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Patient experience and satisfaction of surgically assisted rapid maxillary expansion and mandibular midline distraction

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ABSTRACT

Little is known regarding patient experience and satisfaction with surgically assisted rapid maxillary expansion (SARME) and mandibular midline distraction (MMD). This study therefore aimed to assess patient experience and satisfaction with these techniques in two different groups. The first group answered the post-surgical patient satisfaction questionnaire on a 7-point Likert scale during a long-term follow-up recall. The second group answered a visual analogue scale questionnaire (range: 0–10) with different questions regarding experience and satisfaction, at different time points during the first year of treatment. In both groups, 17 patients were included. Regarding the post-surgical patient satisfaction questionnaire, a mean satisfaction rate of 6.4 (range: 4–7) was reported, with a mean follow-up of 6.5 years post-operatively. In the visual analogue scale group, the mean satisfaction rate was 8.0 and did not significantly differ from the expectations pre-operative ($P = 0.96$). Both procedures showed relatively low pain scores, although a significant higher score was observed in MMD post-operatively ($P = 0.00051$). Regarding hindrance, the scores were moderate; the bone-borne distractor in the mandible gained higher scores than the tooth-borne distractor in the mandible. In conclusion, both SARME and MMD gain high satisfaction rates.

1. Introduction

Surgically assisted rapid maxillary expansion (SARME) and mandibular midline distraction (MMD) are surgical methods to widen respectively the maxilla and mandible. Indications include anterior crowding, posterior crossbite and buccal corridors. In addition, prior to secondary orthognathic surgery (e.g., bilateral sagittal split osteotomy [BSSO] and Le Fort I osteotomy), SARME and MMD might be indicated. The technique involves surgical intervention and intensive contact among the patient, surgeon and orthodontist. Post-operatively, a patient will experience a period with swelling and pain, and during the distraction phase, an esthetically disturbing diastema between the upper or lower incisors appears. This can all be quite uncomfortable for a patient. So far research mainly focused on the biomechanical parameters and surgical technique and outcome, which both have proved to be highly effective and stable in the long term. Low complication rates are reported in the literature. Complications are mild, transient, and manageable, without the need for reoperation (Verstraaten et al., 2010; King et al., 2012; de Gijt et al., 2016, 2017a, 2017b; Carvalho et al., 2020). However, little is reported on expectations and perceptions of patients during and at the end of these treatments. This study aims to assess patient experience and satisfaction during and after SARME and MMD. These clinical outcomes are relevant for orthodontists and surgeons in their choice of treatment.

2. Materials and methods

This study was conducted after approval had been given by the Standing Committee on Ethical Research in Humans of the Erasmus MC, University Medical Center Rotterdam, the Netherlands (MEC, 2011–265 and MEC-2013-367).

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2.1. Post-surgical patient satisfaction questionnaire

The first group consisted of patients who underwent SARME between 2004 and 2008. The patient cohort was derived from the study on the long-term effects of SARME performed in the Erasmus MC, University Medical Center Rotterdam, the Netherlands (Koudstaal et al., 2009). During the long-term follow-up, patients were asked to fill out the post-surgical patient satisfaction questionnaire (PSPSQ) as proposed by Posnick et al. (Appendix I) (Posnick et al., 2008). The questionnaire is specifically designed to assess patient satisfaction after orthognathic treatment. The PSPSQ consists of nine statements with which the patient states his/her agreement on a 7-point Likert scale. The scale ranged from unsatisfied to neutral to very satisfied, with a score of 4 considered neutral. Due to the fact that some patients were treated with other orthognathic surgical interventions, they were asked to answer the question only regarding SARME. A version translated into the Dutch language of the original questionnaire was used.

2.2. Visual analogue scale questionnaire

The second group consisted of patients who underwent SARME and MMD between 2010 and 2012. Inclusion criteria for this group were maxillary and or mandibular discrepancy (uni- or bilateral crossbite, maxillary anterior and/or posterior crowding buccal corridors). Exclusion criteria for this group were congenital (craniofacial) deformity, incomplete records, history of radiation therapy in the area of interest, age under 16 years, and mental retardation. In general, a tooth-borne distractor was used in SARME, and a bone-borne distractor was used in MMD. Patients were asked to fill out a visual analogue scale (VAS) questionnaire on how they perceived the treatment. The design of the questions made it possible to score the same question during the entire treatment period. A score was given on a 10-cm VAS scale (Table 1). The following topics were included: satisfaction regarding dental appearance (VAS, question 1) and appearance of mouth (VAS, question 2), expected and experienced hindrance of the distractor (VAS, questions 3 and 4), expected and experienced impact of the surgery (VAS, question 5), expectation and satisfaction with total outcome (VAS, question 6), and experience of pain (VAS, questions 7 and 8). Questions 3 and 7 apply only to SARME, and questions 4 and 8 apply only to MMD. At different time points the questionnaires were obtained, namely: T1: pre-operatively, T2: direct post-operatively, T3: at stop of distraction, T4: 3 months post-distraction, and T5: 12 months post-operatively.

