# SIMULTANEOUS ERUPTION OF AN IMPACTED PREMOLAR DUE TO TRACTION APPLIED ON ADJACENT IMPACTED TOOTH – WHAT AND WHERE IS THE CONNECTION?

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**The mechanism of tooth eruption and the origin of eruptive forces are still controversial topics. Biological control underlying the eruption phenomenon is yet to be fully elucidated. This article reports a clinical observation that could have been overlooked in the literature. Eruption of an impacted first premolar was noted inadvertently subsequent to an applied traction to the adjacent impacted second premolar in a 47-year-old male subject. A quest to the ongoing controversy of eruption is raised and hypotheses formulated.**

## INTRODUCTION

Eruption of teeth is a physiologic phenomenon, the actual mechanics of which is yet to be fully understood. The time of eruption of the permanent dentition varies from child to child and between sexes.[1] The process of tooth eruption has been described in different stages. These successive stages cover pre-eruptive movements, intraosseous eruption, mucosal penetration and pre and post occlusal eruption. Arrest in eruption may occur in any of these stages.

For diagnostic purposes teeth with arrested eruption are classified according to three conditions diagnosed as impaction, primary retention, and secondary retention.[2]

The frequency with which certain teeth become impacted follows a fairly constant order. The tooth most frequently impacted is the mandibular third molar, followed by the maxillary third molar and the maxillary cuspids. Involvement of the mandibular cuspid is less frequent, while still less common are impactions of the premolars and incisors.

Incidence of unerupted maxillary premolars has been found to be 0.05% in Caucasian population.[3] Teeth of the permanent dentition may fail to erupt either as a result of mechanical obstruction, idiopathic or pathologic in origin, or because of disruption to the eruptive mechanism itself. The process of tooth eruption and some of eruptive forces are still controversial topics.

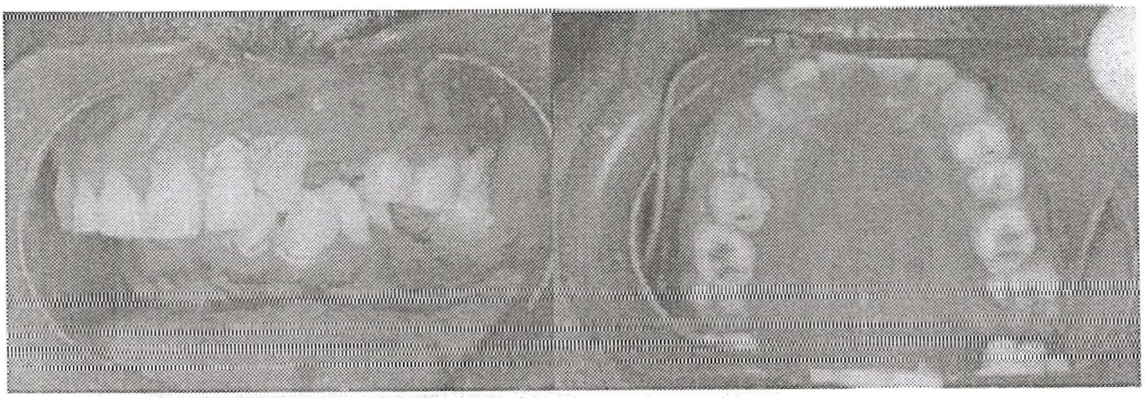
The further the patient is beyond the expected age of eruption, the less likely that the impacted tooth will successfully erupt. After the apex is closed, the chances of success rapidly decrease.[4] When attempting to surgically expose an impacted tooth, the dentist must make sure that the patient knows the risks and consequences of failure. One of these risks is ankylosis. This is particularly true as patients enter their 30s and 40s.[5,6]

In recent years, knowledge of the biology of tooth eruption has greatly increased. Interaction among osteoblasts, osteoclasts and dental follicle involve a complex interplay of regulator genes that encode various transcription factors; protooncogenes and soluble factors.[7]

To understand the basis of abnormal tooth eruption/eruption of impacted or retained teeth, knowledge about basic molecular mechanism involved is essential.

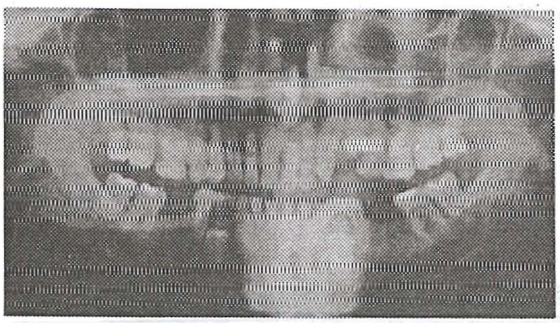
Although there are numerous case reports describing management of impacted teeth, we report of an unusual finding in a case of impacted premolars where orthodontic traction force on only one premolar led to spontaneous eruption of adjacent premolar.

