

Peer Review File

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Reviewer A

Interesting concept in terms of cost of untreated dental caries. However, given caries is multifactorial in nature, no radiographs do not equate to potential undiagnosed carious lesions. Dentistry is moving away from "routine" radiographs because of this, there is no rule to take radiographs given each individual's caries risk.

Reply:

Thank you for the feedback.

Radiographs is still a gold standard for caries diagnosis in many countries, especially those with universal healthcare system, community centers, developing counties. In this study, we focus on specifically BTW which is the most relevant way to diagnose interproximal caries.

Also, as mentioned earlier in the introduction, dentistry is moving towards MID therefor early enamel lesions may not progress, meaning they may not require treatment.

Reply:

Thank you for the feedback.

Yes, but oral hygiene, dry mouth by side effects of certain medications, diet changes are the risk factors, and at least we dentists need to provide definitive diagnosis even its enamel lesions. So, it can be securely monitored.

The radiographs are also pertinent with the dental development of the individual-interproximal carious lesion detected at 12years of age compared to 50 years of age.

Reply:

Thank you for the feedback.

We agree your point. We only include patients with age over 18 who has permanent teeth in this study.

The clinical factors such as ICDAS 4 carious lesion correlated to interproximal carious lesion on radiographs, compare to ICDAS 3 would also be very different.

Reply:

Thank you for the feedback.

We understand, but we could detect ICDAS4 and ICDAS via visual examination. This large caries anyway should be treated without taking bitewings. In this study, we are

focusing on specifically interproximal caries.

Given the limitations of this study, the conclusion "clinicals fail to diagnose a large number of treatable carious lesions" would be inappropriate.

Reply:

Thank you for the feedback.

This conclusion has been updated to state that without BWR, dentists may fail to diagnose many carious lesions, which has been established due to the large number of missed IC lesions.

Reviewer B

Many revisions to grammar and style recommended, see attached PDF with markup.

Reply:

Thank you for the feedback.

The manuscript was reviewed by English editor and revised with your suggestions accordingly.

In particular:

1. caries is not plural. It is a disease, similar to "diabetes"

Reply 1:

This has been noted and updated.

2. Introduce concept of incipient caries earlier in the manuscript

Reply 2:

Early caries lesions were mentioned in the section in the introduction under minimally invasive dentistry.

Changes in the text:

In order to make minimally invasive treatment possible, dental caries needs to be diagnosed in the earliest stages, such as within enamel.

3. Delete methods from results section.

Reply 3:

This section has been moved.

4. BW -- does this refer to "bitewing" or "bitewing radiograph"? Thus, do you need "BW radiograph"? Remain consistent throughout. In many places you also have BTW"? Thus, do you need "BW radiograph"? Remain consistent throughout. In many places

Reply 4:

Thank you for the feedback.

The manuscript was revised accordingly. Abbreviation “BWR” was used for bitewing radiographs throughout the manuscript.

5. Recommend adding "in Japan" to title, since this is a very focused study.

Reply 5:

Thank you for the feedback.

“in Japan” was added in title.

Title: Importance of bitewing radiographs for the early detection of interproximal carious lesions and the impact on healthcare expenditure in Japan.

6. Manuscript is very wordy and should be made more concise. I tried to lend some suggestions.

Reply 6:

Thank you for the feedback and PDF with suggestions.

The paper was revised accordingly.

7. After all suggestions considered, revise abstract to match.

Reply 7:

The abstract was revised accordingly.

You may also want to touch on idea that overdiagnosing lesions on xrays can lead to excess costs in restorative dentistry when dentists do not abide by minimally invasive dentistry. One could argue that only at a certain point do the costs expended by treatment outweigh the costs saved by not taking BW. Overscreening leads to more false positives than underscreening.

Reply:

Thank you for the feedback.

The size of caries on radiograph (BWR) indicates only 70%~75% of the actual size. Taking BWR appropriately thus supports minimal invasive dentistry. First, we as dentists need to make definitive accurate diagnoses including incipient caries; progression can be halted using NaF varnish, oral hygiene instruction, monitoring etc.

