Dens invaginatus: aetiology, classification, prevalence, diagnosis, and treatment considerations

M. HÜLSMANN

Department of Operative Dentistry, Zentrum ZMK, University of Göttingen, Göttingen, Germany

Summary

Dens invaginatus is a malformation of teeth probably resulting from an infolding of the dental papilla during tooth development. Affected teeth show a deep infolding of enamel and dentine starting from the foramen coecum or even the tip of the cusps and which may extend deep into the root. Teeth most affected are maxillary lateral incisors and bilateral occurrence is not uncommon. The malformation shows a broad spectrum of morphologic variations and frequently results in early pulp necrosis. Root canal therapy may present severe problems because of the complex anatomy of the teeth. Aetiology, prevalence, classification, and therapeutic considerations including root canal therapy, apical surgery and prevention of pulpal involvement are reviewed.

Keywords: dens invaginatus, endodontic treatment.

Introduction

Dens invaginatus (Fig. 1a–c) is a rare malformation of teeth, showing a broad spectrum of morphological variations. The affected teeth radiographically show an infolding of enamel and dentine which may extend deep into the pulp cavity and into the root and sometimes even reach the root apex (Fig. 2a–c). Tooth crowns as well as roots may exhibit variations in size and form. This kind of tooth malformation was described first by Ploquet in 1794 (Schaefer 1955), who discovered this anomaly in a whale’s tooth (Westphal 1965).

Dens invaginatus in a human tooth was first described by a dentist named ‘Socrates’ in 1856 (Schulze 1970). In 1873 Mühlreiter reported on ‘anomalous cavities in human teeth’. Baume in 1874 and Busch in 1897 published on this malformation. In 1887 Tomes described the dens invaginatus in his textbook A System of Dental Surgery, as follows: ‘The enamel investing the crown may be, and often is, perfectly well-developed; but we shall find at some point a slight depression, in the centre of which is a small dark spot. If the tooth be divided through its long axis, we shall find that the dark centre of the depression is in fact the chocked-up orifice of a cavity situated within the substance of the tooth, external, however, and perfectly unconnected with the pulp-cavity. If the section be a fortunate one, we shall be able to trace the enamel as it is continued from the exterior of the tooth through the orifice into the cavity, the surface of which is lined more or less completely with this tissue’ (Tomes 1887).


Synonyms for this malformation are: Dens in dente, invaginated odontome, dilated gestant odontome, dilated composite odontome, tooth inclusion, dentoid in dente.

Fig. 1 (a) SEM; (b) microscopic and (c) radiographic appearance of a dental invagination. The invagination is completely filled with debris. At the bottom of the invagination the enamel is missing.

Fig. 2 (a) Invagination in the maxillary left lateral incisor. The invagination is limited to the tooth crown. The malformation was detected by chance. (b) Invagination in the maxillary left lateral incisor. The invagination is extending into the root. At the bottom of the invagination the enamel is missing. The invagination was suspected because of dysmorphic, peg-shaped tooth crown anatomy. (c) Severe case of dens invaginatus with open apex, diverging root and bizarre form of the invagination with a separate apical opening. The malformation was detected because of retarded tooth eruption of tooth 12.
Aetiology of dens invaginatus

The aetiology of dens invaginatus malformation is controversial and remains unclear. Over the last decades several theories have been proposed to explain the aetiology of dental coronal invaginations:

- Growth pressure of the dental arch results in buckling of the enamel organ (Euler 1939, Atkinson 1943).
- Kronfeld (1934) suggested that the invagination results from a focal failure of growth of the internal enamel epithelium while the surrounding normal epithelium continues to proliferate and engulfs the static area.
- Rushton (1937) proposed that the invagination is a result of rapid and aggressive proliferation of a part of the internal enamel epithelium invading the dental papilla. He regarded this as a 'benign neoplasma of limited growth'.
- Oehlers (1957a,b) considered that distortion of the enamel organ during tooth development and subsequent protrusion of a part of the enamel organ will lead to the formation of an enamel-lined channel ending at the cingulum or occasionally at the incisal tip. The latter might be associated with irregular crown form.
- The 'twin-theorie' (Bruszt 1950) suggested a fusion of two tooth-germs.
- Infection was considered to be responsible for the malformation by Fischer (1936) and Sprawson (1937).
- Gustafson & Sundberg (1950) discussed trauma as a causative factor, but could not sufficiently explain why maxillary lateral incisors were affected and not central incisors.

