Literature search queries

Upper airway surgery

Primary:

(sleep apnea syndromes [Majr] or "sleep disordered breathing" or (sleep [Majr] or apnea [Majr])) and (uvulo* or palato* or pharyngo* or tracheo* or septo* or genio* or gloss* or naso* or epiglot* or tonsil* or maxillo* or mandibulo* or turbin* or lingual* or hyo* or *surg or *mandibular or maxillary or mandibular or nasal or turbinate or septum or "nasal valve" or polyp or ethmoid or sphenoid or alar or lingual or tongue or tonsil or palate or pharynx) and (surg* or orthognathic or ESP or multilevel or septoplasty or "turbinate reduction" or "nasal obstruction" or "nasal polypectomy" or sinus or rhinoplasty) Limits: English language, human subjects, adults

Secondary:

("obstructive sleep apnea") and ("hypoglossal nerve stimulation" or "airway stimulation" or "upper airway stimulation") Limits: English language, human subjects, adults

Bariatric Surgery

(sleep apnea syndromes[Majr] OR "sleep disordered breathing" OR sleep[Majr] OR apnea[Majr]) and ("bariatric surgery" OR "metabolic surgery" OR "stomach stapling" OR "gastric bypass" OR "sleeve gastrectomy" OR lagb OR lrygb OR "gastric banding" OR "vertical banded gastroplasty" OR "duodenal switch" OR "biliopancreatic diversion" OR "weight loss surgery" OR LSG OR "obesity surgery" OR Roux*) Limits: English language, human subjects, adults

Inclusion/exclusion criteria

Inclusion criteria

Publication date (i.e., 1970 – present), appropriate control (no surgery or best medical care), outcome data present, surgical procedures including palatal modifications, base of tongue reduction, skeletal modifications, tracheostomy, hypoglossal nerve stimulation (HNS), nasal surgeries, relevant outcomes reported, RCTs with \geq 30 participants, and observational studies with \geq 10 participants, patients >18 years of age, study length \geq 3 months after surgery (except for HNS) but data reported within 1 year for PICOs 1, 3, 4 and data present in a format suitable for meta-analysis

Exclusion criteria

Publication type (i.e., book and book chapters, conference abstracts, dissertations, editorials, letters to the editor, method papers, and guidelines), animal studies, participants <18 years of age, sample size <10 participants, not related to sleep apnea or sleep disordered breathing, study does not address any PICO question, laser-assisted uvulopalatopharyngoplasty procedure.

Box 1. Abbreviations
AHI – apnea-hypopnea index
BMI – body mass index
BP – blood pressure
CPAP – continuous positive airway pressure
DBP – diastolic blood pressure
ESS – Epworth Sleepiness Scale
FOSQ – Functional Outcomes of Sleep Questionnaire
ODI – oxygen desaturation index
PAP -positive airway pressure
PICO – patient, intervention, comparator, outcome
PSQI – Pittsburgh Sleep Quality Index
QOL – quality of life
RDI – respiratory disturbance index
SBP – systolic blood pressure
OR – operating room
LSAT – lowest oxygen saturation
SAQLI – sleep apnea quality of life index
SBP – systolic blood pressure
SF-36 PCS – Short Form 36 Physical Component Score
SF-36 MCS – Short Form 36 Mental Component Score
SF-36 VS – Short Form 36 Vitality Score

Surgical treatment of OSA in adults who were intolerant or unaccepting of PAP or other conservative treatment prior to surgery (PICO 1)

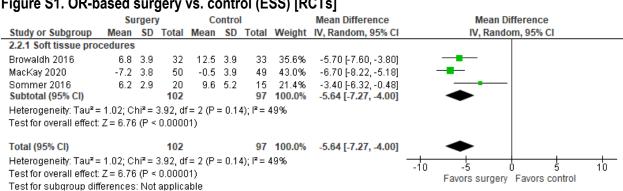


Figure S1. OR-based surgery vs. control (ESS) [RCTs]

Figure S2. OR-based surgery pretreatment vs. posttreatment (ESS)

Study or Subgroup	Posttr Mean	eatme	ent Total		eatme SD		Weight	Mean Difference IV, Random, 95% Cl	Mean Difference IV, Random, 95% Cl
1.2.1 Soft tissue procedu		30	rotai	medii	30	rotar	weight	w, Ranuom, 95% Ci	
		4.5	24	42.2	4.0	24	0.70	6 20 1 0 47 2 0 21	
Adzreil 2017	7.1	4.5	31	13.3	4.6	31	0.7%	-6.20 [-8.47, -3.93]	
Aneeza 2011 Aokor 2018 (CO)	7	4	14	12	6	14	0.5%	-5.00 [-8.78, -1.22]	
Askar 2018 (CO) Askar 2018 (CD)	4.6	1.9	22	12.3	3.7	22	0.7%	-7.70 [-9.44, -5.96]	
Askar 2018 (SB) Aurocci 2010	3.4	1	26	14.5	2.4	26		-11.10 [-12.10, -10.10]	
Aynaci 2018	8.8	1.4	40	20	2	40		-11.20 [-11.96, -10.44]	
Azbay 2016	13	4.7	67	18	4.4	67	0.7%	-5.00 [-6.54, -3.46]	
Babademez 2019 (CO)	3.9	1.8	70	9.9	2	70	0.8%	-6.00 [-6.63, -5.37]	-
Babademez 2019 (JLO)	2.2	1.6	34	7.4	4.4	34	0.7%	-5.20 [-6.77, -3.63]	
Baisch 2006	6.4	4.2	83	9.7	5.3	83	0.8%	-3.30 [-4.75, -1.85]	
Baradaranfar 2015	7.1	1.1	48	12.6	2.2	48	0.8%	-5.50 [-6.20, -4.80]	-
Barbieri 2019	0.4	0.8	42	7.6	6.2	42	0.7%	-7.20 [-9.09, -5.31]	
Barrera 2016	7.6	3.4	18	13.2	4.5	18	0.6%	-5.60 [-8.21, -2.99]	
Benazzo 2008	7	1.5	109	10	3	109	0.8%	-3.00 [-3.63, -2.37]	-
Bican 2010	11.1	2.8	20	17.1	2.7	20	0.7%	-6.00 [-7.70, -4.30]	
Binar 2017 (EAO)	5.2	4	23	11.8	5.6	23	0.6%	-6.60 [-9.41, -3.79]	
Binar 2017 (JLO)	5	3.8	29	10.9	5.7	29	0.7%	-5.90 [-8.39, -3.41]	
Bowden 2005	10.9	6.2	29	13.8	8.2	29	0.5%	-2.90 [-6.64, 0.84]	
Browaldh 2018	6.5	4.2	60	13	3.2	65	0.8%	-6.50 [-7.82, -5.18]	
Cammaroto 2017	5.8	4.3	30	11.9	3.7	30	0.7%	-6.10 [-8.13, -4.07]	——
Cho 2014	6	1.6	23	11.8	3.1	23	0.8%	-5.80 [-7.23, -4.37]	
Choi 2011 (AJRA)	6.3	3.3	22	8.8	3.3	22	0.7%	-2.50 [-4.45, -0.55]	
Choi 2011 (AOHNS)	6.3	3.5	41	10.3	4.3	41	0.7%	-4.00 [-5.70, -2.30]	
Choi 2013	7.3	2.9	20	11.6	4.7	20	0.7%	-4.30 [-6.72, -1.88]	——
Cillo 2013	6.3	3.9	13	15.2	3	13	0.6%	-8.90 [-11.57, -6.23]	<u> </u>
den Herder 2005	3.4	4.3	29	7.6	6.2	31	0.6%	-4.20 [-6.89, -1.51]	
El-Ahl 2016	5.1	2.2	24	11.7	2.9	24	0.8%	-6.60 [-8.06, -5.14]	
El-Anwar 2018	4.6	2.2	40	13.2	5.5	40	0.7%	-8.60 [-10.44, -6.76]	
El-Anwar 2019	4.8	2.4	40	13	3.3	40	0.8%	-8.20 [-9.46, -6.94]	
Emara 2011	8.3	3.9	23	14.2	2.3	23	0.7%	-5.90 [-7.75, -4.05]	
Emara 2016	8.1	2.8	38	16.3	2.1	38	0.8%	-8.20 [-9.31, -7.09]	-
Eun 2008	7.5	4.5	66	11.4	5	66	0.7%	-3.90 [-5.52, -2.28]	
Eun 2009	8.2	4.9	90	11.8	5.1	90	0.8%	-3.60 [-5.06, -2.14]	
Fibbi 2009	4.1	2.5	12	5.9	3.6	12	0.7%	-1.80 [-4.28, 0.68]	
Fiorita 2018	4.2	4.6	30	6	2.8	30	0.7%	-1.80 [-3.73, 0.13]	
Friedman 2007	7.3	1.6	31	14.3	2.2	31	0.8%	-7.00 [-7.96, -6.04]	
Gunawardena 2013	5.8	5.2	27	8.3	5.7	27	0.6%	-2.50 [-5.41, 0.41]	
Ha 2020	7.6	4.6	95	8.7	5	95	0.8%		
	7.7				5.5	508		-1.10 [-2.47, 0.27]	-
Heiser 2019 Hebeen 2012		4.9 1.2	508	11.8 7			0.8%	-4.10 [-4.74, -3.46]	
Hobson 2012	4		31		1.8	31	0.8%	-3.00 [-3.76, -2.24]	
Holmlund 2016	6	4	28	11	6.7	28	0.6%	-5.00 [-7.89, -2.11]	
Huang 2008	5.2	2.2	50	9.8	3.7	50	0.8%	-4.60 [-5.79, -3.41]	
Huang 2016	8	3.7	40	8	5	40	0.7%	0.00 [-1.93, 1.93]	
Jacobowitz 2006	6.7	3.7	37	12.1	4.9	37	0.7%	-5.40 [-7.38, -3.42]	
Kayhan 2016	3.4	1.6	25	13.5	2.8	25	0.8%	-10.10 [-11.36, -8.84]	
Kim 2013	6.6	3.7	92	11.1	5.1	92	0.8%	-4.50 [-5.79, -3.21]	
Komada 2012	7.7	4.2	24	13	4.7	24	0.7%	-5.30 [-7.82, -2.78]	
Lee 2009 (OHNS)	6.9	4.7	69	9.4	4.8	69	0.7%	-2.50 [-4.09, -0.91]	
Lee 2011 (OHNS)	6.5	3	30	10.8	4.2	30	0.7%	-4.30 [-6.15, -2.45]	
Lee 2012	5.9	4.7	13	13.4	6.1	13	0.5%	-7.50 [-11.69, -3.31]	
_ee 2018	8.4	3.9	10	12.9	8.8	10	0.3%	-4.50 [-10.47, 1.47]	
_i 2004	7.5	4.3	55	11.8	4.6	55	0.7%	-4.30 [-5.96, -2.64]	
Li 2008	8	4.7	51	10	4.2	51	0.7%	-2.00 [-3.73, -0.27]	
Li 2009 (AJRA)	7.6	4.5	44	10.6	3.9	44	0.7%	-3.00 [-4.76, -1.24]	
Li 2013 (AOL)	3.1	2.4	67	12.4	5.2	67	0.8%	-9.30 [-10.67, -7.93]	
Li 2013 (EAO)	5	3	78	12.8	4.7	78	0.8%	-7.80 [-9.04, -6.56]	
Li 2013 (OHNS)	7.5	3.6	47	12.2	4.4	47	0.7%	-4.70 [-6.33, -3.07]	
Li 2015	7	3.1	32	12	4.3	32	0.7%	-5.00 [-6.84, -3.16]	
_i 2016	7.5	4.3	25	9.6	4.9	25	0.6%	-2.10 [-4.66, 0.46]	— —
_i 2018	4.9	3.1	25	10.2	4.7	25	0.7%	-5.30 [-7.51, -3.09]	
Lin 2006	7.3	4.3	55	11.1	3.7	55	0.8%	-3.80 [-5.30, -2.30]	
Lin 2010	10	4.3	43	12.8	5.1	43	0.7%	-2.80 [-4.79, -0.81]	
Lin 2013	6.4	4.5	12	13.7	5.2	12	0.5%	-7.30 [-11.19, -3.41]	
Lin 2014	8.7	4.3	35	11	4.2	35	0.7%	-2.30 [-4.29, -0.31]	
Lin 2015	5.7	4.3	39	15.6	5.4	39	0.7%	-9.90 [-12.07, -7.73]	
Lin 2017	9.2	4.5 3.1	47	11.6	4.3	47	0.8%	-2.40 [-3.92, -0.88]	
Liu 2013	9.2	4.2	47 51		4.3 6.1	47 51	0.8%	-7.30 [-9.33, -5.27]	
				12.8					
Lundkvist 2009	6.7	5.2	107	11.3	5.7 6.4	107	0.8%	-4.60 [-6.06, -3.14]	
MacKay 2013 (JCSM) MacKay 2013 (JLO)	5.9 5.3	4.9 1.7	48 16	9.8 11.3	6.1 4.8	48 16	0.7% 0.7%	-3.90 [-6.11, -1.69] -6.00 [-8.50, -3.50]	

Montevecchi 2018	6.1	3.6	111	10.2	4.5	111	0.8%	-4.10 [-5.17, -3.03]	
Mora 2012	4.7	2.2	21	14	3.7	21	0.7%	-9.30 [-11.14, -7.46]	
Moxness 2014	8.9	3.8	59	10.7	3.7	59	0.8%	-1.80 [-3.15, -0.45]	
Mure 2019	8.1	4.9	11	13	3.4	11	0.5%		
								-4.90 [-8.42, -1.38]	
Nakata 2006 Neruntarat 2003	4.8	3.7	30	12.1	4.3	30	0.7%	-7.30 [-9.33, -5.27]	
	8.2	1.7	31	14.9	2.3	31	0.8%	-6.70 [-7.71, -5.69]	
Neruntarat 2011	6.4	2.7	83	16.4	2.8	83	0.8%	-10.00 [-10.84, -9.16]	
Omur 2005	5.4	4.3	22	13.9	2.2	22	0.7%	-8.50 [-10.52, -6.48]	
Pang 2016	2.9	2.1	73	11.5	2.2	73	0.8%	-8.60 [-9.30, -7.90]	-
Pang 2017	4.9	1.4	112	11.5	4.1	112	0.8%	-6.60 [-7.40, -5.80]	
Park 2018	7.9	4.4	29	10.1	4.9	29	0.7%	-2.20 [-4.60, 0.20]	
Peng 2016	5	5	52	11.3	5.4	52	0.7%	-6.30 [-8.30, -4.30]	
Peng 2019	6.8	3.4	48	11.3	5	48	0.7%	-4.50 [-6.21, -2.79]	
Plaza 2019	4.6	6.6	75	11.5	4.7	75	0.7%	-6.90 [-8.73, -5.07]	
Rotenberg 2014	4.1	2.5	126	14.3	3.5	126	0.8%	-10.20 [-10.95, -9.45]	
Roustan 2018	3.1	2.5	20	16.5	4.3	20	0.7%	-13.40 [-15.58, -11.22]	
Salapatas 2016	6.8	2.9	582	12.1	4.8	582	0.8%	-5.30 [-5.76, -4.84]	-
Sezen 2011	6.6	3.1	20	13.9	2.5	20	0.7%	-7.30 [-9.05, -5.55]	
Shah 2018	7	3.4	16	11	4.9	16	0.6%	-4.00 [-6.92, -1.08]	
Shin 2013	9.1	4.1	30	12.3	4.9	30	0.7%	-3.20 [-5.49, -0.91]	
Shuaib 2015	7.1	7.1	26	11.1	7.8	26	0.5%	-4.00 [-8.05, 0.05]	
Sorrenti 2003	6.6	1.4	15	11.3	2	15	0.8%	-4.70 [-5.94, -3.46]	
Sun 2008	8.9	4.9	31	17.1	4.1	31	0.7%	-8.20 [-10.45, -5.95]	
Sundman 2021	6.5	3.7	60	13	3.7	65	0.8%	-6.50 [-7.80, -5.20]	
Toh 2014	5.6	4.4	20	13	2.8	20	0.7%	-7.40 [-9.69, -5.11]	
Turhan 2020	4.1	2.7	64	10.5	5.2	64	0.8%	-6.40 [-7.84, -4.96]	
Verse 2002	7.7	5	26	11.9	4.7	26	0.6%	-4.20 [-6.84, -1.56]	
Vicini 2010 (ORL)	6.9	2.8	10	12.4	3.5	10	0.6%	-5.50 [-8.28, -2.72]	
Vicini 2014 (ORL)	5.7	3.5	243	12.4	5.2	243	0.8%	-6.60 [-7.39, -5.81]	
Vicini 2014 (ORE)	4.3	2	243	12.5	4.9	243 10	0.6%	-7.30 [-10.58, -4.02]	
	4.3 7.9	5	20	11.0	4.9 5.8	20			
Vilaseca 2002 Wang 2012							0.6%	-4.10 [-7.46, -0.74]	
Wang 2013	5.5	3.6	36	12.2	5.8	36	0.7%	-6.70 [-8.93, -4.47]	
Weaver 2011	6.9	4.2	34	12.9	5.5	34	0.7%	-6.00 [-8.33, -3.67]	
Yaremchuk 2011	5.5	3.5	40	11.1	4.8	40	0.7%	-5.60 [-7.44, -3.76]	
Yi 2009	4.8	3.4	34	11.9	6.2	34	0.7%	-7.10 [-9.48, -4.72]	
Yi 2011	6.8	5.2	26	13.5	5.9	26	0.6%	-6.70 [-9.72, -3.68]	
Yin 2007	9.6	5.6	18	16.1	4.3	18	0.6%	-6.50 [-9.76, -3.24]	
Yuksel 2018	3.4	3.2	63	8.2	4.9	63	0.8%	-4.80 [-6.25, -3.35]	
Yuksel 2018 Subtotal (95% CI)			5620			5632	75.4%	-4.80 [-6.25, -3.35] - 5.63 [-6.13, -5.13]	•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84	; Chi² = ′	1353.0:	5620 2, df = 1			5632	75.4%		•
Yuksel 2018 Subtotal (95% CI)	; Chi² = ′	1353.0:	5620 2, df = 1			5632	75.4%		•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2	; Chi² = 1 2.20 (P -	1353.0:	5620 2, df = 1			5632	75.4%		•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal procedures	; Chi² = ′ 2.20 (P	1353.0: < 0.000	5620 2, df = 1 101)	106 (P =	0.000	5632 01); I ² =	75.4% = 92%	-5.63 [-6.13, -5.13]	•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal procedures Brevi 2011 (JOMS)	; Chi ² = 1 2.20 (P 1.4	1353.0: < 0.000 1.9	5620 2, df = 1 101) 33	I06 (P ∝ 15.5	0.000 6.5	5632 01); I ² = 33	75.4% = 92% 0.7%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79]	•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013	; Chi ^z = 1 2.20 (P 1.4 2.6	1353.0: < 0.000 1.9 2	5620 2, df = 1 101) 33 16	106 (P ∝ 15.5 12.9	0.000 6.5 1.7	5632 01); I ² = 33 16	75.4% = 92% 0.7% 0.8%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01]	•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1)	; Chi ² = 1 2.20 (P 1.4 2.6 5.4	1353.0: < 0.000 1.9 2 3.4	5620 2, df = 1 101) 33 16 50	106 (P = 15.5 12.9 14.7	6.5 1.7 7.1	5632 01); I ² = 33 16 50	75.4% = 92% 0.7% 0.8% 0.7%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12]	•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3)	; Chi ^z = 1 2.20 (P 1.4 2.6 5.4 5.4	1353.0: < 0.000 1.9 2 3.4 3.8	5620 2, df = 1 101) 33 16 50 39	106 (P ⊂ 15.5 12.9 14.7 13.7	6.5 1.7 7.1 4.3	5632 01); I ² = 33 16 50 39	75.4% 92% 0.7% 0.8% 0.7% 0.7%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50]	•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Liu 2012	; Chi≊ = 1 2.20 (P 1.4 2.6 5.4 5.4 2.9	1353.0: < 0.000 1.9 2 3.4 3.8 2	5620 2, df = 1 101) 33 16 50 39 11	106 (P = 15.5 12.9 14.7 13.7 20.5	6.5 1.7 7.1 4.3 3.7	5632 01); I ² = 33 16 50 39 11	75.4% = 92% 0.7% 0.8% 0.7% 0.7% 0.7%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11]	•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Liu 2012 Liu 2015	; Chi ² = 1 2.20 (P 1.4 2.6 5.4 5.4 2.9 7.1	1353.03 < 0.000 1.9 2 3.4 3.8 2 2.6	5620 2, df = 1 101) 33 16 50 39 11 16	106 (P = 15.5 12.9 14.7 13.7 20.5 19.5	6.5 1.7 7.1 4.3 3.7 2.9	5632 01); I ² = 33 16 50 39 11 16	75.4% 92% 0.7% 0.8% 0.7% 0.7% 0.7% 0.7%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11] -12.40 [-14.31, -10.49]	•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Liu 2015 Liu 2015 Liu 2016	; Chi ^z = 1 2.20 (P 1.4 2.6 5.4 5.4 2.9 7.1 5.7	1353.03 < 0.000 1.9 2 3.4 3.8 2 2.6 2.7	5620 2, df = 1 101) 33 16 50 39 11 16 20	106 (P = 15.5 12.9 14.7 13.7 20.5 19.5 17	6.5 1.7 7.1 4.3 3.7 2.9 4.8	5632 01); I ² = 33 16 50 39 11 16 20	75.4% = 92% 0.7% 0.8% 0.7% 0.7% 0.7% 0.7% 0.7%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11] -12.40 [-14.31, -10.49] -11.30 [-13.71, -8.89]	•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Liu 2015 Liu 2015 Liu 2016 Makovey 2017	; Chi ^z = 1 2.20 (P 1.4 2.6 5.4 5.4 2.9 7.1 5.7 7.3	1353.0: < 0.000 1.9 2 3.4 3.8 2 2.6 2.7 4.9	5620 2, df = 1 101) 33 16 50 39 11 16 20 11	106 (P = 15.5 12.9 14.7 13.7 20.5 19.5 17 12.6	6.5 1.7 7.1 4.3 3.7 2.9 4.8 6.8	5632 01); I [≠] = 33 16 50 39 11 16 20 11	75.4% = 92% 0.7% 0.7% 0.7% 0.7% 0.7% 0.7% 0.7% 0.4%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11] -12.40 [-14.31, -10.49] -11.30 [-13.71, -8.89] -5.30 [-10.25, -0.35]	•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Liu 2015 Liu 2015 Liu 2016	; Chi ^z = 1 2.20 (P 1.4 2.6 5.4 5.4 2.9 7.1 5.7 7.3 7.3 7.3	1353.03 < 0.000 1.9 2 3.4 3.8 2 2.6 2.7 4.9 3.2	5620 2, df = 1 101) 33 16 50 39 11 16 20 11 10	106 (P = 15.5 12.9 14.7 13.7 20.5 19.5 17	6.5 1.7 7.1 4.3 3.7 2.9 4.8 6.8 3.3	5632 01); I [≠] = 33 16 50 39 11 16 20 11 10	75.4% = 92% 0.7% 0.8% 0.7% 0.7% 0.7% 0.7% 0.7%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11] -12.40 [-14.31, -10.49] -11.30 [-13.71, -8.89]	•
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Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Liu 2015 Liu 2015 Liu 2016 Makovey 2017 Shin 2013 Tsui 2020 Varghese 2012	; Chi ^z = 1 2.20 (P 1.4 2.6 5.4 5.4 2.9 7.1 5.7 7.3 7.3 7.3	1353.03 < 0.000 1.9 2 3.4 3.8 2 2.6 2.7 4.9 3.2	5620 2, df = 1 101) 33 16 50 39 11 16 20 11 10 18 14	106 (P = 15.5 12.9 14.7 13.7 20.5 19.5 19.5 17 12.6 10.1	6.5 1.7 7.1 4.3 3.7 2.9 4.8 6.8 3.3	5632 01); I² = 33 16 50 39 11 16 20 11 10 18 14	75.4% 92% 0.7% 0.8% 0.7% 0.7% 0.7% 0.7% 0.4% 0.6%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11] -12.40 [-14.31, -10.49] -11.30 [-13.71, -8.89] -5.30 [-10.25, -0.35] -2.80 [-5.65, 0.05] -0.20 [-12.14, -8.26] -4.80 [-8.12, -1.48]	•
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Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: $Z = 2$ 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Liu 2012 Liu 2015 Liu 2016 Makovey 2017 Shin 2013 Tsui 2020 Varghese 2012 Subtotal (95% CI) Heterogeneity: Tau ² = 10.4 Test for overall effect: $Z = 9$; Chi ^z = 7 2.20 (P 2.20 (P 2.6 5.4 5.4 2.9 7.1 5.7 7.3 7.3 6.2 8.8 7; Chi ^z = .39 (P <	1353.03 < 0.000 1.9 2 3.4 3.8 2.6 2.7 4.9 3.2 3.7 3.3 3.3	5620 2, df = 1 101) 33 16 50 39 11 16 20 11 10 18 14 238 df = 10	106 (P = 15.5 12.9 14.7 13.7 20.5 19.5 19.5 12.6 10.1 16.4 13.6	6.5 1.7 7.1 4.3 3.7 2.9 4.8 6.8 3.3 2 5.4	5632 01); * = 33 16 50 39 11 16 20 11 10 18 14 238	75.4% = 92% 0.7% 0.7% 0.7% 0.7% 0.7% 0.7% 0.4% 0.6% 0.6% 7.2%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11] -12.40 [-14.31, -10.49] -11.30 [-13.71, -8.89] -5.30 [-10.25, -0.35] -2.80 [-5.65, 0.05] -0.20 [-12.14, -8.26] -4.80 [-8.12, -1.48]	•
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: $Z = 2$ 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Liu 2015 (BJOMS v3) Liu 2015 (BJOMS v3) Liu 2015 Liu 2015 Liu 2016 Makovey 2017 Shin 2013 Tsui 2020 Varghese 2012 Subtotal (95% CI) Heterogeneity: Tau ² = 10.4 Test for overall effect: $Z = 9$; Chi ^z = 7 2.20 (P 1.4 2.6 5.4 5.4 5.4 5.7 7.3 7.3 6.2 8.8 7; Chi ^z = .39 (P < ation	1353.0: < 0.000 1.9 2 3.4 3.8 2.6 2.7 4.9 3.2 3.7 3.3 :95.46, 0.0000	5620 2, df = 1 101) 33 16 50 39 11 16 20 11 10 18 14 238 df = 1(1)	106 (P = 15.5 12.9 14.7 13.7 20.5 19.5 17 12.6 10.1 16.4 13.6) (P < 0.	0.000 6.5 1.7 7.1 4.3 3.7 2.9 4.8 6.8 3.3 2 5.4 000001	5632 01); * = 33 16 50 39 11 16 20 11 10 18 14 238); * = 9	75.4% = 92% 0.7% 0.8% 0.7% 0.7% 0.7% 0.7% 0.4% 0.6% 0.6% 7.2%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11] -12.40 [-14.31, -10.49] -11.30 [-13.71, -8.89] -5.30 [-10.25, -0.35] -2.80 [-5.65, 0.05] -0.20 [-12.14, -8.26] -4.80 [-8.12, -1.48] -9.88 [-11.94, -7.81]	•
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Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: $Z = 2$ 1.2.2 Skeletal procedures Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Liu 2015 Liu 2016 Makovey 2017 Shin 2013 Tsui 2020 Varghese 2012 Subtotal (95% CI) Heterogeneity: Tau ² = 10.4 Test for overall effect: $Z = 9$ 1.2.3 Upper airway stimul : Boon 2018 Catella 2019	; Chi ^z = 7 2.20 (P 2.20 (P 2.4 5.4 5.4 7.1 5.7 7.3 7.3 6.2 8.8 7; Chi ^z = .39 (P < 7.5 10.9	1353.0: < 0.000 1.9 2 3.4 3.8 2 2.6 2.7 4.9 3.2 3.7 3.3 95.46, 0.0000 4.7 6.1	5620 2, df = 1 10 50 39 11 16 20 11 16 20 11 10 18 14 238 df = 1(1) 239 10	106 (P = 15.5 12.9 14.7 13.7 20.5 19.5 17 12.6 10.1 16.4 13.6) (P < 0. 11.9 15.9	6.5 1.7 7.1 4.3 3.7 2.9 4.8 3.3 2 5.4 000001 5.5 3.5	5632 01); F = 33 16 50 39 11 16 20 11 10 18 14 238 14 238); F = 9 261 10	75.4% = 92% 0.7% 0.8% 0.7% 0.7% 0.7% 0.7% 0.4% 0.6% 0.6% 7.2% 0%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11] -12.40 [-14.31, -10.49] -11.30 [-13.71, -8.89] -5.30 [-10.25, -0.35] -2.80 [-5.65, 0.05] -10.20 [-12.14, -8.26] -4.80 [-8.12, -1.48] -9.88 [-11.94, -7.81] -4.40 [-5.29, -3.51] -5.00 [-9.36, -0.64]	•
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Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: Z = 2 1.2.2 Skeletal proceduress Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Liu 2012 Liu 2016 Makovey 2017 Shin 2013 Tsui 2020 Varghese 2012 Subtotal (95% CI) Heterogeneity: Tau ² = 10.4 Test for overall effect: Z = 9 1.2.3 Upper airway stimula Boon 2018 Catella 2019 Choi 2015 Eastwood 2011 Eastwood 2011 Eastwood 2012 Friedman 2016 Hasselbacher 2018 Heiser 2017 Huntley 2018 (AORL) Huntley 2018 (CHNS) Huntley 2019 (ENT) Kent 2016 Lai 2018	(Chi [≠] = 7 2.20 (P 1.4 2.6 5.4 5.4 2.9 7.1 5.7 7.3 6.2 8.8 7; Chi [≠] = 39 (P < ation 7.5 10.9 7.3 8.1 8.3 6.5 5.9 5.9 6.4 5.9 5.9 6.4 5.9 5.9 6.4 5.9	1353.0: < 0.00C 1.9 2 3.4 3.8 2 2.6 2.7 4.9 3.2 3.7 3.3 95.46, 0.000C 4.7 6.1 3.6 4.4 4.5 5.2 4.1 4.2 4.4 4.4 4.5 5.2 4.4 4.3 5.2 4.4 4.5 5.2 4.4 4.5 5.2 4.4 4.5 5.2 4.4 4.5 5.2 4.4 4.5 5.2 4.4 4.5 5.2 4.4 4.5 5.2 4.4 4.5 5.2 4.5 4.5 5.2 4.5 4.5 5.2 4.5 5.2 4.5 5.2 4.5 5.2 4.5 5.2 4.5 4.5 5.2 4.5 5.2 4.5 5.2 4.5 4.5 5.2 4.5 5.2 4.5 5.2 4.5 4.5 5.2 4.5 4.5 5.2 4.5 5.2 4.5 5.2 5.2 5.2 5.2 5.2 5.2 5.2 5	5620 2, df = 1 33 16 50 39 11 16 20 11 10 18 14 238 df = 10 11 10 62 19 22 43 66 31 109 164 27 109 164 21 20 11 109 22 43 35 66 31 109 22 43 20 22 43 20 22 43 20 22 23 43 20 22 22 43 20 22 22 23 20 22 22 23 20 22 22 23 20 22 22 22 22 22 22 22 22 22 22 22 22	106 (P = 15.5 12.9 14.7 20.5 19.5 17 12.6 10.1 16.4 13.6 0 (P < 0. 11.9 15.9 10.8 12.1 11. 12. 12.8 12.6 11. 12.5 10.3 9.8	0.000 6.5 1.7 7.1 4.3 3.7 2.9 4.8 6.8 3.3 2 5.4 000001 5.5 3.5 3.5 3.5 3.5 3.5 3.8 4.7 5.3 4.8 6.3 5.5 5.3 5.6 4.3 5.5 5.7 5.2 4.5	5632 01); F = 33 16 50 39 11 16 20 11 10 18 14 238); F = 9 201 10 62 21 22 43 56 31 108 164 27 20 11 108 164 27 20 121	75.4% = 92% 0.7% 0.8% 0.7% 0.7% 0.7% 0.4% 0.6% 0.6% 0.6% 0.6% 0.8% 0.6% 0.6% 0.6% 0.8% 0.8% 0.8%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.58, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11] -12.40 [-14.31, -10.49] -11.30 [-13.71, -8.89] -5.30 [-10.27, -0.35] -2.80 [-5.65, 0.05] -10.20 [-12.14, -8.26] -4.80 [-8.12, -1.48] -9.88 [-11.94, -7.81] -5.00 [-9.36, -0.64] -3.50 [-4.80, -2.20] -4.00 [-6.82, -1.18] -3.00 [-6.16, 0.16] -3.70 [-5.65, -1.75] -6.30 [-8.12, -4.48] -6.70 [-9.39, -4.01] -5.10 [-6.22, -3.98] -5.10 [-6.10, -4.10] -5.10 [-7.73, -2.47] -4.30 [-7.29, -1.31] -1.10 [-2.21, 0.01]	
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: $Z = 2$ 1.2.2 Skeletal proceduress Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Iislam 2015 (BJOMS v3) Liu 2012 Liu 2015 Liu 2016 Makovey 2017 Shin 2013 Tsui 2020 Varghese 2012 Subtotal (95% CI) Heterogeneity: Tau ² = 10.4 Test for overall effect: $Z = 9$ 1.2.3 Upper airway stimul Boon 2018 Catella 2019 Choi 2015 Eastwood 2020 Friedman 2016 Hasselbacher 2018 Heiser 2017 Huntley 2018 (AORL) Huntley 2018 (CHNS) Huntley 2018 (ENT) Kent 2016 Lai 2018 Mahmoud 2018	$Chi^{z} = 7$ 2.20 (P 1.4 2.6 5.4 5.4 5.4 7.1 5.7 7.3 6.2 8.8 7; Chi^{z} = .39 (P < ation 7.5 10.9 7.3 8.1 8.3 6.5 5.9 6.4 5.2 6.4 5.2 6.4 5.2 6.4 5.2 6.4 5.2 6.4 5.2 6.4 5.2 6.4 5.2 6.4 5.2 6.4 5.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7	1353.0: < 0.000 1.9 2 3.4 3.8 2 2.6 2.7 4.9 3.2 3.7 3.3 95.466, 0.0000 4.7 6.1 3.6 4.4 5.4 4.4 4.4 4.4 4.2 4.3 8.8 8.2 9.5 4.6 8.6 8.6 9.5 4.6 9.5 4.6 8.6 8.7 9.5 4.6 8.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4	5620 2, df = 1 001) 33 16 50 39 11 16 20 11 10 18 14 228 df = 1(1) 10 239 062 19 222 43 56 31 109 164 27 20 121 47	106 (P = 15.5 12.9 14.7 13.7 12.5 19.5 17 12.6 10.1 16.4 13.6 0 (P < 0. 11.9 10.8 12.1 12 12.8 12.1 11.5 10.3 9.8 10	0.000 6.5 1.7 7.1 4.3 3.7 2.9 4.8 6.8 3.3 2 5.4 000001 5.5 3.5 3.5 3.5 3.8 4.7 5.3 4.8 5.3 5.4 000001 5.5 3.5 3.7 5.5 5.5 3.5 3.7 5.2 8.8 4.3 3.7 5.5 5.5 5.5 5.5 5.5 5.5 5.5 5	5632 01); F = 33 16 50 39 11 16 20 11 10 18 14 238 14 228 261 10 8 261 10 22 21 22 23 356 31 108 164 27 20 31 108 164 27 20 21 21 21 24 33 56 31 10 26 31 10 10 10 10 10 10 10 10 10 10 10 10 10	75.4% = 92% 0.7% 0.8% 0.7% 0.7% 0.7% 0.4% 0.6% 0.7% 0.6% 7.2% 0%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.58, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11] -12.40 [-14.31, -10.49] -11.30 [-13.71, -8.89] -5.30 [-10.25, -0.35] -2.80 [-5.65, 0.05] -10.20 [-12.14, -8.26] -4.80 [-8.12, -1.48] -9.88 [-11.94, -7.81] -5.00 [-9.36, -0.64] -3.50 [-4.80, -2.20] -4.00 [-6.82, -1.18] -3.00 [-6.16, 0.16] -3.70 [-5.65, -1.75] -6.30 [-8.12, -4.48] -6.70 [-9.39, -4.01] -5.10 [-6.22, -3.98] -5.10 [-6.10, -4.10] -5.10 [-7.79, -1.31] -1.10 [-2.21, 0.01] -3.00 [-6.05, 0.05]	
Yuksel 2018 Subtotal (95% CI) Heterogeneity: Tau ² = 5.84 Test for overall effect: $Z = 2$ 1.2.2 Skeletal proceduress Brevi 2011 (JOMS) Giarda 2013 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Liu 2012 Liu 2015 Liu 2016 Makovey 2017 Shin 2013 Tsui 2020 Varghese 2012 Subtotal (95% CI) Heterogeneity: Tau ² = 10.4 Test for overall effect: $Z = 9$ 1.2.3 Upper airway stimul: Boon 2018 Catella 2019 Choi 2015 Eastwood 2020 Friedman 2016 Hasselbacher 2018 Heiser 2017 Huntley 2018 (AORL) Huntley 2018 (AORL) Huntley 2019 (ENT) Kent 2016 Lai 2018 Mahmoud 2018 Parikh 2018	; Chi [≠] = 7 2.20 (P 1.4 2.6 5.4 5.4 5.4 5.7 7.3 7.3 6.2 8.8 7; Chi [≠] = 39 (P < ation 7.5 10.9 7.5 10.9 7.5 10.9 7.3 8.3 6.5 5.9 6.4 5.2 6.4 5.2 6.4 5.2 6.4 5.2 6.4 7, 7 7, 7 7, 7 8.3	1353.0; < 0.000 1.9 2 3.4 3.8 2 2.6 2.7 4.9 3.2 2.6 2.7 4.9 3.2 3.7 3.3 3.7 3.3 3.7 3.3 4.7 6.1 3.6 4.4 4.4 4.4 4.4 4.4 4.2 4 4.4 4.3 6.8 1.5	5620 2, df = 1 001) 33 16 50 39 11 16 20 11 18 14 238 df = 10 10 239 22 43 56 31 109 22 43 56 31 109 109 109 109 109 109 109 109 109 10	106 (P = 15.5 12.9 14.7 13.7 12.5 19.5 17 12.6 10.1 16.4 13.6 0 (P < 0. 11.9 15.9 10.8 12.1 11 12 12.8 12.1 11.5 10.3 10.3 10.3 10.3 10.3 10.5 10.	0.000 6.5 1.7 7.1 4.3 3.7 2.9 4.8 6.8 3.3 2 5.4 000001 5.5 3.8 4.7 5.3 5.4 000001 5.5 3.8 4.7 5.3 4.8 5.3 5.4 5.3 5.5 5.3 5.5 5.5 5.3 5.5 5.5 5.5 5.5	5632 01); F = 33 16 50 39 11 16 20 11 18 14 238 261 10 8 24 261 10 22 21 22 43 56 31 108 164 27 20 121 14 7 7	75.4% = 92% 0.7% 0.8% 0.7% 0.7% 0.7% 0.7% 0.6% 0.7% 0.6% 0.6% 0.6% 0.6% 0.6% 0.6% 0.6% 0.8% 0.6% 0.8% 0.6% 0.6%	-5.63 [-6.13, -5.13] -14.10 [-16.41, -11.79] -10.30 [-11.59, -9.01] -9.30 [-11.48, -7.12] -8.30 [-10.10, -6.50] -17.60 [-20.09, -15.11] -12.40 [-14.31, -10.49] -11.30 [-13.71, -8.89] -5.30 [-10.25, -0.35] -2.80 [-5.65, 0.05] -0.20 [-12.14, -8.26] -4.80 [-8.12, -1.48] -9.88 [-11.94, -7.81] -5.00 [-9.36, -0.64] -3.50 [-4.80, -2.20] -4.00 [-6.82, -1.18] -3.00 [-6.16, 0.16] -3.70 [-5.65, -1.75] -6.30 [-8.12, -4.48] -5.10 [-6.12, -3.98] -5.10 [-6.10, -4.10] -5.10 [-7.73, -2.47] -4.30 [-7.29, -1.31] -1.10 [-2.21, 0.01] -3.00 [-6.05, 0.05] -10.40 [-13.39, -7.41]	

