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How to use Miniscrew-assisted rapid palatal expansion to manage arch perimeter in adults

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Abstract
Maxillary arch constriction can result in dental crowding in patients and the correction of the transverse deficiency of maxilla can be useful in correction of the dental crowding as well as for maintain the inclination of incisors. In adults, maxillary arch constriction cannot be corrected in the same way as in children. In children, Rapid palatal expansion (RPE) is normally used to correct the maxillary arch construction. However, in adults, a surgical alternative such as surgically assisted rapid palatal expansion (SARPE) technique is performed to remove the resistance of increased maturation of sutures to allow the correction of maxillary arch constriction. Patients and orthodontists alike are often looking for a non-surgical alternative to avoid the complications associated with SARPE technique. MARPE technique provides a non-surgical alternative to the SARPE technique for the correction of transverse maxillary deficiency in adults. In this review article, miniscrew-assisted rapid palatal expansion technique (MARPE) technique and its use in adult patients for increasing arch perimeter will be described.

Keywords: orthodontics, marpe, sarpe, palatal expansion technique, adults

Introduction

Maxillary arch constriction can lead to crowding of the dental arch and proclination of teeth as well as transverse discrepancy between maxilla and mandible. [1] The treatment of such types of malocclusion depend to a large extent on the correction of the transverse discrepancy. This becomes especially important in cases with previous history of trauma, pathology, flat profile which preclude the extraction of teeth as a potential treatment plan. In young children, maxillary arch constriction can be corrected easily by applying transverse forces on the midpalate suture with the help of rapid palatal expansion technique (RPE). [2] The forces applied through the maxillary expander not only counteract the resistance of the mid palatal sutures but also the resistance of the circummaxillary sutures. [2-4] In adults these sutures are more mature due to higher interdigitation and thus provide higher resistance to the forces exerted by the rapid maxillary expanders. The extent of skeletal expansion also decreases in adults due to this reason. The result is increase in alveolar bending and dental tipping of maxillary posteriors. As a results, there are side effects such as root resorption, periodontal and alveolar bone issues, inadequate expansion, and unstable results when rapid palatal expansion technique is performed in adult patients. A way to overcome these side effects in adults is to increase the amount of skeletal effects and decrease the negative dental effects. A technique known as miniscrew-assisted rapid palatal expansion technique (MARPE) was introduced to the orthodontic field with this purpose.

Arch length discrepancies

Arch length discrepancies can be solved in maxillary and mandibular arches with extraction of upper and lower first premolars. However, in some cases in which patients have a flat profile, it may be necessary to find an alternative to extraction of teeth as it may lead to a negative effect on the profile of the patient. [5] In addition, patients with narrow maxillary arch would benefit from the arch expansion and the resulting narrow buccal corridors. [6] In adult patients when there is posterior crossbite, a surgically assisted rapid palatal expansion (SARPE) can be used to correct the transverse discrepancies between maxilla and mandible. [7] However, this technique leads to a higher expenditure for the patient and has potential surgical complications associated with it. The only alternative that could solve the transverse problems in these patients with adequate skeletal expansion is MARPE technique. With the MARPE technique, the maxillary arch constriction can be corrected. In addition, the increase in maxillary width also provides a solution for reliving the crowding in the maxillary arch.

MARPE clinical technique

MARPE technique has been previously described by Mehta et al. [8] This expansion protocol is considered standard as it has been since followed in multiple studies on MARPE. [9-11] It includes giving local anesthesia and insertion of the miniscrews in the palate close to the maxillary first molar. The expansion screw is then anchored to these miniscrews so that the expansion screw obtains anchorage from the palate. [8] In contrast to the MARPE technique, the RPE technique utilizes 4 bands on the molar and premolar teeth on the right and left. The expansion screw is then fixed on these bands to obtain anchorage from the teeth. The typical activation protocol for both MARPE and RPE appliance is one turn being performed

two times in a day. [8, 9] The usual opening of the expansion screw is 0.25 mm with 1 turn so with two turns, the expansion screw opens to 0.5 mm.