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A)

B)



C)

*Figure 1 - (a) Left buccal occlusion view (b) Maxillary occlusal view (c) Orthopantamograph.*

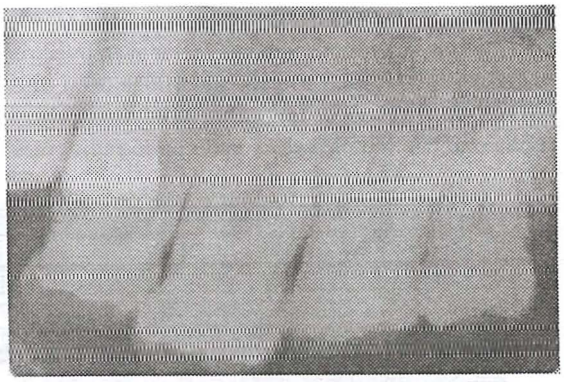
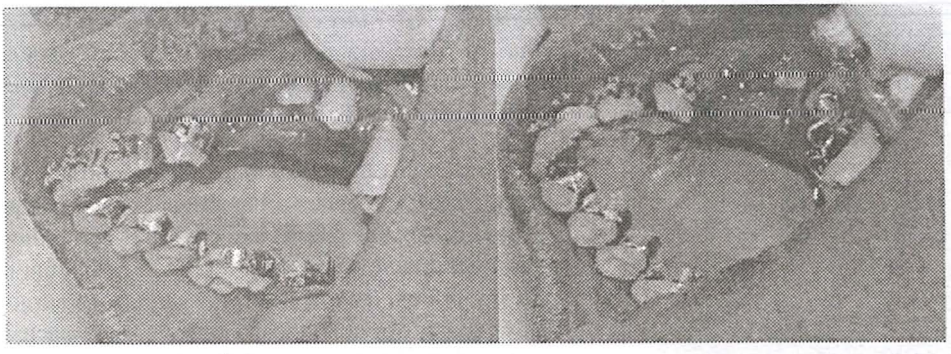


*Figure 2 - Intraoral periapical radiograph of 65.*

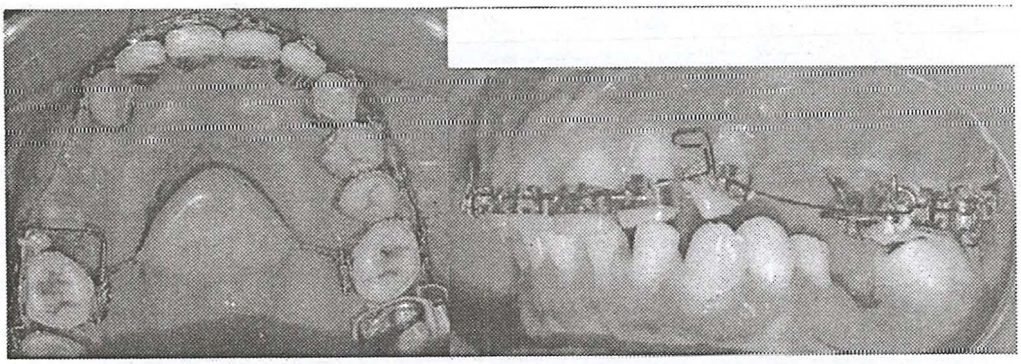
## CASE REPORT

A 47-year-old male patient was referred to Orthodontic department, Manipal College of Dental Sciences, Manipal, Karnataka India from a general practitioner for consultation and management regarding impacted first and second premolars in upper left quadrant. Patient gave history of exfoliation of two teeth in the same quadrant two years ago. There was no relevant medical history.



A B

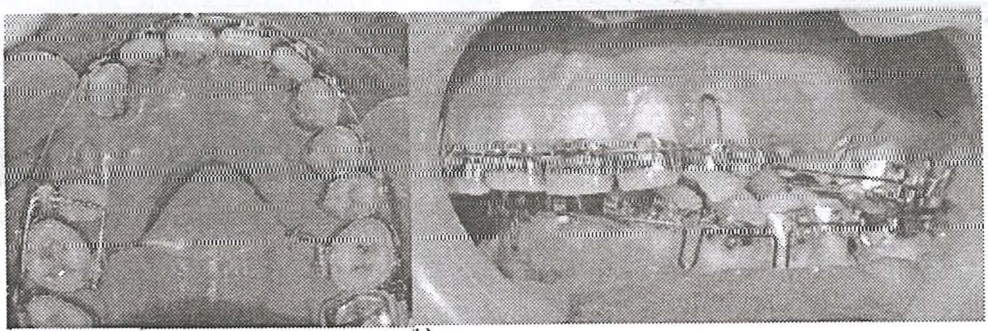
*Figure 3 - (a) surgical exposure of 25 (b) bonded traction hook on 25.*