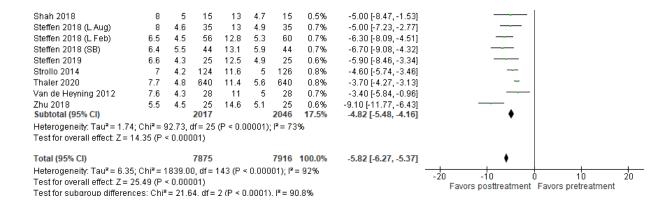


Figure S3. OR-based surgery vs. control (QOL, FOSQ) [RCT]

	Su	rger	y	Co	ontro	I	Mean Difference		Me	an Differe	nce	
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Random, 95% CI		IV, R	andom, 98	5% CI	
2.6.1 Soft tissue pro	cedures											
MacKay 2020	3.6	2.3	50	0.1	2.5	49	3.50 [2.55, 4.45]				+	
								-10	-5	Ó	5	10

Favors control Favors surgery

Figure S4. OR-based surgery pretreatment vs. posttreatment (QOL, FOSQ)

•	Postt	reatm	ent	Pretr	eatm	ent	•	Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% Cl
1.6.1 Soft tissue proce	edures								
Kezirian 2010	17.5	2.7	30	14.6	3.1	30	8.1%	2.90 [1.43, 4.37]	│
Weaver 2011	17.5	2.5	34	14.3	3.4	34	8.5%	3.20 [1.78, 4.62]	
Subtotal (95% CI)			64			64	16.6%	3.06 [2.03, 4.08]	•
Heterogeneity: Tau ² = 0).00; Chi²	= 0.08	l, df = 1	(P = 0.7)	7); l² =	:0%			
Test for overall effect: Z	:= 5.86 (P	< 0.0	0001)						
1.6.2 Skeletal procedu	res								
Boyd 2015	17.3	2.4	30	12.6	3.6	30	7.7%	4.70 [3.15, 6.25]	
Lye 2008	18.9	1.1	15	14.4	2.6	15	8.4%	4.50 [3.07, 5.93]	
Tsui 2020	18.4	1.5	18	13.8	1.1	18	13.1%	4.60 [3.74, 5.46]	
Subtotal (95% CI)			63			63	29.2%	4.60 [3.93, 5.26]	◆
Heterogeneity: Tau ² = 0).00; Chi ^z	= 0.03	, df = 2	(P = 0.9	8); l² =	:0%			
Test for overall effect: Z	:= 13.55 ((P < 0.)	00001)						
1.6.3 Upper airway stir	mulation								
Eastwood 2011	16.7	2.2	19	14.4	2	21	9.3%	2.30 [0.99, 3.61]	
Eastwood 2020	17.2	3	22	15.3	3.3	22	6.1%	1.90 [0.04, 3.76]	
Hasselbacher 2018	17.5	3	56	13.7	3.6	56	9.9%	3.80 [2.57, 5.03]	_
Steffen 2018 (L Feb)	17.5	3	56	13.7	3.6	60	10.0%	3.80 [2.60, 5.00]	_ _
Strollo 2014	17.3	2.9	124	14.3	3.2	126	14.0%	3.00 [2.24, 3.76]	
Van de Heyning 2012	20.2	3.4	28	17.8	4.7	28	4.9%	2.40 [0.25, 4.55]	
Subtotal (95% CI)			305			313	54.2%	3.04 [2.48, 3.60]	•
Heterogeneity: Tau ² = 0).08; Chi²	= 6.02	!, df = 5	(P = 0.3)	0); l² =	:17%			
Test for overall effect: Z	:= 10.63 ((P < 0.)	00001)						
Total (95% CI)			432			440	100.0%	3.47 [2.92, 4.03]	•
Heterogeneity: Tau² = 0).42; Chi²	= 20.5	i0, df=	10 (P = 0	0.02);	l ² = 519	6		
Test for overall effect: Z	= 12.24 ((P < 0.)	00001)						Favors pretreatment Favors posttreatment
Test for subgroup differ	rences: C	hi² = 1	3.53, d	f= 2 (P =	= 0.00	1), I ² = I	85.2%		avois precedurient i avois postiedtillent

Figure S5. OR-based surgery pretreatment vs. posttreatment (QOL, SAQLI)

	Postt	reatm	ent	Pretr	eatme	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
1.46.1 Upper airway	stimulati	on							
Eastwood 2011	4.9	1.3	19	3.2	1	21	29.7%	1.70 [0.98, 2.42]	_
Friedman 2016	4.7	1.2	43	4.3	1	43	36.3%	0.40 [-0.07, 0.87]	⊢ ∎
Subtotal (95% CI)			62			64	66.0%	1.02 [-0.25, 2.29]	
Heterogeneity: Tau ² =	0.75; Ch	i ² = 8.	74, df=	1 (P = 0	.003);	l² = 89	%		
Test for overall effect:	Z=1.57	(P = 0	.12)						
1.46.2 Skeletal proce	edures								
Tsui 2020	5.2	0.8	18	4.2	0.9	18	34.0%	1.00 [0.44, 1.56]	_
Subtotal (95% CI)			18			18	34.0%	1.00 [0.44, 1.56]	
Heterogeneity: Not ap	plicable								
Test for overall effect:	Z= 3.52	(P = 0	.0004)						
Total (95% CI)			80			82	100.0%	0.99 [0.28, 1.70]	
Heterogeneity: Tau ² =	0.30; Ch	i² = 9.	14. df=	2 (P = 0	.01);1	z = 78%	5	_	
Test for overall effect:									-2 -1 U 1 2
Test for subaroup diff			· ·	df = 1 (P	= 0.98	3). I ² = 0	1%		Favors pretreatment Favors posttreatment

Figure S6. OR-based surgery vs. control (QOL, SF-36 PCS) [RCT]

	Su	rger	y	Co	ontro	I	Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Random, 95% CI	IV, Random, 95% Cl
2.11.1 Soft tissue pr	ocedure	s						
Browaldh 2016	51.2	8.8	31	48.3	9.1	31	2.90 [-1.56, 7.36]	
								-10 -5 0 5 10
								Favors control Favors surgery

Figure S7. OR-based surgery pretreatment vs. posttreatment (QOL, SF-36 PCS)

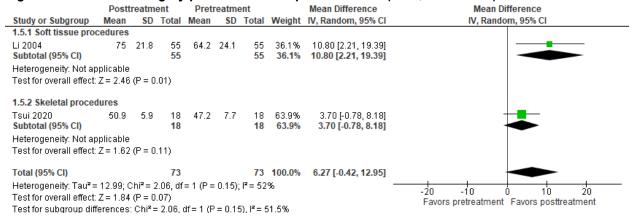


Figure S8. OR-based surgery vs. control (QOL, SF-36 MCS) [RCT]

	Su	rger	/	C	ontrol		Mean Difference	Mean Difference	
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Random, 95% CI	IV, Random, 95% CI	
2.12.1 Soft tissue pro	ocedure	s							
Browaldh 2016	48.1	9.7	31	42.7	11.5	31	5.40 [0.10, 10.70]		
								-10 -5 0 5	10
								Favors control Favors si	irgery

Figure S9. OR-based surgery pretreatment vs. posttreatment (QOL, SF-36 MCS)

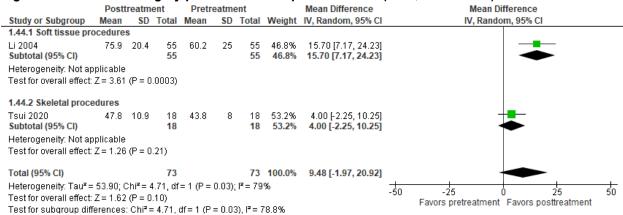


Figure S10. OR-based surgery vs. control (QOL, SF-36 VS) [RCT]

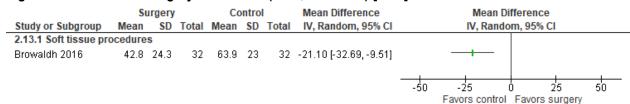


Figure S11. OR-based surgery pretreatment vs. posttreatment (QOL, SF-36 VS)

	Post	treatme	ent	Pret	reatme	ent		Mean Difference		Mean Difference	
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% Cl		IV, Random, 95% CI	
1.45.1 Soft tissue pr	ocedure	S									
Li 2004 Subtotal (95% CI)	68.2	15.8	55 55	54.4	15.9	55 55	82.7% 82.7%	13.80 [7.88, 19.72] 13.80 [7.88, 19.72]			
Heterogeneity: Not ap	pplicable										
Test for overall effect	Z= 4.57	(P < 0	.00001)							
1.45.2 Skeletal proce	edures										
Tsui 2020 Subtotal (95% CI)	66.7	20.1	18 18	49.4	19.6	18 18	17.3% 17.3%	17.30 [4.33, 30.27] 17.30 [4.33, 30.27]			
Heterogeneity: Not ap	pplicable										
Test for overall effect:	Z = 2.61	(P = 0,	.009)								
Total (95% CI)			73			73	100.0%	14.40 [9.02, 19.79]		•	
Heterogeneity: Tau ² =	= 0.00; Cl	hi ² = 0.0	23, df =	1 (P = 0	0.63); P	²= 0%			+		+
Test for overall effect:	: Z = 5.24	(P < 0.	.00001)					-50	-25 Ó 25 Favors pretreatment Favors posttreatment	50
Test for subgroup dif	ferences	: Chi²=	0.23,	df = 1 (P	² = 0.63	i), l ² = ()%			ravors precedencence ravors postileatiment	

Figure S12. OR-based surgery pretreatment vs. posttreatment (QOL, PSQI)

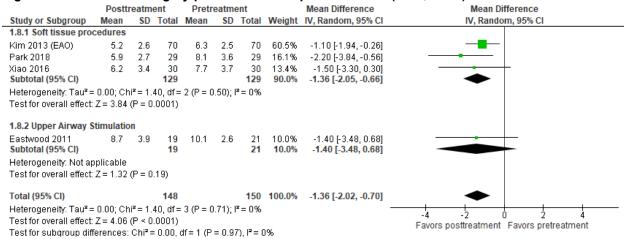
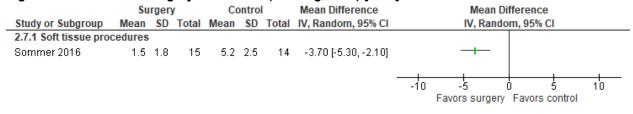


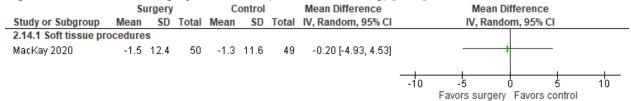
Figure S13. OR-based surgery vs. control (Snoring, VAS) [RCT]



	Postt	reatm	ent	Pretr	eatme	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% Cl	IV, Random, 95% Cl
1.9.1 Soft tissue procedu	res								
Adzreil 2017	2.9	1.6	31	7.3	1	31	2.8%	-4.40 [-5.06, -3.74]	-
Askar 2018 (CO)	2.4	0.9	22	8.8	1.6	22	2.8%	-6.40 [-7.17, -5.63]	
Askar 2018 (SB)	1.9	1.2	26	7.9	1.3	26	2.8%	-6.00 [-6.68, -5.32]	
Babademez 2019 (JLO)	2	0.9	34	7.1	1.7	34	2.8%	-5.10 [-5.75, -4.45]	
Binar 2017 (JLO)	2.3	1.6	29	8.9	1.5	29	2.8%	-6.60 [-7.40, -5.80]	
Cho 2014	4	1.1	23	8.4	1.6	23	2.8%	-4.40 [-5.19, -3.61]	
Choi 2011 (AOHNS)	2.7	1.8	41	5.8	0.8	41	2.8%	-3.10 [-3.70, -2.50]	
El-Ahl 2016	2.1	1.4	24	8.2	1.4	24	2.8%	-6.10 [-6.89, -5.31]	
El-Anwar 2018	2.2	0.6	40	3.6	0.5	40	2.9%	-1.40 [-1.64, -1.16]	
Elbassiouny 2015	2.3	2.7	28	8.6	3.7	28	2.4%	-6.30 [-8.00, -4.60]	
Friedman 2003	2.1	2.2	143	7.6	1.1	143	2.9%	-5.50 [-5.90, -5.10]	-
Friedman 2004	2	2.1	140	7.7	0.4	140	2.9%	-5.70 [-6.05, -5.35]	-
Friedman 2007	0.5	1.3	31	9.5	1.5	31	2.8%	-9.00 [-9.70, -8.30]	
Gunawardena 2013	2.3	3.1	27	7.1	2.1	27	2.6%	-4.80 [-6.21, -3.39]	
Hobson 2012	0	0.8	27	8	0.6	27	2.9%	-8.00 [-8.38, -7.62]	-
Huang 2008	2.4	1.3	50	7.5	2	50	2.8%	-5.10 [-5.76, -4.44]	
Kim 2013	3.6	2.4	92	7.9	2.5	92	2.8%	-4.30 [-5.01, -3.59]	
Lee 2018	4.2	3	10	8.4	0.9	10	2.3%	-4.20 [-6.14, -2.26]	
Li 2015	2.6	1.8	32	7.5	1.9	32	2.8%	-4.90 [-5.81, -3.99]	
Li 2018	2.1	1.9	25	8.7	1.1	25	2.8%	-6.60 [-7.46, -5.74]	
Lin 2010	2.9	1.6	43	8.4	1.6	43	2.8%	-5.50 [-6.18, -4.82]	
Lin 2013	4.2	1.9	27	8.6	1.2	27	2.8%	-4.40 [-5.25, -3.55]	
Lin 2014	3.3	2	35	9.9	0.7	35	2.8%	-6.60 [-7.30, -5.90]	
Lin 2017	3.9	1.9	47	9.4	1.5	47	2.8%	-5.50 [-6.19, -4.81]	
Neruntarat 2011	2.4	1.9	83	8.6	1.4	83	2.9%	-6.20 [-6.71, -5.69]	
Omur 2005	3	2.4	22	8.7	1.8	22	2.6%	-5.70 [-6.95, -4.45]	
Pang 2016	2	1.3	73	8.8	1.2	73	2.9%	-6.80 [-7.21, -6.39]	-
Pang 2018	2.3	0.9	112	7.7	0.8	112	2.9%	-5.40 [-5.62, -5.18]	-
Salapatas 2016	4	2.1	556	8.8	0.8	556	2.9%	-4.80 [-4.99, -4.61]	-
Toh 201 4	2.4	1.8	20	9.5	0.6	20	2.8%	-7.10 [-7.93, -6.27]	
Wang 2013	3	2.1	36	7.3	2.3	36	2.7%	-4.30 [-5.32, -3.28]	
Neaver 2011	1.8	2.2	35	5.3	3.2	35	2.6%	-3.50 [-4.79, -2.21]	
Yi 2009	1.3	0.9	34	3	1.2	34	2.9%	-1.70 [-2.20, -1.20]	-
Yi 2011	1.8	1.1	26	2.4	1.6	26	2.8%	-0.60 [-1.35, 0.15]	
Yuksel 2018	2.2	2.4	63	6.2	2.2	63	2.8%	-4.00 [-4.80, -3.20]	
Subtotal (95% CI)			2087			2087	97.2%	-5.15 [-5.79, -4.50]	•
Heterogeneity: Tau ² = 3.60	•			34 (P < 0	0.0000	01); I² =	98%		
Test for overall effect: Z = 1	15.67 (P ·	< 0.00	001)						
1.9.2 Skeletal procedure	6								
_iu 2012	1.4	0.9	11	9.4	0.8	11	2.8%	-8.00 [-8.71, -7.29]	-
Subtotal (95% CI)			11			11	2.8%	-8.00 [-8.71, -7.29]	◆
Heterogeneity: Not applica Test for overall effect: Z = 3		< 0.00	001)						
Total (95% CI)	· V		2098			2009	100.0%	-5.23 [-5.87, -4.58]	•
Heterogeneity: Tau ² = 3.68). Chiže (007 4		<u> 15 /⊡ - (</u>				-5.25 [-5.07, -4.30]	▼
	\ UNI*=`	i∺∺≍/4	- 11 E	55 I M S I					-10 -5 0 5 10

