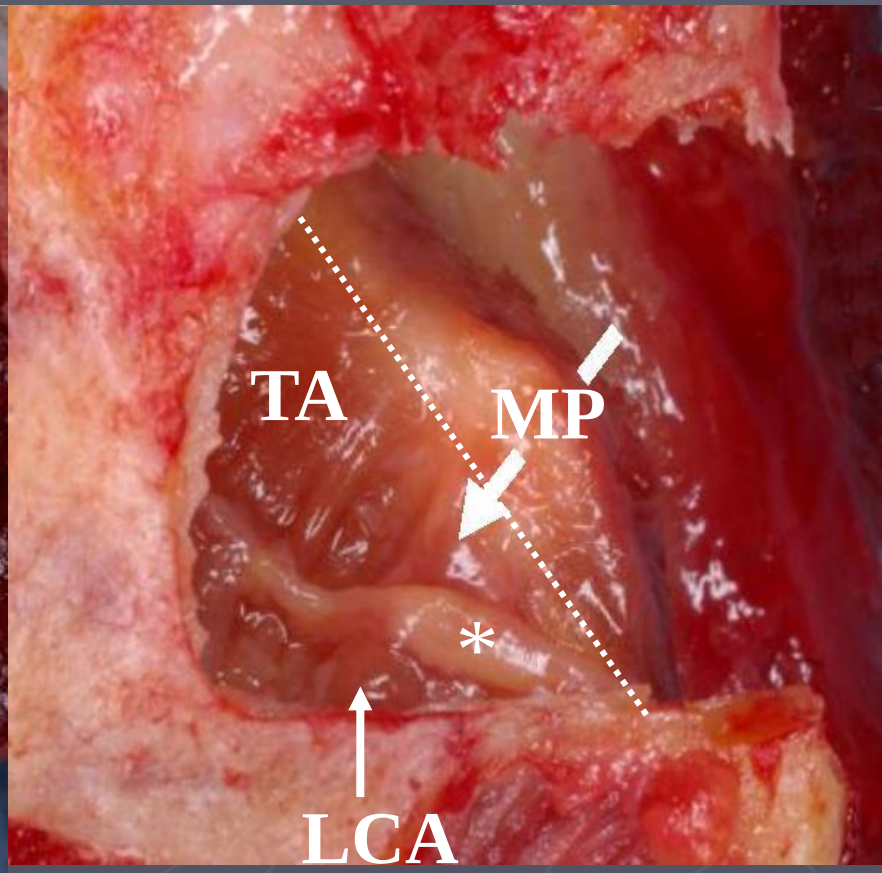
Hiramatsu, Tokashiki et al : 3DCT of the Larynx for Evaluating Unilateral Vocal Fold Paralysis European Archives of ORL 2008

We think……



- Tension is needed for string (=Vocal fold) to produce good vibration and good sound.
- Posterior support of the vocal cord (= arytenoid) should be fixed to obtain strong tension against the healthy side.
- AA stretch the vocal fold and give real tension to vocal fold.

