



Review Article

## Variations in morphology of permanent maxillary lateral incisors and its impact on oral hygiene and diseases

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### ABSTRACT

The permanent maxillary lateral incisors are of great importance from an aesthetic standpoint, as any variation in their shape can lead to an unfavorable visual appearance. Furthermore, morphological variations such as peg-shaped, barrel-shaped, shovel-shaped, and canine-shaped teeth can impact oral hygiene and lead to additional health problems. The etiology of these variations is multifactorial, including genetic, epigenetic, and environmental factors. This paper aims to provide a comprehensive overview of the most common morphological variations of the permanent lateral incisors, including their causes, associated dilemmas, treatment modalities, and the various health and hygiene issues associated with these diverse physical characteristics. By highlighting the potential health and hygiene issues associated with these variations, this paper aims to increase awareness among dental professionals and the general public about the importance of regular dental care and check-ups to maintain oral health and aesthetics. A comprehensive understanding of the causes, dilemmas, and treatment modalities of these morphological variations can aid dental professionals in providing effective and personalized care to their patients. In conclusion, the morphology of the permanent maxillary lateral incisors plays a critical role in dental aesthetics, hygiene, and health.

**Keywords:** Lateral incisor, Morphology, Oral hygiene, Dens invaginatus, Peg lateral

### INTRODUCTION

The lateral incisors are a part of the anterior group of teeth. Thus, they hold a very important role from the esthetics point of view. The permanent maxillary lateral incisors exist in a variety of forms, varying more than the other teeth present in the human dentition (with the exception of the third molars).<sup>[1]</sup> Since these teeth are an aspect of a person's smile, any kind of shape variation may lead to unfavorable aesthetics. Agenesis, size reduction, and morphological variants such as peg-shaped, barrel-shaped, cone-shaped, and canine-shaped kinds are all common variations seen for this tooth.<sup>[2]</sup> Studies revealed that such trait variations can be influenced by genetic, epigenetic, and environmental factors.<sup>[2]</sup> This article explores the most common morphological variations of the permanent lateral incisors from the regular morphology. This includes their peg-shaped forms and dens invaginatus (DI). Peg-laterals are a morphological form of lateral incisors where the shape of these teeth becomes tapered like a peg. It is actually a microdontia form of this tooth. Dens invaginatus or dens in dente is a condition where there is a disturbance in the developing tooth bud before calcification. This causes invagination of the developed tooth surface and also results in weakened enamel and dentin of that region.<sup>[3]</sup> Being a major part of a person's smile, these deviations may harm a person's self-esteem and self-confidence. Other than the disturbed esthetics, a few of these deviations can cause health associated problems such

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as caries, periodontitis, and periapical infections. Thus, it is important that early detection of these forms be taken into consideration for appropriate treatment planning. Early diagnosis will decrease the complications.

The incidence and prevalence of the different morphological forms of permanent maxillary lateral incisors vary across populations and ethnic groups. For example, cone-shaped incisors are more prevalent in East Asian populations, while peg-shaped incisors are more common in Caucasian populations.<sup>[4,5]</sup>

Despite the variations in incidence and prevalence, these morphological variations are relatively common in the general population. In a study conducted on a sample of dental patients, barrel-shaped incisors were found in 31.7% of cases, while cone-shaped incisors were present in 11.7% of cases.<sup>[6]</sup> Similarly, peg-shaped incisors were found in 4.2–8.6% of cases in various studies.<sup>[7]</sup> The prevalence of other morphological variations, such as shovel-shaped and canine-shaped incisors, varies across populations and has not been extensively studied.

Understanding the incidence and prevalence of these morphological forms is important for dental professionals to identify and manage these variations in their patients. A thorough examination of the patient's dental history, family history, and environmental factors can aid in the diagnosis and treatment planning for these morphological variations.

## MORPHOLOGICAL FORMS AND THEIR CAUSATIVES

Morphological variances can be seen in case of permanent maxillary lateral incisors. These include peg-laterals, DI, barrel-shaped, cone-shaped, and canine-shaped, and the presence of a talon's cusp. Among these, the most common traits observed in the general population include peg-laterals and DI.