After expansion

Once the expansion screw is opened with either MARPE or RPE approach, the maxillary arch width starts to increase and the midpalatal suture opens up. [12] During the expansion period, maxillary molar extrusion occurs with both MARPE and RPE leading to a slight increase in the mandibular plane angle. [13] Once the expansion is achieved, the expansion appliance is kept in the patient's arch for 6 months for retention purposes. [14] Unless the patient has class III malocclusion in which cases, right after expansion, the class III mechanics can be started. The class III mechanics can be either performing the facemask therapy for maxillary protraction in young children. [15] In contrast, if the patients are older, then class III elastics can be performed from the skeletal anchorage or miniscrews inserted into the maxilla and mandible. [16] The class III correction with intermaxillary elastics to the skeletal anchorage work more effectively once MARPE procedure is completed. [16] This is because, performing the MARPE procedure helps to increase the width of circummaxillary sutures. [17] After the retention period, bonding of the upper and lower arch could be done to align the teeth. This is typically followed by progression of wire sequence and final finishing and detailing to finish the case.

Comparison of MARPE with other alternatives

SARPE procedure can also provide the correction of maxillary arch constriction in adults. [18] SARPE procedure requires surgical osteotomies for the region involving zygomaticomaxillary buttress and midpaltal suture as these two regions are the areas offering maximum resistance to expansion. [18, 19] The SARPE technique is typically used when the transverse discrepancy between maxilla and mandible is greater than 5 mm. But, in clinical situations, patients do not want to undergo surgery and are often looking for a non-surgical alternative to surgical expansion. If the rapid palatal expansion is undertaken as an alternative to SARPE in such adult patients, they may experience periodontal damage and issues with the alveolar bone. [4, 20] Studies have shown that RPE can cause buccal tipping and issues with bone dehiscence and recession. [21] Thus, MARPE is considered as an alternative to SARPE in adult patients. The reason being that MARPE is a bone borne appliance and the skeletal anchorage is useful to achieve higher skeletal expansion with MARPE. This means that the dental side effects such as bony deshiscence, recession, etc. which is noted with RPE, is not observed with MARPE appliance.

Treatment Results with MARPE

MARPE technique results in an opening of the mid palatal suture anteriorly and posteriorly. The suture opening with MARPE has been found to be more parallel rather than triangular. [8] Even when observed after 28 months, MARPE appliance showed increased skeletal maxillary expansion than RPE. [8] Whereas, the SARPE technique leads to the opening of mid palatal suture in a triangular fashion similar to that of RPE appliance. [22] The reason for these effects observed with MARPE appliance is due to the position of the miniscrews in the palate. Even without surgery, due to the position and anchorage from the miniscrews, there is a favorable distribution of stress on the palate. The result is the parallel opening of the mid palatal suture. [23] This favorable force distribution can also be advantageous in situations with unilateral crossbite. In these cases, U-MARPE can be used with miniscrews anchoring to correct the crossbite on one side. [24]

The evaluation of treatment results with MARPE technique can be performed with xrays, notably 2D xrays such as occlusal radiograph, posterior-anterior radiograph, which were used in older times. In modern orthodontics, CBCT is used to measure the effects of MARPE technique on the mid palatal suture and airway. [8-11] The measurements are done in axial, coronal, and sagittal multiplanar reconstruction views of CBCT which give more accurate information than previous xrays. Artificial Intelligence can also be used to evaluate the xrays and identify the effects of orthodontic treatment. [25] MARPE is therefore more preferred in adult patients as it does not involve surgery and can provide improved skeletal expansion for managing arch perimeter.

Conclusions

MARPE technique is a useful technique for the treatment of maxillary arch constriction in adults who are skeletally mature. It can provide increased skeletal maxillary expansion when assessed at the sutures and decreased dental side effects. MARPE can be considered an alternative to surgical treatment options such as SARPE for correction of transverse maxillary deficiency and managing arch perimeter.

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