Figure S14. OR-based surgery pretreatment vs. posttreatment (Snoring, VAS)

Figure S15. OR-based surgery vs. control (Mean SBP, mmHg) [RCT]



	Postt	reatm	ent	Pret	reatme	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
1.16.1 Soft tissue proce	edures								
de Paula Soares 2014	121.5	10.8	18	126.3	10.3	18	9.6%	-4.80 [-11.69, 2.09]	
Huang 2016	130.8	11.9	40	132.9	14.1	40	10.1%	-2.10 [-7.82, 3.62]	
Kinoshita 2006	131	10	15	133	14.2	15	8.7%	-2.00 [-10.79, 6.79]	
Lee 2009 (OHNS)	124.8	7.3	30	125.6	8.2	30	10.8%	-0.80 [-4.73, 3.13]	
Lee 2011 (OHNS)	128	16	30	127	13	30	9.4%	1.00 [-6.38, 8.38]	_ +
Pang 2018	122	12.5	112	146	15.3	112	10.9%	-24.00 [-27.66, -20.34]	-
Peng 2016	124.8	11	52	135.4	14.5	52	10.4%	-10.60 [-15.55, -5.65]	
Rotenberg 2014	134.5	3.9		143.2	4.3	22	11.2%	-8.70 [-11.13, -6.27]	+
Subtotal (95% CI)			319			319	81.1%	-6.79 [-12.95, -0.63]	◆
Heterogeneity: Tau ² = 70	0.75; Chi [≥]	= 98.2	6, df =	7 (P < 0	.00001	l); l² = 9	93%		
Fest for overall effect: Z :	= 2.16 (P	= 0.03))						
1.16.2 Skeletal procedu	ires								
Makovey 2017	126.2	11.5		134.1	19.9	20	8.1%	-7.90 [-17.97, 2.17]	
Subtotal (95% CI)			20			20	8.1%	-7.90 [-17.97, 2.17]	\bullet
Heterogeneity: Not appli	cable								
Test for overall effect: Z :	= 1.54 (P	= 0.12))						
.16.3 Upper airway sti	mulation								
Nalia 2019	129	20.2	201	130	19.9	201	10.8%	-1.00 [-4.92, 2.92]	
Subtotal (95% CI)			201			201	10.8%	-1.00 [-4.92, 2.92]	◆
Heterogeneity: Not appli	cable								
Test for overall effect: Z :	= 0.50 (P	= 0.62))						
Fotal (95% CI)			540			540	100.0%	-6.28 [-11.61, -0.94]	•
Heterogeneity: Tau ² = 64	4.62; Chi ≊	= 112	41, df=	= 9 (P <	0.000	01); I ² =	92%		-50 -25 0 25 5
Test for overall effect: Z :	= 2.31 (P	= 0.02))						-50 -25 U 25 5 Favors posttreatment Favors pretreatment
	ences: Ch								

Figure S17. OR-based surgery vs. control (Mean DBP, mmHg) [RCT]

	Surgery Contr				ontro	I	Mean Difference	Mean Difference					
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Random, 95% CI	IV, Random, 95% CI					
2.15.1 Soft tissue pro	ocedure	s											
MacKay 2020	-1.3	8.1	50	-0.9	7.7	49	-0.40 [-3.51, 2.71]						
								-4 -2 Ó 2 4					
								Favors surgery Favors control					

Figure S18. OR-based surgery pretreatment vs. posttreatment (Mean DBP, mmHg)

	Postt	reatm	ent	Pretr	reatm	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
1.17.1 Soft tissue proce	edures								
de Paula Soares 2014	78.3	7.6	18	81.2	6.4	18	11.3%	-2.90 [-7.49, 1.69]	
Huang 2016	84.8	11.8	40	85.4	11.2	40	11.1%	-0.60 [-5.64, 4.44]	
Kinoshita 2006	83.5	11.2	15	81.6	15.5	15	8.7%	1.90 [-7.78, 11.58]	-
Lee 2009 (OHNS)	72.6	6.4	30	73.3	6.6	30	11.9%	-0.70 [-3.99, 2.59]	
Lee 2011 (OHNS)	85	12	30	81	11	30	10.8%	4.00 [-1.83, 9.83]	+
Pang 2018	76	7.8	112	91	10.2	112	12.1%	-15.00 [-17.38, -12.62]	
Peng 2016 Subtotal (95% CI)	82.4	10	52 297	91.3	14.1	52 297	11.3% 77.2%	-8.90 [-13.60, -4.20] - 3.49 [-9.60, 2.62]	
Heterogeneity: Tau ² = 60 Test for overall effect: Z =	= 1.12 (P		•	6 (P < 0	.00001	l); ² = 9	33%		
1.17.2 Skeletal procedu									
Makovey 2017 Subtotal (95% CI)	73.9	9.5	20 20	75.4	10.6	20 20	10.5% 10.5%	-1.50 [-7.74, 4.74] - 1.50 [-7.74, 4.74]	
Heterogeneity: Not appli	cable								
Test for overall effect: Z =	= 0.47 (P	= 0.64)	I						
1.17.3 Upper airway stir	nulation								
Walia 2019 Subtotal (95% CI)	78.7	3.5	201 201	77.3	12.3	201 201	12.3% 12.3%	1.40 [-0.37, 3.17] 1.40 [-0.37, 3.17]	 ◆
Heterogeneity: Not appli Test for overall effect: Z =		= 0.12)	I						
Total (95% CI)			518			518	100.0%	-2.69 [-7.87, 2.48]	
Heterogeneity: Tau ² = 58 Test for overall effect: Z = Test for subgroup differe	= 1.02 (P	= 0.31)						_	-20 -10 0 10 20 Favors posttreatment Favors pretreatment

Figure S19. OR-based surgery vs. control (AHI) [RCT]

	Surgery Control							Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
2.1.1 Soft tissue pro	cedures								
Browaldh 2013	21.1	16.7	32	46.8	22.8	33	34.1%	-25.70 [-35.39, -16.01]	
MacKay 2020	-27.4	23.1	50	-9.8	23.9	49	35.7%	-17.60 [-26.86, -8.34]	
Sommer 2016	-18.4	17.4	18	-7.2	15	16	30.2%	-11.20 [-22.09, -0.31]	
Subtotal (95% CI)			100			98	100.0%	-18.44 [-26.41, -10.46]	◆
Heterogeneity: Tau ² :	= 24.07; •	Chi²=	3.88, dt	f= 2 (P =	= 0.14)	$ ^{2} = 40$	3%		
Test for overall effect	: Z = 4.53	8 (P < 0	0.00001)					
Total (95% CI)			100			98	100.0%	-18.44 [-26.41, -10.46]	◆
Heterogeneity: Tau ² :	= 24.07: (Chi²=	3.88. dt	f= 2 (P =	= 0.14)); $ ^2 = 48$	3%		
Test for overall effect	: Z = 4.53) (P < (D È					-50 -25 0 25 50
Test for subgroup dif				·					Favors surgery Favors control

Figure S20. OR-based surgery pretreatment vs. posttreatment (AHI)

	Post	treatm	ent	Pret	reatm	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
1.1.1 Soft tissue procedur	res								
Adzreil 2017	18.5	16.3	31	35	24.3	31	0.5%	-16.50 [-26.80, -6.20]	
Arora 2016	21.2	24.6	11	36.3	21.4	11	0.3%	-15.10 [-34.37, 4.17]	
Askar 2018 (CO)	7.9	3.7	22	29.7	5.5	22	0.6%	-21.80 [-24.57, -19.03]	~
Askar 2018 (SB)	8.3	3	26	28.6	5.5	26	0.6%	-20.30 [-22.71, -17.89]	-
Aynaci 2018	11.7	2.4	40	30.8	5.4	40	0.6%	-19.10 [-20.93, -17.27]	~
Azbay 2016	36.6	18.3	67	45	19.8	67	0.6%	-8.40 [-14.86, -1.94]	
Babademez 2010	8.9	6.5	16	20.1	10.5	16	0.6%	-11.20 [-17.25, -5.15]	
Babademez 2019 (CO)	10.5	3.9	70	20.7	6.6	70	0.6%	-10.20 [-12.00, -8.40]	-
Babademez 2019 (JLO)	6.6	4.6	34	31.2	17.7	34	0.6%	-24.60 [-30.75, -18.45]	
Baisch 2006	19.4	19.7	83	36.4	21.2	83	0.6%	-17.00 [-23.23, -10.77]	
Baradaranfar 2015	10.5	3.3	48	23.2	6.6	48	0.6%	-12.70 [-14.79, -10.61]	-
Barbieri 2019	5.9	1	42	26.6	4.3	42	0.6%	-20.70 [-22.04, -19.36]	-
Barrera 2016	22.9	29.2	18	41.1	29.7	18	0.3%	-18.20 [-37.44, 1.04]	
Benazzo 2008	18.7	16	109	37	19.1	109	0.6%	-18.30 [-22.98, -13.62]	-
Bican 2010	24.6	22.4	20	43.1	27.3	20	0.4%	-18.50 [-33.98, -3.02]	
Binar 2017 (EAO)	11.8	11	23	32.4	20.9	23	0.5%	-20.60 [-30.25, -10.95]	
Binar 2017 (JLO)	13	12.4	29	30.1	20.5	29	0.5%	-17.10 [-25.82, -8.38]	
Blumen 2015	13.7	14.2	24	30.9	12.4	24	0.5%	-17.20 [-24.74, -9.66]	
Bostanci 2016	19.9	17.4	82	47.3	18.7	82	0.6%	-27.40 [-32.93, -21.87]	

Bowden 2005	37.6	28.8	29	36.5	27.6	29	0.4%	1.10 [-13.42, 15.62]
Browaldh 2018	23.6	20.2	60	52.9	20.5	65	0.5%	-29.30 [-36.44, -22.16]
Cammaroto 2017	15.3	10.1	30	35.8	16.5	30	0.5%	-20.50 [-27.42, -13.58]
Chen 2014	27.4	12	77	46.2	15.6	77	0.6%	-18.80 [-23.20, -14.40]
Cho 2014	5.6	3.1	23	32	10.2	23	0.6%	-26.40 [-30.76, -22.04]
Choi 2011 (AJRA)	26.1	21.9	22	28.9	20.4	22	0.4%	-2.80 [-15.31, 9.71]
Choi 2011 (AOHNS)	20.9	22.1	41	45.9	23.4	41	0.5%	-25.00 [-34.85, -15.15]
Choi 2012	20.8	12.5	36	38.3	21	36	0.5%	-17.50 [-25.48, -9.52]
Choi 2013	20.1	20.4	20	37.2	22.9	20	0.4%	-17.10 [-30.54, -3.66]
Choi 2017	17.9	19.7	156	38.3	25	156	0.6%	-20.40 [-25.39, -15.41]
Cillo 2013	12.1	8.2	13	28.3	13.2	13	0.5%	-16.20 [-24.65, -7.75]
Cui 2016	25.3	16.2	12	50.9	30.8	12	0.3%	-25.60 [-45.29, -5.91]
den Herder 2005	22.2	15.2	31	32.1	10.2	31	0.6%	-9.90 [-16.34, -3.46]
de Paula Soares 2014	21	18.3	16	34.9	20.8	18	0.4%	-13.90 [-27.04, -0.76]
El-Ahl 2016	8.9	4.9	24	28.6	4.2	24	0.6%	-19.70 [-22.28, -17.12]
El-Anwar 2018	25	10.2	40	58.6	28.4	40	0.5%	-33.60 [-42.95, -24.25]
El-Anwar 2019	10.5	6.8	40	32	9.8	40	0.6%	-21.50 [-25.20, -17.80]
Elbassiouny 2015	11	2.1	28	46	4.1	28	0.6%	-35.00 [-36.71, -33.29]
Emara 2011	15.4	10.7	23	40.7	17.4	23	0.5%	-25.30 [-33.65, -16.95]
Emara 2016	16.3	10.3	38	42.1	16.3	38	0.6%	-25.80 [-31.93, -19.67]
Eun 2008	13.9	18.7	56	22.9	14.7	56	0.6%	-9.00 [-15.23, -2.77]
Eun 2009	16.6	16.5	90	20.4	8.6	90	0.6%	-3.80 [-7.64, 0.04]
Evans 2020	3.9	12.4	25	37.1	17.1	25	0.5%	-33.20 [-41.48, -24.92]
Fibbi 2009	4.7	3.2	12	14.8	3.1	12	0.6%	-10.10 [-12.62, -7.58]
Friedman 2003	27.3	23.1	277	39.8	24.3	277	0.6%	-12.50 [-16.45, -8.55]
Friedman 2004	31.3	22.6	140	41.7	24.6	140	0.6%	-10.40 [-15.93, -4.87]
Gunawardena 2013	12.5	12	27	44	22.3	27	0.5%	-31.50 [-41.05, -21.95]
Gunbey 2015	15.3	9.8	42	35.8	12.1	42	0.6%	-20.50 [-25.21, -15.79]
Ha 2020	22.2	17	95	43.9	19.8	95	0.6%	-21.70 [-26.95, -16.45]
Hamans 2008	11.8	7.6	10	22.8	11.3	10	0.5%	-11.00 [-19.44, -2.56]
Hasselbacher 2018 (SB)	20.2	13.6	15	34.7	16.2	15	0.5%	-14.50 [-25.20, -3.80]
Hester 1995	9.7	17	15	30.4	21	15	0.4%	-20.70 [-34.37, -7.03]
Hobson 2012	7.5	8.4	31	31.8	27.3	31	0.5%	-24.30 [-34.35, -14.25]
Holmlund 2016	7	9.4	28	40	32.4	28	0.4%	-33.00 [-45.50, -20.50]
Huang 2016	15	29.2	40	35.1	31.5	40	0.4%	-20.10 [-33.41, -6.79]
Jacobowitz 2006	14.9	16.8	37	46.5	24.8	37	0.5%	-31.60 [-41.25, -21.95]
Jung 2020	24.8	19.2	60	46.2	20.6	60	0.5%	-21.40 [-28.53, -14.27]
Karakoc 2018	11.4	13.4	79	21.1	15.6	79	0.5%	-9.70 [-14.23, -5.17]
Karatayli-Ozgursoy 2012	10.6	6.1	20	31	16.4	20	0.5%	-20.40 [-28.07, -12.73]
Katsantonis 1990	46.4	34.8	72	68.5	31.7	72	0.5%	-20.40 [-28.07, -12.73] -22.10 [-32.97, -11.23]
Kayhan 2016	9.4	12.4	25	28.7	17.8	25	0.5%	-19.30 [-27.80, -10.80]
Kezirian 2010	27.8	26.4	30	44.9	28.1	30	0.4%	-17.10 [-30.90, -3.30]
Khan 2009	27.0	28.9	50 63	44.9	20.1 35.4	63	0.4%	-33.70 [-44.98, -22.42]
Kim 2013	20.5	20.9 5.6	92	39.1	21.6	92	0.5%	
Kinoshita 2006	15.6	14.5	92 15	47.9	21.0	92 15	0.0%	-31.20 [-35.76, -26.64] -32.30 [-46.36, -18.24]
Kinosina 2000 Komada 2012	10.7	10.7	24	50.9	22.3	24	0.4%	-40.20 [-50.10, -30.30]
Lee 2010	22.8	21.2	24 69	35	17.5	24 69	0.5%	-12.20 [-18.69, -5.71]
Lee 2010 Lee 2011 (OHNS)	17.9	13.6	30	46.2	22.9	30	0.5%	-28.30 [-37.83, -18.77]
Lee 2012	24.1	19.6	20	55.6	26	20	0.4%	-31.50 [-45.77, -17.23]
Lee 2018	37.1	31.9	10	46.6	35	10	0.2%	-9.50 [-38.85, 19.85]
Li 2006	15.1	15.1	110	44.4	26.6	110	0.6%	-29.30 [-35.02, -23.58]
Li 2008	38.1	32.7	51	37.4	28.9	51	0.5%	0.70 [-11.28, 12.68]
Li 2009 (AJRA)	37.5	31.6	44	36.4	20.5	44	0.4%	1.10 [-11.59, 13.79]
Li 2013 (AOL)	12	7.2	67	48.4	21.7	67	0.6%	-36.40 [-41.87, -30.93]
Li 2013 (EAO)	14.9	8.8	78	40.4		78	0.6%	-26.00 [-30.83, -21.17]
Li 2013 (OHNS)	22.6	17.4	47	59.5	18.2	47	0.5%	-36.90 [-44.10, -29.70]
Li 2014	22.0	21.4	73	41.2	17.3	73	0.5%	-19.20 [-25.51, -12.89]
Li 2015	27.2	21.4	32	52.5	25.9	32	0.5%	-25.30 [-36.92, -13.68]
Li 2016	12.8	8.2	25	45.7	21.7	25	0.5%	-32.90 [-41.99, -23.81]
Li 2018	15.1	12.1	25	39.8	19.9	25	0.5%	-24.70 [-33.83, -15.57]
	19.4		25 97	39.0 36.1	21.5	25 97		-16.70 [-22.33, -11.07]
Lim 2018	23.4	18.4 24.7	43	51.5	21.5	97 43	0.6% 0.5%	-28.10 [-38.69, -17.51]
Lin 2010				43.9	41.1			-26.30 [-51.30, -1.30]
Lin 2013	17.6	16.2	12			12	0.2%	
Lin 2014	26.5	23.5	35	50.6	16.6	35	0.5%	-24.10 [-33.63, -14.57]
Lin 2015	21.9	23.5	39	43.9	32.3	39	0.4%	-22.00 [-34.54, -9.46]
Liu 2013	29.5	22.5	51	65.6	17.2	51	0.5%	-36.10 [-43.87, -28.33]
MacKay 2013 (JLO) Marci 2017	14.5	9.8	17	36.3	11.9	17	0.5%	-21.80 [-29.13, -14.47]
Meraj 2017	21.5	19.3	101	44.9	21.6	101	0.6%	-23.40 [-29.05, -17.75]
Miyazaki 1998	2.9	4.3	10	14.4	19.9	10	0.4%	-11.50 [-24.12, 1.12]
Montevecchi 2018 More 2012	13.5	10.3	111	33.4	19.5	111	0.6%	-19.90 [-24.00, -15.80]
Mora 2012	9	3.1	21	31.8	13	21	0.6%	-22.80 [-28.52, -17.08]
Moxness 2014 Mure 2019	16.6	12.9	59	18.2	13.7	59	0.6%	-1.60 [-6.40, 3.20]
Mure 2019 Muttu 2017	11.6	9.6	11	29.5	21.7	11	0.4%	-17.90 [-31.92, -3.88]
Mutlu 2017 Nekete 2006	12.8	6.6	25	18.9	8.4	25	0.6%	-6.10 [-10.29, -1.91]
Nakata 2006 Noruntarat 2014	30.1	24	30	69 46 6	28.4	30	0.4%	-38.90 [-52.21, -25.59]
Neruntarat 2011 Rong 2016	13.4	5.2	83	45.6 26.2	10.3	83	0.6%	-32.20 [-34.68, -29.72]
Pana 2016	12.6	5.8	73	26.3	17.7	73	0.6%	-13.70 [-17.979.43]

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Pang 2020 (L p.551)	14.6	10.8	326	35	19.2	326	0.6%	-20.40 [-22.79, -18.01]	-
Park 2018	13.8	15.6	29	37.8	24.7	29	0.5%	-24.00 [-34.63, -13.37]	
Peng 2016	18	15.2	52	64.2		52	0.5%	-46.20 [-54.27, -38.13]	
Peng 2019	26	20.2	48		18.9	48	0.5%	-21.00 [-28.83, -13.17]	
Plaza 2019 Potenborg 2014	8.6 19.8	6.7 11.1	75 126	22.1 47.3	12.2	75 126	0.6% 0.6%	-13.50 [-16.65, -10.35] -27.50 [-30.28, -24.72]	
Rotenberg 2014 Roustan 2018	5.2	3.2	20	47.5	11.4 6.5	20	0.6%	-18.40 [-21.58, -15.22]	-
Salapatas 2016	12.7	7.6	601	19.8	5.9	601	0.6%	-7.10 [-7.87, -6.33]	-
Sanders 1990	29.5	38.8	15	66.3	38.5	15	0.2%	-36.80 [-64.46, -9.14]	
Santos 2007	4.4	5.7	10	12.4	4.6	10	0.6%	-8.00 [-12.54, -3.46]	
Sarber 2020	3.1	4.9	31	34.8	25.6	31	0.5%	-31.70 [-40.88, -22.52]	
Sezen 2011	12.4	7.7	20	24.6	9.1	20	0.6%	-12.20 [-17.42, -6.98]	
Shah 2018	28.8	25.4	20		12.4	20	0.4%	-11.50 [-23.89, 0.89]	
Shin 2013 Shuqib 2015	18.5	15.6	30	29.6	21.6	30	0.5%	-11.10 [-20.63, -1.57]	
Shuaib 2015 Simsek 2015	16 9	16.1 8.4	26 37	24.7 17.6	18.8 9.1	26 37	0.5% 0.6%	-8.70 [-18.21, 0.81] -8.60 [-12.59, -4.61]	_
Suh 2013	26.9	24.2	50	55.3	24.6	50	0.5%	-28.40 [-37.96, -18.84]	
Sun 2008	28.6	29.1	31	65.9	23.8	31	0.4%	-37.30 [-50.53, -24.07]	
Sundman 2021	23.6	20.2	60	52.9	20.5	65	0.5%	-29.30 [-36.44, -22.16]	
Suslu 2017	19.6	14	28	31	15.2	28	0.5%	-11.40 [-19.05, -3.75]	
Thaler 2016	31.4	28.6	75	57.5	23.9	75	0.5%	-26.10 [-34.54, -17.66]	
Toh 2014	13.5	17.1	20	41.3	22.1	20	0.4%	-27.80 [-40.05, -15.55]	
Tuncel 2012	6.2	1.7	35	14.6	2.4	35	0.6%	-8.40 [-9.37, -7.43]	-
Turhan 2015 (EAO p3411)	20.5	17.7	90	51.8	18.8	90	0.6%	-31.30 [-36.63, -25.97]	
Turhan 2015 (EAO p995)	20	19.5	31	44.7	17	31	0.5%	-24.70 [-33.81, -15.59]	
Turhan 2020 Verse 2002	18.8 28.9	14.9 24.7	64 26	41.7 31.6	21.3 25.6	64 26	0.6% 0.4%	-22.90 [-29.27, -16.53]	
Vicini 2010 (ORL)	20.9	17.3	10	38.3	23.5	10	0.4%	-2.70 [-16.37, 10.97] -17.70 [-35.79, 0.39]	
Vicini 2014 (HN)	14.8	11.3	24	38.5	17	24	0.5%	-23.70 [-31.87, -15.53]	
Vicini 2014 (ORL)	17.9	18.4	243	43	22.6	243	0.6%	-25.10 [-28.76, -21.44]	-
Vicini 2015	13.6	15.4	10	43.6	26.8	10	0.3%	-30.00 [-49.16, -10.84]	
Vilaseca 2002	44.6	27	20	60.4	16.5	20	0.4%	-15.80 [-29.67, -1.93]	
Walker 1989	60.1	27.6	11	70.3	26.7	11	0.3%	-10.20 [-32.89, 12.49]	
Wang 2013	23.2	18.4	36	59.8	20.5	36	0.5%	-36.60 [-45.60, -27.60]	
Wee 2015	18.7	14.8	27	37.7	18.6	27	0.5%	-19.00 [-27.97, -10.03]	
Wetmore 1986	33.5	29.1	27	64	32.7	27	0.4%	-30.50 [-47.01, -13.99]	
Woodson 2005 Vice 2016	26.4	21.2	74	48.1	27.8	74	0.5%	-21.70 [-29.67, -13.73]	
Xiao 2016 Yaremchuk 2011	43.1 13	21.9 17.4	30 29	49.7 35.9	19.5 24.9	30 29	0.5% 0.5%	-6.60 [-17.09, 3.89] -22.90 [-33.96, -11.84]	
Yi 2009	28.2	32.7	34		12.5	29 34	0.5%	-33.30 [-45.07, -21.53]	
Yi 2011	30.1	23.1	26		17.6	26	0.5%	-35.50 [-46.66, -24.34]	
Yin 2007	21.4	20.3	18	63.8	16.3	18	0.5%	-42.40 [-54.43, -30.37]	
Yuksel 2018	11.6	5.6	63	16.1	7.1	63	0.6%	-4.50 [-6.73, -2.27]	-
Zhang 2013	20.4	17.5	36	54.7	25.2	36	0.5%	-34.30 [-44.32, -24.28]	
Zhang 2014	20.8	18.4	119	62.1	18.2	119	0.6%	-41.30 [-45.95, -36.65]	
Zhao 2017	20	11.9	40	54.2	20.5	40	0.5%	-34.20 [-41.55, -26.85]	
Subtotal (95% CI)	0.1.17 0	300.05	7326			7338	72.5%	-21.03 [-22.75, -19.32]	•
 Heterogeneity: Tau² = 88.24; Test for overall effect: Z = 24. 				I (P < U	00001); in= 95	%		
Testion overall ellect. 2 - 24.	00 (1 ~ 1	0.00001	· · ·						
1.1.2 Skeletal procedures									
Bettega 2000	11.1	8.9	20	59.3	29	20	0.4%	-48.20 [-61.49, -34.91]	
Blumen 2009	14.4	14.5	50	65.5	26.7	50	0.5%	-51.10 [-59.52, -42.68]	
Boyd 2013	17.6	15.9	106	51.3	32.9	106	0.5%	-33.70 [-40.66, -26.74]	
Brevi 2011 (JOMS)	10.5	7.4	33		19.3	33	0.5%	-45.10 [-52.15, -38.05]	
Conradt 1997	5	5.8	15	51.4	16.9	15	0.5%	-46.40 [-55.44, -37.36]	
Gerbino 2014 Giordo 2012	17.3	16.7	10	69.8	35.2	10	0.3%	-52.50 [-76.65, -28.35]	
Giarda 2013 Goh 2003	16.1 11.4	17.5 7.4	16 11	47.1 70.7	22.5 15.9	16 11	0.4% 0.5%	-31.00 [-44.97, -17.03] -59.30 [-69.66, -48.94]	
Goodday 2016	16.1	26.2	13	117.9	9.2	13		-101.80 [-116.89, -86.71]	
Hochban 1997	2.5	3.9	38		17.1	38	0.6%	-42.70 [-48.28, -37.12]	
Hsieh 2014	4.8	4.4	16	35.7	18	16	0.5%	-30.90 [-39.98, -21.82]	
Islam 2015 (BJOMS v1)	7.6	6.3	50	41.3	17.8	50	0.6%	-33.70 [-38.93, -28.47]	
Lin 2011	4.6	4.1	12	35.9	18	12	0.5%	-31.30 [-41.75, -20.85]	
Liu 2012	9.4	7.2	11	67.4	13.3	11	0.5%	-58.00 [-66.94, -49.06]	
Liu 2015	9.3	7.1	16	59.8	25.6	16	0.4%	-50.50 [-63.52, -37.48]	
Liu 2016	9.5	7.4	20	53.6	26.6	20	0.5%	-44.10 [-56.20, -32.00]	
Lye 2008 Malanan 2017	13.9	12.8	15	69.1	23.3	15	0.4%	-55.20 [-68.65, -41.75]	
Makovey 2017 Manikandhan 2014	15.6	12.1	20	49.4	20	20	0.5%	-33.80 [-44.04, -23.56]	
Manikandhan 2014 Ronchi 2013	12.9 8.1	13.8 7.8	13 15	44.9 58.7	22.3 16	13 15	0.4% 0.5%	-32.00 [-46.26, -17.74] -50.60 [-59.61, -41.59]	
Schendel 2014	5.2	8.3	10	42.9	21.2	10	0.5%	-37.70 [-51.81, -23.59]	
Varghese 2012	7.8	10.5	24	45.4	26.4	24	0.4%	-37.60 [-48.97, -26.23]	
Vigneron 2017	25.5	14.7	29	56.7	20.4	29	0.5%	-31.20 [-40.35, -22.05]	
Subtotal (95% CI)			563			563	10.8%	-44.55 [-49.61, -39.48]	•
Listenson site Territ 404 C4	- ONZ	407.70	46 - 22	/D - 0 (100043	12 - 0.822			

