Hypoplastic Canine: Would Treatment Decision be Different if the Diagnosis Were Made with Computed Tomography?

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Abstract: *This article discusses the orthodontic treatment of a girl, 9 years old, who presented with Class II malocclusion, bimaxillary protrusion, anterior open bite, and congenital absence of the right lower premolar, in which a severe hypoplasia on right maxillary canine was only noted after the extractions of the first maxillary premolars.*

Key words: *Hypoplasia;Orthodontics;Cone Beam Computed Tomography;Dental Extraction*

Introduction

In orthodontics, decision-making relies largely on a correct diagnosis based on vital information obtained through a clinical examination of the patient as well as complementary tests comprising casts of the dental arches, photographs, dental and facial x-rays, and/or computed tomography (CT).[1,2]

It is often that during orthodontic planning, orthodontists are faced with a thorny dilemma which has haunted orthodontics since the dawn of its history, i.e., to extract or not to extract.[1,3-5] The key factors in favor of extracting teeth for orthodontic purposes are related to the aesthetic improvement of the face like bimaxillary protrusion, addressing a lack of spaces in the dental arches, and correcting certain malocclusions such as open bite and Class II in adults.[1,6,7]

The teeth more commonly extracted are the first premolars.[8] Under certain circumstances, however, teeth can be extracted due to carious injuries, root resorption, bone loss, or extensive or inadequate restorations.[6]

Dental development disorders, be it related to number (agenesis), form (microdontia, macrodontia), or structure (enamel hypoplasia), can also influence the choice of the tooth to be removed. However, exercising orthodontic movement control can prove more challenging in these cases.[6]

Enamel hypoplasia is manifested as patches, grooves, surface defects, and irregularities in the tooth enamel of mild-to-severe intensity. The causes may range from systemic factors, as in the case of nutritional deficiency and excess fluorine, local factors, by trauma or infection, or hereditary factors (amelogenesis imperfecta).[9] This change can be found clinically by direct visualization of the teeth affected and may not always be identified by x-ray examination.[9]

The purpose of this study is to discuss the diagnosis as well as the decision-making process and alternate treatment approaches by reporting the case of a patient subjected to orthodontic treatment with dental extractions associated with an open bite, dental bimaxillary protrusion, agenesis of a mandibular second premolar, and a maxillary permanent canine with enamel hypoplasia.

Case Report

A female patient aged 9 years and 1 month old presented at the orthodontic clinic accompanied by her legal guardian. Her chief complaints were anterior open bite, protruding teeth, and finger sucking habit (Figure 1).

Clinical examination disclosed a convex facial profile with moderate protrusion of the lips, increased lower third, symmetrical face, competent lips, and low exposure of the maxillary incisors on smiling. The intraoral aspect revealed mixed dentition, two canines on the right side of the upper dental arch, Angle Class II, 6 mm anterior open bite, and 5 mm overjet. The permanent teeth exhibited white spot lesions throughout the crown. There were no anatomical changes, cracks, or enamel discontinuity with underlying dentin exposure, which suggested mild generalized enamel hypoplasia (Figure 1).

Figure 1: Intraoral and facial photographs (at age 9 years and 1 month)

Radiographic examination showed a missing right mandibular second premolar, a right maxillary supernumerary primary canine, and a right maxillary permanent canine showing some rotation (Figure 2). Further information obtained from a profile radiograph and data from cephalometric analysis can be seen in Figure 3. Medical and dental history revealed no systemic changes or noteworthy findings.

Treatment Goals

The major goals were as follows:

1. achieving a Class I relationship
2. establishing proper overjet and overbite by closing the anterior open bite
3. correcting the dental and labial bimaxillary protrusion as well as achieving proper occlusal contacts in all teeth, efficient anterior and lateral disclusions
4. resulting stability

Treatment Alternatives for a Missing Mandibular Premolar

1- Maintaining a primary tooth: In a study[10] which evaluated 41 individuals aged 13.6 to 31.8 years, all presenting with agenesis of one or both mandibular second premolars, and the presence of primary second molars, it was found that only 2 of 59 teeth showed exfoliation. Five of these were extracted, and 2 were replaced by third molars. None of the patients who were over 20 years old lost any tooth whatsoever. Therefore, apparently, the teeth that managed to survive until this age seem to have a good prognosis for long-term survival.

