



## Multiple Shovel Shaped Appearance of Teeth Associated with Dens Invaginatus: A Case Report

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author ZZA designed the study and wrote the first draft of the manuscript. Author ASH managed the literature searches. Author SHH revised the manuscript. All authors read and approved the final manuscript.*

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Case Report

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### **ABSTRACT**

**Introduction:** Shovel appearance of a tooth happens as the highlight of the lateral edges that intertwined with a raised cingulum makes a profound lingual fossa. The ridge fades toward the incisal edge and this gives the tooth a 'shovel' or 'scoop' shape.

**Case Report:** An eight-year-old healthy Malay girl who came for a regular dental check-up at the pediatric dental clinic revealed a shovel appearance of anterior maxillary teeth with various degree upon intra-oral examination. The radiograph showed all teeth exhibit open apex and tooth 12 is associated with the presence of Type I dens invaginatus. Sealing the affected tooth with flowable composite was a good treatment option.

**Conclusion:** A thorough examination, early diagnosis and proper treatment are important to prevent any dental complication that may be associated with these dental anomalies.

*Keywords: Shovel shaped; dens invaginatus; dental anomalies; treatment; management; case report; children.*

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## 1. INTRODUCTION

Shoveling of incisor teeth was first reported by Mühlreiter in 1870 (Mühlreiter 1870) [1]. Shovel appearance was observed in either incisor or canine with a depression in the central and incisal portions accompanied by unusual development of the lateral borders and cingulum of the crown's lingual surface. The maxillary teeth are more common than the mandibular, while permanent is more common than the primary incisor teeth without any gender preferences [2]. Nevertheless, as male generally have a larger tooth, double shoveling was significantly greater in a female. This condition is positively correlated with the mesiodistal diameter, which could be due to the morphogenesis mechanisms, the genes on sex chromosomes, and the levels of sex hormones [3].

Hrdlicka's has classified [1] four variations: (0) no shovel – no perceptible trace of rim and fossa or in which trace of these were so faint or imperfect hence absent of special characterization; (1) trace of shovel – distinct traces of the enamel rim that could not be classed yet as semi-shovel; (2) semi-shovel shaped – the enamel rim was distinct, but the enclosed fossa was shallow, and (3) pronounced shovel shape – the enamel rim with the enclosed fossa were well developed.

Mongoloid dental complex has a high frequency of shovel incisors and has been used as critical indicators for several decades. It can be observed in both living and skeletal materials, and they can be used to show major ethnic differences in dentition [4]. It is considered the most prominent feature in the Mongoloid dentition, with approximately 90% in the Eskimos, American Indians, Pima Indians, and Aleuts. The prevalence is low in European and becomes intermediate in European mixed with Polynesian, Melanesian, and Chinese [2,5]. Among the African and Asian continents, the shoveling incidence is in the range of 5-25% [5-8]. Hence, the identification of shoveling appearance indeed helps in racial identification and the exploration of ancestry.

Dens invaginatus (DI) was first described by a dentist named 'Socrates' in 1858. This refers to a developmental malformation whereby the enamel organ invaginates into the dental papilla during soft tissue development. A number of diverse terms have been utilized to depict this condition, such as 'dens in dente' by Busch in 1897,

suggesting the radiographic appearance of "tooth within a tooth". Hunter in 1951 used the term 'dilated composite odontome', referring to the abnormal dilatation of the dental papilla meanwhile 'gestant anomaly' was proposed Colby (1956) [9,10]. However, DI is the most fitted term since it reflects external part's infoldings (enamel) into the inward part (dentin) with the arrangement of pocket and dead space.

Oehlers, 1957 [8] described the common DI classification. The DI was classified into three categories according to the depth of penetration and communication with the periodontal ligament or periapical tissue determined radiographically from the crown into the root. Type I: The invagination is minimal, and enamel lined. It is confined within the crown of the tooth and does not extend beyond the level of the external amelo-cemental junction. Type II: The invagination is enamel-lined and extends into the pulp chamber but remains within the root canal with no communication with the periodontal ligament. Type III-A: The invagination extends through the root and communicates laterally with the periodontal ligament space through a pseudo-foramen. There is usually no communication with the pulp, which lies compressed within the root. Type III-B: The invagination extends through the root and communicates with the periodontal ligament at the apical foramen. There is usually no communication with the pulp.

