

Olfactory disorders

Basile N. Landis

Unité de Rhinologie-Olfactologie
Service d'Oto-Rhino-Laryngologie et de Chirurgie cervico-faciale
Hôpitaux Universitaires de Genève
Suisse



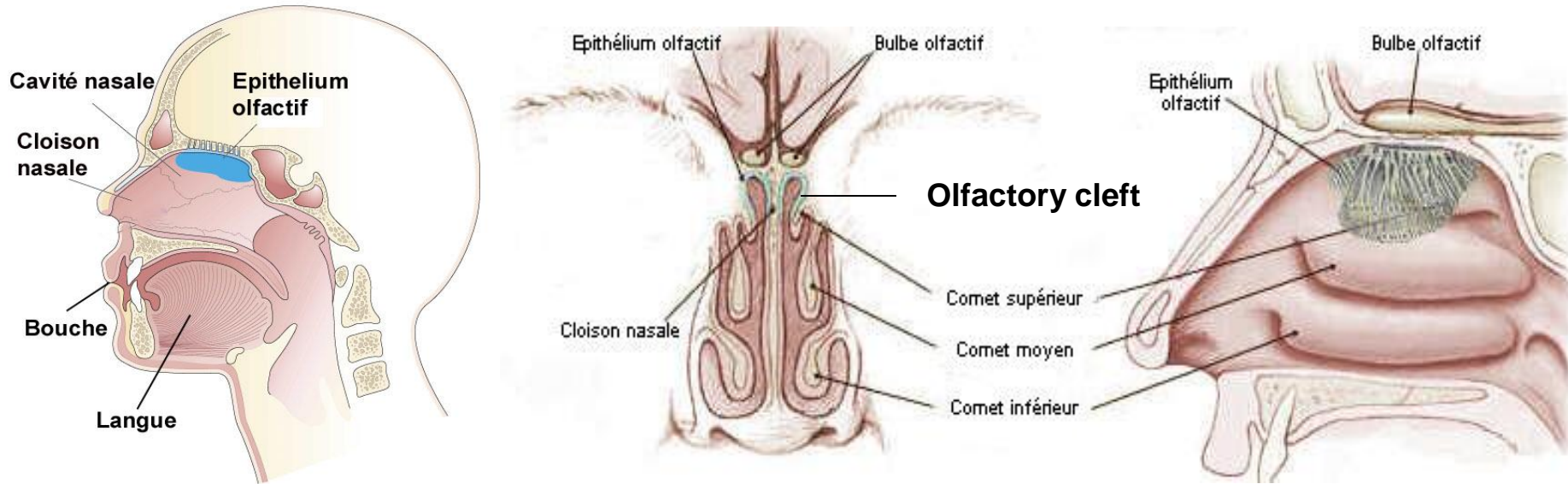
Hôpitaux
Universitaires
Genève



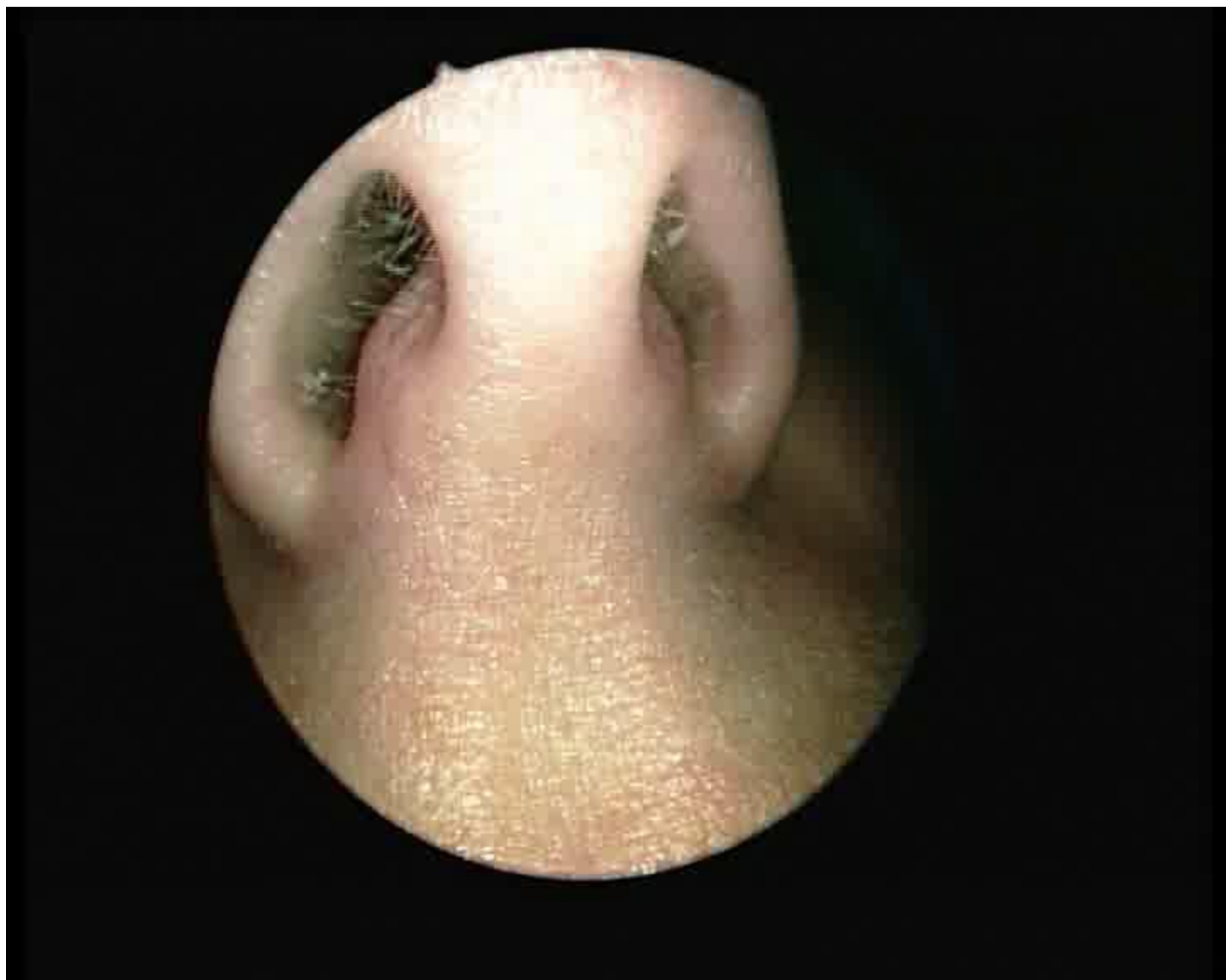
**UNIVERSITÉ
DE GENÈVE**

FACULTÉ DE MÉDECINE

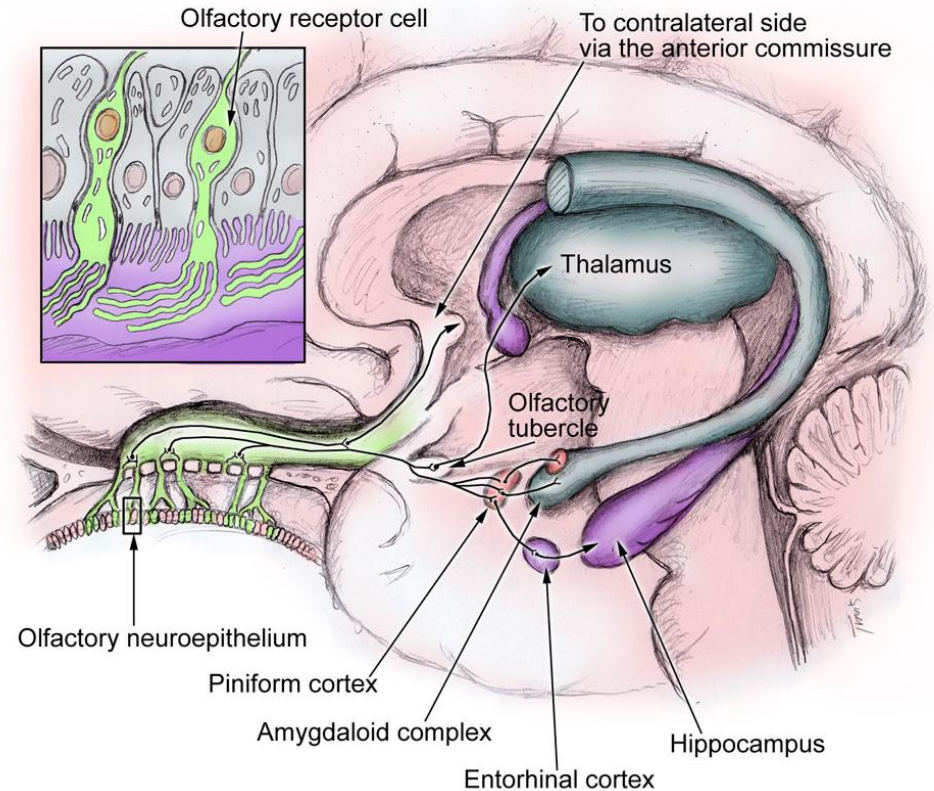
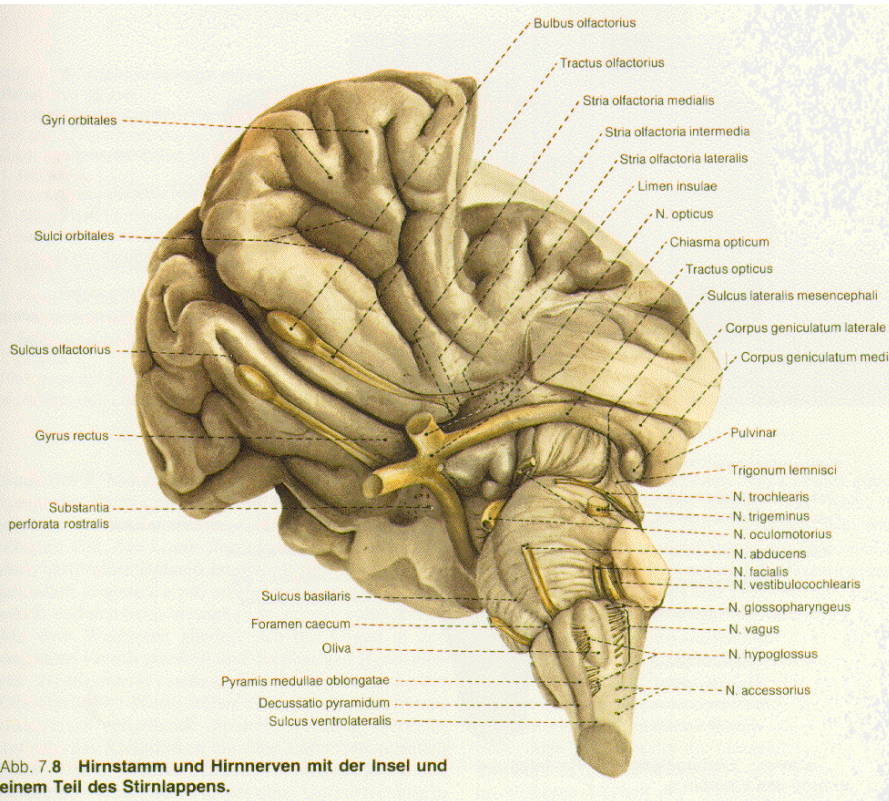
Olfaction - Particularities



- Olfactory epithelium : roof of nasal cavity
- Olfactory Bulb : inside the bony skull
- Surface : 1-2,5 cm² (rabbit 4,5 cm² ; dog 17 cm²) per side
- **Olfactory neurons are located inside the nasal cavity (exposition !)**
- **Continuous regeneration ! (Central Nervous System)**



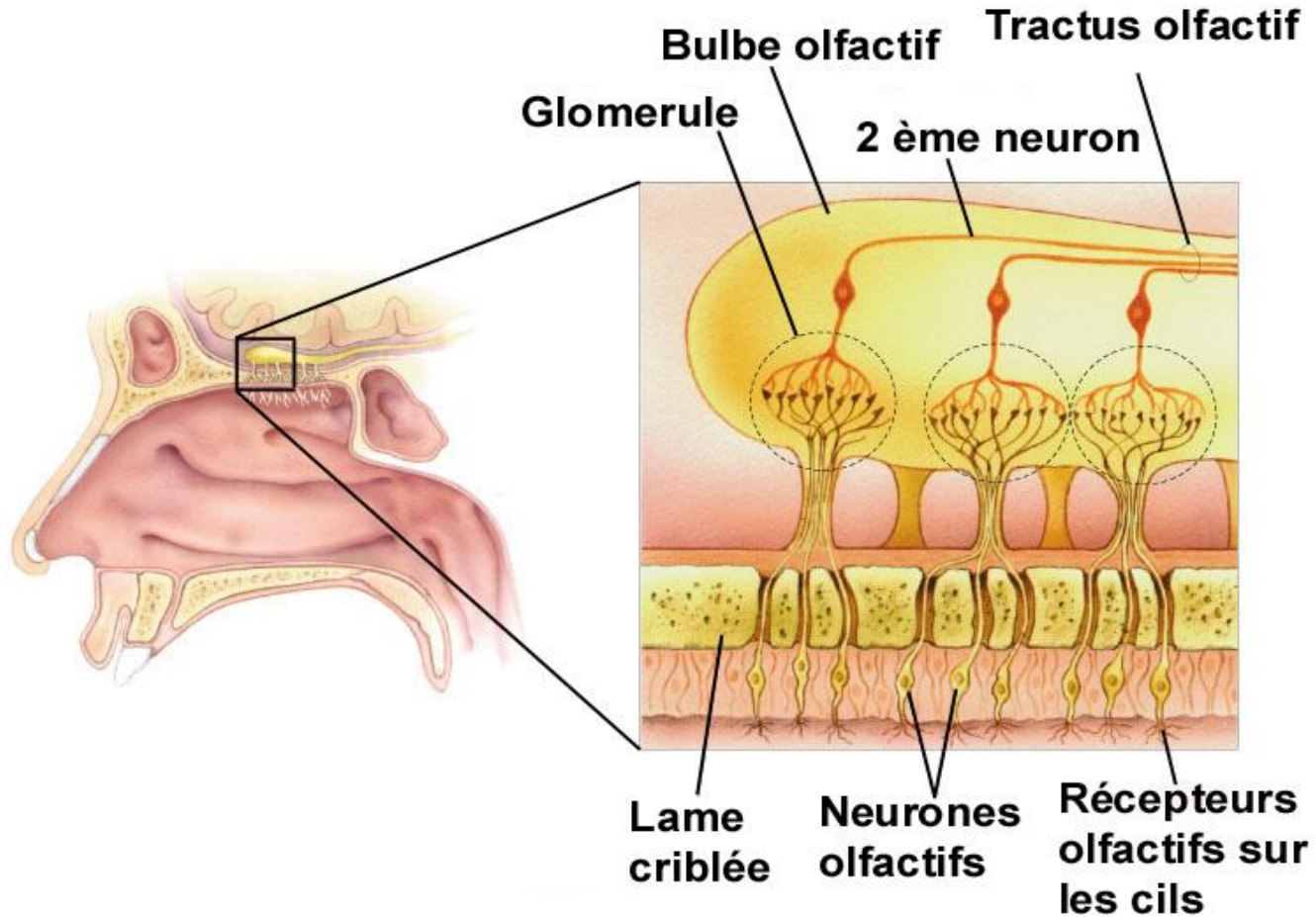
Olfaction - Particularities



- Two olfactory bulbs and tracts
- **Ipsilateral** Projections

- Projects to the limbic system (piriforme cortex = primary cortex)
- **Almost no thalamic projections**
- Orbito-frontal Cortex (secondary cortex)