And doing unnecessary or early restorative tx (class II restorations) means that those restorations will fail and need revision/replacement over time. Can one wait until they see opaque shadows under marginal ridges to take a BW? Would it still be a class II restoration, albeit a little larger than if caught earlier?

Reply:

Thank you for the feedback.

We agree. Doing unnecessary restorative tx creates potential opportunities for failure,

need to redo, and can lead to more invasive tx. However, the optimal timing of class II restoration depends on appropriate monitoring, many patient's factors such as oral hygiene, change of diet and medications. An opaque shadow under the marginal ridge, therefore, may be an indicator but is not the only indicator. Taking BWR, therefore, can help dentists monitor and understand the progression of the disease.

Are Japanese conservative with xrays and similar type medical or dental screenings all around? Or is it just BW for teeth? Do Japanese go to the dentist for preventive care on a normal basis or is this a rarity? If the culture is such that Japanese do not do regular health screenings, like pap smears, Prostate tests, etc -- maybe the lack of BW fits into that culture and will be an uphill battle to fight?

Just some thoughts for the authors to consider for discussion purposes.

Reply:

Thank you for your feedback.

Japan has universal healthcare coverage for both dental and medical. In dentistry, all procedures including initial exam, radiographs and cleaning cost 30% co-pay, but insurance does not cover the preventive care at all. So, BWR will not be covered for the diagnosis/exam purpose, and only covered with "diagnosis".

Students were taught BWR in dental school, but they usually have not had clinical practice. Our previous paper indicated inferior diagnosis accuracy/ability for the Japanese group compared to the US group.

Japanese individuals are not particularly conservative with xrays. Patients appreciate panoramic X-ray believing all diagnosis can be made without taking BWR.

Authors hope that this paper could help both policy makers, dentists and patients to understand an importance of BWR.

New paragraphs were added on the discussion to explain the BWR in Japan.

[Further Comments]

Abstract, Results section. I would *consider* shortening the numbers to be more reader-friendly. For example, 6.8M -204M for class II restorations and 62.7B versus 1.28B. Are these numbers backwards? Or are there numbers missing?

[Response]

Thank you for the suggestion.

The format of all numbers was revised as suggested throughout the manuscript.

Page 6, line 9 – do you mean STROBE?

[Response]

STROBE: S was missing, corrected.

Materials and Methods, line 12. Remove this first sentence. Combine the 2nd and 4th sentences. Line 23, just use the abbreviation. You have already introduced this abbreviation above in line 13.

[Response]

Thank you for the suggestion.

The first sentence was removed and the 2nd and 4th sentences for IRB approval were combined.

Page 12, line 16. Can you end the sentence at examinations? “Checkups and cleanings” sounds colloquial and may not be necessary here. I would scan the rest of the document and remain consistent if you choose to eliminate “checkups and cleanings” here.

[Response]

Thank you for the suggestion.

“Checkups and cleanings” were deleted. It was not mentioned in any other part of the manuscript.

Page 19, line 2. Please use your abbreviation for bitewing radiographs consistently. Same for the figure below.

Same for the legend in Figure 3.

[Response]

Thank you for the suggestion.

Revised figure 1 and legend with BWR.

Reviewer C

This manuscript is a retrospective observational study, which aimed to investigate the effect of not taking BiteWing Radiographs (BW) in the potential subdiagnosis of interproximal caries and evaluated the potential economic impact of this subdiagnosis. The manuscript is well written however, there are some considerations to be made:

FULL TITLE:

The title is clear and concise, entirely appropriate to the manuscript.

ABSTRACT:

- The abstract is well organized and objective. However, it is necessary to specify the type of study performed, the authors firm that is a descriptive study, but this is very general. The authors must be more specific. This study is a retrospective observational study.

Reply:

Thank you for the important feedback.

We specified “a retrospective observational study” in abstract, introduction, methods, and discussion.

