Revista de Ciencias Médicas de Pinar del Río

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2024; 28(S1): e6518

SHORT COMMUNICATION

Efficacy of mini-screw assisted rapid palatal expansion by cone beam computed tomography

Eficacia de la expansión palatina rápida asistida por minitornillos mediante tomografía computarizada de haz cónico

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Received: August 12, 2024
Accepted: August 20, 2024
Published: August 21, 2024

Citar como: Zapata-Hidalgo CD, Albán-Ortiz PF, Toapanta-Chamorro LR. Eficacia de la expansión palatina rápida asistida por minitornillos mediante tomografía computarizada de haz cónico. Rev Ciencias Médicas [Internet]. 2024 [citado: fecha de acceso]; 28(S1): e6518. Disponible en: http://revcmpinar.sld.cu/index.php/publicaciones/article/view/6518

ABSTRACT

Introduction: maxillary transverse deficiency is a fairly common condition affecting deciduous and mixed dentitions, so its diagnosis, planning and much more its complete treatment is a challenge.
Objective: to update the contents on the efficacy of mini-screw assisted rapid palatal expansion treatment (MARPE) and cone beam computed tomography (CBCT).
Methods: an advanced search was carried out in Pubmed and Scielo databases with terms such as: (maxillary expansion) AND (tomography), (MARPE) AND (tomography), (palatal expansion technique) AND (tomography), (tomography) AND (Palatal Expansion Technique), (tomography) AND (maxillary expansion). Inclusion and exclusion criteria were applied: articles performed only in humans, between the years 2018-2022, in English and Spanish languages.
Development: as a protocol, the analysis of the midpalatal suture during the process of its rapid expansion of the palate used study models, two-dimensional images and nowadays three-dimensional images based on computed tomography are used. The usefulness of cone beam computed tomography in the field of orthodontics and the new developments of informative programs already allow the three-dimensional and multiplanar reconstruction of individualized cases, building new possibilities in the diagnosis of the craniofacial complex.
Conclusions: CT (CBCT) is a very effective tool in the diagnosis, planning and execution of mini-screw assisted rapid palatal expansion (MARPE).

Keywords: Expansion; Maxilla; Cone-Beam Computed Tomography; Alveolar Bone; Sutures.

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2024; 28(S1): e6518

RESUMEN

Introducción: la deficiencia maxilar transversal es una condición bastante común que afecta a las denticiones deciduas y mixtas, por eso es un reto su diagnóstico, planificación y mucho más su completo tratamiento.
Objetivo: actualizar los contenidos sobre la eficacia del tratamiento de expansión palatina rápida asistida por minitornillos (MARPE), y la tomografía computarizada de haz cónico (CBCT).
Métodos: se llevó a cabo una búsqueda avanzada en las bases de datos de *Pubmed* y *Scielo* con términos como: (expansión del maxilar) AND (tomografía), (MARPE) AND (tomografía), (técnica de expansión palatina) AND (tomografía), (*tomography*) AND (*Palatal Expansion Technique*), (*tomography*) AND (*maxillary expansion*). Se aplicaron criterios de inclusión y exclusión: artículos realizados solo en humanos, entre los años 2018-2022, en idiomas inglés y español.
Desarrollo: como protocolo, el análisis de la sutura palatina media durante el proceso de su expansión rápida del paladar se utilizaba modelos de estudio, imágenes bidimensionales y hoy en día se usan imágenes tridimensionales basadas en tomografías computarizadas. La utilidad de la tomografía computarizada de haz de cono, en el campo de la Ortodoncia y los nuevos desarrollos de programas informativos, ya permiten la reconstrucción tridimensional y multiplanares de casos individualizados, construyendo nuevas posibilidades en el diagnóstico del complejo craneofacial.
Conclusiones: la tomografía (CBCT) es una herramienta muy efectiva en el diagnóstico, planificación y ejecución para llevar a cabo la expansión palatina rápida asistida por minitornillos (MARPE).

P**alabras clave:** Expansión; Maxilar; Tomografía Computarizada de Haz Cónico; Hueso Alveolar; Sutura.

INTRODUCTION

Maxillary transverse deficiency, as well as unilateral or bilateral posterior crossbite, are some of the most frequent malocclusions found in patients requiring orthodontic treatment. These are associated with other discrepancies that may involve bone, dentoalveolar structures or soft tissues, accompanied by class II or class III skeletal malocclusions, excessive alveolar height, functional modification of the lower jaw, crowding, or a buccal or lingual inclination of teeth. later.[1]

Transverse maxillary deficiency does not show spontaneous correction and must be treated by maxillary expansion immediately after being diagnosed.[2]

According to Angelieri F et al.,[3] the "perfect" time for the correction of a transverse maxillary deficiency, with a rapid expansion of the palate, is preferably before the age of 15. In adolescents and young adults, the midpalatal suture and the surrounding maxillary sutures already begin to fuse and become much more rigid, resulting in greater resistance to the expansion force.

Due to a late diagnosis, a non-surgical treatment was introduced to resolve maxillary transverse deficiency, in adults, which uses mini screws, which assist rapid expansion of the palate or its acronym in English "MARPE", as a first treatment option compared to a surgically assisted rapid palatal expansion or "SARPE".

