Radiation Induced Hypoplasia of the Mandible and Retarded Tooth Development

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ABSTRACT
Few cases of radiation-induced damage to the teeth and jaws, have been reported in the literature. Radiation therapy plays an important role in the treatment of patients affected with head and neck cancer. In spite of its recognized benefits in the treatment of malignant tumors, radiation therapy has several side-effects in the head and neck region. This paper highlights a case report where hypoplasia of the mandible, trismus and stunted permanent teeth roots were observed in an 18-year-old patient who was diagnosed with parameningeal rhabdomyosarcoma—embryonal type group III at the age of 5 years. He had received radiation therapy of 50 Gy to the nasopharynx for about 1 year and was reviewed for a period of 11 years. Full mouth periapical radiographs and panoramic radiograph revealed hypoplasia of the mandible and generalized hypoplasia of the roots of the permanent teeth.

Keywords: Dentin dysplasia, Radiotherapy, Rhabdomyosarcoma, Trismus.

INTRODUCTION
Radiation therapy may be effective alternative to surgery or a valuable adjuvant therapy to surgery and/or chemotherapy in the treatment and locoregional control of malignant head and neck tumors. The adverse effects of irradiation on human adult and developing teeth has been documented widely, which are usually confined to the radiation site. These manifestations may become apparent only after a number of years. We report a case of an 18-year-old patient who, after receiving radiation treatment for rhabdomyosarcoma at the age of 5 years, had hypoplasia of the mandible and stunted roots of all permanent teeth.

CASE REPORT
An 18-year-old male patient reported to the Department of Oral Medicine and Radiology, Dr Syamala Reddy Dental College, Hospital and Research Center, Bengaluru, India with a chief complaint of difficulty in opening his mouth since childhood. Difficulty in mouth opening was first noted in childhood and there was no further reduction in mouth opening. His medical reports from the cancer institute (WIA), Madras revealed that he had parameningeal rhabdomyosarcoma—embryonal type, group III, for which he received radiation therapy of 50 Gy to the nasopharynx for a period of about 1 year at the age of five and he was reviewed for about 11 years. There has been no recurrence of the tumor. He revealed a history of lower left back tooth extraction, four years back.

On general physical examination, the patient was physically small, with a height of 157 cm and weight of 57 kg. He had convex profile with receded chin (Fig. 1). The regional lymph nodes were not palpable. Intraoral hard tissue examination revealed (Fig. 2) (a) midline diastema, (b) generalized enamel hypoplasia, (c) class III moderate dental caries in right maxillary permanent central
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Fig. 2: Intraoral photograph showing midline diastema, generalized enamel hypoplasia, class III dental caries in 11 and 32 incisor and left mandibular permanent lateral incisor, (d) reduced mouth opening of 24 mm, (e) grossly decayed right mandibular permanent first molar, (f) grade III mobile mandibular left second premolar, (g) partially erupted mandibular left permanent second molar and (h) missing right and left maxillary permanent second molar, left mandibular permanent first molar and right mandibular permanent second molar were found. On soft tissue examination, he had generalized gingival inflammation.

Patient full mouth IOPAR (Fig. 3) revealed (a) generalized stunted roots with all permanent teeth, (b) grossly destructed right mandibular permanent first molar, (c) missing left permanent first molar, (d) impacted bilateral maxillary and right mandibular permanent second molar and (e) absence of third molar tooth bud.

Patient’s orthopantomograph (Fig. 4) revealed (a) hypoplasia of the mandible, (b) bilateral hypoplasia of the condyle, (c) deep sigmoid notch bilaterally, (d) reduced vertical height of the ramus bilaterally, (e) stunted roots with all permanent teeth, (f) grossly destructed right mandibular permanent first molar, (g) missing left permanent first molar, (h) bilaterally impacted maxillary and right mandibular permanent second molar, and (i) absence of third molar tooth bud.

On the basis of radiographic findings, a radiographic differential diagnosis of (a) radiation induced changes and hypothyroidism for mandibular micrognathia and type I dentin dysplasia, (b) radiation induced changes, (c) hypothyroidism and (d) hypoparathyroidism for stunted root was considered.

He was subjected to complete hemogram, serum calcium, phosphorus, alkaline phosphatase, and thyroid and parathyroid hormone analysis, and except the alkaline phosphatase (157 IU/L) and parathyroid hormone levels (66.3 pg/ml), all other factors were within normal limits. He underwent scaling and extraction of grade III mobile mandibular left second premolar and grossly decayed right mandibular permanent first molar, which was subjected to tooth sectioning. Histopathological report revealed that the radicular dentin appears disorganized with very minimal tubular architecture. The root also appears to be shortened. Pulp space appears to be obliterated and has a crescent shape. The histopathological features (Fig. 5) were suggestive of dentin dysplasia.

DISCUSSION

Radiation therapy may be either an effective alternative to surgery or a valuable adjuvant therapy to surgery and/or chemotherapy in the treatment and locoregional control of malignant head and neck tumors. In addition to antitumor effects, ionizing irradiation causes damage in normal tissues located in the field of radiation (Table 1). This becomes particularly evident in the head and neck region; a complex area composed of several dissimilar structures that respond differently to radiation.

