

**Maurits de Ruiter, MKA-chirurg**

# **Symposium Sleepless Vivisol Tandheelkundige Slaapgeneeskunde**

Innstyle Maarssen, 16 mei 2024

[mdruiter@diakhuis.nl](mailto:mdruiter@diakhuis.nl)



# CV

- Tandarts: Radboud University Nijmegen
- Arts: Amsterdam University Medical Center
- MKA-opleiding: Amsterdam University Medical Center



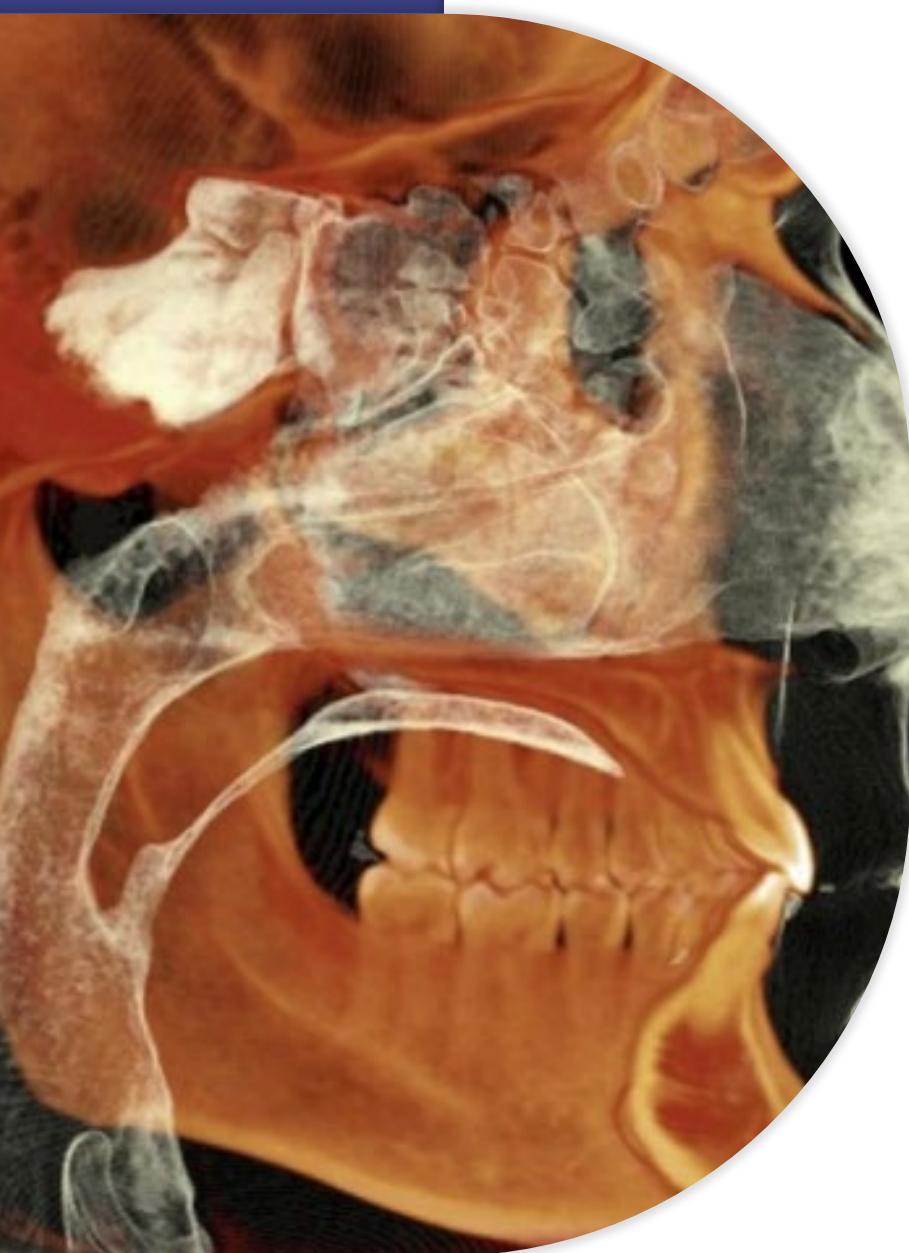
Present: OMF surgeon in Diakonessenhuis Utrecht/Zeist and University Medical Center Utrecht

**No conflict of interest**







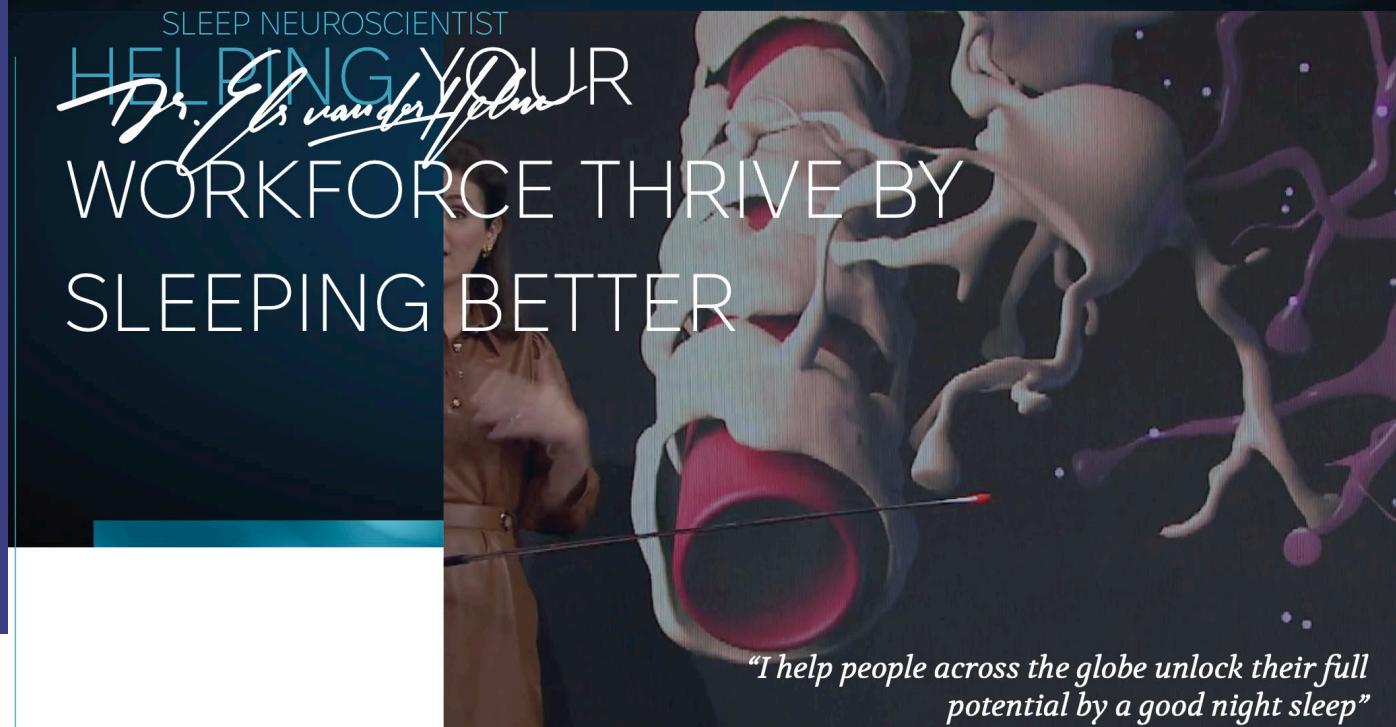


## Learning Objectives

- 1. Wat is Tandheelkundige Slaapgeneeskunde?**
- 2. Mandibulair repositie apparaat (MRA)**
- 3. De kaakoperatie (bimax of MMA)**

## Kijktip!

<https://www.maxvandaag.nl/sessies/themas/media-cultuur/max-masterclass-slaapexpert-els-van-der-helm-over-het-belang-van-goede-nachtrust/>



# PATIENT

**Hoofdklacht!!!!**

**SNORING**

**APNOEA**

**CVD**

**HEADACHE**

**TIREDNESS /  
SLEEPINESS**

**CONCENTRATION**

**DEPRESSION /  
PSYCH**

**ABILITY TO DRIVE**

# PATIENT

## CHARACTERISTICS

GENDER

AGE

BODY WEIGHT

COMORBIDITY

MEDICATION

RELATION -  
PARTNER

JOB – DAILY  
FUNCTIONING

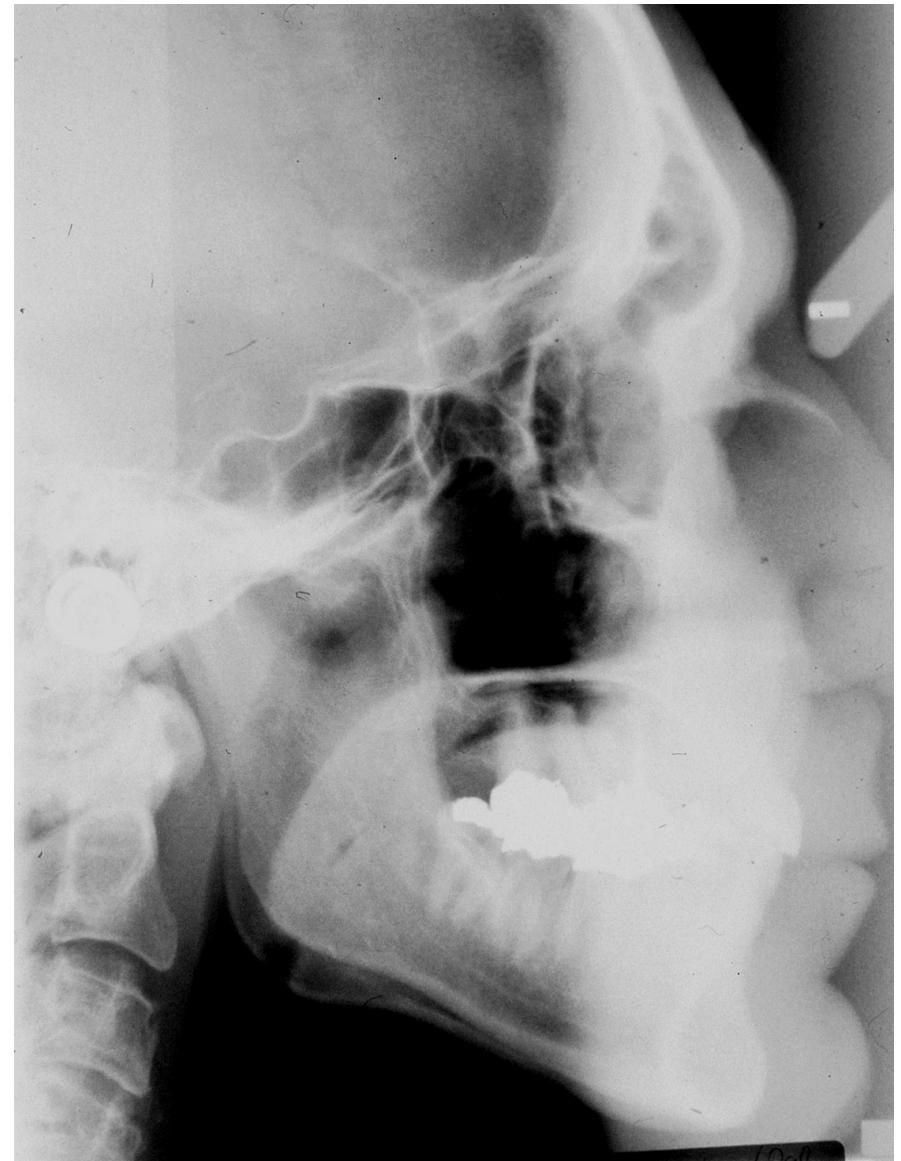
STRESS - PSYCH

## KNO onderzoek

- Neuspassage
- Tonsillen
- Tong (positie, grootte) → Mallampati score
- Nekomtrek

# Tandheelkundig onderzoek

- Tanden / dentitie
  - Pathologie; caries / parodontitis?
  - Dental fit?
- Temporomandibular Joint
- Tandheelkundig behandelplan?
- Heeft u een goed gebit?
- Is de tandarts tevreden?
- Gaat u regelmatig naar de tandarts?



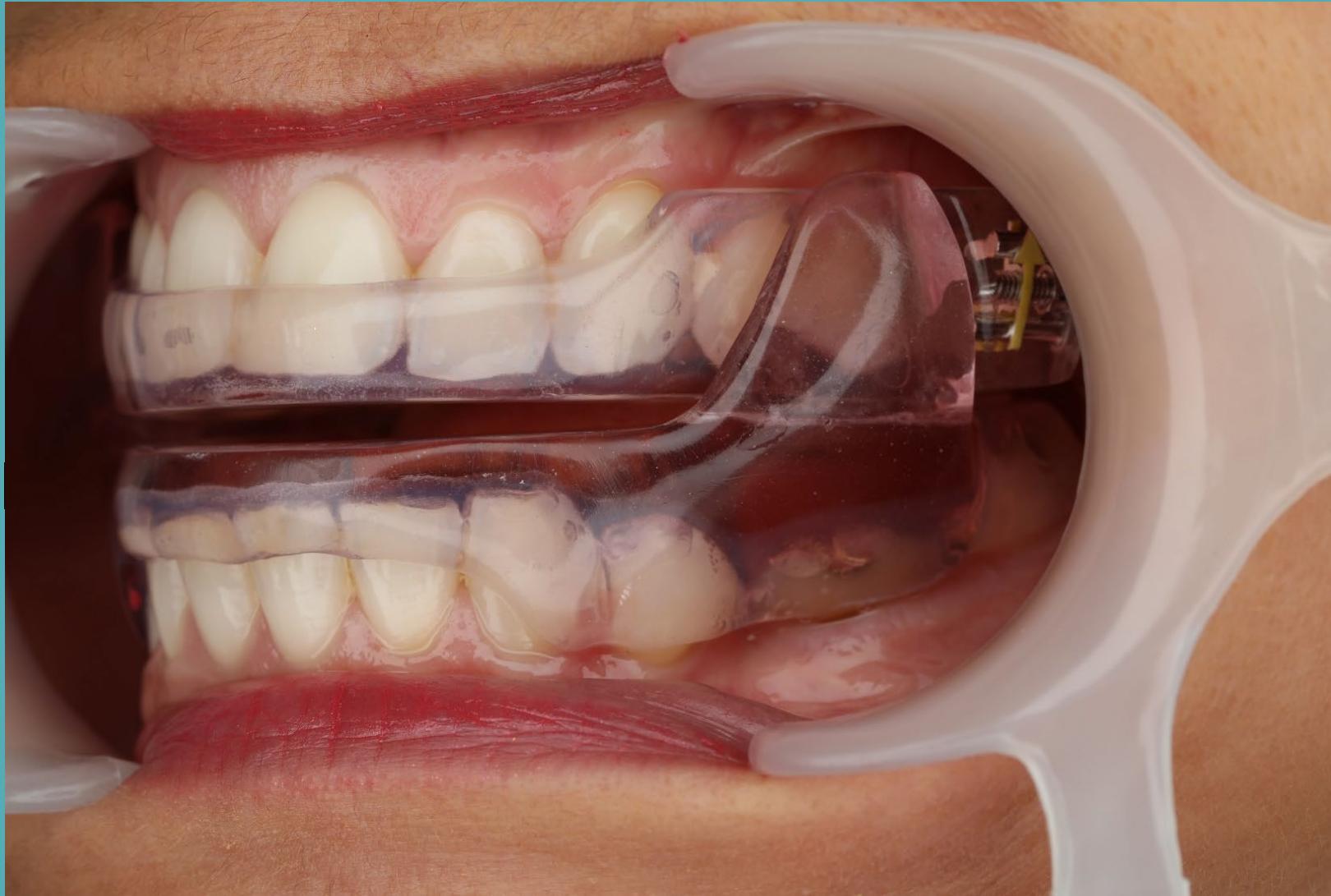
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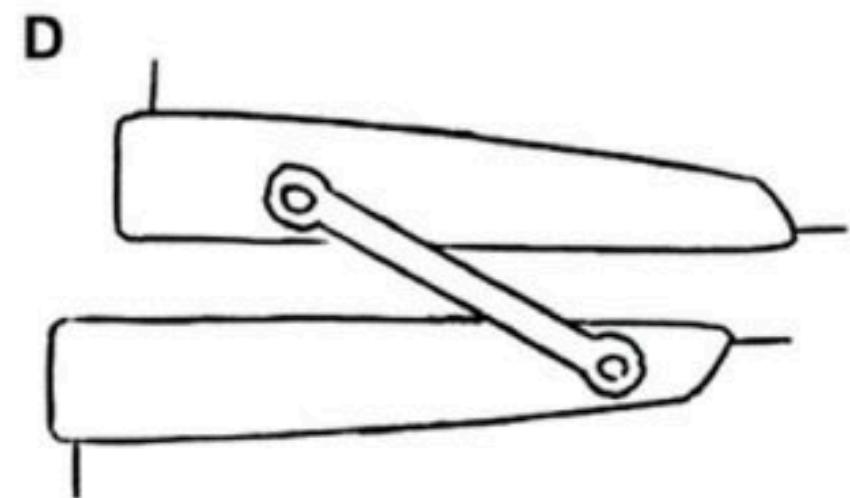
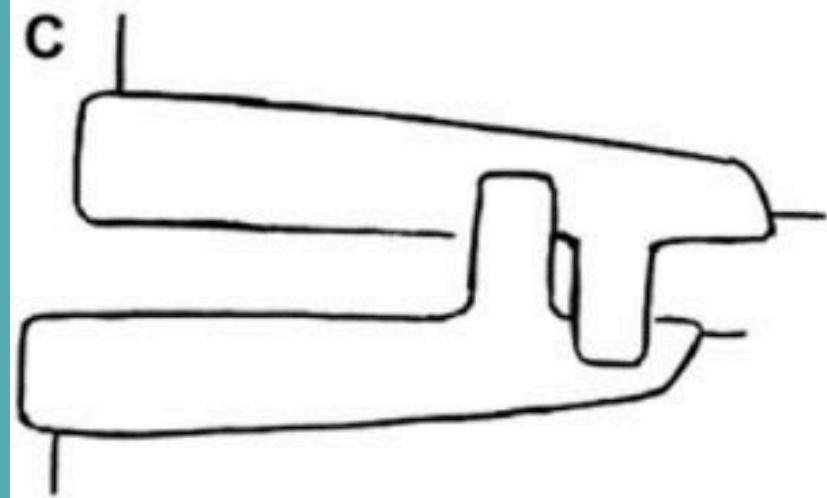
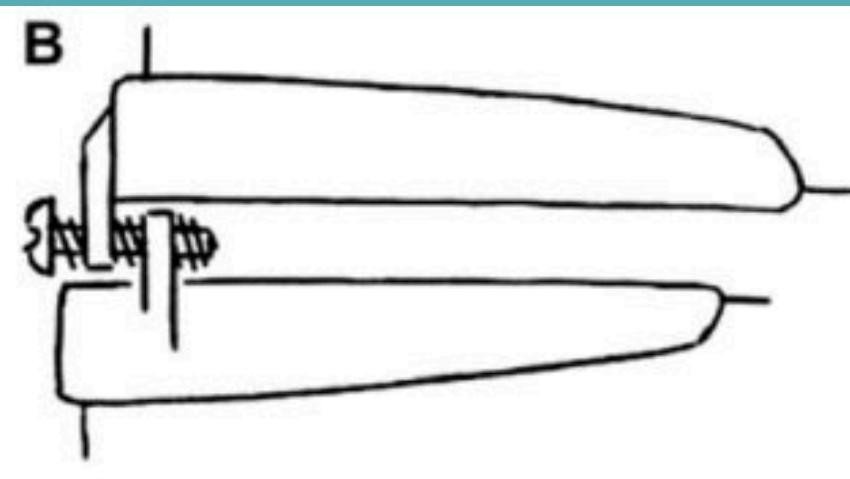
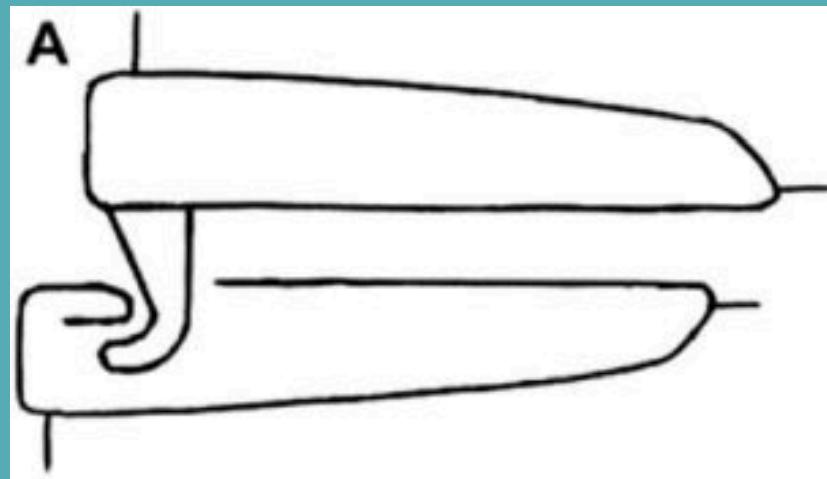