Table 2
Baseline patient characteristics. BB: bone-borne distractor, TB: tooth-borne distractor.

	PSPSQ	VAS
Mean age at surgery (range)	31 (18–47)	31 (17–49)
Male/Female	♀: 10, ♂: 7	♀:10,♂: 7
MMD	BB: 9	TB: 3; BB: 14
SARME	TB: 8; BB: 9	TB: 17

2.3. Statistical analysis

The longitudinal data (VAS scores) were analyzed using a linear mixed model analysis whereby T1 is regarded as baseline (R Core Team [2015]. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.). A P-value < 0.05 was regarded as significant.

3. RESULTS

3.1. PSPSQ

In the PSPSQ study group 17 of the 42 patients responded and completed the questionnaire (Table 2). The mean follow-up time was 6.5 years. Besides SARME, 9 patients underwent MMD; 2 patients a BSSO; and 4 patients a bimaxillary osteotomy. A mean of 6.4 (standard deviation: 0.9; range: 4–7) was given regarding overall satisfaction, and none of the patients reported less than 4. Complete outcomes are summarized in Table 3.

3.2. VAS

In the VAS-group, 17 patients were included, of whom 16 patients received both SARME and MMD and 1 patient was treated with MMD only (Table 2). Complete results are shown in Table 4 and Fig. 1. Of note is the increase in VAS score for patients after T3 regarding dentition and appearance of the mouth, in which the increase regarding dentition is significant for T4 and T5 ($P < 0.05$). The satisfaction of patients with their dentition was statistically higher than patients expected. The hindrance score for the tooth-borne distractor used in the maxilla was lower than the bone-borne distractor used in the mandible. Regarding the impact of the procedures, the lowest scores were given at T3 and T4 and were significant ($P < 0.05$). The overall satisfaction remains stable at a score of around 8 and did not differ significantly from the pre-operative expectations ($P > 0.05$). The pain score for the mandible was post-operatively significantly higher than was expected

Table 1
Visual analogue scale (VAS) questions, translated to English.

VAS questions	
Question 1	How satisfied are you with your dentition?
Question 2	How satisfied are you with your mouth?
Question 3	How much hindrance do you expect to have of the maxillary distractor?
	How much hindrance do you have of the maxillary distractor?
	How much hindrance did you had of the maxillary distractor?
Question 4	How much hindrance do you expect to have of the mandibular distractor?
	How much hindrance do you have of the mandibular distractor?
	How much hindrance did you had of the mandibular distractor?
Question 5	How radical do you expect the surgery to be?
	How radical was the surgery?
Question 6	How satisfied do you expect to be with result?
	How satisfied are you with the result?
Question 7	How much pain do you experience pain of the maxilla?
Question 8	How much pain do you experience pain of the mandible?

Table 3
The results of the PSPSQ.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Mean	5.8	5.8	6.4	6.1	5.8	5.7	6.0	6.1	6.3
SD	1.8	1.3	0.9	0.9	1.1	1.0	1.2	1.1	1.0
Range	2–7	3–7	4–7	4–7	3–7	3–7	2–7	4–7	4–7

Table 4
Mean scores on VAS-questionnaire, T: time point, *: *P*-value = <0.05; **: *P*-value = <0.001, ***: *P*-value = <0,0001.