Peg laterals are one of the most common forms of localized microdontia.<sup>[3]</sup> The mesial and distal surfaces of the crown of maxillary lateral incisor converge incisally, rather than being parallel or diverging, thus forming a peg-shaped or cone-shaped crown.<sup>[3]</sup> The mesiodistal diameter of the crown is reduced.<sup>[8]</sup> According to Shafer's, the root of such a tooth is often shorter than the average length.<sup>[3]</sup> Neville, however, noted the root to be frequently of average length.<sup>[8]</sup> The remaining dentition frequently displays somewhat decreased mesiodistal dimensions when a peg-shaped tooth is present.<sup>[8]</sup>

There are different causes of formation of peg laterals including genetic conditions, developmental anomaly, and endocrine disturbances during intrauterine life (IUL).<sup>[9]</sup> Reports have also shown that the occurrence of peg laterals

may be related to the compromised growth potential seen in patients with cleft lip and palate, or to external factors such as surgical intervention or nutrition.<sup>[10]</sup>

DI, also known as dilated composite odontome, is a developmental anomaly which is the result of an invagination in the surface of the tooth crown before calcification.<sup>[3]</sup> Two forms can be identified – coronal and radicular.<sup>[8]</sup> Predominantly, coronal DI is commonly encountered affecting permanent maxillary lateral incisors, and in the majority of cases, it appears as a simple accentuation in the development of the lingual pit.<sup>[3]</sup> This condition is frequently bilateral.<sup>[3]</sup> The instances documented in the literature show that the anomaly is rather prevalent and that the degree of variance can be exceedingly vast.<sup>[3]</sup> The invagination's depth can vary from a moderately enlarged cingulum pit to a deep infolding that can reach up to the root apex.<sup>[8]</sup> The term “dens in dente,” is a misnomer (still in usage), which originally referred to a severe invagination that gave the appearance of a tooth within a tooth.<sup>[3]</sup> DI is distinguished by the presence of an invagination that is open to the oral cavity. The entrance of the invagination on the crown can appear in the form of a pit, groove, or deep foramen cecum on the palatal or occlusal surface of the tooth. On rare occasions, the opening can be found in other areas such as the buccal face of the crown. The invagination is like a pseudo canal with the walls lined by enamel. The enamel lining may not be uniform, exhibiting interruptions and pits, or it can be lost as a result of caries, resulting in direct communication of dentin, or even the pulp, with the lumen of the pseudo canal.<sup>[11]</sup> The invaginations may be entirely lined by enamel, but cementum is more commonly seen.<sup>[12]</sup> In 1957, Oehlers introduced the most accepted classification of DI based on the radiographic appearance of the invagination and is significant clinically [Table 1].<sup>[11,12]</sup>

The management of all these types depends on various parameters, particularly the extension of the DI, which can reach up to the coronal, middle or apical third of the root. Modifications of the existing classification system have been proposed by various authors. Such alterations, based on the latest diagnostic tools and treatment techniques, aim to better enable the clinicians to make better and more affordable therapeutic decisions.<sup>[13]</sup> Based on clinical findings presented in the report by Kritika *et al.*, the authors suggested further sub-categorization of Oehlers DI Type II into three subtypes based on the advancement of the invagination. This will enable the clinicians to decide on the best-suited root canal technique to be used for any particular case.<sup>[13]</sup> Gul *et al.*, also proposed a new Type IV, where the invagination extends into the pulp chamber beyond the cemento-enamel junction, pushing the main root canal laterally, and making contact with the periodontium, apically, and laterally, through a pseudo foramen. The invagination here also makes contact

**Table 1:** Oehler's classification of dens invaginatus.

Type	Description
Type I	Invagination is limited to crown; up to the cemento-enamel junction
Type II	Invagination extends into the root beyond the cemento-enamel junction; no communication with the dental pulp
Type III A	Invagination extends into the root; lateral communication with the periodontal ligament through a pseudo foramen; no pulpal communication
Type III B	Invagination extends into the root; apical communication with the periodontal ligament through a pseudo foramen; no pulpal communication

with the dental pulp. In addition, there was a lateral canal arising from the main root canal in their case.<sup>[14]</sup>

