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Eruption of Tooth

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Abstract

Teeth move through alveolar bone, whether through the normal process of tooth eruption or by strains generated by orthodontic appliances. Both eruption and orthodontics accomplish this feat through similar fundamental biological processes, osteoclastogenesis and osteogenesis, but there are differences that make their mechanisms unique. A better appreciation of the molecular and cellular events that regulate osteoclastogenesis and osteogenesis in eruption and orthodontics is not only central to our understanding of how these processes occur, but also is needed for ultimate development of the means to control them. Possible future studies in these areas are also discussed, with particular emphasis on translation of fundamental knowledge to improve dental treatments.

Keywords
Tooth, Tooth eruption, primary dentition, permanent dentition, movements.

Introduction

Tooth eruption is the movement of the tooth germ from its non-functional position in the alveolar processes to its final functional position in the oral cavity. The term eruption is different from the term emergence as the latter refers to the moment of appearance of any aspect of the cusp/crown through the gingival. The term for the period until the appearance of the teeth in the oral cavity is the eruption time. It can be normal or delayed. Normal biologic eruption time is the tooth eruption that occurs when the root has formed approximately two-thirds of its final length. Delayed biologic eruption refers to delay in the eruption of the tooth despite the formation of two-third or more than two-thirds of the root.[1]

The eruption is a continuous process that continues throughout life and does not stop on reaching the occlusal plane. In general, the tooth erupts when there is resorption of the overlying alveolar bone so that an eruption pathway forms, guided by anatomic structures, biological, chemical, and molecular mediators that result in the movement of the tooth through the eruption pathway[2,3].

Structure and Function

The tooth eruption is a complex process which divides into five stages:

1. Pre-eruptive Movements,
2. Intra-osseous Stage,
3. Mucosal Penetration,
4. Pre-occlusal,
5. Post-occlusal Stages.

1.Pre-eruptive movements: It occurs before the onset of the eruption in the deciduous as well as in the permanent teeth within the tissues. During development, the tooth germ undergoes intra-alveolar movements. These pre-eruptive movements aim to position the tooth germ in its final position before the initiation of the eruptive movement. These movements are the result of two

types of movements (the movements made by the tooth germ itself, and the passive movements of the tooth germ because of jaw growth)[4].

2.Eruptive movements: It occurs when the tooth moves to its functional position in the arch from its intraosseous position. This phase further divides into intra-alveolar/intra-osseous and supra-alveolar eruption/mucosal penetration. The intraosseous eruption of the tooth begins immediately after the completion of crown formation. It involves the entire phase of the eruption of the tooth germ through bone. It mainly involves axial movements. The supra-osseous eruption consists of the tooth emerging into the oral cavity[4].

3.Preocclusal movements: It refers to the movement before the tooth reaches its functional occlusal position. Once the tooth has appeared in the oral cavity, it is subject to environmental factors such as the pressures of the buccal (cheeks), labial (lips) and tongue musculature, as well as the eruptive forces of adjacent teeth. These forces continue to act until the tooth reaches its final position in the dental arch. In the post-occlusal movements, the tooth remains in its functional position (tooth has reached the occlusal plane). It simultaneously adapts according to the growth of the jaw and compensatory movements caused by wear (proximal and occlusal)[5].

Theories of tooth eruption

There are several proposed theories for tooth eruption.

