METHODS FOR DIAGNOSING DENTAL FLUOROSIS: QUANTITATIVE LASER FLUORESCENCE AND LIGHT-INDUCED FLUORESCENCE

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Summary. Fluoride ion affects the crystal growth of hydroxiapatite crystals. Chronic endemic fluorosis leads to elongated apatite crystals with low density and heterogenic lay down. The up-to-date dental caries treatment and preventive strategies are related to many fluoride sources. The aim of the present study was to investigate and compare the ability of quantitative laser fluorescence (QLF) – DIAGNOdent Classic and quantitative light-induced fluorescence – SoproLife – lamp and intraoral camera, to diagnose dental fluorosis. Thirteen molars of 116 extracted mature human molars from the same dental practice area were diagnosed with fluorosis according to Luckomski scale from 1947. All teeth were exposed to QLIF – SoproLife (Acteon, France) in modes “day light”, “macro image”, “blue light”, and to QLF – DIAGNOdent Classic (Germany). All fluorotic teeth were sectioned in mirror images through the body of stains and lesions – BL or MD with diamond blade – 0.2 mm and observed under magnification x5, x30, x100. Results from cross-sectional histology showed sections with porous enamel, hypomineralized dentine and fissure fluoride caries. Moderate and severe fluorosis (n = 11) was diagnosed by QLF-DIAGNOdent Classic device, with scores 99-which indicates dentine caries. Mild fluorosis (n = 2) was diagnosed by DIAGNOdent Classic device, with scores 30-45-56-, which indicates dentine caries. DIAGNOdent Classic diagnosed fluorosis as caries lesions. QLIF also did not recognize fluorosis from caries lesions. SoproLife “day light” and “macro image” showed a realistic appearance of all tooth surfaces under magnification x 30-100.

Key words: *fluorosis, dental caries*

ETIOLOGY

Fluoride sources are well established in the dental literature [6]. Cross effects of fluoride sources, their manifestation and diagnosis have not been investigated so far. Recently, higher intake of fluoride from different sources was registered in few cohort groups in Bulgaria, discussed in the media, but never described in the dental literature [1]. The most common sources of fluoride are fluoride tablets, water with more than 1.5-2.0 mg/L fluoride, tooth pastes, fluoridated salts, fluoride topical prevention methods and some dental materials, like glass ionomer cements (GIC). Chewing gums, foods like tea and fish, and milk fluoridation are also fluoride sources. The first stage of dental fluorosis can be easily diagnosed as white spots caries lesions [4]. In these cases, the non-operative treatment can harm the dental structures, instead of lead to the expected remineralization.

PATHOGENESIS

The fluoride ion affects structures with mesenchime origin – dentine, and ectodermal origin – enamel. Fluoride lowers the absorption of non-collagenous proteins and hydroxyapatite and affects the crystal growth. Severe chronic endemic fluorosis leads to the formation of elongated apatite crystals with low density and heterogenic lay down. Fluorosis can affect the enamel of front teeth, but can also affect all groups of teeth, mainly the contra-lateral ones. The defects emerge in the apatite crystals and in the organic matrix and lead to caries susceptibility. Subsurface enamel becomes hypomineralized with elongated apatite crystals, layers are hypomineralized and porous. Changes in dentine include incomplete mineralization and maturation, elongated crystals with heterogenic structure and low density [7, 9].

DIAGNOSIS

Correct diagnosis is related to the clinical status and paraclinical examination, changes of the structure and color of the surface (Fig. 1 a, b, c). Riordan described trends in dental practice that practitioners overestimate the scores of fluorosis [5]. In Bulgaria, dental fluorosis occurrence has been underestimated in the last two decades [1].