- In abstract the authors state that the data were collected between June 2013 and 2016 (line 8-9). But the topic Materials and Methods (line 9) is described that the collection was performed in 2013 to 2017. It is necessary to clarify the data collection period.

Reply:

We collected the data from the national database from 2013~2017, and the manuscript was revised.

KEYWORDS:

- Keywords are unsuitable for Mesh Terms indexing standards (Medical Subject Headings).

Reply:

Keywords were revised using Mesh Terms indexing standards.

INTRODUCTION:

- The introduction is presented in a clear and organized way, with consistent literature citations.

- “Although largely preventable, dental caries is the most common chronic disease in the US, with 91% of Americans over the age of 20 having some caries (5).” I suggest confirming this information, maybe it is a decayed or restored tooth. I was unable to access reference number 5.

Reply:

Reference #5 indicated that “The Centers for Disease Control and Prevention this week released statistics on the high prevalence of dental caries (cavities) among U.S. adults, and the numbers are sobering. Ninety-one percent of Americans over 20 have had cavities at some point in their lives. Notably, the agency reports that 27 percent of adults over 20 have untreated caries”.

Changes in the text:

Although largely preventable, dental caries is the most common chronic disease in the US: 91% of Americans over 20 have experienced caries at some point in their lives (5).

OBJECTIVES:

Clear and well defined.

MATERIALS AND METHODS:

- There is a need to report the type of observational study developed.

Reply:

We specified “a retrospective observational study” in abstract, introduction, methods, and discussion.

- “The number of teeth with caries actually treated was calculated as the sum of the number of class II restorations insured, such as, composite fillings, metal inlays, and composite inlays, denoted by codes M0091B, M0092B, M0101A, M0091A, and M0091B from the JMHLW data (22)”. Not necessarily a Class II restoration started from the proximal. The fact that we have a lesion radiographically does not mean that the caries is active and that we would need intervention / treatment.

Reply:

Thank you for the feedback.

We agree. We designed the study such that Class II restoration would represent active interproximal caries. There is no true definitive way to determine whether caries is active or not without continuous monitoring. The purpose of this study is to estimate the effects of not taking BWR on the diagnosis and consequence treatment modality.

- Explain the acronyms used in Figure 2.

Reply:

Figure 2 was revised accordingly and the acronyms were added in the legend.

Changes in the legend:

[E1: The expenditure of preventive care recommended. E2 and D1: The expenditure of class II restorations recommended. D2: The expenditure of extensive treatment recommended.]

- Another important point is that the authors work with the Japanese currency, I suggest making a forecast also in dollars to facilitate the understanding of a greater number of readers about the costs of procedures.

Reply:

Yes, we revised the data in US dollars in figures and the manuscript.

STATISTICAL ANALYSIS Statistical analysis is appropriate

RESULTS

- In table 2, specify where the data were obtained and all acronyms used must be explained, even if they have already been explained in the text of the article.

Reply:

There is no table 2. We carefully reviewed all tables and figures. Figure 2 was revised adding explanation of acronyms.

DISCUSSION:

- The discussion presents interesting points in the literature, but the authors need to better discuss the results obtained in this study. The discussion needs a substantial improvement.

For example:

- In the results (page 6, line 7-9): "In the months of June over the period of 2013 through 2018, there were 4,029,234 total periapical radiographs and 1,347,665 total panoramic radiographs (Fig. 3). In comparison there were only 48,882 bitewings acquired total (Fig. 3)". It is important to discuss why this big difference between BW's shot quantity and other techniques.

Reply:

The data indicated a big difference between the number of BWR taken and periapical and panoramic radiographs. The potential reasons could be 1) Japanese UHCS don't cover BWR for diagnosis purpose. 2) The panoramic radiograph is covered, and patients appreciate them being taken. The most common pattern for a new patient visit is taking panoramic first and then taking a periapical for specific teeth that indicate problems diagnosed by panoramic and clinical examination. 3) Taking BWR addition to the panoramic and periapical radiographs takes too much time and dentists prefer not to do so. 4) Patients do not want to have BWR that are not covered by insurance for diagnostic purposes. This article could help change this unique culture to make both dentists and patients understand the benefit of BWR.