The effects that early irradiation can have on the development and eruption of teeth in humans are related to dosage, period of exposure, stage of tooth development, and the proximity of the teeth to the center of maximum dosage. It has been ascertained that if the radiation precedes the stages of morphodifferentiation and calcification, the tooth bud may be destroyed. Irradiation at a later stage, after calcification has been initiated, may alter cellular differentiation causing malformations or arrested growth. Deleterious effects on undeveloped and developing teeth are observed even when lower dosages are used. Animal studies suggest that the teeth are most vulnerable before histodifferentiation, and that this susceptibility ceases once calcification is complete. The effects may include:

a. Complete absence of teeth
b. Arrested tooth formation
c. Microdontia
d. Altered morphology of the crown
e. Shortness and tapering of roots
f. Narrowing of the pulp canal
g. Widening of the periodontal membrane
h. Delayed tooth eruption.

Takinami S et al (1994) reported a case of hypoplasia of the mandible and teeth, in a 4-year-old boy who had cystic hygroma. At the age of 7 months, he had been treated with radiation followed by surgery. The jaws were included in the radiation field. He was
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Table 1: Depicts the immediate and late adverse effects at different doses of radiotherapy

<table>
<thead>
<tr>
<th>Dose</th>
<th>Radiation effects</th>
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<tr>
<td>4-16 Gy</td>
<td>Radiation dosages to the tooth buds and mandibular growth center cause premature apical closure and hypoplasia of roots of teeth (Lines et al, 1979)</td>
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<tr>
<td>10 Gy</td>
<td>Histologically, taste buds showed signs of degeneration and atrophy (Conger, 1973), mature ameloblasts are permanently damaged (Kaste et al, 1994)</td>
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<td>15 Gy</td>
<td>Within 3 days after irradiation with a single dose, a decrease in salivary flow by nearly 50% can be observed (Vissink et al, 1990; Peter et al, 1995; Coppes et al, 1997 a, b, 2001; Zielstra et al, 2000)</td>
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<tr>
<td>&lt; 30 Gy</td>
<td>Damage to salivary gland is reversible to certain level (Dreyer et al, 1989)</td>
</tr>
<tr>
<td>30 Gy</td>
<td>Taste sensation decreases exponentially, after which it becomes virtually absent (Conger, 1973), Halt’s tooth development at the point of maturation at which the teeth are irradiated (Kaste et al, 1994)</td>
</tr>
<tr>
<td>60 Gy</td>
<td>Extent of reduced flow is dose dependent and reaches essentially zero (White SC and Pharaoh MJ, Oral Radiology (5th ed), 2004)</td>
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<tr>
<td>&gt; 65 Gy</td>
<td>Spontaneous osteoradionecrosis reported to occur in almost 35% of cases (Murray et al, 1980a; Marx, 1983a,b; Marx and Johnson, 1987; Kluth et al, 1988; Constantino et al, 1995; Glanzmann and Grätz, 1995; Curi and Dib, 1997; Tong et al, 1999; Thorn et al, 2000)</td>
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<tr>
<td>&gt; 75 Gy</td>
<td>Extensive degeneration of acini, along with inflammation and fibrosis in the interstitium (Dreyer et al, 1989)</td>
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followed up for 13 years and at the age of 12, the panoramic and periapical radiographs revealed hypoplasia of the roots of permanent teeth, microdontia and premature exfoliation of primary teeth.8

It is generally agreed that dental pulp undergoes a decrease in vascularity with fibrosis and atrophy. Clinically, the pulp response to infection, trauma and dental procedures appears to be compromised, yet pulpal pain is less severe even in the presence of gross dental caries and obvious pulp exposure.8

Trismus may develop due to tumor invasion of the masticatory muscles and/or temporomandibular joint (TMJ), or be the result of radiotherapy if masticatory muscles and/or TMJ is included in the field of radiation, or a combination of both.2,6-8 Generally, trismus develops three to six months after radiation treatment is completed, and frequently becomes a lifelong problem.2,6,7 Trismus is attributed to muscle fibrosis and scarring in response to radiation injury, as well as to fibrosis of the ligaments around the TMJ and scarring of the pterygomandibular raphe.8 Severity of trismus is dependent on the configuration of the radiation field (unilateral or bilateral), the radiation source, and the radiation dose.2 A sudden increase in the trismus may indicate recurrent disease.6

CONCLUSION

Professional follow-up supervision is a key element of successful long-term dental health maintenance after radiotherapy.8 The sequelae of oncotherapy may be as challenging to treat as the disease for which the therapy was used.3 Radiologists can help direct the care of long-term survivors, by recognizing late side effects and providing guidance for dental, medical and surgical restoration of altered odontogenesis in these children.3,8

REFERENCES


Fig. 5: Photomicrograph (25X) showing disorganized radicular dentin with very minimal tubular architecture