Approximal Caries Detection Agreement Between Light Fluorescence and Bitewing Radiographs

Rahaf Sahhaf, BDS[1] - Shuying Jiang, MS[2] - Jorge H. Caceda, DDS,MPH,MS, PhD[1]

[1]Rutgers School of Dental Medicine, Department of Pediatric Dentistry & Community Health, [2]Office of Academic Affairs Newark, New Jersey Universidad Peruana Cayetano Heredia, Department of Community Dentistry, Lima, Peru

Introduction

In order to provide dental treatment for a carious lesion, the dentist must be able to assess accurately the presence and severity of the lesion, along with the degree of cavitation on the surface of each tooth.[1] The use of traditional methods combined with more sensitive methods may assist clinicians in early caries detection and implementing non-invasive treatments.[2] The diagnostic capacity of the Spectra Light Fluorescence System (SLFS) has been studied, and the results showed that the sensitivity and the specificity are acceptable for the detection of occlusal caries.[3] However, no study has evaluated the diagnostic capacity of the SLFS in detecting cavitated and non-cavitated approximal caries lesions in primary and permanent molars. Moreover, no study has determined at what stage of the caries process the SLFS is able to detect the presence of approximal caries when used occlusally. The aims of this study are (1) to determine the agreement between SLFS and bitewing radiographs (BWR) for detecting approximal caries in primary molars and permanent first molars, and (2) to determine the prevalence and distribution of approximal caries in primary molars and permanent first molars in children ages 7-12 years from a public school located in Callao, Lima, Peru.

Null hypothesis
- There is no agreement between SLFS and BWR when they are used in the detection of approximal caries.
- The prevalence and distribution of approximal caries in primary molars and permanent first molars are the same when the BWR and the SLFS are used.