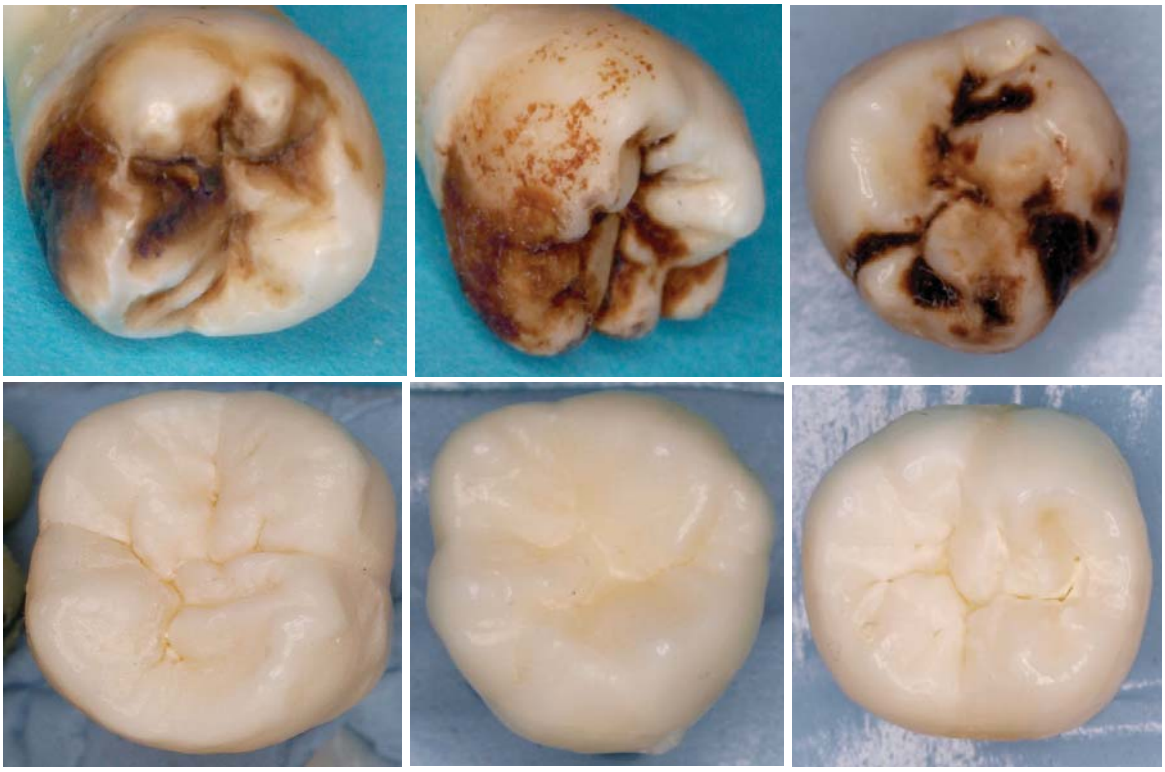


Fig. 1. (a-f) Photos of fluorotic (a, b, c) and healthy (d, e, f) teeth

AIM

The aim of the present study was to investigate and compare the ability of quantitative laser fluorescence (QLF) – DIAGNOdent Classic and light-induced fluorescence (LIF) – SoproLife – lamp and intraoral camera, to diagnose dental fluorosis.

