QLF technology and History

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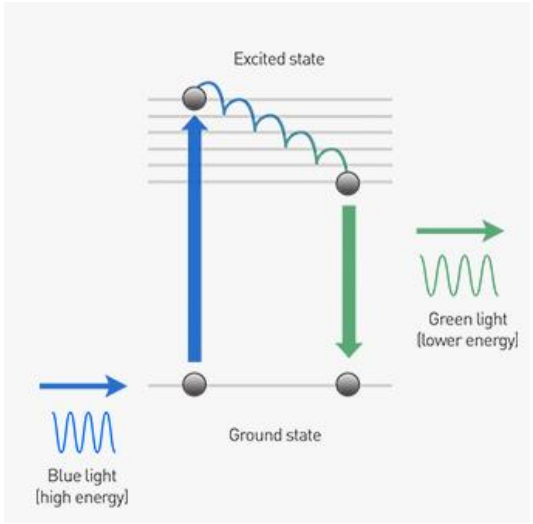
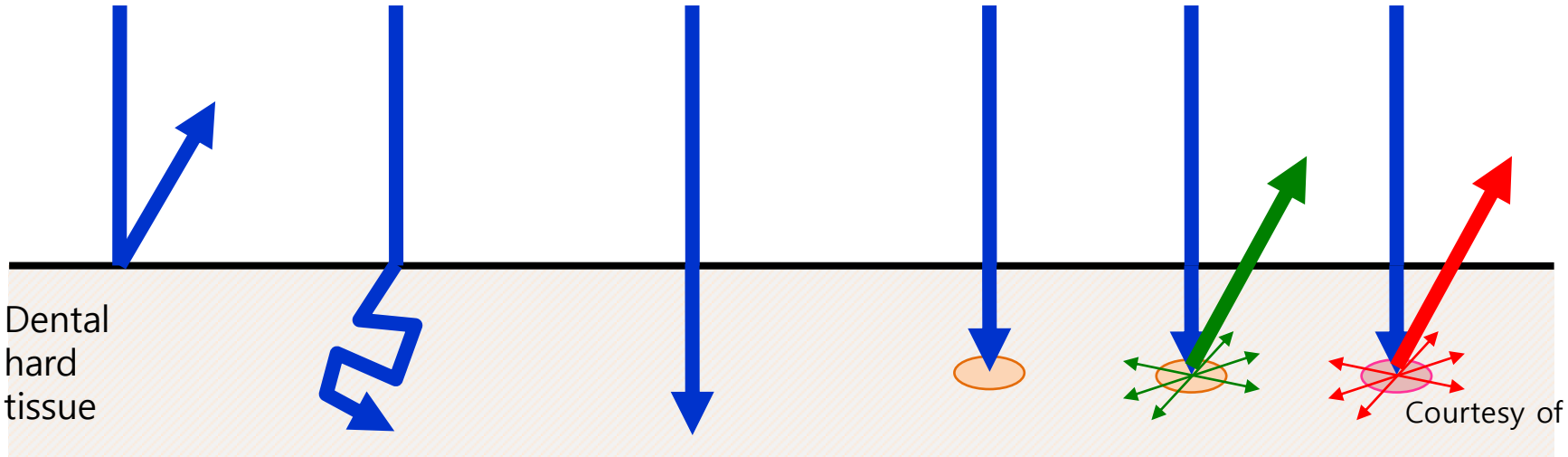
Light interaction with the dental hard tissue