- **Cushioned hammock theory:** Proposed by HarySicher, according to this theory, cushioned hammock ligament below a tooth is responsible for its eruption.[6-8]
- **Root formation theory*:*** According to this theory, the apically directed force by the proliferating root exerts a reactive occlusal force resulting in the coronal movement of the erupting tooth. However, it has been seen that the teeth without roots can erupt, and the teeth erupt even after completion of their root formation. Also, some teeth erupt to a distance greater than their total root length. Moreover, the newly formed dentin at the apex of the root is unmineralized and is vulnerable to trauma.
- **Vascular pressure/ hydrostatic pressure theory:** According to this theory, the local increase in tissue fluid pressure in the vessels of the dental pulp and the periapical region exerts hydrodynamic and hydrostatic pressure within the vessels resulting in tooth eruption.[9]
- **Bone remodelling theory/ Dental follicle theory:**According to this theory, osteoblasts and osteoclasts from the dental follicle cause bone remodeling via resorption in the coronal area and bone apposition in the apical area, thereby, forming a pathway through which tooth can passively erupt.[10]
- **Periodontal ligament traction theory:** According to this theory, the periodontal ligaments-dental follicle complex exerts eruptive force via the traction power of the fibroblasts when they contract.[9]
- **Bite forces theory*:*** According to this theory, soft tissues of the dental follicle detect bite forces, which in turn directs bone remodeling and tooth eruption.[9]
- **Innervation-provoked pressure theory*:*** This theory postulates that the innervation in the root membrane causes pressure in the apical aspect of the tooth resulting in tooth eruption.[11]
- **The equilibrium theory:** According to this theory, once the tooth reaches its functional plane, further eruption occurs in response to the vertical growth of the lower jaw away from the maxilla. As the teeth get more space, it erupts occlusally to maintain occlusal contact with the tooth in the opposing arch.
- **Neuromuscular theory or unification theory*:*** This theory states that the simultaneous and balanced forces of the orofacial muscles that are under the control of the central nervous system, are responsible for the active eruption of a tooth. The coordinated neuromuscular forces convert into electrical, electrochemical, and biomechanical energies to stimulate cellular and molecular actions within and around the dental follicle and enamel organ. This action prepares a pathway as well as other cellular functions for the eruption of a developing tooth.[12]
- **Role of gubernacular cord**: It is a structure composed of connective tissue that links the tooth follicle to the overlying gingiva, thus guiding the course of the tooth eruption.[7]

Eruption Patterns

The age at which deciduous and permanent teeth erupt can vary extensively. The sequence of eruption is more significant than the timing, which may differ in both deciduous and permanent teeth. Generally, a variation of 6 months on either side of the usual eruption date is considered normal. The first teeth to erupt in the oral cavity are the deciduous mandibular central incisors at approximately 5 to 8 months of age, followed by maxillary central incisors a month or two later. In general, by the age of 19 months, the child has a total of 12 erupted deciduous teeth. By 23 months, children should have 16 deciduous teeth, and by 27 months, all the deciduous teeth should have erupted.[13]

The first permanent teeth that emerge in the oral cavity are the maxillary and mandibular first molars at around six years of age (six-year molars). They erupt distally to the deciduous second molars. Their eruption is accompanied by or preceded by the exfoliation of the deciduous mandibular central incisors. Between 6 to 7 years of age, the permanent mandibular incisors erupt, followed by the permanent maxillary incisors between 7 to 9 years of age. The permanent anterior teeth develop lingual or palatal to the deciduous teeth, whereas the permanent premolars develop between and beneath the roots of the deciduous molars they replace.[13].

Clinical Significance

Tooth eruption is a very complex and finely regulated process that influences the healthy development of the craniofacial region. All the factors such as eruption timing, sequence, direction, rate, position, and morphology of teeth are crucial for facial esthetics and phonetics.[14]The eruption of the deciduous teeth is not only significant for maintaining the facial contour, mastication, phonetics, and esthetics, but also they guide the deciduous teeth into their proper position. Estimation of the eruption schedule is a valuable tool in planning a child's dental health that includes diagnostic, preventive, and therapeutic measures.[15] It is also a key indicator during the diagnosis of certain growth disturbances, and to estimate the chronological age of the child with unknown birth records in forensic dentistry.[16] Moreover, it can also act as an aid in interceptive guidance of occlusion, especially when determining the timing of eventual extractions of deciduous teeth and timing of orthodontic treatment.[17]

- **Eruption hematoma:** An eruption hematoma over an erupting tooth that presents as a bluish swelling due to filling of blood-tinged fluid in the follicle surrounding the erupting tooth is usually asymptomatic. They typically rupture spontaneously without any treatment. But sometimes, the size of the hematoma may cause pain and impair eating.

- **Natal/neonatal teeth*:*** They may lead to ulceration on the ventral surface of the tongue due to the sharp incisal edge of the tooth. This condition is known as Riga-Fede disease/syndrome. As the root development of these teeth is incomplete, they are mobile, which increases the possibility of swallowing and aspiration of the teeth. Other complications include injury to the mother's breast and difficulty in suckling..[16] The mobility has also shown to cause degeneration of Hertwig's epithelial sheath that is responsible for the formation of the root. Degeneration of the sheath results in further incomplete root development.

- **Ectopically erupted teeth:** such as nasal teeth may be asymptomatic or may lead to facial pain, obstruction of the nasal cavity, headache, epistaxis (acute hemorrhage from the nostril), foul-smelling rhinorrhea, external nasal deformities, and obstruction of the nasolacrimal duct. Ankylosed teeth interfere with the development of the alveolus in the vertical direction.[17].