Olfaction – Physiology

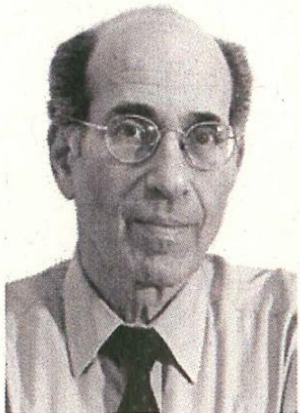


Olfaction – Physiology



The Nobel Prize in Physiology or Medicine 2004

"for their discoveries of odorant receptors and the organization of the olfactory system"



Richard Axel

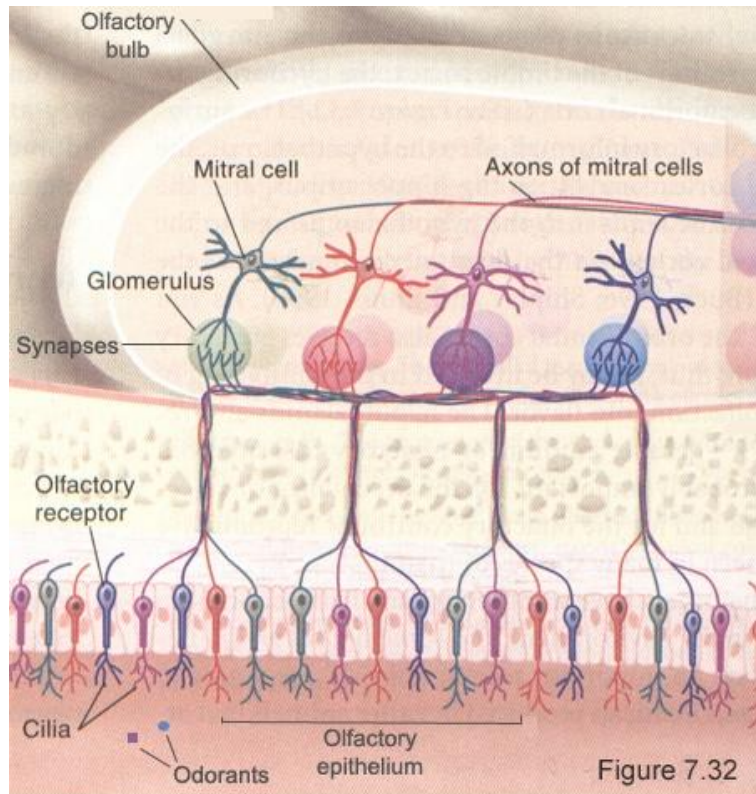


Linda B. Buck

- Humans have approximately 370 genes expressed.
- Each olfactory neuron expresses only one olfactory receptor
- One receptor recognizes numerous molecules.
- One molecule activates a specific pattern of receptors

Discovery of a large gene family coding for proteins expressed only in the olfactory epithelium (approx. 1% of the human genome = 1000 possible receptors)

Olfaction – Physiology



~~One odor = one receptor~~

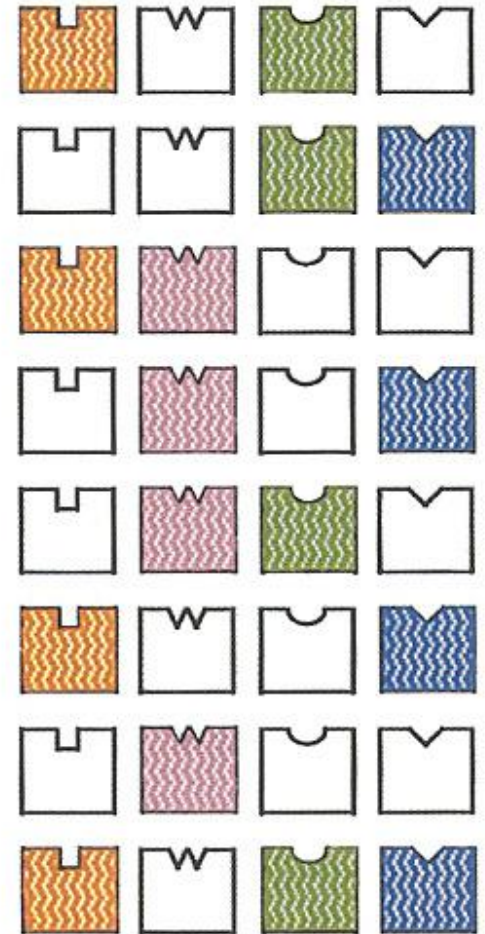
Humans Can Discriminate More than 1 Trillion Olfactory Stimuli

C. Bushdid,^{1*} M. O. Magnasco,² L. B. Vosshall,^{1,3} A. Keller^{1†}

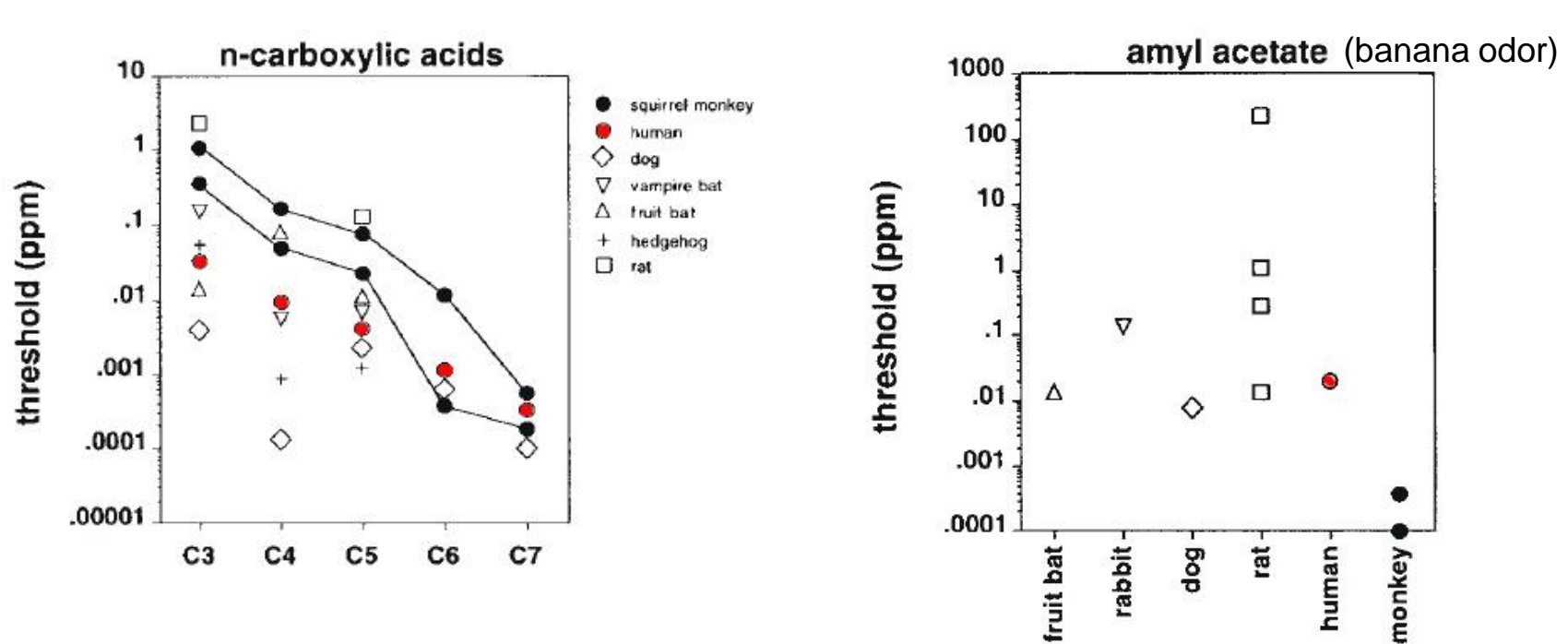
ODORANTS



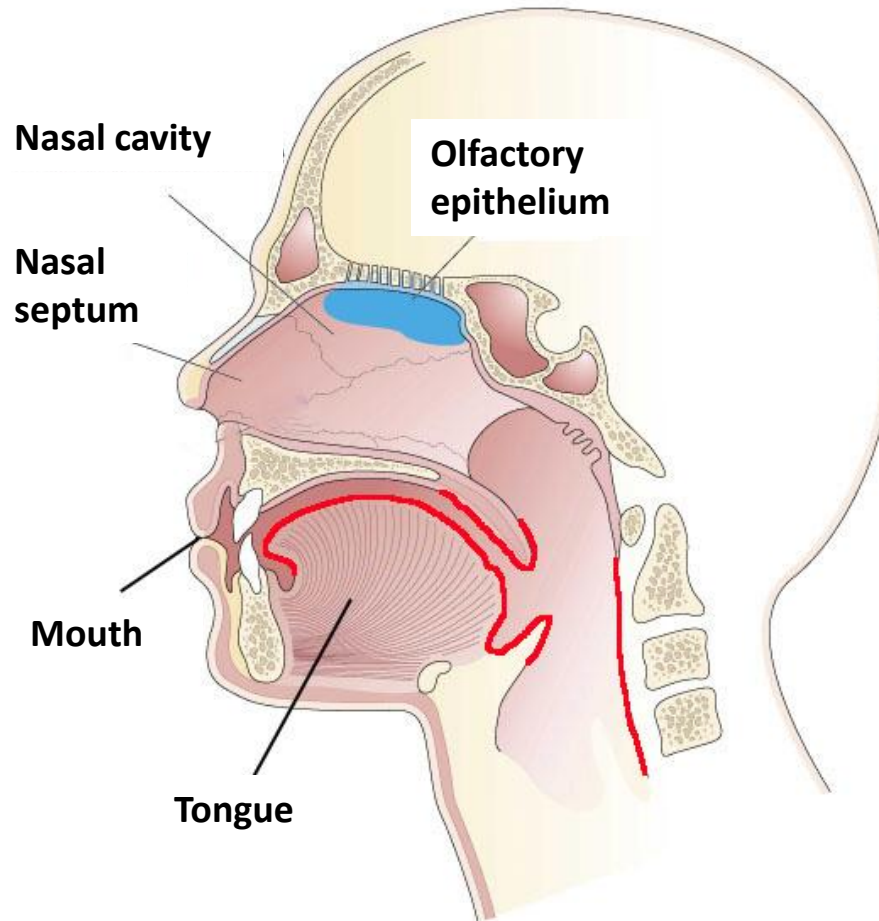
RECEPTORS



Are humans microsmatics?