According to the literature, DI incidence ranging between 0.04% with approximately 26% involves permanent maxillary lateral incisors and are commonly affected (47%), which is frequently bilateral (43%), and this condition is rare in the canines, premolars, and molar [11-13]. DI has also been found in mandibular teeth, deciduous teeth, and supernumerary [9,13]. The recorded male to female ratio is 3:1 [14]. The most observed DI was Type I (69.8%-79%), followed by type II (15%-26.6%) and type III (3.4%-5%) [10,15].

Besides being an isolated variant of the normal population, the following conditions have been found to be reportedly associated with DI namely microdontia, macrodontia, hypodontia, oligodontia, taurodontism, gemination, fusion, supernumerary teeth, dentinogenesis imperfecta, odontomes, coronal agenesis, shovel shaped incisors, mesiodens, obliterated pulp chambers, C-shaped canal configuration, palatoradicular

groove defect, short root anomaly, dilacerations, albinism, periodontal abscess, multiple root canals, cranial suture syndromes, unicystic ameloblastoma and coronal fractures [16].

Interestingly, the presence of dens invaginatus with other anomalies, including the shovel-shaped teeth may indicate underlying syndrome such as Ekman-Westborg-Julin trait (EWJT) and occurrence of these traits most likely due to the autosomal dominant inheritance pattern [17-19]. The rare occurrence of invaginations in shovel-shaped incisors is 11% with 15% mostly occurred in the lateral incisor compared to 5% in the central incisor [20]. The low incidence of this concurrence condition has led this case report in reporting the preventive management of shovel-shaped tooth with DI in an 8-year-old child.

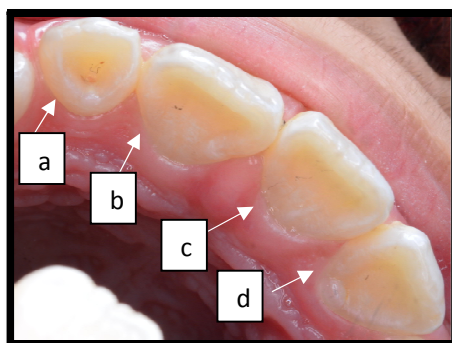
## 2. CASE REPORT

A healthy 8-year-old female was reported to the Paediatric Dental clinic for a regular dental check-up. Her medical and dental history is unremarkable. The father is Malay and the mother is Indonesian. Extra-oral examination revealed no significant findings, whereas the intra-oral examination showed multiple dental caries on the primary and permanent molars and the patient has mixed dentition (all 6's, 12-22, 35-44), ICDAS 02 on teeth 26 and 46, ICDAS 03 on teeth 16 and 36, ICDAS 0 on teeth 53 and 63, ICDAS 06 on teeth 85 and 55, and GIC restoration intact on teeth 54, 64 and 65 [21]. The oral hygiene was fair with mild gingivitis. Further examination disclosed the presence of an anomaly on all permanent anterior maxillary

incisors (Fig. 1). No noticeable abnormalities on the other teeth were disclosed.

Extraoral radiograph was taken for further investigation. The orthopantomogram showed the presence of teeth parallel to the age of the child with anterior maxillary teeth exhibit open apex. However, no periapical lesion was associated with the teeth (Fig. 2a). Intraoral periapical radiograph of tooth 12 revealed radiopaque invaginations from the palatal pits confined to the crowns of the teeth (Fig. 2b). These invaginations were of the enamel-lined minor form, within the confines of the crown and not extending beyond the cemento-enamel junction. This is consistent with the diagnosis of Type I DI [8] with the open apex of the affected tooth. A vitality test was performed, and the teeth were vital. Since no pulp involvement was present, preventive restoration was planned.

