Short-term impact of rapid maxillary expansion on ectopically and normally erupting canines

Sérgio Estelita Barros,[a] Luciana Hoffelder,[b] Fernando Araújo,[b] Guilherme Janson,[c] Kelly Chiqueto,[a] and Eduardo Ferreira[a]

Porto Alegre, Rio Grande do Sul, and Bauru, São Paulo, Brazil

Introduction: The purpose of this study was to evaluate the short-term impact of rapid maxillary expansion (RME) on the eruption paths of ectopically and normally erupting maxillary canines in the mixed dentition. **Methods:** Thirty-two patients with 49 ectopically erupting canines (EEC group; age, 9.53 ± 1.10 years) and 18 patients with 27 normally erupting canines (NEC group; age, 9.25 ± 1.06 years) underwent RME. Thirty-six subjects with 54 normally erupting canines composed the untreated control group (UC group; age, 9.03 ± 0.72 years). Horizontal, vertical, and angular positions of canines and adjacent teeth were evaluated in the expanded (EEC and NEC groups) and unexpanded (UC group) patients using panoramic radiographs taken at 2 times with a 1-year interval. The radiographic evaluation methods included score ranking and proportional measurements to minimize panoramic radiograph limitations. Statistical comparisons were performed among the groups ($P < 0.05$). **Results:** Before expansion, the EEC group's canines were significantly closer to the midline, more distant from the occlusal plane, and more mesially angulated than those in the UC group. After expansion, the canine positions in the EEC and UC groups were similar, whereas the NEC group had a more favorable canine position for eruption. The EEC and NEC groups showed similar canine positional changes, whereas the UC group had the smallest changes. The positions of teeth adjacent to the canine were also significantly affected by RME, and these changes may be associated with improvement of the ectopic canine position. **Conclusions:** The changes produced by RME reduced the percentage of ectopic eruption paths and maintained the nonectopic eruption percentage. (Am J Orthod Dentofacial Orthop 2018;154:524-34)

Developmental problems such as maxillary narrowing, tooth size-arch length discrepancy, teeth agenesis, and peg-shaped maxillary lateral incisor can be diagnosed early, prompting parents to seek orthodontic treatment for their children during the mixed dentition. These clinical deviations have been associated with ectopic eruption and impaction of the maxillary canine, impelling orthodontists to act on malpositioned maxillary canines at an early development stage.[1-6] It has been speculated that the incidence of maxillary canine impaction in an orthodontic practice tends to be much higher (23.5%[7,8]) than the incidence in the population (1%-3%).[9]

When clinical signals are associated with a radiographic diagnosis of canine ectopic eruption, horizontal, vertical, and angular displacements have been radiographically evaluated to predict the canine impaction risk.[10-13] The horizontal displacement of the maxillary canine overlapping the lateral incisor root toward the midline seems to be more relevant to predict the impaction risk than the canine's angular displacement.[8,14] However, the association of other radiographic parameters that evaluate vertical and angular canine displacement may increase the impaction prediction accuracy, avoiding overtreatments.[10]

Several extraction and nonextraction treatment protocols have been proposed to prevent maxillary canine impaction. Extraction can involve only the deciduous canine,[12,15,16] or the deciduous canine and deciduous first molar,[17] but the comparison between them showed

[a]Division of Orthodontics, Faculty of Dentistry, Federal University of Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil.
[b]Division of Pediatric Dentistry, Faculty of Dentistry, Federal University of Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil.
[c]Department of Orthodontics, Bauru Dental School, University of São Paulo, Bauru, São Paulo, Brazil.
All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
Address correspondence to: Sérgio Estelita Barros, Division of Orthodontics, Faculty of Dentistry, Federal University of Rio Grande do Sul, Rua Ramiro Barcelos, 2492, Bairro Santana, Porto Alegre, RS 90035-003, Brazil; e-mail, sergioestelita@yahoo.com.br.
Submitted, June 2017; revised and accepted, January 2018.
0889-5406/$36.00