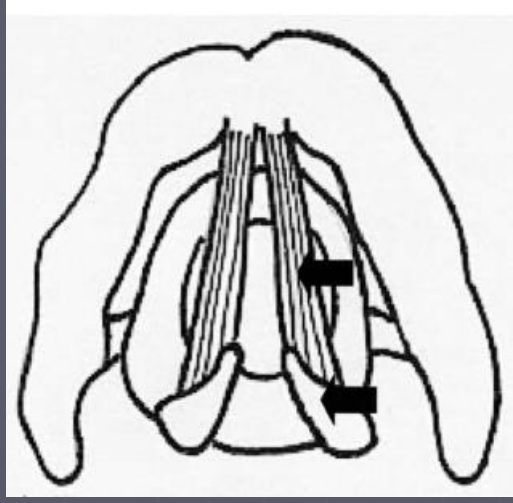


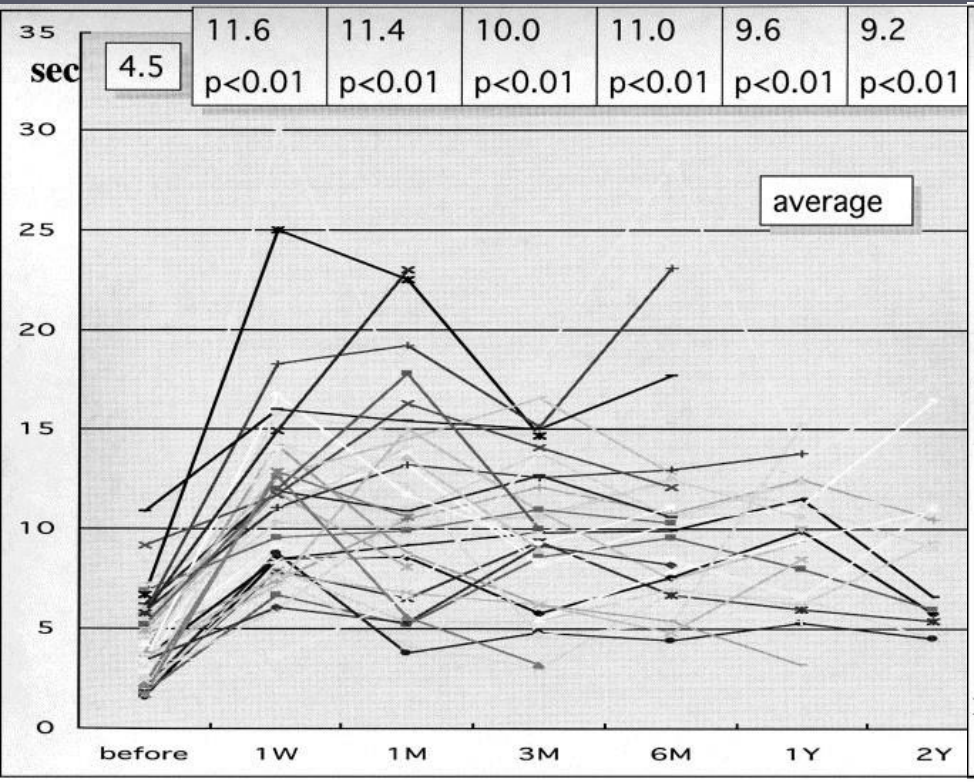


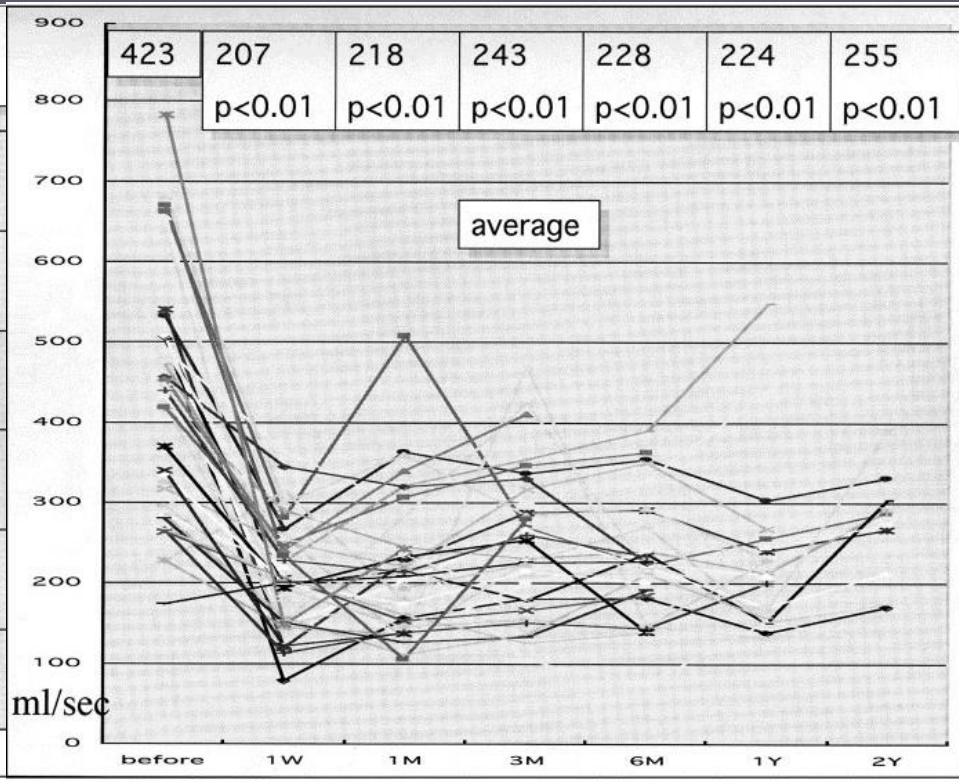
* : adductor branch of the RLN

Postoperative MPT & MFR of possible AA by fat injection