Therefore, routine scaling and oral prophylaxis, fissure sealant using Guardian seal™, (KERR™, USA) on teeth 26, 46, 16, 36, and GIC restoration using GIC Fuji IX extra, (GC, Japan) on teeth 85 and 55 are needed. The sealant of tooth 12 was performed using a flowable composite, Revolution Formula 2™, (KERR™, USA) (Fig. 3). The parents and the patient were informed about the condition. Written consent was obtained from the mother to agree with the dental treatment and the use of her records or photographs for publication purposes. A three-month review showed the tooth was clinically (Fig. 4a) and radiographically (Fig. 4b) asymptomatic. The patient is under regular review every three months since the patient is at high risk for caries.



**Fig. 1. The palatal surface of permanent maxillary teeth with varying degrees of shovel appearance, teeth 12, 22 (white arrows a,d) showing class 1 whereas teeth 11, 21 (white arrows b,c) showing class 2**



Fig. 2a. Orthopantomogram showing a mixed dentition stage. Noted an early eruption of mandibular canines and premolars

Fig. 2b. Periapical radiograph of tooth 12 showing Type I DI (white arrow) and open apex (yellow arrow)

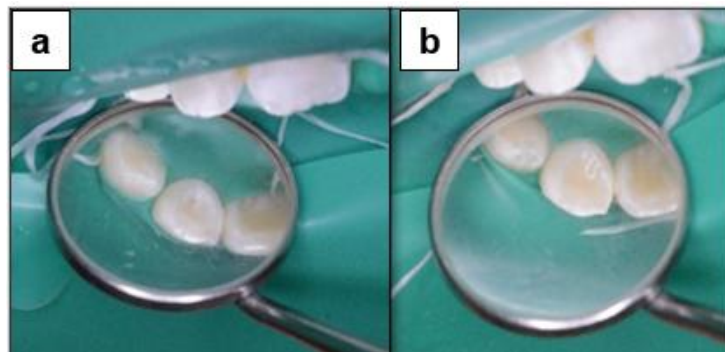


Fig. 3a. Pre-operative photograph of tooth 12 with DI

Fig. 3b. Post-treatment photo of the tooth, which is sealed with flowable composite

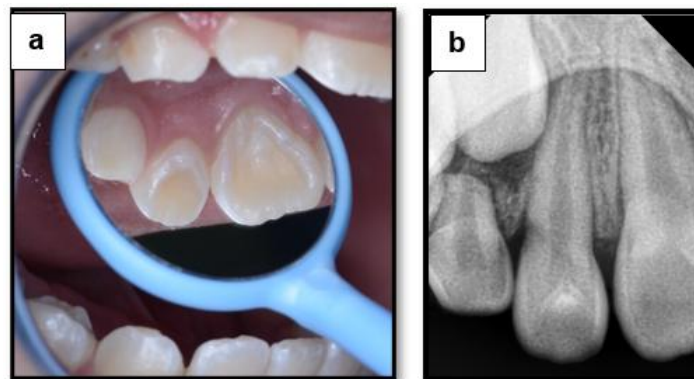


Fig. 4a. Photograph showing the flowable composite is intact after 3-month follow-up

Fig. 4b. Intraoral periapical radiograph of the tooth 12 after three-month follow-up indicating no periapical radiolucency

### 3. DISCUSSION

The morphology variability in the maxillary lateral incisor reflects the interaction of genetic,

epigenetic, and environmental factors [6]. In addition, the maxillary lateral incisor forms in the location of the boundary between the premaxillary (primary palate) and maxillary

processes, and the local factor may relate to the greater variability of the lateral incisor in both size and shape [7].

In DI, the deep invagination allows the entry of irritants into an area separated from pulpal tissue by only a thin layer of enamel and dentine. The narrow lining of the invagination in DI easily retains bacteria, and this condition allows the development of dental caries. In some cases, the enamel-lining is deficient creating channels between the invagination and the pulp. As a result, caries could develop and may lead to infection of the pulp or the periapical tissue. Consequently, pulp necrosis often occurs at early stages, within a few years of eruption, or before root-end closure [17].