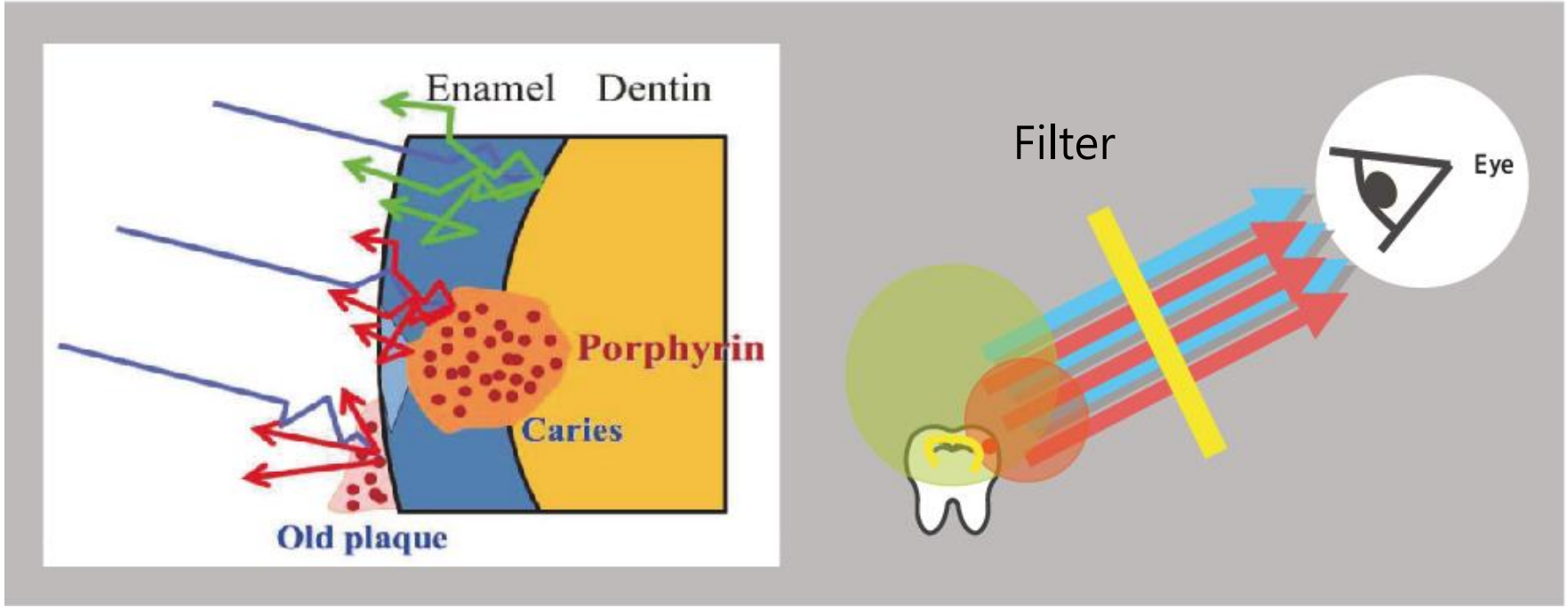
Reflection Scattering Transmission Absorption **Fluorescence**



Courtesy of Prof Baekil Kim

Quantitative Light-induced Fluorescence : **QLF or Qray**

Light source : 405nm (Visible light)



The QLF system can detect not only mineral contents but also bacterial porphyrin-induced red fluorescence at high resolution.

QLF History: 1981

Introduction: Laser Fluorescence

United States Patent [19]
Ingmar

[11] **Patent Number: 4,515,476**
[45] **Date of Patent: May 7, 1985**

[54] **DEVICE FOR THE OCULAR DETERMINATION OF ANY DISCREPANCY IN THE LUMINESCENCE CAPACITY OF THE SURFACE OF A TOOTH FOR THE PURPOSE OF IDENTIFYING ANY CARIED AREA ON THE SURFACE TO THE TOOTH**

[76] Inventor: **Bjelkhagen H. Ingmar**, Hagagatan 54, 113 47 Stockholm, Sweden

[21] Appl. No.: **363,788**

[22] Filed: **Mar. 31, 1982**

[30] **Foreign Application Priority Data**

Apr. 1, 1981 [SE] Sweden 8102103

[51] **Int. Cl.**³ **G01N 21/64;** A61B 6/00
[52] **U.S. Cl.** **356/318;** 128/665; 250/458.1
[58] **Field of Search** 356/317, 318, 417, 237; 350/96.26; 250/458.1, 459.1, 461.1, 461.2; 128/633, 634, 665

