MINIMALLY INVASIVE SURGERY FOR SLEEP DISORDERED BREATHING

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ENT Dept, University Hospital Split

SO FAR....

Sundaram S, Lim J, Lasserson TJ. Surgery for obstructive sleep apnoea in adults. *Cochrane Database of Systematic Reviews* 2005, Issue 4.
Art. No.: CD001004. DOI: 10.1002/14651858.CD001004.pub2.

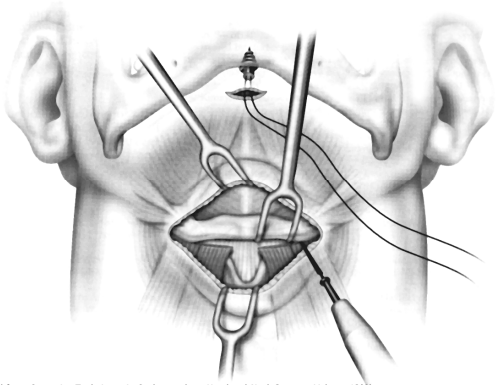
"The studies assembled in the review do not provide evidence to support the use of surgery in sleep apnoea/hypopnoea syndrome, as overall significant benefit has not been demonstrated."

AMERICAN ACADEMY OF SLEEP MEDICINE (AASM)

Practice parameters for the treatment of snoring and obstructive sleep apnea with oral appliances. American Sleep Disorders Association. Sleep 1995;18:511–3.

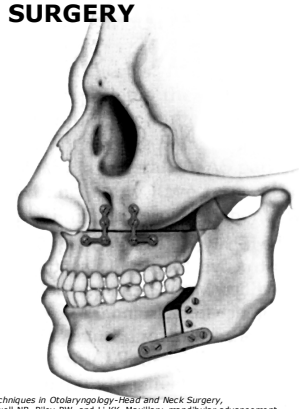
...upper airway surgery may be offered when conservative treatment fails or rejected or inefective.

INVASIVE SURGERY



Reprinted from *Operative Techniques in Otolaryngology-Head and Neck Surgery*, Volume 13(2). Krespi YP and Kacker A, Hyoid suspension for obstructive sleep apnea, p144-149.

INVASIVE SURGERY



Reprinted from *Operative Techniques in Otolaryngology-Head and Neck Surgery*, Volume 13(2). Hester IE, Powell NB, Riley RW, and Li KK, Maxillary-mandibular advancement in obstructive sleep apnea, p135-137,

INVASIVE SURGERY

- perioperative morbidity:
  bleeding,
  infections,
  scarring,
  pain...
- general anaesthesia
  (high risk patients!)

INTENTION OF SURGERY

CURE!!!

INTENTION OF "SLEEP" SURGERY

- **cure the patient**
  - by surgery only
  - combination with other treatment modalities
- **enable other treatments**
  - CPAP
  - oral devices

MINIMALLY INVASIVE SURGERY

- **Criteria for minimally invasive surgery:**

perioperative
low perioperative morbidity
procedure under local anaesthesia
postoperative
outpatient procedure
low postoperative morbidity
low complication rate

DECISION ACCORDING TO SEVERITY OF OBSTRUCTION

SLEEP RELATED BREATHING DISORDERS

WITHOUT UPPER AIRWAY OBSTRUCTION

WITH UPPER AIRWAY OBSTRUCTION

PARTIAL OBSTRUCTION
- **SNORING**
- **UARS**

COMPLETE OBSTRUCTION
- **OSA**
  - **MILD**
  - **MODERATE**
  - **SEVERE**

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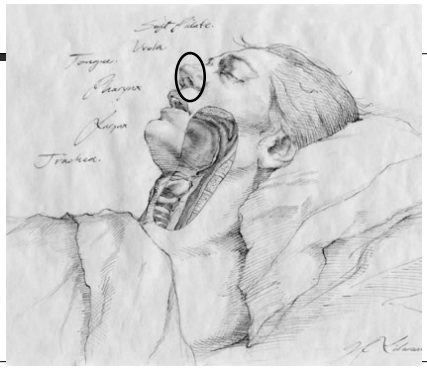

NASAL OBSTRUCTION IS…

- one of the oldest and most common human complaints.
- a considerable handicap for patients and drastically affects quality of life.
- caused by hypertrophy of the inferior turbinates in up to 20% of the population in various European countries.