Conventional radiographs using two-dimensional (2-D) imaging are routinely used to diagnose DI, which is utilized in this case. However, with the rapid development and widespread use of three-dimensional (3-D) imaging, the root canal anatomy in Type II or III DI or the presence of more than one invagination in a tooth can be effectively analyzed. Capar et al. reported CBCT was significantly able to detect DI compare the panoramic [22]. In addition to that, study from Chen et al, using CBCT to investigate DI, stating that DI was not rare, and clinicians should be aware of its existence [23]. Clinically, the identification of complex invagination of the root canal has been facilitated using a dental microscope. Eventually, this will lead to efficient diagnosis and management of DI cases [13].

Teeth affected by DI were considered to have a poor prognosis and extraction was advocated as the treatment of choice in the 1970s. However, with a greater understanding of the morphology of the invagination and its association with pulp disease, preventive action is recommended [16].

Clinical management of dental anomalies varies case by case. Treatment for DI ranges from conservative restoration to invasive approaches [24,25]. No treatment is required in the absence of any detected entrance to the invagination and when visible clinical and radiographic signs of pathosis are missing [11]. The treatment varies from simple preventive treatment such as fissure sealant in early diagnosed cases to root canal treatment, surgical treatment, intentional replantation, or extraction of the tooth. The tendency is to move toward conservative treatments to avoid imposing unnecessary

operative and radical medical procedures on the patient [13,25]. It has been reported that several immature teeth with DI have been treated successfully by pulp revascularization [13].

For Type I invaginations, early detection and prophylactic sealing of the invagination in minor cases or filling of the invagination in severe cases is the recommended therapy [26]. In this case report, the shovel-shaped tooth with DI, the clinical and 2-D radiograph confirm type I DI with no periapical pathosis. Even though the patient had no symptoms, DI treatment is considered necessary because the susceptibility of invagination may result in immediate or eventual contact with dental pulp [24]. Therefore, sealing the pit is sufficient.

Endodontic therapy may be confined to the invagination to preserve the vitality. The success rate of prophylactic invagination treatment was reported of 100% for type I. and reported 11.3% failure rate for type II for six months or longer in conservative and prophylactic DI treatment [27]. Thus prophylactic management for type I DI is recommended and strict observation is advisable for these treatment options [24,26].

The conventional root canal is the method of choice in the case whereby prophylactic or restorative treatment is not possible due to late detection that may lead to early pulp death of the involved pulpal [28,29]. This method is usually uncomplicated [26,30]. Class I DI is uncommonly seen with a badly deformed root canal, and the access cavity instrumentation can be achieved with Gates Glidden burs or ultrasonic tips [12]. The invagination should be eradicated, and the entire invagination should be incorporated into the access cavity. This can be aided by an operating microscope [16].

Root canal treatment solely may lead to failure due to the complex root canal system in the presence of periapical pathology [31]. Hence, using the aid of CBCT to confirm the complex morphology of canal primarily type III DI presented with symptomatic periapical lesion, peri invagination periodontitis, the contemporary endodontic materials, an operating microscope, and MTA can successfully treat the tooth with DI [32-34]. Nevertheless, based on clinical symptoms, crown and root morphology, or prosthetic and esthetic conditions, treatment can be either a nonsurgical or surgical approach or a combination of both [34].

#### 4. CONCLUSION

A thorough clinical inspection and good radiographic knowledge are vital for early detection and treatment of a shovel-shaped tooth with DI. A follow up is mandatory to prevent a failure rate that will eventually bring serious complications such as pulp necrosis and periodontitis, or cystic changes that may occur even in the absence of caries.

#### CONSENT

All authors declare that 'written informed consent was obtained from the parents for publication of this case report and accompanying images'.

#### ETHICAL APPROVAL

As per international standard or university standard, written ethical approval has been collected and presented by the author(s).

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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