Teledentistry for Pediatric Dental Emergency:
Comparison Between Experienced and Novice Users

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Introduction

Teledentistry has the ability to improve access and delivery to oral health care, and lower its costs.[1,2,3] During the COVID-19 pandemic, implementing teledentistry in pediatric field was more important because children present a high risk of asymptomatic transmission due to the prolonged incubation period of the virus.

Due to the fact that trauma and toothache constituted the most common reasons for pediatric dental emergency visits[4] ,the value of accurate diagnosis and recommendations to caregivers via teledentistry cannot be emphasized since diagnostic error has been defined as a major health care issue[5], which causes a substantial source of morbidity, mortality, and costs.

The purpose of this study is to evaluate Dental Students (**DS**) and General Dentists (**GD**) using teledentistry when encountering a pediatric emergency.

Methods

60 GD in Southern California and 85 DS in 3rd and 4th year of Loma Linda University Dental School were recruited. Subjects were randomized to one of the five teledentistry emergency scenario (2 trauma, 2 pain, and 1 control). Each subject will do a real life E-visit on zoom with a standard patient to collect data and give out diagnosis and treatment recommendation. The zoom visit was recorded and reviewed by single investigator to collect quality of diagnosis (QD), quality of treatment (QT) and the detailed information (DI). A post-visit survey collected demographic data, usability, confidence of diagnosis (CD) and confidence of treatment recommendation (CT).