Sapci T, Sahin B, Karavus A, Akbulut UG: Comparison of the effects of radiofrequency tissue ablation, CO2 laser ablation, and partial turbinectomy applications on nasal mucociliary functions. Laryngoscope. 2003;113(3):514-9.
Cavaliere M, Mottola G, Iemma M: Comparison of the effectiveness and safety of radiofrequency turbinoplasty and traditional surgical technique in treatment of inferior turbinate hypertrophy. Otolaryngol Head Neck Surg. 2005;133(6):972-8.
Seeger J, Zeney E, Gundlach P, Stein T, Mueller G: Bipolar radiofrequency-induced thermotherapy of turbinate hypertrophy: pilot study and 20 months' follow-up. Laryngoscope. 2003;113(1):130-5.

IMPACT ON SDB

- minimal (<10%)
- to improve adherence and compliance with nasal CPAP
  - reducing pressure by approximately 2 mbar
  - using CPAP for 2 hours longer per night

HYPERTROPHY CAN BE

- bony
- mucosal

- observed in septal deviation (compensatory hypertrophy) and associated with chronic rhinitis

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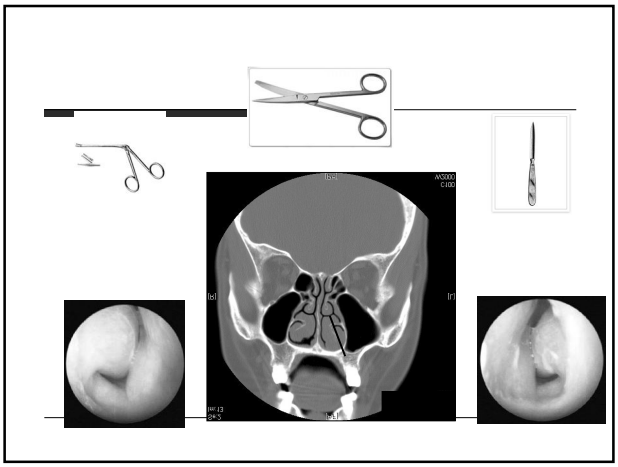
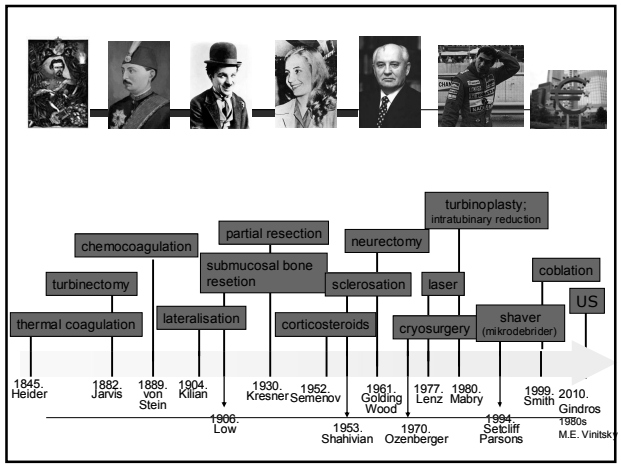
TREATMENT OPTIONS

- pharmacological therapy (using intranasal steroids, antihistamines or decongestants)
- surgery (when pharmacotherapy fails)

Hol MK, Huizing EH: Treatment of inferior turbinate pathology: a review and critical evaluation of the different techniques. Rhinology. 2000;38(4):157-66.
Passali D, Lauriello M, Anselmi M, Bellussi L: Treatment of hypertrophy of the inferior turbinate: long-term results in 382 patients randomly assigned to therapy. Ann Otol Rhinol Laryngol. 1999;108(6):569-75.





Hol MK, Huizing EH: Treatment of inferior turbinate pathology: a review and critical evaluation of the different techniques. Rhinology. 2000;38(4):157-66.
Passali D, Lauriello M, Anselmi M, Bellussi L: Treatment of hypertrophy of the inferior turbinate: long-term results in 382 patients randomly assigned to therapy. Ann Otol Rhinol Laryngol. 1999;108(6):569-75.

RESULTS

COMPLICATIONS

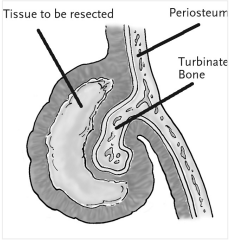
SURGERY

diminishing nasal obstruction

Bleeding, crusting, odor, pain, hyposmia, synechia, bone necrosis infection

An ideal procedure for turbinate reduction should produce an improvement of nasal breathing with minimal discomfort or adverse reactions and should preserve the physiological function of the turbinates.