The above additional explanations were added in the discussion section Page 9 L 2~12.

- The authors also made an estimate of the estimated cost of treatment of caries lesions left undiagnosed. But it would also be interesting to measure what would be the monthly cost of BW correctly used for diagnosis for the discussion of this study. This point would be interesting to assess the impact on health expenses.

Reply:

Estimated cost of BWR if it's taken once a year, would be \$14,649,216 (1.5E+07).

Paragraph was added in the discussion section.

Changes in the text:

Simply calculating, if BWRs were taken for all patients once a year, the cost of BWR (4 bitewings) would be \$14,649,216 (1.5E+07) which is much small expenditure than the expected cost of undiagnosed caries in the progressed stage.

- The Bitewing radiographs are important for the diagnosis of interproximal caries, however, they do not predict caries activity, for determining the treatment of caries

lesions.

Reply:

Agree. We divided estimated number of undiagnosed interproximal caries into enamel and dentin caries using a reference so that caries activity and appropriate treatments are considered in the calculation.

CONCLUSION:

Clear and justified.

REFERENCES:

- Need to be updated

Reply:

We were not able to find any new publication for reference 21 so that kept it and we included paragraph in the limitation section.

[Further Comments]

This manuscript is a retrospective observational study, which aimed to investigate the effect of not taking BiteWing Radiographs (BW) in the potential subdiagnosis of interproximal caries and evaluated the potential economic impact of this subdiagnosis. The authors performed most of the requested changes, however, some important questions could not be adjusted due to the limitations of the methodology used. I understand that the main intention of the authors is to emphasize the importance of interproximal radiographs in the control/diagnosis of caries lesions, but due to methodological limitations (occurring due to the multifactorial nature of caries, possibility of non-progression of lesions in enamel, possibility of false-positive ...). The authors could not achieve the objective of the study and obtain the impact on health expenditures in Japan by not performing routine interproximal radiographs.

[Response]

- Authors understand your points and made serious efforts to support our methodology using 4 new references.

There are countries (both developed countries and developing countries) that don't use BWR for diagnostic purposes although it is routinely used in USA. Countries like Japan which has a universal healthcare system that provides dental care at a very low cost (RCT copay is about \$60), dentists prefer panoramic films (quick and higher fee) over BWR, resulting in missing caries at an initial stage. This paper can help to change this culture in dentistry.

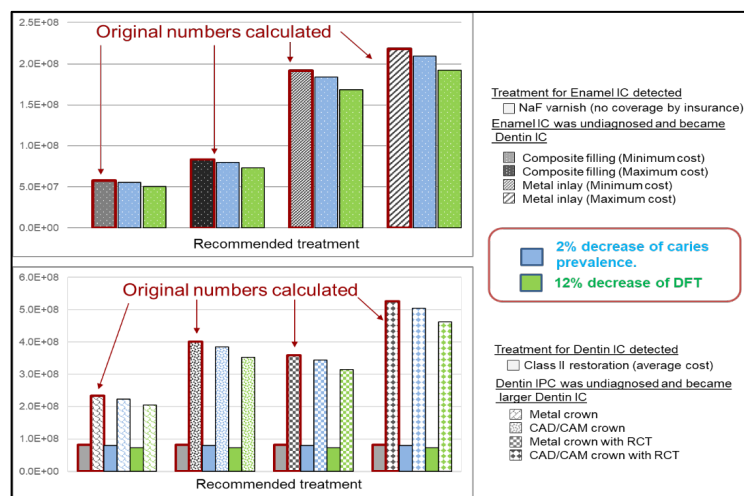
4 new references were added in the limitations section to justify the methodology and importance of our study.