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,494,354 2/1970 Yokota et al. ..... 350/96.26 X
4,290,433 9/1981 Alfano 356/318

FOREIGN PATENT DOCUMENTS

1186602 4/1970 United Kingdom 350/96.26

Primary Examiner—F. L. Evans
Attorney, Agent, or Firm—Burns, Doane, Swecker & Mathis

[57] **ABSTRACT**

A device for the ocular determination of any discrepancy in the luminescence capacity of the surface of a tooth (4) for the purpose of assessing the extent of any part (4a) of the surface of the tooth exhibiting caries and/or a coating and/or a defect. The surface of the tooth (4) is illuminated by a light (3) with a predetermined wavelength and/or wave range, for example a laser light. The luminescence capacity of the surface of the tooth at another wavelength and/or within another wave range shall be assessed, when any caried or similar part (4a) will show a discrepancy in relation to the normal luminescence capacity of the tooth (4) and will be perceived as a darker area. If the surface of the tooth (4) is illuminated by means of a light which is visible to the eye, then the observer (5) shall use an absorption filter (6) capable of absorbing light at the emitted wavelength or wave range reflected from the surface of the tooth. The invention may also be used in the course of treatment in order to determine when the caried part has been removed from the enamel surface and/or dentine surface produced by the treatment.

10 Claims, 4 Drawing Figures

U.S. Patent May 7, 1985 **4,515,476**

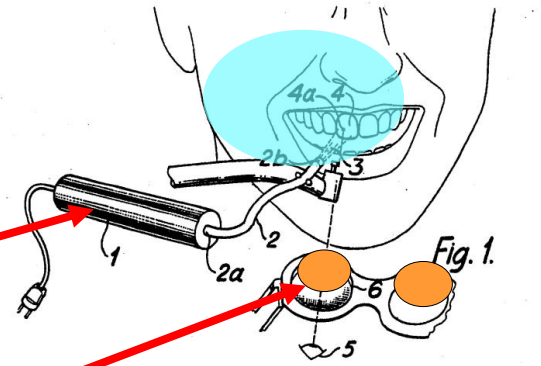


Fig. 1.

Argon Laser
488 nm

Yellow glasses
high pass filter
540 nm

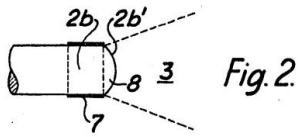


Fig. 2.

White spot shows up as dark spot

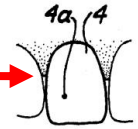


Fig. 3.

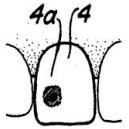
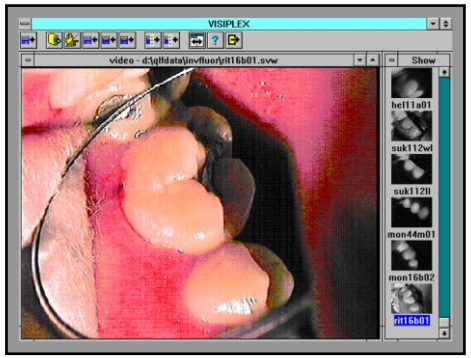
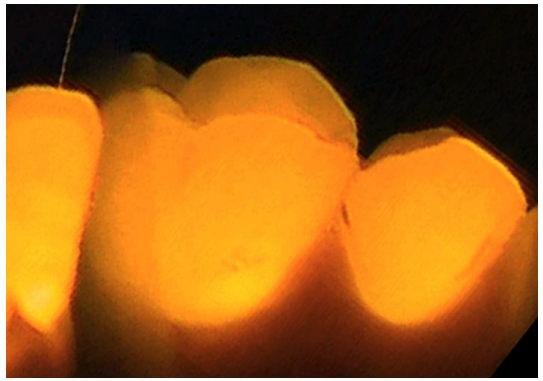