Materials & Methods

This cross-sectional study was based on secondary data collected from the study performed in 2017 on the sensitivity and specificity of three methods used in the detection of occlusal caries. The primary study was approved by the Institutional Committee of Ethics at Peruvian University Cayetano Heredia (Reference No. 60917). This cross sectional study was approved by the Rutgers Institutional Review Board (Pro2019000926, Pro2020002277, Mod2022003448). The occlusal surfaces of primary molars and permanent first molars of 160 children 7-12 years of age were examined to assess the presence of caries in enamel only or caries in dentin. All examinations were conducted by a single calibrated dentist. The participants were school children from the public school "José Olaya de Ventanilla located in Callao, Lima, Peru". For occlusal surfaces evaluation, the visual caries detection examination using the ICDAS II was performed before the SLFS in all cases. Two bitewing radiographs were taken for all children that completed both the visual and SLFS using a conventional radiograph Kodak film and calibrated Kodak radiographic equipment with zero-degree angulation and using the parallel technique. A geometric format that divided the occlusal surface into five zones was used by the examiner to standardize the findings and to discriminate the zones of the occlusal surface presented with dental caries (figure 1). In the present study, the presence of caries in enamel only and in dentin of the mesial and distal occlusal zones using SLFS and the presence of approximal caries in enamel only and in dentin obtained with BWR were compared. SLFS uses six light-emitting diodes (LEDs) to project a blue-violet wavelength of 405 nm to produce a florescence picture. The colors displayed are green, blue, red, orange and yellow as shown in figure 2. The values to assess the severity of the carious lesion using the SLFS are presented in table 2. Using bitewing radiographs, the mesial and distal approximal surfaces of the first and second primary and first permanent molars were evaluated (figure 3). After the radiographs were processed, they were scanned, digitized, and stored in a computer file for their interpretation. The radiographic images were scored from 0 to 5 as shown in table 2.
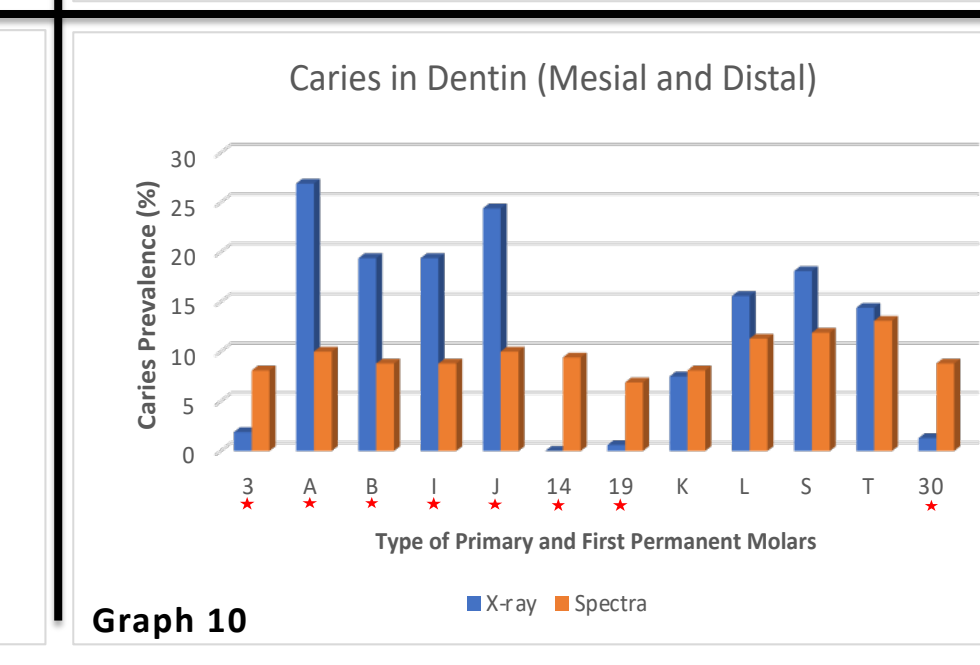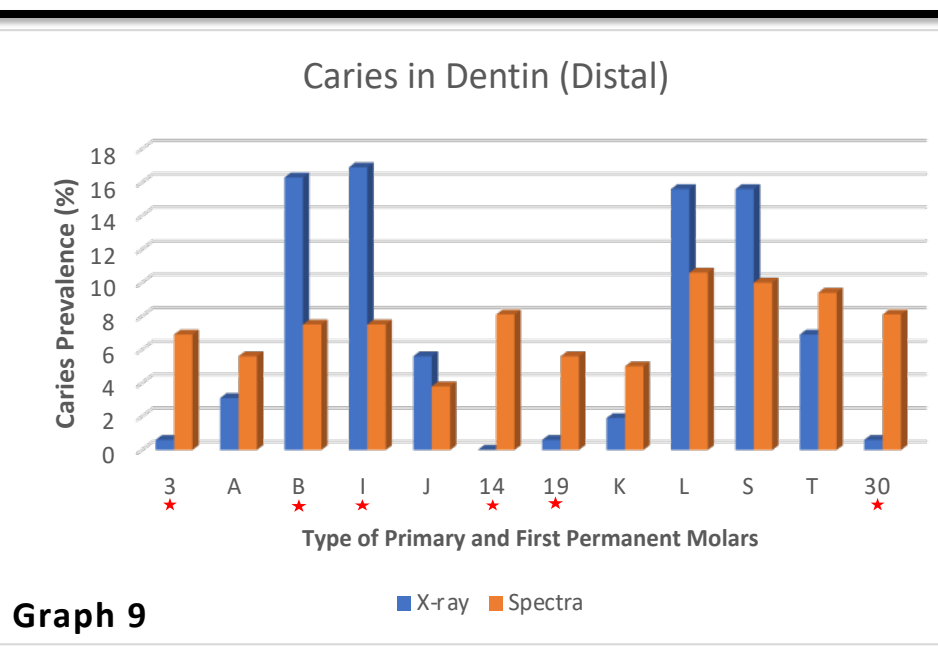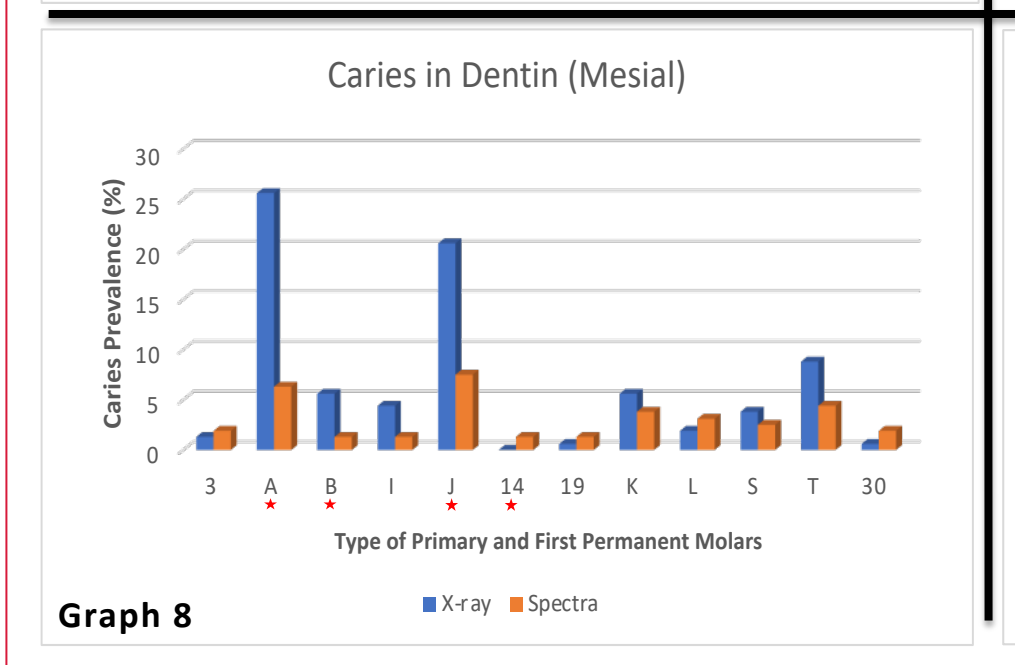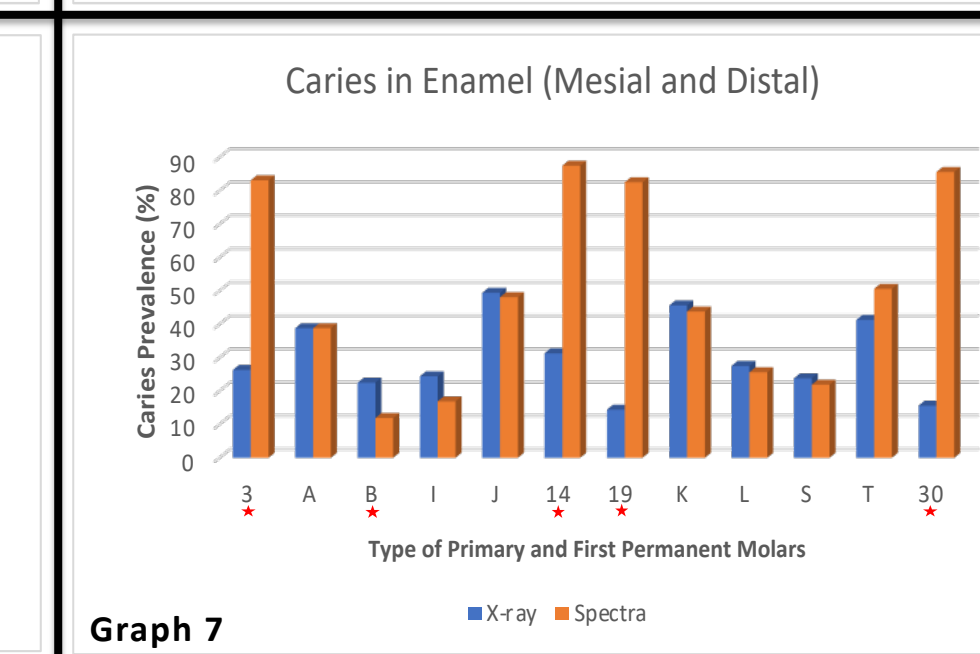
Figures