2- Restoration of the primary tooth: Performed primarily to restore stable occlusal contacts.[11]

3- Slicing or hemisection of a primary tooth: Slicing of primary molars in patients aged 8 and 9 years promotes a relatively controlled mesial movement of the first permanent molars with minimal rotation or inclination.[12] Removal of the distal half of the primary second molar can provide space closure in stages. Then closure of the remaining space can be carried out after removing the mesial half of the primary second molar. Hemisection cases compared with cases involving extraction of the first or second premolars showed significant movement of the molars toward the anterior region, thus facilitating the relationship with the maxillary molars while improving facial aesthetics.[13]

4- Extraction of a primary tooth and spontaneous space closure: The early removal of primary molars favors the mesial movement of the first permanent molar, with minimal inclination.[14] In the event that lateral incisors and mandibular second premolars are missing, the early extraction of the primary teeth and replacement of the lateral incisors with the canines through closure of lower space are recommended.[15] Likewise, in cases where the mandibular second premolars are missing, excellent results can be achieved without compensatory extractions in the maxillary arch.[16]

In cases presenting with ankylosis and submersion of the primary molar, the latter can be removed to allow the eruption of the other teeth and the concurrent closure of the space in order to remove the bony defect. Space closure may

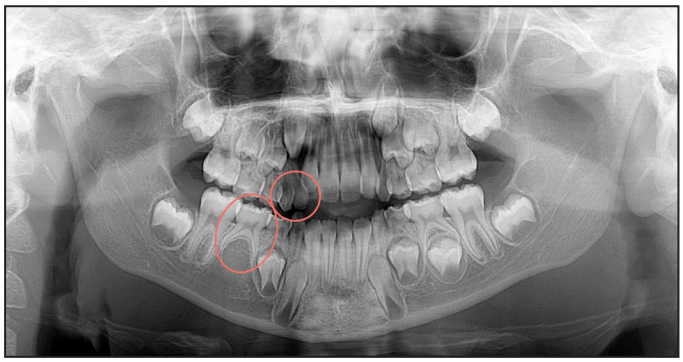


Figure 2: Panoramic radiograph showing specifically the congenital absence of the right mandibular second premolar and the supernumerary maxillary primary canine (at age 9 years and 1 month)

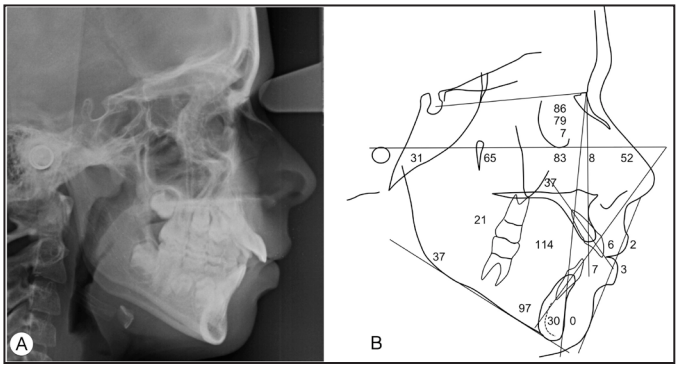


Figure 3: A. Lateral cephalometric radiograph, B- Cephalometric tracing and measurements (at age 9 years and 1 month)

be considered a successful alternative, even in cases where the mandibular second premolars are missing unilaterally.[17]

5- Orthodontic space closure[18]

6- Autograft: Studies evaluating the replacement of missing mandibular second premolars with autograft attained success rates that ranged from 82% to 92% within a four-year period.[19-21] Autograft features a good prognosis in growing patients as it allows the vertical development of the alveolar bone while providing a permanent solution to agenesis cases.[19-21]

7- Replacement of implants and the prosthetic solution: In cases where multiple teeth are missing and involvement of the maxillary premolars occurs, this may be the best alternative.[22] Primary molars should be removed as near as possible to the time when the implant is placed to avoid reducing the buccolingual bone volume. Implants seem to be a good alternative in adolescents with extensive aplasia provided that the craniofacial growth has ceased or is nearly complete.[23]

Treatment Progress and Treatment Performed

At the age of 9 years and 1 month old, only these steps were followed: (1) Extraction of the mesial-most primary canine to assist in correcting the midline, which was slightly deviated, and thereby ensure more space for closing the bite; (2) referral to a speech therapist to assist in eliminating the finger sucking habit; and, (3) waiting for the occlusion to develop, which might include the possibility of late development of the left mandibular second premolar.