CONCEPT:



organ preserving surgery!!!

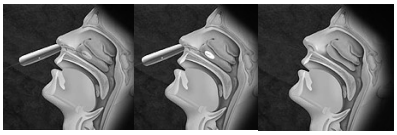
mucosa sparing procedures

nasal breathing

long-term results -

function preservation

COBLATION

\+  +

complications

PATIENTS PREFERENCES

- easy to perform
- in local anaesthesia
- in ambulatory facility
- speed recovery

What have we done?

Efficacy and safety of inferior turbinate coblation channeling in treatment of nasal obstruction
Željka Roje, Goran Račić, and Goran Kardum
(accepted for publication in Coll Antropol)

OBJECTIVES

- prospectively evaluate the safety and effectiveness of coblation channeling for the treatment of nasal obstruction caused by inferior turbinate hypertrophy

SUBJECTS

- 52 patients
- 27 male
- 25 female
- average age: 28,5 years, ranging from 11 – 71

CRITERIA

INCLUSION
- difficult nose breathing
- hypertrophic inferior turbinates refractory to medical therapy

EXCLUSION
- deviated septum
- nasal polyposis
- allergic rhinitis
- recent nasal surgery

METHODS

- medical history and clinical examination
- VAS (for obstruction)
- questionnaire obtaining symptoms: hyposmia, nasal drainage, postnasal drip
- Active anterior rhinomanometry (Rhinomanometer 200, ATMOS, Germany)
- Coblator plasma surgery sistem ArthtroCare ReFlex Ultra 45 Wand (Arthrocare Corp., Sunnyvale, CA, USA)

Questionnaire

Simptoms to evaluate:

- hyposmia
- nasal drainage
- postnasal drip

0 – without simptoms
1 – mild to moderate
2 - severe

SURGICAL PROCEDURE

- The procedures were performed in an ambulatory facility with patients under local anesthesia by injecting 2 % lidocaine, 2ccm in each inferior turbinate by the same surgeon using an ArthroCare ReFlex Ultra 45 wand making three submucousal chanalls per turbinate(power 6 W for each channel).

STUDY DESIGN

0.DAY_____14.DAY_____8 WEEKS

VAS
QUESTIONNAIRE
RMM
CC*

clinical check up

VAS
QUESTIONNAIRE
RMM
clinical check up

**CC – coblation channeling*

RESULTS (1)

- Patients tolerated the procedure well.
- None of them felt discomfort during coblation due to overheating the tissue.
- No significant epistaxis occurred during and after the procedure.

RESULTS (2)

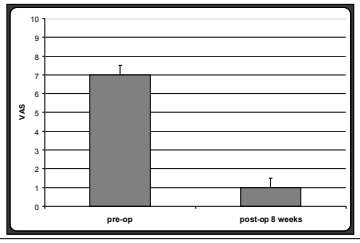
- Mild crusting was noted in 3 (5.7%) patients at the 2-week follow-up visit.
- It was located in the head of the inferior turbinate corresponding with the puncture places for introducing wand.

RESULTS (3)

- No adverse effects were encountered, including bleeding, crusting, dryness, infection, adhesion, or a worsening of obstruction.

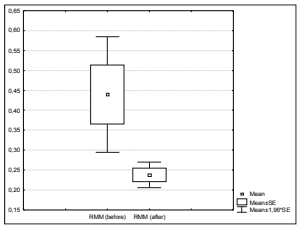
RESULTS (4)

Nasal breathing was improved in all patients significantly decreasing VAS from median 7 (range 2-9) to 1 (range 0-3) (p<0,001)

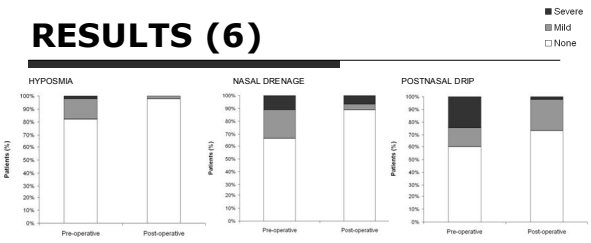


RESULTS (5)

Total nasal resistance decreased from 0,44+/- 0,497 to 0,24+/- 0,110 (p=0,005)



RESULTS (6)



Patients reported improvement in all three scored symptoms separately after the procedure. Improvement was statistically significant: for hyposmia (p=0,005), for nasal drainage (p=0,003) and for postnasal drip (p<0,001).

