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## Primary eruption failure: A review

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### Abstract

Primary failure of eruption (PFE) is a rare condition characterized by non-syndromic eruption failure of permanent teeth in the absence of mechanical obstruction as originally described by Proffit and Vig. It involves restrained eruption of teeth with lack of identified local or general causative factor. Previous Research have correlated a genetic basis to the condition. Genetic testing used in recent years has enabled definitive verification of diagnosis in suspected patients but with the high cost associated with it not feasible for routine use. Diagnosis of PFE is difficult due to its rare occurrence and absence of clinically evident cause of eruption has led to new interest in the subject. The conventional orthodontic-surgical methods employed in the past for getting the unerupted teeth into the dental arch have failed miserably in case of PFE as the application of orthodontic force to the involved tooth results in ankylosis along with all its adverse consequences. An early and competent diagnosis of PFE enables a clinician to abandon orthodontic means doomed to failure and introduce other effective prosthetic and surgical solution for the same. Hence the review to examine the literature thoroughly and provide a complete insight of the condition is attempted.

**Keywords:** primary failure of eruption, genetics, etiology, diagnosis, treatment.

### Introduction

A tooth erupts from its developmental position in jaw towards its functional position within the occlusal plane in an axial or occlusal direction. It appears to be regulated by genes as a localized event in its follicle at chronologically predetermined time. The tooth normally erupts through the bone and oral epithelium co-ordinating with the growth of the jaws. Erupting tooth doesn't force its way through the overlying tissues it is turn controlled by factors such as resorption of overlying bone, tooth roots and alveolar mucosa. In clinical practice though significant divergence from the normal eruption timing and pattern cannot be overlooked.

Proffit and Vig in the year 1981 reported a condition in which malfunction in the eruption mechanism caused a non-ankylosed tooth failing to erupt<sup>[1]</sup>. The main characteristic features of this conditions were failure of an affected tooth to erupt along its eruption path even without any mechanical hindrance. The teeth involved would partially erupt and then eruption will cease completely. They remain submerged but are not ankylosed. Another distinct feature is the occurrence of posterior open bite due to characteristic involvement of posterior teeth. Teeth that are distally placed to the most mesially affected tooth are also affected. It can affect all the posterior quadrants with a clinically distinct unilateral appearance. The repeated failure to extrude the affected tooth using orthodontic force to get the teeth into its correct occlusal position is a key feature of the condition<sup>[1-5]</sup>. Since molar teeth are mainly involved, a typical clinical image of an extensive lateral open bite is seen. Radiological feature shows large radiolucent areas around submerged tooth follicles. The recent advances in diagnosis particularly genetic testing have led clinicians to diagnose and study it as a separate condition, rather than considering it as manifestation as previously thought. High cost associated with genetic testing has not allowed routine clinical use, hence extensive research to find more feasible methods for diagnosing the condition would be required in future.

### Clinical Features

With a prevalence of approximately 0.06% in the population and a gender predilection of Male: Female of 1: 2.25, the occurrence of primary failure of eruption (PFE) is relatively low. A severe open bite in the lateral segments of the dental arches is a characteristic feature of the condition. When an affected teeth remains completely unerupted a typical image of pseudo-

anodontia may be observed creating a posterior open bite as partially erupted teeth are located at some distance from the occlusal plane [7]. Teeth characteristically involved are permanent mainly molars and premolars however it may affect the anterior as well as the deciduous dentition. First molars are of prime importance as they are involved in more than 90% of affected individuals followed by second molars. Eruption of teeth may be restricted in both maxilla and/or mandible with higher a chance for a unilateral occurrence. In about 25% of affected individuals eruption is limited to one quadrant in others two or more quadrants are may be involved. A characteristic feature of this condition is teeth that are located distally to the unerupted tooth are also involved. This implies that if the 2<sup>nd</sup> premolar is the first tooth unerupted, both the first and second molars will remain impacted as well. A skeletal Class III configuration is relatively often present in PFE patient [9]. However, adequate statistical data to prove this aspect is low due to the rare occurrence of the disorder. One of the most significant problems concerning PFE is the application of any orthodontic force inevitably results in ankylosis causing the unerupted tooth remaining in its original submerged position while the other teeth supposed to serve as the anchorage are subject to intrusive force leading to deterioration rather than improvement of the occlusal conditions.