Figure 4: Intraoral and facial photographs (at age 10 years and 11 months)

Figure 5: Dental casts (at age 10 years and 11 months)

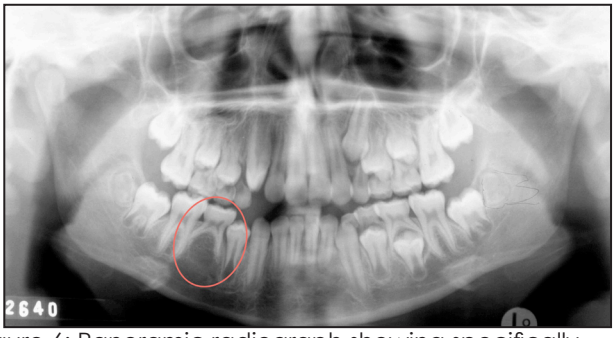


Figure 6: Panoramic radiograph showing specifically the congenital absence of the right mandibular second premolar (at age 10 years and 11 months)

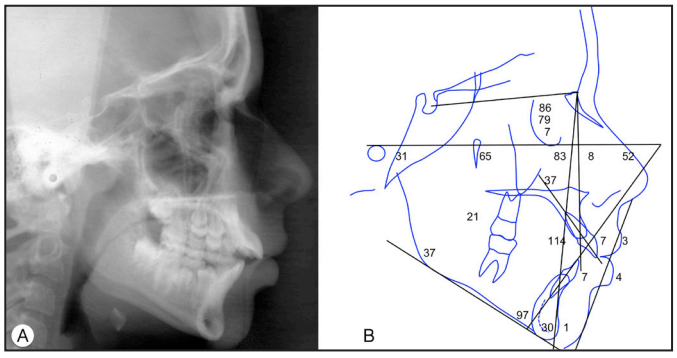


Figure 7: A. Lateral cephalometric radiograph, B- Cephalometric tracing and measurements (at age 10 years and 1 month)

The patient returned for reassessment at the age of 10 years and 11 months old. Clinical details can be seen in Figures 4 and 5. Despite some progress being made in the dentition, the panoramic radiograph basically revealed the missing right mandibular second premolar and right maxillary permanent canine with a mild rotation (Figure 6). The dental and skeletal condition in profile radiography and cephalometric analysis remained much the same (Figures 7 and 8).

It was decided that it was too early to start treatment, but the plan defined at this time, as agreed with the legal guardians, was the extraction of: (1) first maxillary premolars, (2) mandibular primary second molars, and (3) left mandibular second premolar, which resulted in the closure of spaces in the mandibular arch without the need for further procedures in the region of the missing mandibular second premolar.

The patient returned at age 11 years and 7 months old, and a new panoramic radiograph was taken (Figure 9) which revealed that the occlusion had indeed evolved as the first maxillary premolars erupted, exhibiting the same characteristics noted above, i.e. a missing mandibular second premolar and right maxillary premolar while the right permanent canine showed a mild rotation.

The extractions were performed, and the patient returned at age 12, when the orthodontic treatment was started. Fixed orthodontic appliances were bonded to all teeth on both dental arches. The bracket system was Standard Edgewise with 0.022”x0.028” slots.

After the eruption of the right mandibular canine, a severe enamel hypoplasia ensued (Figure 10) which had not been hitherto identified by either the orthodontist or the radiologist

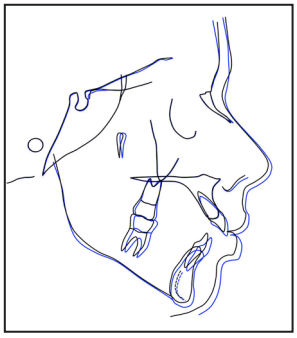


Figure 8: Cephalometric superimposition of the tracings at ages 9 years and 1 month, and 10 years and 11 months