Heterogeneity: Tau² = 121.61; Chi² = 137.76, df = 22 (P < 0.00001); l² = 84% Test for overall effect: Z = 17.23 (P < 0.00001)

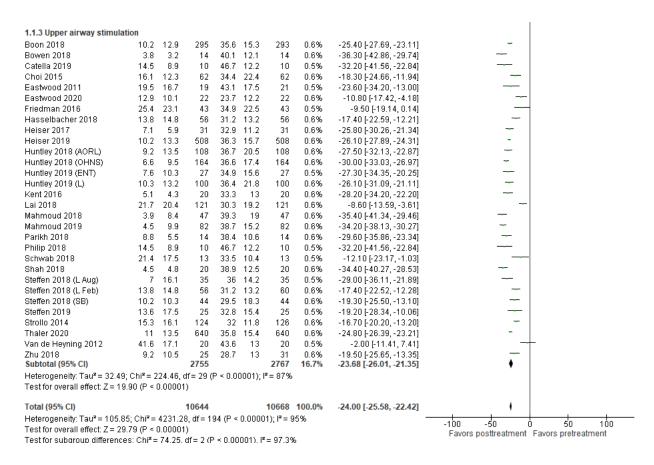


Figure S21. OR-based surgery vs. control (RDI) [RCT]

•			•			•					
	Su	irgery		С	ontrol			Mean Difference	Mean Difference		
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI		
2.3.1 Soft tissue pro	cedures										
Browaldh 2013	25.8	17.3	32	50.1	23.1	33	54.3%	-24.30 [-34.20, -14.40]			
Sommer 2016	21.8	21.8	17	28.7	19.4	16	45.7%	-6.90 [-20.96, 7.16]			
Subtotal (95% CI)			49			49	100.0%	-16.35 [-33.33, 0.64]			
Heterogeneity: Tau ² =	= 112.88;	Chi z =	: 3.93,	df = 1 (F	P = 0.0	5); I ^z = i	75%				
Test for overall effect	Z=1.89	(P = (0.06)								
Total (95% CI)			49			49	100.0%	-16.35 [-33.33, 0.64]			
Heterogeneity: Tau ² =	= 112.88;	Chi ⁼=	: 3.93,	df = 1 (F	P = 0.0	5); I ² = 1	75%	-			
Test for overall effect	Z=1.89	(P = 0).06)						-50 -25 0 25 50 Favors surgery Favors control		
Test for subaroup dif	ferences	: Not a	ipplical	ble					Favors surgery Favors control		

Figure S22. OR-based surgery pretreatment vs. posttreatment (RDI)

-	Post	reatm	-	Pret	reatme	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
1.3.1 Soft tissue pro	cedures								
Baradaranfar 2015	9.4	3.3	48	26.4	8.4	48	4.2%	-17.00 [-19.55, -14.45]	+
Hendler 2001	28.8	27.4	33	60.2	29.9	33	3.1%	-31.40 [-45.24, -17.56]	
Huang 2008	6.1	11.7	50	37.9	21	50	3.9%	-31.80 [-38.46, -25.14]	
Jung 2020	32.5	18.6	60	52	19	60	3.9%	-19.50 [-26.23, -12.77]	
Lee 1999	6.7	5.4	27	53.1	27.6	27	3.5%	-46.40 [-57.01, -35.79]	<u> </u>
Lee 2009 (OHNS)	23.4	7.7	30	34.3	9.7	30	4.1%	-10.90 [-15.33, -6.47]	-
Li 2003	12.5	18.1	33	41.6	28.2	33	3.4%	-29.10 [-40.53, -17.67]	<u> </u>
Li 2005 (AJO)	13.4	19.8	50	44.5	29.4	50	3.6%	-31.10 [-40.92, -21.28]	
Li 2005 (AOL)	11.7	8.3	85	36.3	16.9	85	4.1%	-24.60 [-28.60, -20.60]	
Lin 2006	12.1	19.1	55	43.6	29.7	55	3.7%	-31.50 [-40.83, -22.17]	_ -
Miller 2002	21	7.4	15	38.7	12.3	15	3.9%	-17.70 [-24.96, -10.44]	
Miller 2004	15.9	7.5	24	52.9	17.1	24	3.9%	-37.00 [-44.47, -29.53]	
Neruntarat 2003	14.5	5.8	31	48.2	10.8	31	4.1%	-33.70 [-38.02, -29.38]	+
Omur 2005	17.3	14.2	22	47.5	15.7	22	3.7%	-30.20 [-39.05, -21.35]	- -
Pang 2016	15.6	6.7	73	29.4	16.4	73	4.1%	-13.80 [-17.86, -9.74]	+
Park 2018	17.5	15.4	29	40.5	23	29	3.6%	-23.00 [-33.07, -12.93]	
Robinson 2009	22.1	21.6	68	44	18.6	68	3.9%	-21.90 [-28.68, -15.12]	
Shine 2009	15.4	12.3	60	37.2	20.4	60	4.0%	-21.80 [-27.83, -15.77]	
Sorrenti 2003	24.3	16.1	15	44.5	14.6	15	3.5%	-20.20 [-31.20, -9.20]	
Sundman 2021	28	20.2	59	55.1	19.7	65	3.9%	-27.10 [-34.14, -20.06]	
Tan 2014	13.1	21.7	34	42.2	25.6	34	3.4%	-29.10 [-40.38, -17.82]	
Toh 2014	22.4	17.4	20	52.7	18.6	20		-30.30 [-41.46, -19.14]	<u> </u>
Subtotal (95% CI)			921			927		-25.73 [-29.40, -22.07]	•
Heterogeneity: Tau ² = Test for overall effect					(P < 0.	.00001)	; I ^z = 86%		
1.3.2 Skeletal proce	dures								
Conradt 1998	5.6	9.6	24	59.3	24.1	24	3.5%	-53.70 [-64.08, -43.32]	
Gerbino 2014	10.3	7.2	10	74.1	34.4	10	2.2%	-63.80 [-85.58, -42.02]	
Li 2000 (L p.1684)	8.1	5.9	19	63.6	20.8	19	3.6%	-55.50 [-65.22, -45.78]	
Li 2000 (OHNS)	9.3	10.2	42	57.1	25.4	42	3.8%	-47.80 [-56.08, -39.52]	- - -
Riley 2000	11.1	7	40	71.2	27	40		-60.10 [-68.74, -51.46]	
Subtotal (95% CI)			135			135	16.9%	-54.63 [-59.69, -49.58]	◆
Heterogeneity: Tau ² = Test for overall effect					0.30); I	²=18%	ò		
Total (95% CI)			1056			1062	100.0%	-31.00 [-35.69, -26.31]	◆
Heterogeneity: Tau ² :	= 133.58:	Chi ^z =	339.43	3. df = 21	6 (P < I	0.0000	1); Iž = 929	%	
Test for overall effect					`	-			-100 -50 0 50 100 Favors Posttreatment Favors Pretreatment
					n - 0 (000043	I² = 98.8 9	Y	Favors Fostileaument Favors Pretreatment

	Posttreat	ment	Pretreatr	nent		Risk Difference	Risk Difference
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% CI
1.34.1 Soft tissue proce	edures						
Babademez 2019 (CO)	1	70	0	70	13.5%	0.01 [-0.02, 0.05]	
Haavisto 1994	9	52	0	52	4.6%	0.17 [0.07, 0.28]	
Holmlund 2016	0	28	0	28	8.5%	0.00 [-0.07, 0.07]	
Komada 2012	0	24	0	24	7.1%	0.00 [-0.08, 0.08]	
Omur 2005	0	22	0	22	6.4%	0.00 [-0.08, 0.08]	_
Pang 2020 (L p.2281)	1	217	0	217	18.4%	0.00 [-0.01, 0.02]	+
Robinson 2009	7	64	0	64	6.8%	0.11 [0.03, 0.19]	
Wee 2015	0	47	0	47	13.1%	0.00 [-0.04, 0.04]	-
Subtotal (95% CI)		524		524	78.5%	0.03 [-0.01, 0.07]	◆
Total events	18		0				
Heterogeneity: Tau ² = 0.1	00: Chi ² = 37	.18. df=	7 (P < 0.0	0001):	≈ = 81%		
Test for overall effect: Z =		•	(/1 .			
1.34.2 Skeletal procedu	res						
Liu 2012	0	11	0	11	2.3%	0.00 [-0.16, 0.16]	
Subtotal (95% CI)		11		11	2.3%	0.00 [-0.16, 0.16]	
Total events	0		0				
Heterogeneity: Not appli	cable						
Test for overall effect: Z =	= 0.00 (P = 1.	.00)					
1.34.3 Upper airway stii	mulation						
Thaler 2020	1	640	0	640		0.00 [-0.00, 0.01]	+
Subtotal (95% CI)		640		640	19.1%	0.00 [-0.00, 0.01]	
Total events	1		0				
Heterogeneity: Not appli	cable						
Test for overall effect: Z =	= 0.71 (P = 0.	48)					
Total (95% CI)		1175		1175	100.0%	0.02 [-0.01, 0.04]	•
Total events	19		0				
Heterogeneity: Tau ² = 0.1	00; Chi² = 61	.79, df=	9 (P ≤ 0.0	0001);1	≃ =85%		-0.5 -0.25 0 0.25 0.
Test for overall effect: Z =	= 1.38 (P = 0.	17)					pretreatment posttreatment

Figure S23. OR-based surgery pretreatment vs. posttreatment (persistent dysphagia, incidence)

Figure S24. OR-based surgery pretreatment vs. posttreatment (MD Anderson dysphagia score)

J · · ·			J - J										
	Posttr	eatm	ent	Pretreatment			Mean Difference	Mean Difference					
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Random, 95% CI	IV, Random, 95% CI					
1.51.1 Soft tissue pr	ocedures												
Vicini 2014 (HN)	3.2	4.9	24	3.6	5.7	24	-0.40 [-3.41, 2.61]						
							_						
							-	-4 -2 0 2 4					
								Favors posttreatment Favors pretreatment					

Figure S25. OR-based surgery vs. control (LSAT) [RCT]

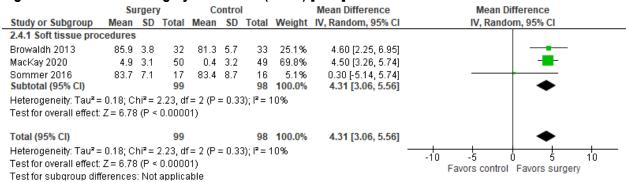


Figure S26. OR-based surgery pretreatment vs. posttreatment (LSAT)

		reatme			eatme			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD 1	Total	Mean	SD	Total	Weight	IV, Random, 95% Cl	IV, Random, 95% CI
.4.1 Soft tissue procedure	s								
skar 2018 (CO)	90.3	4.8	22	80.3	4.4	22	0.9%	10.00 [7.28, 12.72]	
skar 2018 (SB)	93.1	3.1	26	79.4	3.5	26	0.9%	13.70 [11.90, 15.50]	-
ynaci 2018	94	1.4	40	79.6	4.8	40		14.40 [12.85, 15.95]	
zbay 2016	77	7.5	67	75	8.7	67	0.9%	2.00 [-0.75, 4.75]	<u>+-</u>
Babademez 2010	86.6	2	16	84.6	3.4	16	0.9%	2.00 [0.07, 3.93]	
Baisch 2006	85	7.5	83	81.4	9.6	83	0.9%	3.60 [0.98, 6.22]	
			48			48	0.9%		
Baradaranfar 2015	81.8	2.4		78.8	2.9			3.00 [1.94, 4.06]	
Bican 2010	87.8	5.3	20	83	5.8	20	0.8%	4.80 [1.36, 8.24]	
Binar 2017 (EAO)	85.6	3.9	23	80.7	7.2	23	0.8%	4.90 [1.55, 8.25]	
3inar 2017 (JLO)	85.5	3.7	29	80.5	6.5	29	0.9%	5.00 [2.28, 7.72]	
Bostanci 2016	82.3	7.4	82	75.7	8.9	82	0.9%	6.60 [4.09, 9.11]	
Bowden 2005	81.9	10.1	29	72.7	20.5	29	0.5%	9.20 [0.88, 17.52]	
Browaldh 2018	85.3	4.8	60	80.5	6	65	0.9%	4.80 [2.90, 6.70]	
Cho 2014	88.3	1.9	23	83.2	3.1	23	0.9%	5.10 [3.61, 6.59]	-
Choi 2011 (AJRA)	79.8	8.2	22	80.6	7.1	22	0.7%	-0.80 [-5.33, 3.73]	
Choi 2012	86.3	6.5	36	73.3	12.7	36	0.7%	13.00 [8.34, 17.66]	
Choi 2013	82.9	11.3	20	76.4	12	20	0.5%	6.50 [-0.72, 13.72]	<u> </u>
Conway 1985	62.5	17.5	20	37.5	23.1	20		25.00 [12.30, 37.70]	
Cui 2016	83.9	7.4	12	80.7	8.2	12	0.6%	3.20 [-3.05, 9.45]	-+
Dahlof 2002	81.7	9.5	51		10.4	53	0.8%	5.70 [1.87, 9.53]	
El-Ahl 2016	89.3	5.3	24	79.2	4.1	24	0.9%	10.10 [7.42, 12.78]	
			40	79.2		40	0.8%		
El-Anwar 2018 El Anwar 2010	83.6 07.2	4.1			13 6 0			13.30 [9.08, 17.52]	<u>_</u>
El-Anwar 2019 Elbaasioupy 2015	87.2	7.2	40	76.5	6.8	40	0.8%	10.70 [7.63, 13.77]	
Elbassiouny 2015	88.3	1.2	28	75.7	1.3	28		12.60 [11.94, 13.26]	
Emara 2011	87.2	11.1	23	78.9	12.6	23	0.6%	8.30 [1.44, 15.16]	
mara 2016	89.3	11.1	38	79.9	14.8	38	0.6%	9.40 [3.52, 15.28]	
Eun 2008	79.4	16.5	56	79.1	5.7	56	0.7%	0.30 [-4.27, 4.87]	
Eun 2009	80.9	6.5	90	77.8	7.8	90	0.9%	3.10 [1.00, 5.20]	
riedman 2003	86.4	9.8	277	82.6	11.4	277	0.9%	3.80 [2.03, 5.57]	
Junawardena 2013	88	5.2	27	84	5.2	27	0.9%	4.00 [1.23, 6.77]	
Ha 2020	83.8	7.6	95	79	8.1	95	0.9%	4.80 [2.57, 7.03]	
Hendler 2001	80.4	12.3	33	72.4	15.2	33	0.6%	8.00 [1.33, 14.67]	——
Hester 1995	81.9	6.2	15	71.1	9.8	15	0.6%	10.80 [4.93, 16.67]	
Hobson 2012	88	6.5	27	84.4	5.6	27	0.8%	3.60 [0.36, 6.84]	
Huang 2008	84	5.2	50	76	8.5	50	0.9%	8.00 [5.24, 10.76]	
Huang 2016	82.4	11.6	40	79.9	9.5	40	0.7%	2.50 [-2.15, 7.15]	
Huntley 2019 (L)	84.1	8.9	24	80.5	10.6	24	0.7%	3.60 [-1.94, 9.14]	
Jacobowitz 2006	82.8	7.1	37	79	7.4	37	0.8%		
								3.80 [0.50, 7.10]	
Jung 2020 Karakas 2010	83.1	6.3	60 70	78.1	8.3	60	0.9%	5.00 [2.36, 7.64]	
Karakoc 2018	84.7	6.7	79	79.3		79	0.9%	5.40 [2.54, 8.26]	
<ayhan 2016<="" td=""><td>83.9</td><td>6.4</td><td>25</td><td>79.5</td><td>8.8</td><td>25</td><td>0.8%</td><td>4.40 [0.13, 8.67]</td><td></td></ayhan>	83.9	6.4	25	79.5	8.8	25	0.8%	4.40 [0.13, 8.67]	
Kezirian 2010	80.7	7.6	30	82.4	7.7	30	0.8%	-1.70 [-5.57, 2.17]	
<han 2009<="" td=""><td>80.7</td><td>10.7</td><td>63</td><td>73.7</td><td></td><td>63</td><td>0.7%</td><td>7.00 [2.00, 12.00]</td><td> </td></han>	80.7	10.7	63	73.7		63	0.7%	7.00 [2.00, 12.00]	
<im 2013<="" td=""><td>86.4</td><td>11.3</td><td>92</td><td>77</td><td>10.8</td><td>92</td><td>0.8%</td><td>9.40 [6.21, 12.59]</td><td></td></im>	86.4	11.3	92	77	10.8	92	0.8%	9.40 [6.21, 12.59]	
(im 2013 (EAO)	84.5	6.2	70	80.6	5.5	70	0.9%	3.90 [1.96, 5.84]	
(inoshita 2006	80.3	11.8	15	66	12.8	15	0.5%	14.30 [5.49, 23.11]	———
arsson 1991	82	9.4	50	72.6	12.8	50	0.7%	9.40 [5.00, 13.80]	
.ee 2009 (OHNS)	79.8	6.1	30	70.1	8.2	30	0.8%	9.70 [6.04, 13.36]	
.ee 2011 (OHNS)		12.2	30	75.5	9.6	30	0.7%	5.50 [-0.06, 11.06]	<u> </u>
.ee 2012	81.7	8.2	13	75.8	9.6	13	0.6%	5.90 [-0.96, 12.76]	<u> </u>
_i 2004	84.8	10.2	55	78.9	9.8	55	0.8%	5.90 [2.16, 9.64]	
.i 2008	79.5	12.5	51	78.3	11.9	51	0.7%	1.20 [-3.54, 5.94]	
.i 2000 .i 2013 (AOL)	82	5	67	65	13	67		17.00 [13.66, 20.34]	———
Li 2013 (EAO)	78.8	8.4	78		15.6	78	0.8%	13.20 [9.27, 17.13]	·
							0.8%		<u> </u>
i 2014	73	14 5.0	73	68 77 1	12	73		5.00 [0.77, 9.23]	
.i 2016	83.3	5.6	25	77.1		25	0.7%	6.20 [1.54, 10.86]	
.i 2018	87	5.4	25	80.5	8.5	25	0.8%	6.50 [2.55, 10.45]	
.in 2010	82.1	10.9	43	75.5		43	0.7%	6.60 [2.10, 11.10]	
.in 2013	84	6.4	12	83.3	5.5	12	0.7%	0.70 [-4.07, 5.47]	
.in 2014	80.1	11.3	35	70.4	9.9	35	0.7%	9.70 [4.72, 14.68]	
_in 2015	83.4	7.3	39	81.6	8.1	39	0.8%	1.80 [-1.62, 5.22]	+-
_in 2017	80.8	8.2	47	78.2	9.9	47	0.8%	2.60 [-1.08, 6.28]	+
.iu 2013	79.3	11.3	51	70.8	10.9	51	0.8%	8.50 [4.19, 12.81]	
/lacKay 2013 (JLO)	85.7	7.1	17	82	8.9	17	0.7%	3.70 [-1.71, 9.11]	+
diller 2002	88.1	4.9	15	81.8	5.6	15	0.8%	6.30 [2.53, 10.07]	
diller 2004	88.3	7.1	24	80.1	8.4	24	0.7%	8.20 [3.80, 12.60]	<u> </u>
		5.8	10	88.1		10	0.5%		
1iyazaki 1998	90.9							2.80 [-4.69, 10.29]	