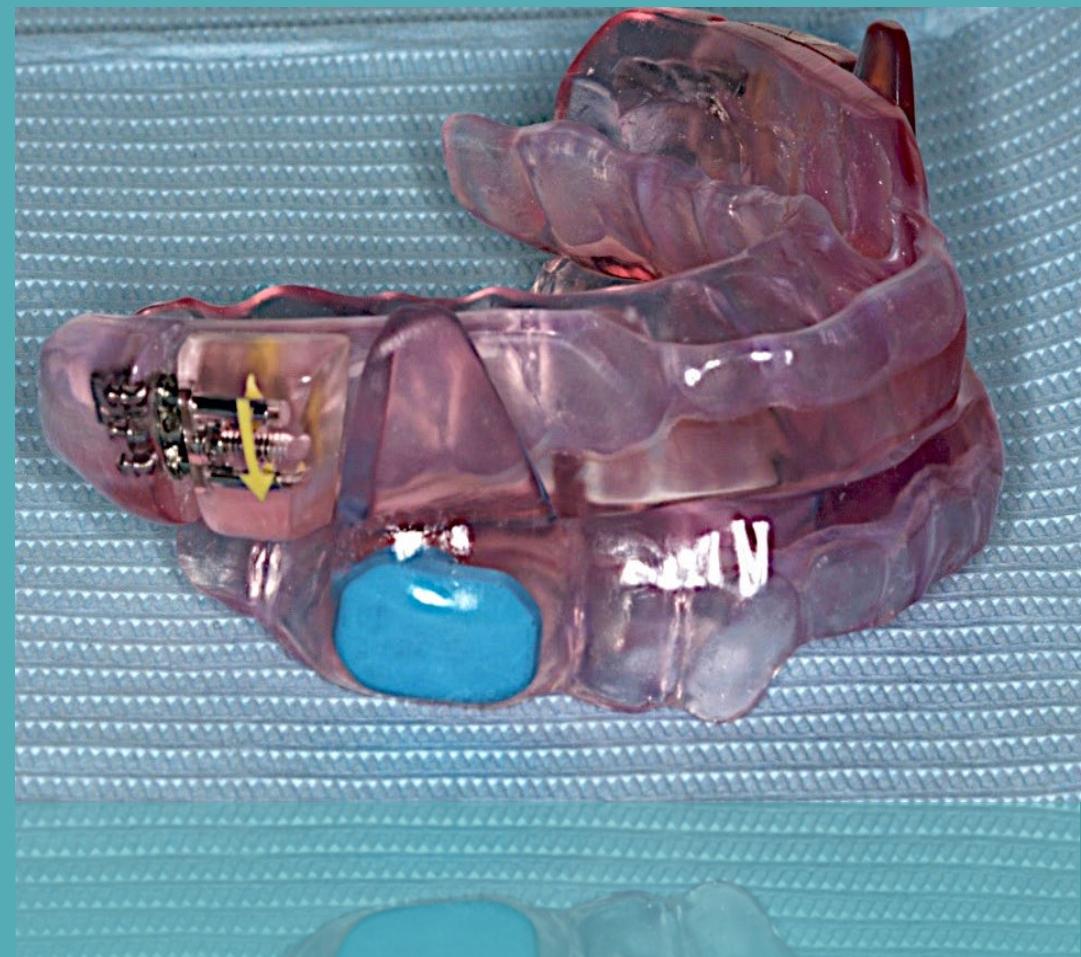
PMKC  
28-08-2014

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C10 C10

**Ma**  
**ANT**







# **Somnomed** **Prosomnus** **Resmed**



## Types of Oral Appliances for Obstructive Sleep Apnea



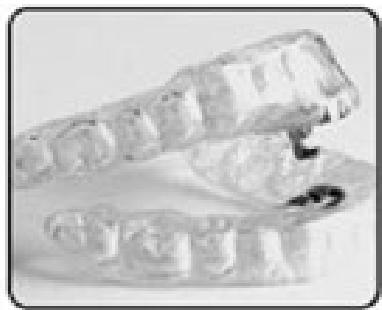
Klearway



Somnomed



Herbst



Tap



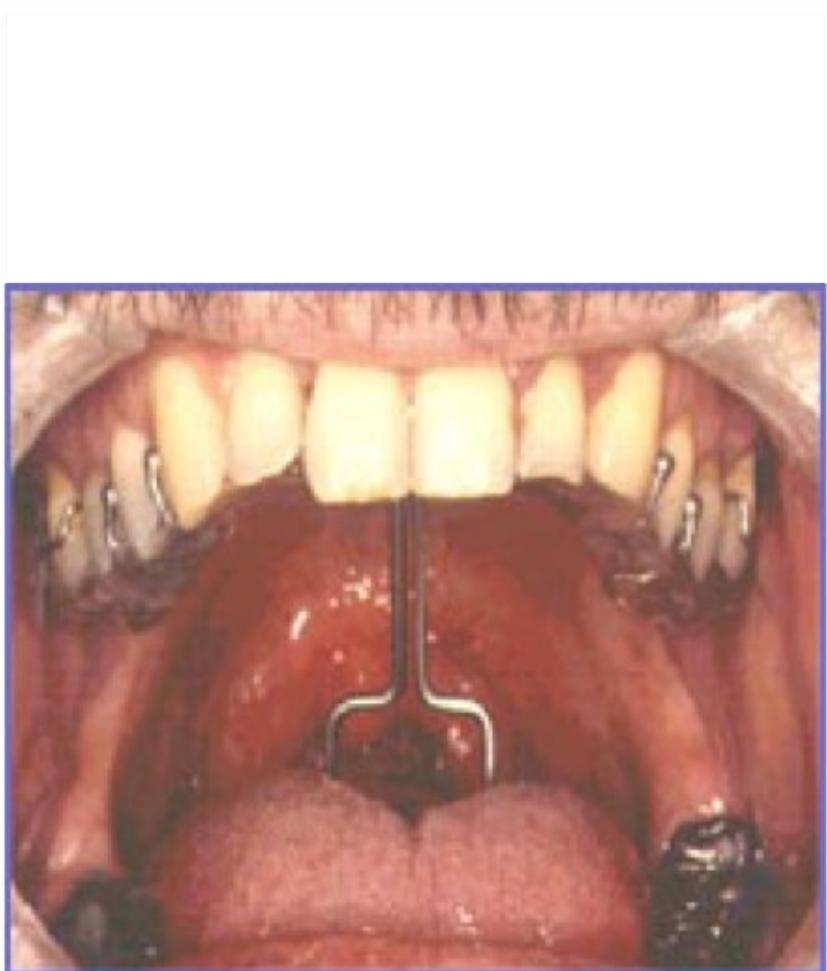
Suad









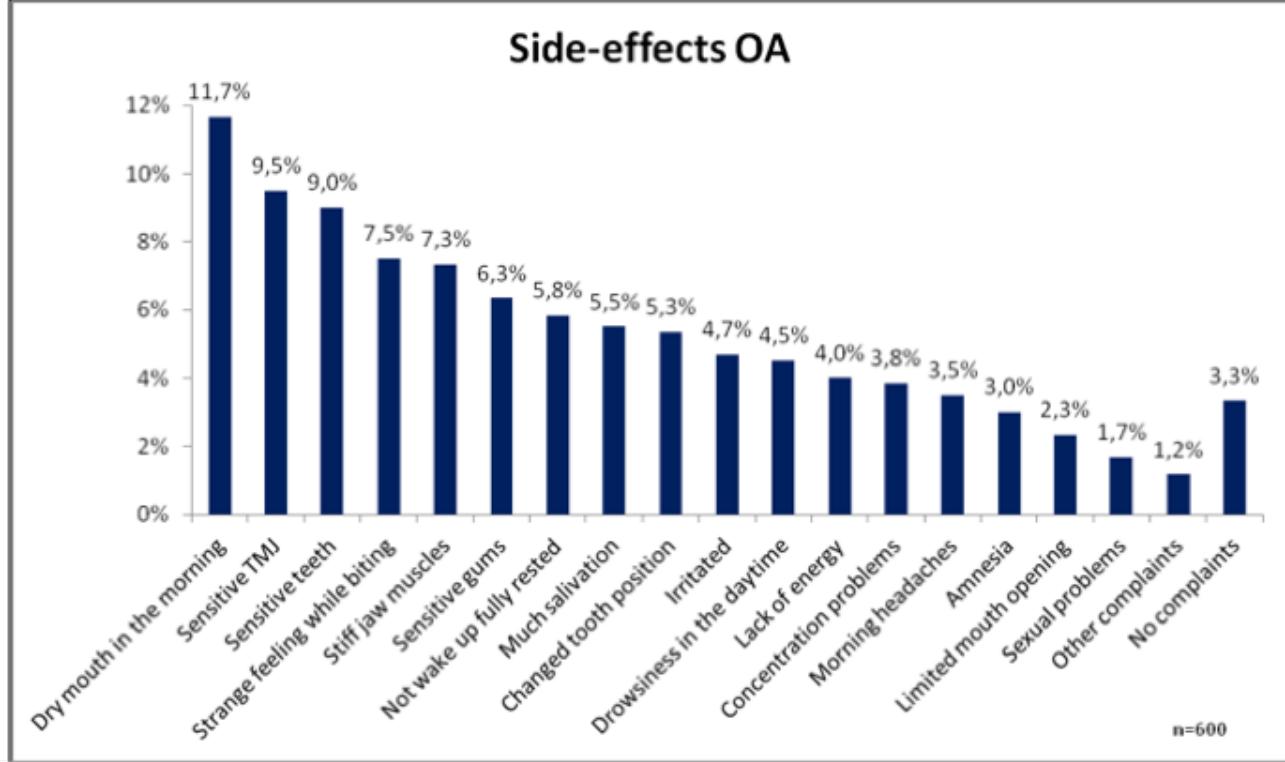




# Snorex

<https://www.youtube.com/watch?v=BQksW4h9V1s&feature=youtu.be>

Ten slotte wordt opgemerkt dat er naast het MRA nog andere “oral appliances” voor de behandeling van OSAS bestaan. Het “tongue-retaining device” (TRD) is ontworpen om de tong ter verbetering van de luchtwegdoorgankelijkheid in een voorwaartse stand te fixeren. Het effect van dit apparaat op de AHI is echter niet significant [Barthlen, 2000]. “Mouth shields” en “soft palate-lifting devices” zijn ervoor bedoeld om snurkgeluiden tegen te gaan, maar zijn bij OSAS niet effectief [Schönhofer, 1997]. Bij een apparaat dat de tong ter verbetering van de luchtpassage naar voren houdt is de patiëntcompliantie bijzonder slecht [Schönhofer, 1997]. Op grond van de literatuur moet een behandeling van OSAS-patiënten met “oral appliances” die de onderkaak niet in een voorwaartse stand fixeren vanwege de slechte behandelingsresultaten worden afgeraden.



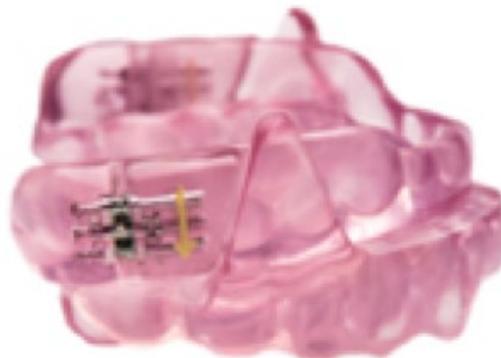
cohort trial, 326 patients, 167 (51%) used questionnaires. de Ruiter et al 2016

## Side Effects

Dry mouth  
 Sensitive TMJ  
 Sensitive teeth  
 Stiff muscles  
 Changed tooth position

## MRA aantallen

- 2018: 3 (flex)
- 2019: 67 (flex en fusion)
- 2020: 123 (flex, fusion)
- 2021: 185 (fusion en avant)
- 2022: 213
- 2023: 255



Ook bij patiënten zonder tanden/kiezen en een kunstgebit (edentate patiënten met bv implantaten)

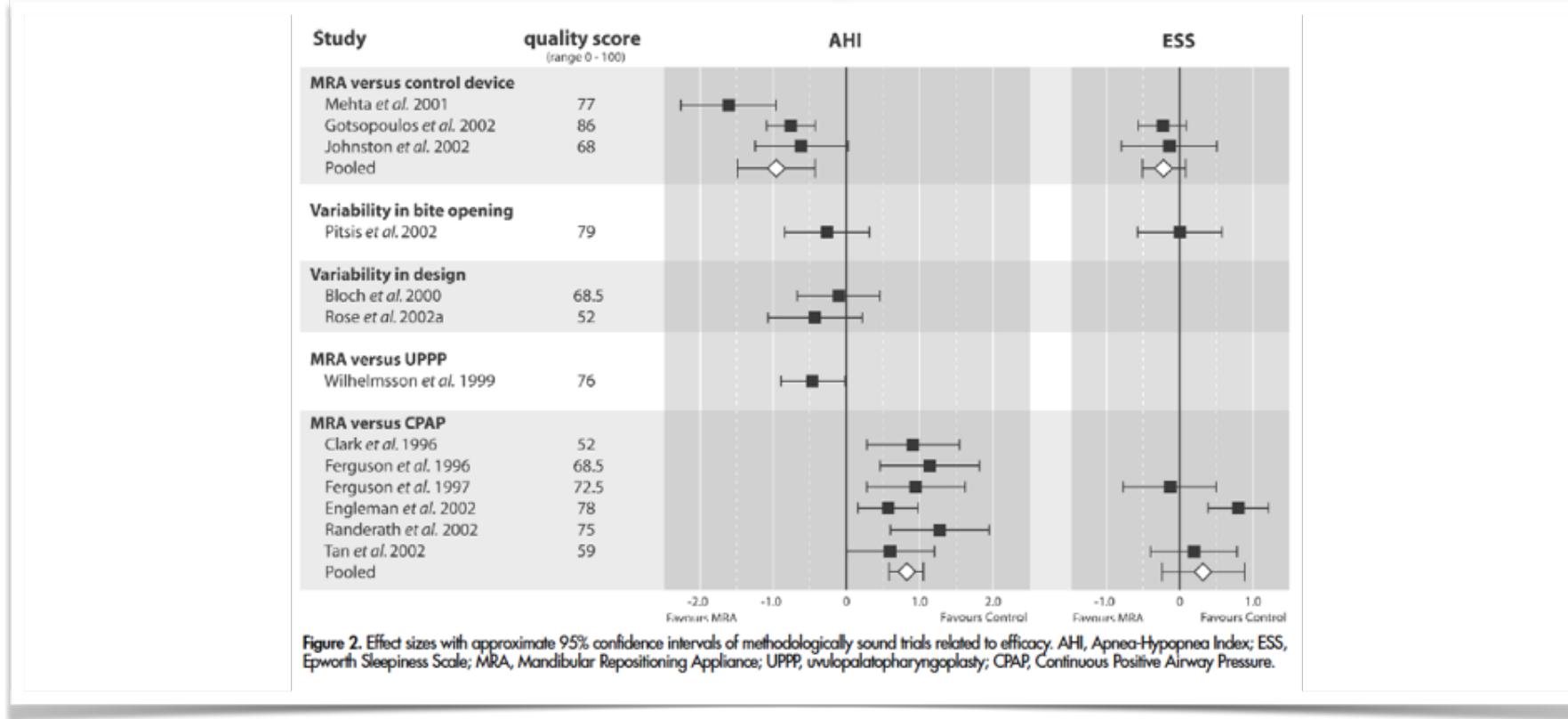
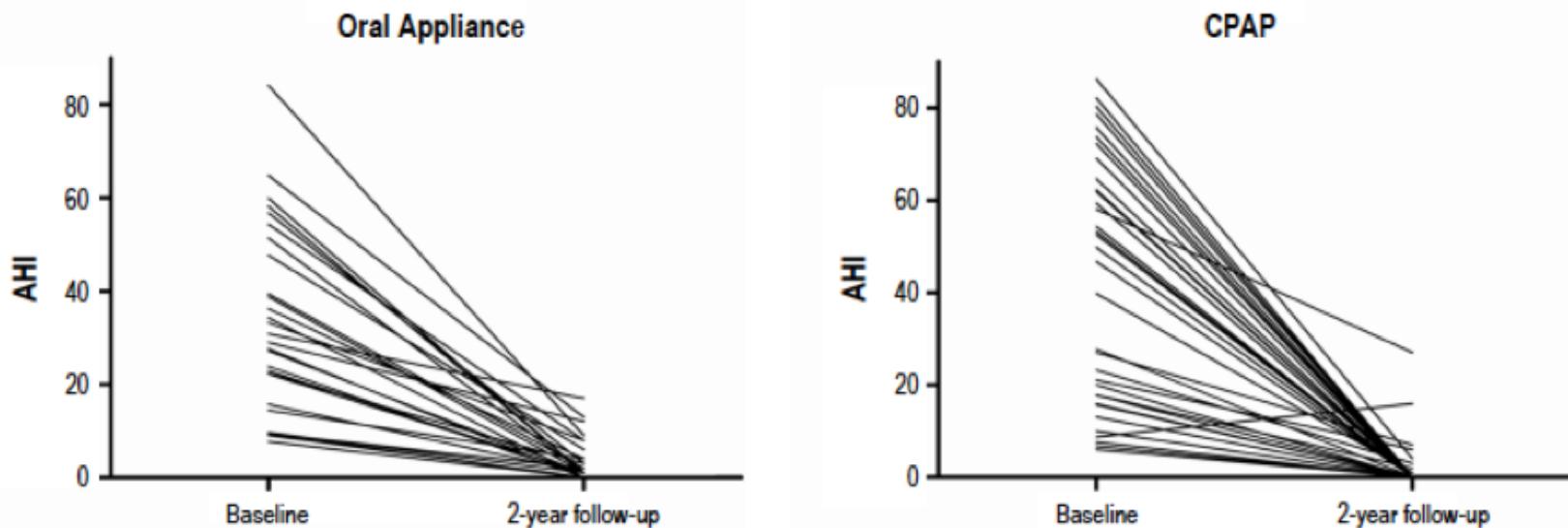


Figure 2. Effect sizes with approximate 95% confidence intervals of methodologically sound trials related to efficacy. AHI, Apnea-Hypopnea Index; ESS, Epworth Sleepiness Scale; MRA, Mandibular Repositioning Appliance; UPPP, uvulopalatopharyngoplasty; CPAP, Continuous Positive Airway Pressure.

Hoekema A, Stegenga B, De Bont LG. Efficacy and co-morbidity of oral appliances in the treatment of obstructive sleep apnea-hypopnea: a systematic review. Crit Rev Oral Biol Med 2004;15:137-55.

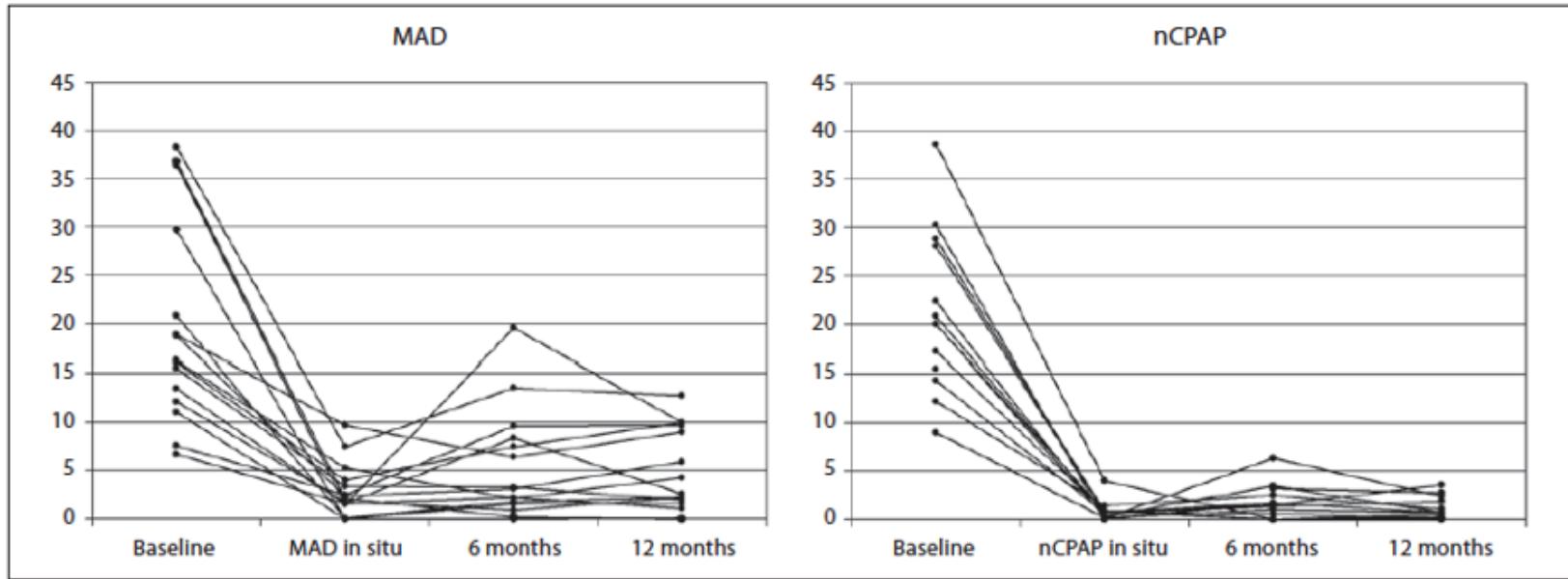
## Efficacy



**Figure 2—**Individual values of the apnea-hypopnea index (AHI) of the patients who completed the entire follow-up in the randomized treatment group. CPAP, continuous positive airway pressure.

Doff, M. H., Hoekema, A., Wijkstra, P. J., van der Hoeven, J. H., Slater, J. J. H., de Bont, L. G., & Stegenga, B. (2013). Oral appliance versus continuous positive airway pressure in obstructive sleep apnea syndrome: a 2-year follow-up. *Sleep*, 36(9), 1289.

## MRA vs CPAP

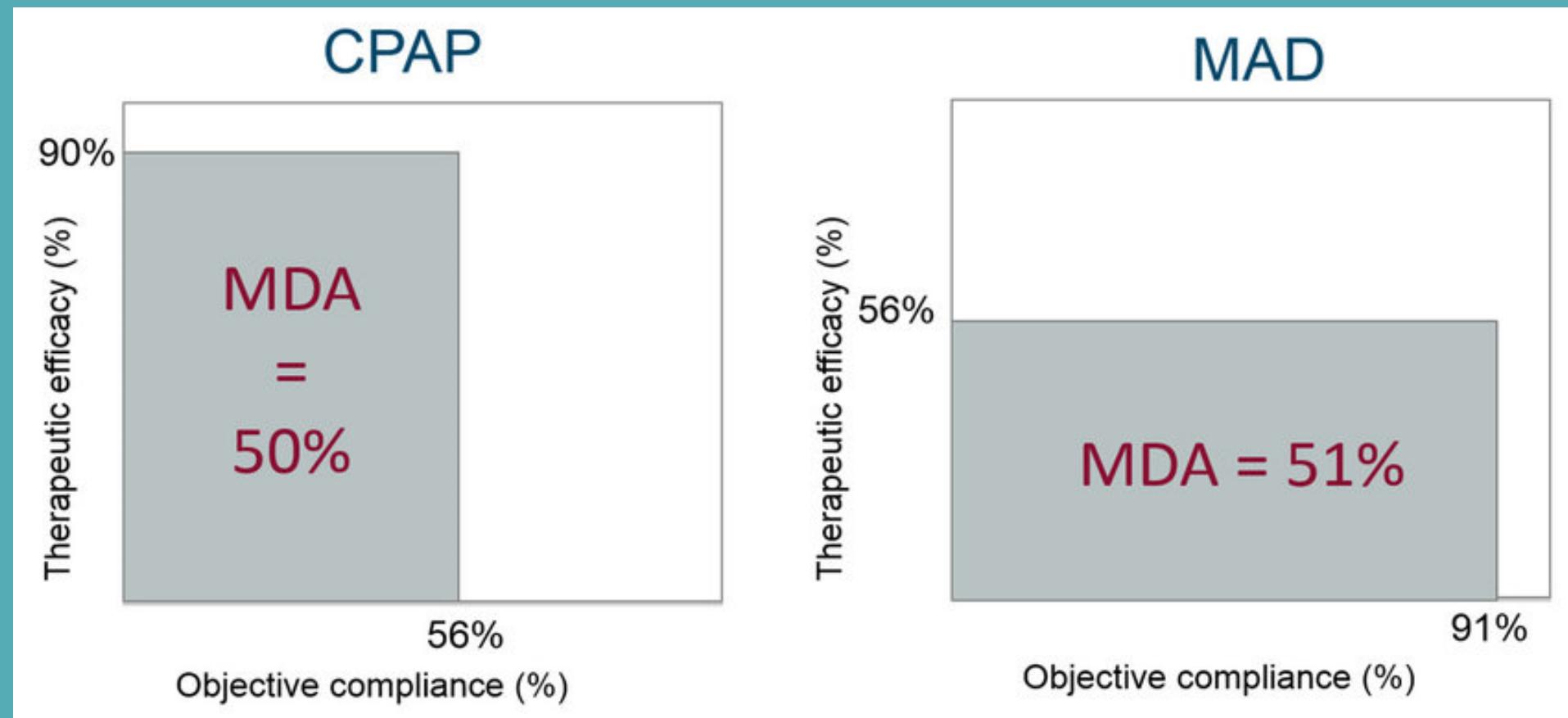


**Fig. 2.** Individual values of the AHI of the 28 patients who completed the entire study protocol (MAD, n = 15; nCPAP, n = 13) obtained from the baseline PSG recordings and from the subsequent therapy evaluation PSG recordings.

Aarab, G., Lobbezoo, F., Hamburger, H. L., & Naeije, M. (2010). Oral appliance therapy versus nasal continuous positive airway pressure in obstructive sleep apnea: a randomized, placebo-controlled trial. *Respiration*, 81(5), 411-419.

## MRA vs nCPAP

# Mean Disease Alleviation



Dieltjens, M., Braem, M. J., Vroegop, A. V., Wouters, K., Verbraecken, J. A., De Backer, W. A., ... & Vanderveken, O. M. (2013). Objectively measured vs self-reported compliance during oral appliance therapy for sleep-disordered breathing. *Chest*, 144(5), 1495-1502.

**Table 2** Overview of the polysomnographic characteristics of the study patients ( $n = 36$ ) per titration position of OA

		Titration, 60%	Titration, 75%	Titration, 90%	P value
Baseline ( $n = 36$ )	( $N = 36$ )				
AHI	12.9 (9.1–16.7)	-	-	-	
ODI	10.0 (6.0–1.8)	-	-	-	
3-month follow-up ( $n = 36$ )	( $N = 13$ )	( $N = 23$ )	-	-	0.052
AHI	9.7 (5.1–14.8)	5.0 (3.4–9.4)	-	-	0.159
ODI	8.0 (4.0–12.0)	5.0 (3.0–8.0)	-	-	
12-month follow-up ( $n = 29$ )	( $N = 3$ )	( $N = 15$ )	( $N = 11$ )	-	
AHI	5.4 (5.0–5.4)	4.4 (2.9–6.6)	7.8 (4.0–14.7)	-	0.127
ODI	7.0 (6.0–7.0)	4.0 (2.0–8.0)	8.0 (7.0–16.0)	-	0.052

All patients started at baseline on 60% of maximum protrusive path

The table gives an overview of median (IQR25–75)

Differences between groups are significant (Kruskal-Wallis test  $P < 0.05$ )

**de Ruiter, M. H. T.**, Aarab, G., de Vries, N., Lobbezoo, F., & de Lange, J. (2020). A stepwise titration protocol for oral appliance therapy in positional obstructive sleep apnea patients: proof of concept. *Sleep and Breathing*, 1–8.