Figure 1

Figure 2

Figure 3
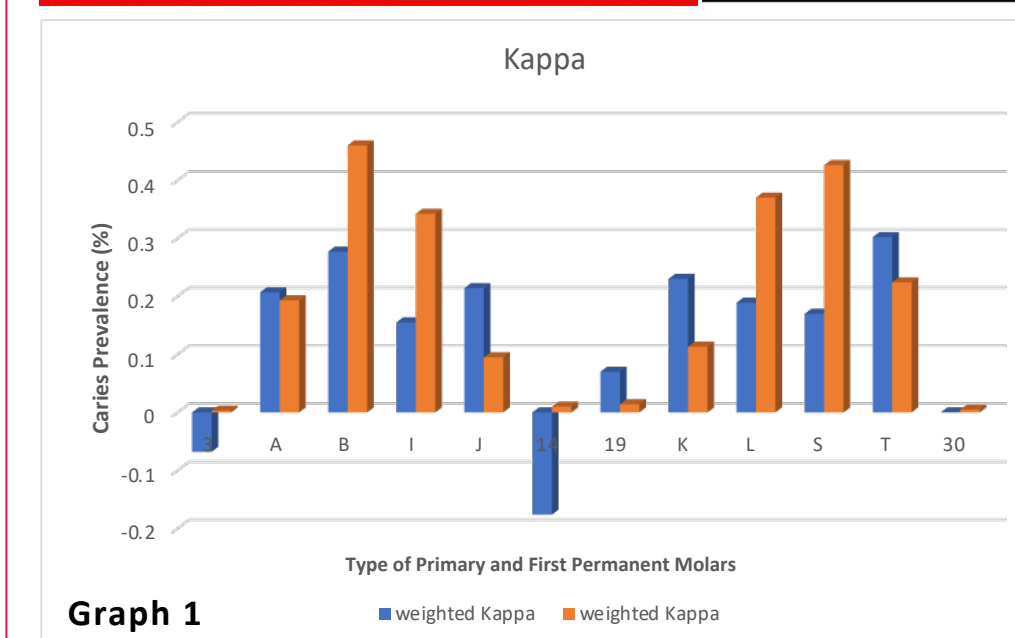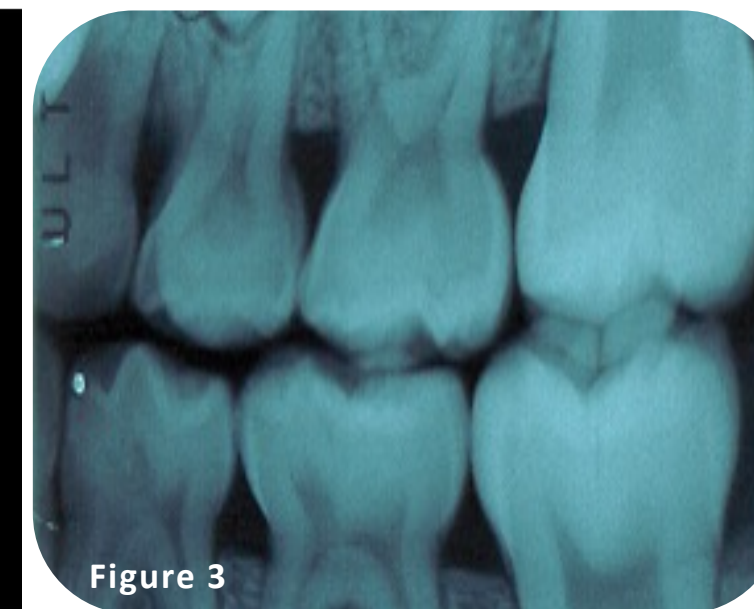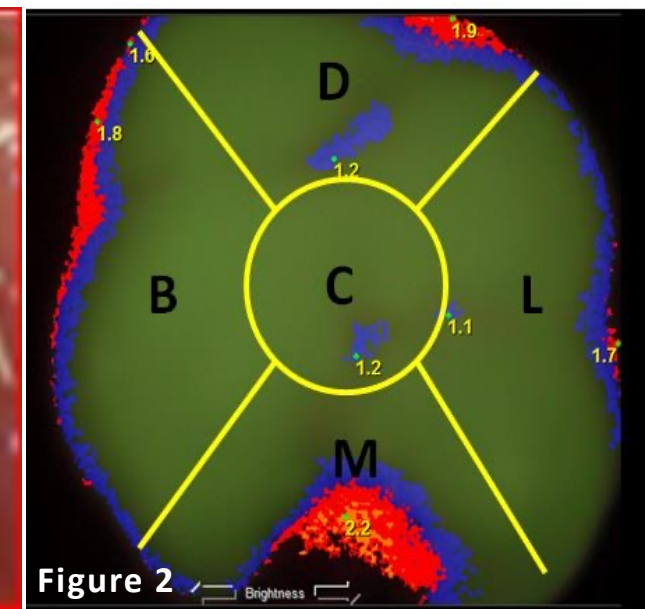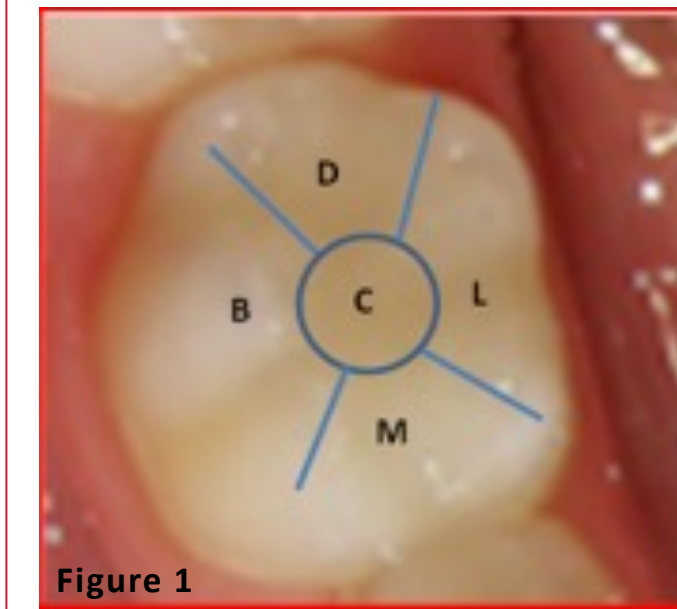
| Table 1 | |
Kappa Value	Interpretation
0.0-0.20	Very Low
0.21-0.40	Low
0.41-0.60	Fair
0.61-0.80	Good
0.81-0.100	Excellent