https://doi.org/10.1016/j.ajodo.2018.01.011

that the latter may be more effective.[17] In general, deciduous canine extraction associated with rapid maxillary expansion (RME), transpalatal arch, or cervical headgear is more effective than only deciduous canine extraction.[16,18-20] Nonextraction treatment protocols include cervical headgear associated or not with RME.[21] Only 1 study evaluated RME alone, but no radiographic follow-up was performed after RME.[22] Thus, lack of the final radiographic records prevented evaluation of the short-term impact of RME on the ectopic canines and adjacent teeth, which could contribute to describe the dental changes associated with impaction prevention of the maxillary canine. In addition, RME has been applied to patients with palatally displaced canines,[19-22] which in general do not have a transverse maxillary deficiency,[22,23] limiting the RME procedure and perhaps its impact on the canine eruption path. Another point to be considered is that preventive protocols involving RME, transpalatal arch, or extraoral headgear can have a symmetric effect between the sides of the dental arch, but a unilateral ectopic canine is a frequent finding,[2] and the impact of these protocols on nonectopic canines has not been evaluated. Finally, clinical observation has suggested significant improvement of the canine's eruption path after 1 year, but no systematic study has evaluated the impact of RME in this short term.[24]

To shed some light on these issues, the objective of this study was to evaluate the short-term impact of RME on the eruption path of ectopically and normally erupting maxillary canines in patients with maxillary transverse deficiency.

MATERIAL AND METHODS

The sample consisted of patients enrolled in a 2-center prospective longitudinal clinical trial at the Faculty of Dentistry, Federal University of Rio Grande do Sul, and the Orthodontic Service of the Military Polyclinic at Porto Alegre, Brazil. The files of the Bauru Dental School Growth Study, University of São Paulo, Brazil, provided the orthodontic records for the untreated group of this historically controlled study. This research was approved by the institutional review board of the Faculty of Dentistry, Federal University of Rio Grande do Sul. The parents of all subjects at each research center signed informed consents.

The values of $\alpha = 0.05$ (type I error) and $\beta = 0.2$ (type II error) were used to calculate the sample size together with the data from a previous study that reported the success rate of RME for redirecting canine eruption.[22] Although the results suggested a minimum of 13 patients in each group, additional patients were admitted because panoramic radiographic measurements may cause greater variability if the structures are to be remeasured on subsequent radiographs. In addition, sample attrition should be considered due to the longitudinal evaluation.

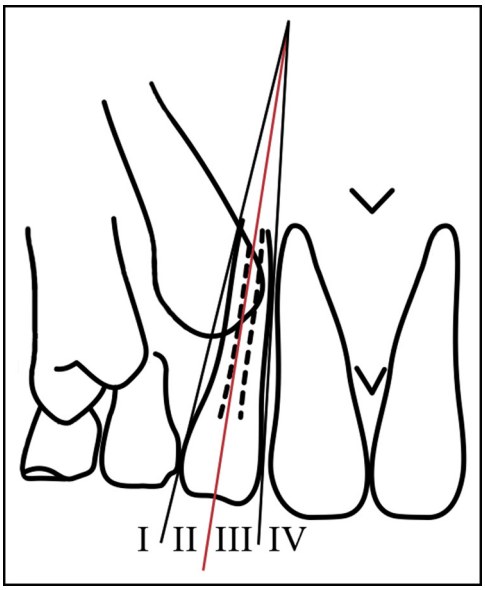

Fig 1. Ranking of canine horizontal sector according to the modification of Lindauer et al.[11] Sector I is located distal to a tangent to the distal crown and root of the lateral incisor; sector II includes the area from the tangent on the distal surface to a midline bisector of the lateral incisor; sector III includes the area from the midline bisector to a tangent to the mesial surface of the lateral incisor crown and root; sector IV includes all areas mesial to sector III.

The selection criteria used in this clinical trial were as follows: (1) patients in the mixed dentition; (2) RME indication due to transverse maxillary deficiency; (3) biologic maturity corresponding to half to two-thirds of canine root completed,[25] which can be classified as Nolla stage[26] 7.2 to 8; (4) ectopic eruption of at least 1 maxillary canine overlapping sector II, III, or IV of the lateral incisor root, diagnosed on panoramic radiographs, according to the method of Lindauer et al[11] (Fig 1); (5) no previous orthodontic treatment; (6) no supernumerary teeth or lateral incisor agenesis; (7) no early loss of deciduous teeth that could benefit canine eruption[17]; (8) no oral pathology associated with eruption disturbance or history of dental trauma; and (9) no craniofacial anomaly or syndrome.

Based on these criteria, 32 patients (13 boys, 19 girls) with 49 ectopically erupting canines (EEC group) and a mean age of 9.53 ± 1.10 years were selected for treatment with RME.