Nakata 2006	93.4	6.4	30	81.4	9.1	30	0.8%	12.00 [8.02, 15.98]
Neruntarat 2003	88.8	2.9	31	81.8	3.8	31	0.9%	7.00 [5.32, 8.68]
Neruntarat 2011	89.2	4.8	83	82.6	5.4	83	0.9%	6.60 [5.05, 8.15]
Pang 2016 Pang 2020 (Lin 551)	89 83.9	3.6 7.7	73 326	83.8 79.6	8.2 9.5	73 326	0.9% 0.9%	5.20 [3.15, 7.25]
Pang 2020 (L p.551) Park 2018	03.9 86.1	5.2	320 29	78.2	9.0 9.4	29	0.9%	4.30 [2.97, 5.63] 7.90 [3.99, 11.81]
Peng 2016	75.6	14	52	55.5	17	52	0.6%	20.10 [14.11, 26.09]
Peng 2019	80.9	8.3	48	70.3	7.1	48	0.8%	10.60 [7.51, 13.69]
Philip-Joet 1991	67.4	19.5	14	51.2	19.6	14	0.2%	16.20 [1.72, 30.68]
Robinson 2009	86.5	6.8	77	81.4	8.1	77	0.9%	5.10 [2.74, 7.46]
Ryan 1990	74	15.5	60	64	18.6	60	0.6%	10.00 [3.87, 16.13]
Salapatas 2016	88.7	4.7	601	87.4	5.4	601	1.0%	1.30 [0.73, 1.87]
Sanders 1990	83.6	9.2	21	73.4	11.5	21	0.6%	10.20 [3.90, 16.50]
Santos 2007	88.4	3.1	10	82.9	9	10	0.6%	5.50 [-0.40, 11.40]
Sarber 2020 Shin 2013	89 86.5	3.1	31 30	82.3 82.7	4.5 10	31 30	0.9%	6.70 [4.78, 8.62]
Shine 2009	87.4	8.2 4.3	50 60	83.9	5.4	50 60	0.7% 0.9%	3.80 [-0.83, 8.43] 3.50 [1.75, 5.25]
Shuaib 2015	87.6	5.5	26	85.6	5.5	26	0.8%	2.00 [-0.99, 4.99]
Sorrenti 2003	84.9	5.2	15	79.1	5.6	15	0.8%	5.80 [1.93, 9.67]
Suh 2013	82.6	7.7	50	78.2	9.4	50	0.8%	4.40 [1.03, 7.77]
Sun 2008	75	12.4	31	72.6	11.9	31	0.6%	2.40 [-3.65, 8.45]
Sundman 2021	85.3	4.8	60	80.5	6	65	0.9%	4.80 [2.90, 6.70]
Tan 2014	83.9	8.6	34	73.3	13.7	34	0.7%	10.60 [5.16, 16.04]
Thaler 2016	83.1	7.3	75	78.8	9.6	75	0.9%	4.30 [1.57, 7.03]
Toh 2014	84.5	7.1	20	72.9	19.3	20	0.4%	11.60 [2.59, 20.61]
Turhan 2015 (EAO p3411)	82.4	6.6	90	75.6	9.3	90	0.9%	6.80 [4.44, 9.16]
Turhan 2020	85.1	5.8	64	80.4	9.4	64	0.9%	4.70 [1.99, 7.41]
Vicini 2010 (ORL)	80.2	8.7	10	72.7	10.9	10	0.5%	7.50 [-1.14, 16.14]
Vicini 2014 (ORL) Vilaseca 2002	83.8 74.8	6.4 12.2	243 20	79.2 68.3	9.1 10.1	243 20	% 9.0 % a n	4.60 [3.20, 6.00] 6.50 [-0.44, 13.44]
Walker 1989	74.0 58.3	21.4	11	00.3 50	19.1	11	0.6% 0.2%	8.30 [-8.65, 25.25]
Wang 2013	85.6	10	36	70.5	12.4	36	0.2%	15.10 [9.90, 20.30]
Wee 2015	83.1	6.4	27	78	9.1	27	0.8%	5.10 [0.90, 9.30]
Wetmore 1986	76.4	13	27	64.8	20.3	27	0.4%	11.60 [2.51, 20.69]
Xiao 2016	76	9.9	30	73.8	8.5	30	0.7%	2.20 [-2.47, 6.87]
Yi 2009	83.4	9.8	34	71.7	11.8	34	0.7%	11.70 [6.54, 16.86]
Yin 2007	81.3	13.3	18	72.4	7.1	18	0.6%	8.90 [1.94, 15.86]
Zonato 2006	80	11	17	82.2	9.8	17	0.6%	-2.20 [-9.20, 4.80]
Subtotal (95% CI)			5431			5443	78.9%	-2.20 [-9.20, 4.80] 6.53 [5.61, 7.44]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83;	Chi² = 1	221.11	5431 , df = 10			5443	78.9%	
Subtotal (95% CI)	Chi² = 1	221.11	5431 , df = 10			5443	78.9%	
Subtotal (95% CI) Heterogeneity: Tau² = 17.83; Test for overall effect: Z = 14.	Chi² = 1	221.11	5431 , df = 10			5443	78.9%	
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83;	Chi² = 1	221.11	5431 , df = 10			5443	78.9%	6.53 [5.61, 7.44]
Subtotal (95% CI) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures	Chi² = 1 02 (P < I	221.11 0.00001	5431 , df = 1())4 (P <	0.0000	5443)1); I ² =	78.9% 91%	
Subtotal (95% CI) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009	Chi² = 1 02 (P ≺ I 84.2	221.11 0.00001 7.4	5431 , df = 1() 50)4 (P < 70.7	0.0000	5443 (1); I ² = 50	78.9% 91% 0.7%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20]
Subtotal (95% CI) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3)	Chi ^z = 1 02 (P < ⊧ 84.2 83.9	221.11 0.00001 7.4 8.8	5431 , df = 1() 50 11)4 (P < 70.7 58.6	0.0000 19.2 12.3	5443 (1); I ² = 50 11	78.9% 91% 0.7% 0.4%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11]
Subtotal (95% CI) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684)	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 88.1	221.11 0.00001 7.4 8.8 7.4 6.7 4	5431 , df = 10) 50 11 50 39 19)4 (P ≤ 70.7 58.6 75.6 75.7 74.3	0.0000 19.2 12.3 10.7 10.5 13.2	5443 (1); ² = 50 11 50 39 19	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.6%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.982)	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 88.1 86	221.11 0.0000 ⁻¹ 7.4 8.8 7.4 6.7 4 7.9	5431 , df = 1() 50 11 50 39 19 21)4 (P ≤ 70.7 58.6 75.6 75.7 74.3 63.9	0.0000 19.2 12.3 10.7 10.5 13.2 17.7	5443 01); I ² = 50 11 50 39 19 21	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.6% 0.5%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.982) Li 2000 (OHNS)	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 88.1 86 87.3	221.11 0.0000 ⁻¹ 7.4 8.8 7.4 6.7 4 7.9 4.6	5431 , df = 10) 50 11 50 39 19 21 42	04 (P < 70.7 58.6 75.6 75.7 74.3 63.9 76.3	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 11.2	5443 (1); ² = 50 11 50 39 19 21 42	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.6% 0.5% 0.8%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (OHNS) Lin 2011	Chi ² = 1 02 (P < 1 83.9 82.3 81.9 88.1 86 87.3 90.6	221.11 0.00001 7.4 8.8 7.4 6.7 4 7.9 4.6 3.6	5431 (df = 10) 50 11 50 39 19 21 42 12	70.7 58.6 75.6 75.7 74.3 63.9 76.3 83	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 11.2 7.2	5443 (1); ² = 50 11 50 39 19 21 42 12	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.6% 0.5% 0.8% 0.7%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1884) Li 2000 (OHNS) Lin 2011 Lin 2012	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 88.1 86 87.3 90.6 88.6	221.11 0.00001 7.4 8.8 7.4 6.7 4 7.9 4.6 3.6 4.6	5431 , df = 10)) 50 11 50 39 19 21 42 12 12 11	70.7 58.6 75.6 75.7 74.3 63.9 76.3 83 63	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 11.2 7.2 10.7	5443 (1); ² = 50 11 50 39 19 21 42 12 11	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.6% 0.8% 0.7% 0.6%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (JCHNS) Lin 2001 Lin 2011 Lin 2012 Lin 2015	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 88.1 86 87.3 90.6 88.6 88.6 88.9	221.11 0.00001 7.4 8.8 7.4 6.7 4 7.9 4.6 3.6 4.6 3.6 4.6 3.4	5431 (df = 10) 50 11 50 39 19 21 42 12 11 16	70.7 58.6 75.6 75.7 74.3 63.9 76.3 83 63 80.8	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 11.2 7.2 10.7 7.6	5443 01); ² = 50 11 50 39 19 21 42 12 12 11 16	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.6% 0.8% 0.7% 0.6% 0.8%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18]
Subtotal (95% CI) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (OHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2016	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 86 87.3 90.6 88.6 88.6 88.9 94.1	221.11 0.0000 ⁴ 7.4 8.8 7.4 6.7 4 7.9 4.6 3.6 4.6 3.4 3.5	5431 (df = 10) 50 11 50 39 19 21 42 12 12 11 16 20	04 (P ≤ 70.7 58.6 75.6 75.7 74.3 63.9 76.3 83 63 80.8 80.8 80.9	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 11.2 7.2 10.7 7.6 8.9	5443 01); ² = 50 11 50 39 19 21 42 12 12 11 16 20	78.9% 91% 0.7% 0.4% 0.8% 0.6% 0.6% 0.8% 0.7% 0.6% 0.8% 0.8%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39]
Subtotal (95% CI) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (CHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2016 Lye 2008	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 88.1 86 87.3 90.6 88.6 88.6 88.9	221.11 0.00001 7.4 8.8 7.4 6.7 4 6.7 4.6 3.6 4.6 3.6 4.6 3.4 3.5 8.2	5431 (df = 10) 50 11 50 39 19 21 42 12 11 16	04 (P ≤ 70.7 58.6 75.6 75.7 74.3 63.9 76.3 83 80.8 80.8 80.9 76.5	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 11.2 7.2 10.7 7.6	5443 01); ² = 50 11 50 39 19 21 42 12 12 11 16	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.6% 0.8% 0.7% 0.6% 0.8%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61]
Subtotal (95% CI) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (OHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2016	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 88.1 86 87.3 90.6 88.6 88.6 88.9 94.1 85	221.11 0.0000 ⁴ 7.4 8.8 7.4 6.7 4 7.9 4.6 3.6 4.6 3.4 3.5	5431 (df = 10) 50 11 50 39 19 21 42 12 12 11 16 20 15	04 (P ≤ 70.7 58.6 75.6 75.7 74.3 63.9 76.3 83 63 80.8 80.8 80.9	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 11.2 7.2 10.7 7.6 8.9 11.4	5443 (1); ² = 50 11 50 39 21 42 12 11 16 20 15	78.9% 91% 0.7% 0.4% 0.8% 0.6% 0.8% 0.6% 0.8% 0.8% 0.8% 0.8%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39]
Subtotal (95% CI) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (L p.1882) Li 2000 (DHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2015 Liu 2016 Lye 2008 Makovey 2017	Chi ² = 1 02 (P < 1 83.9 82.3 81.9 88.1 86 87.3 90.6 88.6 88.6 94.1 85 85.1	221.11 0.00001 7.4 8.8 7.4 6.7 4 7.9 4.6 3.6 4.6 3.6 4.6 3.4 3.5 8.2 6.2	5431 , df = 10) 50 11 50 39 19 21 42 12 11 16 20 15 19	70.7 58.6 75.6 75.7 74.3 63.9 76.3 83 80.8 80.9 76.5 78.1	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 11.2 7.2 10.7 7.6 8.9 11.4 9.8	5443 (1); ² = 50 11 50 39 19 21 42 12 11 16 20 15 19	78.9% 91% 0.7% 0.8% 0.8% 0.6% 0.8% 0.6% 0.8% 0.6% 0.8% 0.6% 0.8%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (OHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2016 Liye 2008 Makovey 2017 Manikandhan 2014	Chi ² = 1 02 (P < 1 83.9 82.3 81.9 88.1 86 87.3 90.6 88.6 88.9 94.1 85 85.1 85.8 81 85.8 86.5	221.11 0.0000 7.4 8.8 7.4 6.7 4 7.9 4.6 3.6 4.6 3.4 3.5 8.2 6.2 12.9	5431 , df = 10) 50 11 50 39 19 21 42 12 11 16 20 15 19 13	70.7 58.6 75.6 75.7 74.3 63.9 76.3 80.8 80.8 80.9 76.5 78.1 68.4	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 11.2 7.2 10.7 7.6 8.9 11.4 9.8 14.7	5443)1); ² = 50 11 50 39 19 21 42 12 11 16 20 15 19 13	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.6% 0.8% 0.6% 0.8% 0.6% 0.8% 0.6% 0.8% 0.8% 0.7% 0.4%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [197, 23.23]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2001 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 88.1 86 87.3 90.6 88.6 88.9 94.1 85.5 85.1 81 85.8	221.11 0.0000 7.4 8.8 7.4 6.7 4.6 3.6 4.6 3.4 3.5 8.2 6.2 12.9 3.9	5431 , df = 10) 50 11 50 39 21 42 12 11 16 20 15 19 13 40 15 21	70.7 58.6 75.6 75.7 74.3 63.9 76.3 83 80.8 80.8 80.8 976.5 78.1 68.4 69.5	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 11.2 7.2 10.7 7.6 8.9 11.4 9.8 14.7 14.8	5443)1); ² = 50 11 50 39 19 21 42 12 11 16 20 15 19 13 40 15 21 21	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.5% 0.8% 0.5% 0.8% 0.6% 0.8% 0.8% 0.6% 0.7% 0.8% 0.8%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47] 5.00 [0.82, 9.18]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (DHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2015 Liu 2016 Lye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% Cl)	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 88.6 87.3 90.6 88.6 88.9 94.1 85 85.1 85.1 85.1 85.8 86.5 86.2	221.11 0.0000 7.4 8.8 7.4 6.7 4.6 3.6 4.6 3.4 3.5 8.2 6.2 12.9 3.9 5.7 5.6	5431 , df = 10) 50 11 50 39 9 21 42 12 12 12 12 12 13 40 15 19 13 40 521 414	04 (P < 70.7 58.6 75.7 74.3 63.9 76.5 78.1 68.4 69.5 73.9 81.2	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 7.6 8.9 11.4 9.8 14.7 14.8 10.1 8	5443 11); ² = 50 11 50 39 19 21 42 12 11 16 20 15 19 13 40 521 41 414	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.8% 0.6% 0.8% 0.8% 0.8% 0.6% 0.8% 0.6% 0.4% 0.7% 0.4% 0.8% 0.8% 11.1%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: $Z = 14$. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (OHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2015 Liu 2016 Lye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% Cl) Heterogeneity: Tau ² = 21.12;	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 88.1 86 87.3 90.6 88.6 88.9 94.1 85 85.1 85.8 85.1 81 85.8 86.5 86.2 Chi ² = 6	221.11 0.0000 7.4 8.8 7.4 6.7 4.6 3.6 4.6 3.4 3.5 6.2 12.9 3.9 5.7 5.6 7.24, d	5431 (df = 10)) 50 11 50 39 19 21 42 12 12 12 12 12 13 40 15 19 13 40 15 21 41 41 41 41	04 (P < 70.7 58.6 75.7 74.3 63.9 76.5 78.1 68.4 69.5 73.9 81.2	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 7.6 8.9 11.4 9.8 14.7 14.8 10.1 8	5443 11); ² = 50 11 50 39 19 21 42 12 11 16 20 15 19 13 40 521 41 414	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.8% 0.6% 0.8% 0.8% 0.8% 0.6% 0.8% 0.6% 0.4% 0.7% 0.4% 0.8% 0.8% 11.1%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47] 5.00 [0.82, 9.18]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (DHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2015 Liu 2016 Lye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% Cl)	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 88.1 86 87.3 90.6 88.6 88.9 94.1 85 85.1 85.8 85.1 81 85.8 86.5 86.2 Chi ² = 6	221.11 0.0000 7.4 8.8 7.4 6.7 4.6 3.6 4.6 3.4 3.5 6.2 12.9 3.9 5.7 5.6 7.24, d	5431 (df = 10)) 50 11 50 39 19 21 42 12 12 12 12 12 13 40 15 19 13 40 15 21 41 41 41 41	04 (P < 70.7 58.6 75.7 74.3 63.9 76.5 78.1 68.4 69.5 73.9 81.2	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 7.6 8.9 11.4 9.8 14.7 14.8 10.1 8	5443 11); ² = 50 11 50 39 19 21 42 12 11 16 20 15 19 13 40 521 41 414	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.8% 0.6% 0.8% 0.8% 0.8% 0.6% 0.8% 0.6% 0.4% 0.7% 0.4% 0.8% 0.8% 11.1%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47] 5.00 [0.82, 9.18]
Subtotal (95% CI) Heterogeneity: Tau ² = 17.83; Test for overall effect: $Z = 14$. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (DHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2015 Liu 2016 Lye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% CI) Heterogeneity: Tau ² = 21.12; Test for overall effect: $Z = 9.0$	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 86 87.3 90.6 88.9 94.1 85.8 85.1 85.1 85.1 85.8 86.5 86.2 Chi ² = 6 7 (P < 0.	221.11 0.0000 7.4 8.8 7.4 6.7 4.6 3.6 4.6 3.4 3.5 6.2 12.9 3.9 5.7 5.6 7.24, d	5431 (df = 10)) 50 11 50 39 19 21 42 12 12 12 12 12 13 40 15 19 13 40 15 21 41 41 41 41	04 (P < 70.7 58.6 75.7 74.3 63.9 76.5 78.1 68.4 69.5 73.9 81.2	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 7.6 8.9 11.4 9.8 14.7 14.8 10.1 8	5443 11); ² = 50 11 50 39 19 21 42 12 11 16 20 15 19 13 40 521 41 414	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.8% 0.6% 0.8% 0.8% 0.8% 0.6% 0.8% 0.6% 0.4% 0.7% 0.4% 0.8% 0.8% 11.1%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47] 5.00 [0.82, 9.18]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: $Z = 14$. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (OHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2015 Liu 2016 Lye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% Cl) Heterogeneity: Tau ² = 21.12;	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 86 87.3 90.6 88.9 94.1 85.8 85.1 85.1 85.1 85.8 86.5 86.2 Chi ² = 6 7 (P < 0.	221.11 0.0000 7.4 8.8 7.4 6.7 4.6 3.6 4.6 3.4 3.5 6.2 12.9 3.9 5.7 5.6 7.24, d	5431 (df = 10)) 50 11 50 39 19 21 42 12 12 12 12 12 13 40 15 19 13 40 15 21 41 41 41 41	04 (P < 70.7 58.6 75.7 74.3 63.9 76.5 78.1 68.4 69.5 73.9 81.2	0.0000 19.2 12.3 10.7 10.5 13.2 17.7 7.6 8.9 11.4 9.8 14.7 14.8 10.1 8	5443 11); ² = 50 11 50 39 19 21 42 12 11 16 20 15 19 13 40 521 41 414	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.8% 0.6% 0.8% 0.8% 0.8% 0.6% 0.8% 0.6% 0.4% 0.7% 0.4% 0.8% 0.8% 11.1%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47] 5.00 [0.82, 9.18]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (DHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2016 Lye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% Cl) Heterogeneity: Tau ² = 21.12; Test for overall effect: Z = 9.0	$Chi^{2} = 1$ 02 (P < 1) 84.2 83.9 82.3 81.9 86 87.3 90.6 88.6 88.6 84.1 85.1 85.1 85.1 85.1 85.2 $Chi^{2} = 6$ 7 (P < 0.2) ion	221.11 0.0000 7.4 8.8 7.4 6.7 4 4.6 3.6 3.4 4.6 3.6 3.4 3.5 8.2 6.2 12.9 3.9 5.7 5.6 5.7 5.6	5431 , df = 1() 50 11 50 39 19 21 42 12 12 12 12 12 13 40 15 21 40 45 21 41 41 45 = 16 (f	70.7 58.6 75.6 75.7 76.3 76.3 76.3 80.8 80.9 76.5 78.1 68.4 69.5 9 81.2 2 < 0.00	0.0000 19.2 12.3 10.7 10.5 17.7 11.2 7.2 10.7 7.6 8.9 11.4 9.8 14.7 14.8 10.1 8 0001);	5443 11); F= 50 11 50 39 19 21 42 12 12 14 20 15 19 13 40 15 21 40 15 21 40 F= 76%	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.8% 0.7% 0.8% 0.8% 0.8% 0.8% 0.8% 0.8% 0.8% 0.8	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47] 5.00 [0.82, 9.18] 11.95 [9.37, 14.53]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (DHNS) Lin 2011 Liu 2015 Liu 2016 Liye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% Cl) Heterogeneity: Tau ² = 21.12; Test for overall effect: Z = 9.0 1.4.3 Upper airway stimulat Bowen 2018	$Chi^{2} = 1$ 02 (P < 1) 84.2 83.9 82.3 81.9 86 87.3 90.6 88.6 88.6 85.1 85.1 85.1 85.4 85.5 86.2 $Chi^{2} = 6$ 7 (P < 0.3) ion 83.5	221.11 0.0000 7.4 8.8 7.4 6.7 4.6 3.6 4.6 3.4 4.6 3.4 3.5 6.2 12.9 3.9 5.7 5.6 7.24, d 00001) 6.6	5431 , df = 10) 50 11 50 39 19 21 42 12 12 12 12 12 13 40 15 21 414 414 414 414	24 (P < 70.7 58.6 75.6 75.7 76.3 80.8 80.9 76.5 78.1 68.4 69.5 73.9 81.2 2 4 0.00 83.1	0.0000 19.2 12.3 10.7 10.5 17.7 11.2 7.2 10.7 7.6 8.9 11.4 9.8 10.1 8 0001); 7	5443 11); F= 50 11 50 39 19 12 12 12 12 12 13 40 15 13 414 F= 76% 13	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.5% 0.8% 0.6% 0.8% 0.6% 0.8% 0.6% 0.7% 0.8% 11.1%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47] 5.00 [0.82, 9.18] 11.95 [9.37, 14.53]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (DHNS) Lin 2011 Liu 2015 Liu 2015 Liu 2015 Liu 2016 Lye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% Cl) Heterogeneity: Tau ² = 21.12; Test for overall effect: Z = 9.0 1.4.3 Upper airway stimulat Bowen 2018 Choi 2015	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 82.3 90.6 87.3 90.6 88.6 88.9 94.1 85 85.1 85.8 85.1 85.8 86.2 Chi ² = 6 7 (P < 0. 83.5 83.6	221.11 0.0000 7.4 8.8 7.4 6.7 4.6 3.6 4.6 3.4 3.5 5.6 5.6 7.24, d 00001) 6.6 6.7	5431 , df = 10) 50 11 50 39 21 42 12 12 12 12 12 12 13 40 15 19 13 40 15 21 414 414 f= 16 (f	04 (P < 70.7 58.6 75.6 75.7 74.3 83 80.8 80.9 76.5 78.1 68.4 69.5 73.9 81.2 < < 0.00 83.1 77.9	0.0000 19.2 12.3 10.7 10.5 13.2 10.7 7.2 10.7 7.6 8.9 11.4 9.8 14.7 14.8 10.1 8 0001); 7 10.9	5443 11); F= 50 11 50 39 19 21 42 12 12 12 12 13 40 15 19 13 40 15 21 41 41 41 F= 76% 13 62	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.6% 0.6% 0.6% 0.6% 0.6% 0.6% 0.6% 0.6	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.77, 18.47] 5.00 [0.82, 9.18] 11.95 [9.37, 14.53] 0.40 [-4.74, 5.54] 5.70 [2.52, 8.88]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (DHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2016 Lye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% Cl) Heterogeneity: Tau ² = 21.12; Test for overall effect: Z = 9.0 1.4.3 Upper airway stimulat Bowen 2018 Choi 2015 Heiser 2017 Huntley 2018 (AORL) Huntley 2018 (OHNS)	$Chi^{2} = 1$ 02 (P < 1) 84.2 83.9 82.3 81.9 86 87.3 90.6 87.3 90.6 88.9 94.1 85.8 85.1 85.1 85.8 86.5 86.5 86.5 86.2 $Chi^{2} = 6$ 7 (P < 0) 83.5 83.6 79.5 83.6 79.5 88.1	221.11 0.0000 7.4 8.8 7.4 6.7 4 4.6 3.6 3.4 3.5 8.2 6.2 12.9 3.9 3.9 5.7 5.6 7.24, d 00001) 6.6 6.7 11.6 3.9 3.9 4	5431 , df = 10) 50 11 50 39 19 21 42 12 12 12 12 12 12 15 19 13 40 15 21 414 45 21 414 45 21 414 414 414 62 21 108 108 108 108 108	24 (P < 70.7 58.6 75.6 75.7 63.9 76.3 80.8 80.9 76.5 78.1 68.4 69.5 78.1 68.4 69.5 78.1 68.4 69.5 73.9 81.2 2 4 0.00 83.1 77.9 74.1 80.9 78.2	0.0000 19.2 12.3 10.7 10.5 17.7 11.2 7.2 10.7 7.6 8.9 11.4 9.8 14.7 14.8 10.1 8 0001); 7 7 8.8 11.4 7.5 8.8	5443 11); ² = 50 11 50 39 19 21 42 12 12 12 14 20 15 19 13 40 15 21 414 47 27 840 15 21 16 20 15 39 9 13 16 20 15 16 20 15 16 20 16 20 17 16 20 16 20 16 20 16 20 16 20 16 20 16 20 16 20 16 20 16 20 16 20 16 20 16 20 16 20 16 21 16 20 16 20 16 21 16 20 16 21 16 20 16 20 16 21 16 20 16 21 16 20 17 16 20 17 16 20 17 16 20 17 16 20 17 16 20 17 16 20 17 16 20 17 16 20 17 16 20 17 17 18 18 20 19 13 20 15 21 404 15 21 15 21 16 16 20 15 21 16 16 21 17 18 18 18 18 18 18 18 18 18 18	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.8% 0.5% 0.8% 0.8% 0.8% 0.6% 0.7% 0.6% 0.7% 0.6% 0.8% 11.1%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47] 5.00 [0.82, 9.18] 11.95 [9.37, 14.53] 0.40 [-4.74, 5.54] 5.70 [2.52, 8.88] 5.20 [-0.53, 10.93] 6.60 [5.01, 8.19] 9.90 [8.42, 11.38]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (DHNS) Lin 2011 Liu 2012 Liu 2016 Lye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% Cl) Heterogeneity: Tau ² = 21.12; Test for overall effect: Z = 9.0 1.4.3 Upper airway stimulat Bowen 2018 Choi 2015 Heiser 2017 Huntley 2018 (AORL) Huntley 2018 (OHNS) Huntley 2018 (OHNS) Huntley 2019 (ENT)	$Chi^{2} = 1$ 02 (P < 1) 84.2 83.9 82.3 81.9 86.3 90.6 88.6 88.6 85.1 85.8 85.1 85.8 85.1 85.8 86.5 86.5 86.5 86.5 86.2 $Chi^{2} = 6$ 7 (P < 0.3) 83.6 79.3 87.3 87.5 88.1 89.9	221.11 0.0000 7.4 8.8 7.4 6.7 4.6 3.6 4.6 3.4 4.6 3.4 3.5 8.2 6.2 12.9 3.9 5.7 5.6 7.24, d 000001) 6.6 6.7 11.6 3.9 4 1.8	5431 , df = 10) 50 11 50 39 19 21 42 12 12 12 12 12 13 40 15 21 414 414 62 21 414 62 31 108 108 108 108 108 108 108	24 (P < 70.7 58.6 75.6 75.7 76.3 80.8 80.9 76.5 78.1 68.4 69.5 78.1 68.4 69.5 9 81.2 2 4 0.01 75.9 81.2 2 4 0.01 74.1 77.9 74.1 80.9 78.2 78.8	0.0000 19.2 12.3 10.7 10.5 17.7 10.5 17.7 10.5 17.7 10.5 17.7 10.5 17.7 10.5 11.4 9.8 10.4 9.8 10.4 14.7 14.8 0.001); 7 10.9 11.4 7.5 8.8 9 11.4 7.5 8.8 9 11.4 7.5 8.8 9 11.5 10.7 10.5 10.	5443 11); F= 50 11 50 39 19 19 12 12 12 12 12 13 40 15 21 414 F=76% 13 62 31 108 108 108 164 27	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.5% 0.8% 0.6% 0.7% 0.6% 0.7% 0.6% 0.7% 0.8% 0.6% 0.7% 0.8% 11.1%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47] 5.00 [0.82, 9.18] 11.95 [9.37, 14.53] 0.40 [-4.74, 5.54] 5.70 [2.52, 8.88] 5.20 [-0.53, 10.93] 6.60 [5.01, 8.19] 9.90 [8.42, 11.38] 11.10 [7.64, 14.56]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (DHNS) Lin 2011 Liu 2012 Liu 2015 Liu 2016 Lye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% Cl) Heterogeneity: Tau ² = 21.12; Test for overall effect: Z = 9.0 1.4.3 Upper airway stimulat Bowen 2018 Choi 2015 Heiser 2017 Huntley 2018 (AORL) Huntley 2018 (OHNS) Huntley 2019 (ENT) Huntley 2019 (L)	Chi ² = 1 02 (P < 1 84.2 83.9 82.3 81.9 82.3 81.9 86 87.3 90.6 87.3 90.6 88.6 88.9 94.1 85 85.1 85.8 85.1 85.8 86.2 Chi ² = 6 7 (P < 0. 60 83.5 83.6 79.3 87.5 83.8 89.9 88.8	221.11 0.0000 7.4 8.8 7.4 6.7 4.6 3.6 4.6 3.4 3.9 5.7 5.6 5.6 5.6 5.6 5.6 6.7 11.6 3.9 4.8 3.9 5.7 4.4 00001)	5431 , df = 10) 50 11 50 39 9 21 42 12 12 12 12 12 12 12 13 40 15 19 13 40 15 21 414 415 414 62 31 108 164 27 76	24 (P < 70.7 58.6 75.6 75.7 74.3 80.8 80.9 76.5 78.1 68.4 69.5 73.9 81.2 2 < 0.00 83.1 77.9 74.1 80.9 74.1 80.9 74.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.8 80.9 78.9 78.9 80.9 78.9 78.9 78.9 78.9 78.9 78.9 78.9 78	0.0000 19.2 12.3 10.7 10.5 17.7 11.2 7.2 10.7 7.6 8.9 11.4 9.8 10.1 8 0001); 7 10.9 11.4 7.5 8.8 9 8.4	5443 11); F= 50 11 50 39 19 21 42 12 12 12 12 13 40 15 19 13 40 15 19 13 40 15 21 41 42 15 19 13 40 52 13 40 52 13 40 52 14 50 50 50 50 50 50 50 50 50 50	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.6% 0.6% 0.6% 0.6% 0.6% 0.6% 0.6% 0.8% 0.8% 0.6% 0.8% 0.8% 0.8% 0.8% 0.8% 0.9%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47] 5.00 [0.82, 9.18] 11.95 [9.37, 14.53] 0.40 [-4.74, 5.54] 5.70 [2.52, 8.88] 5.20 [-0.53, 10.93] 6.60 [5.01, 8.19] 9.90 [8.42, 11.38] 11.10 [7.64, 14.56] 8.50 [6.48, 10.52]
Subtotal (95% Cl) Heterogeneity: Tau ² = 17.83; Test for overall effect: Z = 14. 1.4.2 Skeletal procedures Blumen 2009 Goh 2003 Islam 2015 (BJOMS v1) Islam 2015 (BJOMS v3) Li 2000 (L p.1684) Li 2000 (L p.1684) Li 2000 (DHNS) Lin 2011 Liu 2012 Liu 2016 Lye 2008 Makovey 2017 Manikandhan 2014 Riley 2000 Ronchi 2013 Varghese 2012 Subtotal (95% Cl) Heterogeneity: Tau ² = 21.12; Test for overall effect: Z = 9.0 1.4.3 Upper airway stimulat Bowen 2018 Choi 2015 Heiser 2017 Huntley 2018 (AORL) Huntley 2018 (OHNS) Huntley 2018 (OHNS) Huntley 2019 (ENT)	$Chi^{2} = 1$ 02 (P < 1) 84.2 83.9 82.3 81.9 86.3 90.6 88.6 88.6 85.1 85.8 85.1 85.8 85.1 85.8 86.5 86.5 86.5 86.5 86.2 $Chi^{2} = 6$ 7 (P < 0.3) 83.6 79.3 87.3 87.5 88.1 89.9	221.11 0.0000 7.4 8.8 7.4 6.7 4.6 3.6 4.6 3.4 4.6 3.4 3.5 8.2 6.2 12.9 3.9 5.7 5.6 7.24, d 000001) 6.6 6.7 11.6 3.9 4 1.8	5431 , df = 10) 50 11 50 39 19 21 42 12 12 12 12 12 13 40 15 21 414 414 62 21 414 62 31 108 108 108 108 108 108 108	24 (P < 70.7 58.6 75.6 75.7 76.3 80.8 80.9 76.5 78.1 68.4 69.5 78.1 68.4 69.5 9 81.2 2 4 0.01 75.9 81.2 2 4 0.01 74.1 77.9 74.1 80.9 78.2 78.8	0.0000 19.2 12.3 10.7 10.5 17.7 10.5 17.7 10.5 17.7 10.5 17.7 10.5 17.7 10.5 11.4 9.8 10.4 9.8 10.4 14.7 14.8 0.001); 7 10.9 11.4 7.5 8.8 9 11.4 7.5 8.8 9 11.4 7.5 8.8 9 11.5 10.7 10.5 10.	5443 11); F= 50 11 50 39 19 19 12 12 12 12 12 13 40 15 21 414 F=76% 13 62 31 108 108 108 164 27	78.9% 91% 0.7% 0.4% 0.8% 0.8% 0.5% 0.8% 0.6% 0.7% 0.6% 0.7% 0.6% 0.7% 0.8% 0.6% 0.7% 0.8% 11.1%	6.53 [5.61, 7.44] 13.50 [7.80, 19.20] 25.30 [16.36, 34.24] 6.70 [3.09, 10.31] 6.20 [2.29, 10.11] 13.80 [7.60, 20.00] 22.10 [13.81, 30.39] 11.00 [7.34, 14.66] 7.60 [3.05, 12.15] 25.60 [18.72, 32.48] 8.10 [4.02, 12.18] 13.20 [9.01, 17.39] 8.50 [1.39, 15.61] 7.00 [1.79, 12.21] 12.60 [1.97, 23.23] 16.30 [11.56, 21.04] 12.60 [6.73, 18.47] 5.00 [0.82, 9.18] 11.95 [9.37, 14.53] 0.40 [-4.74, 5.54] 5.70 [2.52, 8.88] 5.20 [-0.53, 10.93] 6.60 [5.01, 8.19] 9.90 [8.42, 11.38] 11.10 [7.64, 14.56]