MATERIALS AND METHODS

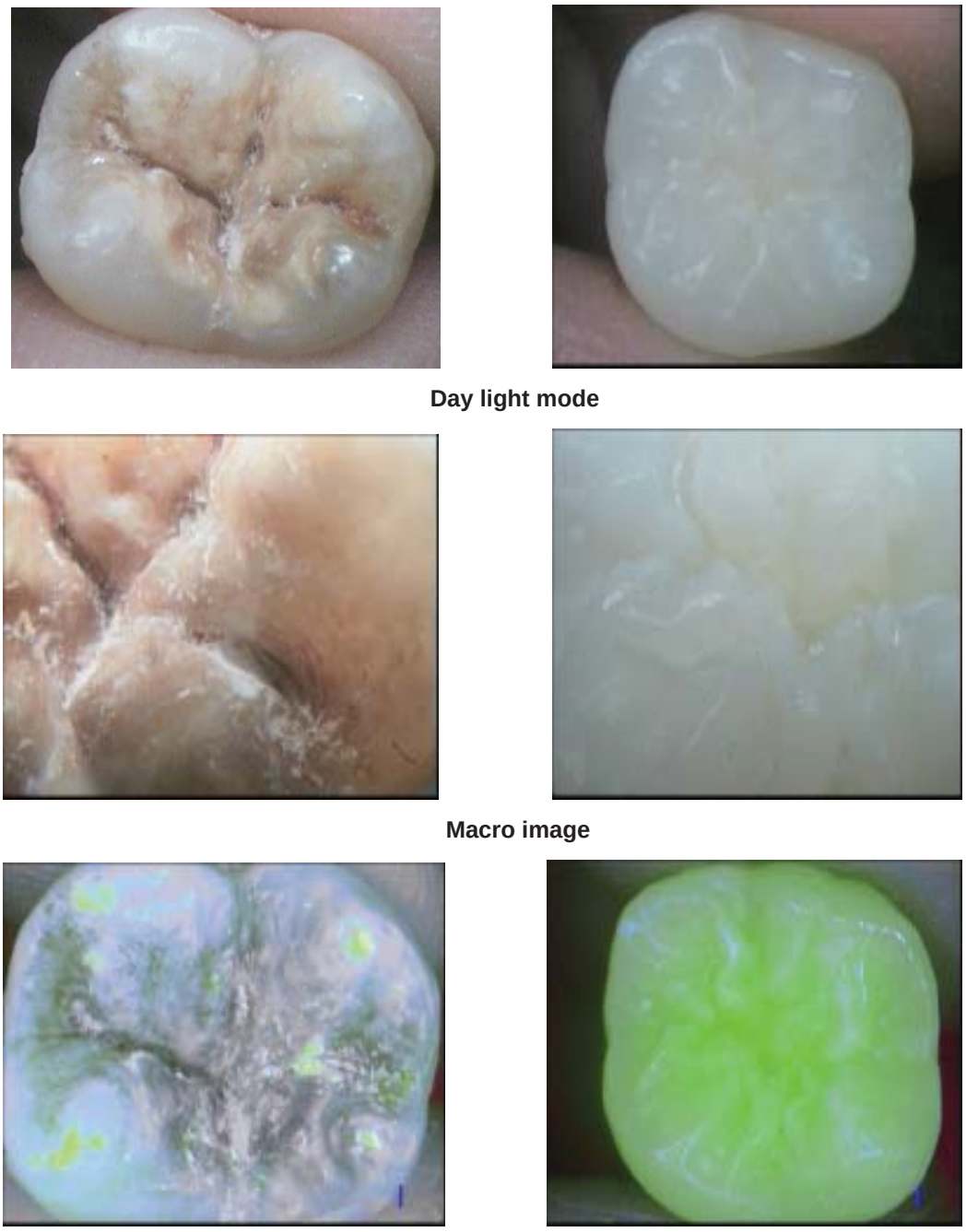
Mature human molars n=116 from the same dental practice area were included in the study. Thirteen teeth were diagnosed with fluorosis according to Luckomski scale. All teeth were exposed to LIF-SoproLife (Acteon, France) in modes “day light”, “macro image”, “blue light” [8] and QLF-DIAGNOdent Classic (Germany). All fluorotic teeth were sectioned in mirror images through the body of stains and lesions – BL or MD with diamond blade – 0.2 mm. The sections were observed under magnification x5, x30, x100.

RESULTS

Moderate and severe fluorosis (n = 11) was diagnosed with quantitative laser fluorescence by QLF-DIAGNOdent Classic device, with scores 99 and recognized

as dentine caries. Mild fluorosis (n = 2) was diagnosed by DIAGNOdent Classic device, with scores 30-45-56-, which indicates dentine caries.

All images of fluorotic teeth are shown in figures 2-6. They were compared with sound enamel surfaces, investigated with the same regime of the used device.



Day light mode

Macro image

Blue light mode

Fig. 2. (a-f) Images of Fluorotic teeth, stage 2 and 3, and healthy teeth – fissures, SoproLife camera in the following modes: “Day light” mode, “Macro image”, and “Blue light” mode

Fig. 3. (a, b) Photos in two modes of stage 4 of fluorosis, with camera and macroimage of Soprolife intraoral camera