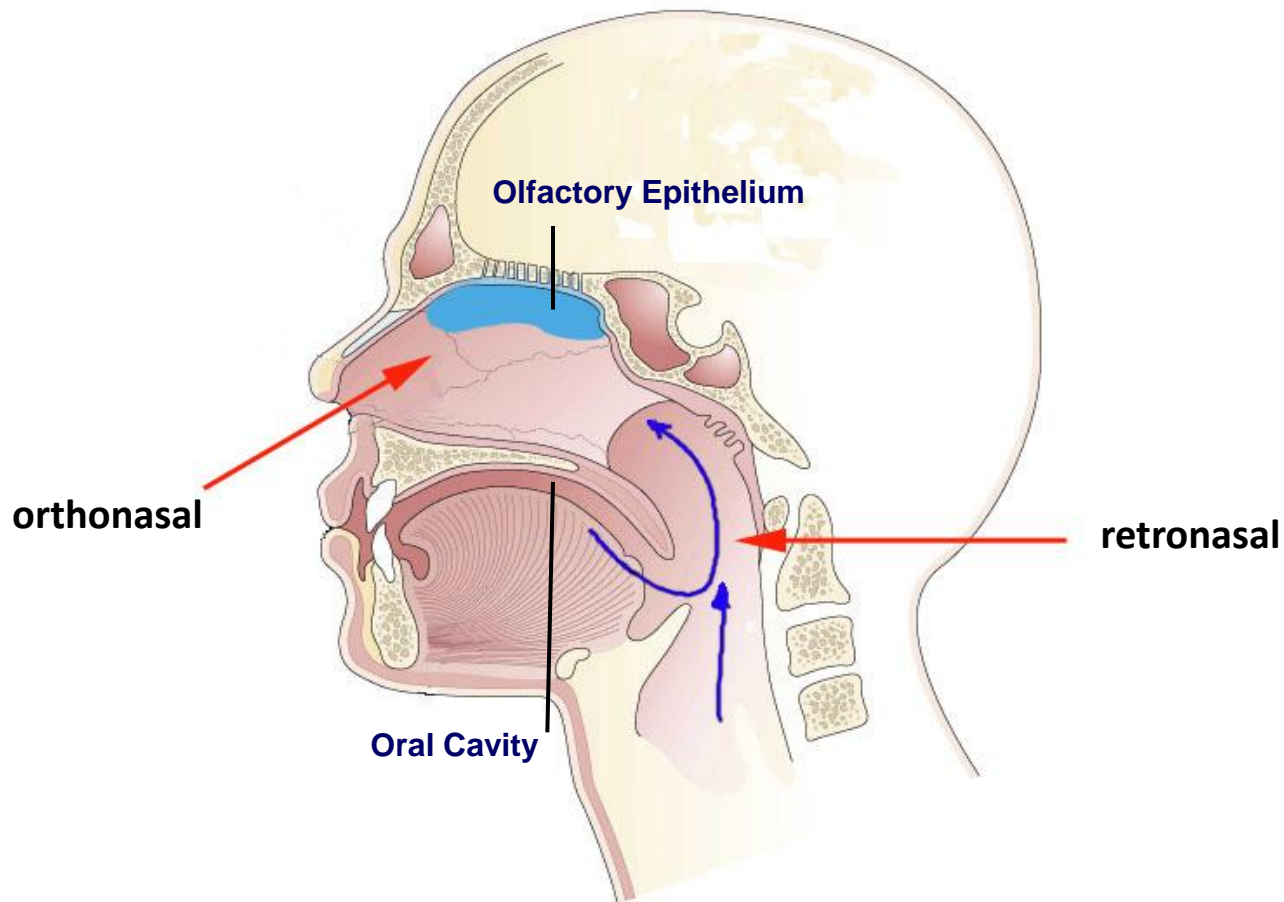


Human Taste & Smell



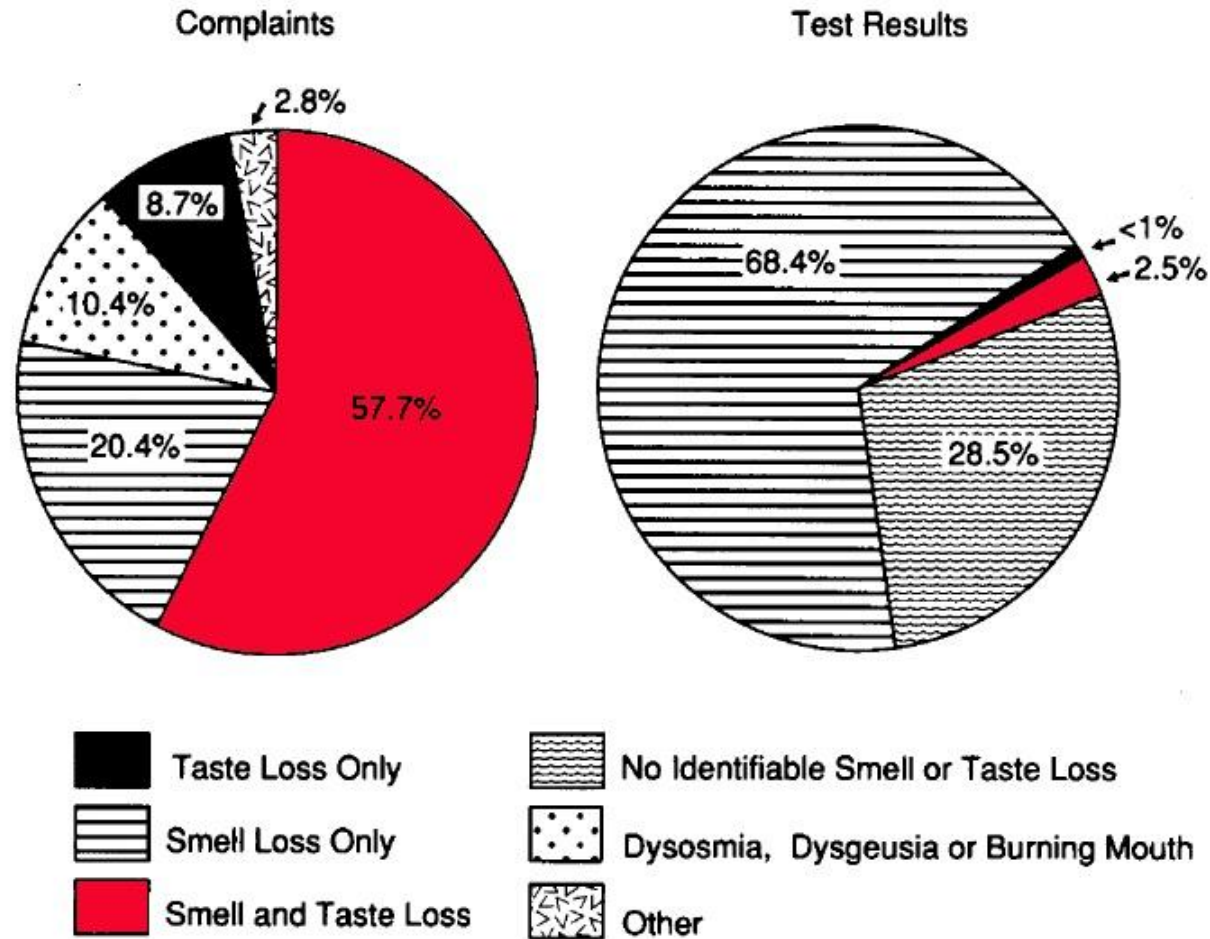
Zones of taste perception
(sweet, salty, sour, bitter, umami)

Retronasal Olfaction



Verbal confusion between smell and taste !

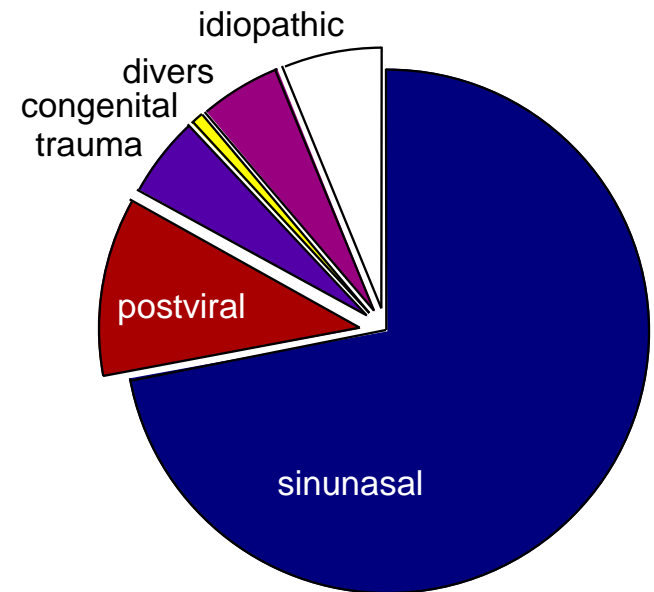
Clinical Consequence



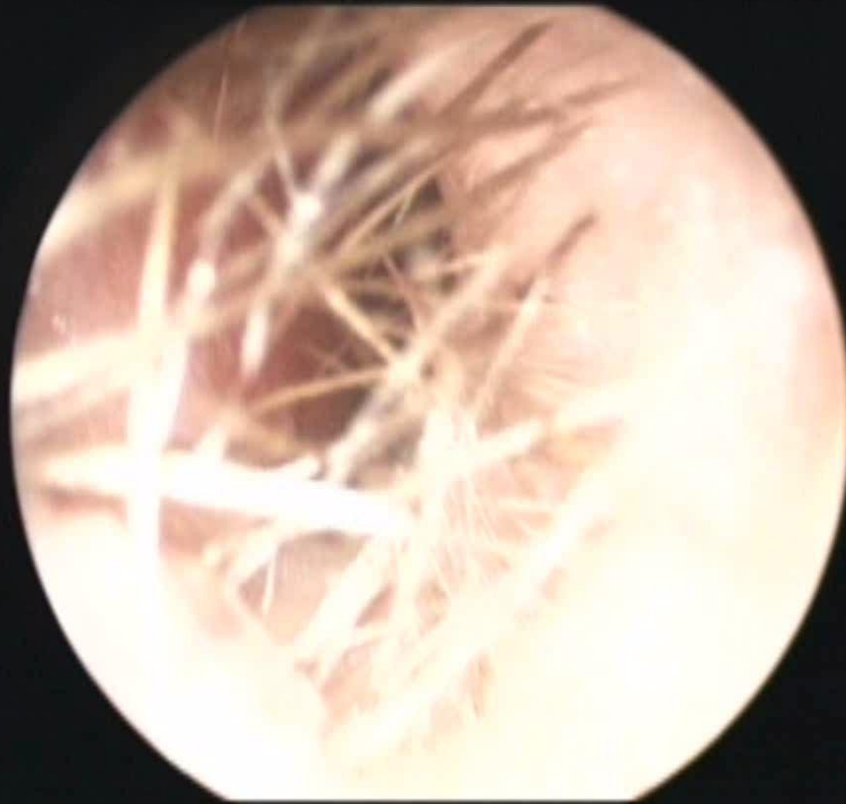
Olfactory impairment \Rightarrow Impairment of « smell and taste »

Olfactory disorders - Causes

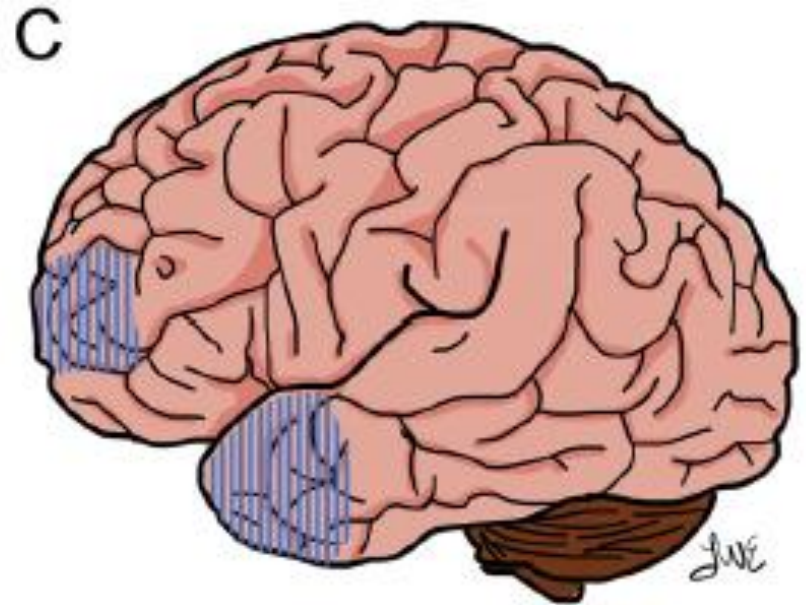
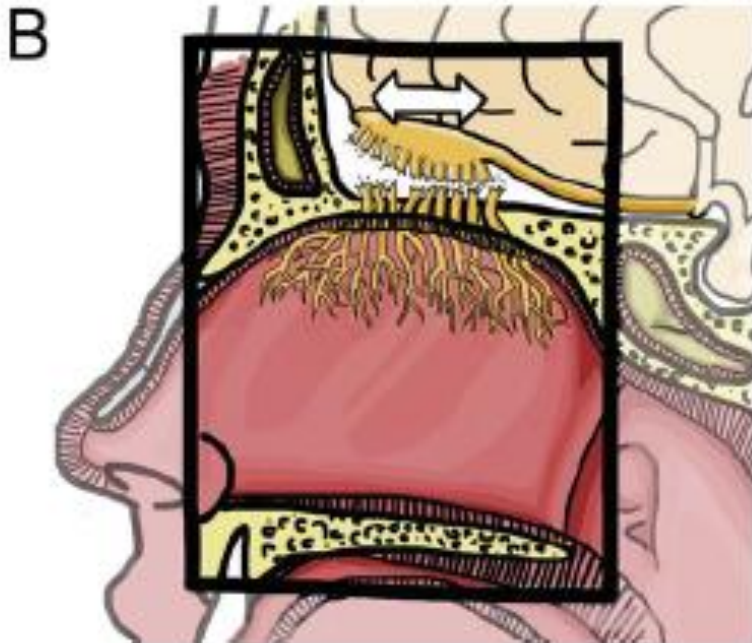
- **Sinunasal** (CRS, Polyps, Allergies, repeated infections, multiple surgeries)
- **Post-infectious** / Post upper respiratory tract infection
- **Posttraumatic**
- Neurological (Parkinson, Alzheimer, and many more)
- Congenital (isolated, syndrome)
- Tumor (brain, nose or paraneoplasia)
- Side effects (toxic, medication)
- Metabolic Diseases
- **Idiopathic**
- Age