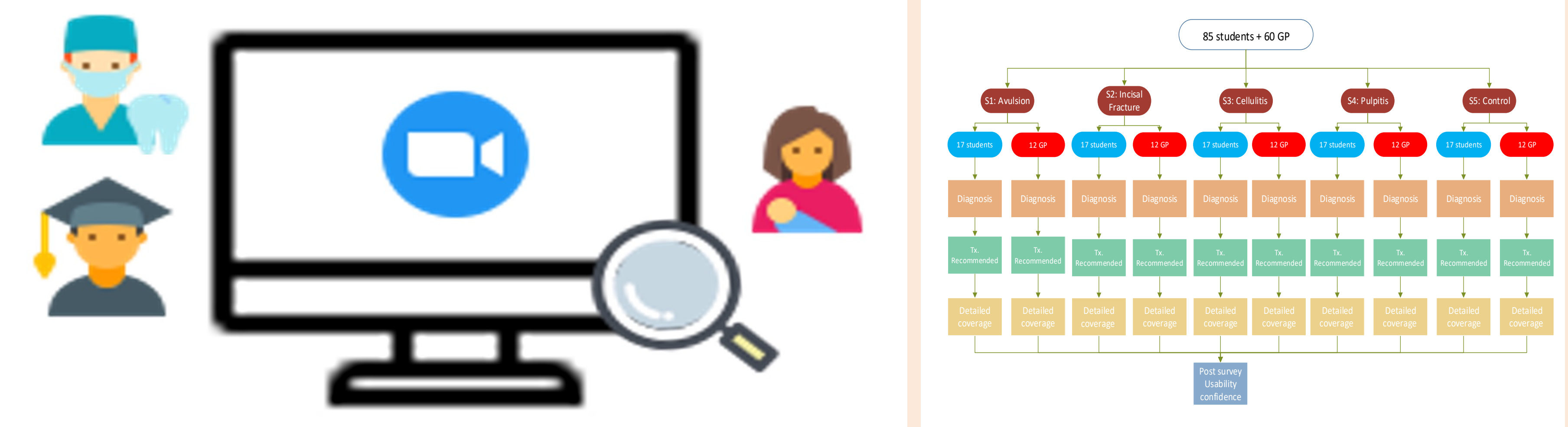

Figure 1. Research flow chart

Doctor: Hello, Mrs. Smith. How are you today? This is_____from loma linda university school of dentistry. At this e-visit today we are going to start John's limited evaluation by asking you some questions about your son's health and dental conditions. Is this OK for you? (Introduce yourself)
Mom: **Yes.**
Doctor: Thanks you. How old is he right now?
Mom: **7 year and 4 months old.**
Doctor: Does John has any medical condition or health history?
Mom: **No. He is healthy.**
Dr.: Does he has a regular dentist? (dental history)
Mom: **Yes. We usually go there for checkup half a year. But since today is Saturday, they did not open the clinic.**
Doctor: Does he has any allergy to medication or food?
Mom: **No. He is not allergy to anything.**
Doctor: Does he take any medication right now?
Mom: **Yes.**
Doctor: If yes, can you provide us the medication list?
Mom: **He's right now taking multivitamin C twice a day.**
Dr.: Does all his immunization up to date?
Mom: **Yes.**
Doctor: Ok. Mom, so why are you seeking dental care today?(C.c.)
Mom: **Doctor, let me forward my son's picture of tooth to you. His front tooth came off this morning.**
Doctor: OK,I see… sorry to hear that. Can you tell me when was the tooth knocked out?
Mom: **This morning, about 10am, 1 hour ago.**
Doctor: How was the tooth knock out?
Mom: **My son was playing skateboard with his brother and just fall off and hit his front face.**
Doctor: Does he lost his conscious at that time or since then?
Mom: **No. He was crying due to the hurt.**
Doctor: Where is the trauma happened? What kind of ground that he fell down and hit his face?
Mom: **At the alley near our house. It was just a normal pavement.**
Doctor: Was the tooth completely knocked out? Or just moved out of position?
Mom: **I don't know…Here's the tooth fragment(forward the picture of the open apex #8)**
Doctor: Mom, what did you do at that time?

Mom: **I gave him gauzes to bite on.**
Doctor: Is it still bleeding right now?
Mom: **No. It looks like the bleeding has stopped.**
Doctor: Where has the tooth been since it was knocked out? (storage medium or not)
Mom: **We put it in the water after we found it on the floor.**
Doctor: Does John have other trauma to his face?
Mom: **Just a little bruise on his face.**
Dr.: Do you find any fragment or tooth pieces in his mouth or soft tissue?
Mom: **I don't know, he cried once I touch his wound, so I'm a little bit scare to touch it.**

History taking
Dr.: Does he ever had any trauma history when he was small?
Mom: **I believe no… as far as I know.**
Dr.: Does he has any developmental issue? For example, motor delay? Or mental issue?
Mom: **His primary doctor actually recommended us to do the ADHD evaluation last year, but since the COVID burst out, we end up forgetting about it.**
Dr.: Is the bruise just came out today after the trauma? Or it has been there before today?
Mom: **It's caused by the trauma today.**
Dr.: Does he need any antibiotics prophylaxis before dental tx?
Mom: **No.**
Dr.: Does he has any bleeding issue during dental tx before?
Mom: **No.**

Trauma scene
Dr.: Do you witness when he fell down?
Mom: **No, I was talking on the phone, but suddenly I heard him crying.**
Dr.: So, do you know how he hit the floor? At the front side? Or did he bump into something?
Mom: **Actually, I didn't witness the detail, but I believe he hit the floor since I saw him crying and trying to get up from the floor.**
Dr.: Do you touch the root part of the tooth when you grab it?
Mom: **I don't know, I just take it up.**