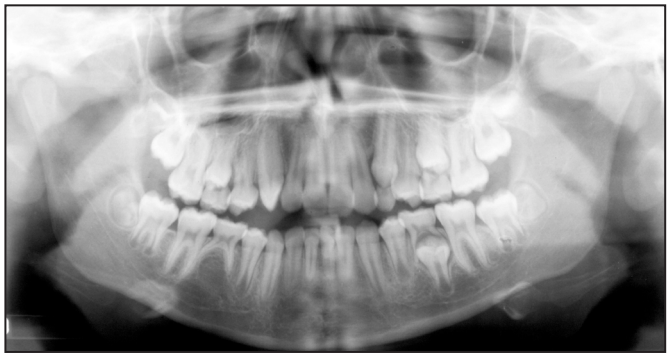


Figure 9: Panoramic radiograph (at age 11 years and 7 months)

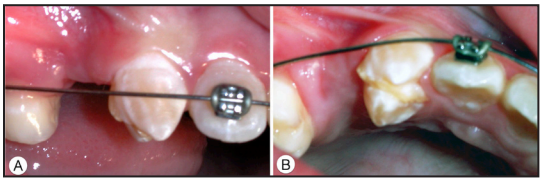


Figure 10: Sagittal (A) and occlusal (B) views of severe enamel hypoplasia in the right maxillary canine

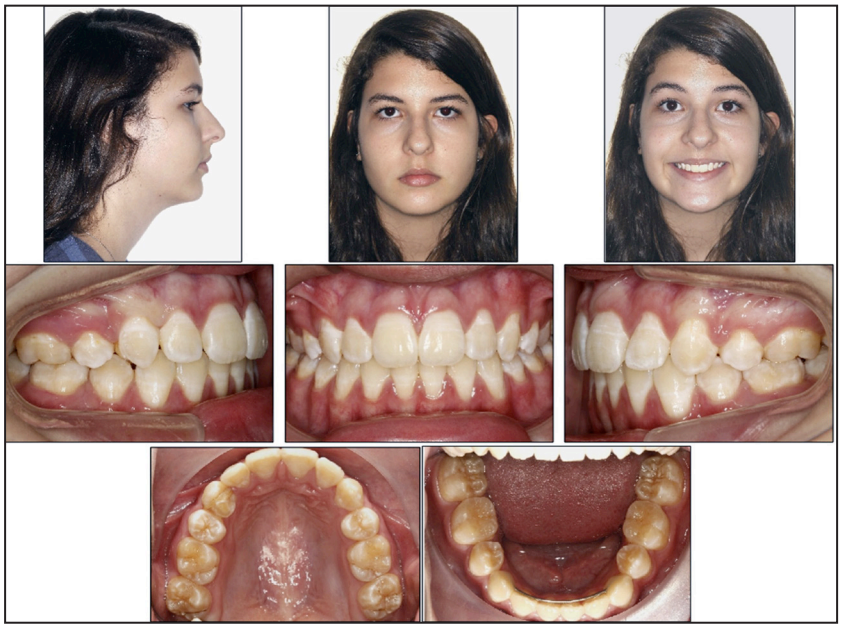


Figure 11: Intraoral and facial photographs at the end of treatment (at age 14 years and 4 month)

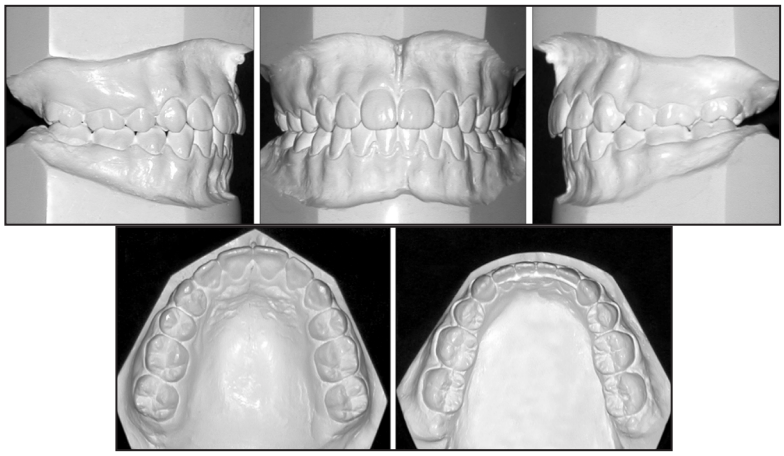


Figure 12: Post-treatment dental casts (at age 14 years and 4 months)