Umeno H et al: 2005

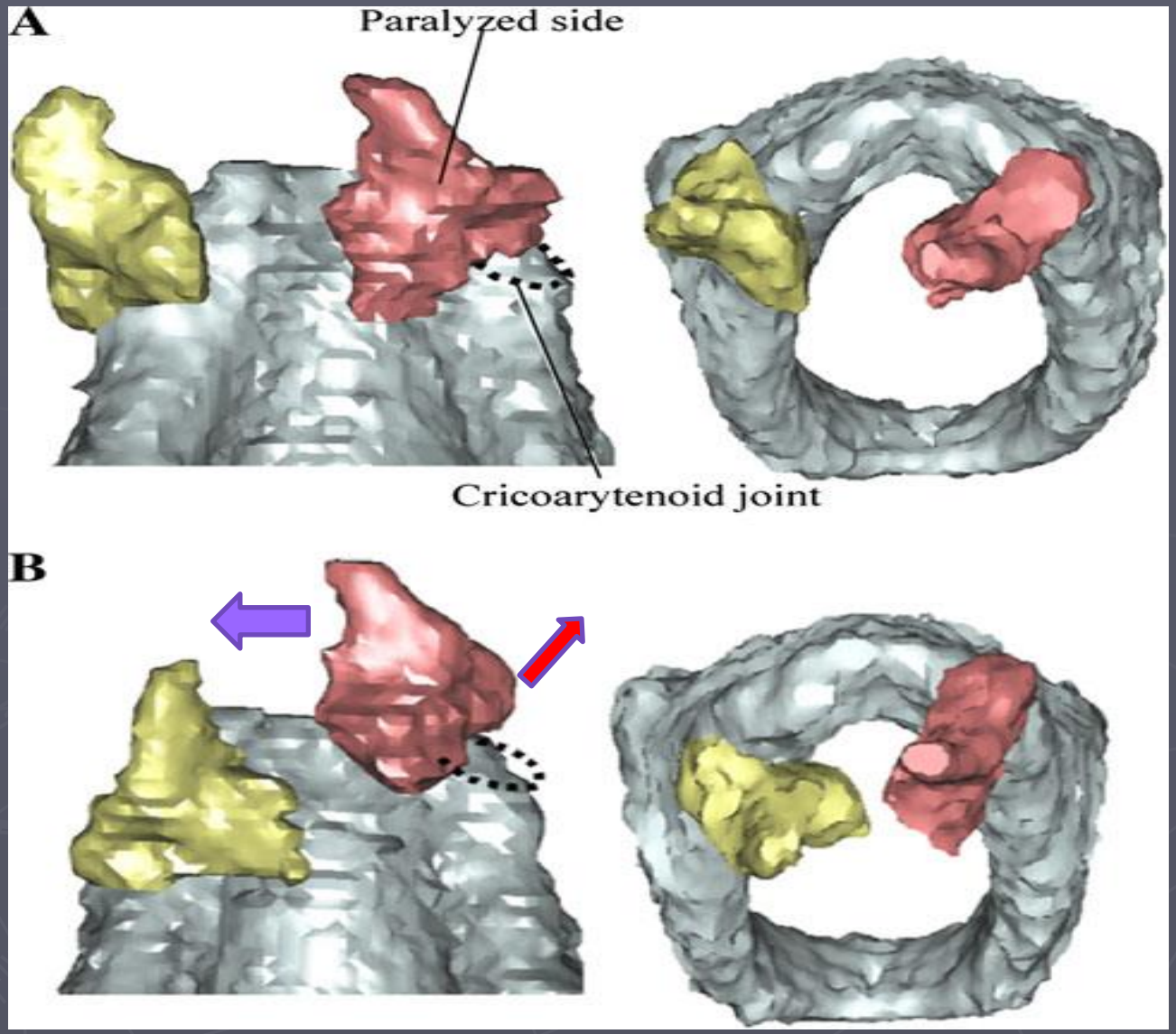






MPT

MFR



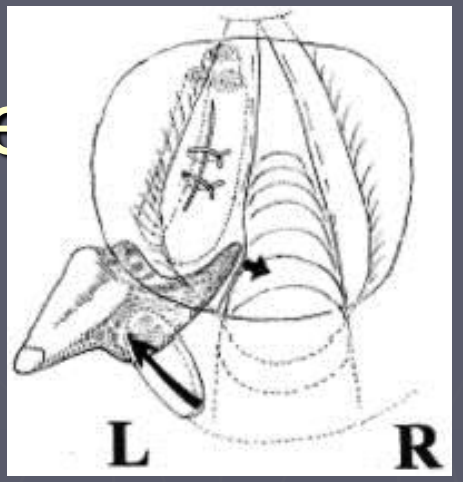
Hiramatsu, Tokashiki et al : European Archives of ORL 2008