## Titration protocol

- Start at 60%
- Advance to 75% / 90%
- Subjective improvement
- Dental side-effects

## Long-term oral appliance therapy in obstructive sleep apnea syndrome: a controlled study on temporomandibular side effects

Michiel H. J. Doff · Steffanie K. B. Veldhuis · Aarnoud Hoekema ·  
James J. R. Huddleston Slater · P. J. Wijkstra · Lambert G. M. de Bont ·  
Boudewijn Stegenga

Received: 2 December 2010 / Accepted: 14 April 2011 / Published online: 3 May 2011  
© Springer-Verlag 2011

*Craniomandibular Dysfunction*

### Limitations

- Initial period: Pain related TMD: OAT 24% vs 6% CPAP
- No limitations in mandibular function
- Transient (persistent 10%)

## Long-term oral appliance therapy in obstructive sleep apnea syndrome: a controlled study on dental side effects

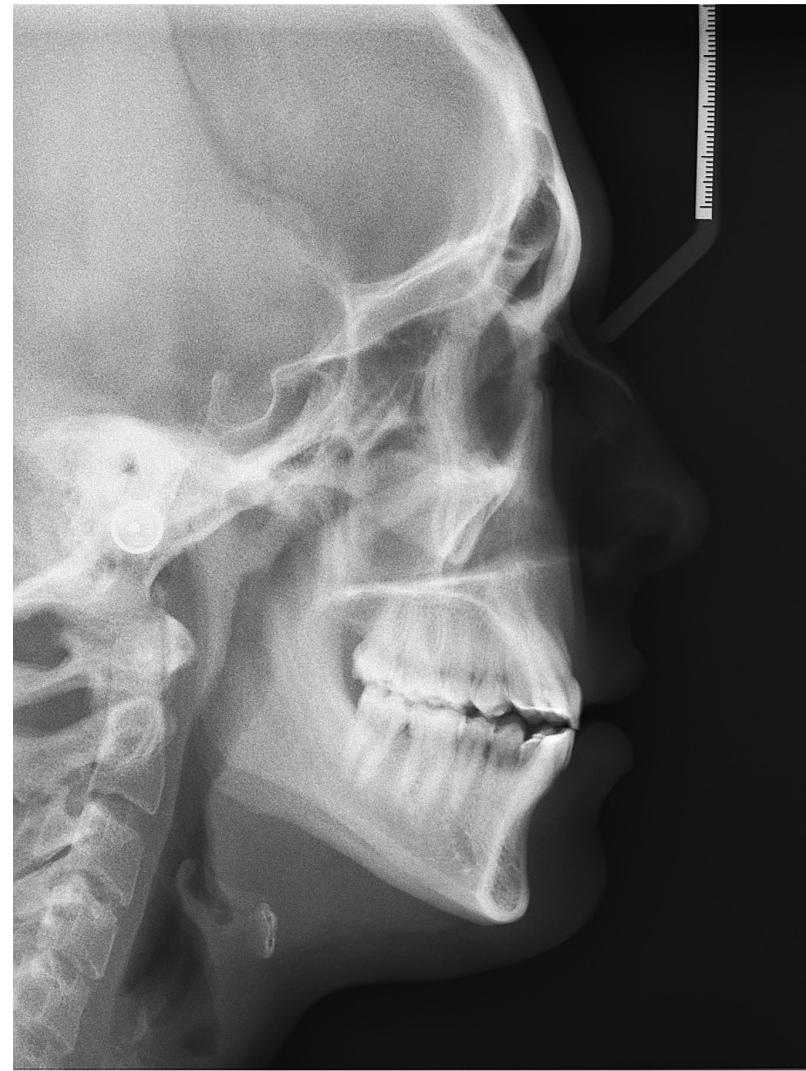
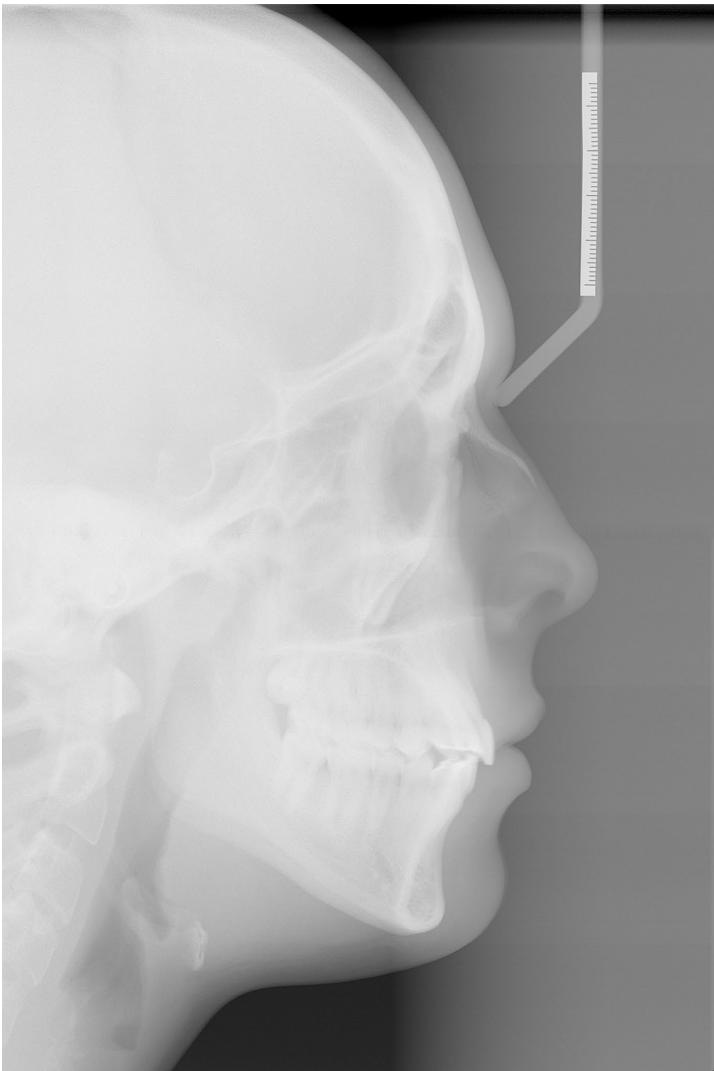
M. H. J. Doff · K. J. Finnema · A. Hoekema ·  
P. J. Wijkstra · L. G. M. de Bont · B. Stegenga

Received: 17 December 2011 / Accepted: 10 April 2012  
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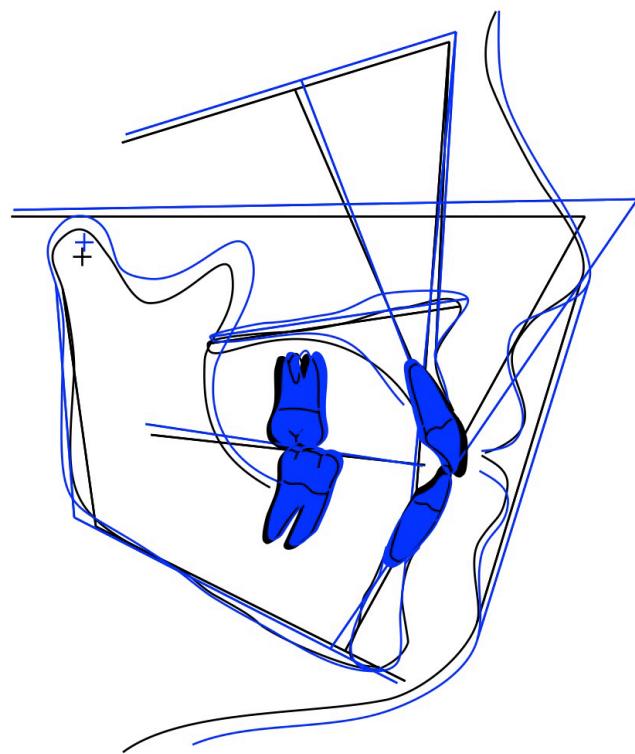
*Dental changes in OAT*

### Limitations

- Overjet and overbite decreased 1.2 and 1.5 mm
- Open bite (posterior)

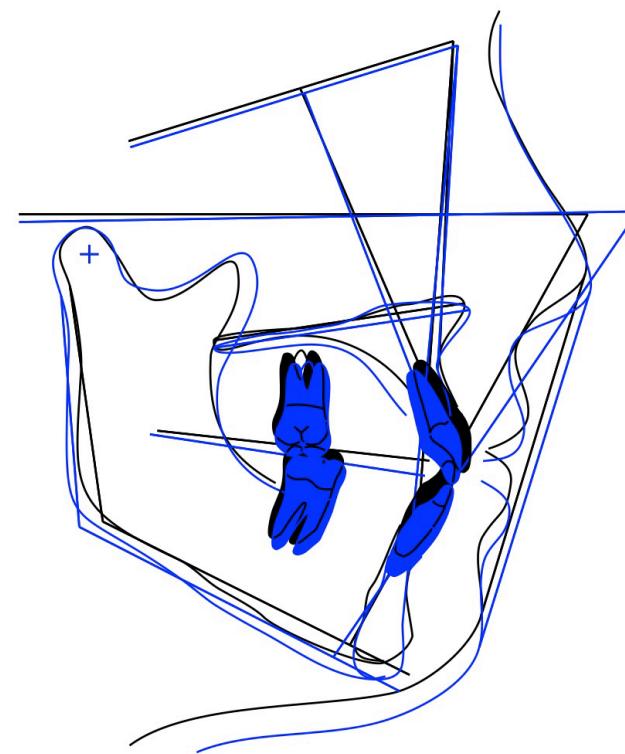


PNS-ANS@A-point (Auto)



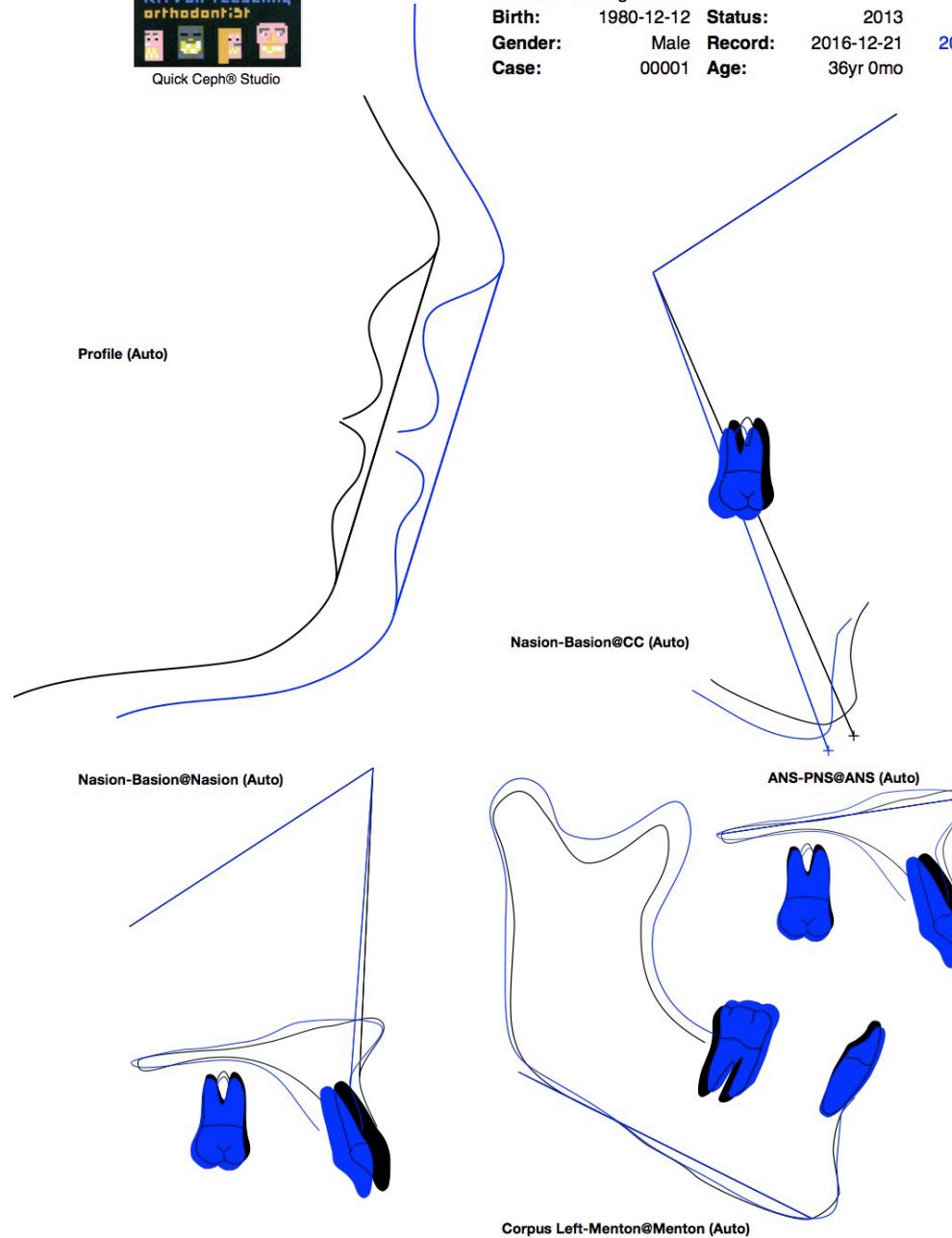
2013  
2016

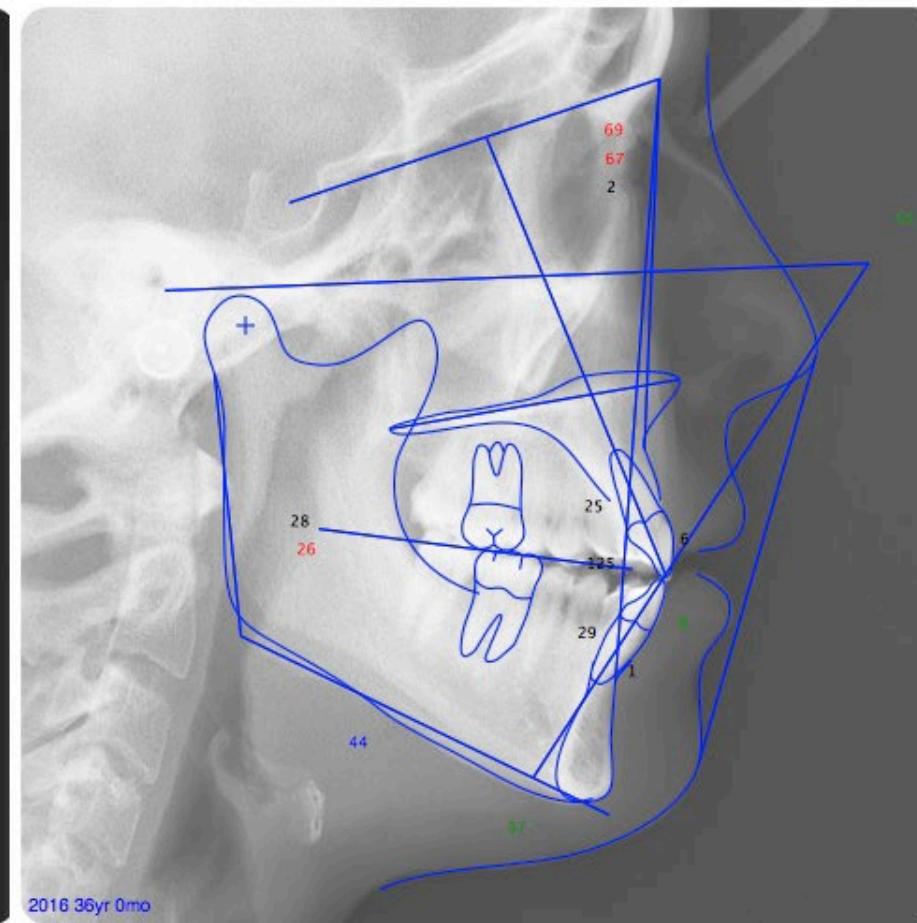
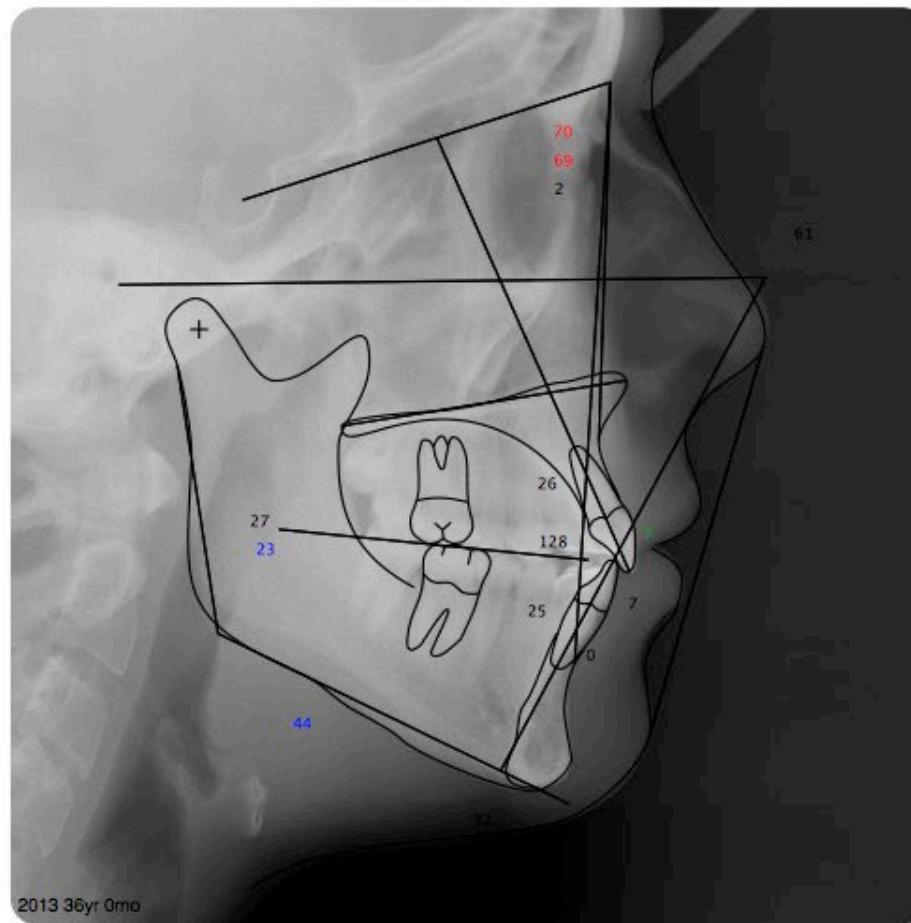
PNS-ANS@Hinge Axis (Auto)



2013  
2016

Name: osas giessen  
Birth: 1980-12-12 Status: 2013 2016  
Gender: Male Record: 2016-12-21 2016-12-21  
Case: 00001 Age: 36yr 0mo 36yr 0mo





# Temporomandibular Aspects in MAD treatment

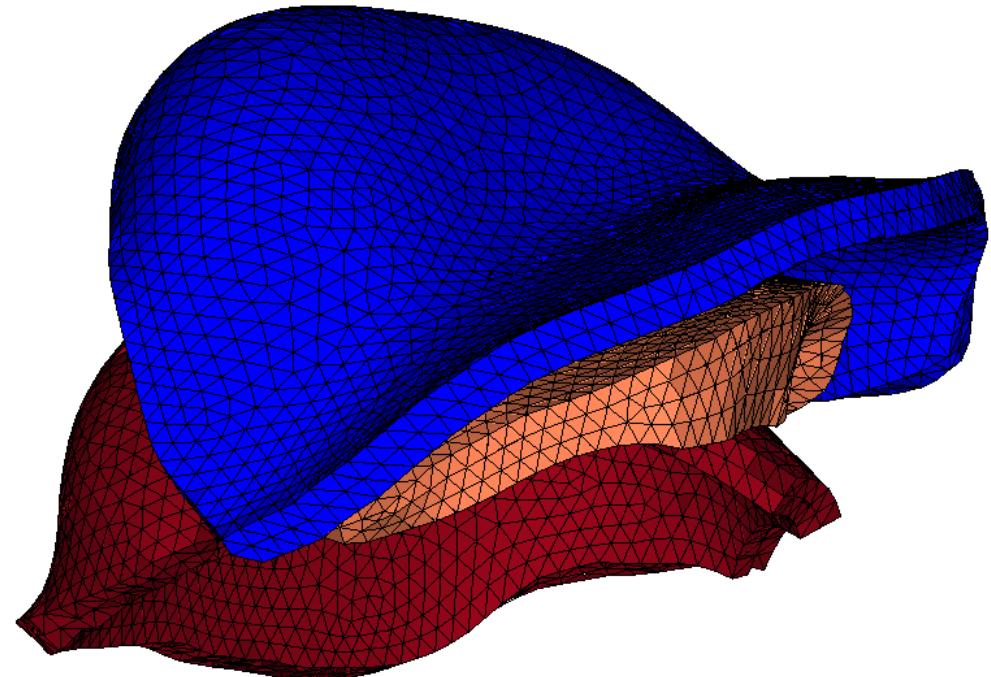
# Finite element model

aantal elementen:

temporaal kraakbeen - 14500

discus - 12500

condylair kraakbeen - 12200

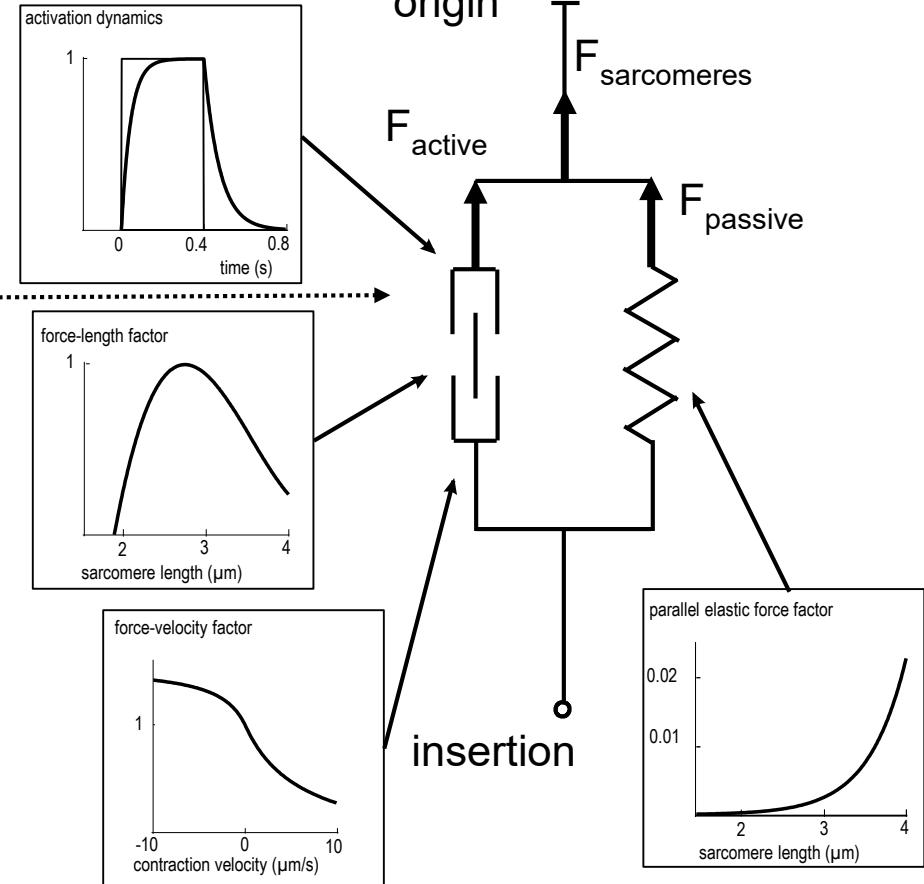


right-anterior view

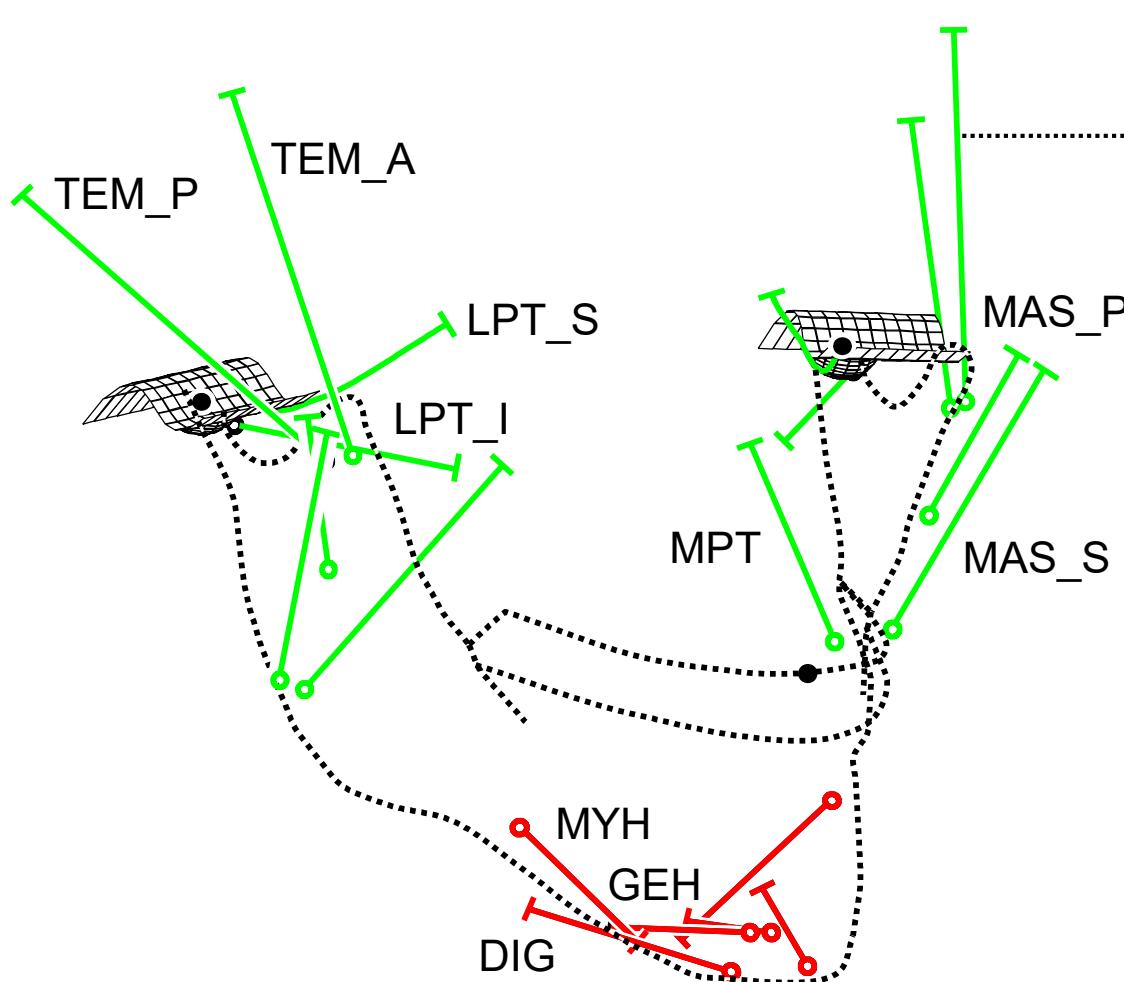
Heidsieck DSP, Koolstra JH, **de Ruiter MHT**, Hoekema A, de Lange J. Biomechanical effects of a mandibular advancement device on the temporomandibular joint. Journal of Cranio-Maxillofacial Surgery 2018; 46(2): 288-292.