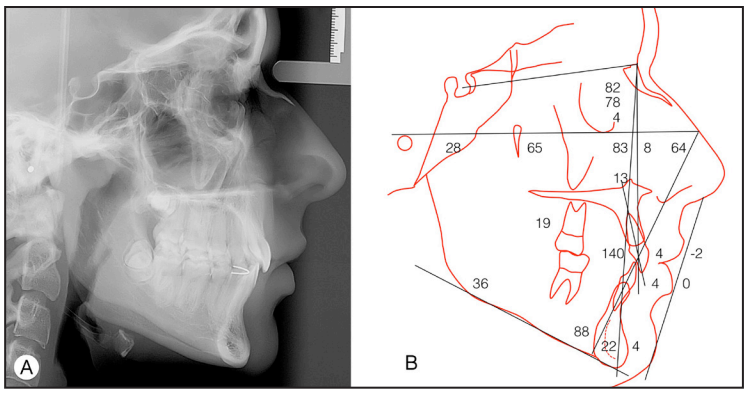


Figure 13: A. Lateral cephalometric radiograph, B- Cephalometric tracing and measurements (at age 14 years and 4 months)

in their various diagnostic reports. Slicing had to be carried out on the lingual part of this canine to improve its relationship with the lower teeth given that there had been changes in the form; and, as a result, some of the contacts were no longer functional.

In order to correct the malocclusion, 0.014", 0.018" and 0.019"x0.025" NiTi Thermoset alignment archwires were used, as well as working and finishing 0.019"x0.025" stainless steel archwires. The stainless steel archwires had delta loops between the lateral incisors and canines to allow the use of intermaxillary elastics. Correction of the molar relationship and overjet was performed with the aid of Class II elastics, from the mandibular second molar tube to the delta loops between the lateral incisors and canines, thereby favoring the movement toward mesial of the mandibular molars and toward distal of the maxillary anterior teeth with an approximate force of 300 to 350 grams each side.

To assist in correcting the open bite, square elastics were used in the delta loops between the lateral incisors and canines in both the maxillary and the mandibular arches. The patient was instructed to use these elastics as long as possible, totaling an average of 14 to 16 hours per day.

Treatment Results

All treatment goals were achieved, and the results, when the patient was 14 years and 4 months old, can be seen in Figures 11-15.

Post-treatment Follow-Up

Two years and 7 months after treatment, when the patient was 16 years and 9 months old, the results remained stable with no major changes or modifications in the hypoplastic canine, which was still performing its functions properly (Figures 16).

Discussion

Although all the aesthetic and functional treatment results can be classified as appropriate, a severe enamel hypoplasia was detected in one of the teeth, which had not been identified in the radiographs and should therefore be addressed. Likewise, the anterior open bite correction strategy also deserves reflection.

The treatment of choice for anterior open bite should take into consideration the major contributing factor to the clinical situation observed beyond the morphological changes brought about by this malocclusion. When the skeletal architecture is the key issue (e.g. hyperdivergent cases with short mandibular rami, increased gonial angle, and increased mandibular plane) orthognathic surgery emerges as a treatment option worthy of consideration.[24,25]

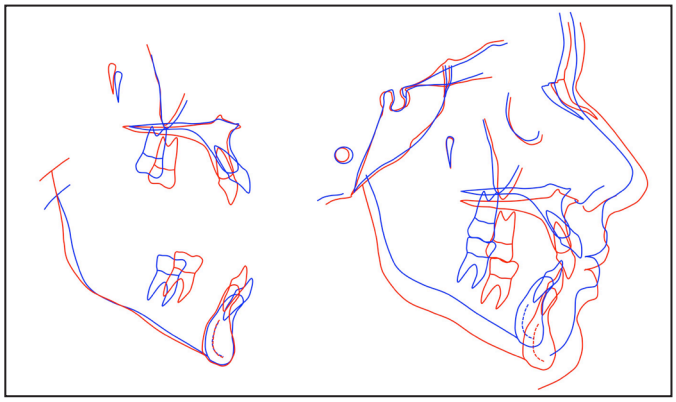
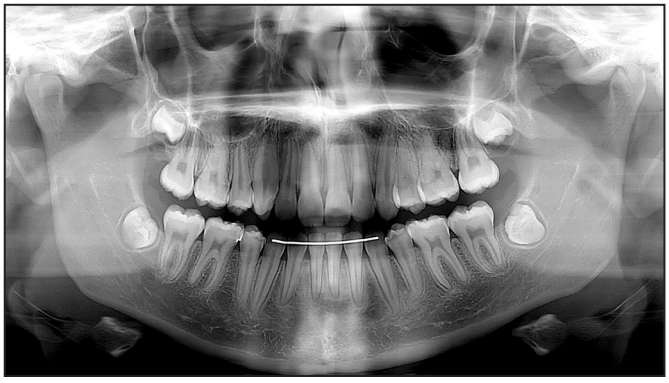