IF WE REMEMBER FROM THE BEGINING OF THE STORY…

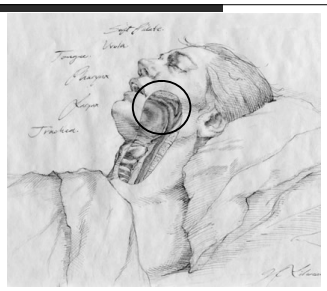
An ideal procedure for turbinate reduction should be to obtain an improvement of nasal breathing with minimal discomfort or adverse reactions and should preserve the physiological function of the turbinates.

WE CAN SAY ACCORDING TO OUR RESULTS…

Coblation tissue reduction of the inferior turbinate meets all criteria for an ideal method in treatment of inferior turbinate enlargement.

BUT, LONG TERM RESULTS?

Do it again!!!



MINIMALLY INVASIVE OROPHARYNGEAL SURGERY

- soft palate
  - radiofrequency surgery (COBLATION)
  - Pillar palatal implants
  - injection snoreplasty
- tonsils
  - radiofrequency surgery (COBLATION)
- tongue base
  - radiofrequency surgery (COBLATION)

INJECTION SNOREPLASTY

with sodium tetradycil sulphate as sclerosing agent
stiffening of the soft palate

INJECTION SNOREPLASTY

- easy to perform
- repeatable
- no surgery involved
- success rate as in other soft palate minimally invasive procedures

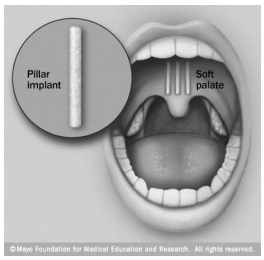
Brietzke SE, Mair EA. Injection snoreplasty: extended follow-up and new objective data. Otolaryngol Head Neck Surg.2003;128(5):605-15.
Iseri M, Balcioglu O. Radiofrequency versus injection snoreplasty in simple snoring. Otolaryngol Head Neck Surg. 2005 Aug;133(2):224-8.
Al-Jassim AH, Lesser TH. Single dose injection snoreplasty: investigation or treatment? J Laryngol Otol. 2008 Nov;122(11):1190-3.

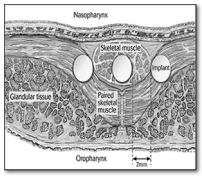
...during the lunch break therapy...

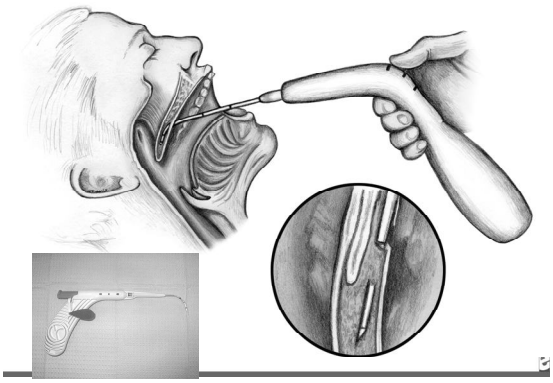
Sleep News
Snoring could be cured by £3 injection

16/11/2009

PALATAL (PILLAR) IMPLANTS







Author	N	Follow-up	AHI pre	AHI post	Success %	EBM
Friedman et al. 2006	29	7.5	12.7	11.5	24.1	4
Walker et al. 2006	53	3.0	25.0	22.0	20.8	3b
Nordgard et al. 2006	25	3.0	16.2	12.1	36	3b
Nordgard et al. 2007	26	12.0	16.5	12.5	50	3b
Goesler et al. 2007	16	3.0	16.5	11.2	37.5	3b
Friedman et al. 2008	29	3.0	23.8	15.9	41.9	1b
Steward et al. 2008	47	3.0	16.8	13.9	26	1b
All	225	4.6	19.0	15.2	31.3	B

Maurer JT. Update on surgical treatment for sleep apnoea. Swiss Med Wkly 2009;139:624-8.