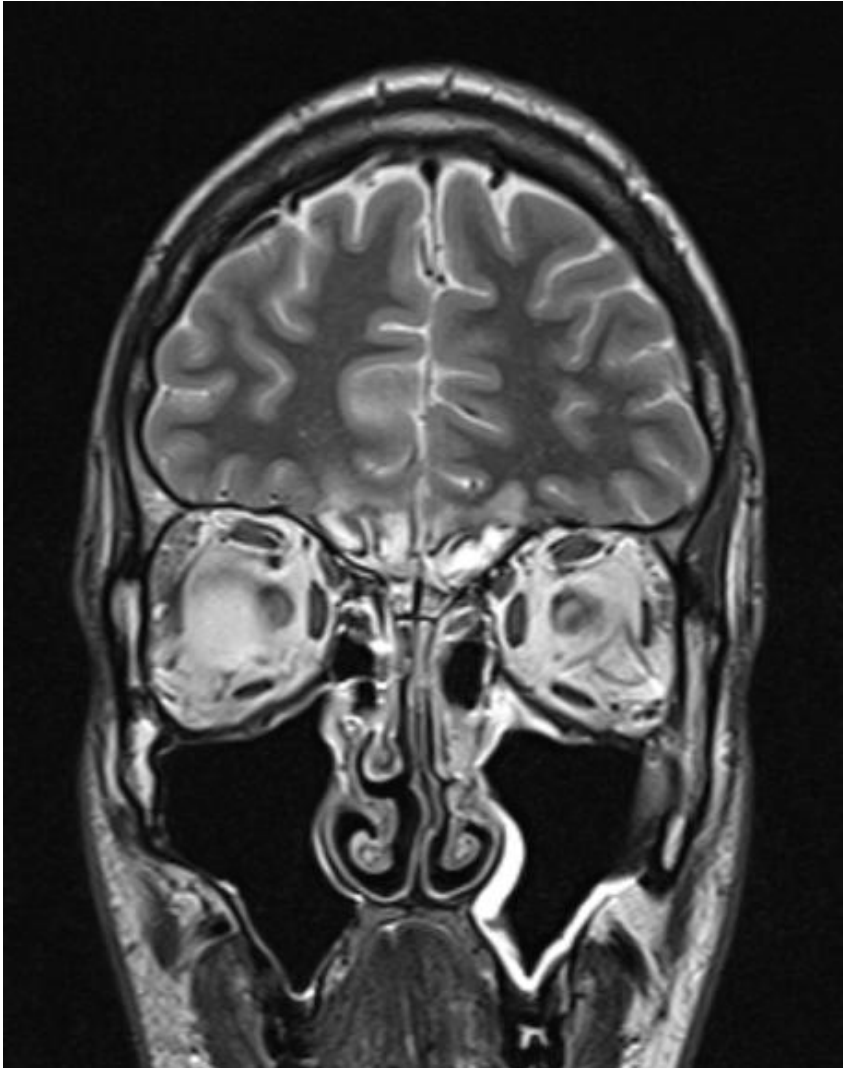
Sinunasal causes



Trauma



Trauma



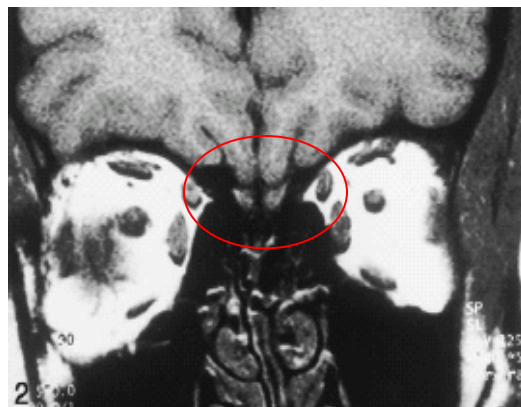
Frontobasal damage

Post-infectious

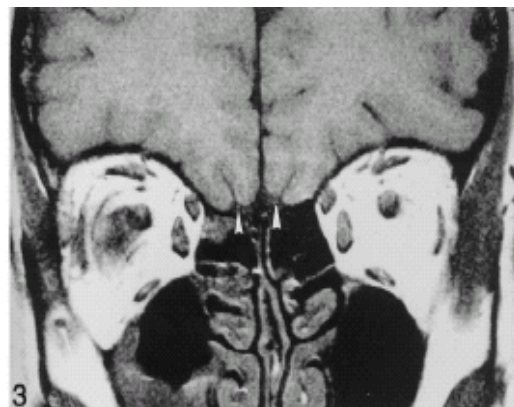
- Mostly after upper respiratory tract infection
 - Mechanism unknown
 - Infection directly damaging olfactory epithelium
 - Defense response with collateral olfactory damage
 - Ratio male : female - 1 : 2
 - Good recovery rate
 - Often accompanied by parosmia
-

Congenital Anosmia

- Absent olfactory function since birth
- Not necessarily familial (rare!)
- Isolated (**most frequent**)
- Within a Syndrome



Normal



Congenital anosmia

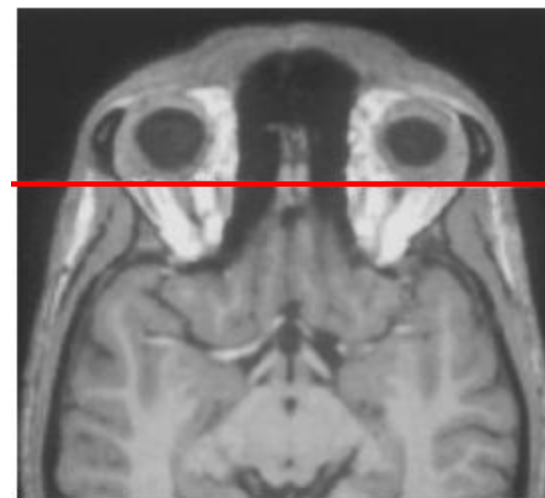


FIG 1. Transverse reformation of a 3D data set of an MP-RAGE image. The eyeballs and olfactory bulbs are visible. The coronal plane indicates position of the plane of the PPTE. Note that in normosmic subjects with normal olfactory bulb, this plane cuts through the olfactory bulb.

MR Evaluation in Patients with Isolated Anosmia Since Birth or Early Childhood

Nasreddin D. Abolmaali, Volker Hietschold, Thomas J. Vogl, Karl-Bernd Hüttenbrink, and Thomas Hummel

Congenital Anosmia

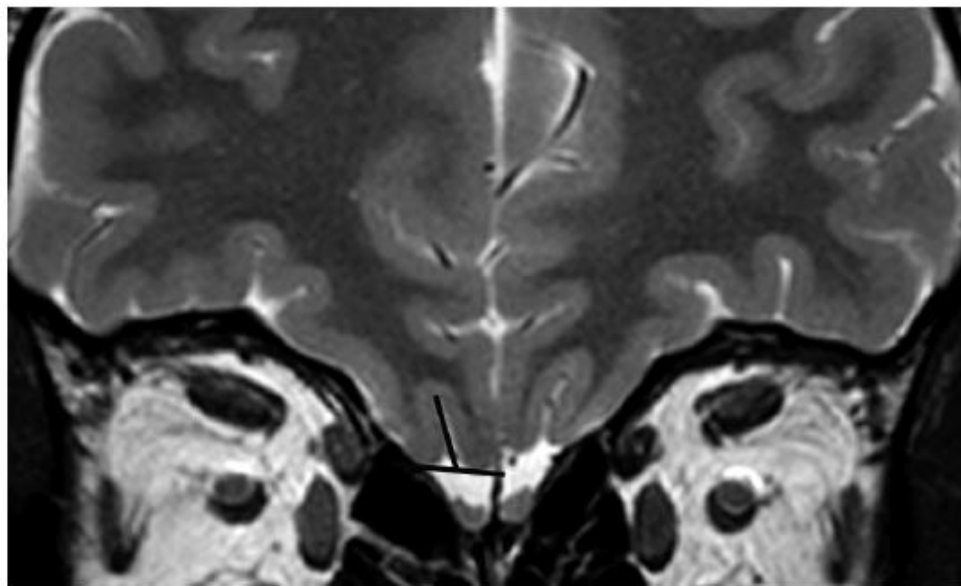


Fig 1. Coronal T2-weighted 2-mm-thick view by using FSE in a control subject. It shows how to measure the OS depth in the PPTE plane. A straight line tangent to the top surfaces of gyrus rectus and medial orbital gyrus is drawn; the depth of the OS is measured by drawing the most perpendicular line possible connecting this tangent line to the deepest point of the OS.

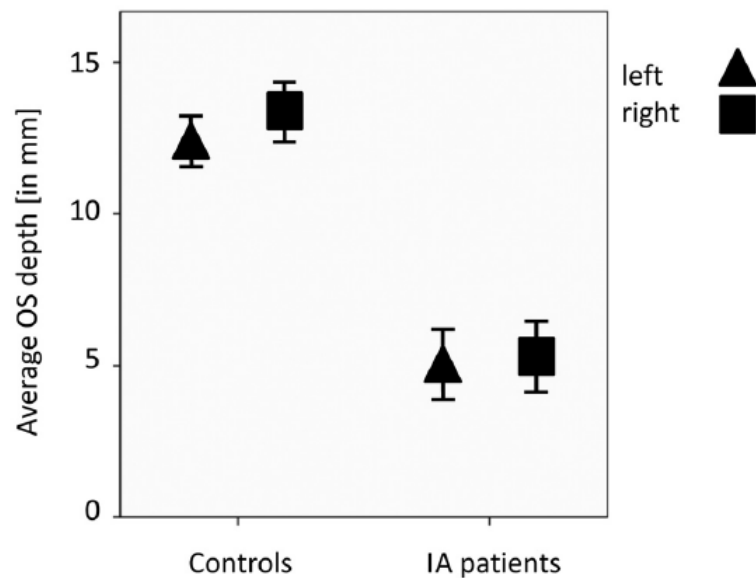


Fig 2. Average OS depth in PPTE in patients with IA compared with that of healthy controls (95% confidence interval). The OS depth is significantly deeper in controls than in patients with IA.