The etiology of DI is still not clearly understood. Numerous factors have been proposed as contributing factors to DI, including pressure from other tooth germs, trauma, infection, focal growth acceleration of the tooth bud, focal growth retardation of the tooth bud, and restriction of the dental arch. These factors may have been applied to the tooth germ during development and may put pressure on the enamel organ.<sup>[12]</sup>

Other variations of the permanent maxillary lateral incisors include several patterns, such as cone-shaped, barrel-shaped, and canine-shaped teeth. Cone-shaped incisors are characterized by a pointed and narrow crown, whereas barrel-shaped incisors have a wider and rounder shape. Canine-shaped incisors have a pointed crown and a curved shape, resembling the canine teeth in animals. Shovel-shaped incisors, on the other hand, have a thin and flat crown, resembling a shovel. These variations can result from different genetic, epigenetic, and environmental factors and may have a significant impact on dental aesthetics, hygiene, and health.

### IMPACT ON ORAL HYGIENE

Patients with peg-laterals frequently have esthetic concerns and typically require orthodontic treatment or prosthetic restoration. There may be an issue of food lodgment/plaque retention and thus subsequent periodontal infection or dental caries. As a consequence, in clinical practice, when encountering a patient with peg-laterals, careful observation and attention to other probable dental defects are essential for proper diagnosis and treatment planning.<sup>[15]</sup>

In the cases of DI, food debris may become packed in that area with resultant caries and consequent infection of the pulp, occasionally even before the tooth has completely erupted.<sup>[3]</sup> Before tooth eruption, the invagination is filled by remnants of the dental papilla or the enamel epithelium.

After the tooth's eruption, the invagination opens in the oral cavity, where it may retain saliva, food debris, and microorganisms. Bacterial colonization and buildup in the invagination, whether with or without caries development, provide a significant risk for unfavorable pulp responses including inflammation, necrosis, and infection.<sup>[11]</sup>

### COMPLICATIONS

Peg-laterals may be associated with other dental anomalies, such as canine transposition and over retained deciduous teeth. Individuals with malformed lateral incisors often display a midline diastema caused by the distal shifting of the central incisor.<sup>[9]</sup> It was noted that with a missing or peg-shaped lateral incisor, there was a decrease in the overall mesiodistal tooth widths in that specific quadrant. Bozkaya *et al.*, analyzed in their report that a peg-shaped lateral incisor caused reduction in the widths of all teeth. Furthermore, the teeth in the quadrants with missing or peg-shaped lateral incisors were found to be narrower than the teeth in the quadrants with normal lateral incisors.<sup>[16]</sup> Kim *et al.*, (2017) studied that patients with unilateral peg-laterals have shown a high frequency of missing contralateral maxillary lateral incisors. The authors also reported that there is a close association between the crown width of lateral incisors and the root length. Peg-laterals tend to have shorter root lengths than normal lateral incisors; therefore, reduction in the mesiodistal width of peg-laterals reflects a reduction in root length. Dental anomalies with a high incidence in patients with peg-laterals included congenitally missing teeth, DI, palatally displaced canines, supernumerary teeth, and tooth transposition.<sup>[15]</sup>

Cases of DI may appear to have regular morphology, except on the lingual surface, where the tooth usually possesses an abnormally deep lingual pit. This might be accompanied by a slight overdevelopment of the cingulum, often referred to as talon cusp or lingual tubercle. The crown can be canine-shaped or peg like in some instances. Occasionally, the labiolingual or mesiodistal diameter of the crown can be observed to have been increased. DI may also be accompanied by a bifid cingulum. In rare occurrences, the condition may be found in conjunction with incisal notching associated with a labial groove. When DI is identified earlier, modest preventative actions can be taken up to avoid subsequent complications, which can vary from dental caries in the invagination to pulp involvement, ultimately leading to intricate and highly complicated endodontic treatments. If left undiagnosed, and thus untreated, it may result in pulp involvement, pulp infection and necrosis, and formation of periapical lesions. DI may also show a local intrinsic weakness in the enamel, since the invaginated enamel is frequently hypomineralized, making it more prone to deterioration. Furthermore, in the invagination, both enamel and dentin

