Journal of Cranio-Maxillo-Facial Surgery xxx (2018) 1–7

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Bone-borne surgically assisted rapid maxillary expansion: A retrospective three-dimensional evaluation of the asymmetry in expansion

Martin P. Huizinga*, Jene W. Meulstee, Pieter U. Dijkstra, Rutger H. Schepers, Johan Jansma

Department of Oral and Maxillofacial Surgery, (Head: Prof. F.K.L. Spijkervet, DMD, PhD), University Medical Center Groningen, Hanzeplein 1, P.O. Box 30.001, 9700RB, Groningen, The Netherlands

ARTICLE INFO

Article history:
Paper received 30 July 2017
Accepted 7 May 2018
Available online xxx

Keywords:
Surgicaly assisted rapid maxillary expansion
Asymmetrical expansion
Bone-borne distractor
Maxillary osteotomy
Imaging, three-dimensional
Palatal expansion technique

ABSTRACT

Purpose: Asymmetrical expansion occurs in patients treated with Surgically Assisted Rapid Maxillary Expansion (SARME). In the clinical setting, this asymmetrical expansion is seen in multiple directions. However, the frequency, actual directions and amount of asymmetry are unclear. Hence, the aim of this study was to analyze the directions and amount of asymmetrical lateral expansion in non-syndromic patients with transversal maxillary hypoplasia on employing bone-borne transpalatal distraction by means of SARME. Treatment involved corticotomies of all four bony supports, including pterygomaxillary disjunction.

Materials and methods: A retrospective case series was formed from patients treated with SARME. Pre- and postdistraction Cone Beam Computed Tomography scans were superimposed. A reference frame was created to analyze lateral expansion asymmetries in five directions.

Results: Clinical relevant asymmetries (>3.0 mm) in at least one of the investigated directions occurred in 55% of the patients. Lateral expansion asymmetries occurred mostly in the inferior-anterior part between the left and right segment and asymmetry in total expansion was noted between the anterior and posterior part of the maxilla.

Conclusion: This study confirms the clinical suspicion that using SARME with a bone-borne distractor and pterygomaxillary disjunction to treat non-syndromic patients with transversal maxillary hypoplasia, results in regular asymmetrical lateral expansion.

© 2018 European Association for Cranio-Maxillo-Facial Surgery. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Skeletally mature patients with functional or aesthetic problems due to transversal hypoplasia of the maxilla can be treated with a combined surgical-orthodontic treatment modality called surgically assisted rapid maxillary expansion (SARME). SARME is indicated in patients with transverse maxillary hypoplasia, inadequate occlusion and a synostosed midpalatal suture. The age to perform SARME is generally considered 14 years and older, although large interindividual variation is seen in midpalatal suture closing in relation to age (Mommaerts, 1999; Koudstaal et al., 2005; Haghanifar et al., 2017). SARME is applied to release the areas of bony resistance of the maxilla in order to prevent adverse skeletal and dental effects (e.g. alveolar bending, tooth tipping and periodontal membrane compression) during expansion and is combined with pre- and postsurgical orthodontic treatment (Mommaerts, 1999). The treatment results in an increase in transversal maxillary dimension, nasal cavity width and arch perimeter, providing adequate dental arch space for dentition alignment and space for the tongue (Pinto et al., 2001; Matteini and Mommaerts, 2001; Koudstaal et al., 2005; Lagravère et al., 2006; Asscherickx et al., 2016). SARME can be aided by a tooth-borne or a bone-borne transpalatal distractor (TPD). The advantages of a bone-borne palatal distractor have been theorized and weakly proved. The advantages include the following: the forces act directly on the bone at the mechanically desired level; overexpansion is not required; and it prevents dental side effects such as tipping of

* Corresponding author. Afdeling Mondziekten, Kaak- en Aangezichtschirurgie, Hanzeplein 1, P.O. Box 30.001, 9700RB, Groningen, The Netherlands. Fax: +31 50 361 28 31.
E-mail address: mphuizinga@gmail.com (M.P. Huizinga).

https://doi.org/10.1016/j.jcms.2018.05.021
1010-5182/© 2018 European Association for Cranio-Maxillo-Facial Surgery. Published by Elsevier Ltd. All rights reserved.

Please cite this article in press as: Huizinga MP, et al., Bone-borne surgically assisted rapid maxillary expansion: A retrospective three-dimensional evaluation of the asymmetry in expansion, Journal of Cranio-Maxillo-Facial Surgery (2018), https://doi.org/10.1016/j.jcms.2018.05.021

anchor teeth and periodontal defects (Koudstaal et al., 2005, 2009a, 2009b; Verstraaten et al., 2010; Nada et al., 2012). Both tooth-borne and bone-borne distractors are well-accepted treatment modalities and have advantages and disadvantages relative to one another. The short- and long-term treatment outcomes have been evaluated extensively as well as the adverse dental effects (Koudstaal et al., 2005, 2009b; Lagravère et al., 2006; Landes et al., 2009; Verstraaten et al., 2010; Nada et al., 2012; Vilani et al., 2012; Asscherickx et al., 2016).

Many surgical procedures exist for mobilising the maxilla, but their use, especially regarding whether or not to dissect the pterygoid plates from the maxilla, vary (Mommaerts, 1999; Pinto et al., 2001; Laudemann et al., 2009; Verstraaten et al., 2010). SARME is a safe treatment with mostly minor problems that can usually be resolved easily (Neyt et al., 2002; Verlinden et al., 2011; Williams et al., 2012).