ORIGINAL RESEARCH

C. Huart
T. Meusel
J. Gerber
T. Duprez
P. Rombaux
T. Hummel

The Depth of the Olfactory Sulcus Is an Indicator of Congenital Anosmia

AJNR Am J Neuroradiol 32:1911–914 | Nov 2011

Congenital Anosmia



Congenital anosmia

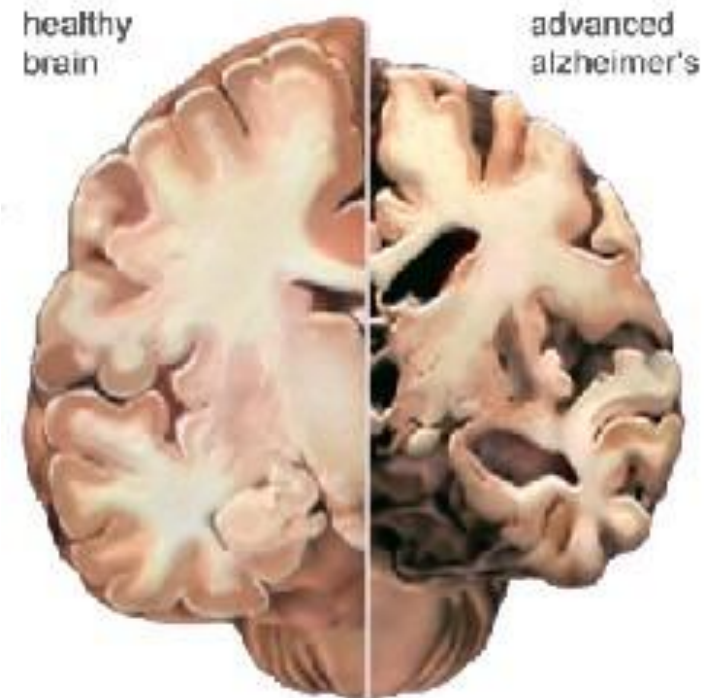


Normal

Early Symptom in Neurodegenerative Diseases



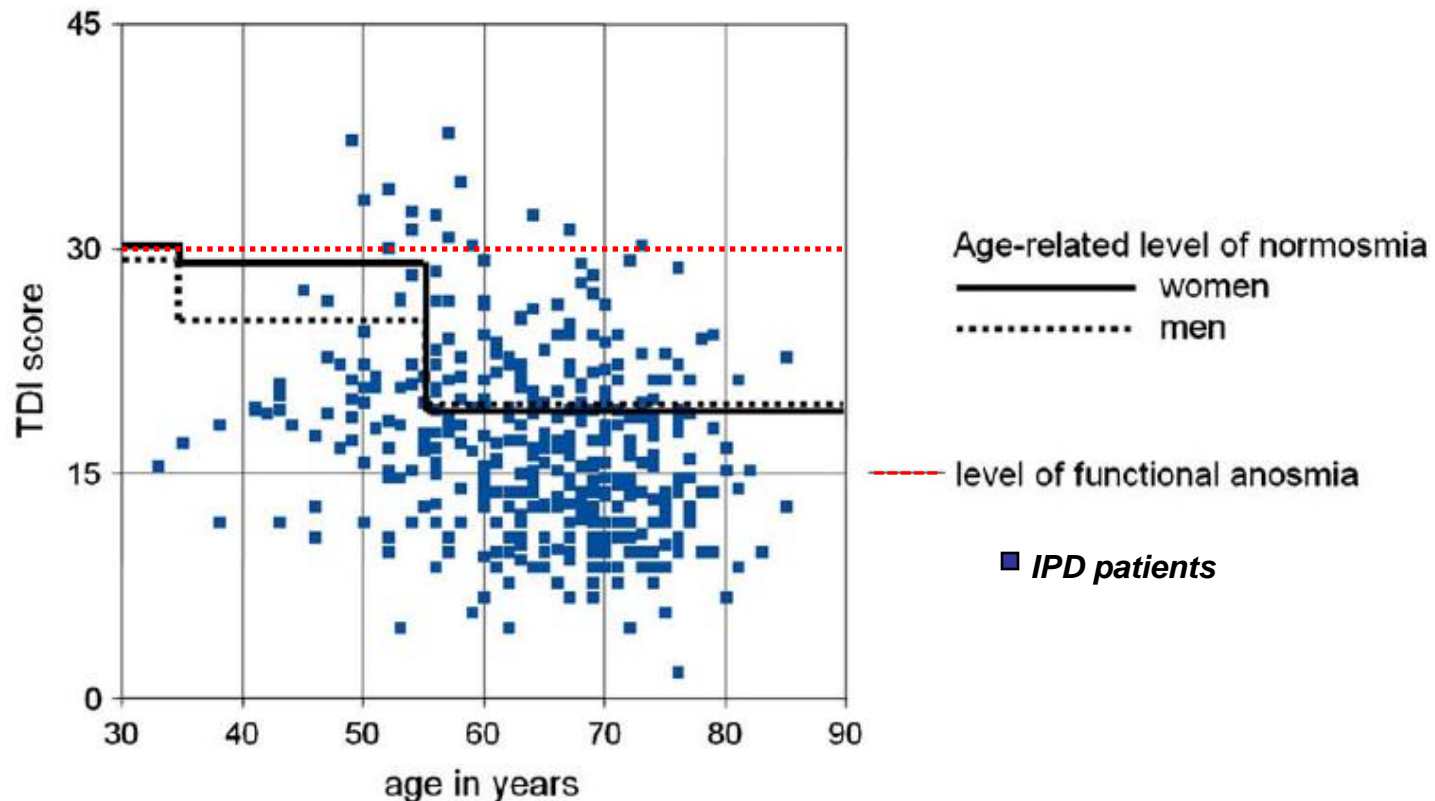
Parkinson



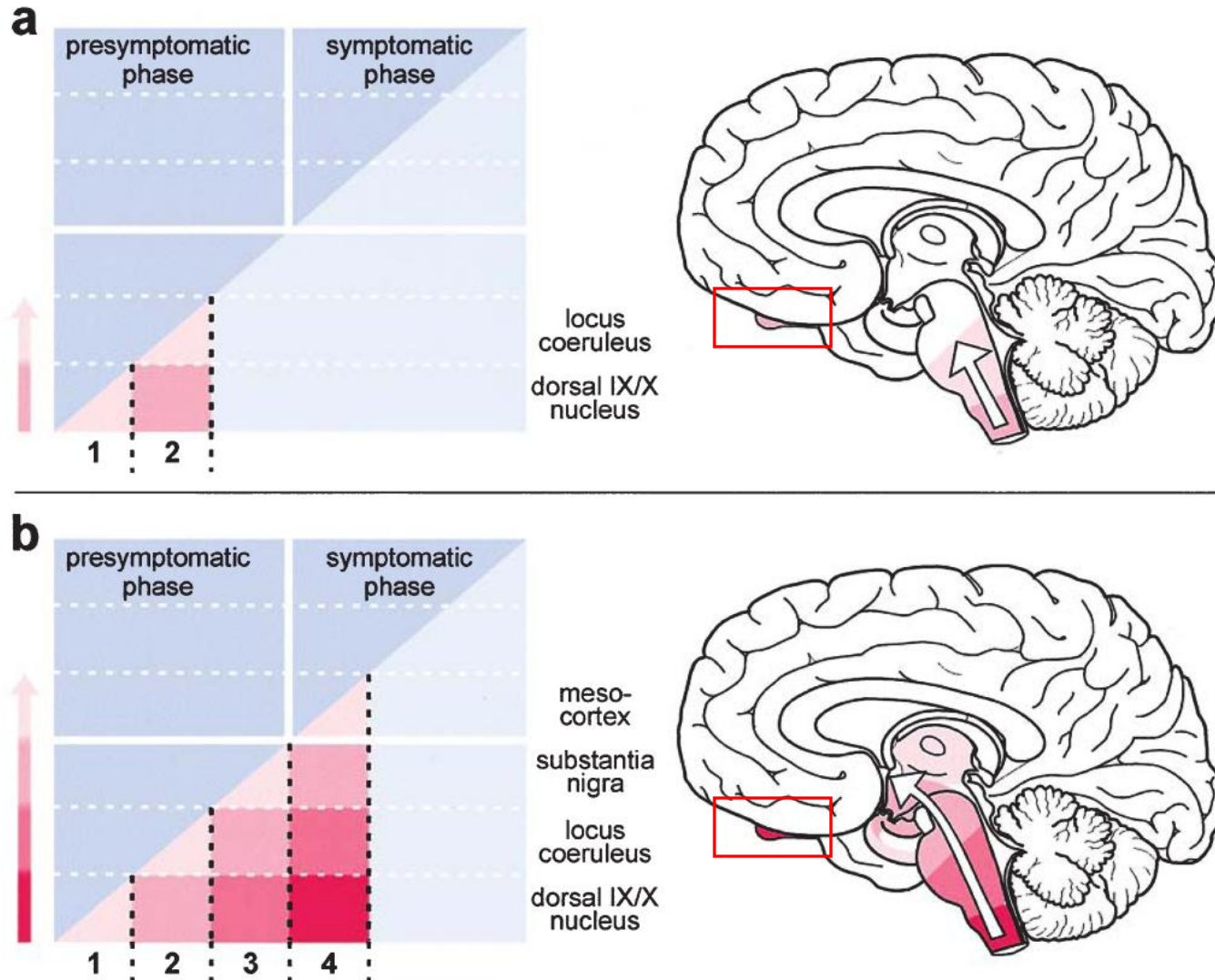
Alzheimer

Idiopathic Parkinsons Disease

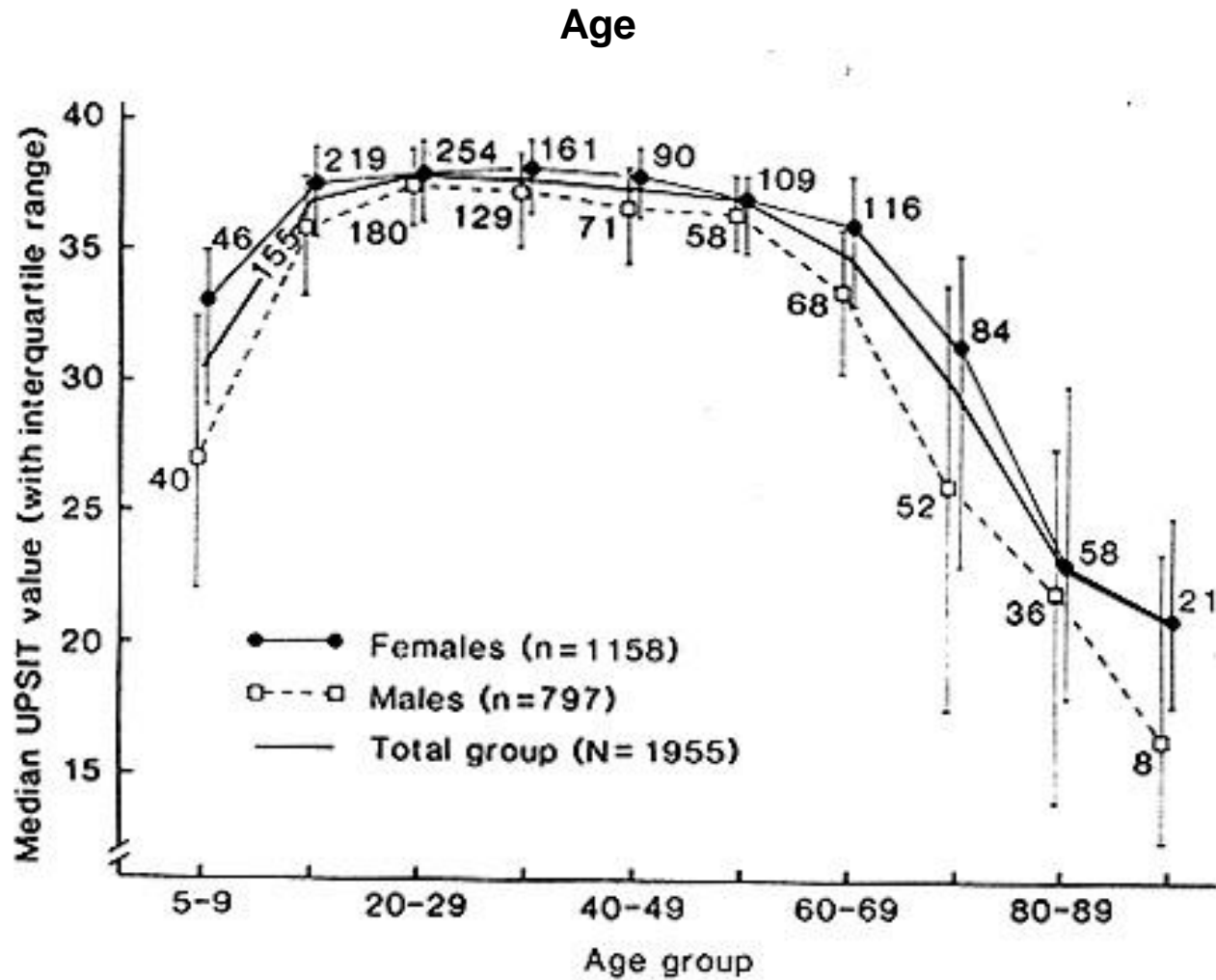
- At the moment of the diagnosis a severe olfactory disorder is found in 75 % to 95 % of the patients