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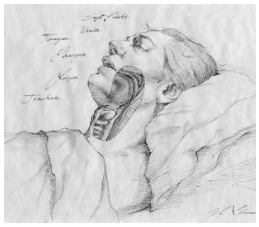
Nordgard et al. 2007	26	12.0	16.5	12.5	50	3b
Goesler et al. 2007	16	3.0	16.5	11.2	37.5	3b
Friedman et al. 2008	29	3.0	23.8	15.9	41.9	1b
Steward et al. 2008	47	3.0	16.8	13.9	26	1b
All	225	4.6	19.0	15.2	31.3	B

Maurer JT. Update on surgical treatment for sleep apnoea. Swiss Med Wkly 2009;139:624-8.

RADIOFREQUENCY (RF)

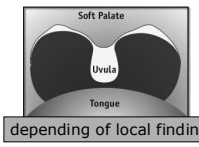
- interstitially (coagulating tissue)
- superfitially (vaporisation or cutting)
- for soft palate, tongue base and tonsils



reported success is 16 – 83%

SOFT PALATE

- interstitial treatment (without tissue removal)
- RF uvulopalatoplasty (with tissue removal)



depending of local findings

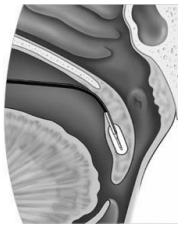
•*Verse T. Update on surgery for obstructive sleep apnea syndrome. HNO 2008;56(11):1098-104.*
•*Baisch Alexander; Maurer Joachim T; Hörmann Karl; Stuck Boris A combined radiofrequency assisted uvulopalatoplasty in the treatment of snoring. European archives of oto-rhino-laryngology 2009;266(1):125-30.*
•*Stuck BA; Sauter A; Hormann K; Verse T; Maurer JT Sleep. Radiofrequency surgery of the soft palate in the treatment of snoring. A placebo-controlled trial. 2005 Jul 1;28(7):847-50.*

Interstitial treatment

INDICATIONS:
snoring and mild OSA
AHI<15
mild webbing, short uvula
no, or small tonsils

4-6 lesions
once or twice

What do we do?
COBLATION CHANNELING



Stuck BA; Sauter A; Hormann K; Verse T; Maurer JT Radiofrequency surgery of the soft palate in the treatment of snoring. A placebo-controlled trial. Sleep. 2005 Jul 1;28(7):847-50.

Johnson JT, et al. Reduction of snoring with a plasma-mediated radiofrequency-based ablation (Coblation) device. Ear Nose Throat J. 2008 Jan;87(1):40-3.

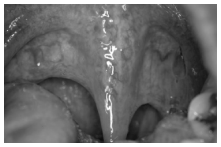
Bäck LJ, et al. Bipolar radiofrequency thermal ablation of the soft palate in habitual snorers without significant desaturations assessed by magnetic resonance imaging. Am J Respir Crit Care Med. 2002 Sep 15;166(6):865-71.

RF uvulopalatoplasty

INDICATIONS:
snoring and mild OSA
AHI<15
extreme webbing and/or long uvula
no, or small tonsils

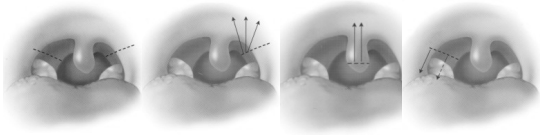
once

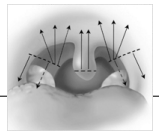
TISSUE REMOVAL



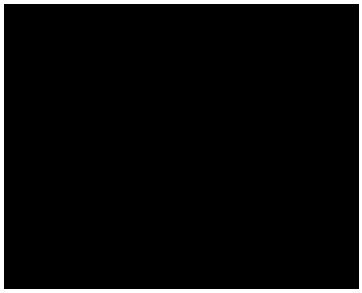
What do we do?
CAUP (coblation assisted upper airway procedure)

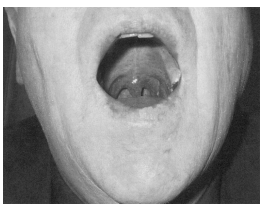
combination of interstitial treatmet and tissue removal treatment

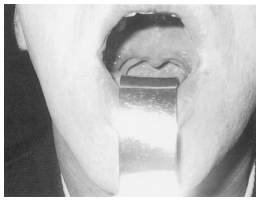




What do we do?
CAUP







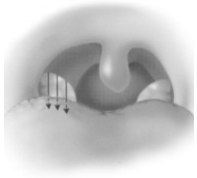
TONSILLS

- ☐ tonsillectomy
- ☐ tonsillotomy
- ☐ tonsill`s channeling

CHANNELING

- under the local anaesthesia
- efficacy?

