Teleorthodontics: Perception and Reliability of Virtual Records for Orthodontic Decision Making

2022 Research Aid Awards (RAA)

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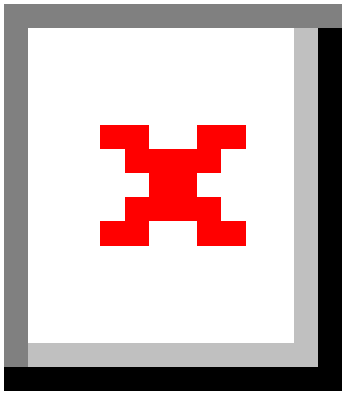
FollowUp Form

Award Information



In an attempt to make things a little easier for the reviewer who will read this report, please consider these two questions before this is sent for review:

- *Is this an example of your very best work, in that it provides sufficient explanation and justification, and is something otherwise worthy of publication? (We do publish the Final Report on our website, so this does need to be complete and polished.)*
- *Does this Final Report provide the level of detail, etc. that you would expect, if you were the reviewer?*

Title of Project:*

Teleorthodontics: Perception and Reliability of Virtual Records for Orthodontic Decision Making

Award Type

Research Aid Award (RAA)

Period of AAOF Support
July 1, 2022 through June 30, 2023

Institution
University at Buffalo School of Dental Medicine

Names of principal advisor(s) / mentor(s), co-investigator(s) and consultant(s)
Dr. Thikriat Al-Jewair; Dr. Ashish Gurav; Dr. Gregory Wilding

Amount of Funding
$5,000.00

Abstract
(add specific directions for each type here)

Introduction: In light of the COVID-19 pandemic, many dental and orthodontic offices incorporated teledentistry into their practice. Teleorthodontics, a subset of teledentistry, aims to deliver health-related information and orthodontic care remotely using information technology and telecommunication. Teleorthodontics encompasses the diagnosis, treatment, monitoring and prevention of problems associated with orthodontic care. Before the COVID-19 pandemic, studies have shown teleorthodontics being used for monitoring patients with fixed orthodontic appliances, monitoring patients with clear aligner therapy (CAT) and for the management of orthodontic-related emergencies. In response to the inability to schedule in-person appointments, many orthodontic offices began offering virtual consultation appointments promising an individualized treatment plan based on records provided from the patient. This study aims to assess the current overall perception of teleorthodontics from a worldwide view and determine the reliability of virtually obtained records for orthodontic decision making.
Study Objectives: The primary objective of this study is to determine the knowledge, perception and utilization rates of teleorthodontics among orthodontists in the United States, Europe, and Australia. This study also aims to assess the intra-observer reproducibility of treatment planning when using different diagnostic information formats: in-office diagnostic records (clinically obtained) vs patient-provided (remotely obtained) diagnostic records.
Significance: The first part of this study is significant because it will evaluate the worldwide perception of teleorthodontics - to our knowledge, no other study has attempted to do this. Understanding the worldwide perception of teleorthodontics is important because it gives insight to where the profession is heading in the future. The second part of this study is significant because it evaluates the effectiveness and efficiency of teleorthodontics and will determine if it is as reliable as in-person examination, diagnosis, and delivery of treatment.
Methods: The first part of this study is an international cross-sectional epidemiological survey to determine the knowledge, perception, and utilization rate of teleorthodontics among orthodontists in the United States, Europe, and Australia. Upon IRB approval, several orthodontic professional organizations including the American Association of Orthodontists (AAO), the European Federation of Orthodontists (FEO), the British Orthodontic Society (BOS), the Australian Society of Orthodontists (ASO), and the World Federation of Orthodontists (WFO) will be contacted to distribute a survey to their respective active orthodontist members assessing their knowledge, perception and utilization of teleorthodontics. The second part of this study will be a cross-sectional clinical study determining the intra-observer reliability of remotely obtained (intra- and

extra-oral photographs provided by patient via smartphone application) and clinically obtained (intra- and extra-oral photographs, radiographic images and intraoral scans) diagnostic records for patients presenting for orthodontic treatment. Nine orthodontic cases of various difficulties will be selected from the individuals seeking orthodontic treatment (age 12-65) at the University at Buffalo Advanced Orthodontic clinic. Analysis will be performed by three groups of orthodontic specialists with varying degrees of experience; 6 orthodontic residents (third year class), 6 licensed orthodontists with fewer than 10 years of experience, and 6 licensed orthodontists with 10 or more years of experience (n=18). First, the observers will assess the remotely obtained orthodontic records provided by the patient and determine the most appropriate treatment strategy. One month later, the observers will be provided the clinically obtained full orthodontic records to re-determine the best treatment strategy. Kappa statistics will be calculated to measure intra-observer reliability. Data will also be analyzed according to orthodontist experience level and case difficulty (ABO Discrepancy Index).
Hypothesis: Part I: There will be a positive perception of teleorthodontics among practicing orthodontists. There will not be a difference in the overall knowledge, perception and utilization of teleorthodontics between orthodontists in different countries. Part II: The decision to treat and the treatment plans developed by the orthodontists will not be different based on the type of records they are provided (remote vs clinical).