Braak Studies - Dual hit theory

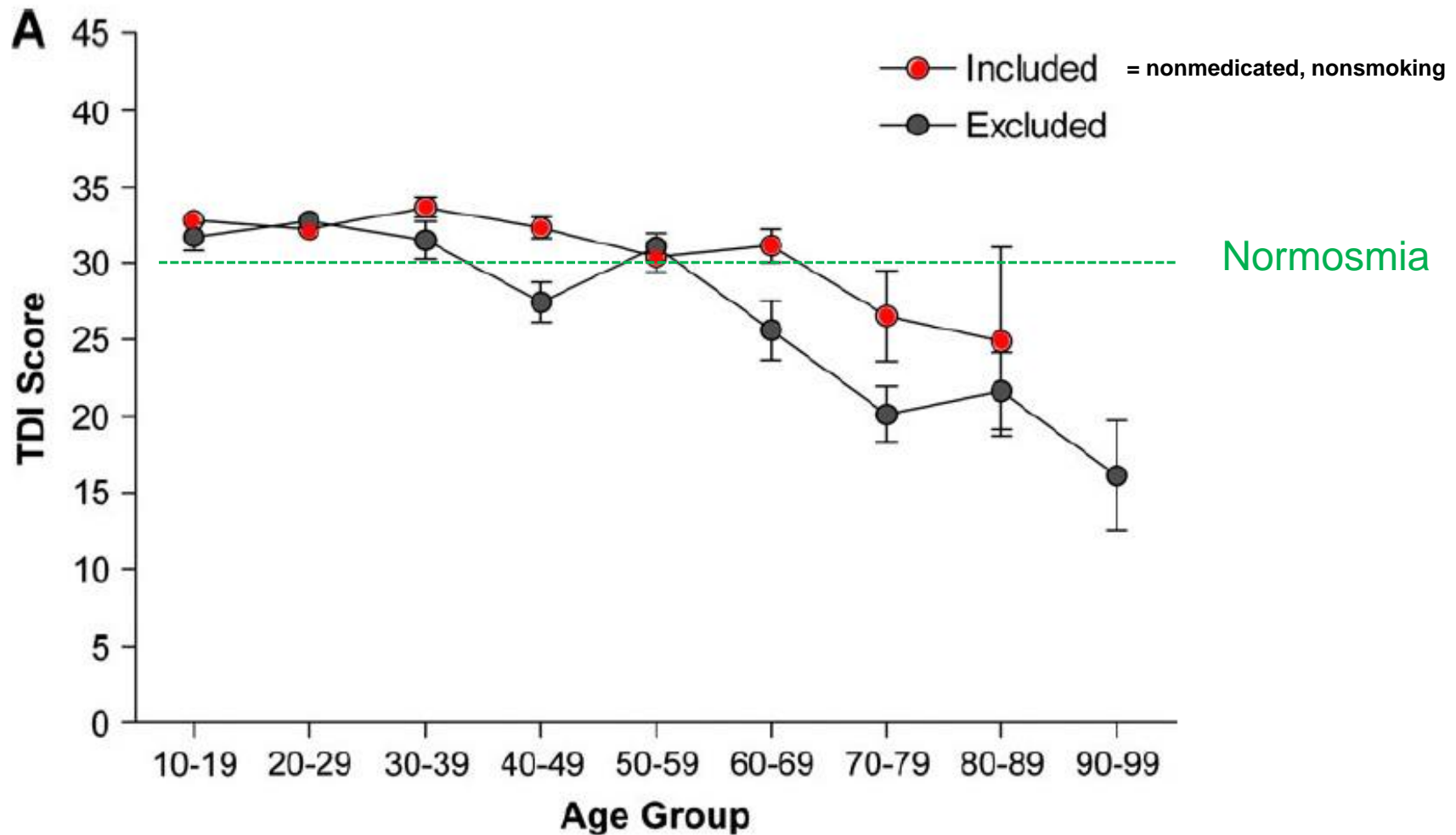


Presbyosmia

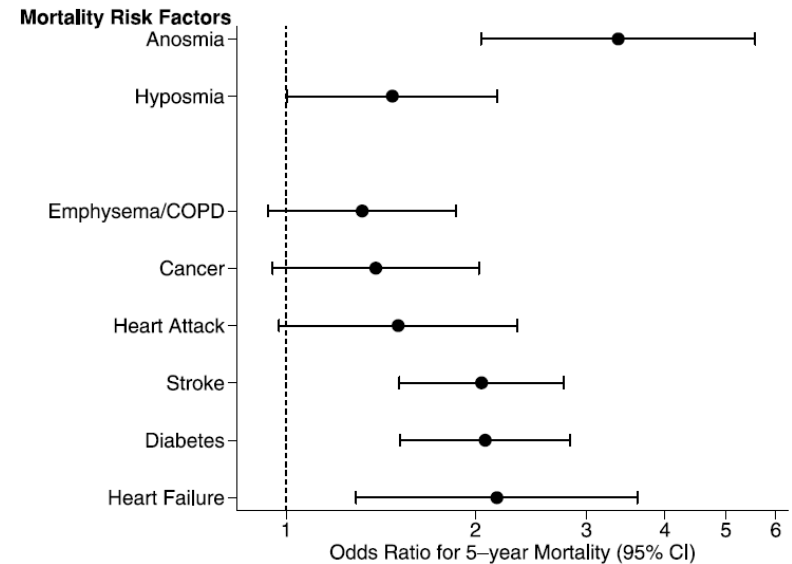
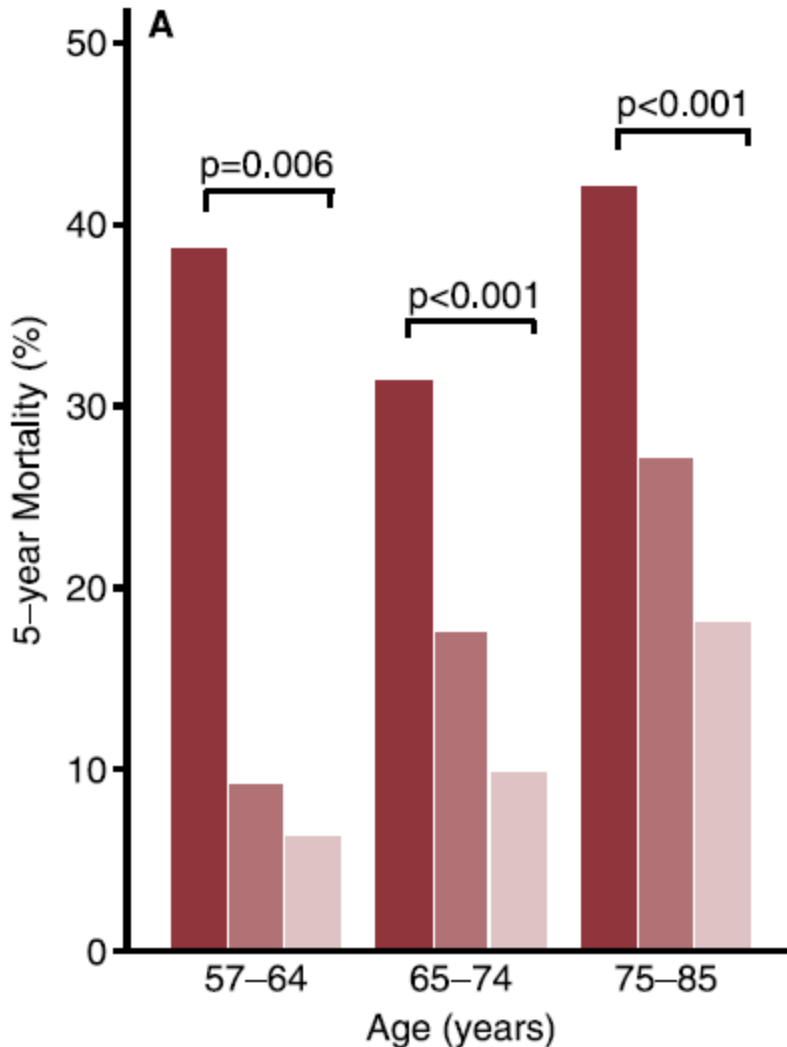


Olfactory Ability in the Healthy Population: Reassessing Presbyosmia

Alan Mackay-Sim¹, Amy N.B. Johnston^{1,2}, Caroline Owen³ and Thomas H. J. Burne^{1,4}



Olfactory function as Biomarker



Olfactory Dysfunction Predicts 5-Year Mortality in Older Adults

Jayant M. Pinto^{1*}, Kristen E. Wroblewski², David W. Kern^{3,4}, L. Philip Schumm², Martha K. McClintock^{3,4}

Investigation - Testing

Olfactory disorders – What to do ?

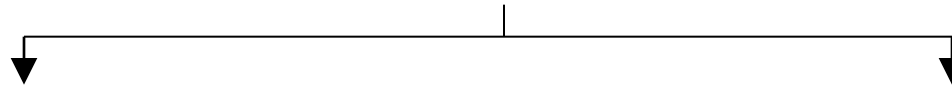
- Patients History
- Examination / Nasal Endoscopy
- Olfactory / Gustatory testing
- Imaging

Goals:

- 1) Diagnosis
- 2) Exclude Tumor (value of imaging currently controversially discussed)

Olfactory symptoms

Clinical Classification (Symptoms)

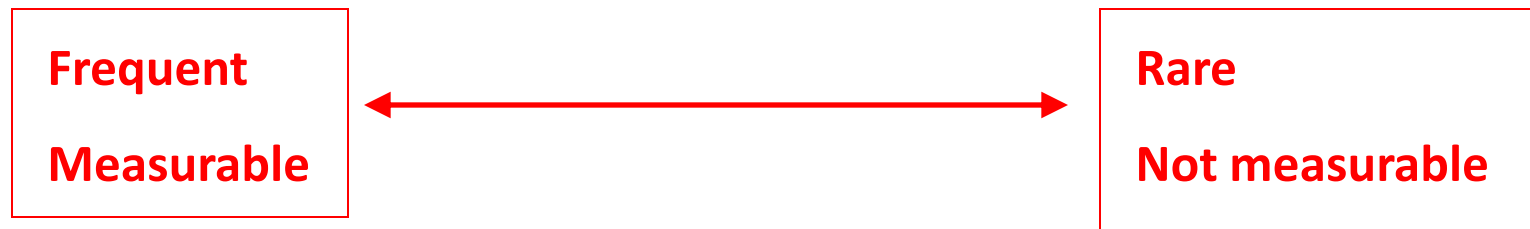


Quantitative Disorder

- **Hyposmia** (decreased olfactory function)
- **Anosmia** (olfactory loss)
- **Hyperosmia** (increased olfactory performances – rare !)
- **Specific Anosmia** (e.g. androstenone, isovaleric acid)

Qualitative Disorder

- **Parosmia** (triggered distorted odor perception) = *olfactory distortion*
- **Phantosmia** (olfactory hallucination without a trigger)



Olfaction – Patients History

- PAROSMIA

- **Postviral**
- **Posttraumatic**
- ...

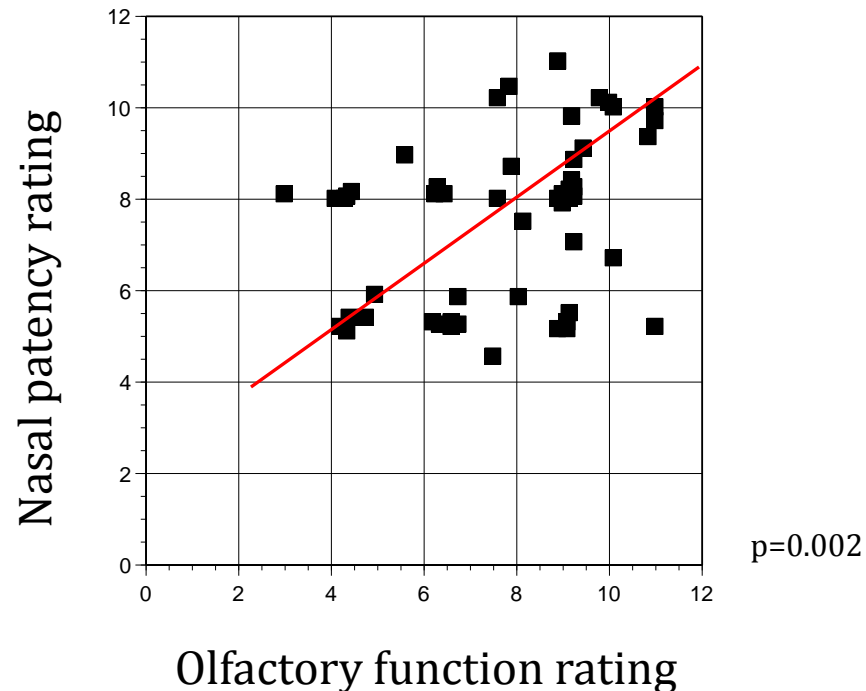
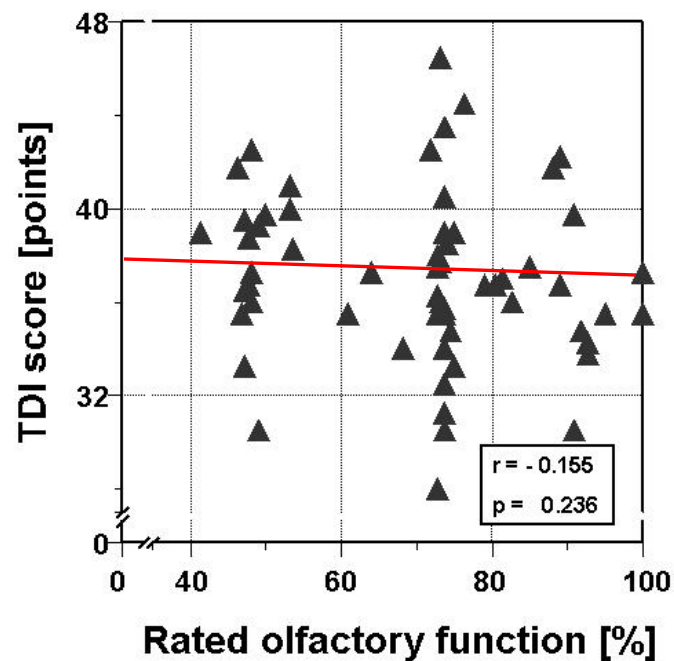
→ **distinct causes**

- PHANTOSMIA

- Posttraumatic
- Postviral
- Tumors !
- **Psychiatric !**
- **Neurological** (Stroke, MS etc.)
!

→ **Phantosmia has a large DD and most causes have to be ruled out**

Olfaction - Tests



- Self – rating is **unreliable**
- Rating olfactory function is rating nasal patency (obstruction)

⇒ Testing rather than asking !

Tests

Psychophysical (subjective)

- Quick
- Collaboration required
- Clinical routine

Objective

- Time consuming
- Mainly research
- Medico-legal issues

- *Ex.: event related potentials, fMRI, PET*

Olfaction - Tests

Which Test ?

Psychophysical Tests :

- **Sniffin' Sticks** Hummel, 1997
- **UPSIT** (University of Pennsylvania Identification Test) Doty, 1984
- **CCCRC** (Connecticut Chemosensory Clinical Research Center) Cain, 1988
- **Zürcher Geruchstest** Briner, 1999
- **Biolfa** Lecanu, 1999
- **T & T Olfactometer** Zusho, 1981
- **SOIT** (Scandinavian Odor Identification Test) Nordin, 1998
- etc...



Testing

Screening Tests – Odor Identification

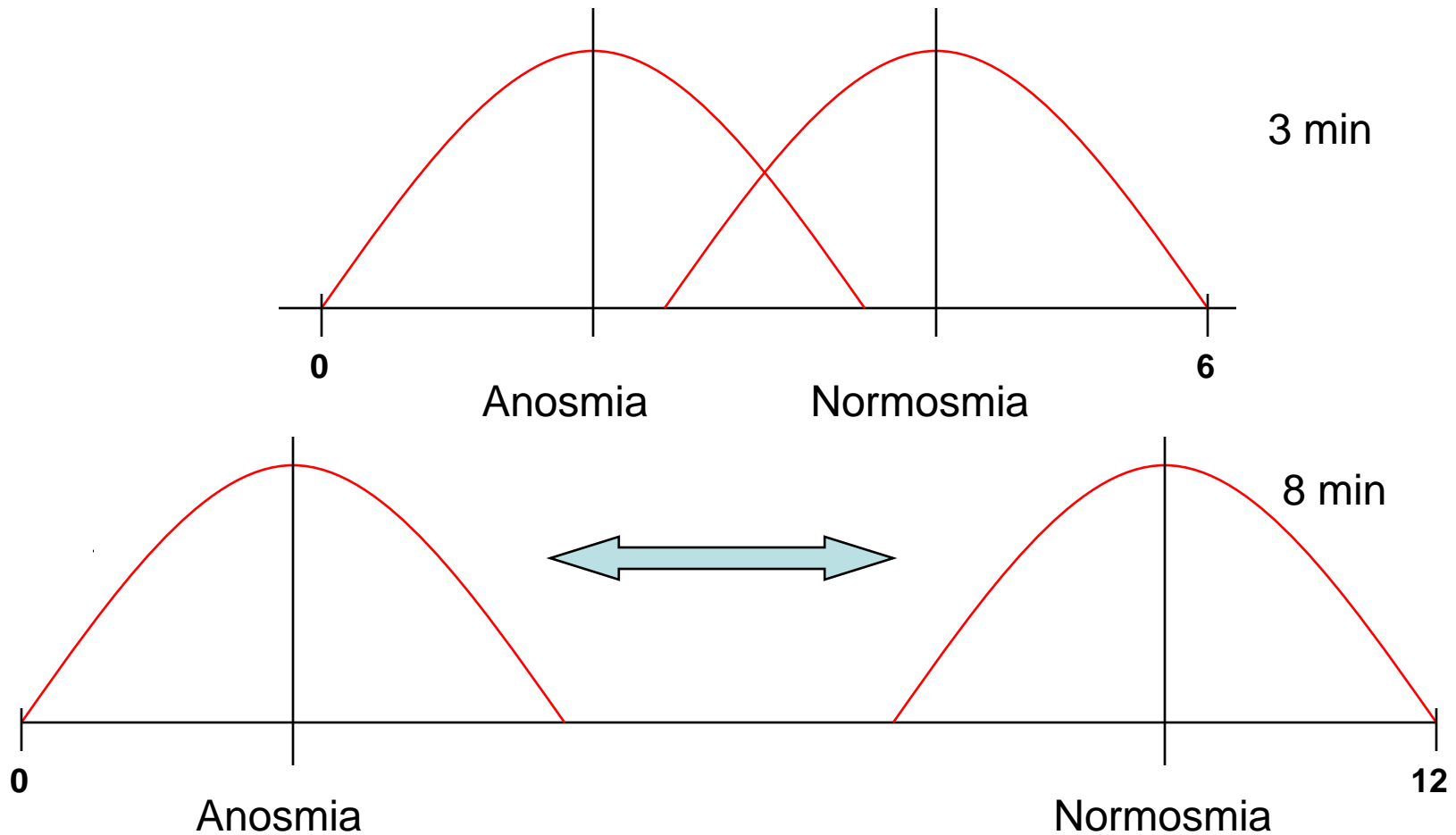


1	orange	blackberry	strawberry	pineapple	9	onion	sauerkraut	garlic	carrots
2	smoke	shoe leather	glue	grass	10	cigarette	coffee	wine	candle smoke
3	honey	vanillin	chocolate	cinnamon	11	melon	peach	orange	apple
4	chives	peppermint	spruce	onion	12	clove	pepper	cinnamon	mustard
5	coconut	banana	walnut	cherry	13	pear	plum	peach	pineapple
6	peach	apple	lemon	grapefruit	14	camomile	raspberry	rose	cherry
7	licorice	gummibears	chewing gum	cookies	15	aniseed	rum	honey	spruce
8	mustard	rubber	menthol	turpentine	16	bread	fish	cheese	ham