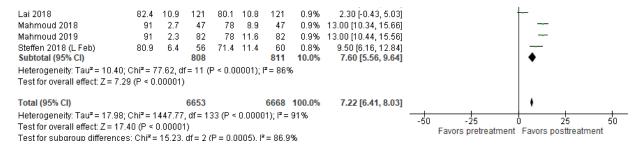


Figure S27. OR-based surgery vs. control (ODI) [RCT]

•						•		-	
	St	urgery		С	ontrol			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
2.8.1 Soft tissue pro	cedures								
Browaldh 2013	14	13.1	32	35.6	21.3	33	43.6%	-21.60 [-30.17, -13.03]	
MacKay 2020	-17.7	16	50	-4.2	16.6	49	56.4%	-13.50 [-19.92, -7.08]	
Subtotal (95% CI)			82			82	100.0%	-17.03 [-24.91, -9.16]	◆
Heterogeneity: Tau ² =	= 17.88; (Chi² =	2.20, ď	f = 1 (P :	= 0.14); l² = 5√	4%		
Test for overall effect	Z= 4.24	I (P ≺ (0.0001)	i i					
Total (95% CI)			82			82	100.0%	-17.03 [-24.91, -9.16]	•
Heterogeneity: Tau ² =	= 17.88; (Chi ⁼=	2.20, d	f=1 (P :	= 0.14); I² = 54	4%		
Test for overall effect:	Z= 4.24	I (P < (0.0001)	-					-50 -25 0 25 50 Favors surgery Favors control
Test for subgroup dif	ferences	: Not a	applical	ble					Favors surgery Favors control

Figure S28. OR-based surgery pretreatment vs. posttreatment (ODI)

•	Postt	reatm	ent	Pretr	eatme	ent	•	Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
1.11.1 Soft tissue procedur	es								
Azbay 2016	37.8	17	67	49	16.7	67	2.3%	-11.20 [-16.91, -5.49]	
Barbieri 2019	3.6	2.8	42	23.8	8.4	42	2.5%	-20.20 [-22.88, -17.52]	-
Bayir 2016	10.2	7.3	35	12	7.6	35	2.5%	-1.80 [-5.29, 1.69]	
Binar 2017 (EAO)	9.4	11	23	32.8	28	23	1.6%	-23.40 [-35.69, -11.11]	
Binar 2017 (JLO)	11.4	12.8	29	31.9	26.4	29	1.7%	-20.50 [-31.18, -9.82]	
Bostanci 2016	17.7	15.9	82	44.8	21.4	82	2.3%	-27.10 [-32.87, -21.33]	
Browaldh 2018	16	16.4	60	42.8	22.7	65	2.2%	-26.80 [-33.70, -19.90]	
Dahlof 2002	12.6	15.1	51	22.8	15.3	53	2.3%	-10.20 [-16.04, -4.36]	
Gunawardena 2013	6.1	5.2	27	26.1	21.8	27	2.0%	-20.00 [-28.45, -11.55]	
Hasselbacher 2018 (SB)	16.1	13	15	25.3	18.6	15	1.7%	-9.20 [-20.68, 2.28]	
Jung 2020	21	17.4	60	40	20.9	60	2.2%	-19.00 [-25.88, -12.12]	
Karakoc 2018	14.5	13.6	79	24.2	15.5	79	2.4%	-9.70 [-14.25, -5.15]	-
Kim 2013 (EAO)	11.6	13	70	24.4	15.3	70	2.4%	-12.80 [-17.50, -8.10]	
Larsson 1991	11.8	9.4	50	32.4	20.6	50	2.2%	-20.60 [-26.88, -14.32]	
Larsson 1994	11	5	48	32	10	48	2.5%	-21.00 [-24.16, -17.84]	-
Lee 2009 (OHNS)	18.4	5.8	30	28.2	7.7	30	2.5%	-9.80 [-13.25, -6.35]	-
Lee 2011 (OHNS)	14.1	15.4	30	37.5	27.9	30	1.7%	-23.40 [-34.80, -12.00]	
Lundkvist 2009	10.8	11.5	120	27.2	20.1	120	2.4%	-16.40 [-20.54, -12.26]	-
Montevecchi 2018	12.7	10.8	111	29.6	20.7	111	2.4%	-16.90 [-21.24, -12.56]	
Mora 2012	2.1	1.8	21	24	8.7	21	2.5%	-21.90 [-25.70, -18.10]	
Moxness 2014	12.4	10.7	59	14.2	12.2	59	2.4%	-1.80 [-5.94, 2.34]	-+
Mutlu 2017	8.8	6.4	25	12.5	8.1	25	2.4%	-3.70 [-7.75, 0.35]	
Park 2018	11.6	15.4	29	33.1	24.1	29	1.8%	-21.50 [-31.91, -11.09]	
Roustan 2018	4.8	2.7	20	19.3	6.1	20	2.5%	-14.50 [-17.42, -11.58]	-
Sundman 2021	16	16.4	60	42.8	22.7	65	2.2%	-26.80 [-33.70, -19.90]	
Turhan 2015 (EAO p3411)	18.2	15.5	90	48	19.5	90	2.3%	-29.80 [-34.95, -24.65]	
Turhan 2020	14.5	13.9	64	33.4	22.7	64	2.2%	-18.90 [-25.42, -12.38]	
Verse 2002	39.7	25.2	26	40.3	25.8	26	1.4%	-0.60 [-14.46, 13.26]	
Vicini 2015	12.9	16.3	10	44.7	27.3	10	1.0%	-31.80 [-51.51, -12.09]	
Wee 2015	14.7	13.1	27	31.7	20.7	27	1.9%	-17.00 [-26.24, -7.76]	
Subtotal (95% CI)			1460			1472	64.2%	-16.55 [-19.51, -13.58]	♦
Heterogeneity: Tau ² = 55.86;	Chi ² = 2	77.61,	df = 29	(P < 0.0	00001)); I ^z = 90)%		

Heterogeneity: Tau² = 55.86; Chi² = 277.61, df = 29 (P < 0.00001); I² = 90%

Test for overall effect: Z = 10.92 (P < 0.00001)

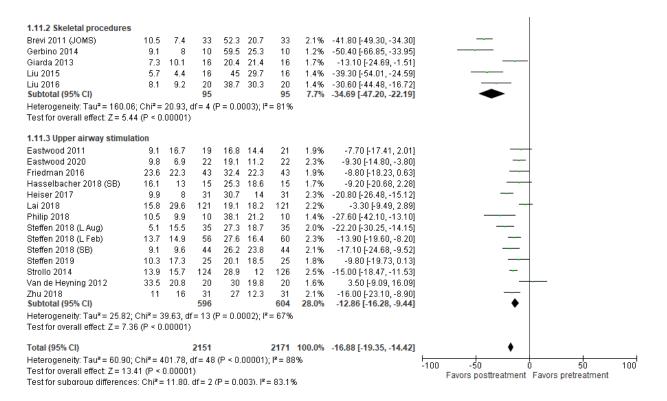


Figure S29. OR-based surgery pretreatment vs. posttreatment (persistent taste alteration, incidence)

	Posttreat	ment	Pretreat	ment		Risk Difference	Risk Difference
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	M-H, Random, 95% Cl
1.36.1 Soft tissue pr	ocedures						
Aneeza 2011	1	14	0	14	3.0%	0.07 [-0.11, 0.25]	
Haavisto 1994	2	52	0	52	24.2%	0.04 [-0.02, 0.10]	
Li 2016	1	25	0	25	8.8%	0.04 [-0.06, 0.14]	+
Lin 2015	3	39	0	39	10.7%	0.08 [-0.02, 0.17]	+ - -
Robinson 2009	1	64	0	64	53.3%	0.02 [-0.03, 0.06]	
Subtotal (95% CI)		194		194	100.0%	0.03 [0.00, 0.06]	◆
Total events	8		0				
Heterogeneity: Tau ² =	= 0.00; Chi ² =	= 2.09, d	lf = 4 (P =	0.72); l²	= 0%		
Test for overall effect	Z = 2.01 (P	= 0.04)					
Total (95% CI)		194		194	100.0%	0.03 [0.00, 0.06]	◆
Total events	8		0				
Heterogeneity: Tau ² =	= 0.00; Chi ² =	= 2.09, d	lf = 4 (P =	0.72); l²	= 0%		-0.5 -0.25 0 0.25 0.5
Test for overall effect	Z = 2.01 (P	= 0.04)					-0.5 -0.25 0 0.25 0.5 pretreatment posttreatment
Test for subgroup dif	ferences: No	ot applic	able				preceatment postileatment

Figure S30. OR-based surgery pretreatment vs. posttreatment (persistent mandibular paresthesia, incidence)

,							
	Postreat	ment	Pretreat	ment		Risk Difference	Risk Difference
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	M-H, Random, 95% Cl
1.28.1 Soft tissue pro	ocedures						
Miller 2004	5	32	0	32	14.0%	0.16 [0.02, 0.29]	
Robinson 2009	11	64	0	64	17.6%	0.17 [0.08, 0.27]	
Subtotal (95% CI)		96		96	31.6%	0.17 [0.09, 0.24]	◆
Total events	16		0				
Heterogeneity: Tau ² =	0.00; Chi²	= 0.03,	df = 1 (P =	0.85); P	²=0%		
Test for overall effect:	Z = 4.21 (P	< 0.00	D1)				
1.28.2 Skeletal proce	edures						
Boyd 2015	0	30	0	30	20.8%	0.00 [-0.06, 0.06]	+
Goh 2003	3	11	0	11	5.8%	0.27 [-0.01, 0.55]	
Li 2000	4	42	0	42	17.5%	0.10 [-0.00, 0.19]	
Liu 2012	1	11	0	11	8.2%	0.09 [-0.13, 0.31]	
Riley 2000	5	40	0	40	16.2%	0.13 [0.02, 0.23]	
Subtotal (95% CI)		134		134	68.4%	0.09 [-0.00, 0.18]	◆
Total events	13		0				
Heterogeneity: Tau ^z =	0.01; Chi²	= 10.95	, df = 4 (P	= 0.03);	I ^z = 63%		
Test for overall effect:	Z=1.87 (P	= 0.06))				
Total (95% CI)		230		230	100.0%	0.11 [0.03, 0.19]	◆
Total events	29		0				
Heterogeneity: Tau ² =	0.01; Chi²	= 18.15	, df = 6 (P	= 0.006); l² = 67%	6	-1 -0.5 0 0.5 1
Test for overall effect:	Z = 2.85 (P	= 0.00	4)				pretreatment posttreatment
Test for subgroup diff	erences: C	hi² = 1.3	71, df = 1 (P = 0.19	l), l² = 41.	5%	precedencial postileautient

Figure S31. OR-based surgery pretreatment vs. posttreatment (persistent perceived worsening of facial appearance, incidence)

	Posttreat	tment	Pretreat	ment	Risk Difference		Risk Difference			
Study or Subgroup	Events	Total	Events	Total	M-H, Random, 95% Cl		M-H, Random, 95% Cl			
1.31.1 Skeletal proc	edures									
Boyd 2015	4	30	0	30	0.13 [0.00, 0.27]					
						—				
						-1	-0.5 0 0.5 pretreatment posttreatment			

Figure S32. OR-based surgery pretreatment vs. posttreatment (persistent aspiration, incidence)

	Posttreat	ment	Pretreat	ment	Risk Difference	Risk Difference			
Study or Subgroup	Events	Total	Events	Total	M-H, Random, 95% Cl	M-H, Random, 95% CI			
1.33.1 Soft tissue pro	ocedures								
Robinson 2009	3	64	0	64	0.05 [-0.01, 0.11]	++			
						-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -			
						pretreatment posttreatment			

Figure S33. OR-based surgery pretreatment vs. posttreatment (persistent hemorrhage, incidence)

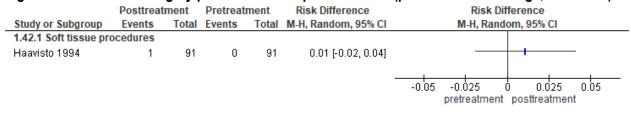


Figure S34. OR-based surgery pretreatment vs. posttreatment (persistent globus pharyngeus, incidence)

	Posttreat	ment	Pretreat	ment	Risk Difference	Risk Difference				
Study or Subgroup	Events	Total	Events	Total	M-H, Random, 95% Cl		M-H, Random, 95% Cl			
1.43.1 Soft tissue pro	ocedures									
Hobson 2012	1	27	0	27	0.04 [-0.06, 0.13]		_			
						-0.2	-0.1 pretreatm	Ó 1ent pos	0.1 ttreatment	0.2

Table S1. Summary of findings table for the surgical treatment of obstructive sleep apnea in adults who were intolerant or unaccepting of CPAP

References: Adzreil 2017 (1); Aneeza 2011 (2); Arora 2016 (3); Askar 2018 CO (4); Askar 2018 SB (5); Aynaci 2018 (6); Azbay 2016 (7); Babademez 2010 (8); Babademez 2019 (9); Babademez 2019 (CO) (10); Baisch 2006 (11); Baradaranfar 2015 (12); Barbieri 2019 (13); Barrera 2016 (14); Bayir 2016 (15); Benazzo 2008 (16); Bettega 2000 (17); Bican 2010 (18); Binar 2017 JLO (19); Binar 2017 EAO (20); Blumen 2009 (21); Blumen 2015 (22); Boon 2018 (23); Bostanci 2016 (24); Bowden 2005 (25); Bowen 2018 (26); Boyd 2013 (27); Boyd 2015 (28); Brevi 2011 (29); Browaldh 2013 (30); Browaldh 2016 (31); Browaldh 2018 (32); Cammaroto 2017 (33); Catella 2019 (34); Chen 2014 (35); Cho 2014 (36); Choi 2011a (37); Choi 2011b (38); Choi 2012 (39); Choi 2013 (40); Choi 2015 (41); Choi 2017 (42); Cillo 2013 (43); Conradt 1997 (44); Conradt 1998 (45); Conway 1985 (46); Cui 2016 (47); Dahlof 2002 (48); de Paula Soares 2014 (49); den Herder 2005 (50); Eastwood 2011 (51); Eastwood 2020 (52); El-Ahl 2016 (53); El-Anwar 2018 (54); El-Anwar 2019 (55); Élbassiouny 2015 (56), Emara 2011 (57); Emara 2016 (58); Eun 2008 (59); Eun 2009 (60); Evans 2019 (61); Fibbi 2009 (62); Fiorita 2018 (63); Freidman 2003 (64); Friedman 2004 (65); Friedman 2007 (66); Friedman 2016 (67); Gerbino 2014 (68); Giarda 2013 (69); Goh 2003 (70); Goodday 2016 (71); Gunawardena 2013 (72); Gunbey 2015 (73); Ha 2020 (74); Haavisto 1994 (75); Hamans 2008 (76); Hasselbacher 2018 EAORL (77) Hasselbacher 2018 SB (78); Heiser 2017 (79); Heiser 2019 (80); Hendler 2001 (81); Hester 1995 (82); Hobson 2012 (83); Hochban 1997 (84); Holmlund 2016 (85); Hsieh 2014 (86); Huang 2008 (87); Huang 2016 (88); Huntley 2018 AORL (89); Huntley 2018 OHNS (90); Huntley 2019 ENT (91); Huntley 2019 L (92); Islam 2015a (93); Islam 2015b (94); Jacobowitz 2006 (95); Jung 2020 (96); Karakoc 2018 (97); Karatayli-Ozgursoy 2012 (98); Katsantonis 1990 (99); Kayhan 2016 (100); Kent 2016 (101); Kezirian 2010 (102); Khan 2009 (103); Kim 2013 CO (104); Kim 2013 EAO (105); Kinoshita 2006 (106); Komada 2012 (107); Lai 2018 (108); Larsson 1991 (109); Larsson 1994 (110); Lee 1999 (111); Lee 2009 OHNS (112); Lee 2010 (1113); Lee 2011 (114); Lee 2012 (115); Lee 2018 (116); Li 2000 (117); Li 2000 (L) (118); Li 2000 (L p.982) (119); Li 2003 (120); Li 2004 (121); Li 2005a (122); Li 2005b (123); Li 2006 (124); Li 2008 (125); Li 2009 (126); Li 2013a (127); Li 2013b (128); Li 2013c (129); Li 2014 (130); Li 2015 (131); Li 2016 (132); Li 2018 (133); Lim 2018 (134); Lin 2006 (135); Lin 2010 (136); Lin 2011 (137); Lin 2013 (138); Lin 2014 (139); Lin 2015 (140); Lin 2017 (141); Liu 2012 (142); Liu 2013 (143); Liu 2015 (144); Liu 2016 (145); Lundkvist 2009 (146); Lye 2008 (147); Mackay 2013a (148); MacKay 2013b (149); MacKay 2020 (150); Mahmoud 2018 (151); Mahmoud 2019 (152); Makovey 2017 (153); Manikandhan 2014 (154); Meraj 2017 (155); Miller 2002 (156); Miller 2004 (157); Miyazaki 1998 (158); Montevecchi 2018 (159); Mora 2012 (160); Moxness 2014 (161); Mure 2019 (162); Mutlu 2017 (163); Nakata 2006 (164); Neruntarat 2003 (165); Neruntarat 2011 (166); Omur 2005 (167); Pang 2016 (168); Pang 2017 (169); Pang 2020 (L p.551) (170); Pang 2020 (L p.2281) (171); Parikh 2018 (172); Park 2018 (173); Peng 2016 (174); Peng 2019 (175); Philip 2018 (176); Philip-Joet 1991 (177); Plaza 2019 (178); Riley 2000 (179); Robinson 2009 (180); Ronchi 2013 (181); Rotenberg 2014 (182); Roustan 2018 (183); Ryan 1990 (184); Salapatas 2016 (185); Sanders 1990 (186); Santos 2007 (187); Sarber 2020 (188); Schendel 2014 (189); Schwab 2018 (190); Sezen 2011 (191); Shah 2018 (192); Shin 2013 (193); Shine 2009 (194); Shuaib 2015 (195); Simsek 2015 (196); Sommer 2016 (197); Sorrenti 2003 (198); Steffen 2018 (L Aug) (199); Steffen 2018 L Feb (200); Steffen 2018 (SB) (201); Steffen 2019 (202); Strollo 2014 (203); Suh 2013 (204); Sun 2008 (205); Sundman 2021 (206); Suslu 2017 (207); Tan 2014 (208); Thaler 2016 (209); Thaler 2020 (210); Toh 2014 (211); Tsui 2020 (212); Tuncel 2012 (213); Turhan 2015a (214); Turhan 2015b (215); Turhan 2020 (216); Van de Heyning 2012 (217); Varghese 2012 (218); Verse 2002 (219); Vicini 2010 (220); Vicini 2014 HN (221); Vicini 2014 ORL (222); Vicini 2015 (223); Vigneron 2017 (224); Vilaseca 2002 (225); Walia 2019 (226); Walker 1989 (227); Wang 2013 (228); Weaver 2011 (229); Wee 2015 (230); Wetmore 1986 (231); Woodson 2005 (232); Xiao 2016 (233); Yaremchuk 2011 (234); Yi 2009 (235); Yi 2011 (236); Yin 2007 (237); Yuksel 2018 (238); Zhang 2013 (239); Zhang 2014 (240); Zhao 2017 (241); Zhu 2018 (242); Zonato 2006 (243)

Outcomes	Quality of the evidence (GRADE)	Anticipated absolute effects* (95% CI) MD between pre-surgery and post-surgery or surgery and control	№ of participants (studies)
ESS* (Surgery vs Control)	⊕⊕⊕⊕ HIGH	The mean difference in ESS score of the surgery group was 5.6 points ^A lower (7.3 lower to 4.0 lower) than the control group.	199 (3 RCTs) ^{31,150,197}
ESS* (Pre- vs. Post- surgery)	⊕⊕⊖⊖ Low	The mean difference in ESS score after surgery was 5.8 points ^A lower (6.3 lower to 5.4 lower) than before surgery.	7875 (145 observational studies) 1.2,4-7,9-14,16,18-20,23,25,29,32- 34,36-38,40,41,43,50-55,57-60,62,63,66,67,69,72,74,77,79,80,83,85,87-91,93- 95,100-101,107,108,112,114-116,121,125-129,131-133,135,136,138-146,148- 151,153,159-162,164-169,172-176,178,182,183,185,188,191-193,195,197- 203,205,206,210-212,216-223,225,228,229,234-238,242
Sleep-related QOL* (FOSQ) (Surgery vs Control)	⊕⊕⊕⊖ MODERATE ¹	The mean difference in FOSQ score of the surgery group was 3.5 points ^A higher (2.6 higher to 4.4 higher) than the control group.	99 (1 RCT) ¹⁵⁰

Sleep-related QOL* (FOSQ) (Pre- vs. Post-surgery)	⊕⊕⊖⊖ LOW	The mean difference in FOSQ score after surgery was 3.5 points ^ higher (2.9 higher to 4.0 higher) than before surgery.	432 (11 observational studies) 28.51.52.77.102.147.200.203.212.217.229
Sleep apnea related QOL* (SAQLI) (Pre- vs Post-surgery)	⊕⊖⊖⊖ VERY LOW ^{1,2}	The mean difference in SAQLI score after surgery was 1 point $^{\rm B}$ higher (0.03 higher to 1.7 higher) than before surgery.	80 (3 observational studies) ^{51,67,212}
General QOL* (SF-36 Physical Component Summary) (Surgery vs Control)	⊕⊕⊕⊖ MODERATE ¹	The mean difference in SF-36 Physical Summary Score in the surgery group was 2.9 points ^B higher (1.6 lower to 7.4 higher) than the control group.	62 (1 RCT) ³¹
General QOL* (SF-36 Physical Component Summary) (Pre- vs Post-surgery)	⊕⊖⊖⊖ VERY LOW ^{1,2}	The mean difference in SF-36 Physical Summary Score after surgery was 6.3 points ^A higher (0.4 lower to 13.0 higher) than before surgery.	73 (2 observational studies) ^{121,212}
General QOL* (SF-36 Mental Component Summary) (Surgery vs Control)	⊕⊕⊕⊖ MODERATE 1.2	The mean difference in SF-36 Mental Summary Score in the surgery group was 5.4 points ^A higher (0.1 higher to 10.7 higher) than the control group.	62 (1 RCT) ³¹
General QOL* (SF-36 Mental Component Summary) (Pre- vs Post-surgery)	⊕OOO VERY LOW ¹	The mean difference in SF-36 Mental Summary Score after surgery was 9.5 points ^A higher (2.0 lower to 20.9 higher) than before surgery.	73 (2 observational studies) ^{121,212}
General QOL* (SF-36 Vitality Score) (Surgery vs Control)	⊕⊕⊕⊖ MODERATE ^{1,2}	The mean difference in SF-36 Vitality Score in the surgery group was 21.1 points $^{\rm A}$ lower (32.7 lower to 9.5 lower) than the control group.	55 (1 RCT) ³¹
General QOL* (SF-36 Vitality score) (Pre- vs Post-surgery)	⊕⊖⊖⊖ VERY LOW ^{1,2}	The mean difference in SF-36 Vitality Score after surgery was 14.4 points ^A higher (9.0 higher to 19.8 higher) than before surgery.	73 (2 observational studies) ^{121,212}
Sleep quality* (PSQI) (Pre- vs. Post- surgery)	⊕⊕⊖⊖ LOW	The mean difference in PSQI score after surgery was 1.4 points ^B lower (2.0 lower to 0.7 lower) than before surgery.	148 (4 observational studies) 51,105,173,233
Snoring*, VAS (Surgery vs Control)	⊕⊕⊕⊖ MODERATE 1,2	The mean difference in snoring score in the surgery group was 3.7 points ^ lower (5.3 lower to 2.1 lower) than the control group.	29 (1 RCT) ¹⁹⁷
Snoring*, VAS (Pre- vs Post-surgery)	⊕⊕⊖⊖ LOW	The mean difference in snoring score after surgery was 5.2 points ^ lower (5.9 lower to 4.6 lower) than before surgery.	2098 (36 observational studies) 1,4,5,9,19,36,38,53,54,56,64- 66,72,83,87,104,116,131,133,136,138,139,141,142,166- 169,185,197,211,228,229,235,236,238
Systolic BP* (Surgery vs Control)	⊕⊕⊖⊖ LOW ²	The mean difference in systolic BP in the surgery group was 0.2 points $^{\rm B}$ lower (4.9 lower to 4.5 higher) than the control group.	99 (1 RCT) ¹⁵⁰
Systolic BP* (Pre- vs Post-surgery)	⊕○○○ VERY LOW ²	The mean difference in systolic BP after surgery was 6.3 mmHg ^A lower (11.6 lower to 0.9 lower) than before surgery.	540 (10 observational studies) ^{49,88,106,112,114,153,169,174,182,226}
Diastolic BP* (Surgery vs Control)	⊕⊕⊖⊖ LOW ²	The mean difference in diastolic BP in the surgery group was 0.4 points $^{\rm B}$ lower (3.5 lower to 2.7 higher) than the control group.	99 (1 RCT) ¹⁵⁰
Diastolic BP* (Pre- vs Post-surgery)	⊕⊕⊖⊖ Low	The mean difference in diastolic BP after surgery was 2.7 mmHg $^{\rm A}$ lower (7.9 lower to 2.5 higher) than before surgery.	518 (9 observational studies) ^{49,88,106,112,114,153,169,174,226}
AHI* (Surgery vs Control)	⊕⊕⊕⊕ HIGH	The mean difference in AHI in the surgery group was 18.4 events/hr ^A lower (26.4 lower to -10.5 lower) than in the control group.	198 (3 RCTs) ^{30,150,197}