	T	Vas-score	p-value	
Question 1	T1	3.0		
	T2	2.4	0,4462	
	T3	4.3	0,0774	
	T4	5.1	0,0044	**
	T5	5.9	0,0017	**
Question 2	T1	4.8		
	T2	4.6	0.828	
	T3	4.0	0.325	
	T4	5.7	0.222	
	T5	6.5	0.052	
Question 3	T1	4.8		
	T2	4.4	0.64	
	T3	3.9	0.3	
	T4	3.8	0.23	
	T5	3.9	0.4	
Question 4	T1	5.4		
	T2	5.4	0.99	
	T3	4.6	0.29	
	T4	5.3	0.92	
	T5	5.3	0.98	
Question 5	T1	5.3		
	T2	4.1	0,0871	
	T3	3.1	0,0018	**
	T4	4.0	0,0381	*
	T5	5.0	0,6887	
Question 6	T1	8.0		
	T2	7.5	0.47	
	T3	7.2	0.27	
	T4	8.0	0.96	
	T5	7.6	0.65	
Question 7	T1	1.8		
	T2	1.9	0.919	
	T3	1.0	0.146	
	T4	1.1	0.222	
	T5	0.1	0.025	*
Question 8	T1	1.4		
	T2	3.5	0,00051	***
	T3	1.5	0,95657	
	T4	1.7	0,65168	
	T5	0.2	0,06831	

($P < 0.05$). In addition, the scores given for the mandible were higher than for maxilla.

4. Discussion

In this study, patients who underwent MMD and SARME were examined on their expectations and satisfaction. Both procedures showed high satisfaction scores in both the PSPSQ and VAS questionnaires. Relatively low pain scores were observed, although a significant higher score was seen in MMD post-operatively ($P < 0.05$). Regarding hindrance, the scores were moderate, whereby regarding the mandible, the bone-borne distractor gained higher scores than the tooth-borne distractor.

In the literature, studies assessing patient satisfaction following orthognathic surgery are relatively uncommon, and, specifically, studies regarding SARME and MMD are scarce (Koudstaal et al., 2005; de Gijt et al., 2012; Pacheco-Pereira et al., 2016). In recent years, a shift towards a more holistic view of (surgical) treatments appears in the literature, and not only biomechanical aspects are deemed to be essential. Researchers have focused on complication rates, costs-effectiveness, and patient satisfaction (Kanatas et al., 2010). Assessment of patient satisfaction is not only important for surgeons to improve their treatment, it is also important for future patients so they can be well informed. In addition, value-based healthcare initiatives advocate registration of outcome measurements, including patient satisfaction, as it will help to improve quality and to curb inefficiencies (Rodrigues et al., 2016).

4.1. PSPSQ

The PSPSQ results indicate that all patients who underwent SARME were very satisfied with the treatment, and no patient was dissatisfied. However, not every patient in our study would recommend the treatment to others (PSPSQ, question 2) and/or would undergo the treatment again (PSPSQ, question 1). This might indicate that patients experience the treatment as demanding and intense. This suggests that, even when there is a good indication for treatment, careful patient selection is advisable to avoid patient disappointment.

Regarding the questions specifically focused on orthognathic surgery, all questions had above-average ratings. The questions regarding bite, sensory disturbances, and temporomandibular joint/facial pain received the best ratings. Improvement of the bite is one of the foundations of orthognathic surgery, the high score combined with no patient scoring under 4 indicates that SARME has a positive influence on bite and underpins the indication for SARME. Regarding joint and facial pain, the high score implies that SARME has little effect on these factors after the normal healing period. Biomechanically, it would be very surprising if temporomandibular joint pain occurred, since no surgery is performed on the mandible and the joints are theoretically not loaded differently. However, due to surgical and orthodontic treatment, the occlusion changes, which might contribute to this observation. The score for sensory disturbances is related to chin and lower lip disturbances, which are less relevant for this study. Primarily because it is physically not related to the surgical field, the score might be affected by other surgeries that were performed in that region, such as BSSO or MMD.

The questions concerning breathing, articulation, and speech had a mean score ranging between 5.7 and 6.0. Breathing might be affected by SARME, as it enlarges the nasal cavity and could therefore contribute to improved breathing (Buck et al., 2016). Notably, articulation and speech would be important aspects to discuss pre-operatively, as they received the lowest reported scores. Although the scores are above average, it might imply that after SARME speech and articulation are affected.

4.2. VAS

In general, patients were satisfied with the overall results, and these met their expectations. Satisfaction scores during the treatment ranged between 7.2 and 8.0 and are in concordance with the long-term results of the PSPSQ. Regarding dentition and appearance of the mouth, an increase in scores was found, with an initial decrease during the post-surgical and distraction phase. Although SARME seems to have a positive effect on these parameters, the end scores for dentition and for the appearance of the mouth were 5.9 and 6.5. These results might be affected by the fact that 8 patients needed secondary orthognathic surgery and therefore scored lower on these parameters. A study in a large, separate group that would consist only of patients who did not need secondary orthognathic surgery would overcome this bias.