## muscle model

origin

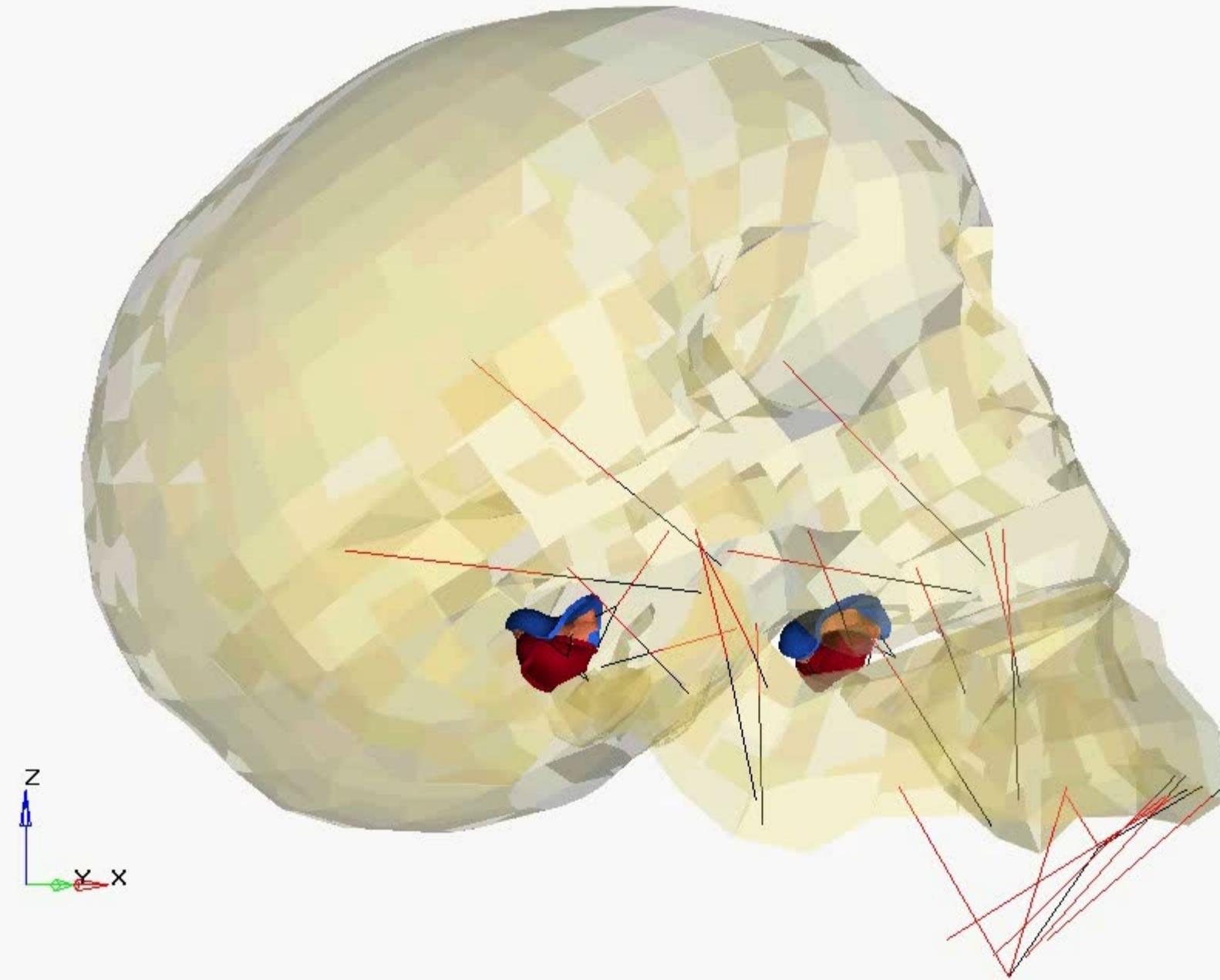


insertion



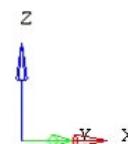
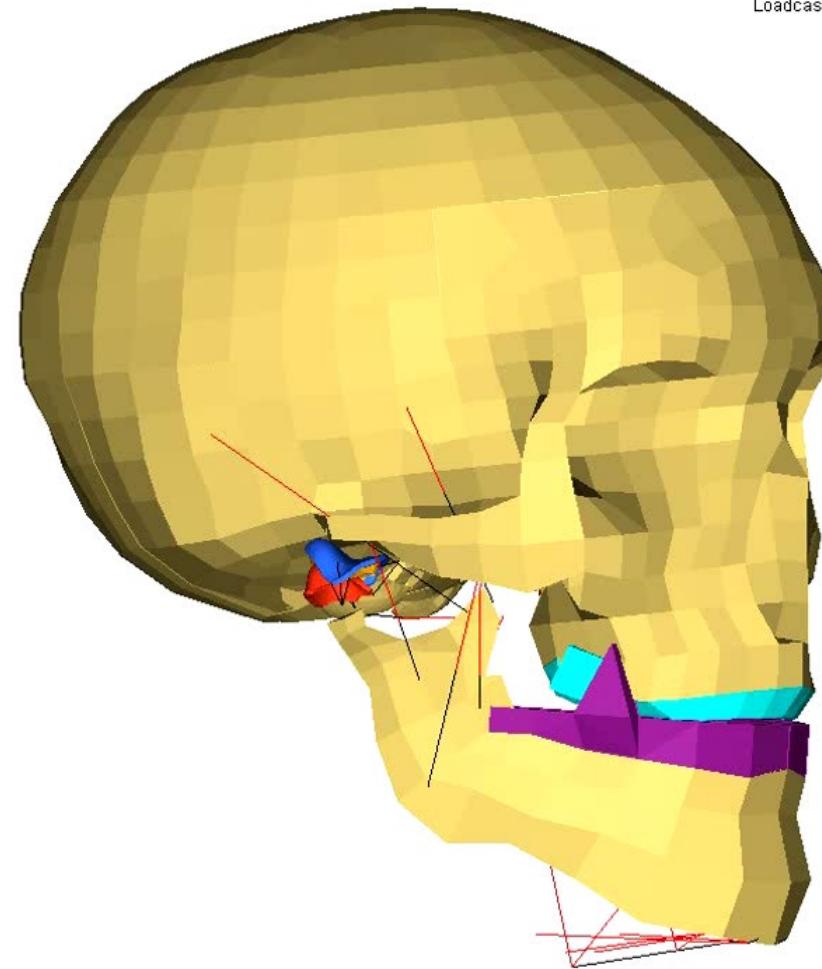
jaw model

Time = 0.004000

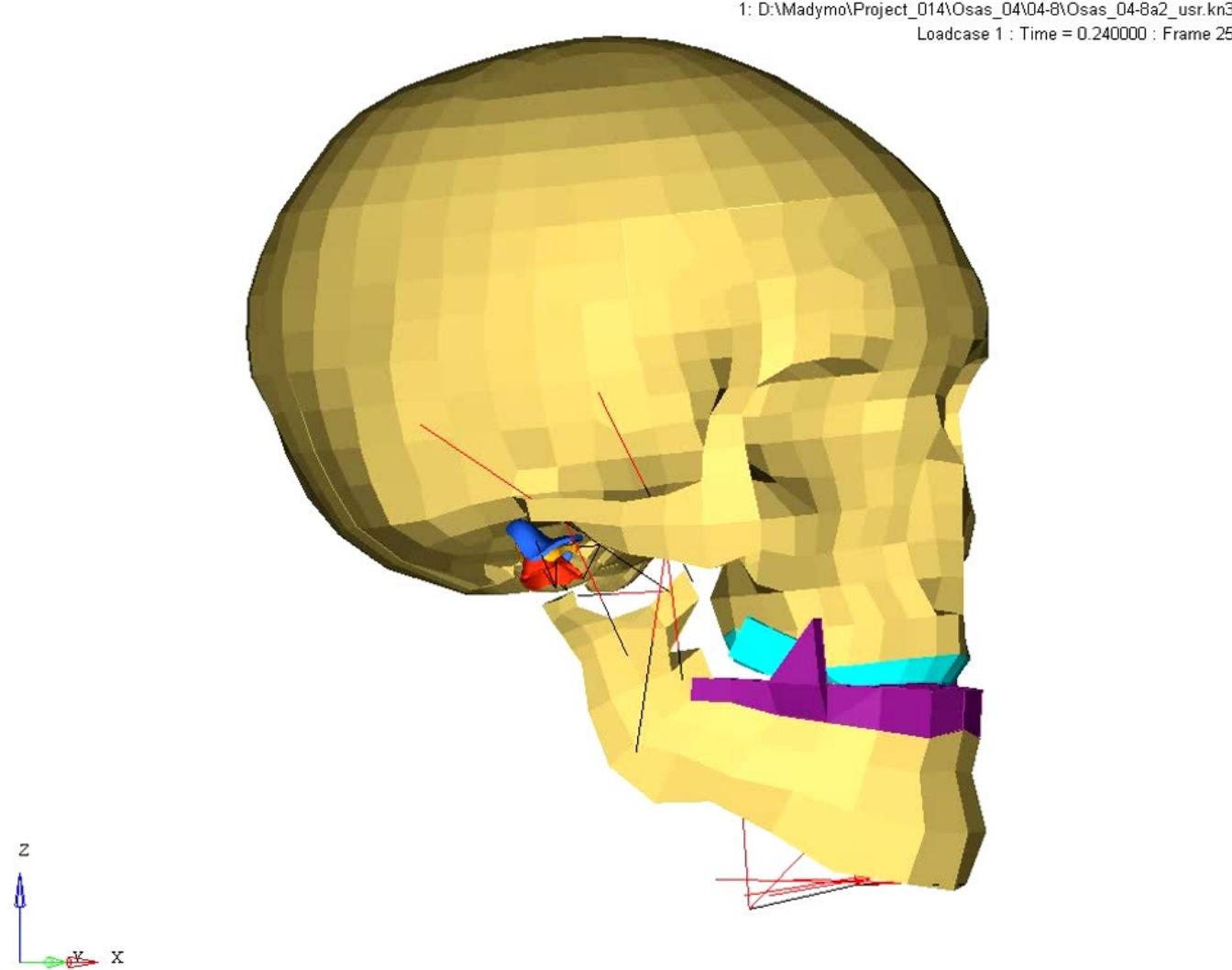


# Open and close

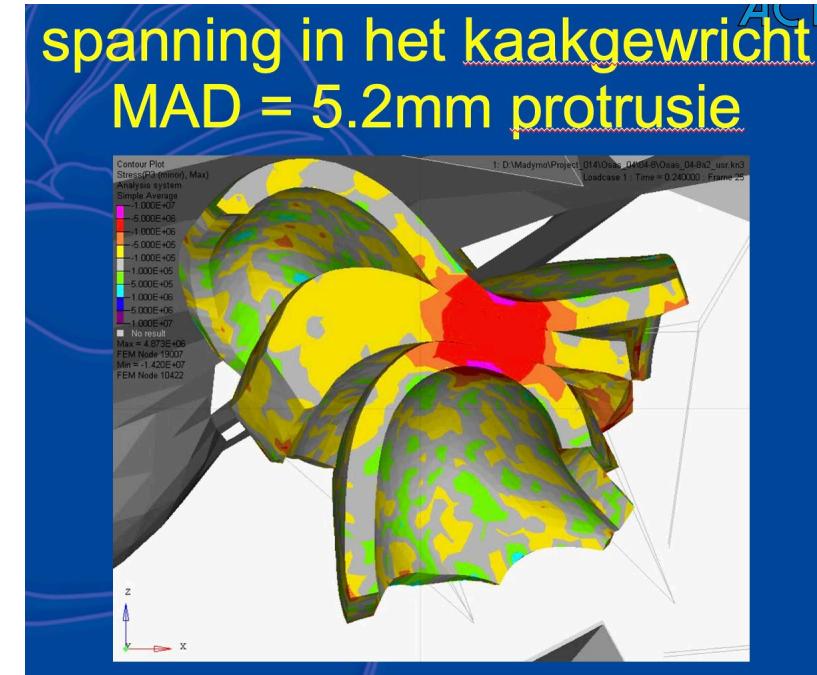
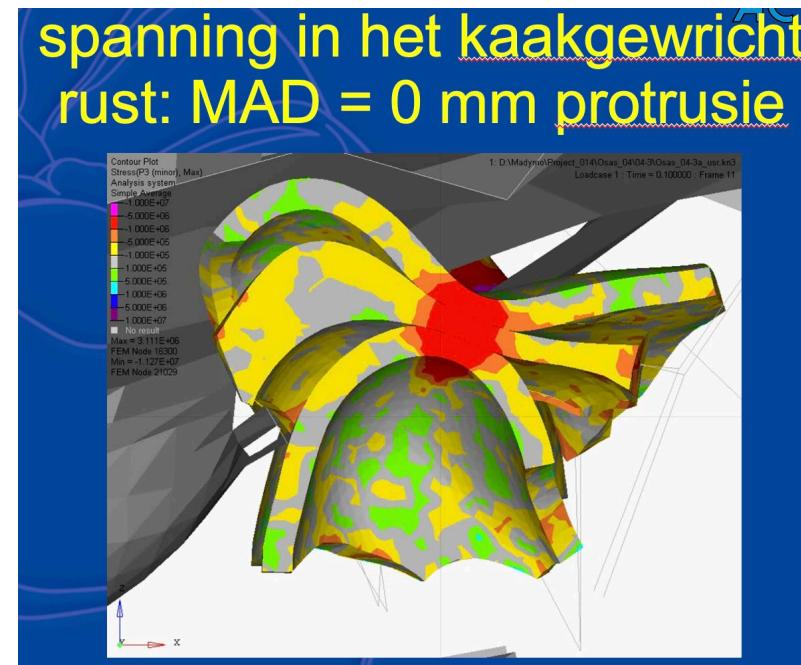
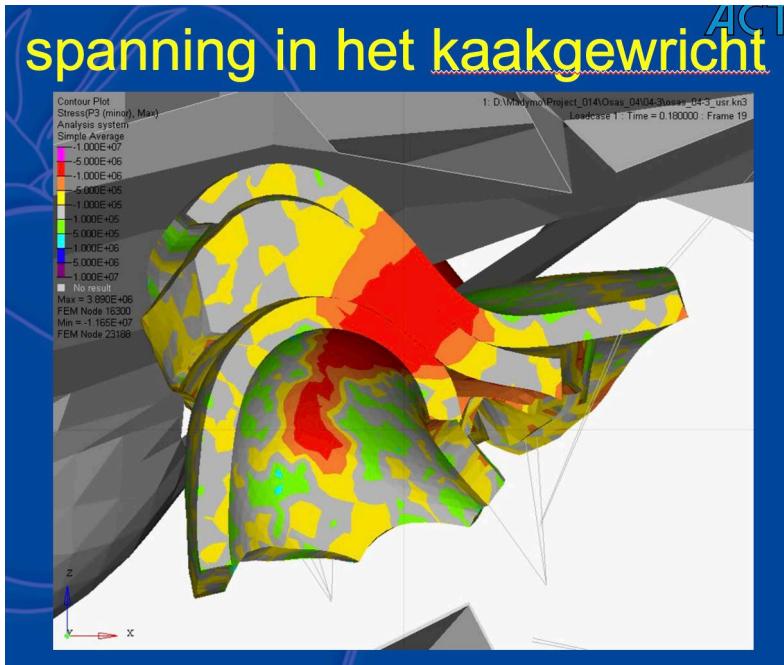
1: D:\Madymo\Project\_014\Osas\_04\04-3\osas\_04-3\_usr.kn3  
Loadcase 1 : Time = 0.180000 : Frame 19



# 5.2 mm protrusion



# Tension in Joint



# Conclusion

**Usage of a MAD could result in (temporarily) remodelling of the JOINT, but no substantial extra forces are expected**



# Edentulous patient

Sleep Breath (2016) 20:395–404  
DOI 10.1007/s11325-015-1285-9



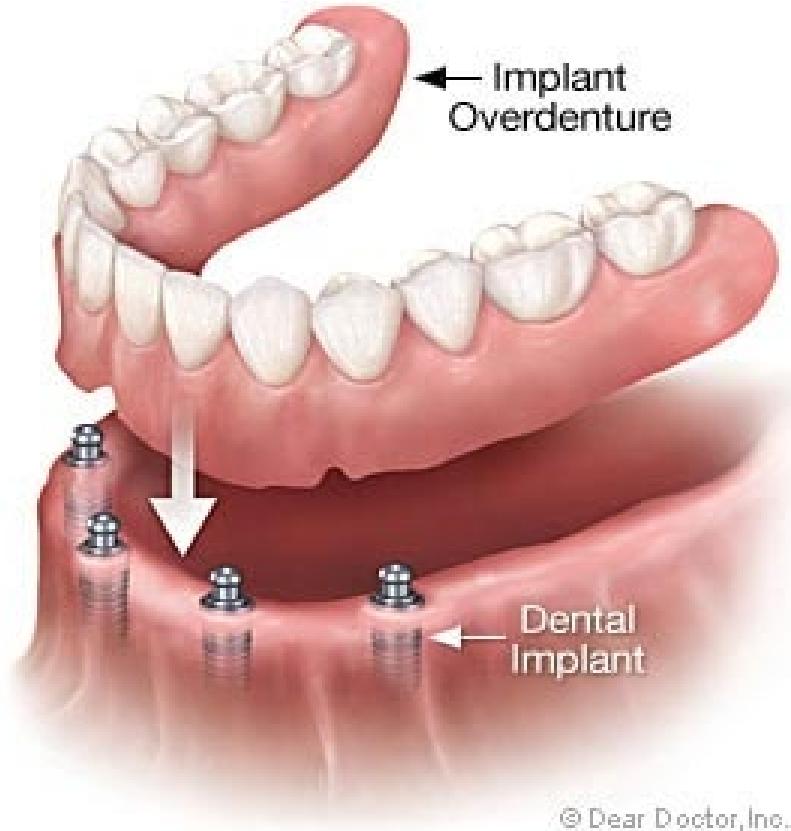
DENTISTRY • REVIEW

## Management of obstructive sleep apnea in edentulous patients: an overview of the literature

David S. P. Heidsieck<sup>1</sup> • Maurits H. T. de Ruiter<sup>1</sup> • Jan de Lange<sup>1</sup>

Received: 4 May 2015 / Revised: 20 October 2015 / Accepted: 28 October 2015 / Published online: 19 November 2015  
© The Author(s) 2015. This article is published with open access at Springerlink.com

- Dental status of 34% of the patient is unfit for MAD
- Treatment options are limited; CPAP or surgery



© Dear Doctor, Inc.

## Implantaat gedragen MRA

Randomised controlled trial

- Continuous Positive Airway Pressure
- Implanataat gedragen MRA

# POSA trial: MRA versus SPT



# Conclusion POSA trial MRD vs SPT

*High efficacy (AHI van 12.9 naar 5.0)*

*High compliance ( >4 uur 5D/week 80-90%)*

*de Ruiter et al. Durability of treatment effects of the Sleep Position Trainer versus oral appliance therapy in positional OSA: 12-month follow-up of a randomized controlled trial. Sleep and Breathing (2018): 441-450.*

# **Maxillomandibular Advancement**

## **MMA**



# Pick your winners

## NO

Comorbidity  
"older" patients  
Neck circumference >43 cm  
Previous multilevel surgery (ENT)

## YES

"Young" patients (<55 years)  
Maxilla and mandibular hypoplasia  
(orthognathic)  
No BMI restriction  
No AHI restriction

- Patient characteristics

**Success on AHI**

**MMA = CPAP**

**2008**



Available online at [www.sciencedirect.com](http://www.sciencedirect.com)



American Journal of Otolaryngology–Head and Neck Medicine and Surgery 31 (2010) 14–20

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American Journal of  
OTOLARYNGOLOGY

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[www.elsevier.com/locate/amjoto](http://www.elsevier.com/locate/amjoto)

## Surgery vs ventilation in adult severe obstructive sleep apnea syndrome<sup>☆</sup>

Claudio Vicini, MD<sup>a</sup>, Iacopo Dallan, MD<sup>b,\*</sup>, Aldo Campanini, MD<sup>a</sup>, Andrea De Vito, MD<sup>a</sup>,  
Francesca Barbanti, MD<sup>a</sup>, Gianluca Giorgiomarrano, MD<sup>a</sup>, Marcello Bosi, MD<sup>c</sup>,  
Giuseppe Plazzi, MD<sup>d</sup>, Federica Provini, MD<sup>d</sup>, Elio Lugaresi, MD<sup>d</sup>

<sup>a</sup>ENT & Oral Surgery Unit, Ospedale Morgagni Pietrantoni, Forlì, Italy

<sup>b</sup>Second ENT Unit, Azienda Ospedaliero-Universitaria Pisana, Pisa, Italy

<sup>c</sup>Sleep Centre, Pneumologic Unit, Ospedale Morgagni Pietrantoni, Forlì, Italy

<sup>d</sup>Sleep Centre, Neurological Clinic, University of Bologna, Bologna, Italy

Received 12 May 2008

Success on AHI

MMA > MLS

2020

Sleep Medicine Reviews 57 (2021) 101471



Contents lists available at [ScienceDirect](#)

## Sleep Medicine Reviews

journal homepage: [www.elsevier.com/locate/smrv](http://www.elsevier.com/locate/smrv)



### CLINICAL REVIEW

## Maxillomandibular advancement versus multilevel surgery for treatment of obstructive sleep apnea: A systematic review and meta-analysis<sup>☆</sup>



Ning Zhou <sup>a,b,\*</sup>, Jean-Pierre T.F. Ho <sup>a</sup>, Zhengfei Huang <sup>b,c</sup>, René Spijker <sup>d,e</sup>,  
Nico de Vries <sup>b,f,g</sup>, Ghizlane Aarab <sup>b</sup>, Frank Lobbezoo <sup>b</sup>, Madeline J.L. Ravesloot <sup>f</sup>,  
Jan de Lange <sup>a</sup>

**Success on AHI**

**MMA = Inspire**

**2021**



Journal of  
*Clinical Medicine*



*Systematic Review*

## **Maxillomandibular Advancement and Upper Airway Stimulation for Treatment of Obstructive Sleep Apnea: A Systematic Review**

Ning Zhou <sup>1,2,3,\*†</sup>, Jean-Pierre T. F. Ho <sup>1,2,4,†</sup> , René Spijker <sup>5,6</sup>, Ghizlane Aarab <sup>3</sup>, Nico de Vries <sup>3,7,8</sup>, Madeline J. L. Ravesloot <sup>7</sup>  and Jan de Lange <sup>1,2</sup>

# Resultaten

## Surgical success:

- AHI drop below <20 *and* >50%

## Surgical cure

- AHI drop <5

	Literature MMA <sup>1</sup>	Our MMA cohort <sup>2</sup>
Success	86%	71%
Cure	43%	24%

1. Zaghi S, Holty JE, Cortal V, et al. Maxillomandibular Advancement for Treatment of Obstructive Sleep Apnea: A Meta-analysis. JAMA Otolaryngol Head Neck Surg 2016;142:58-66.

2. de Ruiter MHT, Apperloo RC, Milstein DMJ, de Lange J. Assessment of obstructive sleep apnoea treatment success or failure after maxillomandibular advancement. Int J Oral Maxillofac Surg 2017 46(11), 1357-1362.

# Kenmerken kaakoperatie op het Diak

-  3D planning operatie
-  Soms orthodontische behandeling erbij (een slotjes beugel)
-  Operatie duurt ongeveer 100-120 min
-  Twee MKA-chirurgen voeren dit samen uit
-  Soms een nachtje na operatie op de Intensive Care
-  Naar huis na soms 1 nacht, meestal 2 nachten.
-  Controles na een week, twee weken, 6 weken, 3 maanden, 1 jaar en 2 jaar

# Complicaties van de kaakoperatie

- ✓ 80-90% effectief (net zo goed als CPAP)
- ⚠ 10-40% kans op schade aan de zenuw in de onderkaak (gevoel)
- + 40% kans op matig stand kiezen op elkaar (daarom de ortho)
- 😢 Ander gezicht, esthetisch
- 👁 Goede, intensieve patientenbegeleiding

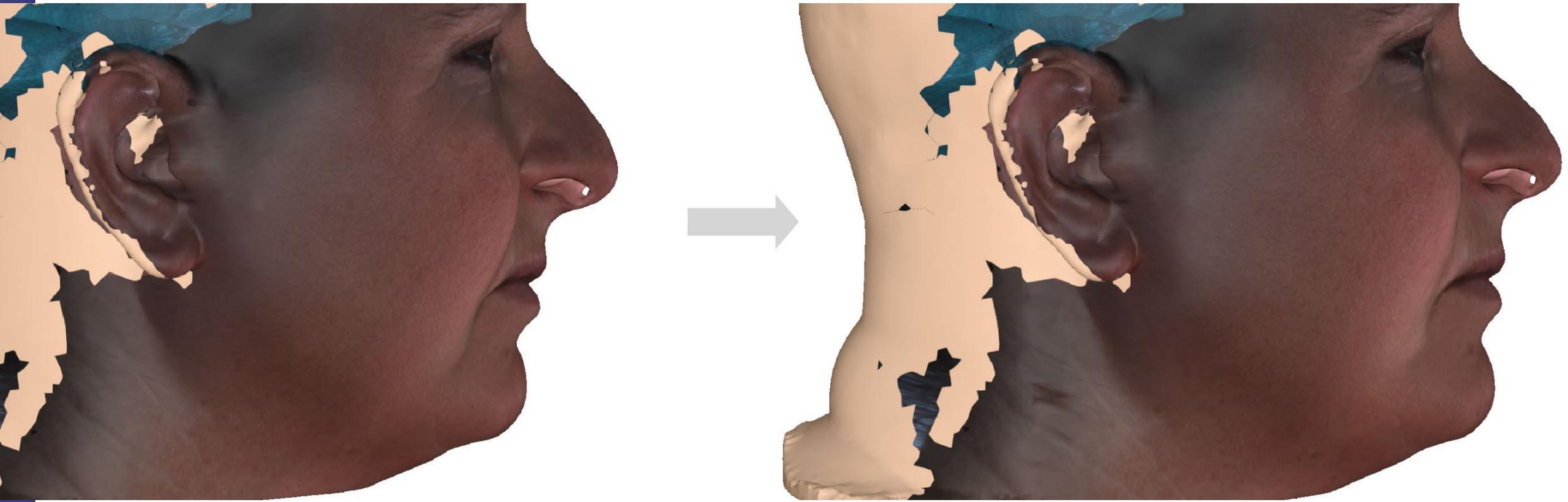
## Esthetiek van het gezicht

	Study patients (n = 37)	MMA success (n=24)	MMA Failure (n=13)
	Mean ( $\pm$ SD)	Mean ( $\pm$ SD)	Mean ( $\pm$ SD)
VAS snoring pre-operative (0-10)	8.3 ( $\pm$ 2.1)	8.4 ( $\pm$ 1.8)	8.0 ( $\pm$ 2.6)
VAS snoring post-operative (0-10)	2.0 ( $\pm$ 2.1)	1.9 ( $\pm$ 1.9)	2.0 ( $\pm$ 2.4)
VAS aesthetics pre-operative (0-10)	5.8 ( $\pm$ 2.2)	6.2 ( $\pm$ 1.9)	5.1 ( $\pm$ 2.7)
VAS aesthetics post-operative (0-10)	5.1 ( $\pm$ 2.3)	5.7 ( $\pm$ 2.1)	4.0 ( $\pm$ 2.2)