### Radiological Finding

PFE presents characteristic radiological image as well. Enlarged bony crypts around the tooth-germ crowns formed due to resorption of the alveolar process called as resorption chimneys are seen [3]. These “chimneys” suggests a proper resorption process and deficiency of eruptive force to move the tooth-germ along the path of eruption. Primary tooth ankylosis and hypodontia are some characteristic features presented more frequently in patients with PFE than general population.

### Classification of Primary Eruption Failure

Failure of eruption has been divided into three distinctive categories by Sylvia A and Frazier Bowers into [4-5]

1. Primary failure of eruption (PFE).
2. Mechanical failure of eruption (MFE).
3. Indeterminate failure of eruption (IFE).

Recently mutations in parathyroid hormone receptor 1 (PTH1R) have been identified as heritable basis of this dental phenotype in several familial cases of PFE. Several types of non-syndromic PFE, including type I and type II have been discussed in literature, with both types primarily affecting the posterior segments, either unilaterally or bilaterally. Type II is further characterized by greater eruption potential of the most distal tooth affected with PFE.

### Mapping

Decker *et al.* (2008) in his three generation study on a German family with PFE genotyped 8 affected and 4 unaffected members segregating autosomal dominant PFE. Two regions with a maximum lod score of 2.41, on chromosome 3p24.3-p14.3 and 13q31.3-q33.1 was revealed by parametric linkage analysis with a dominant model.

### Molecular Genetics

The candidate gene PTHR1 and heterozygosity for a splice site mutation in affected individuals was observed by Decker *et al.* (2008) [5]. Unaffected family members or controls, showed no such mutation. The result predicted to premature proteolytic degradation of the precursor protein or a functionless receptor

suggesting that haplo-insufficiency of PTHR1 is to be the underlying principle of nonsyndromic PFE.

### The Diagnostic Criteria for PFE

Absence of clinically evident cause of eruption and rare occurrence makes diagnosing of PFE difficult [1-5]. The conventional orthodontic and surgical methods used in past to bring unerupted teeth into the dental arch have proved to be futile as the application of orthodontic force inevitably results in ankylosis of the involved tooth.

### ii Treatment

Severity of the disorder and the patient's age is the criteria behind selection of treatment modality. In children the main therapeutic goal is to ensure the proper development of the oral apparatus and emphasis should be put on regaining the masticatory efficiency which is already reduced in patients with PFE [8]. Removable prosthesis, which children easily adapt to helps in restoring the Masticatory function. It can be used as a temporary solution during the developmental period and should be replaced every few months to avoid restricting proper craniofacial growth. For management of PFE in adult patients generally depends on the severity of the disorder which can be assessed by the number of affected teeth and their eruption status. Teeth that are partially embedded but located relatively close to the occlusal plane can be restored with a crown provided the crown root ratio is maintained. Dental implant can always be considered in mild to moderate cases of PFE with bone grafting at the extraction site whenever required [10-15]. Advanced surgical procedures, such as segmental osteotomy or osteodistraction combined with prosthetic solution in PFE management has been successfully used and considered over orthodontic therapy as conventional orthodontic method may inevitably cause ankylosis of the involved tooth and worsen the condition [10].

### Discussion

Lack of knowledge and research about the eruptive process makes it even more difficult to diagnose disorders of tooth eruption. The diagnosis of PFE is based upon clinical and radiographic characteristics and response to the treatment. Firstly to diagnose failure of eruption is to assess role of any local or systemic or mechanical factors responsible for the condition. Mechanical obstruction (ankylosis) versus failure of the eruption mechanism is the main differential diagnosis. To distinguish between the two is the key to determining the prognosis for the affected teeth.