Figure 14: Superimposition of cephalometric tracings at ages 11 years and 7 months, and 14 years and 4 months



15:Panoramic radiograph after orthodontic treatment (at age 14 years and 4 months)

Figure 16. Intraoral and facial photographs of the patient 2 years and 7 months after treatment (at age 16 years and 9 month)

Open bite correction is favored by the space closure that results from extracting the premolars followed by incisor uprighting, thus reducing the interincisal angle and favoring the closure of the mandibular plane (thanks to the mesial movement experienced by the posterior teeth). Furthermore, open bite correction stability with extractions can be considered superior to stability in cases treated without extractions.[26] In this clinical case, dental and labial bimaxillary protrusions were sufficient to justify per se an indication to perform extractions in both dental arches. Therefore, in light of the results, the decision to extract was highly justifiable.

The mandibular second premolar homologous to the missing tooth was extracted with the purpose of preserving the symmetry of the arch, thus facilitating orthodontic mechanics. Moreover, in the maxillary arch, despite the finding of a more severe manifestation of hypoplasia in the enamel of the right canine after removal of the first premolar, this approach proved correct. Symmetry was maintained in the maxillary arch as well as improved control of the movement of the maxillary anterior teeth distally (anchorage control).

Even if the buccal surface of the right canine was affected by the most severe manifestations of hypoplasia, today's restorative and/or prosthetic resources could circumvent satisfactorily any adverse effects that might interfere with the aesthetics of the crown.[24] Periodontal aesthetics with appropriate gingival contour and canine eminence are naturally obtained when a canine root with normal shape and size is present.

In the event that one decides to extract this canine, the movement towards mesial of the right first premolar poses a daunting mechanical challenge (by increasing treatment time and possibly extending the need to use temporary anchorage devices) as well as aesthetic challenge, which would likely not yield results as favorable as those observed in the present report. Obtaining symmetry in the gingival contour and in the anatomy of the crown with the presence of the natural canine on the other side would require the intrusion of this premolar and subsequently an extensive restoration.[27]

In a hypoplastic canine, one can note some dentin exposure resulting from anatomical recontouring, which may eventually require the restoration of this tooth. However, compared with the alternative option of replacing the canine with the first premolar, the need for restoration would be immediate, and one could expect limitations in gingival aesthetics.

It may come as a surprise to the orthodontists, patients, and all those responsible for identifying the problem when they first notice the eruption of the right maxillary canine. The question to be asked at this point is whether it would be possible to foresee it before it actually happens. The answer is yes, if a cone beam CT scan is taken ahead of time.

There is still heated debate in the scientific community regarding the use of cone beam computed tomography for diagnostic purposes in orthodontics. Nevertheless, the current consensus

seems to be that this type of examination should not be used as a standard part of the orthodontic records.[28] Given that the radiographic image only suggested that this tooth was slightly rotated, there would be no support to justify the patient's additional exposure to x-ray radiation with a CT scan.
No doubt, one could consider that if the Cone Beam Computed Tomography (CBCT) had been performed ahead of time, the decision to preserve the canine – and, if necessary eventually, to restore the tooth – would be the same decision reached through conventional radiography due to the aesthetic and functional reasons that would justify either the maintenance of the canine, or the proper restoration of the remaining root.

Conclusions

Despite the fact that no early perception of the canine hypoplasia occurred prior to the extraction of the 3 premolars, the results achieved by taking advantage of the hypoplastic canine seem to have constituted the best possible solution.
In orthodontics, CBCT scans can contribute to the diagnosis but should not be trivialized. Even when CBCT images are used, the decision to preserve the canine, as illustrated in this clinical case, would not change.

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