Most authors, meanwhile, consider dens invaginatus as a deep folding of the foramen coecum during tooth development which in some cases even may result in a second apical foramen (Schulze 1970). On the other hand the invagination also may start from the incisal edge of the tooth. Genetic factors cannot be excluded (Grahnen 1962, Casamassimo et al. 1978, Ireland et al. 1987, Hosey & Bedi 1996).

Classification of dens invaginatus

The first classification of invaginated teeth was published by Hallet (1953). The most commonly used classification proposed by Oehlers (1957a) is shown in Fig. 3. He described the anomaly occurring in three forms:

Type I: an enamel-lined minor form occurring within the confines of the crown not extending beyond the amelocemental junction.

Type II: an enamel-lined form which invades the root but remains confined as a blind sac. It may or may not communicate with the dental pulp.

Type III: a form which penetrates through the root perforating at the apical area showing a 'second foramen' in the apical or in the periodontal area. There is no immediate communication with the pulp. The invagination may be completely lined by enamel, but frequently cementum will be found lining the invagination.

Oehlers (1957a,b) also described different crown forms (normal with a deep lingual or palatal pit; conical, barrel-shaped or peg-shaped with an incisal pit) relating to the three groups mentioned above. In addition, Ulmansky & Hermel (1964) and Vincent-Townend (1974) described an 'incipient dens in dente', a deep palatal or lingual pit completely lined by enamel with no communication to the pulp. Oehlers (1958) also presented radicular invaginations.

Schulze & Brand (1972) proposed a more detailed classification (Fig. 4), also including invaginations starting at the incisal edge or the top of the crown and also including dysmorphic root configurations.

Prevalence of dens invaginatus

A summary of the results of investigations on the prevalence of invaginated teeth is presented in Table 1. It is difficult to compare findings because of the differences in study design, sample size and composition, and diagnostic criteria. The teeth most affected are maxillary lateral incisors and bilateral occurrence is not uncommon and occurs in 43% of all cases (Grahnen et al. 1959).
Swanson & McCarthy (1947) were the first to present bilateral dens invaginatus malformation, Conklin (1968) presented a patient with all maxillary central and lateral incisors affected, and Burton et al. (1980) published a case with six teeth involved, the maxillary incisors and also the maxillary canines. Krolls (1969) detected dental invaginations in maxillary central incisors as well as in several maxillary and mandibular bicuspids in one patient. Conklin (1978) found the anomaly in four mandibular incisors in one patient. Double invaginations in one tooth were reported by Rushton (1937), Archer & Silverman (1950), Oehlers (1957a), Grahnen et al. (1959), Ulmansky & Hermel (1964), Schulze & Brand (1972), Brill & Phillips (1974), Bhatt & Dholakia (1975), Conklin (1975), Cole et al. (1978), Gotoh et al. (1979), Mader (1979), Rotstein et al. (1987a), and Vairabhaya (1989). Triple invaginations were described by Hitchin & McHugh (1954) and Mader (1977). In rare cases even primary teeth seem to be affected (Rabinowitch 1952).

Cases of dental invaginations in supernumerary teeth have been presented as well as in canines and bicuspids (Archer & Silverman 1950, Schwenzer 1957, Kruse 1962, Klamm 1969, Conklin 1975, Banner 1978).