Graph 1

| Table 2 | |
SLFS Scoring System	Radiographic Scoring System
0 = Sound Enamel	0 = No radiolucency
1 = Enamel Caries	1 = Radiolucency in the outer ½ of the enamel
	2 = Radiolucency in the inner ½ of the enamel
2 = Caries up to the DEJ + Outer Dentin Caries	3 = Radiolucency in the outer ½ of the dentin + DEJ
3 = Deep dentin caries	4 = Radiolucency in the inner ½ of the dentin
4 = Deep dentin caries into pulp	5 = Radiolucency into the pulp

Graph 2 — Total Caries (Mesial)

Graph 3 — Total Caries (Distal)

Graph 4 — Total Caries (Mesial and Distal)

Graph 5 — Caries in Enamel (Mesial)

Graph 6 — Caries in Enamel (Distal)

Graph 7 — Caries in Enamel (Mesial and Distal)

Graph 8 — Caries in Dentin (Mesial)

Graph 9 — Caries in Dentin (Distal)

Graph 10 — Caries in Dentin (Mesial and Distal)
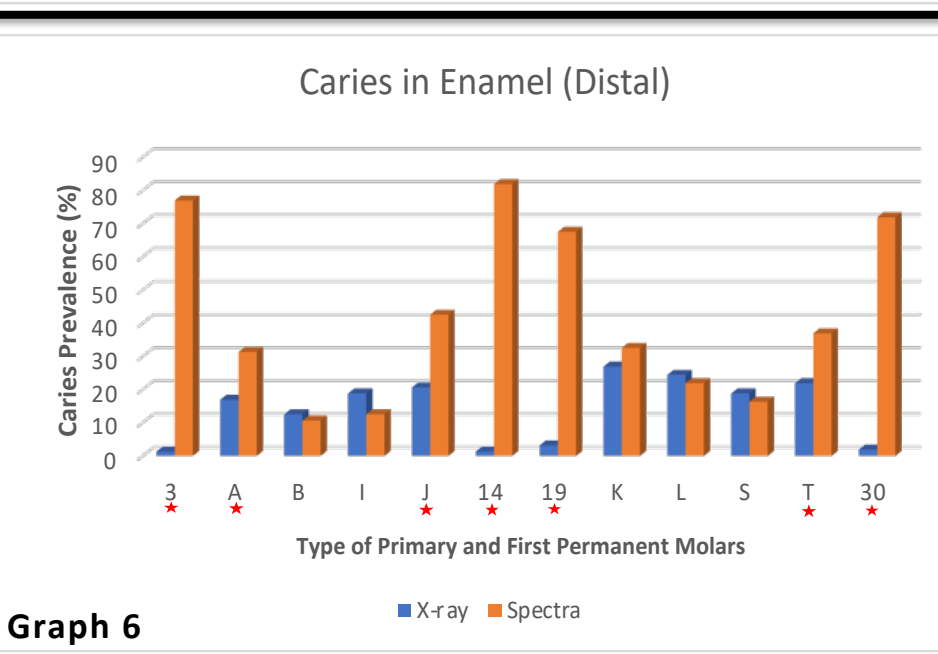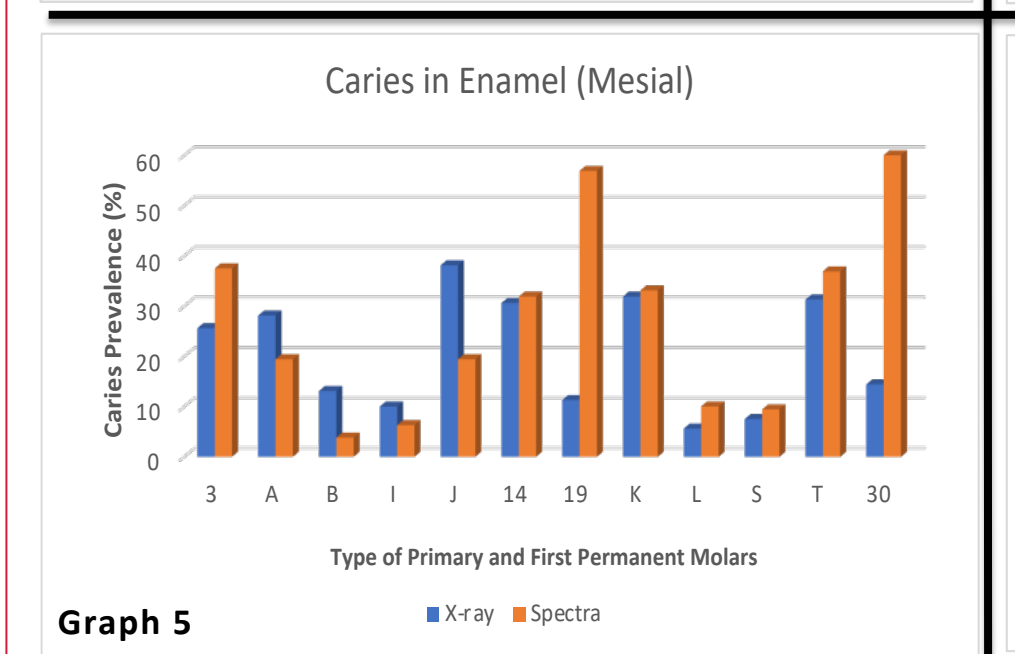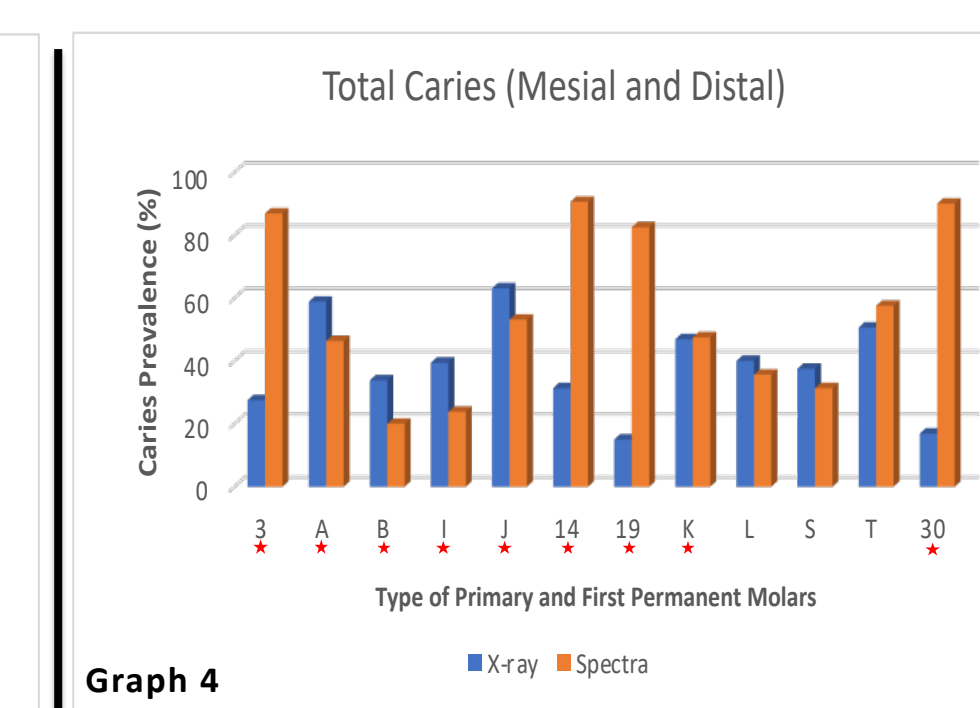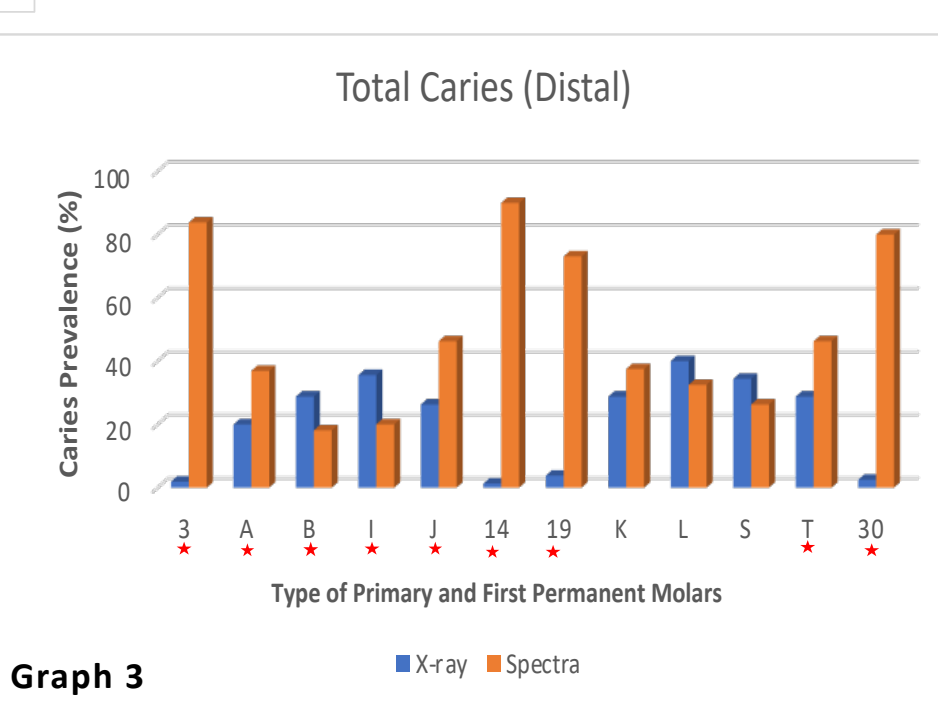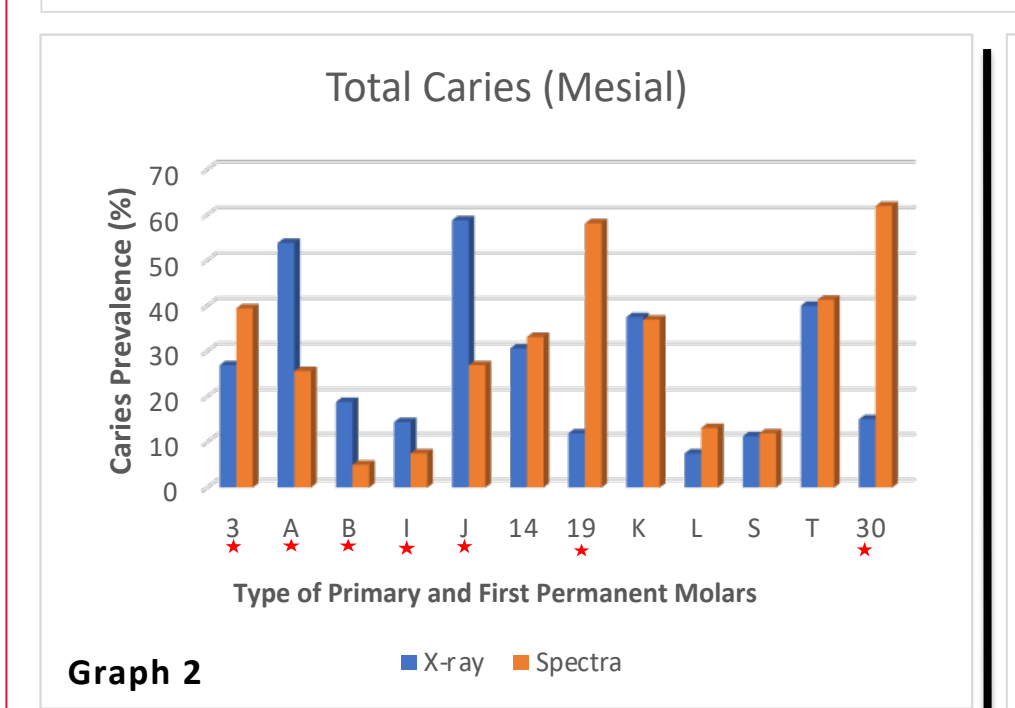
Results