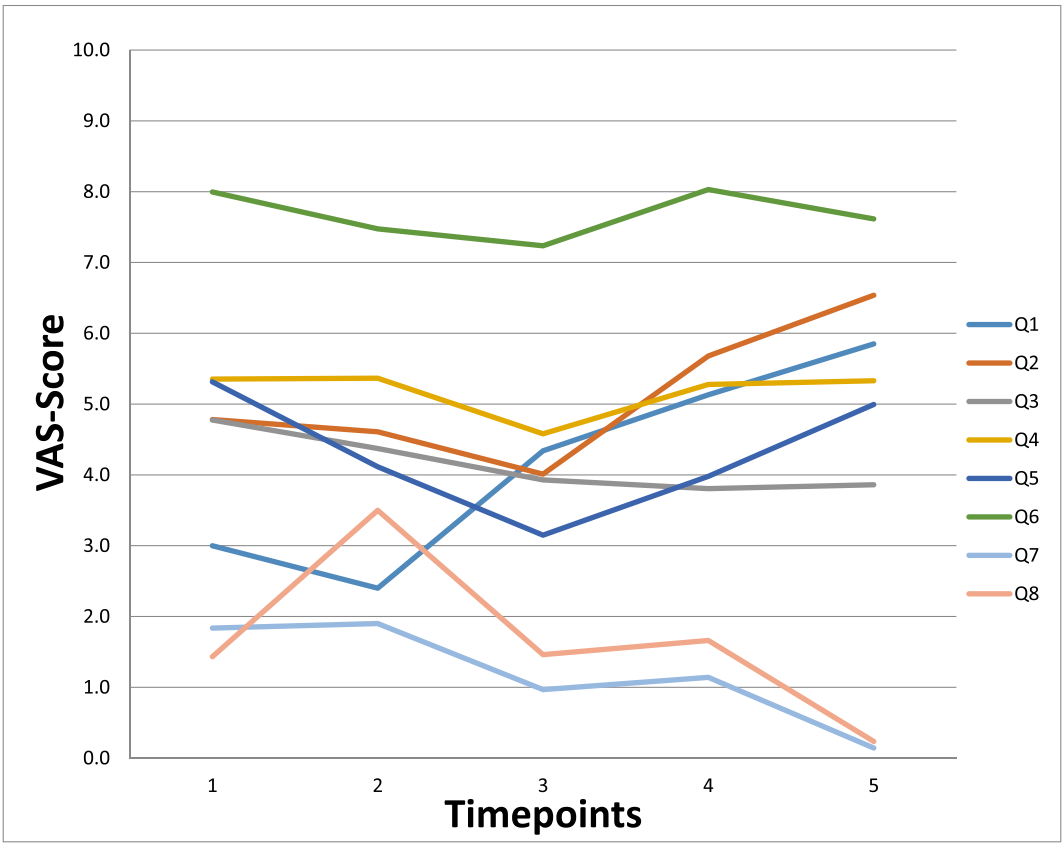

Fig. 1. Visual VAS-scores of the different questions (Q1-Q8) at different time points.

Results regarding the hindrance of distractors show that these tend to be mildly uncomfortable for patients, with the distractors used in the mandible tending to be more distressing than the ones used for SARME. The same is observed in pain scores, which are relatively low, with an increase post-operatively. The relatively low score can be attributed to the fact that patients were administered analgesics post-operatively. In MMD, the position of bone-borne distractors penetrating the mucosa increases the risk of dehiscence, and the close relation to the lips can contribute to pain and hindrance for patients. In our department, these findings contributed to the decision to preferably use tooth-borne distractor in MMD. Future research is necessary that clarifies the biomechanical differences in types of distractors used for MMD.

Patients estimate the severity of the procedure as medium, although the scores were higher before the procedure and at the 1-year follow up. This would be explained by the fact that patients report the lowest severity score just after the distraction was finished. At that point, they might assume that everything was "normal" again and not realize that a healing and consolidation period was still needed. When the distractors are still in place, a soft diet is indicated, and a diastema might be noticeable between the incisors. One of the aims of this study was to assess the experience of patients during the procedures, to help enable surgeons and orthodontists to better inform patients. The above suggests that in our clinic, patients should perhaps be better informed, considering the period after the distraction phase.