Table 1  Investigations on the prevalence of dens invaginatus

<table>
<thead>
<tr>
<th>Author/Country</th>
<th>Year</th>
<th>Sample</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mühlreiter (Austria)</td>
<td>1873</td>
<td>500 extracted lateral maxillary incisors (histological investigation)</td>
<td>2.8% of teeth</td>
</tr>
<tr>
<td>Atkinson (USA)</td>
<td>1943</td>
<td>500 lateral maxillary incisors</td>
<td>10% of teeth</td>
</tr>
<tr>
<td>Boyne (USA)</td>
<td>1952</td>
<td>1000 maxillary incisors</td>
<td>0.3% of teeth</td>
</tr>
<tr>
<td>Stephens (unknown)</td>
<td>1953</td>
<td>150 full-mouth surveys</td>
<td>8%</td>
</tr>
<tr>
<td>Shafer (USA)</td>
<td>1953</td>
<td>1000 patients</td>
<td>3.6% (cited by Hovland &amp; Block 1977)</td>
</tr>
<tr>
<td>Hallet (unknown)</td>
<td>1953</td>
<td>2542 full-mouth surveys</td>
<td>1.3% of patients (cited by Hovland &amp; Block 1977)</td>
</tr>
<tr>
<td>Amos (USA)</td>
<td>1955</td>
<td>586 full-mouth surveys</td>
<td>0.5% of maxillary central incisors (cited by Hovland &amp; Block 1977)</td>
</tr>
<tr>
<td>Grahnen et al. (Sweden)</td>
<td>1959</td>
<td>1000 full mouth surveys</td>
<td>5.1% of patients</td>
</tr>
<tr>
<td></td>
<td></td>
<td>203 full mouth surveys</td>
<td>6.9% (students of dentistry)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3020 right maxillary incisors</td>
<td>2.7% of patients</td>
</tr>
<tr>
<td>Ulmansky &amp; Hermel (Israel)</td>
<td>1964</td>
<td>500 full mouth surveys</td>
<td>2% of patients</td>
</tr>
<tr>
<td>Poyton &amp; Morgan (Canada)</td>
<td>1966</td>
<td>5000 full mouth surveys</td>
<td>0.25% of patients (cited by Hovland &amp; Block 1977)</td>
</tr>
<tr>
<td>Miyoshi et al. (Japan)</td>
<td>1971</td>
<td>extracted maxillary lateral incisors</td>
<td>38.5% of teeth (cited by Gotoh et al. 1979)</td>
</tr>
<tr>
<td>Fujiki et al. (Japan)</td>
<td>1974</td>
<td>2126 lateral maxillary incisors</td>
<td>4.2% of teeth (cited by Gotoh et al. 1979)</td>
</tr>
<tr>
<td>Thomas (USA)</td>
<td>1974</td>
<td>1886 full mouth surveys</td>
<td>7.74% of patients</td>
</tr>
<tr>
<td>Gotoh et al. (Japan)</td>
<td>1979</td>
<td>766 lateral maxillary incisors</td>
<td>9.66% of teeth</td>
</tr>
<tr>
<td>Ruprecht et al. (Saudi Arabia)</td>
<td>1986</td>
<td>1581 full mouth surveys</td>
<td>1.7% of patients</td>
</tr>
<tr>
<td>Ruprecht et al. (Saudi Arabia)</td>
<td>1987</td>
<td>300 full mouth surveys</td>
<td>10% of patients</td>
</tr>
</tbody>
</table>

Histological findings

Several reports on microscopic, ultrastructural and microradiographic investigations of teeth with a dens invaginatus malformation show a wide range of findings and thus reproduce the macroscopic variety of this anomaly. The dentine below the invagination may be intact without irregularities (Brabant & Klees 1956, Omnell et al. 1960, Piatelli & Trisi 1993) but also may contain strains of vital connective tissue (Omnell et al. 1960) or even fine canals with communication to the dental pulp (Kronfeld 1934, Fischer 1936, Hoepfel 1936, Gustafson & Sundberg 1950, Hitchin & McHugh 1954, Oehlers 1957a, Rushton 1958). Some authors reported hypomineralized or irregularly structured dentine (Omnell et al. 1960, Vincent-Townend 1974, Beynon 1982). The structure and thickness of the enamel lining the invagination also may vary widely. The enamel was described as irregularly structured by Atkinson (1943), Beynon (1982) and Piatelli & Trisi (1993). Beynon (1982) reported hypomineralized enamel at the base of the invagination whereas Morfis (1992), in a chemical analysis, detected up to eight times more phosphate and calcium compared with the outer enamel, but in his analysis magnesium was missing completely. Bloch-Zupan et al. (1995) found differences in structure and composition between the external and internal enamel. The internal enamel exhibited atypical and more complex rod shapes and its surface presented the typical honeycomb pattern but no perikymata, which, however, were observed on the outer surface of the tooth.

Diagnosis of dens invaginatus

In most cases a dens invaginatus is detected by chance on the radiograph. Clinically, an unusual crown morphology (‘dilated’, ‘peg-shaped’, ‘barrel-shaped’) or a deep foramen coecum may be important hints, but affected teeth also may show no clinical signs of the malformation. As maxillary lateral incisors are the teeth most susceptible to coronal invaginations these teeth should be investigated thoroughly clinically and radiographically, at least in all cases with a deep pit at the foramen coecum. If one tooth is affected in a patient the contralateral tooth should also be investigated. As pulpal involvement of teeth with coronal invaginations may occur a short time after tooth eruption early diagnosis is mandatory to instigate preventive treatment.