A total of 2,982 surfaces were analyzed for the purposes of the current investigation. SAS 9.4 software and SPSS statistics 28 software were used for data analysis. The significance level was set to 0.05 for all tests. The weighted Kappa coefficients of the agreement in the detection of caries in primary molars and permanent first molars between SLFS and BWR showed very low to fair agreement between the two systems as shown in graph 1 and table 1. For the mesial surfaces, the agreement was significant for the following teeth: A, B, J, 14, K and T. The agreement among these teeth except tooth 14 ranged from 0.207 to 0.302, indicating that there was a low agreement between the two system. The agreement of the systems for the detection of caries in tooth 14 was 0.176 indicating there was a very low agreement although the p-value was less than 0.05. For the distal surfaces, the weighted Kappa was significant for the following teeth: A, B, I, L, S and T. The agreement for tooth A was 0.193 indicating a very low agreement. For teeth I, L and T the agreement was 0.342, 0.370, and 0.224 respectively, indicating low agreement, and for teeth B and S it was 0.460 and 0.426, indicating fair agreement. Summary estimates of the prevalence of dental caries using the SLFS and the BWR are presented in graphs 2-10. The use of SLFS showed a higher prevalence of total dental caries in the mesial and the distal zones of permanent first molars. BWR showed a higher prevalence of total dental caries of the mesial surface in primary molars. However, the prevalence of total dental caries in the distal occlusal zone/surface was higher in primary first molars using SLFS and in primary second molars using BWR. The results of the study revealed that caries in the enamel only on the mesial and distal zones of the occlusal surfaces had a higher prevalence in the permanent first molars when SLFS was used. The prevalence of caries in enamel only in the approximal mesial surface was high in primary molars using BWR. However, the prevalence of caries in enamel only in the occlusal distal zone of the primary molars was higher using SLFS. The prevalence of mesial and distal caries in dentin of permanent first molars was higher using SLFS and the prevalence of mesial and distal caries in dentin of primary molars was higher using BWR. BWR resulted in higher prevalence of caries in dentin on the approximal mesial surface of primary molars, however, on permanent first molars the prevalence of mesial caries in dentin was higher using SLFS. On permanent first molars the prevalence of caries in dentin of the occlusal distal zone was higher using SLFS. For the primary molars the prevalence of distal caries in dentin was higher using BWR.