In accordance with our study, Gareau et al. and Rocha et al. using self-made questionnaires, reported high satisfaction rates in patients who underwent SARME (Rocha et al., 2008; Garreau et al., 2016). However, no study was performed that monitored patients undergoing SARME and MMD in one operation. The study by Gareau et al. reported patient experience using bone-borne and tooth-borne distractors (Garreau et al., 2016). They concluded that use of a bone-borne distractor was favored over a tooth-borne distractor, mainly because patients report the bone-borne distractor to be easier to use, and all patients who used a tooth-borne distractor needed help from another person. This is, however, not our own experience. In addition, due to the jack-screw configuration of the bone-borne distractor used in their study, a specific activation pattern is needed, which could potentially cause misuse of the distractor (Garreau et al., 2016). Due to the similar biomechanical effects as well as the absence of a need for surgical removal and a shorter operation time, we advocate using a tooth-borne device. Rocha et al. advocate pre-operative counseling to bring patients' expectations in line with the normal course of treatment program, which is in accordance with findings of this study (Rocha et al., 2008).

Recently, Baranto et al. reported patient satisfaction outcomes using a self-made questionnaire in 30 patients who underwent SARME with a combined bone- and tooth-borne (hybrid) distractor. Of these 30 patients, 29 were satisfied with this treatment and had no regrets. Other pre-operative difficulties such as those relating to biting, chewing, dental position, facial appearance, speech, and self-esteem had improved with this treatment, according to most of the patients. Worsening of pain in the temporomandibular joint (TMJ) region was uncommon among the patients (6.7%) (Baranto et al., 2020). These findings are broadly in line with our own experience as well.

A few limitations of this study need to be addressed. First, although the questionnaire that we used has been used previously to evaluate patient satisfaction regarding complex orthognathic surgery (Posnick et al., 2008), it has yet not been validated, which is

a major limitation. Second, there might be a selection bias, because the response rate in our study was relatively low. This might have biased our results and could lead to limited generalizability. Third, responses to questionnaires given at the long term might be affected by additional orthognathic surgery and could be subject to recall bias.

5. Conclusion

In our study, despite the limitations, patients who underwent SARME and MMD to widen respectively the maxilla and mandible are satisfied with their treatment. This finding could support orthodontists and surgeons in their choice of treatment.

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This work did not receive any funding.

Declaration of Competing Interest

The authors declare that there were no conflicts of interest.

Appendix I. Post-surgical patient satisfaction questionnaire (PSPSQ)

Post Treatment Questionnaire

(Please circle your response to each question)

If you had to make the decision again, how likely would you be to undergo this same surgery?

1 2 3 4 5 6 7
Not at all — Neutral — Very Likely

How likely would you be to recommend this same surgery to others?

1 2 3 4 5 6 7
Not at all — Neutral — Very Likely

Considering everything, how satisfied are you now with the results of surgery?

1 2 3 4 5 6 7
Not at all Satisfied — Neutral — Very Satisfied

Overall, how satisfied are you with your current bite?

1 2 3 4 5 6 7
Not at all Satisfied — Neutral — Very Satisfied

Overall, how satisfied are you with your current speech articulation?

1 2 3 4 5 6 7
Not at all Satisfied — Neutral — Very Satisfied

Overall, how satisfied are you with your current lip posture and lip closure?

1 2 3 4 5 6 7
Not at all Satisfied — Neutral — Very Satisfied

Overall, how satisfied are you with your current breathing?

1 2 3 4 5 6 7
Not at all Satisfied — Neutral — Very Satisfied

Overall, how accepting are you with your current level of TMJ / facial pain

1 2 3 4 5 6 7
Not at all Accepting — Neutral — Very Accepting

Overall, how accepting are you with your current level of lower lip/chin sensation

1 2 3 4 5 6 7
Not at all Accepting — Neutral — Very Accepting

References

Baranto, H., Weiner, C.K., Burt, I.A., Rosen, A., 2020. Satisfactory outcomes after orthognathic surgery with surgically assisted rapid maxillary expansion using a hybrid device. J Oral Sci 62, 107–111.

Buck, L.M., Dalci, O., Darendeliler, M.A., Papadopoulou, A.K., 2016. Effect of surgically assisted rapid maxillary expansion on upper airway volume: a systematic review. J Oral Maxillofac Surg 74, 1025–1043.