AHI* (Pre- vs Post- surgery)	⊕⊕⊕⊖ MODERATE ³	The mean difference in AHI after surgery was 24.1 events/hr A lower (25.7 lower to 22.5 lower) than before surgery. The mean AHI before surgery was 39.0 (18.2) events/hr and after surgery was 16.6 (14.6) events/hr for a 58% reduction.	10652 (194 observational studies) 1.3-14,16-27,29.30,32-44,47,49- 62,64,65,67-74,76-80,82-86,88-93,95-104,106-108,113-116,124-134,136- 140,142-145,147,149-155,158-164,166,168,170,172-176,178,181-183,185-193, 195-197,199-205,207,209-211,213-225,227,228,230-242			
RDI* (Surgery vs Control)	⊕⊕⊕⊖ MODERATE ^{1,2}	The mean difference in RDI in the surgery group was 16.4 events/hr ^A lower (33.3 lower to 0.6 higher) than in the control group.	98 (2 RCTs) ^{30, 197}			
RDI* (Pre- vs Post- surgery)	⊕⊕⊕⊖ MODERATE ³	The mean difference in RDI after surgery was 31.0 events/hr ^A lower (35.7 lower to 26.3 lower) than before surgery. The mean RDI before surgery was 45.3 (20.6) events/hr and after surgery was 16.1 (13.3) events/hr for a 64% reduction.	965 (27 observational studies) 11.44.64.76.82.104.105.110- 113.115.116.128.145.146.154.156.157.159.166.167.180.184.190.192			
Permanent dysphagia, Risk* (Pre- vs Post-surgery)	⊕⊖⊖⊖ VERY LOW ²	The mean difference in risk of permanent dysphagia between pre- and post-surgery was 0.02 ^B higher (-0.01 lower to 0.04 higher).	1175 (10 observational studies) ^{10,75,85,107,142,167,171,180,210,230}			
MD Anderson dysphagia score* (Pre- vs Post-surgery)	⊕OOO VERY LOW ^{1,2}	The mean difference in MD Anderson permanent dysphagia score was 0.4 points $^{\rm B}$ lower (3.4 lower to 2.6 higher) than before surgery.	24 (1 observational study) 221			
LSAT (Surgery vs Control)	⊕⊕⊕⊖ MODERATE ^{1,2}	The mean difference in LSAT in the surgery group was 4.3% $^{\rm B}$ higher (3.1 higher to 5.6 higher) than in the control group.	197 (3 RCTs) ^{30,150,197}			
LSAT (Pre- vs Post- surgery)	⊕⊕⊖⊖ LOW	The mean difference in LSAT after surgery was 7.2% A higher (6.4 higher to 8.0 higher) than before surgery. The mean LSAT before surgery was 78.0 (9.4)% and after surgery was 84.4 (7.2)% for a 8.2% increase.	6653 (133 observational studies) 4-8,11,12,18-21,24- 26,30,32,36,37,39-41,46-48,53-60,64,70,72,74,79,81-83,87-97,100-106,108- 109,112,114,115,117-119,121,125,127-130,132,133,136-145,147,149-154,156- 158,164-166,168,170,173-175,177,179-181,184-188,193-195,197,198,200,204- 206,208,209,211,215,216,218,220,222,225,227,228,230,231,233,235,237,243			
ODI (Surgery vs Control)	⊕⊕⊕⊕ HIGH	The mean difference in ODI in the surgery group was 17.0 points ^A lower (24.9 lower to 9.2 lower) than in the control group.	164 (2 RCTs) ^{30,150}			
ODI (Pre- vs Post- surgery)	⊕⊕⊕⊖ MODERATE ³	The mean difference in ODI after surgery was 16.9 points ^A lower (19.4 lower to 14.4 lower) than before surgery. The mean ODI before surgery was 30.9 (18.2) and after surgery was 14.3 (13.8) for a reduction of 54%.	2151 (48 observational studies) 7.13,15,19,20,24,29,32,48,51,52,67- 69,72,77-79,96,97,105,108-110,112,114,144-146,159-161,163,173,176,183,199- 203,206,214,216,217,219,223,230,242			

¹Quality of evidence was downgraded due to imprecision associated with small sample size (i.e., <100) ²Quality of evidence was downgraded due to imprecision (i.e., 95% Cl of mean difference crosses clinical significance threshold) ³Quality of evidence was upgraded due to large effect ^AMean difference meets or exceeds clinical significance threshold ^BMean difference does not meet clinical significance threshold

Bariatric surgery for the treatment of OSA in obese adults (PICO 2)

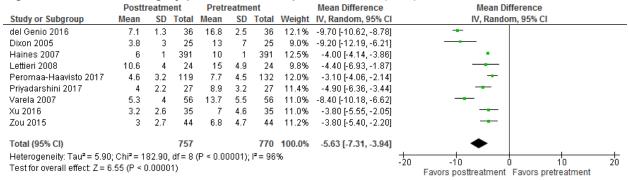


Figure S35. Bariatric surgery pretreatment vs. posttreatment (ESS)

Figure S36. Bariatric surgery pretreatment vs. posttreatment (Daytime sleepiness frequency)

	Posttreat	ment	Pretreatment		Odds Ratio	Odds Ratio						
Study or Subgroup	Events	Total	Events	Total	M-H, Random, 95% Cl		M-H, Rand	om, 95% Cl				
Grunstein 2007	202	1592	411	1592	0.42 [0.35, 0.50]		+-					
						0.2	0.5		5			
						Favo	ors posttreatment	Favors pretr	eatment			

Figure S37. Bariatric surgery pretreatment vs. posttreatment (SBP, mmHg)

	Postt	reatm	ent	Pret	reatme	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Bakker 2013	108.6	14.2	12	114.5	19.3	12	11.0%	-5.90 [-19.46, 7.66]	
de Assuncao Machado 2018 -	124.5	14	28	133.6	11.4	28	27.6%	-9.10 [-15.79, -2.41]	
Dixon 2005	128.6	23.6	25	140.6	22.6	25	12.1%	-12.00 [-24.81, 0.81]	
Krieger 2012	120.5	12.8	24	123.1	14.4	24	23.8%	-2.60 [-10.31, 5.11]	—
Xu 2016	120	12.9	35	135.9	17.7	35	25.4%	-15.90 [-23.16, -8.64]	
Total (95% CI)			124			124	100.0%	-9.28 [-14.33, -4.23]	•
Heterogeneity: Tau ² = 12.40; C	hi² = 6.4	9, df = 4	4 (P = 0	l.17); I [≥] :	= 38%				-50 -25 0 25 50
Test for overall effect: Z = 3.60	(P = 0.00	103)							Favors posttreatment Favors Pretreatment

Figure S38. Bariatric surgery pretreatment vs. posttreatment (DBP, mmHg)

	Postt	reatm	ent	Pret	reatme	ent		Mean Difference	Mean Difference			
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI			
Bakker 2013	73.1	9.2	12	76.7	8.4	12	16.2%	-3.60 [-10.65, 3.45]				
de Assuncao Machado 2018 -	82.5	11.5	28	94.7	12	28	19.8%	-12.20 [-18.36, -6.04]	_			
Dixon 2005	84.3	13.1	25	88.3	14.1	25	14.6%	-4.00 [-11.54, 3.54]				
Krieger 2012	70.2	9.3	24	74.4	10.5	24	22.4%	-4.20 [-9.81, 1.41]				
Xu 2016	76.2	8.1	35	85	12.2	35	26.9%	-8.80 [-13.65, -3.95]				
Total (95% CI)			124			124	100.0%	-6.89 [-10.16, -3.63]	◆			
Heterogeneity: Tau ² = 4.17; Ch	i² = 5.73,	df = 4	(P = 0.)	22); I ^z =	30%				-20 -10 0 10 20			
fest for overall effect: Z = 4.14 (P < 0.0001)								-20 -10 0 10 20 Favors posttreatment Favors pretreatment				

Figure S39. Bariatric surgery vs. nutritional care (AHI, events/hr) [RCT]

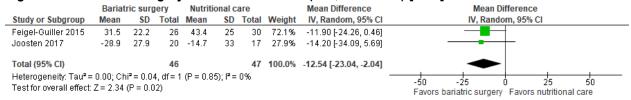


Figure S40. Bariatric surgery pretreatment vs. posttreatment (AHI, events/hr)

•	Postt	reatm	ent	Pret	reatm	ent	•	Mean Difference	Mean Difference
Study or Subgroup	Mean	SD					Weight		IV, Random, 95% Cl
Al-Jumaily 2018	5.6	10.2	10	38.1	29.4	10	3.8%	-32.50 [-51.79, -13.21]	_
Bae 2014	9.3	12.9	10	51	34.2	10	3.3%	-41.70 [-64.35, -19.05]	
Bakker 2013	12.3	13.2	12	35.5	42.9	12	2.9%	-23.20 [-48.60, 2.20]	
del Genio 2016	5.8	7.2	36	32.8	10.2	36	6.1%	-27.00 [-31.08, -22.92]	+
de Raaf 2016	8.5	8.9	205	32.3	20.5	205	6.2%	-23.80 [-26.86, -20.74]	+
Dixon 2005	13.4	13	25	61.6	34	25	4.6%	-48.20 [-62.47, -33.93]	(
Fritscher 2007	30	24.9	12	66.5	30.9	12	3.3%	-36.50 [-58.95, -14.05]	
Jiao 2016	3	7	39	13	23.5	39	5.7%	-10.00 [-17.70, -2.30]	
Krieger 2012	19	21.7	24	34.2	35	24	4.2%	-15.20 [-31.68, 1.28]	
Lage-Hansen 2018	3.7	4.4	36	12.8	13.8	36	6.1%	-9.10 [-13.83, -4.37]	
Lettieri 2008	24.5	18.1	24	47.9	33.8	24	4.4%	-23.40 [-38.74, -8.06]	<u> </u>
Peromaa-Haavisto 2017	9.9	11.2	119	27.6	24.6	132	6.1%	-17.70 [-22.35, -13.05]	-
Poitou 2006	9.7	7.7	35	24.5	16	35	5.9%	-14.80 [-20.68, -8.92]	-
Priyadarshini 2017	20.2	23.1	27	31.8	20.4	27	5.1%	-11.60 [-23.22, 0.02]	
Shaarawy 2016	12.8	11.3	22	55.8	8.3	22	5.9%	-43.00 [-48.86, -37.14]	
Sillo 2018	1.4	1.7	47	6.4	6.1	47	6.3%	-5.00 [-6.81, -3.19]	•
Sugerman 1992	26	26	40	64	39	40	4.6%	-38.00 [-52.53, -23.47]	
Valencia-Flores 2004	27.1	25.6	28	71.9	47.9	28	3.6%	-44.80 [-64.92, -24.68]	<u> </u>
Xu 2016	7.7	11.5	35	21.5	14.5	35	5.9%	-13.80 [-19.93, -7.67]	
Zou 2015	7.1	9.4	44	22.4	17.8	44	5.9%	-15.30 [-21.25, -9.35]	
Total (95% CI)			830			843	100.0%	-23.12 [-29.01, -17.24]	◆
Heterogeneity: Tau ² = 142	.81: Chi ≃	= 331.	27. df=	19 (P <	0.000	01): I ² =	= 94%		
Test for overall effect: Z = 7						21 -			-100 -50 Ó 50 10
· · · · · · · · · · · · · · · · · · ·			· ·						Favors posttreatment Favors pretreatment

Figure S41. Bariatric surgery pretreatment vs. posttreatment (RDI)

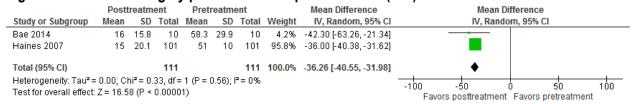


Figure S42. Bariatric surgery pretreatment vs. posttreatment (LSAT, %)

	Post	reatm	ent	Preti	reatme	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% Cl
Bae 2014	86	6.8	10	81.8	6.4	10	8.2%	4.20 [-1.59, 9.99]	
Fritscher 2007	78.7	13.7	12	64.7	13.4	12	2.6%	14.00 [3.16, 24.84]	
Haines 2007	86	7.3	54	77	14.7	54	13.1%	9.00 [4.62, 13.38]	_ _
Jiao 2016	89	6	39	82	14	39	11.4%	7.00 [2.22, 11.78]	
Krieger 2012	84	7.4	24	80.6	6.9	24	14.9%	3.40 [-0.65, 7.45]	
Lettieri 2008	84.5	5.8	24	76.5	12.1	24	9.3%	8.00 [2.63, 13.37]	
Poitou 2006	82.5	6.5	35	73	11.8	35	12.7%	9.50 [5.04, 13.96]	
Xu 2016	86.6	7	35	77.1	11.3	35	13.0%	9.50 [5.10, 13.90]	
Zou 2015	86.7	6.7	44	77.1	11.9	44	14.9%	9.60 [5.56, 13.64]	
Total (95% CI)			277			277	100.0%	7.80 [6.04, 9.57]	◆
Heterogeneity: Tau ² :	= 1.19; CI	hi² = 9.	58, df =	8 (P = 0	0.30); F	² =16%	6	_	
Test for overall effect	Z = 8.66	(P < 0	.00001)					-20 -10 0 10 20 Favors pretreatment Favors posttreatment

Figure S43. Bariatric surgery pretreatment vs. posttreatment (ODI)

	Post	treatm	ent	Pret	reatme	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Bae 2014	8.6	13	10	61	34.2	10	5.6%	-52.40 [-75.08, -29.72]	-
Lage-Hansen 2018	4.3	5.1	33	18.2	20.3	35	23.2%	-13.90 [-20.85, -6.95]	-
Poitou 2006	10.8	8.3	35	26.9	18.9	35	23.4%	-16.10 [-22.94, -9.26]	+
Xu 2016	6.9	10.7	35	26.5	18.6	35	22.8%	-19.60 [-26.71, -12.49]	-
Zou 2015	6.4	9	44	25.4	18.6	44	25.0%	-19.00 [-25.11, -12.89]	+
Total (95% CI)			157			159	100.0%	-19.13 [-24.97, -13.30]	•
Heterogeneity: Tau ² = Test for overall effect:					= 0.03)); I² = 6	3%		-100 -50 0 50 100
reactor overall effect.	2 - 0.45	0 - 0.	00001	/					Favors posttreatment Favors pretreatment

Figure S44. Bariatric surgery pretreatment vs. posttreatment (Snoring, %)

	Posttr	eatm	ent	Preti	reatme	ent	Mean Difference		Mean [)ifference		
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Random, 95% CI		IV, Rand	om, 95% C	1	
Bae 2014	30.7	25	10	68.5	27.6	10	-37.80 [-60.88, -14.72]					
								-100	-50	0	50	100
								Favors	posttreatmen	t Favors p	retreat	tment

Figure S45. Bariatric surgery pretreatment vs. posttreatment (Snoring frequency)

	Posttreat	ment	Pretreat	ment		Odds Ratio	Odds Ratio	
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95	% CI
Grunstein 2007	172	1592	708	1592	61.4%	0.15 [0.13, 0.18]		
Lettieri 2008	23	24	22	24	38.6%	2.09 [0.18, 24.73]		
Total (95% CI)		1616		1616	100.0%	0.42 [0.03, 5.10]		
Total events	195		730					
Heterogeneity: Tau ² =	: 2.65; Chi ≇ :	= 4.32, c	lf=1 (P=	0.04); I ^z	= 77%			
Test for overall effect:	Z=0.69 (P	= 0.49)					0.02 0.1 1 Favors posttreatment Favor	10 50 s pretreatment

Figure S46. Bariatric surgery vs. nutritional care (BMI, kg/m²) [RCT]

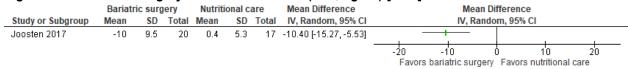


Figure S47. Bariatric surgery pretreatment vs. posttreatment (BMI, kg/m²)

J									
	Postt				reatm			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD.	Total	Weight	IV, Random, 95% CI	IV, Random, 95% Cl
Al-Jumaily 2018	30.3	3.6	10	48.5	6.5	10	3.5%	-18.20 [-22.81, -13.59]	
Bae 2014	26.9	4.4	10	39.9	8.3	10	2.9%	-13.00 [-18.82, -7.18]	
Bakker 2013	33.9	7.2	12	45.9	7.9	12	2.8%	-12.00 [-18.05, -5.95]	
de Assuncao 2018	30.3	3.4	25	43.2	5.5	25	4.6%	-12.90 [-15.43, -10.37]	-
lel Genio 2016	32.1	6.6	36	51.3	11.6	36	3.6%	-19.20 [-23.56, -14.84]	
de Raaf 2016	33.7	5.5	205	46	7.2	205	5.1%	-12.30 [-13.54, -11.06]	+
Dixon 2005	37.2	7.2	25	52.7	9.5	25	3.5%	-15.50 [-20.17, -10.83]	
Fredheim 2013	33.4	4.8	44	47.5	5.6	44	4.8%	-14.10 [-16.28, -11.92]	-
Fritscher 2007	34.1	8.1	12	55.5	10.1	12	2.3%	-21.40 [-28.73, -14.07]	
Haines 2007	38	10	101	56	10	101	4.5%	-18.00 [-20.76, -15.24]	
Hariri 2018 (SORD)	34.8	6.9	736	43.9	7.5	930	5.3%	-9.10 [-9.79, -8.41]	•
liao 2016	24.2	2.7	39	30.7	3.7	39	5.1%	-6.50 [-7.94, -5.06]	+
krieger 2012	35.6	8.2	24	47.2	11	24	3.1%	-11.60 [-17.09, -6.11]	
age-Hansen 2018	30.8	4.8	36	44.4	5.2	36	4.7%	-13.60 [-15.91, -11.29]	
ankford 2005_	32.2	7.8	15	48.3	7.4	15	3.1%	-16.10 [-21.54, -10.66]	
_ettieri 2008	32.1	5.5	24	51	10.4	24	3.4%	-18.90 [-23.61, -14.19]	
Peromaa-Haavisto 2017	33	5.1	128	43.9	6.4	132	5.1%	-10.90 [-12.30, -9.50]	+
Pillar 1994	33	7.5	14	45	7.2	14	3.1%	-12.00 [-17.45, -6.55]	
Poitou 2006	39.9	7.7	35	51.3	8.3	35	4.0%	-11.40 [-15.15, -7.65]	
Priyadarshini 2017	41.2	8.2	27	48.4	8.2	27	3.6%	-7.20 [-11.57, -2.83]	
3haarawy 2016	35.9	4.8	22	48.2	7.3	22	4.0%	-12.30 [-15.95, -8.65]	
Sillo 2018	36.4	5.7	47	51	7.6	47	4.5%	-14.60 [-17.32, -11.88]	
Sugerman 1992	38	9	31	56	13	61	3.5%	-18.00 [-22.55, -13.45]	
(u 2016	24.3	2.7	35	31.1	3.6	35	5.0%	-6.80 [-8.29, -5.31]	+
Zou 2015	24.4	2.6	44	31.1	3.4	44	5.1%	-6.70 [-7.96, -5.44]	-
Total (95% CI)			1737			1965	100.0%	-12.82 [-14.29, -11.35]	•
Heterogeneity: Tau ² = 10.6	30; Chi = =	238.4	6, df = 3	24 (P < I	0.0000	1); I ^z =	90%		-50 -25 0 25 5
Fest for overall effect: Z = 1	17.08 (P <	0.000	001)						
	`								Favors posttreatment Favors pretreatment

Figure S48. Bariatric surgery pretreatment vs. posttreatment (PAP pressure, cm H₂O)

U								(
	Postt	reatm	ent	Pretr	eatme	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Haines 2007	7	5.6	31	11	9.1	83	18.1%	-4.00 [-6.78, -1.22]	_
Lankford 2005	8.8	2.7	15	11.3	3	15	33.6%	-2.50 [-4.54, -0.46]	
Lettieri 2008	8.4	2.1	24	11.5	3.7	24	48.3%	-3.10 [-4.80, -1.40]	
Total (95% CI)			70			122	100.0%	-3.06 [-4.24, -1.88]	•
Heterogeneity: Tau ² = Test for overall effect:					l.69); I	²=0%			-10 -5 0 5 10 Favors Posttreatment Favors Pretreatment

Figure S49. Bariatric surgery pretreatment vs. posttreatment (iron malabsorption, incidence)

-	Posttreat	tment	Pretreat	ment	Risk Difference		Ris	k Differe	nce	•
Study or Subgroup	Events	Total	Events	Total	M-H, Random, 95% Cl		M-H, F	landom,	95% CI	
Fritscher 2007	1	12	0	12	0.08 [-0.12, 0.29]					
						-0.5	-0.25 pretreatm	o nent pos	0.25 sttreatment	0.5

Figure S50. Bariatric surgery vs. nutritional care (gastric ulcer, incidence) [RCT]

		Bariatric s	urgery	Nutritiona	l care	Risk Difference		Ris	k Differei	nce	
Study	or Subgroup	Events	Total	Events	Total	M-H, Random, 95% Cl		M-H, R	andom, 9	95% CI	
Feigel	Guiller 2015	1	30	0	33	0.03 [-0.05, 0.12]	-0.2				
							0.2	pretreatm	nent pos	ttreatmen	it 0.2

Table S2. Summary of findings table for the bariatric surgical treatment of obstructive sleep apnea in adults with obesity

References: Al-Jumaily 2018 (1); Bae 2014 (2); Bakker 2013 (3); de Assuncao Machado2018 (4); de Raaf 2016 (5); Del Genio 2016 (6); Dixon 2005 (7); Feigel-Guiller 2015 (8); Fredheim 2013 (9); Fritscher 2007 (10); Grunstein 2007 (11); Haines 2007 (12); Hariri 2018 (13); Jiao 2016 (14); Joosten 2017 (15); Krieger 2012 (16); Lage-Hansen 2018 (17); Lankford 2005 (18); Lettieri 2008 (19); Peroma-Haavisto 2017 (20); Pillar 1994 (21); Poitou 2006 (22); Priyadarshini 2017 (23); Shaarawy 2016 (24); Sillo 2018 (25); Sugerman 1992 (26); Valencia-Flores 2004 (27); Varela 2007 (28); Xu 2016 (29); Zou 2015 (30)

Outcomes	Quality of the evidence (GRADE)	Anticipated absolute effects* (95% Cl) MD between pre-surgery and post-surgery or surgery and control	№ of participants (studies)
ESS* (Pre- vs Post-	⊕⊕⊕⊖	The mean ESS after surgery was 5.6 points ^A lower (7.3 lower to 3.9 lower) than before surgery.	757
surgery)	MODERATE ³		(9 observational studies) 6.7,12,19,20,23,28-30
Daytime sleepiness*	⊕⊕⊖⊖	The odds ratio for daytime sleepiness was 0.4 $^{\rm A}$ (0.35 to 0.5) after surgery vs before surgery.	1592
(Pre- vs Post-surgery)	Low		(1 observational study) ¹²
SBP* (Pre- vs Post-	⊕⊕⊕⊖	The mean SBP after surgery was 9.3 mmHg ^A lower (14.3 lower to 4.2 lower) than before surgery.	124
surgery)	MODERATE ³		(5 observational studies) ^{3,4,7,16,29}
DBP* (Pre- vs Post-	⊕⊕⊕⊖	The mean DBP after surgery was 6.9 mmHg ^A lower (10.2 lower to 3.6 lower) than before surgery.	124
surgery)	MODERATE ³		(5 observational studies) ^{3,4,7,16,29}
AHI* (Surgery vs	⊕⊕⊕⊖	The mean AHI in the surgery group was 12.5 events/hr ^A lower (23.0 lower to 2.0 lower) than in the control group.	46
Control)	MODERATE ²		(2 RCTs) ^{8,15}
AHI* (Pre- vs Post-	⊕⊕⊕⊖	The mean AHI after surgery was 23.1 events/hr ^A lower (29.0 lower to 17.2 lower) than before surgery. The mean AHI before surgery was 34.8 events/hr and was 11.7 events/hr after surgery for a reduction of 66%.	830
surgery)	MODERATE ³		(20 observational studies) ^{1-3,5-7,10,14,16,17,19,20,22-27,29,30}
RDI* (Pre- vs Post- surgery)	⊕⊕⊕⊖ MODERATE ¹	The mean RDI after surgery was 36.3 events/hr ^A lower (40.6 lower to 32.0 lower) than before surgery. The mean RDI before surgery was 51.3events/hr and was 15.0 events/hr after surgery for a reduction of 71%.	111 (2 observational studies) ^{2,12}