ReFlex Ultra 55



TONSILLOTOMY

- in children with no history of infections

TONSILLECTOMY

What have we done?

Roje Z, Racić G, Dogas Z, Pisac VP, Timms M.
Postoperative morbidity and histopathologic characteristics of tonsillar tissue following coblation tonsillectomy in children: a prospective randomized single-blind study.
Coll Antropol. 2009 Mar;33(1):293-8.

TONSILLECTOMY

QUESTION 1

- **Known:**
  Coblation causes less thermal damage to the tissue.*
- **Unknown:**
  1. Depth of the thermal damage?
  2. Is there correlation between the depth of the thermal damage and postoperative morbidity?

*Timms MS, Temple RH. Coblation tonsillectomy: a double blind randomized controlled study. J Laryngol Otol 2002;116:450-452.

QUESTION 2

- **Known:**
  Resuming normal physical activity and normal diet is faster after coblation tonsillectomy.*
- **Unknown:**
  Why?
  1. Because of the less thermal damage?
  2. Because of the less intensive systemic inflammatory response?

*Temple RH, Timms MS. Pediatric coblation tonsillectomy. Int J Pediatr Otorhinolaryngol 2001;61:195-198.
*Vinker KE, Dan DM, Kang R, Haupert MS, Magit A, Madgy DN. Pediatric total tonsillectomy using coblation compared to conventional electrosurgery: a prospetive, controlled single-blind study. Otolaryngol Head Neck Surg 2004;130:732-735.

HYPOTHESIS

Coblation causes less thermal damage of the tissue and subsequentely less systemic inflammatory reaction and thus less postoperative morbidity.

OBJECTIVES

- To determine the depth of thermal damage to tonsillar tissue due to radiofrequency ablation, and to compare it with thermal damage to tonsillar tissue following conventional tonsillectomy; to correlate the depth of thermal damage to tonsillar tissue with the parameters of postoperative morbidity.
- To compare systemic immunological reaction, postoperative pain severity, time to resuming normal physical activity, and incidence of postoperative bleeding between two groups of tonsillectomized children aged up to 16 years.
- To correlate the depth of thermal damage to tonsillar tissue with the parameters of systemic inflammatory reaction.
- To correlate parameters of systemic inflammatory reaction with parameters of postoperative morbidity.

MATERIALS AND METHODS

- The prospective, randomized single blind study included 100 children aged 3-16 years scheduled for tonsillectomy at our department for chronic tonsillitis and/or respiratory obstruction. The children were randomly assigned into two groups submitted either to conventional tonsillectomy with bipolar diathermy coagulation or to radiofrequency tonsillectomy, with a 14-day follow up.

OUTCOMES

- Primary outcome was the depth of thermal damage to tonsillar tissue (histopathologic study). Secondary outcomes were: severity and duration of postoperative pain (based on the use of analgesics during the postoperative period); postoperative day of resuming normal physical activity; rate of postoperative hemorrhage; systemic inflammatory reaction on surgery (based on CRP and fibrinogen blood level before and 7 th postop day).

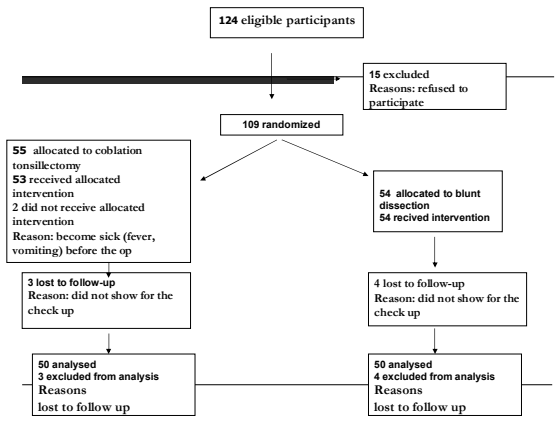
QUESUESTIONNAIRES FOR THE PARENTS:

1. ANALGETIC CONSUPTION:

	1.day	2.day	3.day	4.day	5.day	6.dan	7.day	8.day	9.day	10.day	11.day	12.day	13.day	14.day
Ibuprofen Dalsy Neofen														
Paracetamol Plicet Lupocet Lekadol Panadol														