Conclusion

Tooth eruption occurs as the result of a programmed and localized expression of molecules needed for alveolar bone resorption and formation, whereas orthodontic tooth movement focuses on the expression of these molecules for resorption and expression after induction by a mechanical force. Despite the different stimuli for gene expression commonalities exist in terms of the genes ultimately

expressed and the end results achieved .Thus, it is instructive for researchers in both arenas, tooth eruption and orthodontic tooth movement, to follow the literature in both disciplines.

References

1. Sutton PR, Graze HR. The blood-vessel thrust theory of tooth eruption and migration. Med. Hypotheses. 1985 Nov;18(3):289-95. [PubMed]

2. Cahill DR, Marks SC. Tooth eruption: evidence for the central role of the dental follicle. J. Oral Pathol. 1980 Jul;9(4):189-200. [PubMed]

3. Marks SC, Cahill DR. Experimental study in the dog of the non-active role of the tooth in the eruptive process. Arch. Oral Biol. 1984;29(4):311-22. [PubMed]

4. Kasugai S, Suzuki S, Shibata S, Yasui S, Amano H, Ogura H. Measurements of the isometric contractile forces generated by dog periodontal ligament fibroblasts in vitro. Arch. Oral Biol. 1990;35(8):597-601. [PubMed]

5.Sarrafpour B, Swain M, Li Q, Zoellner H. Tooth eruption results from bone remodelling driven by bite forces sensed by soft tissue dental follicles: a finite element analysis. PLoS ONE. 2013;8(3):e58803. [PMC free article] [PubMed]

6.Kjær I. Mechanism of human tooth eruption: review article including a new theory for future studies on the eruption process. Scientifica (Cairo). 2014;2014:341905. [PMC free article] [PubMed]

7.Carollo DA, Hoffman RL, Brodie AG. Histology and function of the dental gubernacular cord. Angle Orthod. 1971 Oct;41(4):300-7. [PubMed]

8. Kumar V, Shivanna V, Kopuri RC. Knowledge and attitude of pediatricians toward digit sucking habit in children. J Indian Soc PedodPrev Dent. 2019 Jan-Mar;37(1):18-24. [PubMed]

9.Kurihara K, Fukui T, Sakaue K, Hori K, Ono T, Saito I. The effect of tongue thrusting on tongue pressure production during swallowing in adult anterior open bite cases. J Oral Rehabil. 2019 Oct;46(10):895-902. [PubMed]

10. Agrawal S, Koirala B, Dali M, Shrestha S, Bhagat T, Niraula SR. Prevalence of Oral Habits of Schoolchildren in the Mixed Dentition in Dharan, Nepal. J Dent Child (Chic). 2019 May 15;86(2):88-92. [PubMed]

11. Mhaske S, Yuwanati MB, Mhaske A, Ragavendra R, Kamath K, Saawarn S. Natal and neonatal teeth: an overview of the literature. ISRN Pediatr. 2013 Aug 18;2013:956269. [PMC free article] [PubMed]

12. Sutton PR. Migrating nonerupted mandibular premolars: a case of migration into the coronoid process. Oral Surg. Oral Med. Oral Pathol. 1968 Jan;25(1):87-98. [PubMed]

13. Shapira Y, Kuftinec MM. Intrabony migration of impacted teeth. Angle Orthod. 2003 Dec;73(6):738-43; discussion 744. [PubMed]

14. Gorski JP, Marks SC. Current concepts of the biology of tooth eruption. Crit. Rev. Oral Biol. Med. 1992;3(3):185-206. [PubMed]

15. Soliman NL, El-Zainy MA, Hassan RM, Aly RM. Timing of deciduous teeth emergence in Egyptian children. East. Mediterr. Health J. 2011 Nov;17(11):875-81. [PubMed]

16. Almonaitiene R, Balciuniene I, Tutkuviene J. Factors influencing permanent teeth eruption. Part one--general factors. Stomatologija. 2010;12(3):67-72. [PubMed]

17. Hughes TE, Bockmann MR, Seow K, Gotjamanos T, Gully N, Richards LC, Townsend GC. Strong genetic control of emergence of human primary incisors. J. Dent. Res. 2007 Dec;86(12):1160-5. [PubMed]