Actually, references indicated followings:

- 1) The prevalence of dental caries among adults aged 20–64 years (2011-2016) was 90%, which is a slight decrease from 92% during 1999–2004. Decreases of 2 to 4 percentage points were observed among adults who were younger (aged 20–34 and 35–49 years), male, non-Hispanic white, not-poor, and better educated and who had never or formerly smoked. Among adults with caries, mean DFT was 7.4, lower than the estimate of 8.2 during 1999–2004. Mean DFT and FT both decreased by about 1 tooth overall (ref #33: CDC. Oral Health Surveillance Report, 2019).
- 2) One tooth decrease (8.2 to 7.4) on DFT similar to 12% decrease in untreated caries was the data from the other publication (Health, United States, 2019).
- 3) A strong effect of age manifested in caries experience, period and cohort effects aside. Caries levels increased through to adolescence; thereafter, there was a larger increase in DFT in adulthood. Compared with the aging effect, period and cohort effects on caries experience were small. Population DFT scores decreased over time in all countries except Japan (American Journal of Public Health, 2014).
- 4) DFT in Japanese adults (age 25~65) is 12.0 in 2011~2016 and 12.9 in 1999~2004, (Ministry of Health L, and Welfare. 2016 Dental disease fact-finding survey conclusion).

Base on the above findings from references, the amount (\$) of estimated expenditure was calculated reflecting the recent caries prevalence decrease in USA (4%) and DFT decrease (12%: 1 tooth decrease from 8.2 to 7.4). Reflecting a 4% decrease in caries prevalence, the estimated expenditure will decrease to 96%, and with 12% decrease of DFT, the estimated expenditure will decrease to 88%. These differences are not large and don't change our objectives. These considerations were added to the limitations section.

*The figure for these data (for Figure 5) is shown below for your information.



- We fully understand your concerns of possibility of non-progression of lesions in enamel and false positives. Therefore dentists should take BWR to carefully monitor interproximal caries.

Reviewer D

General comments:

The reasoning behind the lack of BW screening in Japan is not addressed other than eluding to the Universal Healthcare. Is this purely financial or are historic rates of caries low? Traditional Japanese diet is low in refined sugar so caries incidence may not compare to those in the US. This paper (<https://doi.org/10.3390/nu10020118>) indicates that some Japanese are shifting toward a modern (high sugar) diet which will increase the incidence of caries.

Reply:

The reasoning behind the lack of BW screening in Japan was addressed in discussion (Same comment by another reviewer).

The reasoning behind the lack of BW screening in Japan is not because of diet, it is more historical pattern. When I moved to US 20 years ago after 19 years academic clinical experience at a Japanese university dental hospital as prosthodontist, I had a hard time reading BWR accurately.

Changes in the text:

“The data indicated a big difference between the number of BWR taken and periapical and panoramic radiographs. The potential reasons could be 1) Japanese UHCS don't cover BWR for diagnosis purpose. 2) The panoramic radiograph is covered, and patients appreciate them being taken. The most common pattern for a new patient visit is taking panoramic first and then taking a periapical for specific teeth that indicate problems diagnosed by panoramic and clinical examination. 3) Taking BWR addition to the panoramic and periapical radiographs takes too much time and dentists prefer not to do so. 4) Patients do not want to have BWR that are not covered by insurance for diagnostic purposes. This article could help change this unique culture to make both dentists and patients understand the benefit of BWR”.

Additional reply:

The reasoning behind the lack of BW screening in Japan is not because of diet, it is more historical pattern. When I moved to US 20 years ago after 19 years academic clinical experience at a Japanese university dental hospital as prosthodontist, I had a hard time reading BWR accurately.

Specify the published standard of care in Japan. Is the PA/pan used only for

symptomatic or clinically visible lesions? BW is not necessary for loosely spaced teeth and if PA is ordered only for tight contacts, this may be adequate. It should be noted that IC can be seen on PA.

Reply:

The common pattern of standard of care for new patients was added in the discussion as above. Page 9 L 2~12.