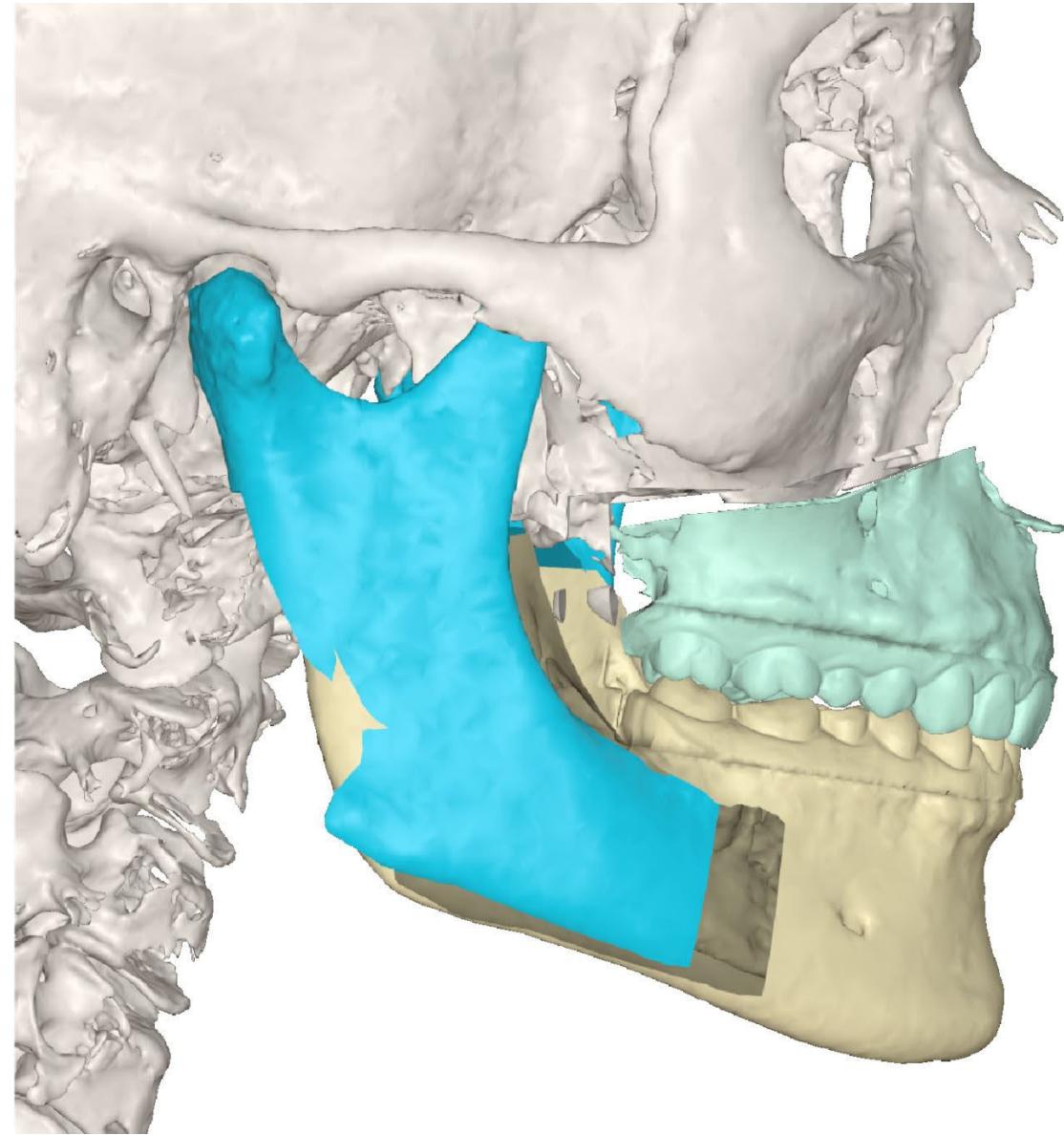
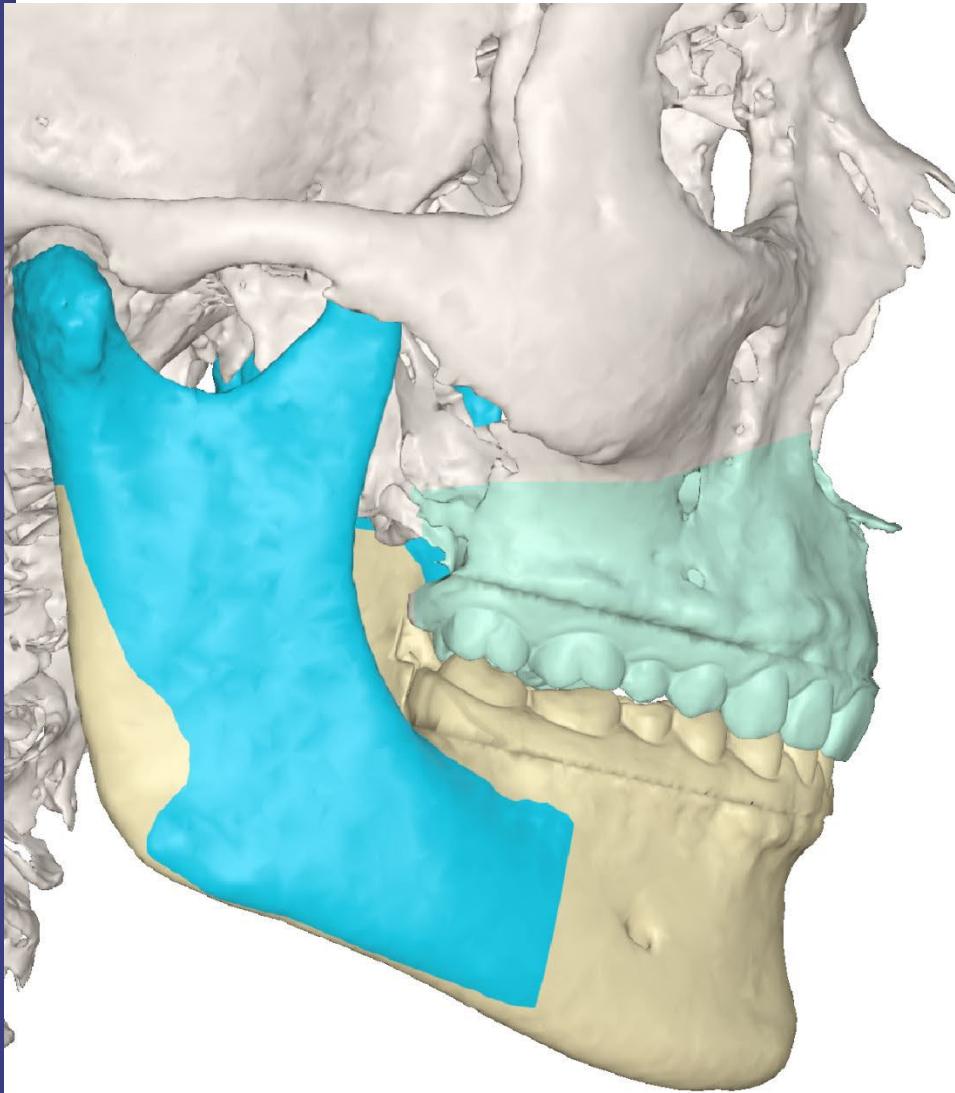
# Case 1

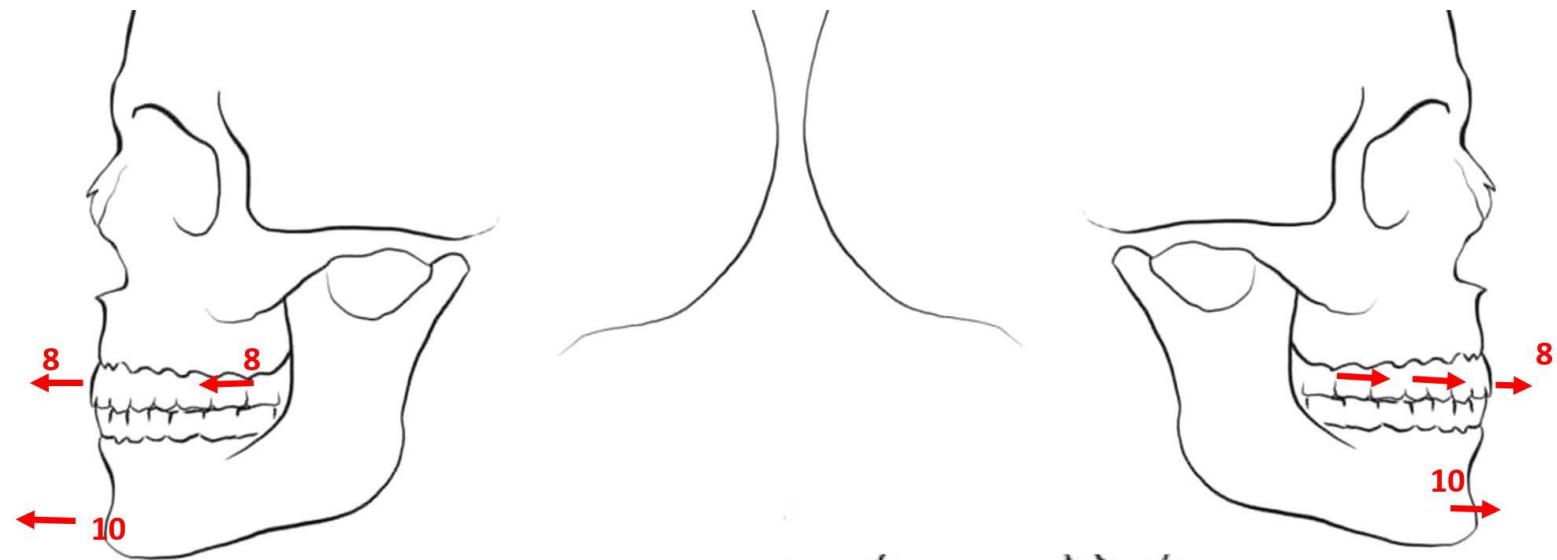


**Mw N**  
**53 jaar**  
**OSA – AHI 20**  
**CPAP intolerantie**  
**MRA intolerantie**

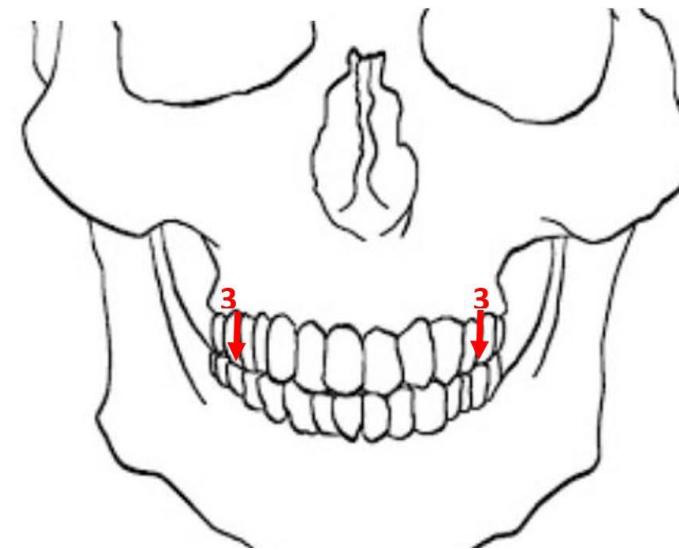






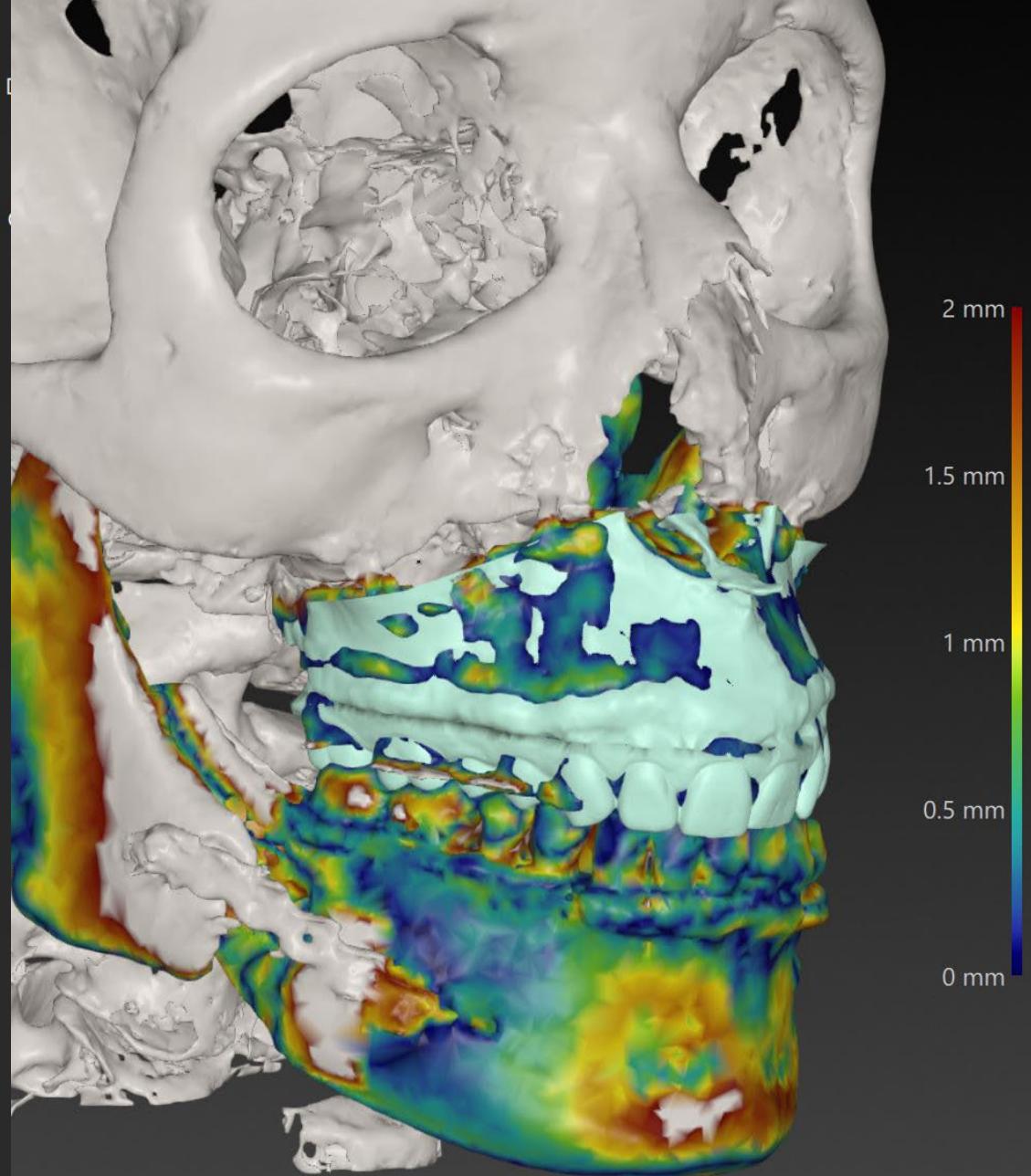
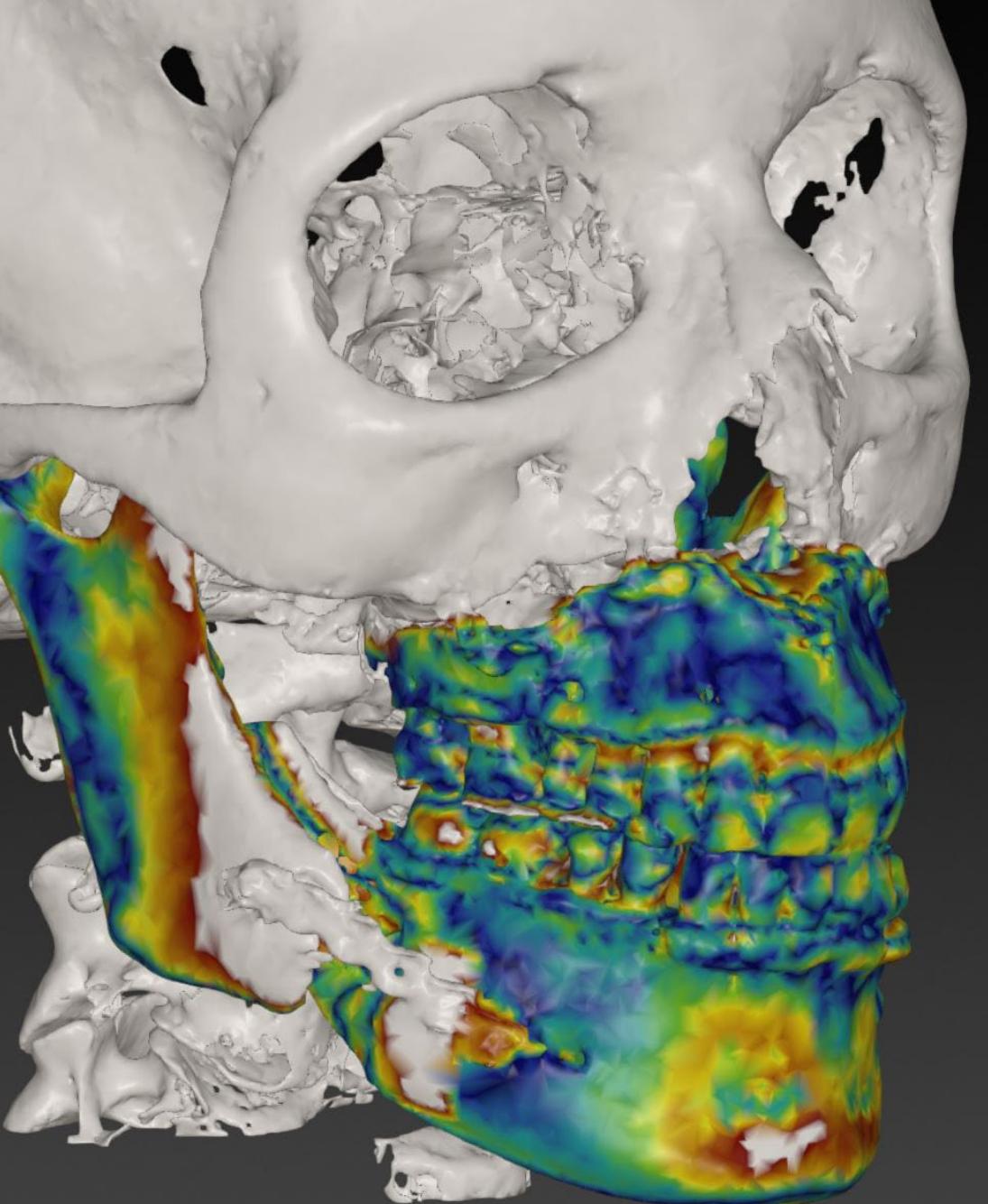


Bimax



UMC Utrecht  3D Face Lab







**Mw N**  
**53 jaar**  
**OSA – AHI 20**  
**CPAP intolerantie**  
**MRA intolerantie**



53 jaar  
OSA – AHI 20 gedaald naar 7!

Sensibiliteit maxilla gestoord  
Nog bezig met orthodontie

## Case 2



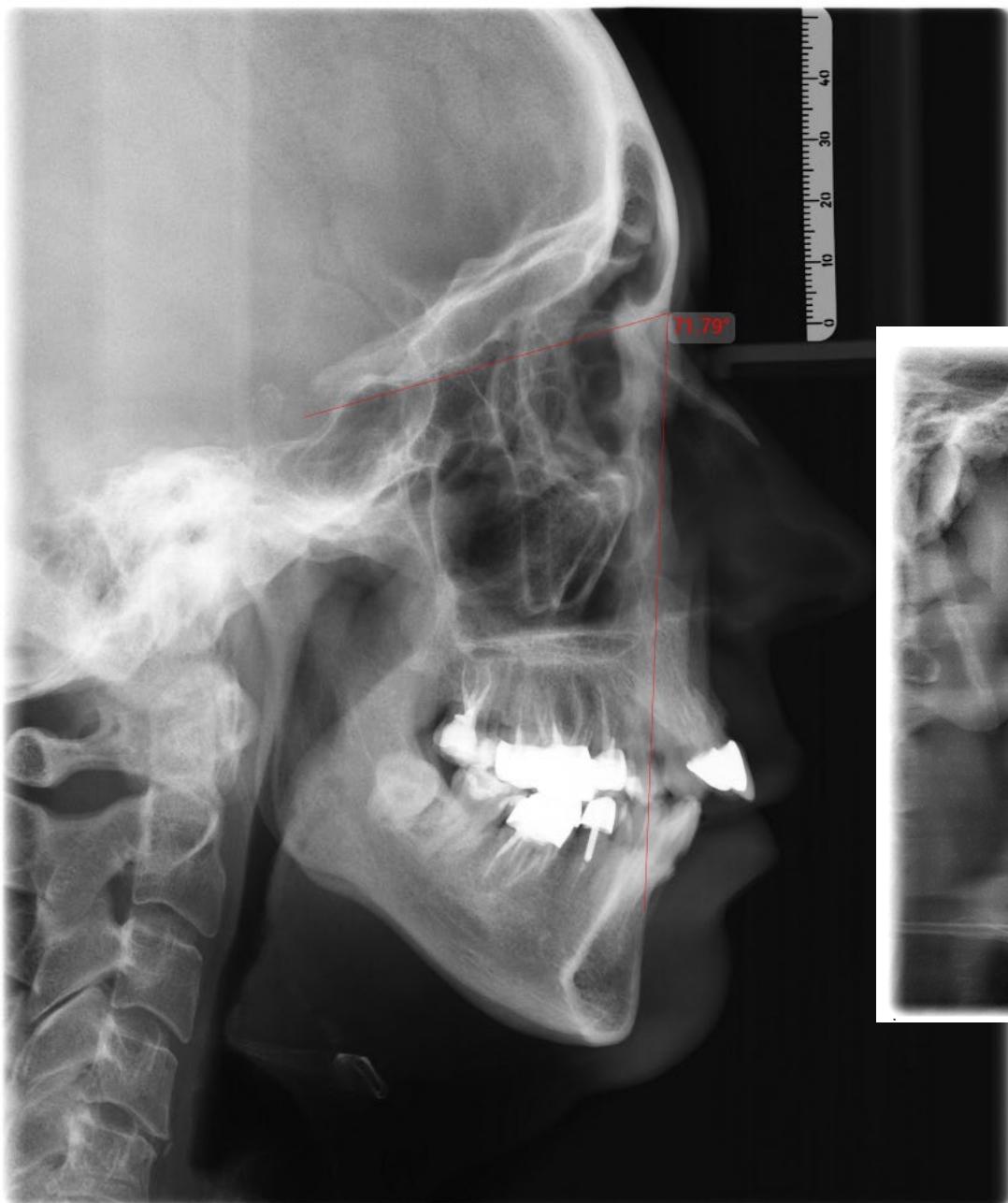
## Patient D

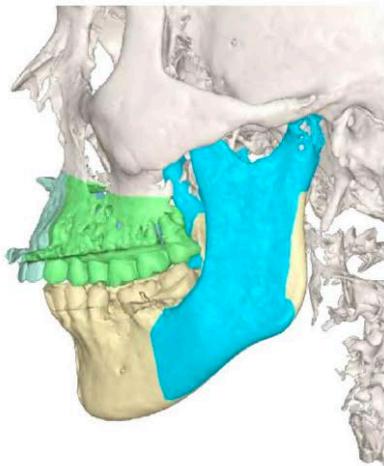
**Female  
48 yrs ; AHI 29,6**

**CPAP intolerance  
MAD intolerance**

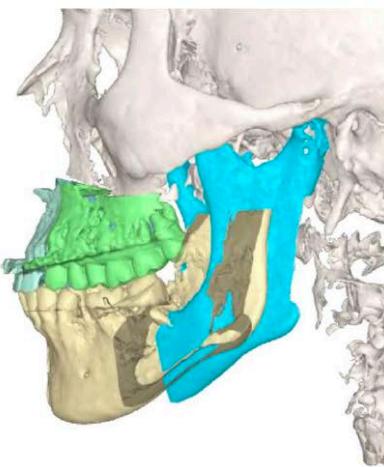
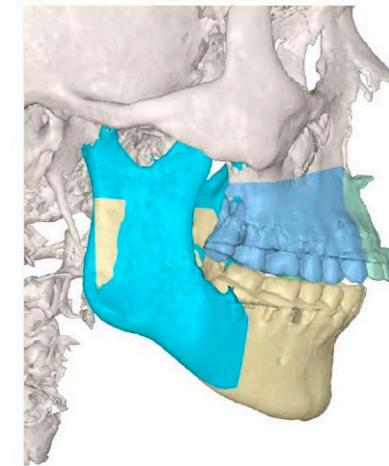
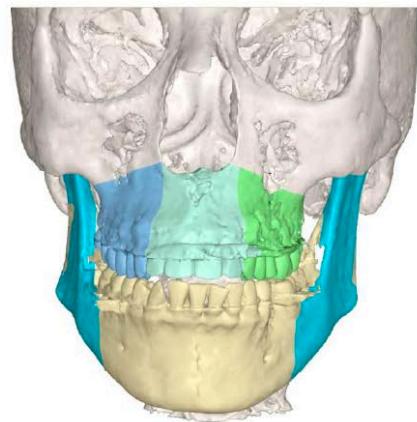




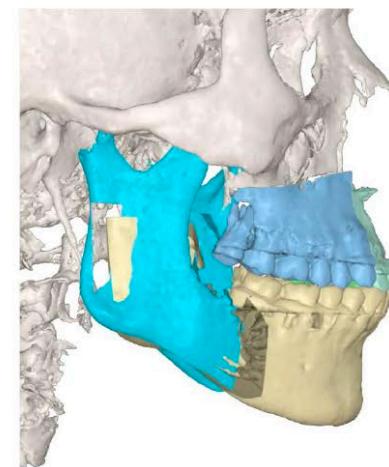
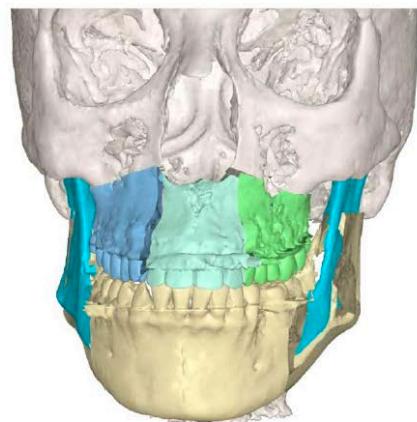