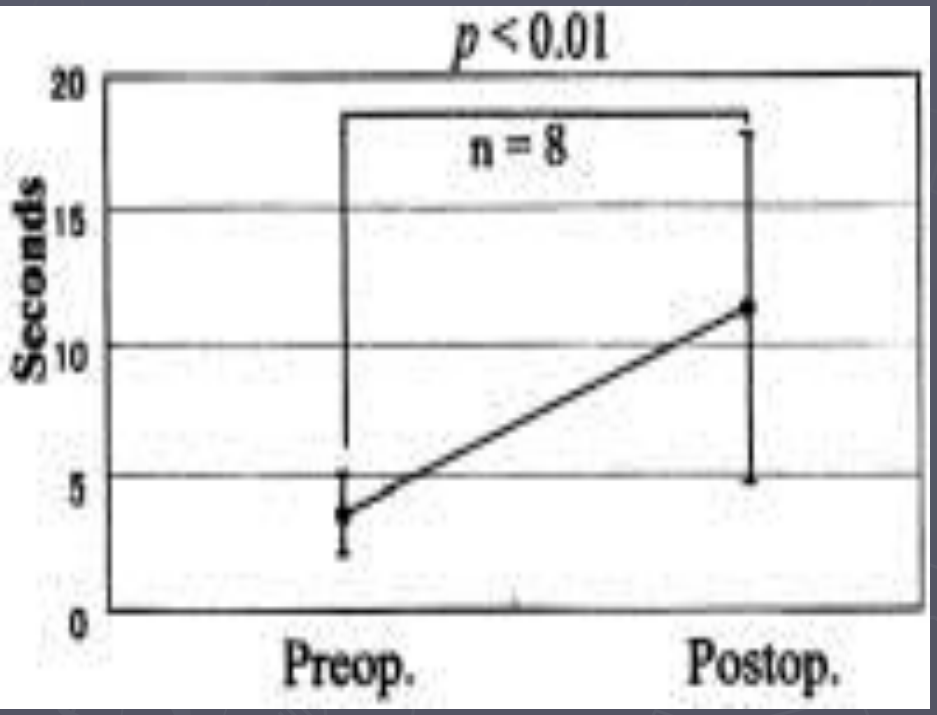
- 過剰なⅠ型のため声の聴覚印象が悪くゴアテックスを二期的に減量した症例が2例あった
- 2例とも聴覚印象はG(2)からG(0)となった

	術前		減量前		減量後	
	MPT	MFR	MPT	MFR	MPT	MFR
症例1	4	698	18	253	20	145
症例2	3	795	9	139	12	105

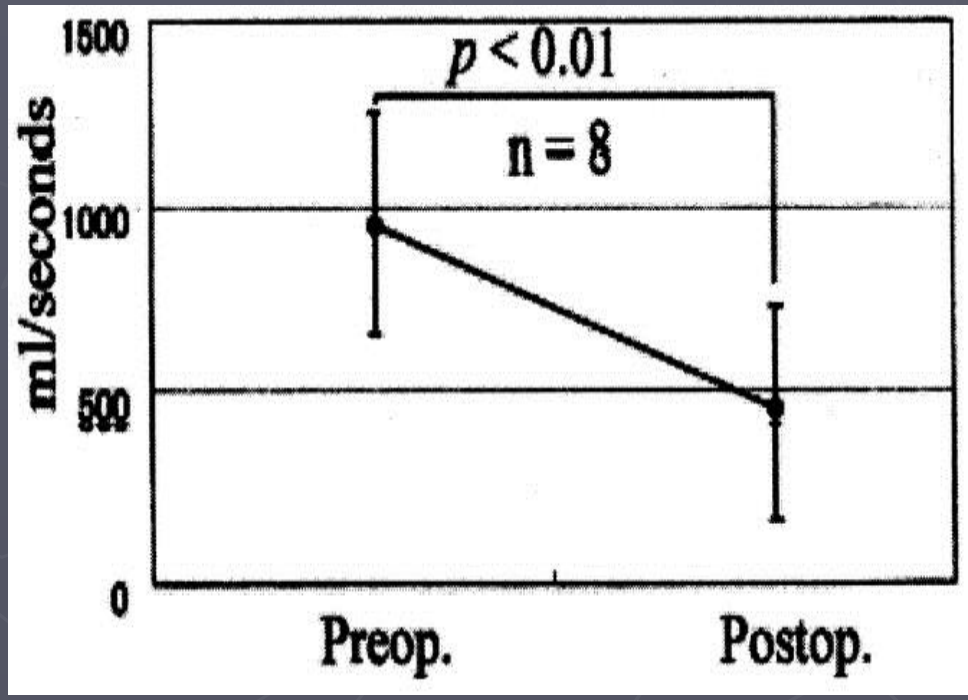
Postoperative MPT & MFR of possible AA by fascia implantation

Nishiyama et al : 2005





MPT



MFR