Clinical features

The invagination allows entry of irritants into an area which is separated from pulp tissue by only a thin layer of enamel and dentine and presents a predisposition for the development of dental caries. In some cases the enamel-lining is incomplete (Fig. 1). Channels may also exist between the invagination and the pulp (Kronfeld 1934, Hitchin & McHugh 1954). Therefore, pulp necrosis often occurs rather early, within a few years of eruption, sometimes even before root end closure (Swanson & McCarthy 1947, Umlansky & Hermel 1964, Stepanik 1968, Ferguson et al. 1980, Morfis & Lentzari 1989, Nik-Hussein 1994, Hülsmann & Radlanski 1994) (Fig. 5a, b). Other reported sequelae of undiagnosed and untreated coronal invaginations are abscess formation (Schaefer 1955, Petz 1956, Kendrick 1971, Greenfield & Cambruzzi 1986, Chen et al. 1990, Whyman & McFayden 1994), retention of neighbouring teeth (Schaefer 1955, Petz 1956, Conklin 1975, Mader 1977), displacement of teeth (Schaefer 1955, Petz 1956), cysts (Rebel & Rohmann 1934, Schwenzer 1957, Conklin 1978, Klammt 1969, Burzynski 1973, Saminy 1977, Murphy & Doku 1977, Augsburger & Brandebura 1978, Greenfield & Cambruzzi 1986), and internal resorption (Shapiro 1970, Hülsmann & Radlanski 1994) (Fig. 6).

The dental literature on dens invaginatus malformations contains several case reports presenting invaginated teeth coincident with other dental anomalies, malformations and even dental or medical syndromes (Table 2).

Treatment considerations

Preventive and restorative treatment

Teeth with deep palatal or incisal invaginations or foramina coeca should be treated with fissure sealing before carious destruction can occur. A composite restoration and strict periodic review is recommended (Rotstein et al. 1987b, Hülsmann & Radlanski 1994). If no entrance to the invagination can be detected and no signs of pathosis are visible clinically and radiographically no treatment is indicated, but strict observation is recommended (Hülsmann 1995b, Duckmanton 1995, Hülsmann 1996).
Root canal treatment

A review of the literature shows that extraction of teeth with invaginations was the preferred therapy until the 1970s (Hülsmann 1995a). Grossman (1974) and Creaven (1975) were the first to describe root canal treatment of the invagination only (root invagination treatment) and Tagger (1977) and Hovland & Block (1977) the first to present cases treated with conventional root canal therapy (Fig. 7a,b). Root canal treatment may present several problems because of the irregular shape of the root canal system(s). If there are no radiographic signs of pulp pathosis and no communication between the invagination and the root canal, root canal treatment or, in minor cases, even a composite or amalgam filling of the invagination will be adequate (DeSmit & Demaut 1982). When the invagination has a separate apical or lateral foramen, root canal treatment of the invagination is indicated (Grossman 1974, Creaven 1975, Bolanos et al. 1988, Szajkis & Kaufman 1993, Wells & Meyer 1993, Ikeda et al. 1995). In some cases it may be possible to bur through the invagination to get access to the apical foramen. When these minor forms of invaginations are eliminated root canal therapy in most cases will not present further problems. In certain cases the invagination has to be treated as a separate root canal (Cole et al. 1978, Zillich et al. 1983, Eldeeb 1984, Greenfield & Cambruazzi 1986, Mangani & Ruddle 1994, Khabbaz et al. 1995).

When pulp necrosis occurs before root-end closure, apexification procedures with calcium hydroxide may be necessary (Ferguson et al. 1980, Morfis & Lentzari 1989, Vairabhaya 1989, Hülsmann & Radlanski 1994, Nagatani et al. 1995) (Fig. 5a–c).