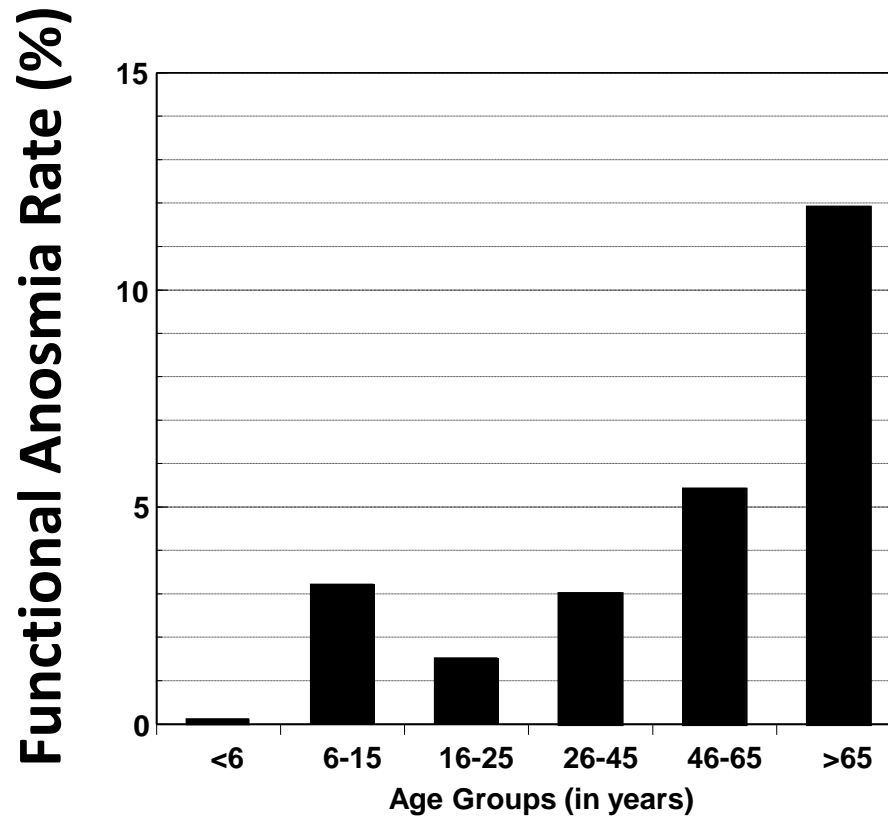
25 % chance of scoring correctly per odor

Testing



The more odors you use, the more reliable the result is !

Frequency within the population



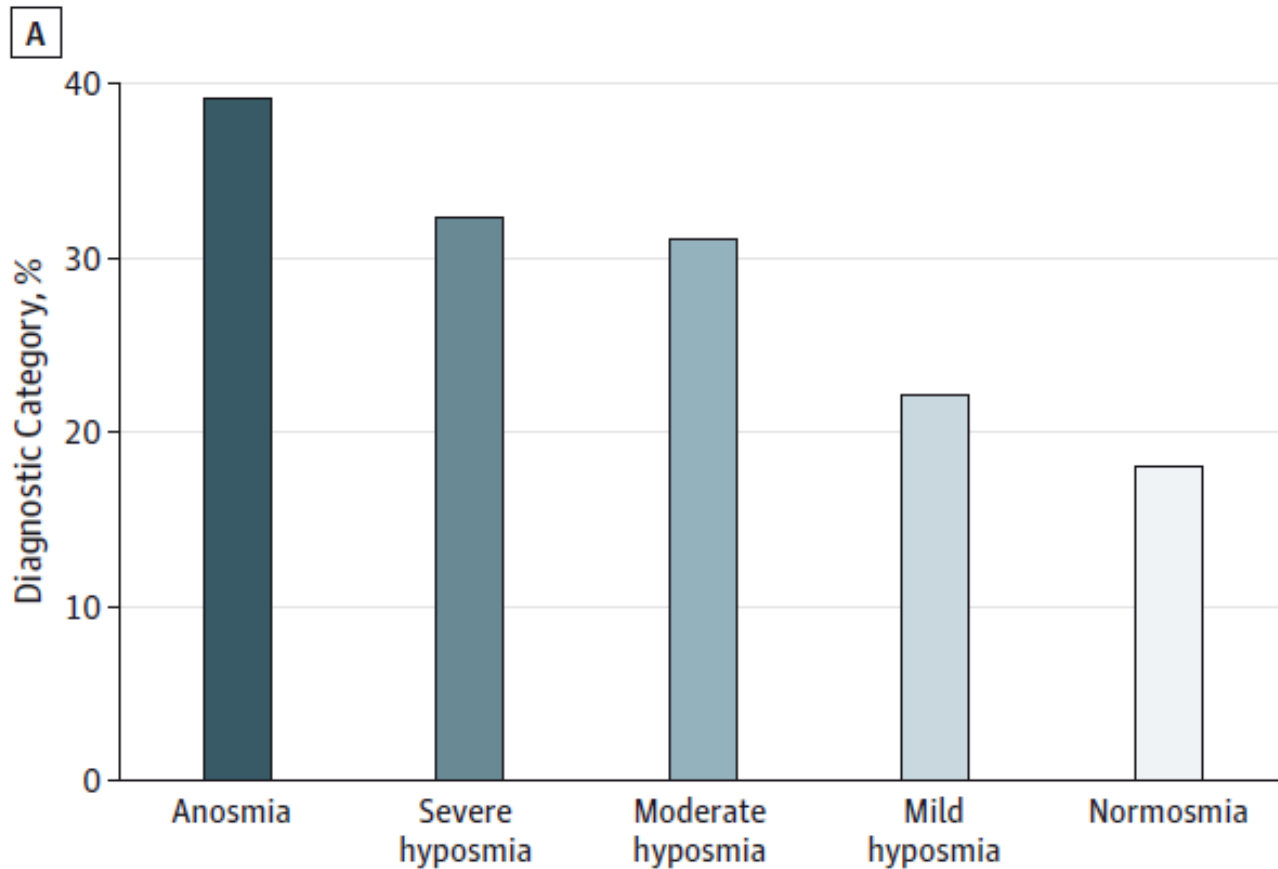
- 5 % anosmia in the population
- 15 % hyposmia in the population

Consequences

Olfaction – Consequences

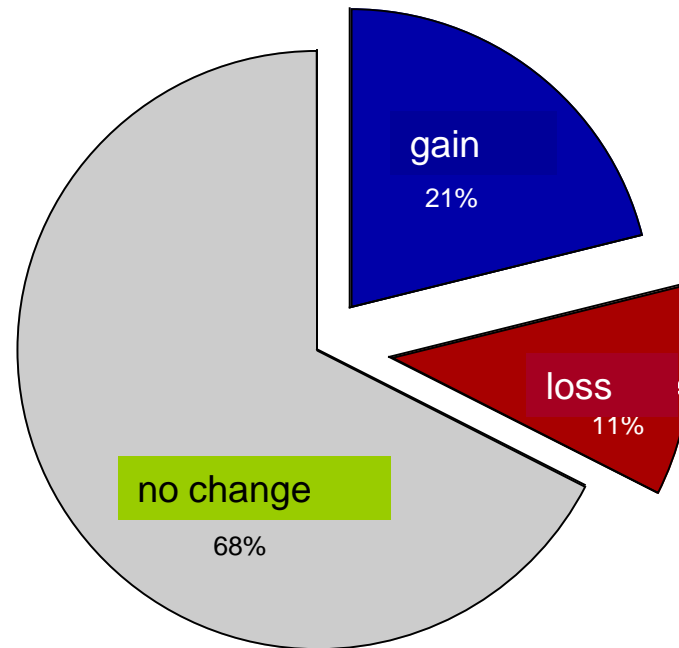
- **Missing alarm system**
 - Spoiled food
 - smoke, gas leak
- **Insecurity (no control of own odors)**
- **Decreased life quality**
 - Pleasure Eating ↓
 - Social communication (spring, partners smell,....)
- **Depression**

Hazardous Events and Olfactory disorders



Olfaction – Consequences

Weight loss ?



Treatments

Therapy: According to the Cause

- **Sinunasal:** Treatment of the nasal problem
 - Medical (steroid, anti-allergic)
 - Surgery
- **Post-infectious:** Smell training, Spontaneous Recovery in 65 % of the cases over a 2-3 year period
- **Trauma:** Smell training, Spontaneous Recovery in 15 % of the cases over a 2 year period
- **Neurodegenerative:** yet no treatment
- **Congenital:** yet no treatment
- **Idiopathic:** Exclusion of other causes

Drug application



Pipette
(Nasal Drops)



Sprayer
(Nasal Spray)

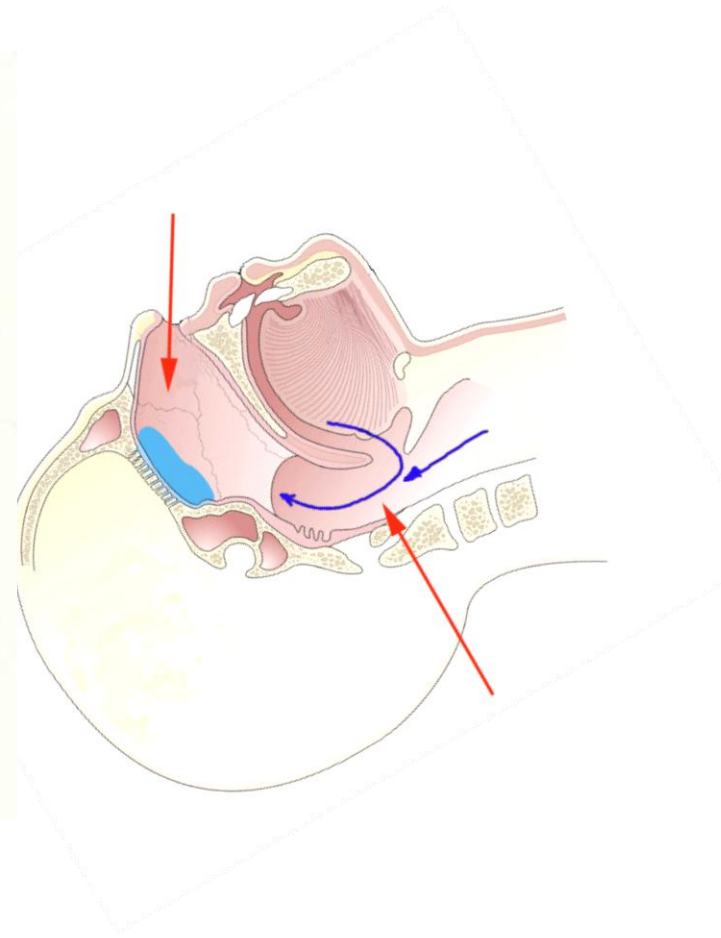


Plastic Tubing
(Squirt System)

Drug application



Topical Steroids



Mygind's Position AND LIQUID local steroid drops for access to the olfactory cleft

Olfactory function and FESS

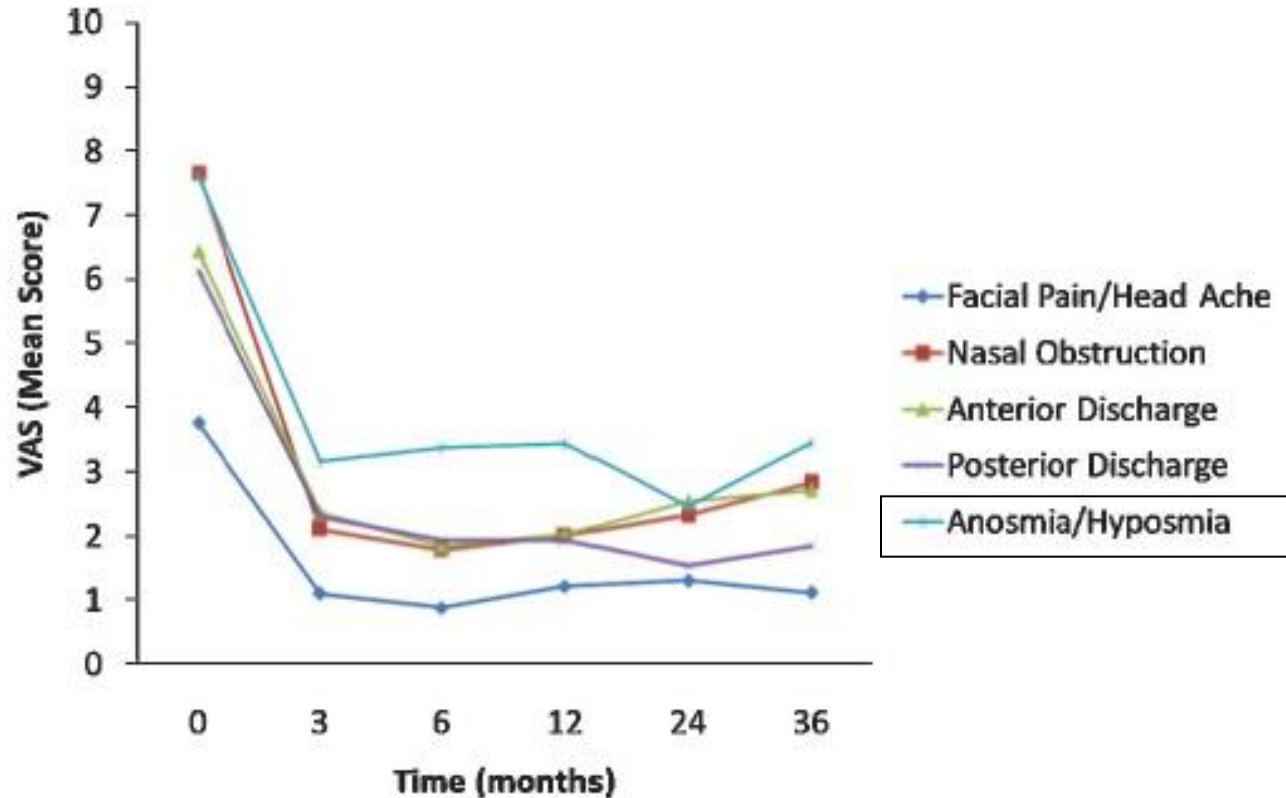


Figure 1. Mean Symptom score for all patients preoperatively and at 3, 6, 12, 24, and 36 months after functional ESS.