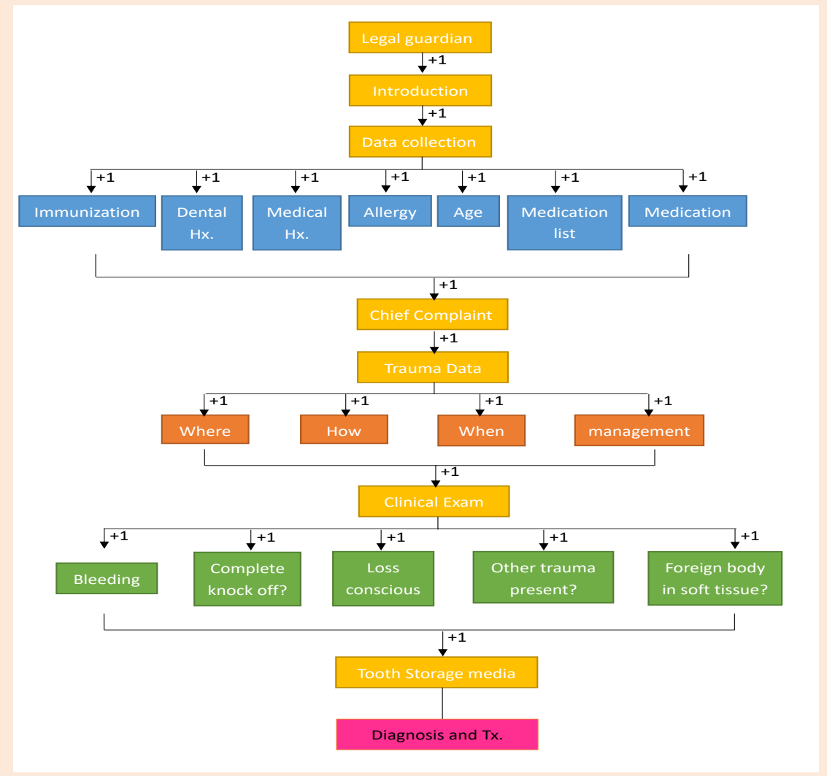

Figure 2. Scripts for the standard patient and the data points collected

Scenarios	Basic data	Pt info	Chief complaint related data	Total
Avulsion	5	7	9	19
Incisal fx.	4	7	9	20
Cellulitis	4	7	12	23
Pulpitis	4	7	8	19
Gingivitis (Control)	4	7	9	20

Table 1. Data points collected in each scenario

Results

- **Demographic background**

1. A total of 145 participants (n=85 DS and n=60 GD) were recruited for the study.
2. Significant difference regarding the age, years in practice, and practice setting between the two groups. (Table 2)

- **Quality of diagnosis (QD) and Quality of tx. recommendation (QT)**

1. GD scored significantly higher than DS in QD and QT regarding all 5 scenarios except control (Figure 3&4), which is correlated with age, years in practice. → Experience could affect the validity of teledentistry.
2. DS scored significantly higher in control scenario. (Figure 3)
   → DS will need their supervisor when facing treatment-needed scenarios.
3. For GD, avulsion scenario scored high in QD, but low in QT. (Figure 3&4)
   → The importance to update knowledge regarding dental trauma.
4. For GD, cellulitis scenario scored low in QD, but high in QT. (Figure 3&4)
   → Although the providers cannot provide the exact diagnosis, they can refer patient to immediate medical consultation when life-threatening scenarios happened.

- **Confidence of diagnosis (CD) and Confidence of tx. recommendation (CT)**

1. GD scored significantly higher than DS in CD and CT regarding all 5 scenarios. (Figure 5&6)
2. For DS, CT was significantly correlated with DI.
   →Gathering more DI can help novice users to increase their confident when using teledentistry.