The estimation is based on a 25 year old paper in which it is not clear if the subjects had been receiving dental care prior to becoming new patients in the clinic at UCLA. The caries rate in that population may therefore be very inflated in comparison to the Japanese population with ongoing clinical examinations. This is addressed as a study limitation in the discussion section but may warrant some approximate error bar.

Reply:

We added further limitations, potential over or under-estimation in the discussion.

Changes in the text: Page 11: L 11~18

Although the results could be over or under-estimated due to the accuracy of the formula used, the results of this study could provide an important message to nations not using BWR for routine examinations, check-ups, and cleanings.

The authors specify necessity of training in BW. If clinicians are using PA and pan, they have likely been trained to recognize caries on a radiograph.

Reply:

Our previous publications indicated superiority of BWR over PA on diagnosis accuracy of interproximal caries, and the Japan team had less ability/skill on BWR reading than US team. Therefore, they need training of BWR reading indeed.

Minor comments:

BW and BTW alternate within the text. BW should be used consistently.

Reply:

Yes, we revised the manuscript throughout using BWR.

p.5, line 19 "will progress" should be "may progress"

Reply:

Yes, we revised the manuscript

p.6, line 7: "In the months of June over the period of 2013 through 2018..." is confusing.

Reply:

Changes in the text:

From 2013 through 2018, 4,029,234 total periapical radiographs and 1,347,665 total panoramic radiographs were taken per month.

Fig.2 "cares" should be "care"

Reply:

Yes, we revised the manuscript

Reviewer E

1. Page 3, Line 3, 4:

Suggest providing the ranges of sensitivity and specificity of BWs for early dental caries.

Reply 1:

The statement of sensitivity and specificity of BWR and periapical radiograph were included in the introduction.

Changes in the text:

“BWR show significantly better sensitivity than periapical radiographs for all levels of caries progression (BWR: 94.5 for dentin caries, 90.43~82.7 for enamel caries, periapical: 69.7 for dentin caries, 3901~56.2 for enamel caries), although there was no significant difference on specificity (18).”

2. Page 3, Line 9:

Suggest omitting the word "Routine" as it implies a time-based prescription of BW radiography without consideration of clinical findings and needs.

Reply 2:

"Routine" was deleted.

3. Page 4, Line 7 (and in Figure 1)

Use of BTW is inconsistent with previous abbreviation (BW). This needs to be reviewed throughout the manuscript. Similarly, in Figure 1, the use of IPC/IC as an abbreviation should be kept consistent.

Reply 3:

We used BWR thorough the manuscript and revised.

4. Page 4, Line 9-10

Additional background information on Japan's healthcare and reimbursement system is required (if not here, then under the Introduction). Assuming that all public healthcare expenses are reported to the Japanese universal healthcare system, are there any private sector figures that might have been missed out, or are these all

reported to UHCS?

Reply 4:

Additional background of Japanese universal healthcare system was introduced in the introduction section.

Changes in the text: Page 3, L 20~23

“The Japanese universal healthcare system was selected because medical and dental care are recorded together. For dentistry, insurance covers most dental services except for preventative care, aesthetic restorations, dental implants, orthodontics, among others. In 2011, the Japanese Ministry of Health, Labor and Welfare established that third parties can access the UHCS database under government guidelines”.

5. Page 4, Line 19

Further justification for the formula presented in Figure 1 is required. If the number of interest is Number of teeth where IC is undiagnosed by not taking BW, shouldn't the formula be "Total number of teeth with IC (including those diagnosed with and without BWs) - Number of teeth that had caries (which were diagnosed without BWs)"?

Reply 5:

The number of interest is the number of undiagnosed IC in the patient population. To get this number, therefore, we looked at the number of carious teeth expected (as established by White's formula) and the number of treated teeth. BWR are simply a tool for diagnosis and have been well documented their efficacy. The number of IC teeth diagnosed with BWR could not be counted using the data available.

In the formula used by the authors, for "Number of teeth were IC were actually treated", i.e. based on the sum of class II restorations, how did the authors confirm that these diagnosis were made without BWs?