Autosomal dominant inheritance in failure of eruption of permanent teeth was described by Shokeir (1974).

Characteristic features of primary failure of tooth eruption was first described by Proffit and Vig (1981) [1]. Clinical picture reveals most commonly affected teeth are the posteriors with a unilateral open bite as a common finding. The involved teeth may or may not erupt into occlusion before submerging. In case of deciduous dentition primary second molars are most commonly involved, a unilateral (most common) and sometimes a bilateral involvement may be seen with the affected tooth failing to erupt and becoming ankylosed in later stages. Any orthodontic treatment remains unsuccessful in extruding the affected teeth and usually leads to ankylosis.

Rasmussen and Kotsaki (1997) described 5 cases with inherited retarded failure of eruption in the permanent as well as primary dentition involving one or more primary second molars. Study reported fourteen teeth that underwent primary failure of eruption (PFE): two of the patients had all four

molars unerupted, the other patients had three two and one unerupted tooth, respectively. No significant differences was appreciated between gender, jaws, or sides. The unerupted teeth were found to be always deeply seated beyond their normal position of eruption with correct axial angulation in most cases.

Involvement of incisors, molars, and premolars in all quadrants was described by O'Connell and Torske (1999)<sup>[8]</sup> in a case of six year-old girl with primary retention in the deciduous and the permanent dentition. Only six teeth had erupted (all central incisors and the lower lateral incisors) at three and a half years of age with panoramic radiograph revealing the presence of all primary teeth and normal development of the permanent teeth. Thirteen of her primary teeth had erupted at six years of age with normal size, shape, and quality of enamel. All primary teeth were seen radiographically except the upper second premolars all the permanent tooth buds of all teeth were identified. When compared to previous radiographs little progress in tooth eruption was seen however root development of the permanent teeth continued. The sequence of eruption was abrupt with the upper lateral incisors erupting more than 1 year later than the cuspids and the first molars. By ten years of age no more teeth had erupted and the patient showed no to minimal response to repeated surgical intervention to expose and eruption of affected teeth. Primary incisors were the only teeth with any occlusal contact with significant resorption and mobility. Her growth and development was otherwise normal with no other skeletal or craniofacial abnormality.

Case of bilateral posterior open bite in two sisters due to failure of eruption of the permanent dentition was reported by DiBiase and Leggat (2000)<sup>[10]</sup> with noticeable involvement of the first and second molars in younger sister. In both cases any orthodontic correction tried had little or no effect. Normal eruption of the upper third molars, distal to the posterior open bite was a distinct feature in the sisters.

Ahmad *et al.* (2006) described five new and thirty-five previously published cases of PFE in the permanent dentition other than the third molars. They suggested PFE incorporates two isolated conditions, one with a complete localized failure of eruption and the other where teeth prior to the eruption failure shows some initial eruption which they termed as, 'secondary retention.

Malfunction of the eruption mechanism causing a non-ankylosed teeth failing to erupt was described by Frazier-Bowers *et al.* (2007)<sup>[4]</sup>. Even after the eruption path getting cleared failure of an affected tooth to move toward its and erupt is one of the primary identifying characteristic of the condition. Teeth becomes relatively submerged although not ankylosed, only posterior teeth are affected resulting in a posterior open bite and all teeth distal to the most mesial affected tooth getting affected are the other key characteristic features of the condition. Teeth getting affected unilaterally and lack of response to orthodontic force are other important features.

## Conclusion

Primary failure of eruption is a very rare anomaly and in the truest sense a eruption defect which manifests as a complete failure of eruption without a distinct local or systemic etiology. Diagnosing the condition accurately by following a methodical approach and rehabilitation of the patient through surgical, orthodontic or by prosthodontic measures is the present accepted approach the condition.

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