LSAT (Pre-vs Post-	⊕⊕⊖⊖	The mean LSAT after surgery was 7.8% ^A higher (6.0 higher to 9.6 higher) than before surgery. The mean LSAT was 77.7% before surgery and was 85.5% after surgery for an increase of 10%.	277
surgery)	LOW		(9 observational studies) ^{2,10,12,14,16,19,22,29,30}
ODI (Pre- vs. Post-	⊕⊕⊕⊖	The mean ODI after surgery was 19.1 points ^A lower (25.0 lower to 13.3 lower) than before surgery. The mean ODI was 26.3 before surgery and was 7.2 after surgery for a reduction of 73%.	157
surgery)	MODERATE ³		(5 observational studies) ^{2,17,22,29,30}
% of Patients Snoring	⊕⊖⊖⊖	The mean % of patients snoring after surgery was 37.8% ^A lower (60.9 lower to 14.7 lower) than before surgery.	10
(Pre- vs Post-surgery)	VERY LOW 1		(1 observational study) ²
Snoring Frequency	⊕⊖⊖⊖	The odds ratio of snoring after surgery was 0.4 lower (0.03 lower to 5.10 higher) than before surgery.	1616
(Pre- vs Post-surgery)	VERY LOW ²		(2 observational studies) ^{11,19}
BMI (Surgery vs	⊕⊕⊕⊖	The mean BMI in the surgery group was 10.4 kg/m ^{2 A} lower (15.3 lower to 5.5 lower) than in the control group.	37
Control)	MODERATE ¹		(1 RCT) ¹⁵
BMI (Pre- vs Post-	⊕⊕⊕⊖	The mean BMI after surgery was 12.8 kg/m ^{2 A} lower (14.3 lower to 11.4 lower) than before surgery.	1737
surgery)	MODERATE ³		(25 observational studies) ^{1-7,9,10,12-14,16-26,29,30}
Optimal PAP Pressure (Pre- vs Post-surgery)	⊕⊖⊖⊖ VERY LOW 1	The mean optimal PAP pressure after surgery was 3.1 cm $^{\rm A}$ H_2O lower (4.2 lower to 1.9 lower) than before surgery.	70 (3 observational studies) ^{12,18,19}

*Critical Outcomes ¹Quality of evidence was downgraded due to imprecision associated with small sample size (<100 participants) ²Quality of evidence was downgraded due to imprecision (i.e., 95% CI of mean difference crosses clinical significance threshold) ³Quality of evidence was upgraded due to large effect ⁴Mean difference meets or exceeds clinical significance threshold ^BMean difference does not meet clinical significance threshold

Surgical treatment of OSA in adults to facilitate use of CPAP (PICO 3)

Figure S51. OR-based adjunctive surgery pretreatment vs. posttreatment (ESS)

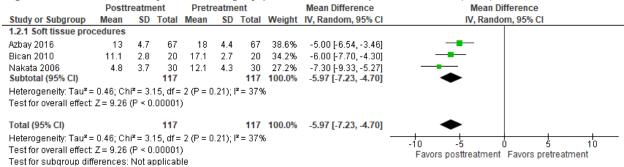
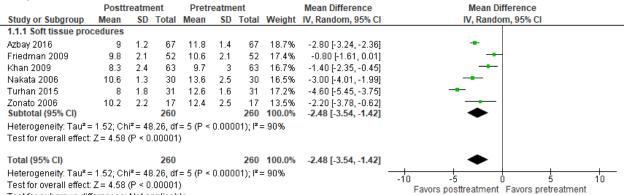


Figure S52. OR-based adjunctive surgery pretreatment vs. posttreatment (optimal CPAP level, cm H2O)



Test for subgroup differences: Not applicable

Figure S53. OR-based adjunctive surgery pretreatment vs. posttreatment (Adherence, hrs/night)

	Posttr	reatm	ent	Pretreatment				Mean Difference	Mean Difference		
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI		
1.3.1 Soft tissue pro	cedures										
Friedman 2009	3.2	2.6	52	0.02	0.14	52	48.9%	3.18 [2.47, 3.89]	_ _		
Turhan 2015	6.5	0.9	31	5.3	0.8	31	51.1%	1.20 [0.78, 1.62]	-		
Subtotal (95% CI)			83			83	100.0%	2.17 [0.23, 4.11]			
Heterogeneity: Tau ² =	= 1.87; Ch	i ^z = 22	2.13, df	= 1 (P <	0.000	i01); l² =	= 95%				
Test for overall effect	: Z = 2.19	(P = 0	.03)								
Total (95% CI)			83			83	100.0%	2.17 [0.23, 4.11]			
Heterogeneity: Tau ² =	= 1.87; Ch	i² = 22	2.13, df	= 1 (P <	0.000	i01); l² =	= 95%	-			
Test for overall effect:	: Z = 2.19	(P = 0	.03)						-4 -2 U 2 4 Favors pretreatment Favors postreatment		
Test for subgroup dif	ferences:	Not a	pplicab	le					Favors precedurient Favors poscedurient		

Figure S54. OR-based adjunctive surgery pretreatment vs. posttreatment (AHI)

0						• •			N 1
	Post	treatm	ent	Pretr	reatm	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
1.4.1 Soft tissue pro	cedures								
Azbay 2016	36.6	18.3	67	45	19.8	67	21.9%	-8.40 [-14.86, -1.94]	
Friedman 2009	50.1	19.7	52	63.2	22	52	21.1%	-13.10 [-21.13, -5.07]	_
Khan 2009	28.3	28.9	63	62	35.4	63	19.0%	-33.70 [-44.98, -22.42]	_
Nakata 2006	30.1	24	30	69	28.4	30	17.6%	-38.90 [-52.21, -25.59]	
Turhan 2015	20	19.5	31	44.7	17	31	20.4%	-24.70 [-33.81, -15.59]	_ _
Subtotal (95% CI)			243			243	100.0%	-22.89 [-33.89, -11.89]	\bullet
Heterogeneity: Tau ² =	= 132.71;	Chi ² =	28.90,	df = 4 (F)	P < 0.0	0001);	I² = 86%		
Test for overall effect	Z = 4.08	(P < 0	.0001)						
Total (95% CI)			243			243	100.0%	-22.89 [-33.89, -11.89]	◆
Heterogeneity: Tau ² =	= 132.71;	Chi ^z =	28.90,	df = 4 (F	P < 0.0	0001);	I ² = 86%		
Test for overall effect	Z = 4.08	(P < 0	.0001)						-50 -25 0 25 5i Favors posttreatment Favors pretreatment
Test for subaroup dif	ferences	: Not a	pplicab	le					Favors postileaunent Favors preueaunent

Figure S55. OR-based adjunctive surgery pretreatment vs. posttreatment (LSAT)

	Postti	eatm	ent	Pretr	reatme	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean SD Tot		Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
1.5.1 Soft tissue pro	cedures								
Friedman 2009	80.4	7.8	52	71.9	14.3	52	46.0%	8.50 [4.07, 12.93]	│
Nakata 2006 Subtotal (95% CI)	93.4	6.4	30 82	81.4	9.1	30 <mark>82</mark>	54.0% 100.0%	12.00 [8.02, 15.98] 10.39 [6.97, 13.81]	▲
Heterogeneity: Tau ² = Test for overall effect:	•		•	,	0.25); I	²= 25%	6		
Total (95% CI)			82			82	100.0%	10.39 [6.97, 13.81]	•
Heterogeneity: Tau² = Test for overall effect: Test for subgroup dif	: Z = 5.96	(P < 0	.00001)	D.25); I	²= 25%	6		-20 -10 0 10 20 Favors pretreament Favors posttreatment

Table S3. Summary of findings table for the surgical treatment of obstructive sleep apnea in adults to facilitate CPAP therapy

Outcomes	Quality of the evidence	Anticipated absolute effects* (95% CI)	№ of participants (studies)
Outcomes	(GRADE)	MD between pre-surgery and post-surgery or surgery and control	(studies)
ESS* (Pre- vs. Post- surgery)	⊕⊕⊖⊖ LOW	The mean difference in ESS score after surgery was 6.0 points ^A lower (7.2 lower to 4.7 lower) than before surgery.	117 (3 observational studies) ^{1,2,5}
Optimal CPAP Pressure* (Pre- vs Post-surgery)	⊕⊕⊖⊖ Low	The mean difference in optimal CPAP pressure after surgery was 2.5 cm $^{\rm A}{\rm H_2O}$ lower (3.5 lower to 1.4 lower) than before surgery.	260 (6 observational studies) ^{1,3-7}
CPAP Adherence* (Pre- vs. Post- surgery)	⊕⊖⊖⊖ VERY LOW ^{1,2}	The mean difference in CPAP adherence after surgery was 2.2 hrs/night [^] higher (0.2 higher to 4.11 higher) than before surgery.	83 (2 observational studies) ^{3,6}
AHI (Pre- vs Post- surgery)	⊕⊕⊖⊖ LOW	The mean difference in AHI after surgery was 22.9 events/hr ^A lower (33.9 lower to 11.9 lower) than before surgery. The mean AHI before surgery was 56.2 events/hr and after surgery was 33.3 events/hr for a reduction of 41%.	243 (5 observational studies) ^{1,3-6}
LSAT (Pre- vs Post- surgery)	⊕OOO VERY LOW ^{1,2}	The mean difference in LSAT after surgery was 10.4% ^A higher (7.0 higher to 13.8 higher) than before surgery. The mean LSAT before surgery was 77.0% and after surgery was 87.4% for an increase of 13.5%	82 (2 observational studies) ^{3,5}

*Critical Outcomes

¹Quality of evidence was downgraded due to imprecision associated with small sample size (<100 participants) ²Quality of evidence was downgraded due to imprecision (i.e., 95% Cl of mean difference crosses clinical significance threshold) ^AMean difference meets or exceeds clinical significance threshold

Surgical treatment of adult OSA as an initial therapy (PICO 4)

Figure S56. OR-based surgery vs. control (ESS) [RCT]

-		-				-					
	Su	irger	y	Co	ontro	I	Mean Difference		Mean D	Difference	
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Random, 95% Cl		IV, Rand	lom, 95% Cl	
1.2.1 Tonsillar hyper	trophy										
Sommer 2016	6.2	2.9	20	9.6	5.2	15	-3.40 [-6.32, -0.48]			-	
								-10	-5	Ó Ś	10
									Favors surger	y Favors cont	rol

Figure S57. OR-based surgery pretreatment vs. posttreatment (ESS)

	Postti	reatm	ent	Pretr	eatm	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% Cl	IV, Random, 95% Cl
2.2.2 Tonsillar hyper	trophy								
Holmlund 2016	6	4	28	11	6.7	28	58.5%	-5.00 [-7.89, -2.11]	
Komada 2012 Subtotal (95% CI)	5.8	4.7	10 38	13.3	3.2	10 38	41.5% 100.0 %	-7.50 [-11.02, -3.98] -6.04 [-8.45, -3.62]	_ - ►
Heterogeneity: Tau ² = Test for overall effect:				-	1.28); 1	-= 139	0		
Total (95% CI)			38			38	100.0%	-6.04 [-8.45, -3.62]	◆
Heterogeneity: Tau ² = Test for overall effect: Test for subgroup dif	Z= 4.90	(P < 0	.00001)	1.28); I	²=139	6	-	-20 -10 0 10 20 Favors posttreatment Favors pretreatment

Figure S58. OR-based surgery vs. control (Snoring, VAS) [RCT]

	Su	/	Co	ontro	1	Mean Difference	Mean Difference			
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Random, 95% Cl	IV, Random, 95% Cl		
1.5.1 Tonsillar hype	trophy									
Sommer 2016	1.5	1.8	15	5.2	2.5	14	-3.70 [-5.30, -2.10]	-+		
								-10 -5 0 5 10 Favors surgery Favors control		

Figure S59. OR-based surgery pretreatment vs. posttreatment (Snoring, VAS)

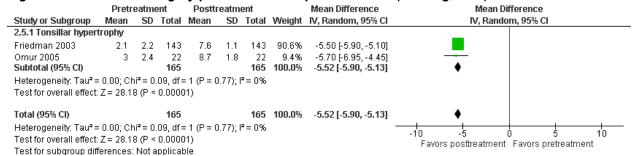


Figure S60. OR-based surgery vs. control (AHI) [RCT]

	Su	irgery	,	Co	ontro	I		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% Cl	IV, Random, 95% Cl
1.1.1 Tonsillar hyper	trophy								
Browaldh 2013	16	9	16	46	19	13	49.7%	-30.00 [-41.23, -18.77]	
Sommer 2016 Subtotal (95% CI)	-18.4	17.4	18 34	-7.2	15	16 29	50.3% 100.0%	-11.20 [-22.09, -0.31] - 20.55 [-38.97, -2.12]	-
Heterogeneity: Tau ² = Test for overall effect				df = 1 (F	^y = U.	U2); I*=	= 82%		
Total (95% CI)			34			29	100.0%	-20.55 [-38.97, -2.12]	
Heterogeneity: Tau ² =	= 144.86;	Chi ² =	= 5.55,	df = 1 (F	^o = 0.	02); I ² =	= 82%		-50 -25 0 25 50
Test for overall effect	: Z = 2.19	(P=0	0.03)						-50 -25 0 25 50 Favors surgery Favors control
Test for subgroup dif	ferences	: Not a	applical	ble					

Figure S61. OR-based surgery pretreatment vs. posttreatment (AHI)

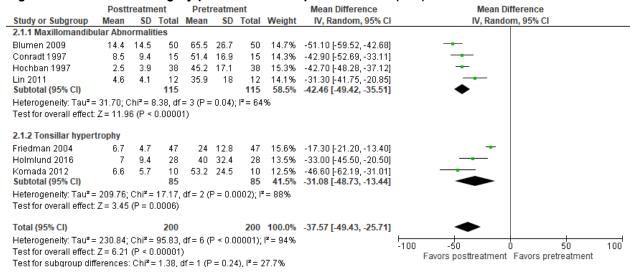


Figure S62. OR-based surgery vs. control (RDI) [RCT]

	S	urgery		Control			Mean Difference	Mean Difference				
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Random, 95% Cl	IV, Random, 95% Cl				
1.3.1 Tonsillar hyp	ertrophy											
Sommer 2016	21.8	21.8	17	28.7	19.4	16	-6.90 [-20.96, 7.16]					
								-20 -10 0 10 20 Favors surgery Favors control				

Figure S63. OR-based surgery pretreatment vs. posttreatment (RDI)

	Posttr	reatme	ent	Pret	reatm	ent		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
2.3.1 Maxillomandibu	ılar abno	rmaliti	es						
Conradt 1998 Subtotal (95% CI)	5.6	9.6	24 24	59.3	24.1	24 24		-53.70 [-64.08, -43.32] - 53.70 [-64.08, -43.32]	
Heterogeneity: Not ap	plicable								•
Test for overall effect:	Z = 10.14	4 (P < 0	0.0000	1)					
2.3.2 Tonsillar hypert	rophy								
Tan 2014 Subtotal (95% CI)	13.1	21.7	34 34	42.2	25.6	34 34		-29.10 [-40.38, -17.82] - 29.10 [-40.38, -17.82]	*
Heterogeneity: Not ap	plicable								
Test for overall effect:	Z = 5.06	(P < 0.	00001)					
Total (95% CI)			58			58	100.0%	-41.50 [-65.61, -17.40]	
Heterogeneity: Tau ² = Test for overall effect: Test for subgroup diff	Z = 3.37	(P = 0.	0007)						-100 -50 0 50 100 Favors posttreatment Favors pretreatment

Figure S64. OR-based surgery vs. control (LSAT) [RCT]

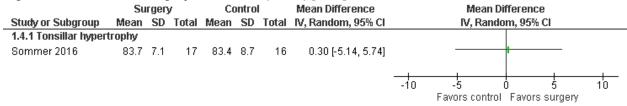


Figure S65. OR-based surgery pretreatment vs. posttreatment (LSAT)

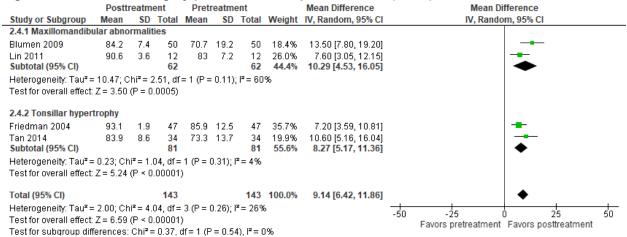


Figure S66. OR-based surgery pretreatment vs. posttreatment (ODI)

	Pretro	eatme	ent	Postt	reatm	ent	Mean Difference	Mean Difference			
Study or Subgroup	Mean SD Total		Mean	SD	Total	IV, Random, 95% Cl	IV, Random, 95% Cl				
2.6.1 Tonsillar hyper	trophy										
Wee 2015 1	14.3	6.7	27	32.8	21.1	27	-18.50 [-26.85, -10.15]				
								-50 -25	Ó 25 5		
								Favors posttreatment	Favors pretreatment		

Figure S67. OR-based surgery pretreatment vs. posttreatment (persistent dysphagia, incidence)

•		U U					<i>, , ,</i>		
	Posttreat	Posttreatment		Pretreatment		Risk Difference	Risk Difference		
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% Cl		
2.10.1 Tonsillar hyp	ertrophy								
Omur 2005	0	22	0	22	16.3%	0.00 [-0.08, 0.08]	+		
Wee 2015	0	47	0	47	28.3%	0.00 [-0.04, 0.04]	+		
Komada 2012	0	24	0	24	17.8%	0.00 [-0.08, 0.08]	_		
Holmlund 2016	0	28	0	28	20.5%	0.00 [-0.07, 0.07]	_		
Robinson 2009	7	64	0	64	17.1%	0.11 [0.03, 0.19]			
Subtotal (95% CI)		185		185	100.0%	0.02 [-0.03, 0.06]			
Total events	7		0						
Heterogeneity: Tau ² :	= 0.00; Chi ² =	= 9.28, d	if = 4 (P =	0.05); l ²	= 57%				
Test for overall effect	t: Z = 0.80 (P	= 0.42)							
Total (95% Cl)		185		185	100.0%	0.02 [-0.03, 0.06]	-		
Total events	7		0						
Heterogeneity: Tau ² :	= 0.00; Chi ^z =	= 9.28, d	f = 4 (P =	0.05); I ^z	= 57%	-			
Test for overall effect	t: Z = 0.80 (P	= 0.42)				-0.2 -0.1 0 0.1 0.2 pretreatment posttreatment			
Test for subaroun di	, fforoncoe: Nr	ht annlir	ahla				preueaunent postieaunent		

Test for subgroup differences: Not applicable

	Pretro	treatment Posttreatment		Mean Difference	Mean Difference						
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Random, 95% Cl		IV, Rando	m, 95% Cl	
2.7.1 Tonsillar hypeti	rophy										
Rotenberg 2014	134.5	3.9	22	143.2	4.3	22	-8.70 [-11.13, -6.27]		-		
									-		
								-20	-10 Ó) 1'O	20
								Favors p	osttreatment	Favors pretrea	tment

Figure S68. OR-based surgery pretreatment vs. posttreatment (mean SBP, mm Hg)

Figure S69. OR-based surgery pretreatment vs. posttreatment (persistent taste alteration, incidence)

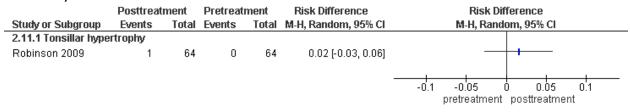


Figure S70. OR-based surgery pretreatment vs. posttreatment (persistent mandibular paresthesia, incidence)

	Posttreat	ment	Pretreat	ment		Risk Difference	Risk Difference
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% Cl
2.12.1 Tonsillar hype	rtrophy						
Miller 2004	5	32	0	32	33.6%	0.16 [0.02, 0.29]	
Robinson 2009 Subtotal (95% CI)	11	64 96	0	64 96	66.4% 100.0 %	0.17 [0.08, 0.27] 0.17 [0.09, 0.24]	
Total events	16		0				
Heterogeneity: Tau ² =	: 0.00; Chi ² :	= 0.03, d	lf=1 (P=	0.85); I ^z	= 0%		
Test for overall effect:	Z=4.21 (P	< 0.000	1)				
Total (95% CI)		96		96	100.0%	0.17 [0.09, 0.24]	•
Total events	16		0				
Heterogeneity: Tau² = Test for overall effect: Test for subgroup diff	Z = 4.21 (P	< 0.000	1)	0.85); I²	= 0%		-0.5 -0.25 0 0.25 0.5 pretreatment posttreatment

Figure S71. OR-based surgery pretreatment vs. posttreatment (persistent aspiration, incidence)

					•			•	,
	Posttreat	tment	Pretreatment		Risk Difference		Risk Difference		
Study or Subgroup	Events	Total	Events	Total	M-H, Random, 95% Cl		M-H, Rand	iom, 95% Ci	
2.14.1 Tonsillar hype	ertrophy								
Robinson 2009	3	64	0	64	0.05 [-0.01, 0.11]		-	+ +	
						-0.2	-0.1	0 0.1	0.2
							pretreatment	posttreatment	

Table S4. Summary of findings table for the surgical treatment of obstructive sleep apnea in adults as an initial therapy

References: Blumen 2009 (1); Browaldh 2013 (2); Conradt 1997 (3); Conradt 1998 (4); Friedman 2003 (5); Friedman 2004 (6); Hochban 1997 (7); Holmlund 2016 (8); Komada 2012 (9); Lin 2011 (10); Miller 2004 (11); Omur 2005 (12); Robinson 2009 (13); Rotenberg 2014 (14); Sommer 2016 (15); Tan 2014 (16); Wee 2015 (17)

Outcomes	Quality of the evidence (GRADE)	Anticipated absolute effects* (95% Cl) MD between pre-surgery and post-surgery or surgery and control	№ of participants (studies)
ESS* (Surgery vs	⊕⊕⊕⊖	The mean ESS in the surgery group was 3.4 points ^A lower (6.3 lower to 0.5 lower) than in the control group.	35
Control)	MODERATE ^{1,2}		(1 RCT) ¹⁵
ESS* (Pre- vs Post-	⊕○○○	The mean ESS after tonsillectomy was 6.0 points ^A lower (8.4 lower to 3.6 lower) than before surgery.	38
surgery)	VERY LOW 1		(2 observational studies) ^{8,9}
Snoring VAS*	⊕⊕⊕⊖	The mean snoring VAS in the surgery group was 3.7 points ^A lower (5.3 lower to 2.1 lower) than in the control group.	29
(Surgery vs Control)	MODERATE ^{1,2}		(1 RCT) ¹⁵
Snoring VAS* (Pre-	⊕⊕⊖⊖	The mean snoring VAS after surgery was 5.5 points ^A lower (5.9 lower to 5.1 lower) than before surgery.	165
vs Post-surgery)	LOW		(2 observational studies) ^{5,14}
AHI* (Surgery vs	⊕⊕⊕⊖	The mean AHI in the tonsillectomy group was 20.6 events/hr	63
Control)	MODERATE ^{1,2}	^ lower (39.0 lower to 2.1 lower) than in the control group.	(2 RCTs) ^{2,15}
AHI* (Pre- vs Post-	⊕⊕⊕⊖	The mean AHI after surgery was 37.6 events/hr ^A lower (49.4 lower to 25.7 lower) than before surgery. The mean AHI before surgery was 44.8 events/hr and after surgery was 7.2 events/hr for a reduction of 84%. The mean AHI after surgery for patients with maxillomandibular abnormalities was 42.5 events/hr lower (49.4 lower to 35.5 lower) than before surgery. The mean AHI was reduced by 85% with craniofacial procedures. The mean AHI after surgery for patients with tonsillar hypertrophy was 31.1 events/hr lower (48.7 lower to 13.4 lower) than before surgery. The mean AHI was reduced by 82% with tonsillectomy.	200
surgery)	MODERATE ³		(7 observational studies) ^{1,3,5-9}
RDI* (Surgery vs	⊕⊕⊕⊖	The mean RDI in the surgery group was 6.9 events/hr ^A lower (21.0 lower to 7.2 lower) than in the control group.	33
Control)	MODERATE ¹		(1 RCT) ¹⁵
RDI* (Pre- vs Post- surgery)	⊕⊖⊖⊖ VERY LOW 1	The mean RDI after surgery was 41.5 events/hr ^A lower (65.6 lower to 17.4 lower) than before surgery. The mean RDI before surgery was 50.8 events/hr and was 9.3 events/hr after surgery for a reduction of 82%. The mean RDI after surgery for patients with maxillomandibular abnormalities was 53.7 events/hr lower (64.1 lower to 43.3 lower) than before surgery for a reduction of 91%. The mean RDI after surgery for patients with tonsillar hypertrophy was 29.1 events/hr lower (40.4 lower to 17.8 lower) than before surgery for a reduction of 69%.	58 (2 observational studies) ^{4,16}
LSAT* (Surgery vs	⊕⊖⊖⊖	The mean LSAT in the surgery group was 0.3 % ^B higher (5.1 lower to 5.7 higher) than in the control group.	33
Control)	VERY LOW 1,4		(1 RCT) ¹⁵
LSAT* (Pre- vs Post-	⊕⊕⊖⊖	The mean LSAT after surgery was 9.1% ^A higher 6.4 higher to 11.9 higher) than before surgery for an increase of 16%. The mean LSAT after surgery for patients with maxillomandibular abnormalities was 10.3% higher (4.5 higher to 16.0 higher) than before surgery. The mean LSAT after surgery for patients with tonsillar hypertrophy was 8.3% higher (5.2 higher to 11.4 higher) than before surgery.	143
surgery)	LOW		(4 observational studies) ^{1,6,10,16}
ODI* (Pre- vs. Post-	⊕○○○	The mean ODI after surgery in patients with tonsillar hypertrophy was 18.5 points ^A lower (26.8 lower to 10.2 lower) than before surgery. The mean ODI before surgery was 32.8 and was 14.3 after surgery for a reduction of 56%.	27
surgery)	VERY LOW ¹		(1 observational study) ¹⁷

Permanent dysphagia* (Pre- vs Post-surgery)	⊕⊖⊖⊖ VERY LOW ²	The risk difference in permanent dysphagia after surgery was 0.02 $^{\rm B}$ higher (0.03 lower to 0.06 higher)	185 (5 observational studies) ^{8,9,12,13,17}
SBP (Pre- vs Post-	⊕⊖⊖⊖	The mean SBP after surgery for patients with tonsillar hypertrophy was 8.7 mmHg $^{\rm A}$ lower (11.1 lower to 6.3 lower) than before surgery.	22
surgery)	VERY LOW ¹		(1 observational study) ¹⁴

*Critical Outcomes ¹Quality of evidence was downgraded due to imprecision associated with small sample size (<100 participants) ²Quality of evidence was downgraded due to imprecision (i.e., 95% Cl of mean difference crosses clinical significance threshold) ³Quality of evidence was downgraded due to imprecision (i.e., 95% Cl of mean difference crosses clinical significance threshold in both directions) ⁴Quality of evidence was downgraded due to imprecision (i.e., 95% Cl of mean difference crosses clinical significance threshold in both directions) ⁴Mean difference meets or exceeds clinical significance threshold ^BMean difference does not meet clinical significance threshold