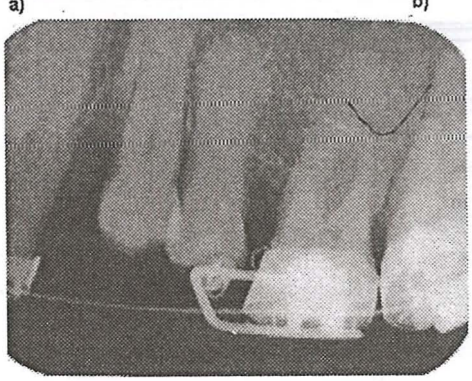
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*Figure 4 -After two months of orthodontic traction (a) Maxillary occlusal view (b) Left buccal occlusion view.*

On clinical examination, it was noted that in the second quadrant first and second premolars were missing and deciduous second molar was over retained with increased overjet and 100% deep bite. Orthodontic records, including study models, a cephalometric radiograph, a panoramic radiograph and periapical radiographs were taken. On radiographic examination it was revealed that in the second quadrant first and second premolars were at the crestal level of alveolar ridge (figure 1 a,b,c and 2). After clinical and radiographic examination fixed mechanotherapy was decided for the patient. The



a) b)



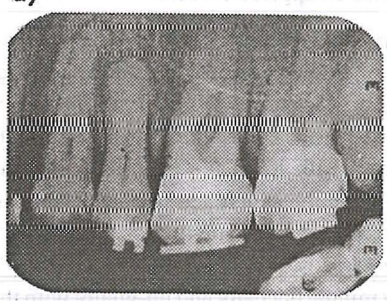
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*Figure 5 - After three months of orthodontic traction (a) Maxillary occlusal view (b) Left buccal occlusion view (c) Intraoral periapical radiograph of 25.*

main treatment objective was guided eruption of the impacted teeth to obtain a functional occlusion and achieve acceptable overjet and overbite. The orthodontic treatment plan called for fixed orthodontic therapy in conjunction with oral surgery to surgically expose & orthodontically relocate the impacted teeth and extraction of maxillary first premolar for



a) b)



c)

***Figure 6 -After seven months of orthodontic traction (a) Maxillary occlusal view (b) Left buccal occlusion view (c) Intraoral periapical radiograph of 25.***

correction of increased overjet.

The risks and benefits of treatment were discussed in detail with the patient. Treatment was started with .022" x .028" Standard Edgewise appliance. After completing initial leveling, patient was referred to Department of Oral and Maxillofacial Surgery for the extraction of over retained deciduous second molar and surgical exposure of impacted second premolar. The patient received local anesthesia via infraorbital injection, which was supplemented by a buccal infiltration in the immediate operative area. To reveal the tooth, the surgeon raised an apical mucoperiosteal flap on the buccal side of the permanent first molar's roots. After exposure of the flap cusp tips of both premolars were visible (figure 3 a). Bone uncovering was done only for second premolar and the decision was made to delay the extraction of first premolar for a later date as a preventive measure if the second premolar failed to show any eruptive movement or developed any complication during the treatment, so that the first premolar may be attempted for repositioning. Traction hook that had an attached traction chain was bonded to the exposed crown of the second premolar before suturing the flap (figure 3 b).

In an attempt to relocate the impacted second premolar while simultaneously intruding the supraerupted first molar, an extended C-shaped stainless steel bar of 1mm from the first molar was designed and fabricated. The ends of the C-shaped bar were soldered to the buccal and lingual of the first molar band. The intermediate curved component of the design received the elastic traction from the traction device that was bonded to the second premolar. This assembly allowed for an advantageous reciprocal anchorage. After a period of two months, emergence of second premolar cusp tip was noted (figure 4 a,b).

An interesting observation noted by the end of third month was that of spontaneous emergence of first premolar even though traction force had been applied only to second premolar (figure 5 a,b,c). By the end of eight months of orthodontic traction second premolar had aligned in the arch while first

premolar was 5mm above the gingival margin without any force application (figure 6 a,b,c).

What caused this spontaneous eruption of first premolar, which had been lying dormant for many years, subsequent to the orthodontic traction on adjacent second premolar?