Respond to the following questions:

Detailed results and inferences:*

If the work has been published, please attach a pdf of manuscript below by clicking "Upload a file".
OR
Use the text box below to describe in detail the results of your study. The intent is to share the knowledge you have generated with the AAOF and orthodontic community specifically and other who may benefit from your study. Table, Figures, Statistical Analysis, and interpretation of results should also be attached by clicking "Upload a file".

Teleorthodontics AAOF Results.pdf
Please see attached.

Were the original, specific aims of the proposal realized?*

Yes.

Were the results published?*

No

Have the results of this proposal been presented?*

Yes

To what extent have you used, or how do you intend to use, AAOF funding to further your career?*

The funds I received from the AAOF have allowed me to gain insightful knowledge in orthodontics. I have made many connections with orthodontists throughout the world, was able to present this research to hundreds of people and really gain an appreciation for research in orthodontics. Without the funding from the AAOF, I can definitively say my time as a resident would not have been as fun and as educational as it has been. Thank you for everything.

Comment: *The AAOF PARC appreciates your dedication to this project and embracing the spirit of advancing our specialty through new knowledge. We hope to see you in future projects and initiatives during your career.*

Accounting: Were there any leftover funds?

[Unanswered]

Comment: *I don't see where the question about leftover funds was answered. Please respond.*

Not Published

Are there plans to publish? If not, why not?*

Yes, there are plans to publish. We are currently beginning the publication process now.

Presented

Please list titles, author or co-authors of these presentation/s, year and locations:*

Title: Teleorthodontics: Perception and Reliability of Virtually Obtained Records for Orthodontic Decision Making

Co-authors: Dr. Thikriat Al-Jewair, Dr. Ashish Gurav, Dr. Gregory Wilding

2023: AADOCR (Portland, Oregon) and AAO Annual Meeting (Chicago, Illinois)

Was AAOF support acknowledged?

If so, please describe:

Yes.

Internal Review

Reviewer comments

Reviewer Status*

Incomplete (needs more information)

Comment: *Please provide answer on whether there were funds leftover. If yes, they must be returned to the AAOF.*

File Attachment Summary

Applicant File Uploads

- Teleorthodontics AAOF Results.pdf

Part I survey

Sample Demographics

A total of 503 practicing orthodontists responded to the survey. Of the returned survey, 462 were complete (91.8%) and 41 were partially complete (8.2%). Around 65% of the responses were from the United States (n=297), 18.6% were from Europe (n=85), 11.2% were from Australia (n=51) and 5.3% were from Asia (n=24). Of the sample, 64.2% (n=294) were male, 74.6% (n=344) were Caucasian, 46.6% (n=215) practiced was in a suburban demographic with a population between 10,000-100,000 residents, 51.6% (n=237) practiced in a single office, 38.4% (n=176) have been practicing 20 or more years, and 45.0% (n=206) were board certified. In regards to age, 3.3% of respondents were aged 20-29 (n=15), 26.7% were aged 30-39 (n=122), 23.6% were aged 40-49 (n=108), 21.7% were aged 50-59 (n=99), 19.0% were aged 60-69 (n=87) and 5.7% were over the age of 70 (n=26). Sample demographics are presented in Table 1.

Overall knowledge, perception and utilization:

96.9% (n=463) of respondents claimed to have been familiar with the term "tele-dentistry" or "tele-medicine." (Figure 3) 96.0% (n=461) agreed that tele-dentistry is the use of computers, internet and other technologies to diagnose and provide advice about treatment over a distance (Figure 4). 50.7% (n=242) agreed tele-dentistry could be applied in every branch of dentistry (Figure 5). 67.2% (n=322) were "somewhat familiar" with the orthodontic applications of tele-dentistry, 26.5% (n=127) were "very familiar" and only 6.3% (n=30) were "not familiar at all" about the orthodontic applications of teledentistry (Figure 6). 74.9% (n=358) claimed conferences, speeches or professional meetings "sometimes or rarely" focus on teleorthodontics,

16.1% (n=77) claimed it is “always or often” a focus and 9.0% (n=43) claimed teleorthodontics is never a focus at these events (Figure 7).