Conclusions

There was a very low to fair agreement between SLFS and BWR in the detection of the approximal caries in primary molars and permanent first molars. In addition, caries prevalence varied among the mesial and distal zones/surfaces among first primary molars, second primary molars, and permanent first molars using SLFS and BWR.

Acknowledgements

References

1. Anusavice, K. (2001). Clinical Decision-Making for Coronal Caries Management in the Permanent Dentition. Journal of Dental Education, 65(10), 1143–1146. https://doi.org/10.1002/j.0022-0337.2001.65.10.tb03463.x
2. Gomez, J. (2015). Detection and diagnosis of the early caries lesion. BMC Oral Health, 15(1). https://doi.org/10.1186/1472-6831-15-S1-S3
3. Graye, M., Markowitz, K., Strickland, M., Guay, G., Burke, M., & Houpt, M. (2012). In vitro evaluation of the Spectra early caries detection system. The Journal of clinical dentistry, 23(1), 1–6.
* Figure 1,2; Picture courtesy: Caceda JH. Estudio comparativo de la sensibilidad, especificidad, concordancia y prevalencia de caries de tres sistemas usados en la detección de caries oclusal en niños. 2017. Repositorio Institucional de la Universidad Peruana Cayetano Heredia. RI: https://hdl.handle.net/20.500.12866/1379.