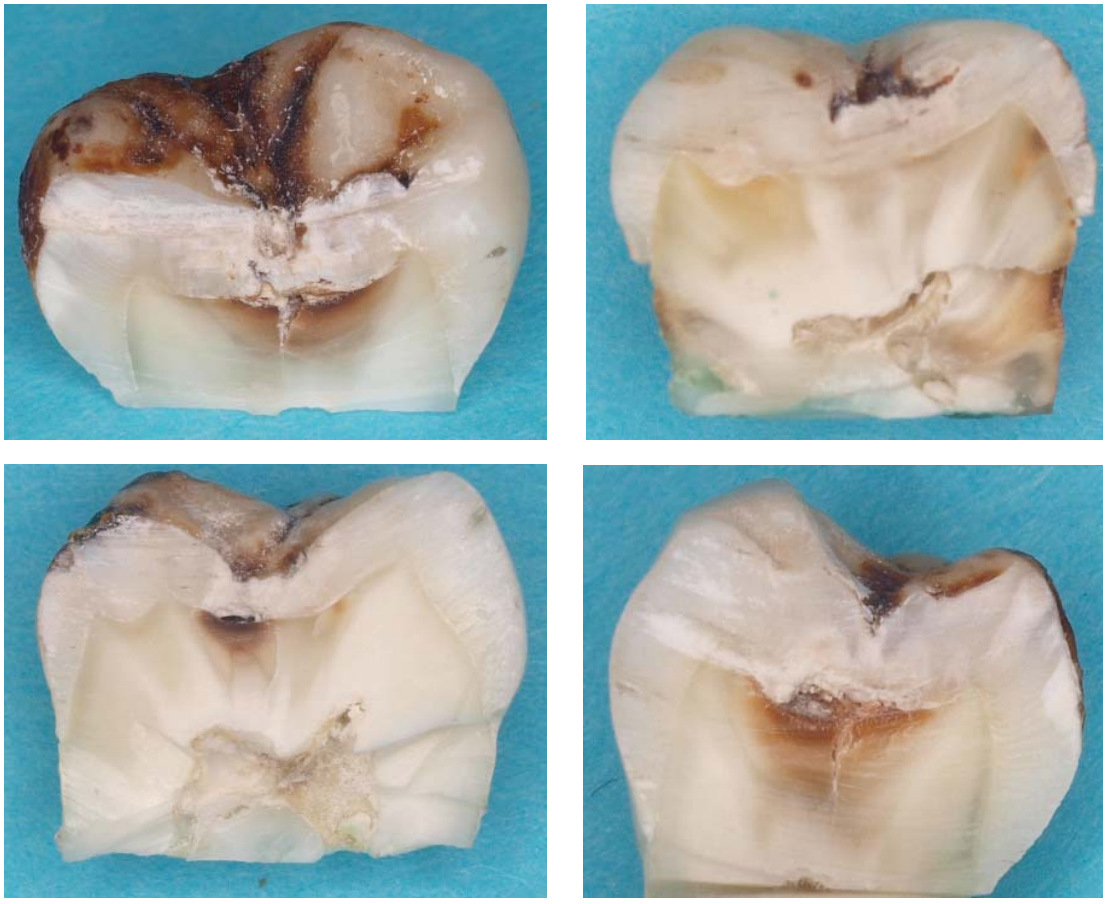


Fig. 4. (a-d) Histology results: vertical sections with porous enamel, hypomineralized dentine and fissure fluoride caries of the teeth

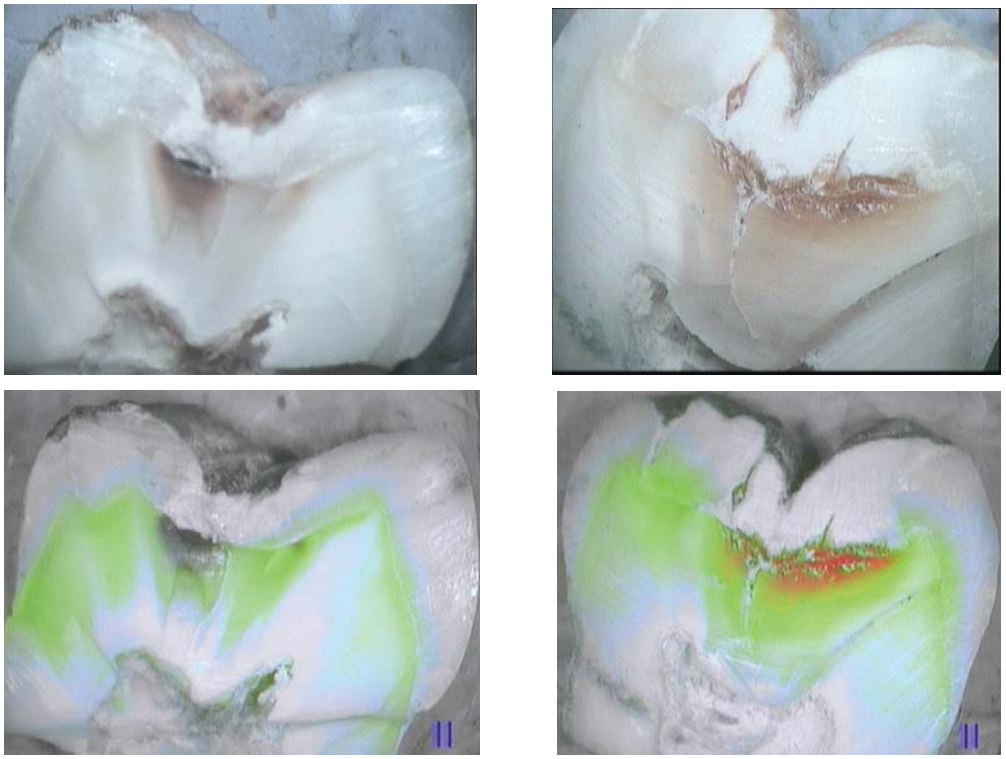


Fig. 5. (a-d) Histology sections observed with LIF – “day-light”, “treatment” mode

