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Follow up of surgically-assisted rapid maxillary expansion after 6.5 years: skeletal and dental effects

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Abstract

Surgically-assisted rapid maxillary expansion (SARME) is a technique used to widen the maxilla, and we present the results of our long-term follow up (6.5 years). Seventeen patients who had been treated with SARME and prospectively followed were invited for long-term follow up by dental casts and posteroanterior cephalograms. The following measurements were made on the dental casts: transverse distances at canine, premolar, and molar level, length of the arch, and width and depth of the palate at premolar and molar level. The distance between the left and right nasal bases and the widening of the inferior maxilla were measured on the posteroanterior cephalograms. Boneborne and toothborne distractors were used in 8 and 9 patients, respectively. In the study of dental casts, there was a significant increase in transverse width in the canine ($P < 0.001$), premolar ($P < 0.001$) and molar ($P = 0{,}001$) and these remained stable in the long term. The arch length did not increase significantly, but the palatal width increased significantly in the premolar ($P < 0.001$) and molar ($P = 0.001$) regions. No effect was seen in palatal depth. On the posteroanterior cephalograms the width of the inferior part of the maxilla was increased, but not significantly so. There were no significant changes at the nasal base. We conclude that SARME is a predictable technique to widen the maxilla in the long term.

Keywords: SARME; SARPE; Long-term; Skeletal; Dental

Introduction

Indications for surgically-assisted rapid maxillary expansion (SARME) include transverse discrepancies, which can present in both syndromic and non-syndromic patients. Clinically, transverse discrepancies include a unilateral or bilateral crossbite, buccal corridors, anterior crowding, buccal tipping of the maxillary molars, and lingual tipping of the mandibular molars. Congenital deformities that may affect the maxillary width include: clefts, frontonasal dysplasia, Apert syndrome, Pfeiffer syndrome, and Saethre-Chotzen syndrome (acrocephalosyndactyly type III).[1]

Successful skeletal maxillary expansion can be achieved with conventional orthodontic rapid maxillary expansion, but after the age of about 15 years surgical intervention may be necessary to expand the maxilla successfully. It has been suggested that the heavy interdigitation of the midpalatal and circum-maxillary sutures may be why it is resistant to separation.[2–4] Recently, successful expansion using bone anchors has been reported.[18] Different operations have also been described, including a bilateral corticotomy. In addition, a midline osteotomy may be necessary. Some authors favour release of the pterygoid plates, and some do not.[19]

After the osteotomies the expansion is initiated with a distractor, two different types of which are available: boneborne (applied to the maxillary bone) and toothborne (fixed to two or more teeth on each side of the maxilla). No significant differences were found between the two in a prospective,

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randomised, controlled trial.[5] As little is known about the effects of SARME in the long term, we have focussed on dental and skeletal tissue.

Patients and methods

An observational study was done at the Erasmus University Medical Centre, Rotterdam The Netherlands. The group of patients was derived from the prospective study on SARME by Koudstaal et al.[5] After approval had been given by the Standing Committee on Ethical Research in Humans of the Erasmus University Medical Centre Rotterdam in 2011 (MEC 2011-265), all patients were invited by mail to return to our clinic for long-term follow up. All patients had been operated on before 2008. During the initial study, dental casts and posteroanterior cephalograms were obtained at fixed time points: preoperatively (T1), immediately postoperatively (T2), and one year postoperatively (T3). Only patients who returned for the long-term follow up were included in the study. Dental casts and posteroanterior cephalograms were obtained for the long-term follow up (T4).

Surgical technique

The precise surgical technique and specific types of distractors used during the original study were described by Koudstaal et al.[5]

Dental cast study

On the dental cast the following transverse distances were measured: intercanine, interfirst premolar, and interfirst molar. The perimeter of the arch, and width and depth of the palate were also recorded. The depth and width of the palate were measured at the first premolar and first molar level. Because the distractor was in place at T2, we made no measurements at this time. For the intercanine, interfirst premolar, and interfirst molars, the tips of the (disto)buccal cusps were used (Fig. 1).[5] To measure the perimeter of the arch, the distances between the contact points on the mesial surface of the first molar, the mesial surface of the first premolar, and the distal surface of the central incisor on both sides were added together.[6] To assess the width and depth of the palate we used the technique described by Northway et al.[7] All measurements on the dental casts were made with electronic digital calipers that were accurate to 0.02 mm (Kraftixx®, art.0906-90, kwb Germany GmbH).

Analysis of posteroanterior cephalograms

To evaluate the skeletal response when the maxilla was expanded we made cephalometric analyses on posteroanterior cephalograms. To assess widening of the nasal floor we measured the distance between the lowest points of the left and right piriform apertures (NN). To assess widening of the inferior part of the maxilla, we measured the distance between the intersection of the molar and the alveolar processes on the left and right (MM). The distance between the left and right zygomatic processes (ZZ) were used as controls. All measurements were made digitally with Sidexis (Phillips, Eindhoven,The Netherlands).

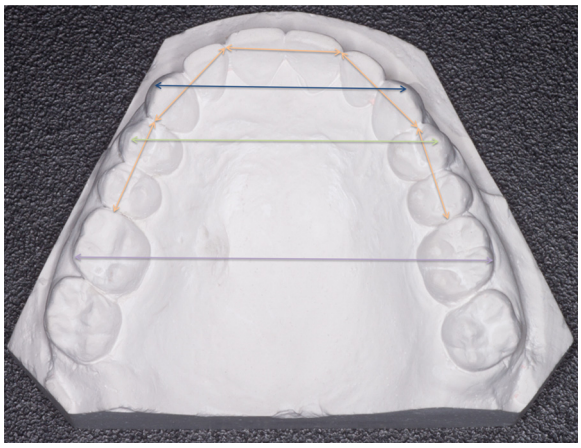

Fig. 1. Dental cast analysis. Blue line = intercanine distance, green line = interpremolar distance, purple line = intermolar distance, and orange line = arch length.

Statistical analysis

The statistical analysis (in association with the department of Biostatistics of the Erasmus Medical Centre, Rotterdam) was made using IBM SPSS Statistics for Windows (version 20.0, IBM Corp, Armonk, NY). All measurements were made twice by the authors and the mean value used for the analysis. The longitudinal changes were evaluated using a mixed models ANOVA, with a Bonferroni test. Because of the fact that other operations may have been necessary during the follow up period, LeFort 1 osteotomy and extractions of teeth were added as fixed factors in the analysis of the posteroanterior cephalograms and the dental casts, respectively. Probabilities of less than 0.05 were accepted as significant.

Reliability analysis

To assess interobserver and intraobserver agreement we calculated an intraclass correlation coefficient (ICC). All measurements were also made by the second author. An ICC value of 0.9 or more was considered reliable.

Results

Baseline characteristics

Seventeen of the original 42 patients contacted were included in the long-term follow up. The mean (range) age at operation

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