Carvalho, P.H.A., Moura, L.B., Trento, G.S., Holzinger, D., Gabrielli, M.A.C., Gabrielli, M.F.R., Pereira Filho, V.A., 2020. Surgically assisted rapid maxillary expansion: a systematic review of complications. Int J Oral Maxillofac Surg 49, 325–332.

de Gijt, J.P., Gul, A., Sutedja, H., Wolvius, E.B., van der Wal, K.G.H., Koudstaal, M.J., 2016. Long-term (6.5 years) follow-up of mandibular midline distraction. J Craniomaxillofac Surg 44, 1576–1582.

de Gijt, J.P., Gul, A., Tjoa, S.T., Wolvius, E.B., van der Wal, K.G., Koudstaal, M.J., 2017a. Follow up of surgically-assisted rapid maxillary expansion after 6.5 years: skeletal and dental effects. Br J Oral Maxillofac Surg 55, 56–60.

de Gijt, J.P., Gul, A., Wolvius, E.B., van der Wal, K.G.H., Koudstaal, M.J., 2017b. Complications in mandibular midline distraction. Craniomaxillofac Trauma Reconstr 10, 204–207.

de Gijt, J.P., Vervoorn, K., Wolvius, E.B., Van der Wal, K.G., Koudstaal, M.J., 2012. Mandibular midline distraction: a systematic review. J Craniomaxillofac Surg 40, 248–260.

Garreau, E., Bouscaillou, J., Rattier, S., Ferri, J., Raoul, G., 2016. Bone-borne distractor versus tooth-borne distractor for orthodontic distraction after surgical maxillary expansion: the patient's point of view. Int Orthod 14, 214–232.

Kanatas, A.N., Rogers, S.N., 2010. A systematic review of patient self-completed questionnaires suitable for oral and maxillofacial surgery. Br J Oral Maxillofac Surg 48, 579–590.

King, J.W., Wallace, J.C., Winter, D.L., Niculescu, J.A., 2012. Long-term skeletal and dental stability of mandibular symphyseal distraction osteogenesis with a hybrid distractor. Am J Orthod Dentofacial Orthop 141, 60–70.

Koudstaal, M.J., Poort, L.J., van der Wal, K.G., Wolvius, E.B., Prahl-Andersen, B., Schulten, A.J., 2005. Surgically assisted rapid maxillary expansion (SARME): a review of the literature. Int J Oral Maxillofac Surg 34, 709–714.

Koudstaal, M.J., Wolvius, E.B., Schulten, A.J., Hop, W.C., van der Wal, K.G., 2009. Stability, tipping and relapse of bone-borne versus tooth-borne surgically assisted rapid maxillary expansion; a prospective randomized patient trial. Int J Oral Maxillofac Surg 38, 308–315.

Pacheco-Pereira, C., Abreu, L.G., Dick, B.D., De Luca Canto, G., Paiva, S.M., Flores-Mir, C., 2016. Patient satisfaction after orthodontic treatment combined with orthognathic surgery: a systematic review. Angle Orthod 86, 495–508.

Posnick, J.C., Wallace, J., 2008. Complex orthognathic surgery: assessment of patient satisfaction. J Oral Maxillofac Surg 66, 934–942.

Rocha, N.S., Cavalcante, J.R., de Oliveira e Silva, E.D., Caubi, A.F., Laureano Filho, J.R., Gondim, D.G., 2008. Patient's perception of improvement after surgical assisted maxillary expansion (SAME): pilot study. Med Oral Patol Oral Cir Bucal 13, E783–E787.

Rodrigues, I.A., Sprinkhuizen, S.M., Barthelmes, D., Blumenkranz, M., Cheung, G., Haller, J., Johnston, R., Kim, R., Klaver, C., McKibbin, M., Ngah, N.F., Pershing, S., Shankar, D., Tamura, H., Tufail, A., Weng, C.Y., Westborg, I., Yelf, C., Yoshimura, N., Gillies, M.C., 2016. Defining a minimum set of standardized patient-centered outcome measures for macular degeneration. Am J Ophthalmol 168, 1–12.

Verstraaten, J., Kuijpers-Jagtman, A.M., Mommaerts, M.Y., Berge, S.J., Nada, R.M., Schols, J.G., 2010. Eurocran distraction osteogenesis: a systematic review of the effects of bone-borne surgical assisted rapid maxillary expansion. J Craniomaxillofac Surg 38, 166–174.