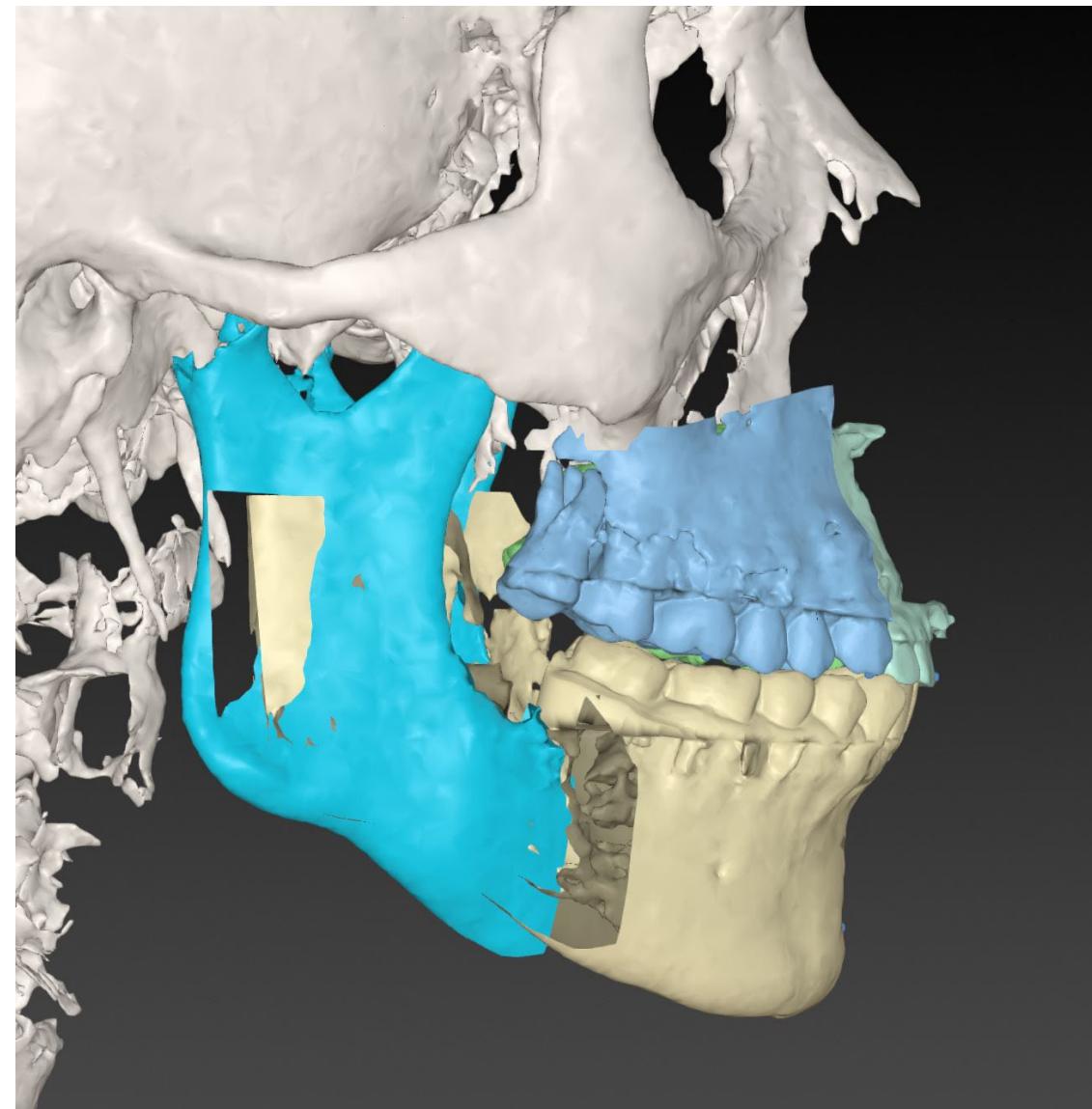
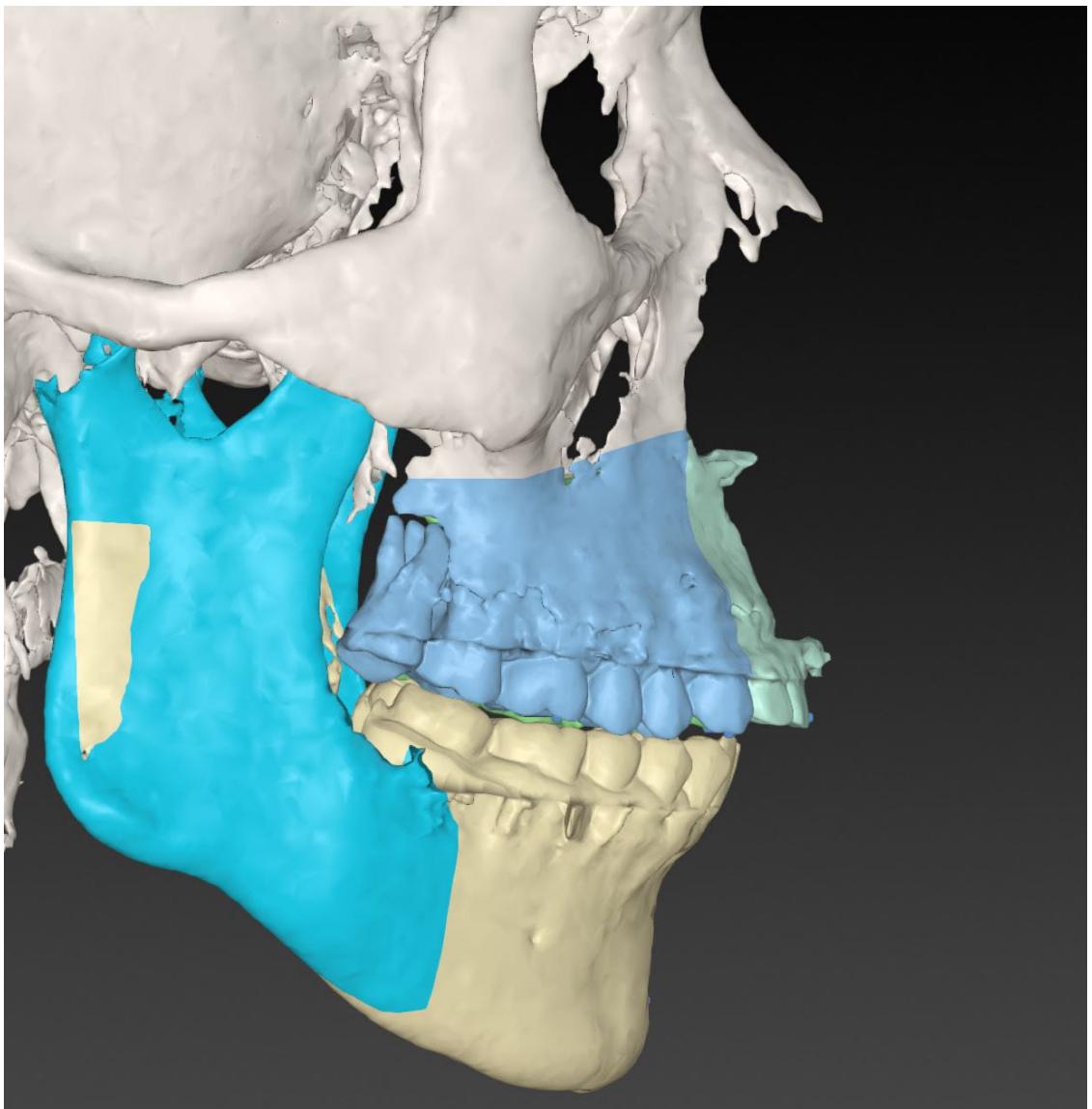
PRE-OP POSITION



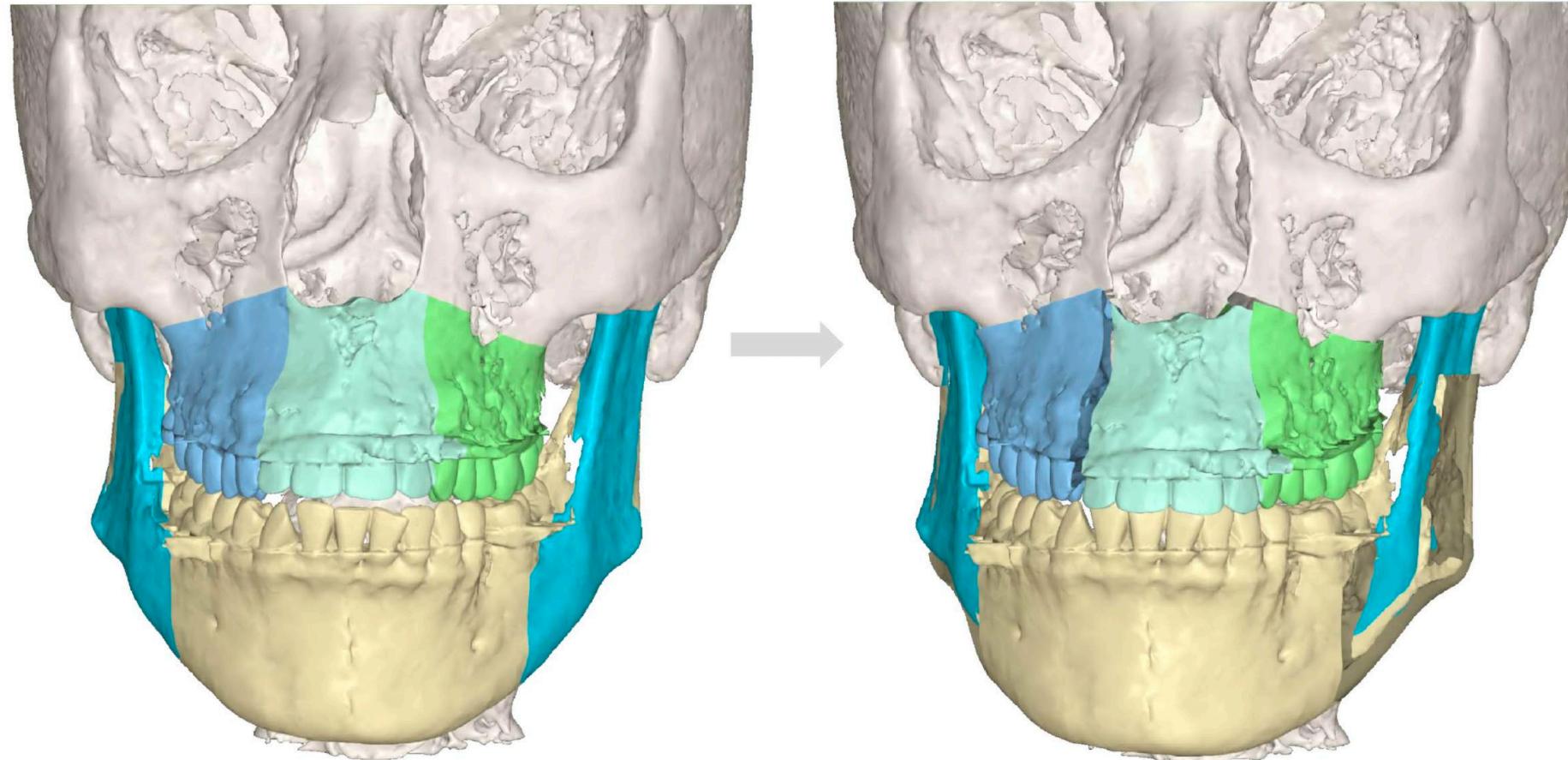
FINAL POSITION

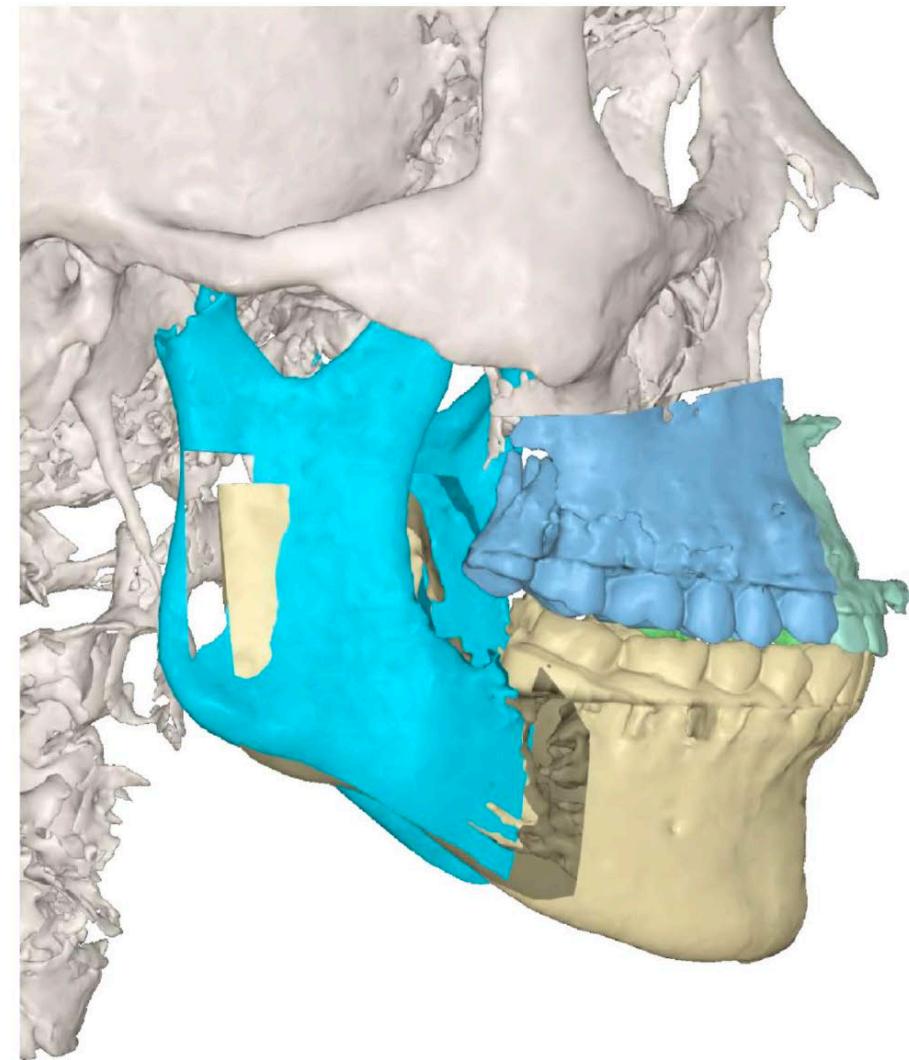
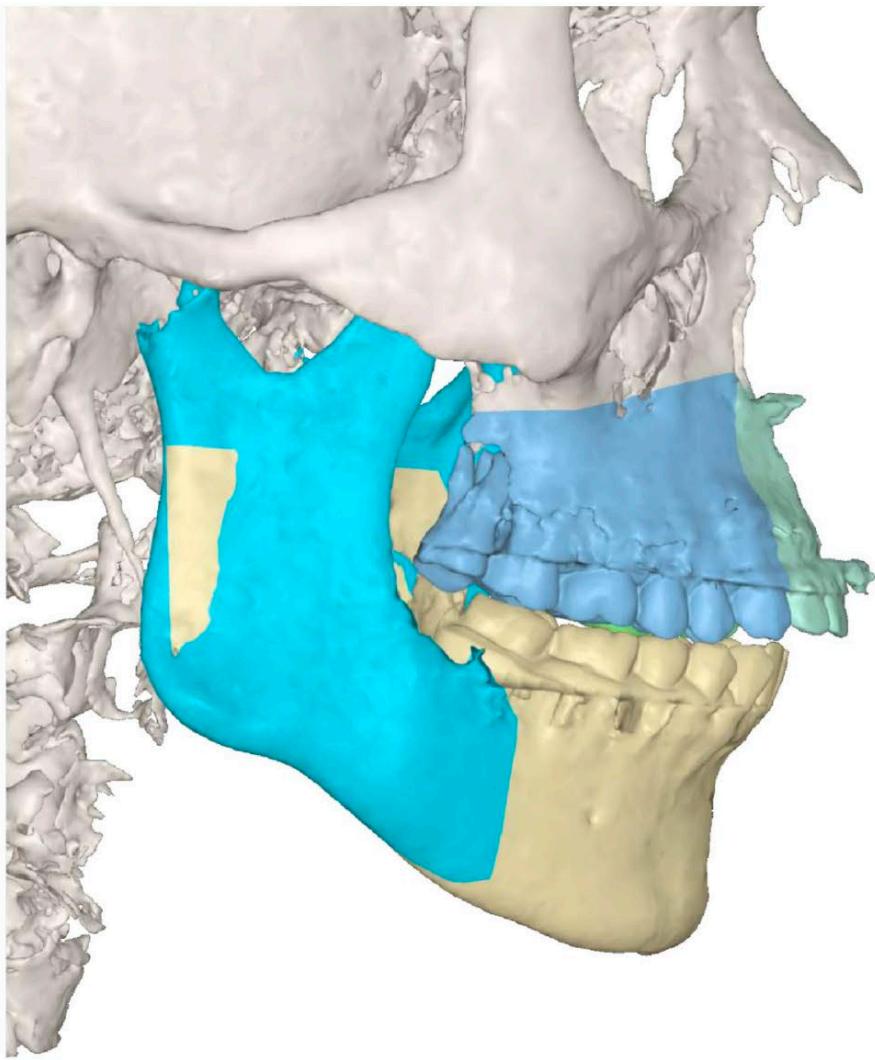


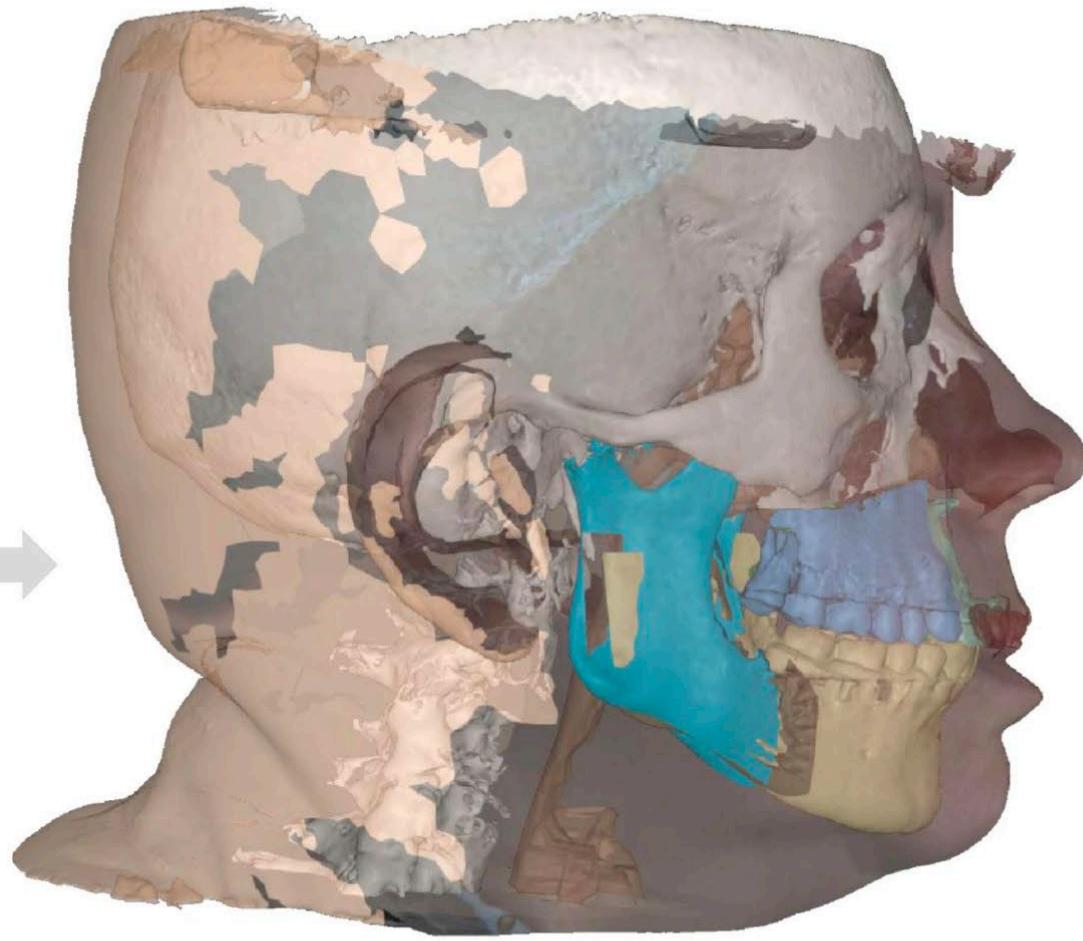
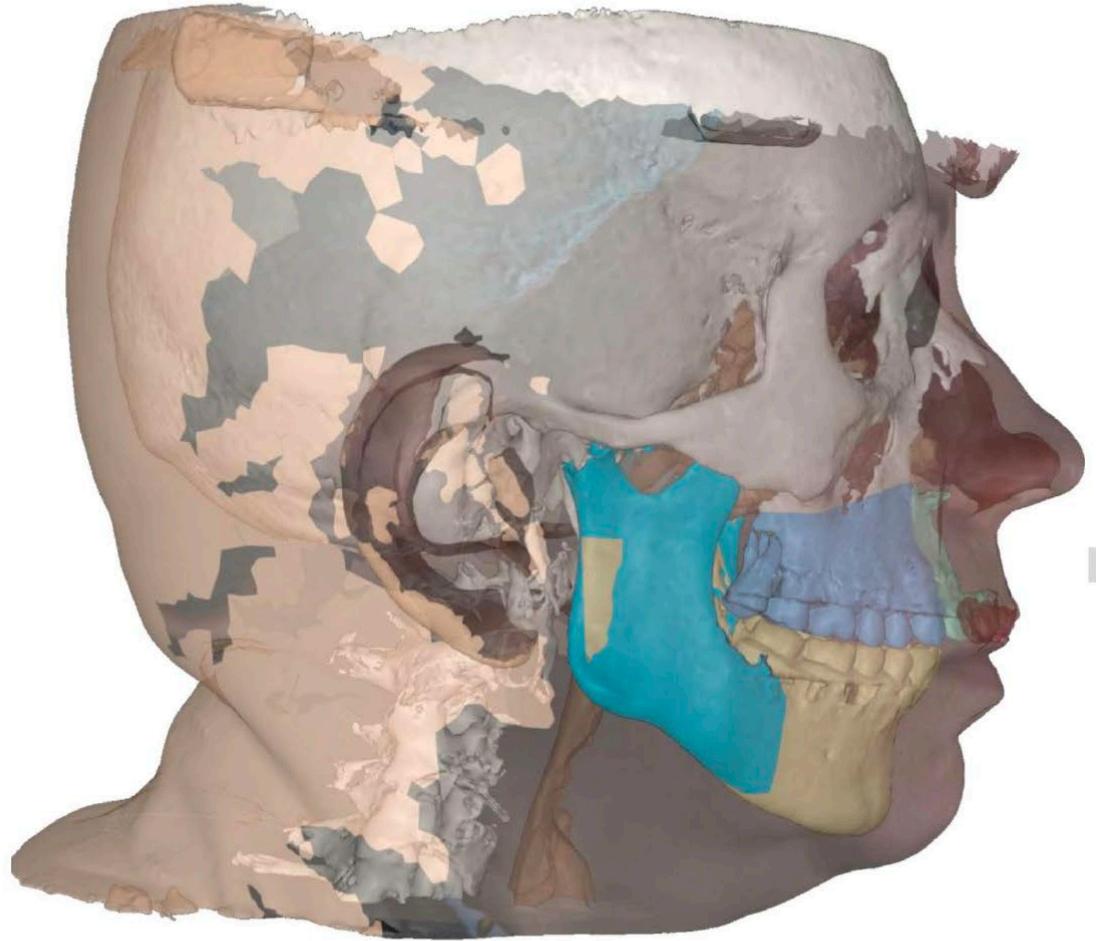
Planning: le Fort in 3 delen, 3mm advancement, front 2 mm caudal, posterieur 0 mm  
BSSO volgt