50.3% (n=240) were “somewhat familiar” with the legal aspects of teleorthodontics in their country (Figure 8).73.1% (n=350) were “not familiar” with teleorthodontics use in other countries, 25.5% (n=122) were “somewhat familiar” with teleorthodontics use in other countries and 1.5% (n=7) were “very familiar” with teleorthodontics use in other countries (Figure 9). 89.5% (n=428) were “not familiar” with the legal aspects of teleorthodontics in other countries, 10.0% (n=48) were “somewhat familiar” with the legal aspects of teleorthodontics in other countries and 0.4% (n=2) were “very familiar” with the legal aspects of teleorthodontics in different countries (Figure 10). 26.8% (n=128) believed continuous training in teleorthodontics is “very necessary”, 60.0% (n=287) believed continuous training is “somewhat necessary” and 13.2% (n=63) believed continuous training was “not necessary at all” (Figure 11). 56.5% (n=268) have not received training on teleorthodontics, 28.3% (n=134) have received informal training on teleorthodontics, 5.1% (n=24) have received formal training on teleorthodontics and 10.1% (n=48) have received both a formal and informal training on teleorthodontics (Figure 12).

35.9% (n=169) “strongly agreed” that teleorthodontics can be useful for monitoring patients undergoing orthodontic treatment, 49.0% (n=231) “agreed” that teleorthodontics can be useful for monitoring patients undergoing orthodontic treatment, 10.6% (n=50) were “neutral” when asked if teleorthodontics can be useful for monitoring patients undergoing orthodontic treatment, 2.8% (n=13) “disagreed” that teleorthodontics can be useful for monitoring patients undergoing orthodontic treatment and 1.7% (n=8) “strongly disagreed” that teleorthodontics can be useful for monitoring patients undergoing orthodontic treatment (Figure 13).

24.4% (n=114) “strongly agreed” teleorthodontics can save clinical time. 48.0% (n=224) “agreed” teleorthodontics can save clinical time, 17.8% (n=83) were “neutral” in perceiving teleorthodontics can save clinical time. 8.8% (n=41) “disagreed” teleorthodontics can save clinical time and 1.1% (n=5) “strongly disagreed” teleorthodontics can save clinical time (Figure 14).

14.7% (n=69)“strongly agreed” using teleorthodontics could be financially beneficial for their office, 35.6% (n=167) “agreed” using teleorthodontics could be financially beneficial for their office, 39.9% (n=187) were “neutral” when asked if using teleorthodontics could be financially beneficial for their office, 8.1% (n=38) “disagreed” using teleorthodontics could be financially beneficial for their office and 1.7% (n=8) “strongly disagreed” using teleorthodontics could be financially beneficial for their office (Figure 15).

7.0% (n=33) “strongly agreed” teleorthodontics will reduce the effort of the orthodontist, 13.6% (n=64) “agreed” teleorthodontics will reduce the effort of the orthodontist, 30.3% (n=143) claimed to be “neutral” when asked if they perceive teleorthodontics effect on reducing the effort of the orthodontist, 38.3% (n=181) “disagreed” teleorthodontics will reduce the effort of the orthodontist and 10.8% (n=51) “strongly disagreed” teleorthodontics will reduce the effort of the orthodontist (Figure 16). 80.0% (n=373) of orthodontists were concerned of the possible legal issues associated with interacting with patients online while 20.0% (n=93) were not concerned (Figure 17).

53.0% (n=245) of orthodontists have already used teleorthodontics in their practice, 27.1% (n=125) of orthodontists have not used teleorthodontics in their practice, but they are interested in starting within one year and 19.9% (n=92) have not used teleorthodontics in their office nor do they plan to start (Figure 18).

When asked to select multiple applications for how they would use teleorthodontics in their practice, 80.7% (n=360)would use teleorthodontics for managing patient emergencies, 74.4% (n=332)would use teleorthodontics for monitoring patients progress and compliance with clear aligners, 60.5% (n=270) would use teleorthodontics for initial screening and consultation of patients, 42.2% (n=188)would use teleorthodontics as a means for communicating between multiple practices, 30.3% (n=135) would use teleorthodontics to monitor the progress of traditional braces and functional appliances, 26.2% (n=117) would use teleorthodontics for obtaining diagnostic records and 25.8% (n=115) would use teleorthodontics for treatment planning cases in their office (Figure 19).