Reply 5:

It cannot be confirmed; however, BWR are hardly taken in Japan as Figure 3 showed, class II restorations are usually made based on PA or PAN or visual examination.

6. Page 5, Line 3 and Line 22

White's estimation is based on 490 patients in the US in the 1990's. There may be differences in demographics between US and Japan, and caries risk (where White's data is from 20 years ago). Is there alternative data that more recent and specific to Japan that can be used?

Noted that this point has been addressed in the “Limitations” section, but the use of this estimate presents a significant flaw to the design of this study.

Reply 6:

I understand your criticism, but there is no other reference to use for this estimation. In this retrospective observational study, even if the results could be over-estimated or under-estimated, the results of this study could provide important message to the countries that are not using BWR for routine examination and cleaning checkup. Indeed, there are countries that are not using BWR.

Changes in the text:

“In this study, although the results could be over-estimated or under-estimated due to the level of accuracy of the formula used, the results of this study could provide important message to the countries that are not using BWR for routine examination and cleaning checkup”.

7. Page 5, Lines 16-21/Figure 2

This formula incorporates the consequences of diagnosed caries but doesn't seem to account for the fact that the progression of caries occurs over time, sometimes years. Did the authors account for this, and for the possibility of lesions being diagnosed before it reaches a later stage? For example, if IC was undiagnosed at the E1 stage, was it possible that it was detected at the next visit, but before the lesion reaches E2?

Reply 7(1):

E1 stage caries is hardly seen on PA, but yes there is a chance that it could be seen on PA before getting E2 (dentinal caries). However, it is very important to diagnose caries at the early stage by BWR so that preventive care can be used.

We performed a retrospective observational study, so we plan to do a prospective study to clarify these issues suggested. Thank you for your great feedback.

Are the authors assuming that no BWs will be taken throughout all subsequent visits, and that all caries initially undiagnosed will continue to remain undiagnosed until the next stage of caries progression? Are there any other assumptions held by the authors in using this formula?

Reply 7(2):

Having the data of that BWR is hardly taken in Japan (Figure 3), authors assume that interproximal caries in enamel will be undiagnosed till it becomes dentin caries or touching the ED junction on PA (which is already in dentin).

8. Page 6, Line 17

Results for “Number of IC that could be missed by not taking BTW” could be heavily flawed based on assumptions predicated on White’s estimates (see comment above for Page 5, Line3/22)

Reply 8:

We understand your criticism, however there is no reference available to use for this

estimation. We explained more about this issue in the limitation section.

Changes in the text:

“In this study, although the results could be over-estimated or under-estimated due to the level of accuracy of the formula used, the results of this study could provide important message to the countries that are not using BWR for routine examination and cleaning checkup”.

“Furthermore, a prospective observational clinical study should be performed to monitor the undiagnosed IC over time”.

9. Page 7, Line 6 to Page 8 Line 5

Results here need to address the questions raised about the methodology (see comment above for Page 5, Lines 16-21).

Reply 9(1):

Additional paragraphs were included in the discussion.

Changes in the text:

“In this study, although the results could be over-estimated or under-estimated due to the level of accuracy of the formula used, the results of this study could provide important message to the countries that are not using BWR for routine examination and cleaning checkup”.

“Furthermore, a prospective observational clinical study should be performed to monitor the undiagnosed IC over time”.

Additionally, please address whether the percentages of dentinal caries is overestimated in these Results. If caries is present within the dentine (D1 stage), these would likely be picked up on the periapical radiographs, which seems to be taken in high volumes based on Figure 3, even if BW radiographs were not taken.

Reply 9(2):

Thank you very much for your feedback. Authors fully agree and revised the calculation, focusing only on shallow dentin caries that could be missed on PA. The expected scenario is “shallow dentin caries is missed at the first exam visit and progressed and found on PA for later visit”. Figure 5B was revised and \$numbers in the manuscript were also revised accordingly.