## DISCUSSION

Impaction of premolars especially in maxillary arch has been a rare occurrence unless as a part of systemic condition/syndrome. Etiological factors for premolar impaction appear to include arch length deficiency, ectopic position of tooth germ, obstacles to eruption such as an ankylosed primary molar, presence of supernumerary teeth or odontomas and genetic factors.[8] In the present case, the possible cause for impaction of premolars could be due to retained deciduous teeth and also overlying mucosal barrier. Usually, relief of etiological factor responsible for impaction allows the concerned tooth to erupt and if the impacted tooth does not erupt by itself, surgical exposure of the impacted tooth followed by orthodontic traction is a viable treatment option. However as the age advances or as seen in adult orthodontic patients, chances of eruption of impacted teeth by orthodontic traction diminishes.[4] The teeth that have been impacted for many years undergo pathologic changes that prevent their eruption even when all other factors are favorable. [9] Adults need to know what level of success can be expected in treating the impacted tooth and the expected duration of treatment. Because these cases are relatively rare, most orthodontists have limited experience and a search in the literature is noncontributory due to lack of published studies performed to answer these questions.

Henceforth before starting any adult orthodontic case with impacted teeth, proper evaluation of the impacted tooth and its prognosis needs to be determined. In the present case one positive factor in the prognosis was that both premolars were at the level of alveolar crest. Another factor in the patient's favor was that the teeth were in a vertical position and no break in the continuity of periodontal ligament was seen in IOPA. Most of the force needed would be in the vertical plane, with a minimum of force needed in the other planes of space. A third positive factor was that there was adequate space for the teeth to erupt. Despite these positive factors, the patient was informed that the chances for success were only moderate.

Periodontal ligament continuity is also of importance when pulling an impacted tooth through traction force. Conclusions from recent studies showed that the PDL might be both the medium of force transfer and the means by which alveolar bone remodels in response to applied forces.[10]

So in the present case it can be assumed that because of traction force, tension developed in the periodontal ligament fibers leading the second premolar to erupt and thereby bringing the alveolar bone along with it. In the alveolar bone there are Sharpey's fibers which occasionally pass uninterruptedly through the bone of the alveolar process to continue as principal fibers of an adjacent PDL, or they may mingle buccally and lingually with the fibers of the periosteum that cover the outer cortical plates of the alveolar process.[11] This continuity of Sharpey's fiber between the two impacted premolars could have created a mechano-chemical transduction of orthodontic force to the neighboring tooth leading to the spontaneous eruption of Maxillary first premolar. The mechanical stimulus of traction force also starts a series of cellular events leading to bone remodeling which are necessary for eruptive process.

Rygh and Brudvik[12] observed a great increase in vascularity in areas of periodontal ligament tension, as indicated by an increase in the space occupied by blood vessels in histologic sections of rodent jaws. Transmission electron microscopic studies permitted identification of many cells paravascularly, concomitant with the vascular infiltration. Macrophages and leukocytes, along with proteins and fluids, seemed to have migrated from PDL capillaries. These cells are known to be able to produce various signaling molecules that participate in force-induced tissue remodeling.

Because of application of orthodontic force neurotransmitters[17] (such as. neuropeptides, substance P, vasoactive intestinal polypeptide, and calcitonin gene related peptide) and cytokines (such as. IL-1,2,3,6,8, tumor necrosis factor alpha, Gamma interferon, and osteoclast differentiation factor) directly or indirectly stimulates osteoblastic and osteoclastic functions which are secondary mediators playing a key role in bone remodeling.[13] Recently role of dental follicle in tooth eruption has gained popularity. In the present case, the orthodontic force could have activated the remnant cells of dental follicle in periodontal ligament of first premolar leading the tooth to erupt.

One must also consider the fact that surgical exposure might have created an eruptive stimulus in the first premolar.[15]

Thus, we assume that application of traction force on second premolar would have created tension on its periodontal ligament which in turn was transmitted through sharpey's fibers to adjacent first premolar leading to a cascade of cellular events; along with alveolar bone remodeling which provides a stimulus for first premolar to erupt in oral cavity.

## CONCLUSIONS

Surgical exposure and orthodontic traction of impacted premolar in a 47 year old patient is a clinical challenge. Furthermore, when such treatment is undertaken, its successful completion should be expected to take considerably longer, in both the simpler and the more difficult cases. This increased duration of treatment time also increases the demand on anchorage concern in the vertical plane. So just by applying orthodontic force to single tooth in multiple adjacent teeth impaction cases, adjacent tooth can be brought into occlusion by mechano-chemical transduction of force. It also reduces the amount of taxation on the anchorage and reduces the amount of arch collapse. Further research is needed to elucidate the precise mechanism for this hypothesis.

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