The main concerns noted when asked about using teleorthodontics were as followed: 72.9% (n=334)had concerns about patient privacy and confidentiality, 65.1% (n=298) were concerned with increased time dedicated outside the office, 41.3% (n=189) were concerned with lack of clinical usefulness, 31.4% (n=144) were concerned about the increased workload, 27.5% (n=126) were concerned about the increased workload , 27.5% (n=126) were concerned with lack of a user-friendly software, 24.5% (n=112) were concerned with lack of a valid and reliable software, 21.8% (n=100) were concerned with lack of efficient training, 20.7% (n=95) were concerned with the negative attitudes of the staff involved and 18.3% (n=84) were concerned with the increased cost of equipment involved in using teleorthodontics (Figure 20).

Knowledge, perception and utilization by region

According to the Fisher's exact test, there was a significant difference amongst countries when asked about the familiarity of teleorthodontics (p=0.001) (Table 2). When this difference was investigated further using the Pairwise Fisher's Exact test, Europe's knowledge of

teleorthodontics was significantly less compared to Australia (p=0.003) and the United States (p=0.002). Australia and the United States were more familiar with the orthodontic applications of teledentistry compared to Europe (Table 2). The survey respondents from the United States were also less knowledgeable about the use of teleorthodontics in other countries; specifically compared to Australia (p=0.013) (Table 4). There was also a significant difference observed when respondents were asked about their familiarity of the legal aspects of teleorthodontics in their own countries (p=0.001) and in other countries (p=0.002) (Table 3 and Table 5). Australia was more knowledgeable about the legal aspects of teleorthodontics in their own country compared to the respondents from Asia (p=0.021), Europe (p=0.034) and the United States (p=0.004) (Table 3). Furthermore, Australia was also the most knowledgeable about the legal aspects of teleorthodontics in other countries, but only statistically more familiar when compared to the United States (p=0.013) (Table 5). Finally, there was no difference amongst the respondents when asked about the amount of training they had on teleorthodontics (p=0.789) (Table 6).

The Fisher's exact test was also used to analyze if there was a difference in the perception of teleorthodontics based on the respondent's country. No significant difference was observed when the respondents were asked if they perceived teleorthodontics being a viable option for monitoring patients undergoing orthodontic treatment (p=0.757), being financially beneficial for their office (p=0.482), saving clinical time (p=0.811) or for reducing the effort of the orthodontist (p=0.789). There was also no difference in concern of legal issues such as patient data and privacy observed based on the respondent's location (p=0.231). This information can be seen in Tables 7-11.

There was a significant difference observed in the current use of teleorthodontics amongst respondents ($p=0.042$) suggesting that the United States had the largest proportion of respondents currently using teleorthodontics, however there was no statistical difference when comparing the United States at the pairwise level; Asia ($p=0.575$), Australia ($p=1.0$) and Europe ($p=0.132$). This information can be seen in Table 12. When analyzing the application of teleorthodontics there was a significant difference for obtaining diagnostic records ($p=0.009$) and for monitoring patients undergoing traditional orthodontic treatment ($p=0.042$). Although the proportion of respondents from the United States appeared to differ compared to other countries, no statistically significant differences were noted at the pairwise level (Tables 13 and 14). Of all the concerns listed, the only significant difference noticed amongst the countries was observed was when respondents were concerned with the lack of a valid and reliable software ($p=0.033$) where the respondents from Australia were more concerned compared to other countries but they were only significantly more concerned compared to the United States ($p=0.039$) (Table 15). Although the United States has the lowest proportion of respondents that were concerned about this issue, it was not significantly different than Europe or Asia.

Knowledge, perception and utilization according to demographic variables

There was no significant difference in knowledge or perception of teleorthodontics based on the respondents age demographic (Table 16). There was a significant difference observed when comparing practice demographic and use of teleorthodontics in practice ($p<0.001$) with rural practices being significantly less likely to use teleorthodontics in their practice compared to urban practices ($p=0.004$) and suburban practices ($p<0.001$) (Table 17). However, the difference noticed when using teleorthodontics to manage emergencies

(p=0.013) had the most support from rural practices. Rural practices were significantly more likely to use teleorthodontics to manage emergencies compared to suburban (p=0.019) and urban (p=0.018) practices (Table 18). Rural practices were much more concerned with using teleorthodontics, some of their significant concerns were having no clinical usefulness compared to suburban (p=0.021) and urban (p=0.002) practices, having to dedicate more time outside the office compared to suburban (p=0.001) and urban (p=0.001) practices, not having suitable training compared to suburban offices (p=0.038), using a software that is not user friendly compared to suburban (p=0.012) and urban (p=0.001) offices, and with the increased cost of equipment compared to urban offices (p=0.05). Information listing the various concerns previously mentioned can be found in Tables 20-24.