Clinical asymmetrical expansion was observed on applying SARME. However, the frequency, direction and amount of asymmetry have not yet been quantified, and the predictability of the outcomes of SARME is questioned. The international literature mentions that transversal asymmetrical results occur (Koudstaal et al., 2005, 2009b; Rameiri et al., 2005; Verstraaten et al., 2010; Kober et al., 2011; Verlinden et al., 2011). However, only a few studies focused primarily on the symmetry in maxillary expansion after applying SARME with a bone-borne distractor and pterygomaxillary disjunction (PMD) (Ramieri et al., 2005; Landes et al., 2009; Nada et al., 2012). Quantifying the occurrence, degree and direction of asymmetrical expansion may help clinicians to plan further treatment and to manage patients' treatment expectations. Furthermore, it could aid in suitably modifying the surgical and distraction protocol and orthodontic treatment following distraction.

The aim of this study was to analyze asymmetry in lateral expansion in non-syndromic patients with transversal maxillary hypoplasia undergoing bone-borne transpalatal distraction using SARME, with corticotomies of all four bony supports including pterygomaxillary disjunction. Three-dimensional (3D) analyses of voxel-based superimposed cone beam computed tomography (CBCT) scans of the maxilla were used.

2. Materials and Methods

2.1. Study design and sample

A retrospective case series was formed. The study sample consisted entirely of non-syndromic patients aged ≥14 years. They were referred by an orthodontist to the department of Oral and Maxillofacial Surgery at the University Medical Center Groningen (UMCG), Groningen, The Netherlands, between February 2009 and January 2016 for bilateral transpalatal distraction using SARME because of transversal maxillary hypoplasia. Patients were excluded if they failed to go through the activation period or when one of the CBCT scans was inadequate for our newly designed evaluation method.

2.2. Surgical treatment

One experienced oral and maxillofacial surgeon (J.J.) operated on all the patients using the same surgical protocol. All four areas of resistance to lateral forces were mobilised. Bilateral corticotomies were made with a round bur; the piriform aperture passed the zygomatric buttress to the pterygomaxillary junction. The maxilla was detached from the pterygoid process, split midline and mobilised with an osteotome without a full downgraft. The nasal septum was not released from its palatal base, and the anterior nasal spine was left intact. A bone-borne TPD (Classic or All-in-one, Surgi-Tec, Sint-Denijs-Westrem, Belgium) was placed and fixed as cranially as possible on the palate at, preferably, the level of the second premolar and first molar. After a latency period of 5–7 days, the patients had to activate the distractor once or twice a day (0.33–0.66 mm) until adequate expansion was reached according to the referring orthodontist and treating surgeon. No overexpansion was performed. The distractor was subsequently locked with a blocking screw for a consolidation period of 3 months, during which orthodontic treatment was initiated. Orthodontic treatment commenced no sooner than 6 weeks after the start of the consolidation period. Subsequently, the TPD was removed under local anaesthesia and a second CBCT scan was taken immediately thereafter. Details regarding the treatment protocol and patient characteristics were retrieved from the patient records.

2.3. Image processing and measurements

During the study period, CBCT scans were taken using the i-CAT CBCT (i-CAT, Imaging Sciences International, Hatfield, PA, USA) at 120 kV, 0.3 mm voxelsize.

A 3D reconstruction was made of the predistraction and postdistraction CBCT scans using the Maxilim software (Medicim, Mechelen, Belgium) (Fig. 1A). The grey values of the CBCT scans were superimposed using a voxel-based registration method (Fig. 1B). The anterior cranial base and both zygomatic arches were crucial for image-based registration because these landmarks provide accurate and reproducible results, as they are not influenced by treatment (Nada et al., 2011; Magnusson et al., 2012).

The Blender software (Blender Foundation, Amsterdam, the Netherlands) was used to process the generated images of the maxilla further, whereby all skeletal structures, except for the maxilla, were removed (Fig. 1C). A reference frame was then created of both the pre- and postdistraction maxilla (Fig. 2).

A horizontal base-plane was designed at the height of the cement–bone junction between the central incisors to the anterior side of the left and right second molars. Parallel planes were made at 2.5 mm, 6.0 mm and 8.5 mm cranially. Vertical planes were located at the anterior and distal side of the first molars and central incisors, also at the cement–bone junction. This frame was used to locate six corresponding surface areas on both scans to measure the expansion and to determine the asymmetries (Fig. 3).

Subsequently, the rest of the maxillary surface was removed to retain the six corresponding surface areas on both scans, making the lateral expansion visible. Surface based mapping was performed with Matlab software (Mathworks, Natick, MA, USA) using the iterative closest point algorithm (Zhang, 1994). The surface areas of the predistraction maxilla were mapped onto the corresponding surface areas of the postdistraction maxilla. The lateral displacement, perpendicular to the vertical plane of the reference frame, between the corresponding surface areas, was calculated in millimeters (mm). This procedure provided the outcome data of the absolute lateral expansion of the left and right maxillary segments of the surface areas.

Two observers (M.H. and J.M.) image processed half of the study sample each. They created the reference frames to analyze the inter-observer reliability and assessed all six surface areas in three randomly chosen patients independently.

Five independent experienced orthodontists were consulted. They decided that an expansion difference of more than 3.0 mm was clinically relevant. The consensus of the orthodontists was that smaller differences could be compensated by postdistraction orthodontic treatment.

Please cite this article in press as: Huizinga MP, et al., Bone-borne surgically assisted rapid maxillary expansion: A retrospective three-dimensional evaluation of the asymmetry in expansion, Journal of Cranio-Maxillo-Facial Surgery (2018), https://doi.org/10.1016/j.jcms.2018.05.021

Download English Version:

https://daneshyari.com/en/article/8698720

Download Persian Version:

https://daneshyari.com/article/8698720

Daneshyari.com