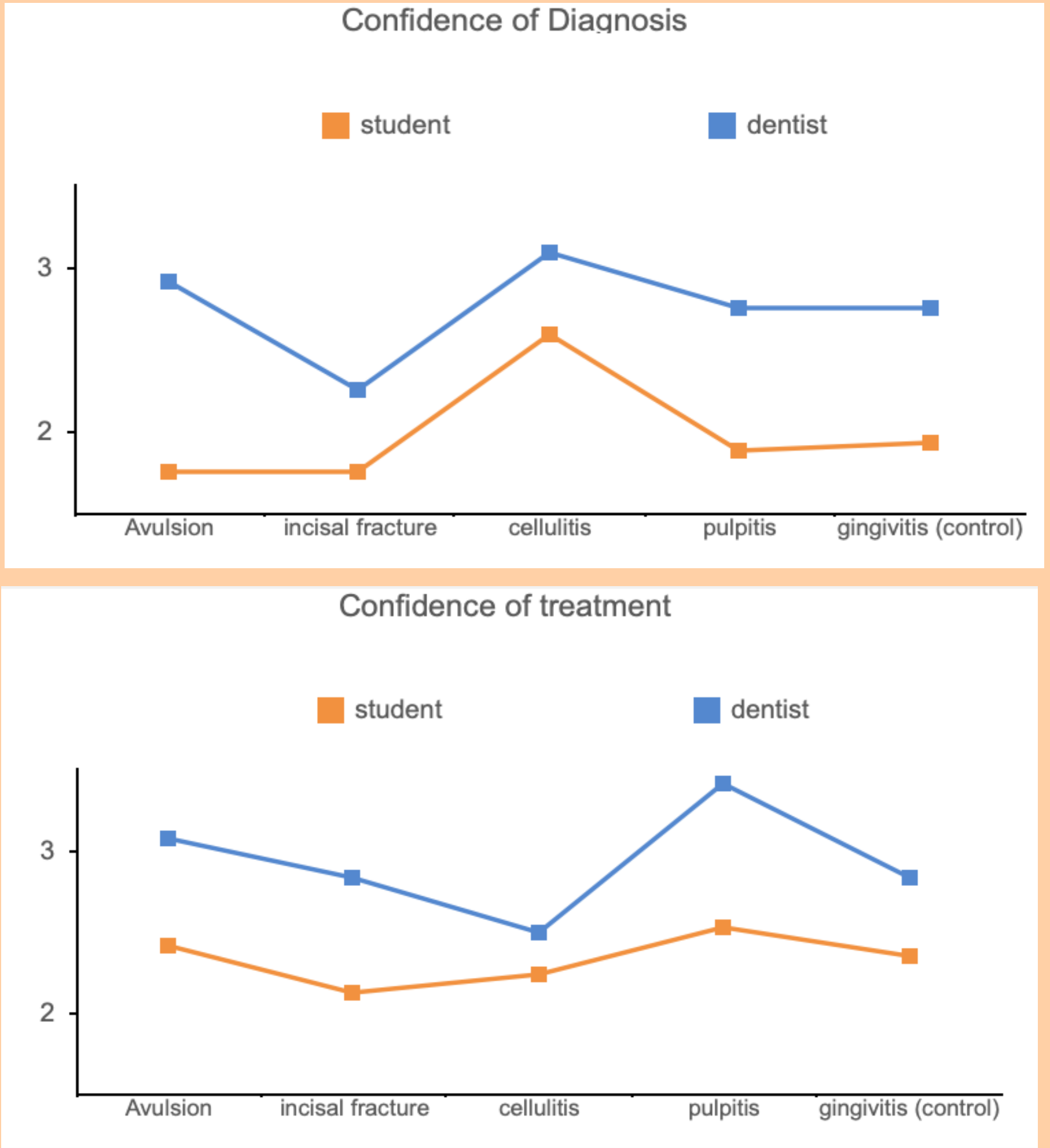

Figure 5. and 6. Comparison of CD and CT between GD and DS

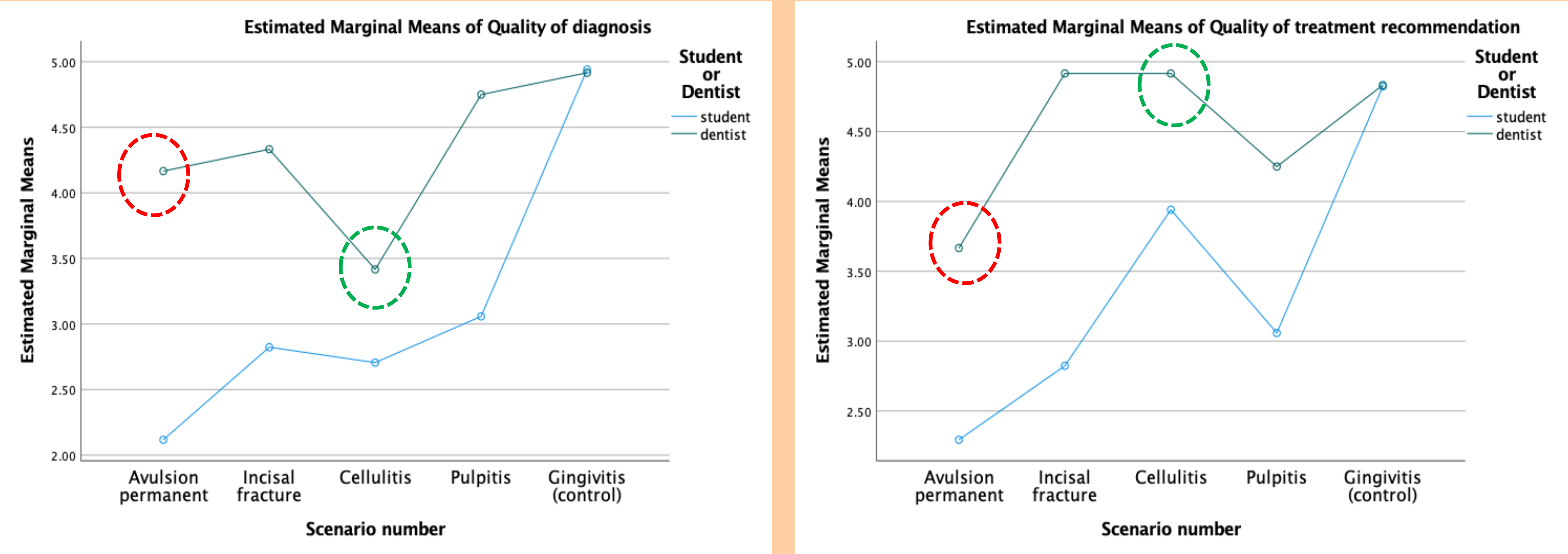

Figure 3. and 4. Comparison of QD and QT between GD and DS

- **Usability**

1. Both GD and DS hold positive attitude towards the usability of teledentistry. (Table 3.)
2. 3 main difficulties of using teledentistry:
   (1) lack of X ray, (2) image quality and quantity,
   (3) lack of clinical exam