Table 2 Dental anomalies described in association with dens invaginatus

<table>
<thead>
<tr>
<th>Anomaly</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microdontia</td>
<td>Casamassimo et al. 1978</td>
</tr>
<tr>
<td>Macroodontia</td>
<td>Ekman-Westberg &amp; Julin 1974</td>
</tr>
<tr>
<td>Hypodontia</td>
<td>Hülsmann 1995c</td>
</tr>
<tr>
<td>Oligodontia</td>
<td>Conklin 1978, Ruprecht et al. 1986</td>
</tr>
<tr>
<td>Amelogenesis imperfecta</td>
<td>Kerebel et al. 1983</td>
</tr>
<tr>
<td>Invagination in an odontome</td>
<td>Hitchin &amp; McHugh 1954</td>
</tr>
<tr>
<td>Multiple odontomes</td>
<td>Robbins &amp; Keene 1964</td>
</tr>
<tr>
<td>Coronal agenesis</td>
<td>Hics &amp; Flaitz 1985</td>
</tr>
<tr>
<td>Williams syndrome</td>
<td>Oncag et al. 1995</td>
</tr>
</tbody>
</table>
The large and irregular volume of the root canal system makes proper shaping and cleaning difficult. Irrigation, supported by ultrasonic cleaning of the root canal system has been described as an efficient means of disinfection (Cunningham et al. 1982) and has therefore been recommended for cleaning of the complex morphology of the root canal system in teeth with dens invaginatus (Skoner & Wallace 1994). For obturation of such teeth warm gutta-percha techniques including vertical condensation or thermoplastic filling techniques have been recommended (Rotstein et al. 1987b, Hülsmann & Radlanski 1994, Mangani & Ruddle 1994).

**Surgical treatment**

Surgical treatment should be considered in cases of endodontic failure and in teeth which cannot be treated non-surgically because of anatomical problems or failure to gain access to all parts of the root canal system (Harnisch 1970, Hata & Toda 1987, Teplitsky & Singer 1987, Rotstein et al. 1987b, Kulild & Weller 1989, Suchina et al. 1989, Hülsmann & Radlanski 1994, Benenati 1994, Olmez et al. 1995) (Fig. 8a,b). Cole et al. (1978) and Lindner et al. (1995) even proposed intentional replantation with retrograde surgery in otherwise hopeless cases.

---

Fig. 6 (a) Pulp necrosis, apical periodontitis, sinus tract, and lateral resorptive perforation in tooth 12 showing a dens invaginatus malformation. (b) Clinical view of the tooth crown of the same tooth before treatment. A deep foramen coecum with caries is visible. (c) After preparation of the access cavity the entrance to the invagination is visible at the palatal aspect (arrow). The main root canal orifice can be seen at the top of the cavity at the buccal aspect.
Fig. 7  (a) Right maxillary lateral incisor in the same patient as in Fig. 5. The invagination was detected by preventive radiographic examination, clinically no invagination nor carious lesion were detected. The invagination has resulted in an internal resorption with perforation. (b) Obturation with injectable gutta-percha, resulting in a slight lateral overfill.

Fig. 8  (a) Radiograph of tooth 23 showing a bizarre lateral coronal invagination which seems to be open to the lateral periodontium. The main root canal was root canal treated, but no communication to the invagination could be detected. (b) As no access to the invagination was found coronally the invagination was treated surgically. Probably root canal treatment of the main root canal would not have been necessary.
Extraction

Extraction is indicated only in teeth with severe anatomical irregularities that cannot be treated non-surgically or by apical surgery, and in supernumerary teeth (Figs 9a,b and 10). Additionally Rotstein et al. (1987b) advocated extraction when abnormal crown morphology presents aesthetic or functional problems.

References

diagnosis, and treatment options. Poster-presentation, 6th ESE-
Congress, Tel Aviv, 1995.


HÜLSMANN M, RADLANSKI R (1994) Möglichkeiten der konservativen
Therapie des Dens invaginatus. Deutsche Zahnärztliche Zeitschrift 49,
804–8.

IKEDA H, YOSHOKA T, SUEDA H (1995) Importance of clinical examina-
tion and diagnosis. Oral Surgery, Oral Medicine and Oral Pathology 79,
88–91.

IRELAND JE, BLACK JP, SCURES CC (1987) Short roots, taurodontia and

KENDRICK JK (1971) Periapical abscess from dens in dente. Oral

imperfecta with dens in dente. Oral Surgery, Oral Medicine and Oral
Pathology 55, 279–85.

KHABAZ MG, KONSTANTAKI MN, SYKARAS SN (1995) Dens invagi-
natus in a mandibular lateral incisor. International Endodontic

KITCHEN PC (1935) Dens in dente. Journal of Dental Research 15,
117–21.

KLAMAT J (1969) Dens invaginatus und Zyste. Deutsche Zahn-, Mund-
und Kieferheilkunde 53, 336–47.


KRONFELD R (1934) Dens in dente. Journal of Dental Research 14,
49–66.

Deutsche Zahnärztliche Zeitschrift 17, 1532–5.

KÜNZEL W (1956) Bilaterales Vorkommen des Dens in dente.
Zahnärztliche Praxis 7, 1–2.