2. "GETTING BACK ON THE NORMAL PHYSICAL ACTIVITY":

1.day	2.day	3.day	4.day	5.day	6.day	7.day	8.day	9.day	10.day	11.day	12.day	13.day	14.day



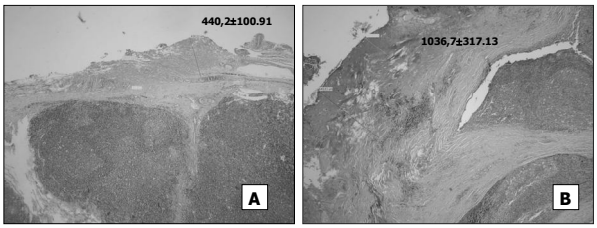
The study was approved by the Split University Hospital Medical Ethics Committee.

ALL PROCEDURES WERE UNDERTAKEN BY THE SAME SURGEON AND THE SAME ANAESTHETIST IN ATTENDANCE.

RESULTS (1) – THERMAL DAMAGE

- The mean depth of thermal damage to tonsillar tissue operated by radiofrequency was 440.2±100.91 and by blunt dissection with diathermy coagulation 1036.7±317.13. Statistically significant differences were observed in the depth of thermal damage to tonsillar tissue (t =12.7; p<0.001).

Depth of thermal damage to tonsillar tissue following coblation (A) and conventional tonsillectomy with bipolar diathermy coagulation (B) (H-E, x400).



RESULTS (2) – POSTOPERATIVE PAIN

- Mean number of analgetic application in radiofrequency group was 4 (0-19), and in classical group 10 (1-28) (Z= -5.3; p< 0.001). Children operated by radiofrequency used analgetics for 2 (0-7) days *vs.* 4 (1-8) days in classical group which is also statistically significant (Z=-5.6; p< 0.001).

RESULTS (3) – PHYSICAL ACTIVITY

- Children operated on coblation technique faster resumed normal physical activities: in 2 (1-7) *vs.* 4 (1-9) days which is statistically significant (Z=-4.9; p<0.001).

RESULTS (4) – POSTOPERATIVE BLEEDING

- There was no statistically significant difference in postoperative haemorrhage between the groups (t=0.34; p>0.05).

RESULTS (5) – SYSTEMIC INFLAMMATORY REACTION

- CRP ($t = -4.7$; $p < 0.001$) and fibrinogen ($t = -4.6$; $p<0.001$) blood level statistically significant increased in classical group after the procedure.

RESULTS (6) - CORRELATION

- There was statistically significat correlation between postoperative morbidity and thermal tissue damage: less thermal damage is associated with less postoperative morbidity through less analgetic applications ($r = 0.48$; $p<0,001$), less days on analgetic consumption ($r = 0.48$; $p<0.001$), and faster resuming normal physical activities ($r = 0.45$; $p<0.001$).

RESULTS (7) - CORRELATION

- There was statistically significant correlation between depth of thermal damage to tonsillar tissue and increased CRP blood level after the surgery ($r=0.30$; $p< 0.01$).

RESULTS (8) - CORRELATION

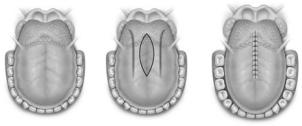
- There was statistically significant correlation between increased CRP blood level after the surgery and postoperative analgetic consumption through increased analgetic application ($r= 0.28$; $p < 0.01$) and more days on analgetic consumption ($r= 0.26$; $p < 0.01$). There was correlation between increased CRP blood level and faster resuming normal physical activities ($r=0.30$; $p< 0.01$).

CONCLUSIONS

- In this study we have correlated postoperative morbidity and thermal tissue damage: less thermal damage is associated with less postoperative morbidity. Coblation tonsillectomy induces a statistically significant lower depth of thermal tissue damage than conventional tonsillectomy with bipolar diathermy coagulation and statistically significant less systemic inflammatory reaction on surgery.
- Children operated on coblation technique experienced statistically significant less postoperative pain and faster resumed normal physical activities.