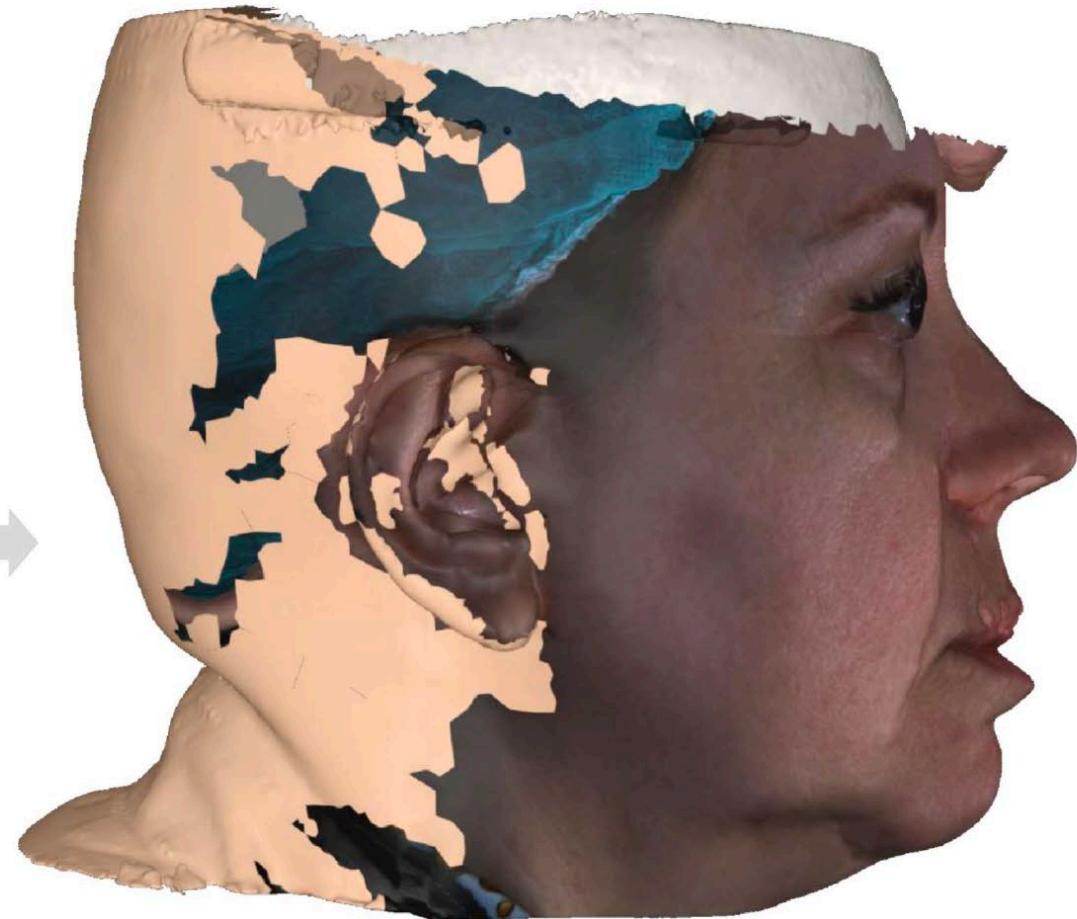
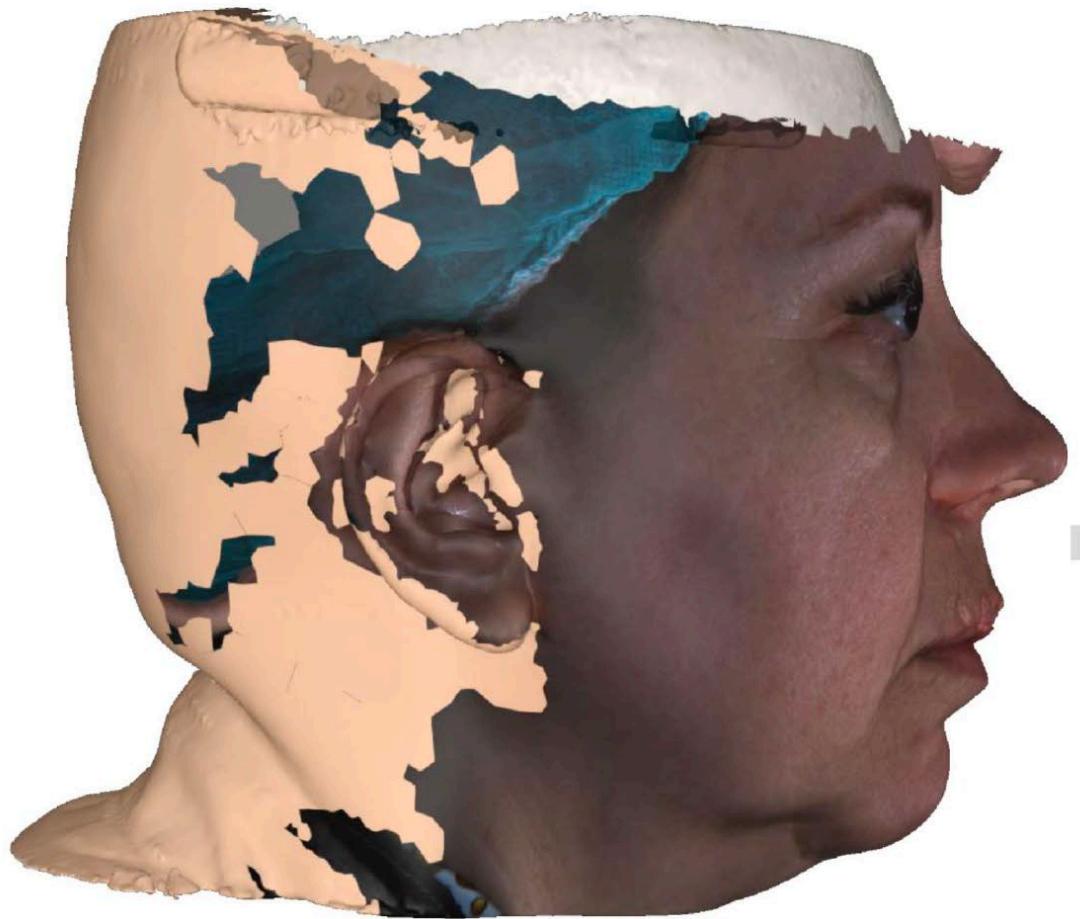


## PLANNING SUMMARY











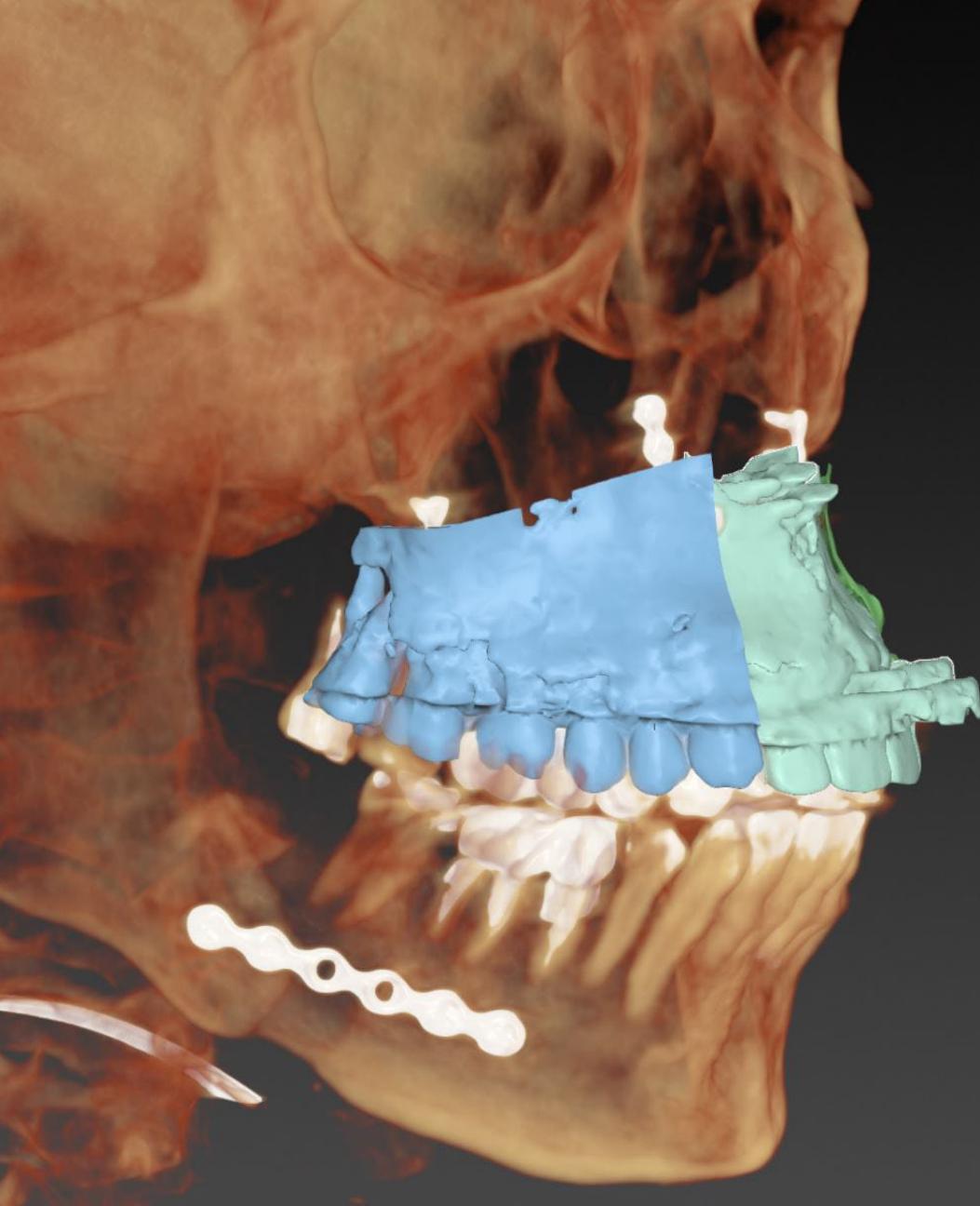
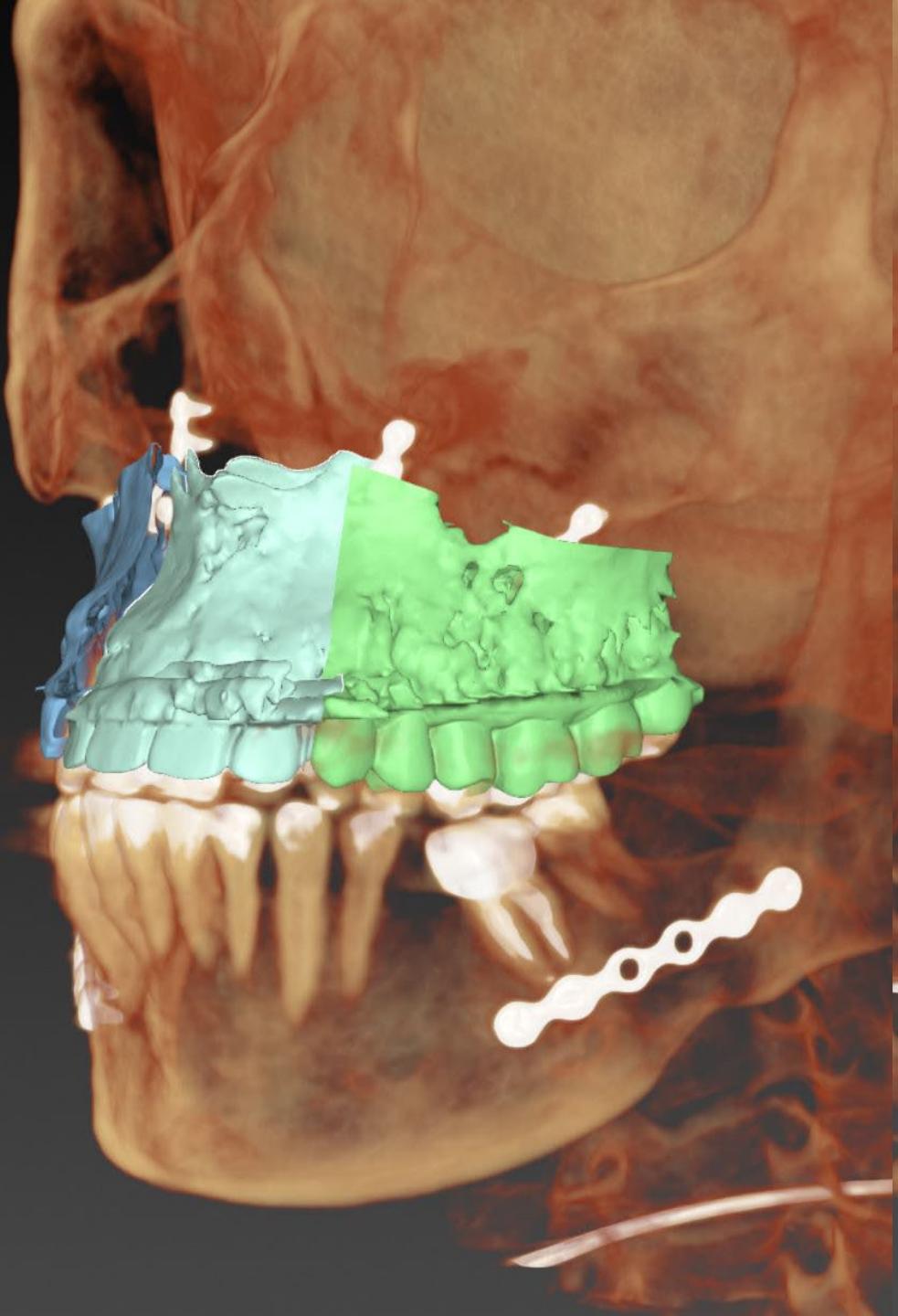


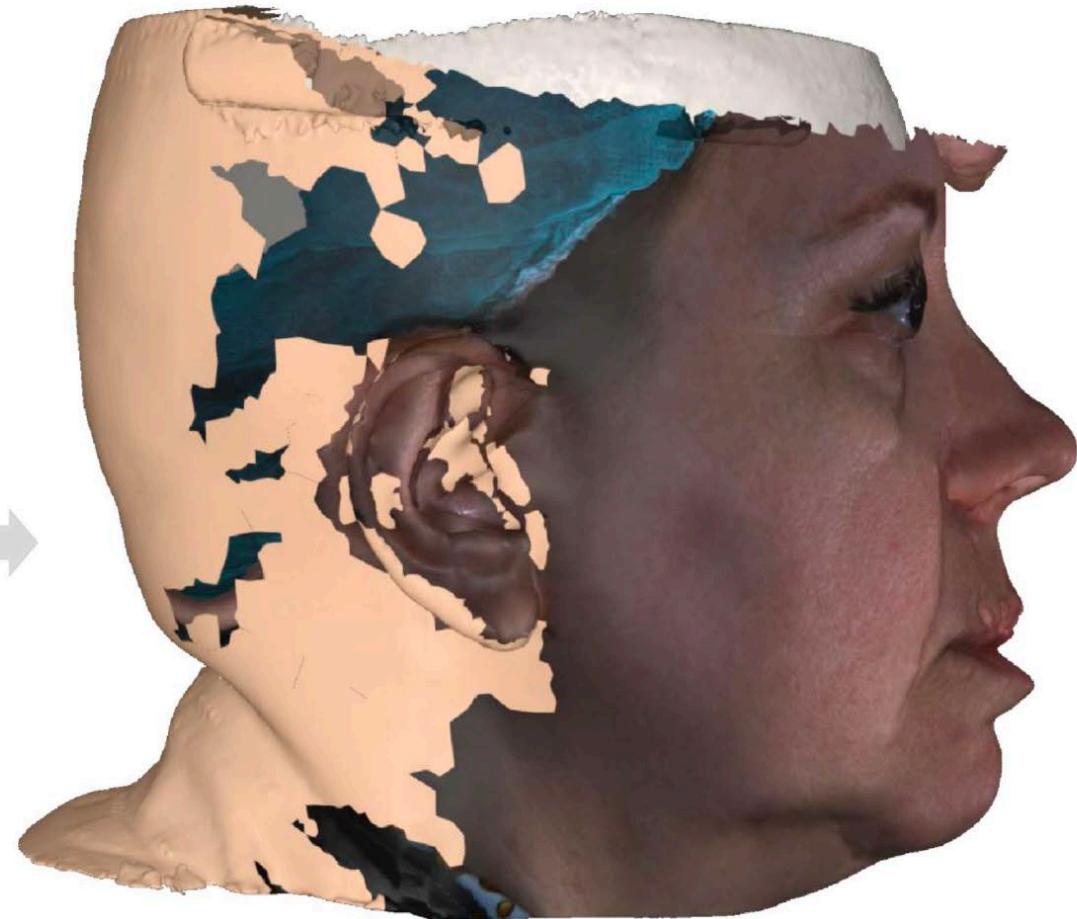
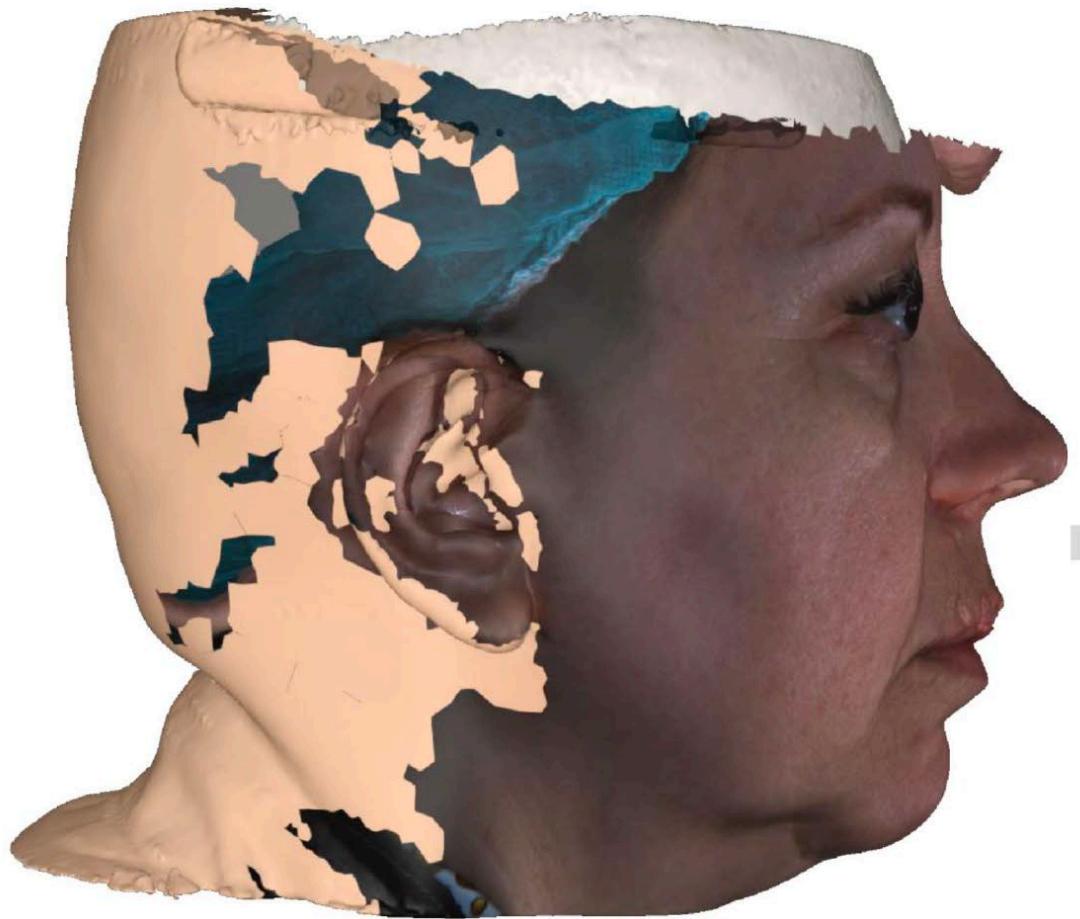
L















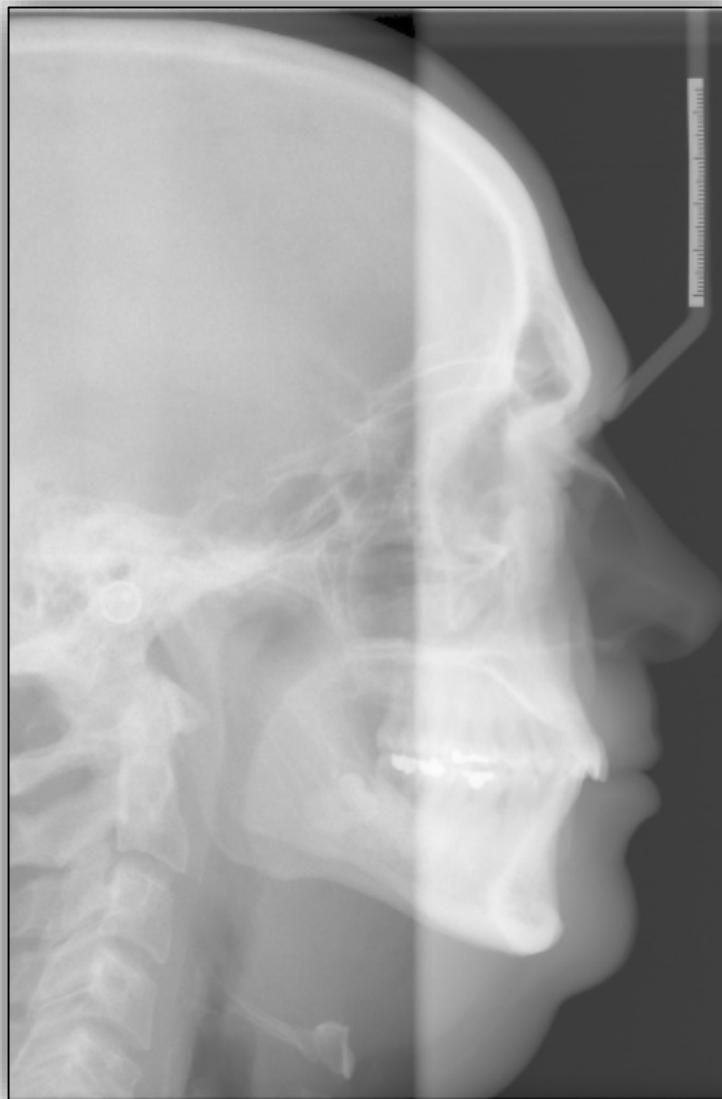
## Patient D

**Female**

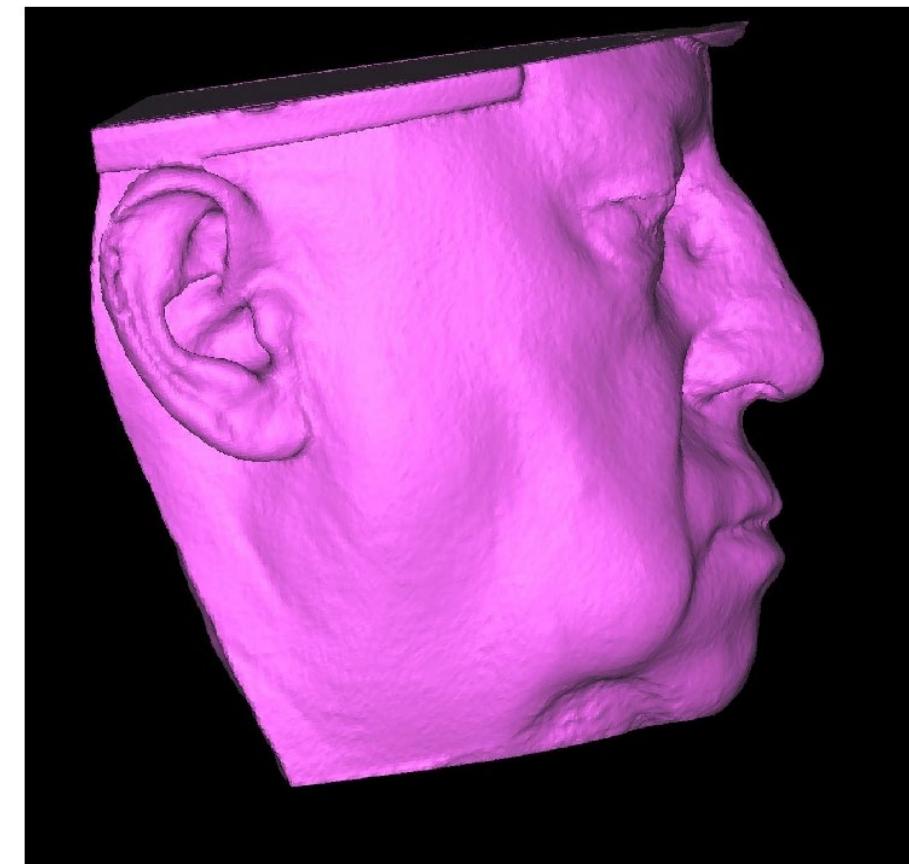
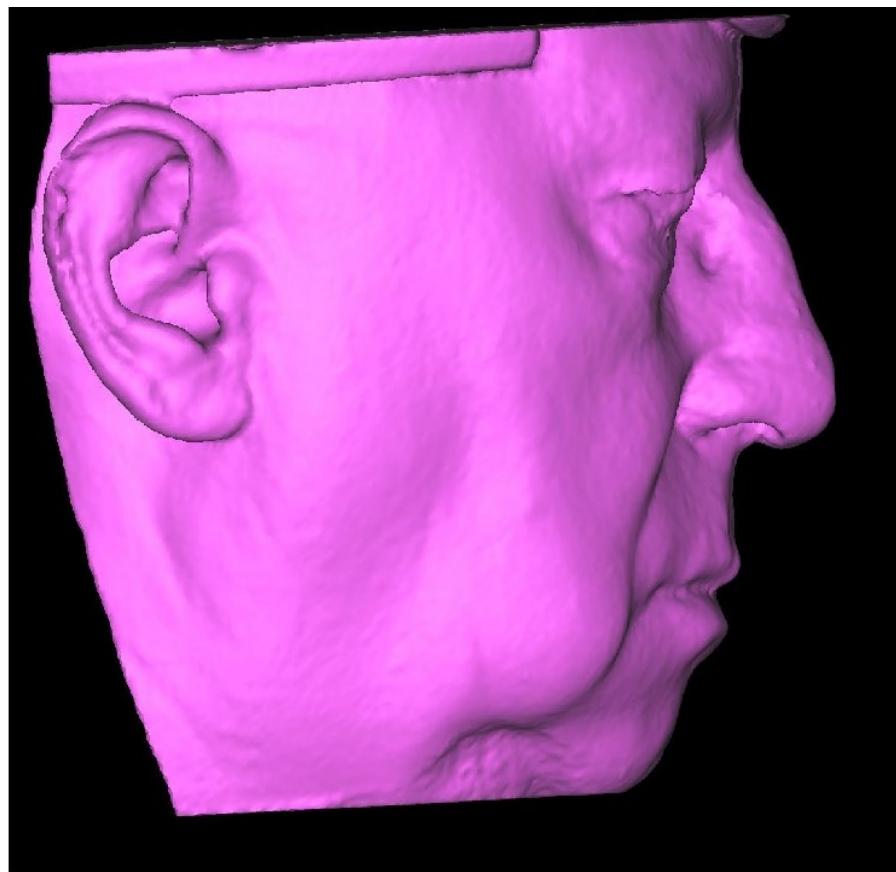
**48 yrs ; AHI 29,6  
85 kg**