Table 2. Demographics of subjects

Characteristic	Dental students (N=85)	General dentists (N=60)	P-value (X^2 test)
Age			**<0.001***
20-30 years old	76(89.4%)	6(10.0%)	
31-40 years old	9(10.6%)	25(41.7%)	
>40 years old	0	29(48.3%)	
Years in practice			**<0.001***
Students	80(94%)	0	
<2 years	2(2.5%)	7(11.6%)	
2-5 years	3(3.5%)	10(16.7%)	
6-10 years	0	9(15%)	
>10 years	0	34(56.7%)	
Gender			**0.365(NS)**
Male	43(50.6%)	26(43.3%)	
Female	42(49.4%)	33(55%)	
Do not want to disclosure	0	1(1.7%)	
Practice setting			**<0.001***
Student	85(100%)	0	
Full time faculty	0	29(48.3%)	
Private Practitioner	0	29(48.3%)	
Community Health	0	2(3.4%)	

Table 3. Usability of subjects

Characteristic	Dental students (N=85)	General dentists (N=60)	P-value (X^2 test)
The teledentistry is helpful in making a diagnosis.			0.211
Strongly agree	7(8.2%)	5(8.3%)	
Agree	39(45.9%)	22(36.7%)	
Neutral	22(25.9%)	20(33.3%)	
Disagree	17(20%)	10(16.7%)	
Strongly disagree	0	3	
The teledentistry is helpful in making a treatment recommendation.			0.327
Strongly agree	7(8.2%)	5(8.3%)	
Agree	49(57.6%)	35(58.3%)	
Neutral	20(23.5%)	12(20%)	
Disagree	9(10.6%)	5(8.3%)	
Strongly disagree	0	3(5%)	
The teledentistry is easy to use.			0.742
Strongly agree	13(15.3%)	8(13.3%)	
Agree	51(60%)	40(66.7%)	
Neutral	15(17.6%)	10(16.7%)	
Disagree	6(7.1%)	2(3.33%)	
Strongly disagree	0	0	
I like to use teledentistry in my practice.			0.059
I will always use it.	1(1.2%)	2(3.33%)	
I will often use it.	22(25.9%)	7(11.7%)	
I will sometimes use it.	51(60%)	34(56.7%)	
I will rarely use it.	8(9.4%)	14(23.3%)	
I will never use it.	3(3.5%)	3(5%)	
Teledentistry will improve the care I provided.			0.348
Strongly agree	8(9.4%)	4(6.7%)	
Agree	55(64.7%)	32(53.3%)	
Neutral	17(20%)	19(31.7%)	
Disagree	4(4.7%)	5(8.3%)	
Strongly disagree	1(1.2%)	0	

Discussion

This study showed that teledentistry can provide good diagnosis(74.5%) and treatment planning(77.2%) with 54.4-93.8% sensitivity and 100% specificity. The finding was comparable to telemedicine and similar to a 2022 study showing that sensitivity and specificity for dental referrals and diagnostic treatment planning were higher than other index/reference tests.[6]

Overall, this study showed that GD performed better than DS in all the index except DI, which is also related to age and years in practice. GD showed higher sensitivity when compared to DS, which is 83.3-93.8% and 54.4-57.4% respectively. The findings are similar to multiple literatures that compared between experienced users and novice users.[7-9] Most of the studies indicate that there is significant association between years of experience and the care provided. The finding of this study suggested that novice users will need supervisors when using teledentistry to diagnose treatment-needed scenarios. Additionally, gathering more DI not only correlated with the quality of care, but also increase the confident of novice users.

One of the strengths of our study is that the five scenarios were designed to be experimental scenarios. Our study adds to the body of evidence that it is important for both experienced and novice dentists to update their knowledge of dental trauma and severe life-threatening emergency.

Conclusion

Based on the present study's results, the following conclusions can be made:

1. Teledentistry is effective for diagnosing and managing most pediatric dental emergencies, especially with high specificity. .
2. Experienced users provided a better quality of visit compared to novice users; so, dental students should be supervised when performing a teledentistry visit. Also, novice users can increase their confidence of treatment planning by asking more detailed information.
3. More education is recommended in more severe emergency scenarios, such as avulsion and cellulitis.

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