

REMOTE TELE-DENTISTRY VERSUS IN-PERSON ORTHODONTICS: DO PATIENTS PERCEIVE ANY DIFFERENCES?*¹Aalok Y. Shukla, ²Dr. Rodrigo Sousa Uva, ³Hiten RH Patel¹Uplift Health, Dublin.²Clinica Geraldés Barba, Lisbon, Portugal.³University Hospital North Norway, Tromsø, Norway.

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ABSTRACT

Telemedicine has emerged in mainstream clinical practice across multiple disciplines including general practice, dermatology and physiotherapy, due to the availability of economically acceptable technologies. As a branch of Telemedicine, Teledentistry services have sought to shift from Teleconsultation alone to Teleconsultation plus Remote treatment models, due to perceived costs and time saving possibilities for the consumer and health care provider. This is mostly applied in Orthodontics, the branch of dentistry concerned with the alignment of teeth. As so, a new commercially available Teleorthodontic platform was developed with the aim of increasing patient access with these treatments. **Aim:** to compare the patients' perceived quality of care for remote orthodontic service (ROS) versus traditional in clinic orthodontic (TICO). **Material and Methods:** In this study, we evaluated the patient perceived quality of a remote orthodontic service (ROS) with clear aligners versus traditional in clinic orthodontic (TICO) care using accepted fixed appliances requiring manual adjustments. Both groups were surveyed to evaluate their perception of quality of care by evaluating the patients' orthodontic treatment related responses (confidence, assessment, plan, design and treatment) by means of a questionnaire (Appendix I). **Results:** 21 ROS and 21 TICO patients were evaluated. The ROS group responded with higher satisfaction scores across all four categories measured compared to the TICO group. 76.2% (n=16) of the remote group and 47.6% (n=10) of in-clinic patients were confident that the respective type of approach would work for them, showing a marginally statistically significant association. **Conclusions:** Our study suggests patient acceptance and satisfaction for ROS, may be related to the increased involvement of the remote patient in the therapeutic process, with a more patient centred model. More investigation is needed to evaluate this further across to determine optimal parameters for this new model.

KEYWORDS: Telemedicine, Teledentistry & Teleorthodontics, Teletreatment, Remote Treatment, Remote Orthodontics, Remote therapy, Teledentistry, Telemedicine.

INTRODUCTION

Telemedicine projects and applications are increasing in global popularity.^[1] Technological expansion and the widespread use of mobile communications is enabling reduced costs for all classes of consumer products.^[2] Despite many efforts, dentistry is still mainly private worldwide and not affordable by a large portion of populations.^[3] As stated in La Cascada declaration,^[3] "Dentists are paid for, or evaluated based upon, the number of such procedures performed, rather than for establishing health. In the private sector, dentists are under constant pressure to ensure adequate returns on investment. Frequently, this results in over-treatment."

Standard of care in orthodontics is provided by orthodontists and general dentists in clinics. This involves a very time consuming and laborious process,

affecting both the time and financial resources of both dentist and patient. In the last decade, CAT (clear aligner therapy) has increased in popularity driven by the increased societal demands for more aesthetic orthodontic treatment options driven by an ever increasingly image conscious society.^[4] Clear aligners are more aesthetic based on patient perception, and have less interference with eating habits and have the potential to provide less risk for caries and periodontal disease during treatment due to their removable nature.^[4,5] Other described advantages include: possibility to do teeth whitening during treatment, less potential for emergencies and soft tissue injuries and better perception of improvement by patients associated.^[6] From a practice management point of view, CAT has been described as allowing professionals to reduce chair-time with patients with positive financial advantages in a private practice.^[7]

Most patients would consider being treated with CAT but many clinicians are reluctant to provide it due to a perceived lack of control over the treatment course (because of necessary cooperation in wearing time), unfamiliarity with the technology involved (CAD/CAM) and the high lab costs in providing the treatment affecting their profitability.^[6] This means that many patients who approach clinics for an orthodontic solution find CAT expensive, or fixed appliances aesthetically unappealing. Although the use of a fixed lingual appliance could be an aesthetic treatment option for adults, it is financially out of reach for the majority of the population.

A new commercial purpose designed Teledentistry platform & service was developed with the aim of digitising the traditional in clinic orthodontic patient experience. It enables professional assessment, prescription and communication from an Orthodontic professional via a mobile interface combined with a digital laboratory platform enabling CAD/CAM design, review and dentist prescription remotely. This is then combined with the ability to have the aligners manufactured in stages according to progress and then delivered direct to the patient's home instead of the clinic, combined with all monthly review appointments being conducted by photo review. The professional dentist is able to change, stop and control the orthodontic prescription and alter the subsequent aligner sequence remotely. The patient is able to maintain clinical visits with their general dental practitioner, whilst having their orthodontic treatment remotely supervised. This enables professional remote assessment and monitoring of orthodontic treatment with a level of control above most standard CAT solutions. These are usually fully executed by the laboratory technician with little clinical dentist input.