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2024; 28(S1): e6518

It is also known as "microimplant-assisted rapid maxillary expansion." The "MARPE" consists of between two or four miniscrews, with a monocortical or bicortical anchorage.Recent studies and research that used "MARPE" demonstrated a very high success rate in separating the middle suture of the palate in young adult patients, where the percentage ranged from 72 % to 92 %.[4,5] But, in some cases, certain failures in the total separation of the midpalatal suture and cases of asymmetric expansion were also reported.[6,7]

The skeletal support, provided by the miniscrews during assisted rapid palatal expansion, allows a better and complete distribution of the forces applied when there is an incomplete suture closure, gaining a greater orthopedic effect, by opening the middle part of the palate, palatal suture and minimizing the possible side effects.[8]

New images of a cone beam computed tomography (CBCT) have provided information of a significant increase in skeletal dimension in adolescent and young adult patients, after being treated with "MARPE", where the adverse effects that occur are reduced. directly into the dentoalveolar system, therefore, it continues to be maintained that this treatment option may be a future GOLD STANDARD, to solve maxillary transverse discrepancies.[9]

As a protocol, the analysis of the middle palatine suture during the process of its rapid expansion of the palate used study models, two-dimensional images, and today three-dimensional images based on computed tomography are used. The usefulness of cone beam computed tomography, in the field of Orthodontics and the new developments of information programs, already allow three-dimensional and multiplanar reconstruction of individualized cases, building new possibilities in the diagnosis of the craniofacial complex.[10, 11]

For all the reasons presented, the present literature review study aimed to construct a review of the literature on all the information currently available on the effectiveness of miniscrew-assisted rapid palatal expansion (MARPE) treatment, and beam computed tomography. conical (CBCT).

METHODS

An advanced search was carried out in the Pubmed and Scielo databases with terms such as(maxillary expansion) AND (tomography), (MARPE) AND (tomography), (palatal expansion technique) AND (tomography), (tomography) AND (Palatal Expansion Technique), (tomography) AND (maxillary expansion). Inclusion and exclusion criteria were applied: articles carried out only on humans, between the years 2018-2022, in English and Spanish languages. Those that, in addition to not complying with the aforementioned, were of a narrative review, clinical case or letters to the editor were excluded.

From the main search, 1206 scientific articles were obtained. Those that were repeated were excluded, those that did not meet the criteria were excluded, and those that were not related to the topic investigated were also excluded. Finally, works that could not be read in their entirety were deleted. The articles included in this review were 33.

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Rev Ciencias Médicas. 2024; 28(S1): e6518

DEVELOPMENT

One of the objectives of orthopedic maxillary extension are to ensure a buccolingual alveolar environment along with lateral displacement of the buccal segment to establish adequate lateral dimensions of the maxilla.[12]In Previous studies, dental expanders have shown inevitable side effects such as bone dehiscence and short-term skeletal recurrence at the end of the sclerosis period in children due to buccal displacement of anchor teeth.[13]

The study suggests that even with successful suture separation, side effects on tooth fixation may persist during the expansion and integration phases. In contrast, pure bone extenders have a significantly smaller increase in interdental width compared to conventional dental extenders in adolescents, despite the lack of side effects on alveolar bone.[14]

As a result, a tooth-and-bone-supported maxillary expander, a simple combination of a conventional expander and a bone-supported fixation device, showed good orthopedic and alveolar bone expansion even in young adults. However, the respective functions of tooth anchors and miniscrews remain unclear. To analyze the changes during expansion and consolidation, a comprehensive three-dimensional observation of the maxilla at the end of the expansion and consolidation period was required.Therefore, a CBCT was essential to evaluate changes at all three time points. [15]

It is generally accepted that chronological age is not a precise parameter fordiagnose bone maturation due to the great variability in the stages of development of the middle palatine suture throughout the patient's life.[16]

It has been observed that the skeletal effectsdue to maxillary dilation, they are greater in younger prepubertal patients, while pubertal or postpubertal periods can have an adverse effect, affecting the dentoalveolar level. However, approximately 11% of the adult population still has stage 4 cervical vertebral maturation index. This rate is not high, but should be considered clinically relevant.[17]

Garrett found values similar to our studyon alveolar flexion after RME with the use of an expander, observing an alveolar flexion of 13 % (0,84 mm), but the effect of tooth inclination is greater 39 % in premolars (2,34 mm) and 49 % (3,27 mm) in fully dilated first molars obtained in patients with a mean age of 13.8 years.[18]These data show a trendtoward decreased orthopedic bone effect, increased alveolar flexion, and orthodontic anteroposterior tilt, which is consistent with previous reports. Compared with the maxillary expander placed on the bone, the expander placed at the dental level showed twice the bending effect of the alveolar bone.[19]

CONCLUSIONS

Tomography (CBCT) is a very effective tool in the diagnosis, planning and execution to carry out miniscrew-assisted rapid palatal expansion (MARPE). Tomographic analysis in all its planes allows us to considerably reduce the risk of biomechanical failure of the apparatus as well as the risk of perforation of important anatomical structures.

Conflict of interest statement
The authors declare that there are no conflicts of interest.

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2024; 28(S1): e6518

Author contributions
All authors participated in conceptualization, data curation, formal analysis, research, methodology, supervision, writing-original draft, writing-review and editing.

Financing
No financing

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