may be thinner than in the crown. Contact of this dentin to pulp is also possible through fine canals. Hence, early pulp involvement may occur, followed by pulpal infection and necrosis developing soon after eruption of the tooth.<sup>[12]</sup> Communication of the invagination with the oral cavity may cause pre-dentin damage and chronic inflammation of the pulp, resulting in internal root resorption (IRR). IRR associated with DI is a rare finding. Its prevalence, however, should not be underestimated. DI Types 1 and 2 should be evaluated even if they are asymptomatic to prevent the development of IRR and further complications.<sup>[17]</sup>

## TREATMENT MODALITIES

The treatment options for peg-laterals include restoration of morphological form of existing tooth, or by transposition of canine followed by recontouring, or extraction of peg lateral followed by implant placement. Orthodontic therapy, direct composite bonding on the affected laterals, indirect composite placement, porcelain bonded metal crowns, direct bonding of crowns to teeth, crown lengthening to improve gingival height before direct bonding, extractions, and implant placement may be used to treat the condition.<sup>[18]</sup> Uchino *et al.* concluded in their study that the non-extraction approach was the most commonly employed therapy for peg laterals in cases of both unilateral and bilateral clefts.<sup>[10]</sup> Orthodontic therapy improves lateral incisor position as well as redistributes interproximal diastemas, facilitating direct or indirect restorations. Direct resin composite bonding is favored, being the most conservative approach for reestablishing lateral incisor form. Furthermore, it is more affordable than ceramic veneers.<sup>[19]</sup> The presence of caries, however, can increase the need for tooth extraction if the prognosis is poor. In cases of clefts, extraction of a tooth close to a cleft should be avoided whenever possible. This is due to the fact that extraction induces alveolar bone resorption at the site as well as gingival recession of teeth close to the defect.<sup>[10]</sup>

The management of teeth with DI varies according to the extent of the invagination, pulp, and periradicular condition, and the stage of root development. Therapy options include preventive sealing of the invagination, non-invasive root canal treatment, apexification or regenerative endodontic procedures, periradicular surgery, intended replantation, or extraction.<sup>[11]</sup> Because of their limited depth, standard oral hygiene protocols are sufficient for mild cases of Type I DI. Type II DI cases involve a very deep invagination. This may create a significant endodontic complexity when pulp involvement occurs. Conventional endodontic treatment through or near an enamel-lined passage or structure might be challenging. It has thus been proposed that basic preventative measures taken soon after detection may help avoid subsequent difficulties.<sup>[12]</sup> Because every case of DI

is unique, any standardization of treatment approaches is difficult and may not be adequate to cope with all the situations. Therefore, anatomy-based planning is essential for success and requires a good imaging diagnosis. Conventional periapical radiographs are usually of limited diagnostic value because they show only a bi-dimensional view of the very complex anatomy of DI. Cone-beam computed tomography has become an invaluable tool to define the invagination type, establish its three-dimensional spatial relationship with the tooth anatomy and the pulp space, and plan the best treatment strategy. New technologies such as guided endodontics and computer-aided dynamic navigation may be used for planning and more accurate management of DI.<sup>[11]</sup>

## CONCLUSION

The permanent maxillary lateral incisors exhibit a wide range of morphological features, making them one of the most variable teeth in the human dentition (excluding third molars). Peg-laterals and DI are the most frequently observed variations. These variations in the morphology of this tooth can cause issues with oral hygiene, such as food impaction and plaque accumulation, which can increase the risk of dental caries and periodontal disease. In addition, they can also impact speech and affect an individual's self-esteem and confidence. Understanding the unique characteristics and implications of these morphological patterns is crucial for dental professionals to provide appropriate diagnoses and treatment to their patients. Early detection of such variations can help avoid complicated cases in the future, providing benefits to both the patient and the dentist. Moreover, advancements in technology and imaging techniques have the potential to revolutionize both diagnosis and treatment approaches for these variations.

## Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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## Conflicts of interest

There are no conflicts of interest.

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