KULILD JC, WELGER N (1989) Treatment considerations in dens invagi-

LEIBRICH F, WUSTROW P (1920) Zwei Fälle einer eigenartigen Zahnmhi-
bildung. Deutsche Monatschrift für Zahnheilkunde 38, 15–22.


LINGAR A (1955) Über die Genese des ‘Dens in dente’. Österreichische

MADER C (1977) Triple dens in dente. Oral Surgery, Oral Medicine and
Oral Pathology 44, 966.

MADER C (1979) Double dens in dente in a geminated tooth. Oral

MADER CL, ZIELKE DR (1982) Incomplete dens in dente in a fused

MANGANI F, RUDDLE CJ (1994) Endodontic treatment of a ‘very partic-

MILLER WD (1901) Einige seltene Zahnanomalien. Deutsche Zeitschrift
für Zahnheilkunde 10, 397–410.

MIYOSHI S, FUJWARA J, NAKATA T, YAMAMOTO K, DEGUCHI K (1971)
Biology 13, 539–44.

MORFIS AS (1992) Chemical analysis of a dens invaginatus by S.E.M.
microanalyses. Journal of Clinical Pediatric Dentistry 17, 79–82.


MÜHLREITER E (1873) Die Natur der anomalen Höhlenbildung im
oberen Seitenzahngebilde. Deutsche Zeitschrift für Zahnheilkunde 13,
367–72.


NAGATANI T, HIRABAYASHI M, OSADA T (1995) Introduction of root-
end closure for traumatized immature tooth with Dens invaginatus

NICK-HUSSAIN NN (1994) Dens invaginatus: Complications and treat-
ment of non-vital infected tooth. Journal of Clinical Pediatric Dentistry
18, 303–6.

OEHLERS FA (1957a) Dens invaginatus. I. Variations of the invagin-
ation process and associated anterior crown forms. Oral Surgery, Oral
Medicine and Oral Pathology 10, 1204–18.

OEHLERS FA (1957b) Dens invaginatus. II. Associated posterior crown
Pathology 10, 1302–16.

OEHLERS FA (1958) The radicular variety of dens invaginatus. Oral

central incisor: surgical endodontic treatment. Journal of Clinical
Pediatric Dentistry 20, 53–6.

OMNEILL KA, SWANBECK GL, LINDAH L (1960) Dens invaginatus. II. A
microradiographical, histological and micro X-ray diffraction study.

Clinical Pediatric Dentistry 19, 301–4.

PECORA JD, CONRADO CA, ZUCOLOTTO WG, SOUSA NETO MD, SAUYY PC
(1993) Root canal therapy of an anomalous maxillary central incisor:
a case report. Endodontics and Dental Traumatology 9, 260–2.

PETZ R (1956) Beitrag zum ‘Dens in dente’. Deutsche Zahnmedizin 6,
100–5.

PIATELLI A, TRISI P (1993) Dens invaginatus: a histological study of
undermineralized material. Endodontics and Dental Traumatology 9,
191–5.

POYTON GH, MORGAN GA (1966) Dens in dente. Dental Radiography

RABINOWITCH BZ (1952) Dens in dente: primary tooth. Report of a

REBEL HH, ROHMANN C (1934) ‘Dens in dente’. Deutsche Zahnärztliche
Wochenschrift 37, 83–5.

ROBBINS IM, KEENE HJ (1964) Multiple morphologic dental anomalies.

ROSTEIN I, STARBOHL A, FREIDMAN S (1987a) Endodontic therapy for
dens invaginatus in a maxillary second premolar. Oral Surgery, Oral

ROSTEIN I, STARBOHL A, HELING I, FREIDMAN S (1987b) Clinical
considerations in the treatment of dens invaginatus. Endodontics and
Dental Traumatology 3, 249–54.


significance of dental invagination. Journal of Pedodontics 11,
176–81.


RUSHTON MA (1958) Invaginated teeth (dens in dente): Contents of the
invagination. Oral Surgery, Oral Medicine and Oral Pathology 11,
1378–87.

Quintessence International 8, 91–2.

SCHAEFER H (1953) Über das Vorkommen des ‘dens in dente’.
Schweizer Monatschrift für Zahnmedizin 63, 779–87.

SCHAEFER H (1955a) Über das Vorkommen des Dens in dente. Deutsche
Zahnärztliche Zeitschrift 10, 988–93.

SCHLIZE C (1970) Developmental abnormalities of the teeth and the