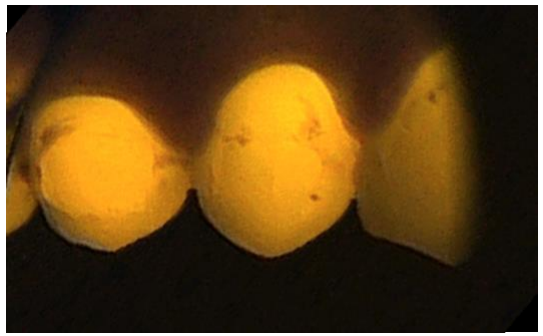
Fig. 4.

QLF History: 1992



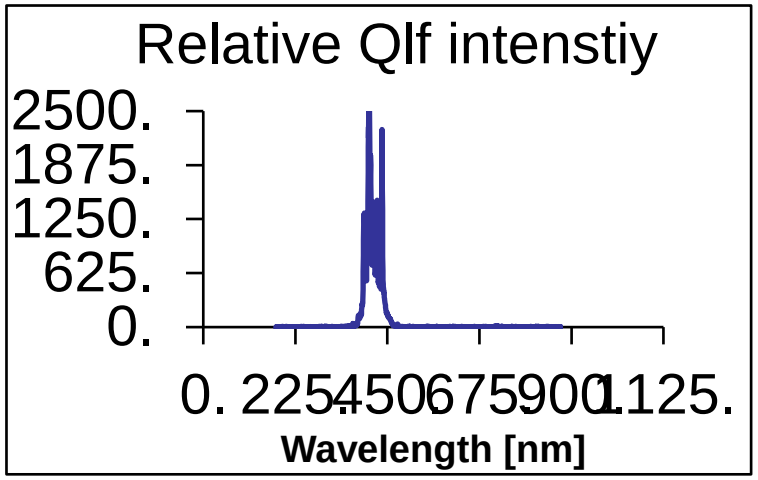
PC

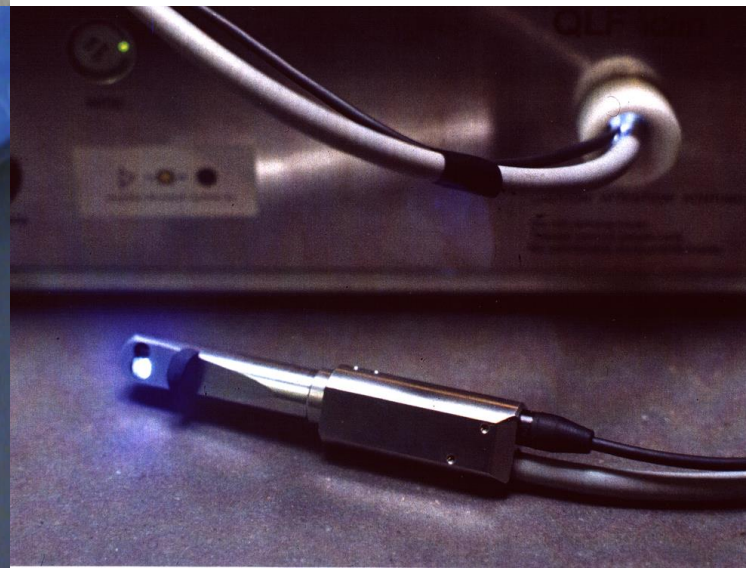




Argon Laser 488 nm

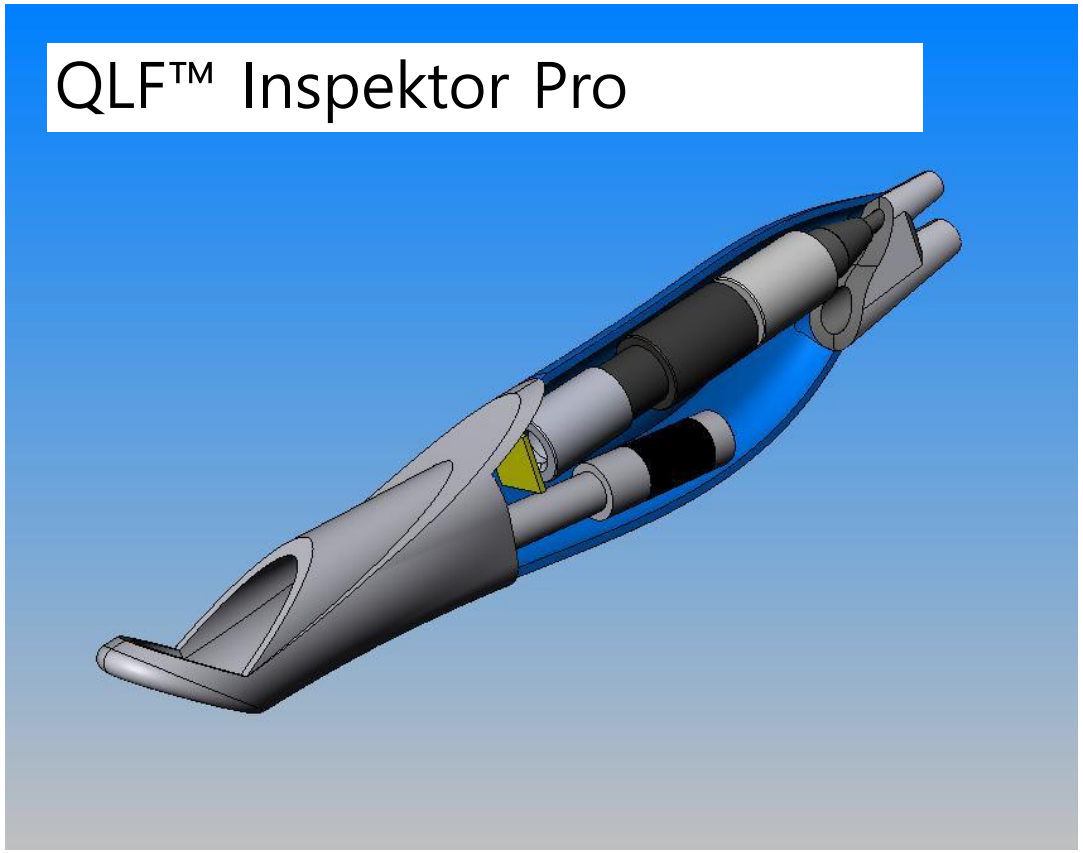
QLF History: 1996





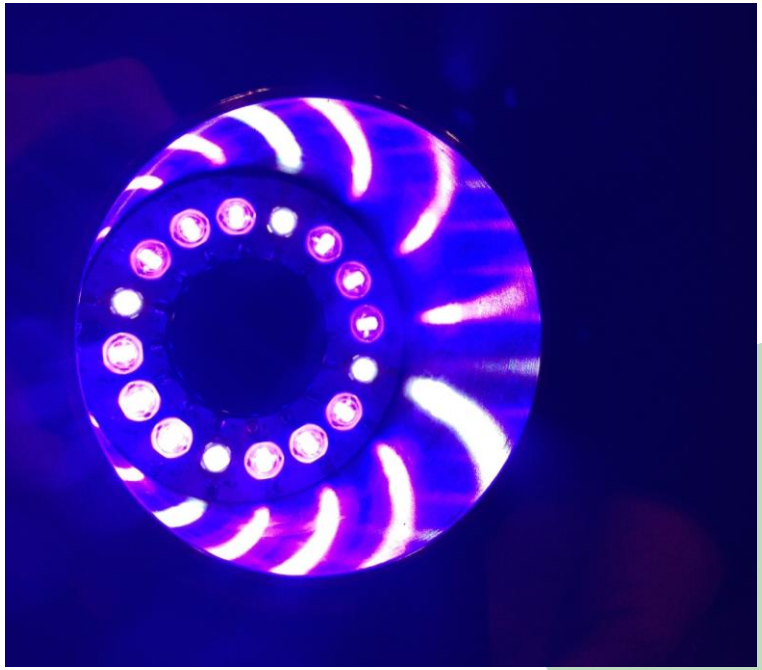
QLF History: 2004

2004, FDA approval
2005, ADA approval

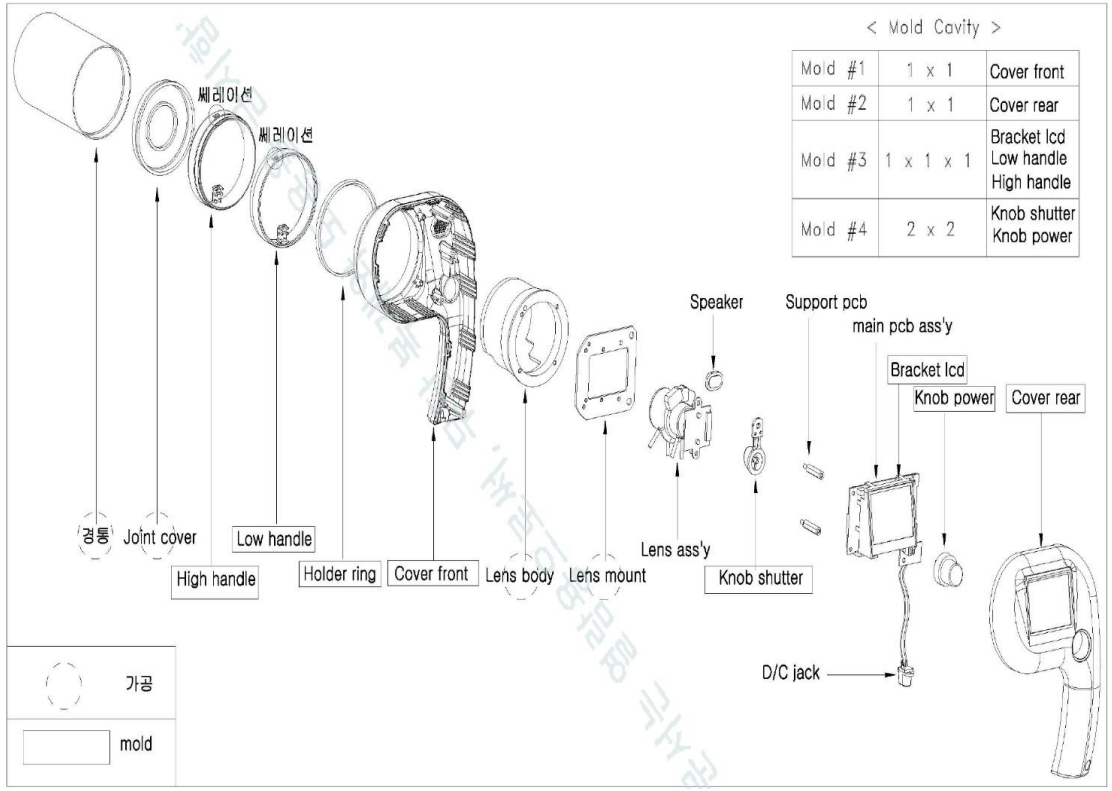


QLF History: 2011

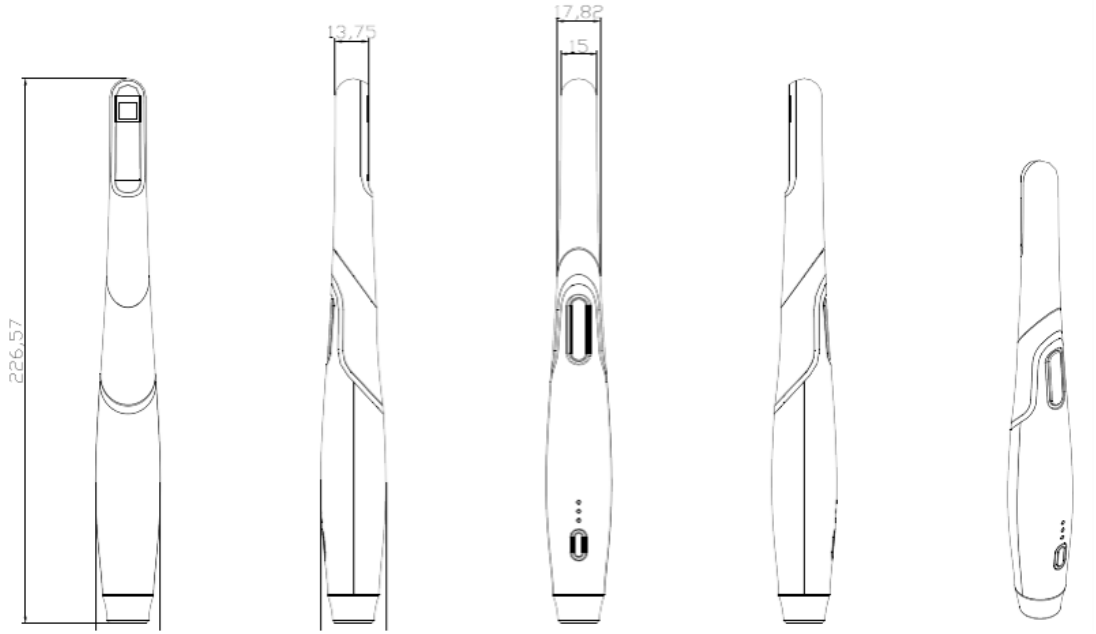
QLF-D
Quantitative light-induced fluorescence-digital



QLF History: 2014



QLF History: 2015



Qraypen™

QLF History: 2018

Qraypen C™