Olfaction – Smell Training



rose



lemon



eucalyptus



cloves



Instruction:
Smell these odors in the
morning and evening two times
briefly for 4-6 months

Olfactory training in post-URTI smell disorders

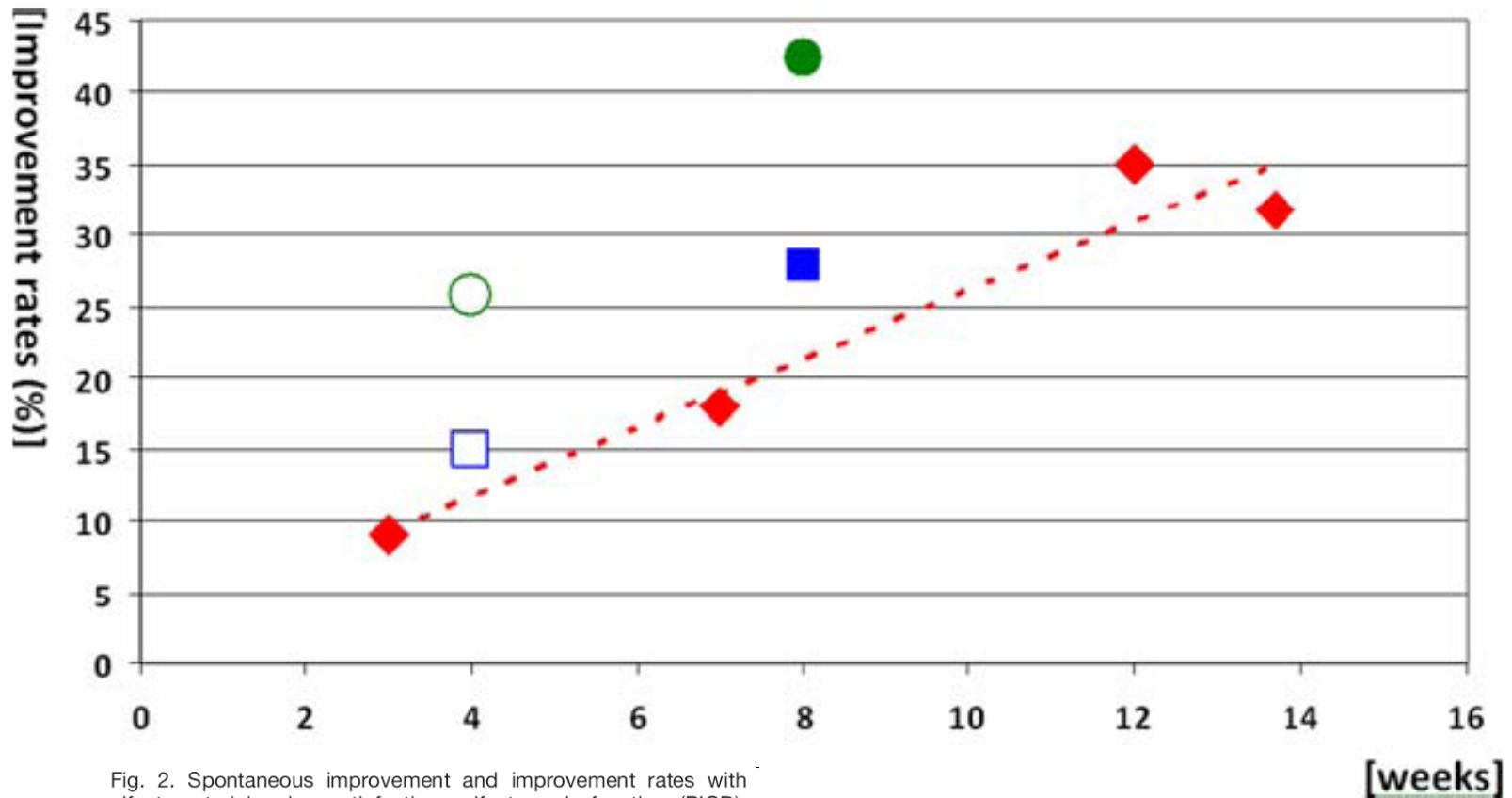
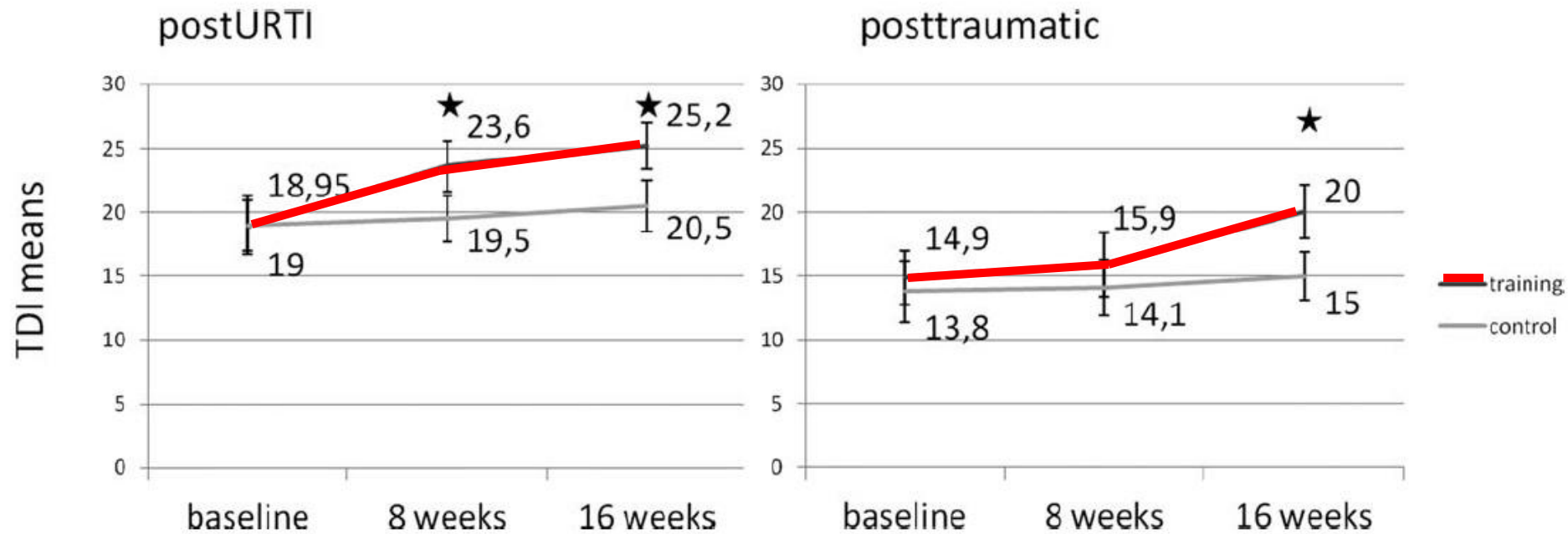


Fig. 2. Spontaneous improvement and improvement rates with olfactory training in postinfectious olfactory dysfunction (PIOD). Rhombuses: spontaneous improvement rates of PIOD adapted from the literature with a linear trend line.^{6-9,13} Squares: improvement rates in the low-high-training group at V2 (open squares) and V3 (filled). Circles: improvement rates in the high-low-training group at V2 (open circles) and V3 (filled circles). [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

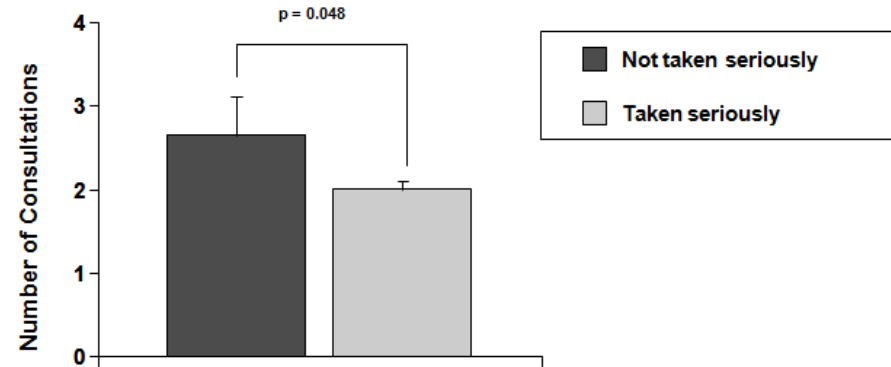
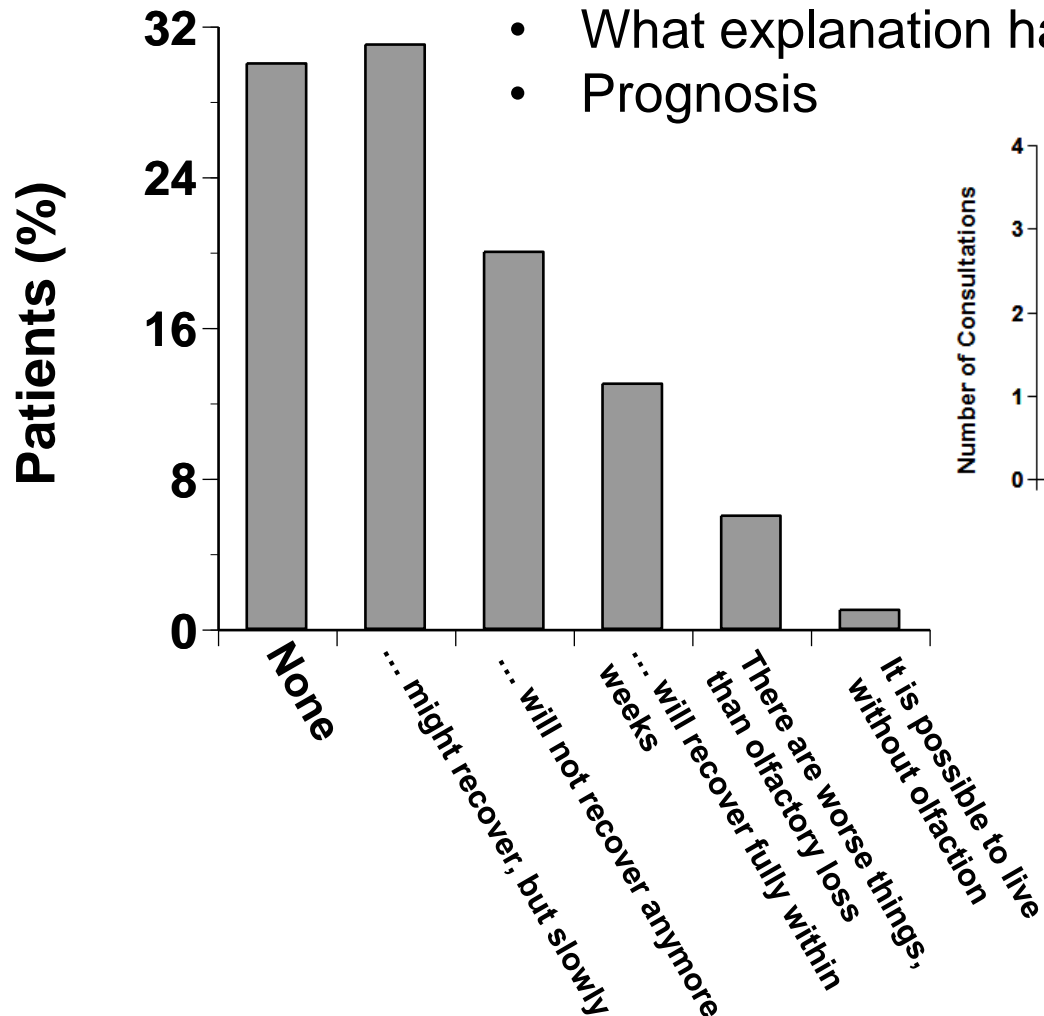
Smell training



What is also part of the treatment

Information and Follow up !

- What explanation have you been given.
- Prognosis



Conclusion

- **Human olfactory function is better than commonly assumed (not a rudiment)**
- **Olfactory disorders are frequent**
- **The most frequent cause is related to nasal problems**
- **Smell and Taste are often confounded**
- **Patients history is crucial**
- **ENT examination and formal testing mandatory**
- **Correct counseling and follow up is important**
- **Olfactory function might be useful as biomarker**

Conclusion

- ...still a lot to do !



Je vous remercie de votre attention !