**Nu AHI 4 (78 kg)  
Subjectief veel  
verbetering**

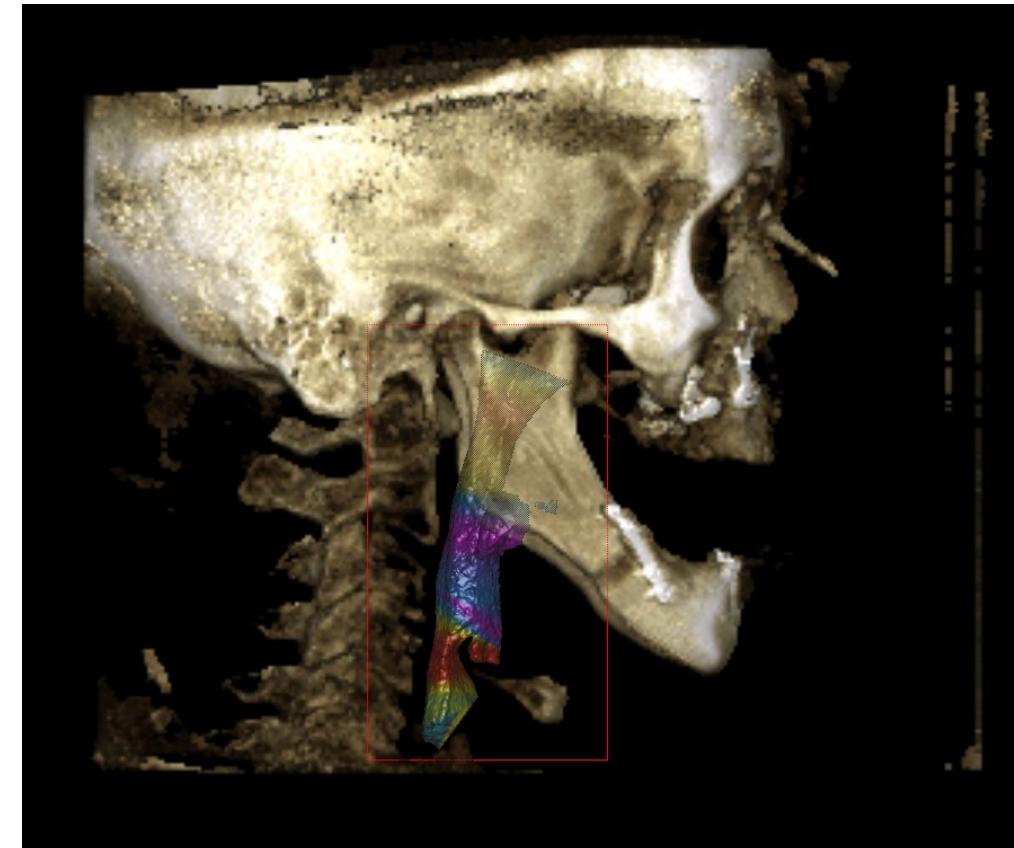
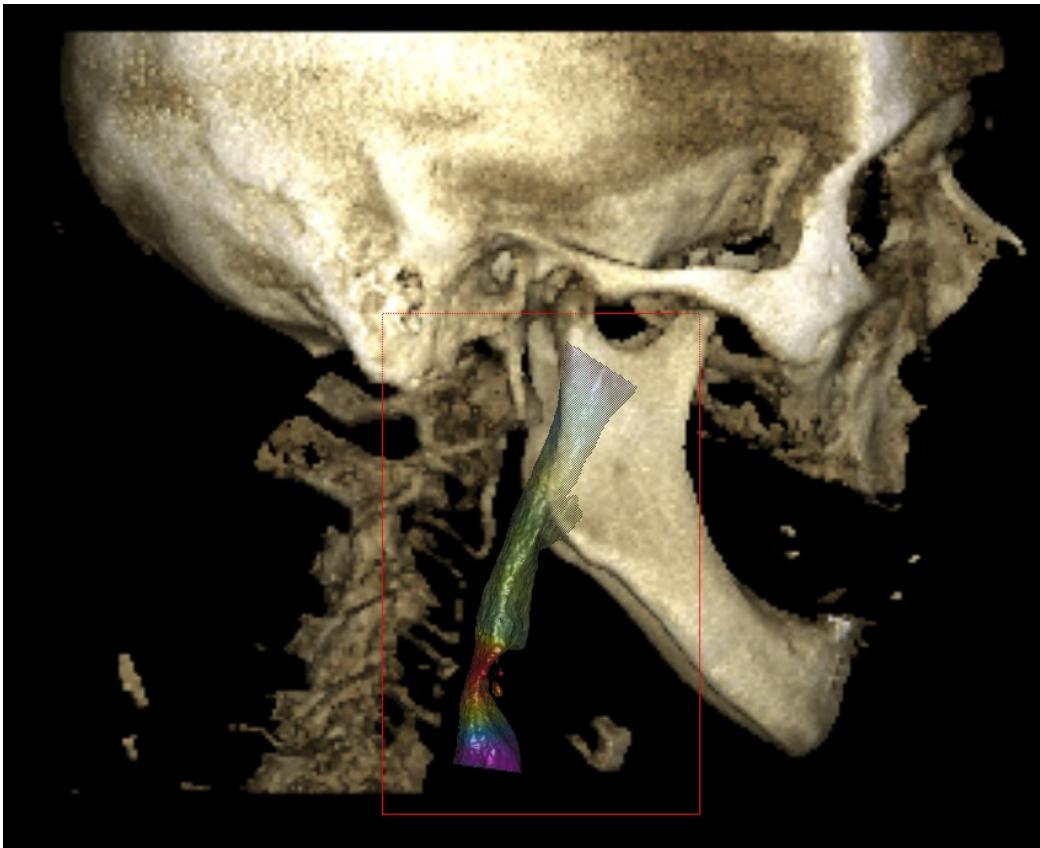
## Case 3

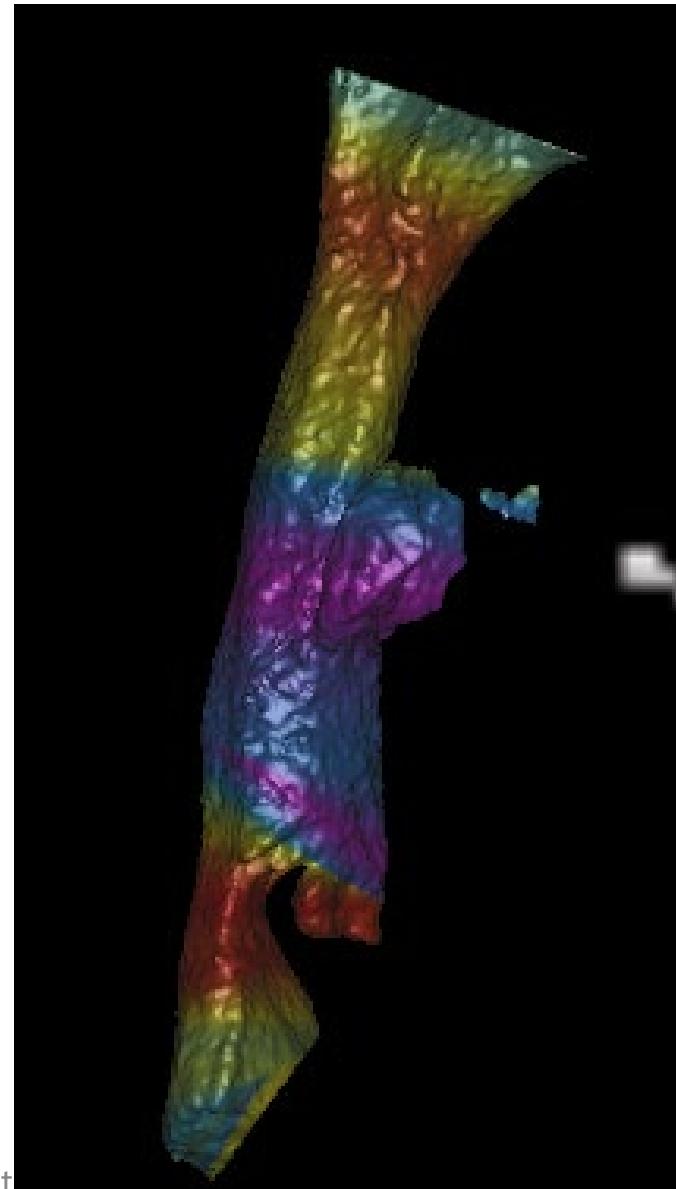
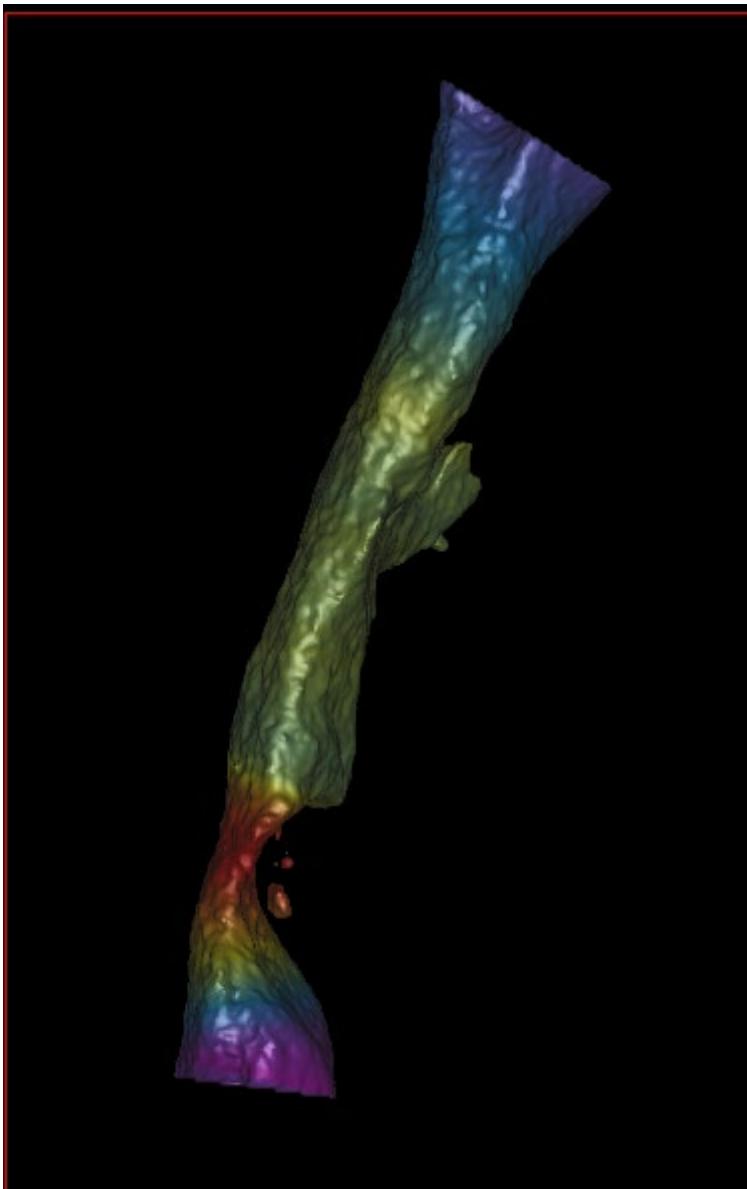






## Edentulous case





## Indicatie voor MMA

1. Matig-ernstige OSA (>15) ; hoe hoger, hoe beter ☺
2. CPAP intolerantie / falen
3. MRA intolerantie / falen
4. Leeftijd
5. Geringe mate van co-morbiditeit
6. Enige mate van retrognathie (terugliggende onderkaak)
7. Geen BMI restrictie
8. Bij voorkeur geen eerdere KNO-ingrepen
  
9. Mijn behandelplanning: "*maximaal naar voren, met behoud van esthetiek*"



## Patient R

**Male  
40 yrs ; AHI 3  
MAD worked but now  
no OSA anymore**

**Wish for correction**

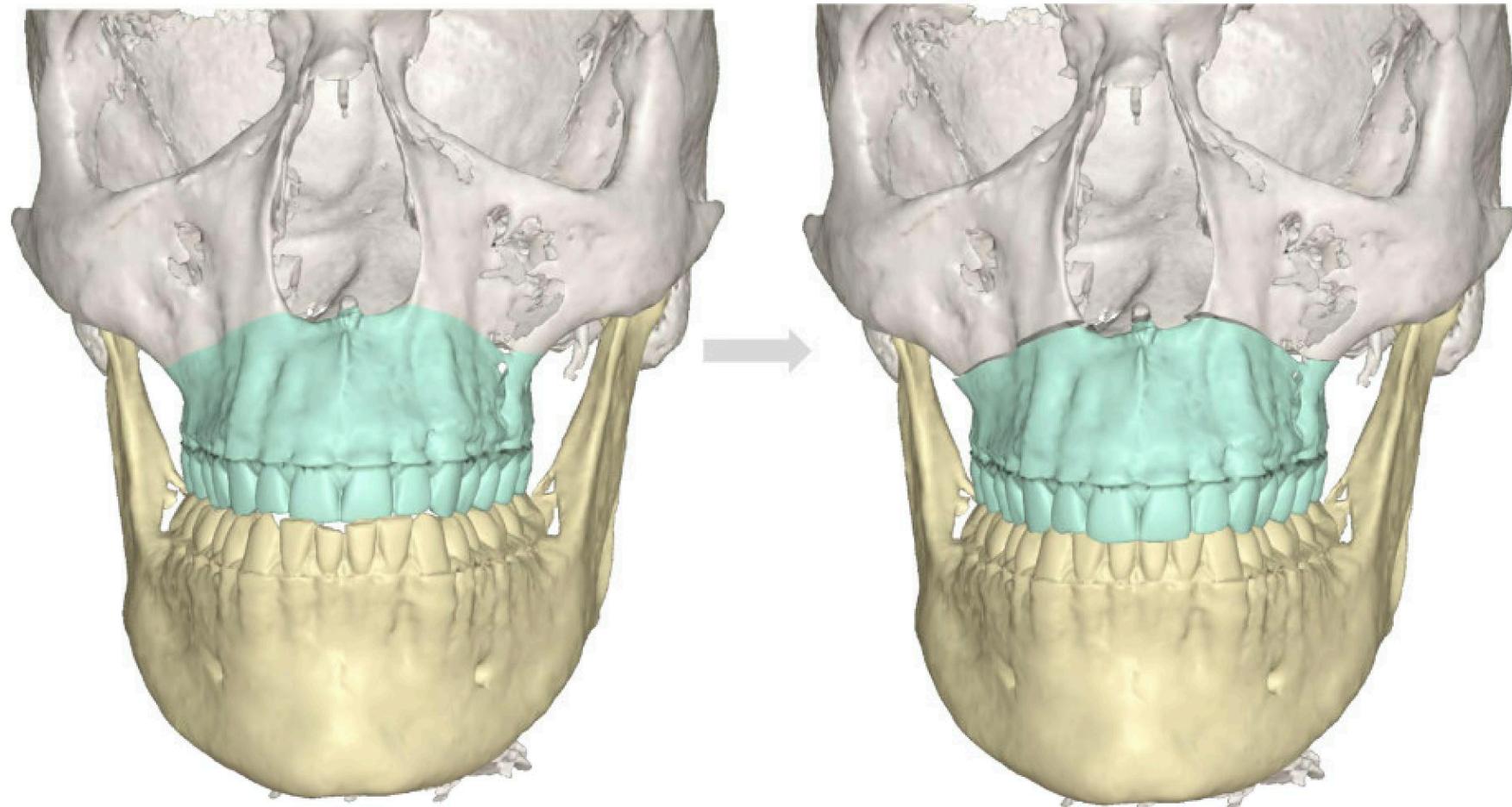
**PDF**

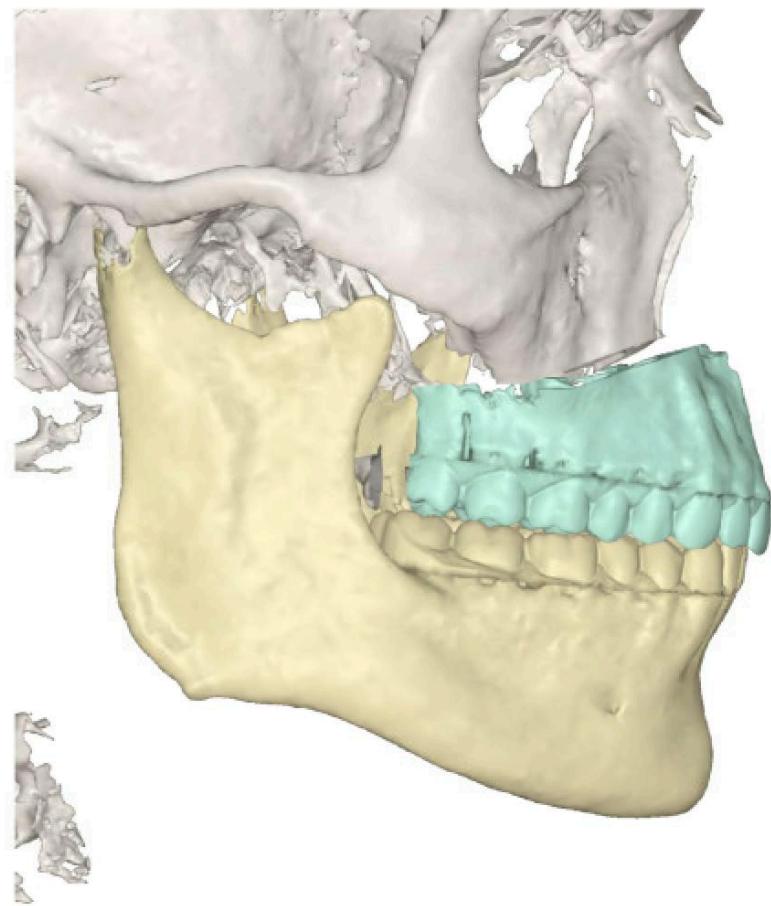
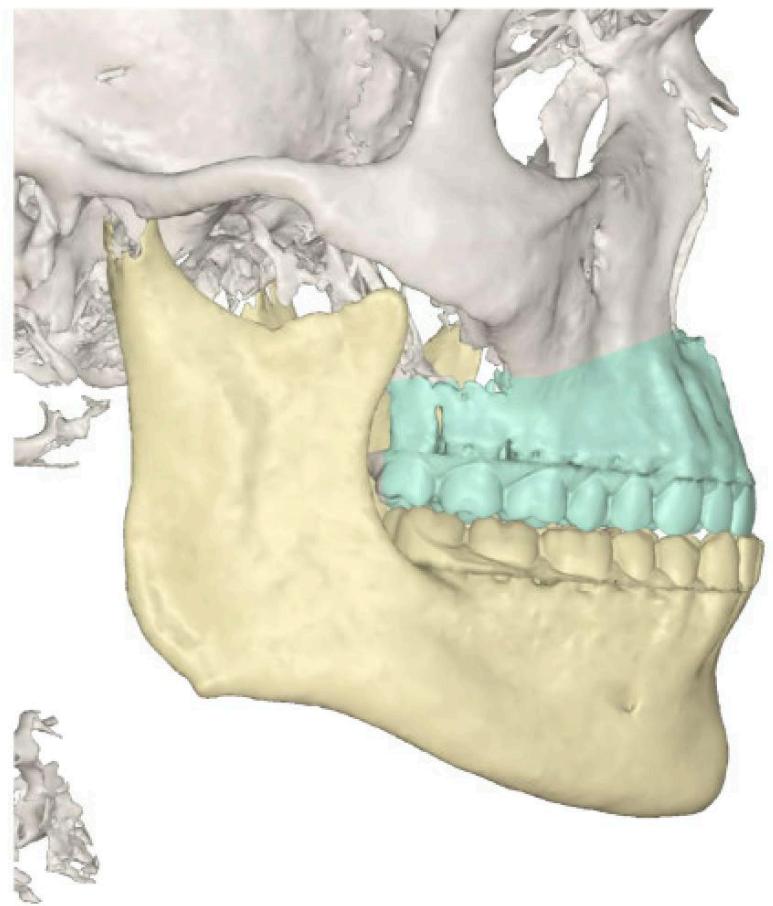
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<input type="checkbox"/> 28-12-2021	<input type="checkbox"/> 28-12-2021 - - Medische beelden	<input type="checkbox"/> 28-12-2021 - - Medische beelden	<input type="checkbox"/> 28-12-2021 - - Medische beelden
151729736: Rogier Rensink 29-3-2016 16:22:36	151729736: Rogier Rensink 29-3-2016 16:22:30	151729736: Rogier Rensink 9-7-2014 09:09:24	151729736: Rogier Rensink 9-7-2014 09:09:38
			
<input type="checkbox"/> 28-12-2021 - - Medische beelden	<input type="checkbox"/> 28-12-2021 - - Medische beelden	<input type="checkbox"/> 28-12-2021 - - Medische beelden	<input type="checkbox"/> 28-12-2021 - - Medische beelden

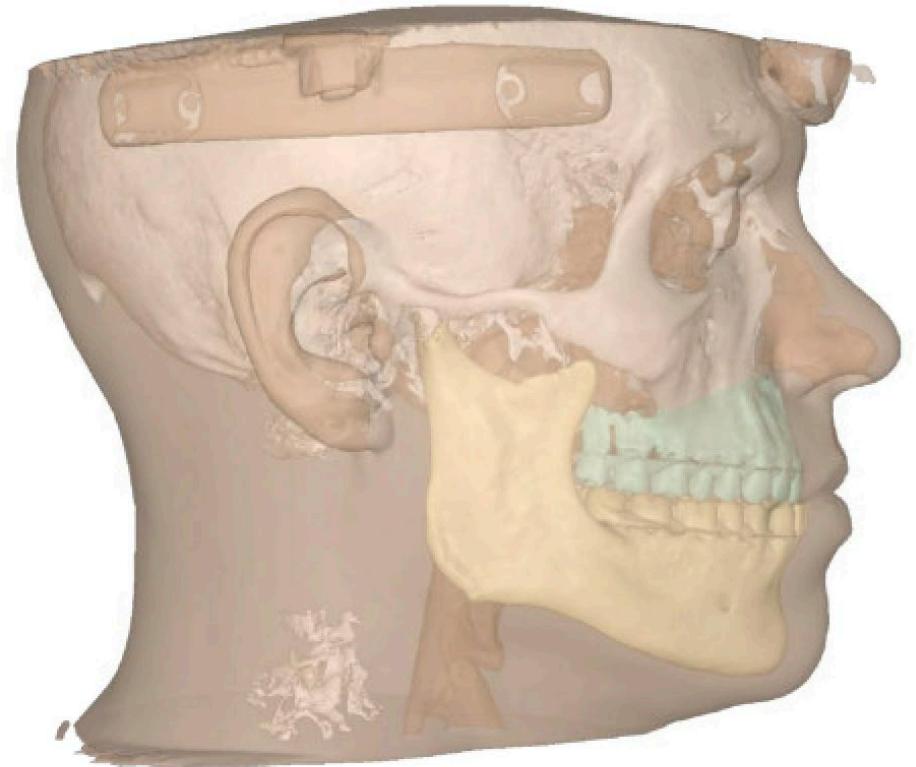


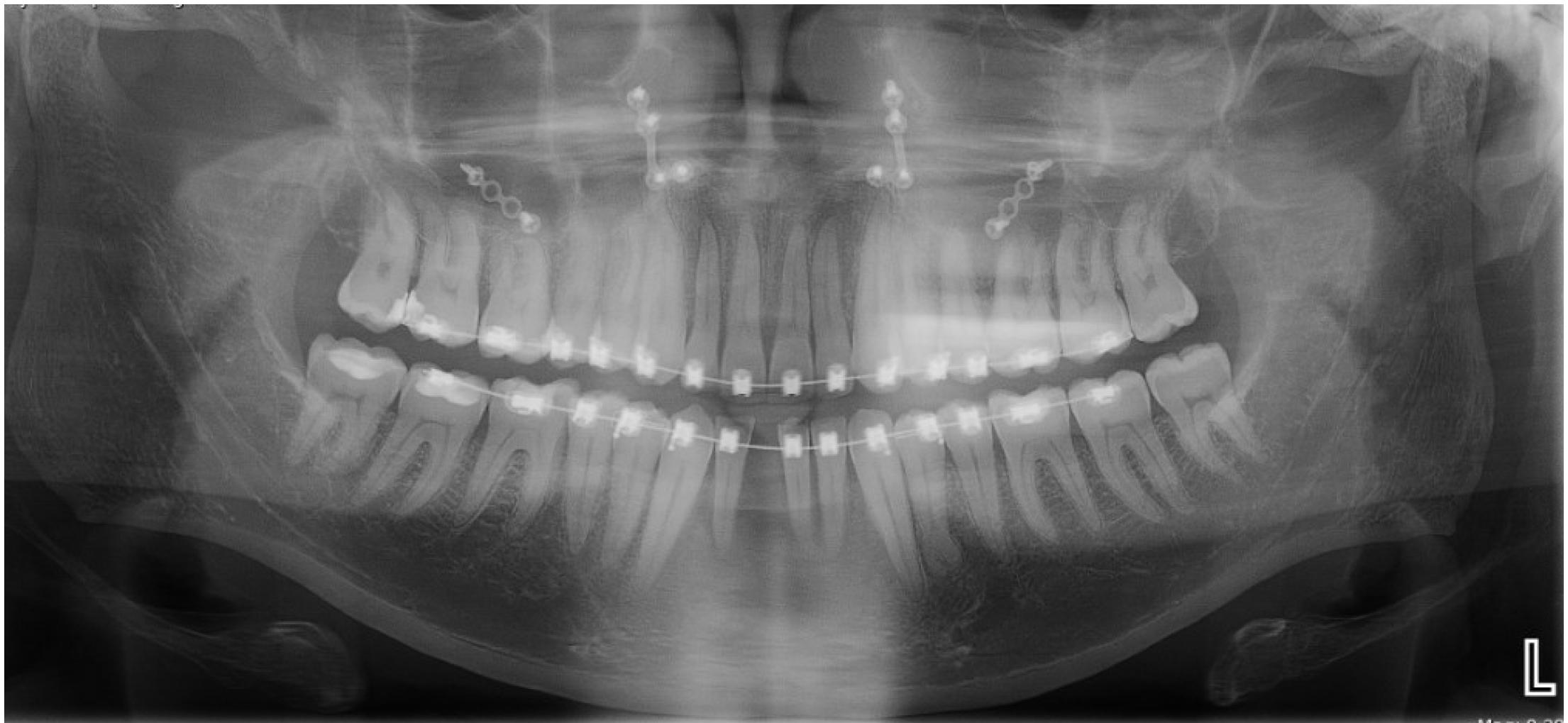
Date: 10/03/22  
Time: 15:56:48

## PLANNING SUMMARY









# Nieuwe ontwikkelingen

# **Associatie van mondgezondheid en OSA (en MRA)**

# **MOSA**

Systematisch literatuur onderzoek  
Start cohort 2025

# QOMAS

- 80 patiënten
- Observationeel cohort
- 6 vragenlijsten: SF-36, ESS, OQLQ, OHIP-14, FOSQ en EQ-5D-3L
- Prospectief
- Pre operatief tot 3 jaar follow up.



Haya Al-Bayyati  
Geneeskunde student - UvA





# RETRO-QOMAS

- circa 60 patiënten
- Observationeel cohort
- 6 vragenlijsten: SF-36, ESS, OQLQ, OHIP-14, FOSQ en EQ-5D-3L
- Retrospectief
- Alleen post-operatief

# Hartelijk dank voor uw aandacht!



**mdruiter@diakhuis.nl**

**osas@diakhuis.nl**