Comparison of QLF systems

1st generation

Inspektor pro

2nd generation

QLF-D

3rd generation

QrayCam

QrayPen

Comparison of fluorescence loss measurements among various generations of QLF devices

[1)]Department of Preventive Dentistry & Public Oral Health, Yonsei University College of Dentistry, [2)]BK21 PLUS Project, Yonsei University College of Dentistry, [3)]Department of Health Services Research, University of Liverpool, Liverpool, United Kingdom, [4)]Inspektor Research Systems BV, Amsterdam, The Netherlands

Seok-Woo Park[1,2)], Hyung-Suk Lee[1,2)], Sang-Kyeom Kim[1,2)], Eun-Song Lee[1,2], Elbert de Josselin de Jong[1,2,3,4)], Baek-Il Kim[1,2)]

ABSTRACT

Comparison of fluorescence loss measurements among various generations of QLF devices

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Purpose: The aim of *in vitro* study was to compare the diagnostic accuracy to detect non-cavitated enamel caries on smooth surface by using four kinds of the QLF devices.

Materials and Methods: A total of 52 human permanent premolars and molars were used. Fluorescence images were captured by the QLF devices (Inspektor Pro, QLF-D, Qraycam, and Qraypen). Fluorescence loss of the QLF was calculated. The severity of lesions was categorized into the following 3 scores using polarized light microscopy: normal (S), enamel demineralization to outer half of enamel (D1), and inner half of the enamel up to the dentin-enamel junction (D2). The Kruskal-Wallis test was used to compare the fluorescence loss among the QLF devices. Spearman rank correlation coefficient between histological scores and fluorescence loss of the devices was calculated. The sensitivity, specificity, and area under the receiver operating curve (AUROC) were calculated to compare their diagnostic accuracies.