TONGUE BASE

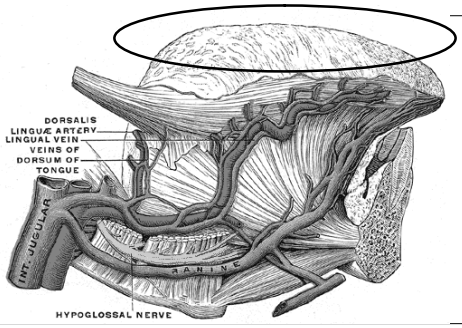
"hot potato" in snoring surgery



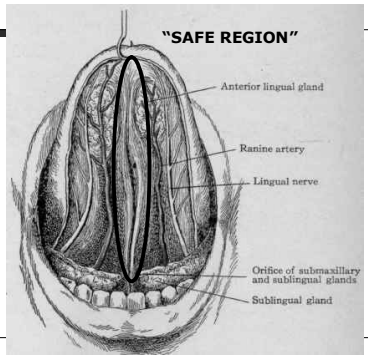
PROBLEMS:

- demanding region
- postoperative pain
- postoperative oedema
- nerve injury
- postoperative necrosis

"SAFE REGION"



"SAFE REGION"



RF treatment of the tongue base

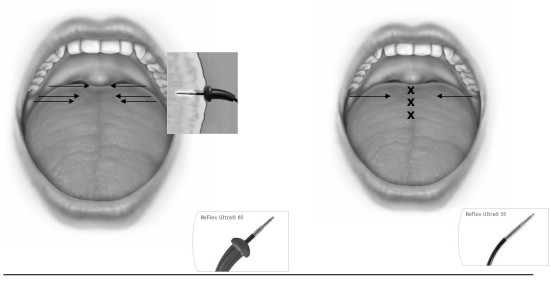
- interstitially – without tissue removal is minimally invasive surgery
- superfitially with tissue removal is invasive!!!!

RF is the only minimally invasive treatment of the tongue base till now.

reported success is 20 – 68%

no change in swallowing or speech

What do we do?
COBLATION CHANNELING



Author	N	Follow-up	AHI pre	AHI post	EBM
Powell et al. 1999	15	4.0	47.0	20.7	3b
Woodson et al. 2001	56	1.5	40.5	32.8	2b
Stuck et al. 2002	18	1.0	32.1	24.9	3b
Li et al. 2002	16	28.0	39.5	28.7	3b
Riley et al. 2003	19	3.0	35.1	15.1	3b
den Herder et al. 2006	10	12.0	12.9	10.6	3b
All	134	5.9	37.2	25.7	B

Maurer JT. Update on surgical treatment for sleep apnoea. Swiss Med Wkly 2009;139:624-8.

COMBINATIONS

- usually: RF for tongue base and UPP
  - slightly better outcome then tongue base procedures alone
  - preferred in OSA patients (not for snorers)

Farrar J, Ryan J, Oliver E, Gillespie MB. Radiofrequency ablation for the treatment of obstructive sleep apnea: a meta-analysis. Laryngoscope. 2008 Oct;118(10):1878-83.
Stuck BA, Starzak K, Verse T, Hörmann K, Maurer JT. Complications of temperature-controlled radiofrequency volumetric tissue reduction for sleep-disordered breathing. Acta Otolaryngol. 2003 May;123(4):532-5.
Verse T. Update on surgery for obstructive sleep apnea syndrome.HNO 2008;56(11):1098-104.
Neruntarat C, Chantapant S. Radfofrequency surgery for the treatment of obstructive sleep apnea: Short-term and long-term results. Otolaryngol Head Neck Surg. 2009;141:722-6.

COMBINATIONS

- RF-UPP and snoreplasty*
- RF-UPP and Pillar System#

*O'Connor-Reina C, Garcia-Iriarte MT, Gomez Angel D, Rodríguez-Díaz A. Bipolar radiofrequency uvulopalatoplasty combined with injection snoreplasty:a reasonable option for the problem of snoring. ORL J Otorhinolaryngol Relat Spec. 2009;71(2):105-11.
#Friedman M, Scalch P, Joseph NJ. Palatal stiffening after failed UPPP with the Pillar Implant System. Laryngoscope.2006;116:1956-61.

SHOULD WE USE MINIMALLY INVASIVE SURGERY FOR SDB?

- **YES,** because it is:
  - safe
  - easy to perform
  - not too expensive
  - a very few side effects
  - repeatable
  - does not exlude other treatment options (CPAP)
  - complementary with CPAP
  - number of papers suggest that it is helpful in mild OSA (Grade B)

Roje Z, Racic G.
Management of rhinophyma with coblation.
Dermatol Surg. 2010 Dec;36(12):2057-60.