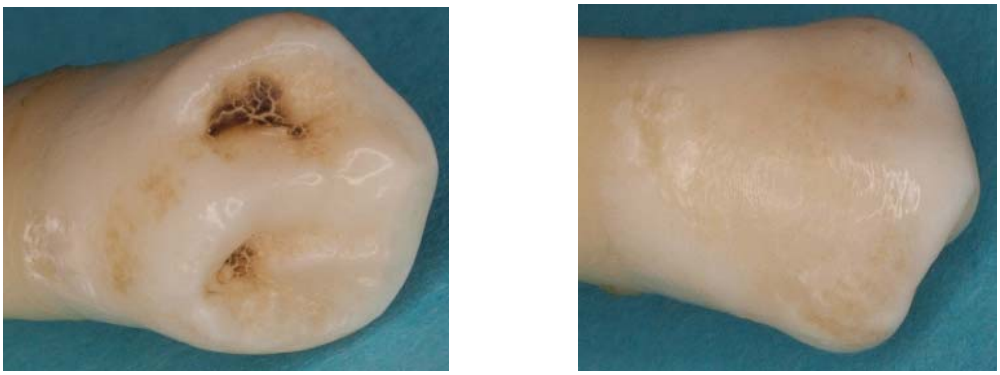


Fig. 6. (a, b) Dental fluorosis stage 1-2, white, light brown and brown spots

Classification of H. T. Dean, 1942 [6]

1. **Very Mild** – Small, opaque, paper white areas scattered irregularly over the tooth but not involving as much as 25 percent of the tooth surface. Frequently included in this classification are teeth showing no more than 1-2 mm of white opacity.

2. **Mild** – The white opaque areas in the enamel of the teeth are more extensive but do not involve as much as 50 percent of the tooth.

3. **Moderate** – All enamel surfaces of the teeth are affected, and the surfaces subject to attrition show wear. Brown stain is frequently a disfiguring feature.

4. **Severe** – All enamel surfaces are affected and the general form of the tooth may be affected. The major diagnostic sign of this classification is discrete or confluent pitting. Brown stains are widespread and teeth often present a corroded-like appearance.

Classification of Thylstrup-Fejerskov, 1978 [3]

1. Narrow white lines corresponding to the perikymata.
2. **Smooth surfaces and pits and fissures:** Scattered areas of opacity <2 mm in diameter and pronounced opacity of cuspal ridges.
3. **Smooth surfaces:** Irregular cloudy areas, confluent areas of marked opacity seen in fissures, too.
4. **Smooth surfaces and fissures:** The entire surface exhibits marked opacity or appears chalky white. Parts of surface exposed to attrition appear less affected.
5. **Smooth surfaces and fissures:** Entire surface with marked opacities larger than 2 mm in diameter.
6. **Pits:** Regularly arranged in horizontal bands < 2 mm in vertical extension. Confluent areas < 3 mm in diameter exhibit loss of enamel. Marked attrition.
7. **Loss of outermost enamel:** In irregular areas involving < 1/2 of the entire surface. Changes in the morphology caused by merging pits and marked attrition.
8. **Pitts and fissures:** Loss of outermost enamel involving > 1/2 of the surface.
9. **Pitts and fissures:** Loss of main part of enamel with change in anatomic appearance of the surface.

Classification of Luckomski from 1947, currently in use in the Faculty of Dental Medicine in Sofia [2]

1. White spots or tiny strips
2. White-yellow spots or tiny strips
3. Yellow-brown spots or strips
4. Brown-black spots in enamel

CONCLUSIONS

1. Moderate and severe fluorosis is diagnosed by QLF-DIAGNO dent Classic device, (n = 11) with scores 99 and recognized as dentine caries.
2. Mild fluorosis is diagnosed by DIAGNO dent Classic device, (n = 2) with scores 30-45-56- which indicates dentine caries.
3. DIAGNO dent Classic diagnoses fluorosis as caries lesions.
4. LIF also does not recognize fluorosis from a caries lesion.
5. SoproLife “day light” and “macro image” show a realistic appearance of all teeth surfaces under magnification x 30-100 and act as an intraoral camera with high magnification, up to 100 times.

6. Only clinical knowledge and careful examination can diagnosed Dental Fluorosis stage 1, i.e. white spots.

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