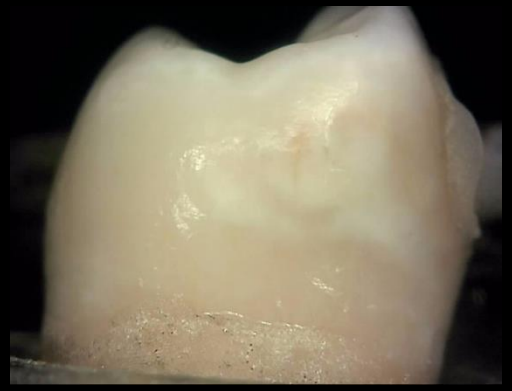
Results: The correlation coefficients between histological scores and the fluorescence loss of the devices showed 0.77 to 0.81 ($P < 0.001$). All histological scores, the fluorescence loss among the devices showed no statistical difference. Among the devices, sensitivity, specificity, and AUC values of the fluorescence loss showed 0.84 to 0.94, 0.76 to 0.90, and 0.90 to 0.92, respectively.

Conclusions: All QLF devices had no difference with excellent diagnostic accuracies to detect non-cavitated enamel caries on smooth surface.

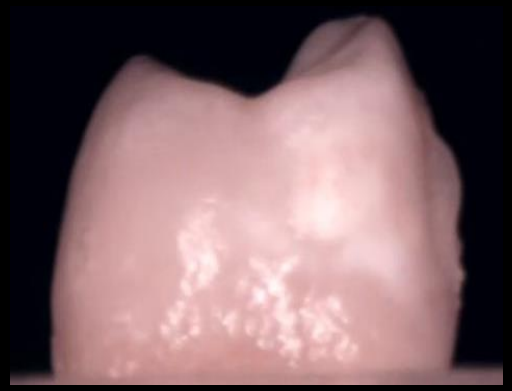
QLF-D




QrayCam




QrayPen




Comparison of QLF systems

Table 1. Distribution of fluorescence parameters from each QLF devices

QLF device	Histological score*			Correlation†
	S (n=21)	D1 (n=18)	D2 (n=13)	
Inspektor Pro	0.00 (0.00, 5.45)	9.85 (6.53, 13.33)	16.60 (14.20, 25.70)	0.78
QLF-D	0.00 (0.00, 0.00)	8.65 (5.80, 13.60)	18.10 (14.55, 27.45)	0.81
Qraycam	0.00 (0.00, 5.85)	9.15 (7.68, 17.25)	25.00 (19.25, 37.35)	0.78
Qraypen	0.00 (0.00, 6.35)	10.20 (6.78, 15.55)	19.90 (15.25, 29.10)	0.77
P-value	0.694	0.628	0.347	

All values represent median (25^{th} , 75^{th} percentiles).
P-values were calculated by Kruskal-Wallis test.
† indicated statistically significance by Spearman rank correlation, $P < 0.0001$.

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Quantitative Light-induced Fluorescence

QLF : **Academic** field

Qray : **Clinical** field

신의료기술 최종 인정 및 고시

"정량광형광기를 이용한 치아우식증 검사" 신의료기술인정(2018-8-13)

보건복지부고시 제2018 - 165호

「의료법」 제53조 및 「신의료기술평가에 관한 규칙」 제4조에 의한 「신의료기술의 안전성·유효성 평가결과 고시」(보건복지부 고시 제2018 - 140호, 2018. 7. 12.)를 다음과 같이 개정·발령합니다.

2018년 08월 13일

보건복지부장관

신의료기술명	고시날짜
341. 부분치수절단술	2013.10.10
496. 자가치아 유래 골 이식술	2015.01.29
680. 치근 천공 수복	2017.10.16
717. 정량광형광기를 이용한 치아우식증 검사	2018.08.13

전체 신의료기술	719
치과 신의료기술	4
백분율	0.556%