[Further Comments]

I have reviewed the revised manuscript and I still have significant concerns regarding the methodology that has not been adequately addressed by the authors.

Page 6, Line 11-12 // Page 9, Lines 15-18 // Page 12, Lines 14-17

As commented on previously, using White’s estimation presents a significant

methodological flaw to this study. It is not sufficient to just state “Although the results could be over 15 or under-estimated due to the accuracy of the formula used, the results of this study could provide 16 an important message to nations not using BWRs for routine examinations, check-ups, and 17 cleanings.”

There are different implications if the estimates cannot be correctly applied to the Japanese population. If White over-estimates the prevalence of IC (interproximal caries) present in the Japanese population (meaning the actual IC prevalence in Japan is lower), then undiagnosed IC rate is over-estimated, and the importance of BWR would be over-estimated/inflated.

I believe that the above would be the case, given that the other reviewers’ comments that also highlighted how the caries rate in the USA population from a 25 year old paper might be very inflated in comparison to the Japanese population. Unless the authors are able to use more recent estimates from a Japanese population, the current methodology of this submission, as it stands, is still flawed.

[Response]

Thank you for the important feedback.

Authors understand your points and took serious effort to support our methodology using 4 new references.

Sadly, it was reported that DFT in Japanese adults (age 25~65) was 12.0 in 2011~2016 and 12.9 in 1999~2004 (2016 Dental disease fact-finding survey conclusion by the Japanese Ministry of Health, Labor and Welfare).

Furthermore, it was reported by the American Journal of Public Health that DMFT scores decreased over time in all countries (UK, USA and Sweden) except Japan. There were decreases in population DMFT values over time in all countries except Japan; namely from 18.0 (95% CI = 16.7, 19.3) to 15.7 (95% CI = 13.8, 17.7) over 4 decades in England and Wales, from 17.0 (95% CI = 14.4, 19.6) to 12.5 (95% CI = 11.0, 14.0) over 4 decades in the United States, and from 18.3 (95% CI = 16.7, 20.0) to 15.3 (95% CI = 13.5, 17.0) over 3 decades in Sweden. In Japan, caries levels have remained fairly stable since 1957.

Through these major revisions, authors searched for evidence to support the methodology of White’s paper. We used the four references listed below, to recalculate the estimated expenditure and added the information to the discussion section. Basically, decrease of caries prevalence and decrease of DFT in US were small so that the estimated expenditure became 88% ~96% of the original numbers. In contrast, in Japan caries levels have remained fairly stable since 1957, and actual DFT in Japan was higher than US.

1) National Health and Nutrition Examination, CDC, Oral Health Surveillance

Report, 2019: <https://www.cdc.gov/oralhealth/publications/OHSR-2019-index.html>.

- 2) CDC. Health, United States 2019, Available from: <https://www.cdc.gov/nchs/data/abus/abus19-508.pdf>.
- 3) Bernabé E, Sheiham A. Age, period and cohort trends in caries of permanent teeth in four developed countries. *Am J Public Health*. 2014;104(7):e115-21.
- 4) Ministry of Health L, and Welfare. 2016 Dental disease fact-finding survey conclusion 2016, Available from: <https://www.mhlw.go.jp/toukei/list/dl/62-28-02.pdf>.

Page 10, Lines 1-11 and Figure 5b

There are too many assumptions here. The authors are assuming that dentinal caries won't be detected as the D1 stage and (subsequently D2) either by clinical examination or on the PA radiographs, and especially before D1/2 caries gets to the stage that it requires Metal or CAD/CAM crown, or an RCT. Clinically, this is very unlikely.

[Response]

Unfortunately, routine examinations with BWR is not the standard of care in Japan, and patients usually come to the dentist when they are symptomatic.

Figure 5-B indicated the worst-case scenarios. The caries progresses not only toward coronally but also buccally and lingually (we see this trend often in daily practice), then the cusp will lose supported dentin structure, and treatment indications are onlay, crown, and may also include root canal treatment.