Knowledge, perception and utilization according to generation (age).

There was no difference in knowledge of teleorthodontics based on the respondents age demographic. The proportion of respondents aged 20-29 that were not concerned with legal issues such as patient data and privacy was considerably higher than any other age demographic, however this difference was not statistically significant (p=0.196) (Table 25). There was a significant difference based on the current use of teleorthodontics in practice (p=0.001) with orthodontists aged 60-69 and 70+ being less likely to use teleorthodontics in their office compared to orthodontists aged 30-39; p=0.013 and p=0.002 respectively (Table 26). There was a difference observed when assessing if teleorthodontics would be a viable option for initial screening of patients (p<0.001) with respondents aged 30-39 having the highest proportion of supporters and respondents aged 60-69 having the lowest proportion of supporters (Table 27). Although orthodontists aged 60-69 had the least amount of support for utilizing teleorthodontics for initial screenings of patients, they were only significantly less than orthodontists aged 30-39

($p<0.001$) and 40-49 ($p=0.004$). There was also a difference observed between age demographics when asked if teleorthodontics could be used for diagnostic records ($p<0.001$). Again, orthodontists aged 60-69 had the lowest proportion of supporters but only significantly less than orthodontists aged 30-39 ($p=0.004$) and 40-49 ($p=0.04$) (Table 28). Orthodontists aged 30-39 had the highest proportion of respondents supporting the use of teleorthodontics for monitoring patients undergoing CAT with orthodontists aged 70+ having the least support for this application. Compared to other aged demographics, orthodontists aged 70+ were only significantly less likely to use teleorthodontics to monitor CAT compared to orthodontists aged 30-39 ($p<0.001$) and 40-49 ($p=0.004$) (Table 29). There was an appreciable difference in age demographic when asked if teleorthodontics could be used to monitor patients undergoing functional appliances ($p=0.018$) however no statistically significant differences were observed when using the pairwise exact tests (Table 30). Using teleorthodontics to communicate between practices was also statistically different based on the respondents age ($p<0.001$) with the highest amount of support from orthodontists aged 20-29. This group of orthodontists was statistically more likely to use teleorthodontics for communication purposes compared to all other age demographics except orthodontists aged 40-49 ($p=0.066$) (Table 31). The only concern that was statistically significant based on age was increased time dedicated outside the office ($p<0.001$) with orthodontists aged 60-69 being less concerned with this issue compared to those aged 30-39 ($p=0.004$) and 40-49 ($p=0.005$) (Table 32).

Knowledge, perception and utilization according to gender.

There was no difference in knowledge, perception or utilization of teleorthodontics based on a person's identified gender.

Part II – Intra-Rater Reliability

Residents:

When the resident group was evaluated, there was no statistically significant reliability for creating a consistent treatment plan (k=-0.08 [-0.17, 0.15]), treatment modality (k=0.04 [-0.26, 0.21]) or treatment plan with a modality (k=-0.03 [-0.10, 0.03]) (Table 33).

Orthodontists with less than 10 years of experience:

When the orthodontists with less than ten years of experience had their treatment, plans evaluated, they was a statistically significant reliability for treatment plan selection (k=0.26[0.05, 0.39]). However, they were unable to consistently create a treatment modality (k=0.27[-0.05, 0.61]) and treatment plan with a modality (k=0.16 [-0.01, 0.31]) (Table 33).

Orthodontists with 10 or more years of expeirence:

When the orthodontists with ten years or more of experience were evaluated for intra-reliability, they were able to demonstrate significant reliability for treatment plan (k=0.25 [0.07, 0.40]), treatment modality (k=0.43 [0.32, 0.62]) and treatment plan with a modality (k=0.25 [0.14, 0.42]) (Table 33).

Between Group Pairwise Analysis:

A significant difference was noticed when comparing the treatment plan selections of Groups 1 and 2 (p=0.041) and Groups1 and 3 (p=0.025). However, only Group 1 and Group 3 demonstrated significantly different treatment modality (p=0.026) and treatment plan with modality (p=0.013) selections (Table 34).

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