The technology platform was designed to digitise all these separate components, enabling clinicians to manage patient care and practice clinically from a laptop or tablet, assessing, and processing treatment plans to be shared with patients via any mobile device. The platform enables secure encrypted two-way communication. Patients begin by taking high resolution intra & extra oral photos of specific guided views, and answering a clinical questionnaire assessment. Following this initial screening for eligibility, a guided home-based impression pack is sent. These impressions are then 3D scanned and sent to an orthodontist. They will then utilise this 3D data plus dental records & x-rays uploaded by the patient to the portal to remotely create a treatment plan for the patient. Any questions can be asked and answered as per a normal consent process. Upon acceptance, the prescription is sent to the lab and the aligners are then made and sent to the patient. The aligners are sent in stages, each stage dependent on the successful completion of previous stage. Evolution is tele-monitored by the prescribing orthodontist, starting with the original aligner insertion and then subsequently via

review messages within the platform. Photos and written answers are used to facilitate two-way communication.

The aim of this paper is to do a pilot study to evaluate patient perception, acceptance, technology performance, and the perceived quality of remote orthodontics using clear aligners through the ROS platform vs in-clinic traditionally delivered orthodontics.

MATERIAL AND METHODS

This study was designed as a longitudinal cohort study involving 42 adult orthodontic patients divide in 2 groups and completed by using 2 questionnaires to measure the patient's perception regarding the quality of care. The patients accepted into the study were required to be over 18 years of age and not to had under orthodontic treatment before.

Adult patients attending Orthodontic clinics (TICO) in Lisbon, Portugal, for orthodontic treatment, using fixed appliances, were offered the opportunity to respond to our in-clinic questionnaire (Appendix I – blank sheet with the questions asked – 4 groups). From the clinics, 21 patients completed the questionnaire. This set of patients was seen by 2 different orthodontists in physical dental offices for fixed orthodontic treatment. The treatment sequence involved a initial consultation, treatment plan presentation, placement of the fixed appliances and finally monthly adjustment appointments for the duration of treatment.

Adult patients seeking remote orthodontic care (ROS) were randomly selected and offered the opportunity to respond to our in-clinic questionnaire (Appendix I). This set of patients was assessed and treated wholly remotely. They started with a free e-consultation via their mobile phone submitting photos and answers to questions in order to determine if they were suitable for the treatment. The treatment sequence continued with the deliverance of a home impression kit and the patients were guided through the app. They received a video simulation, photo predictions and full written orthodontic report through their app. Any clarifying questions were done through the app. Once completed these steps, they could order their clear aligners which were manufactured and sent to them in stages on successful completion of each stage. Every month they had a review through the app and their progress was reviewed and updated.

The average treatment duration in both groups was 6-12 months. Two surveys were designed from the perspectives of the patient during treatment, the questions were based around patient perception of the main steps of the orthodontic patient journey. A scale from 0-10 was assigned to help rate each step. The survey was developed for this study and not based on any other current tool (Appendix I – Questionnaire 1 – User Perspective in Clinic Orthodontics and Questionnaire 2 – User Perspective in Remote Orthodontics).

1. Survey for remote aligner patients: the questions included key questions such as their perception of their assessment, report, aligner insertion and fit, tooth movement progress and satisfaction of experience.
2. Survey for in-clinic orthodontic patients: the questions included key questions such as their assessment, consent discussions, brace fit, tooth movement progress and satisfaction of experience.

RESULTS

Prior to performing any statistical tests the data was carefully screened for missing cases, input errors and potential outliers, none of which were present, therefore no exclusion of observations were necessary. Considering the ordinal nature of the questions used and that regardless of the 10-point Likert scale used their distribution deviated from normality in most cases, non-parametric inferential tests were performed to analyse group differences in the form of chi square independence and Mann-Whitney U tests. All analyses were carried out using SPSS 25 at findings were considered statistically significant and the set alpha level of $p < 0.005$.

The reported levels of perceived confidence for the respective treatment dimensions are presented in Table 1. 76.2% (n=16) of the remote group and 47.6% (n=10) of in-clinic patients were confident that the respective type of approach would work for them, showing a marginally statistically significant association, $\chi^2(1) = 3.635, p = 0.57$.

Comparing satisfaction levels on the actual treatment carried out remote groups reported significantly higher scores on all questions considered together ($U = 68.5, Z = -3.832, p < 0.001$).

Specifically, they were found to be more satisfied regarding assessment accuracy ($U = 81.5, Z = -3.555, p < 0.001$), the clarifications and answers about their questions received ($U = 114.5, Z = -2.734, p < 0.01$) and the treatment plan itself ($U = 55.5, Z = -4.248, p < 0.001$). They were also more confident with the brace alignment process ($U = 54.5, Z = -4.265, p < 0.001$), their tooth movement progress ($U = 127.5, Z = -2.387, p < 0.05$) and showed higher overall treatment satisfaction ($U = 40.5, Z = -4.688, p > 0.001$), with most results being found highly statistically significant. In contrast no significant differences were found when considering dentist supervision ($U = 180.5, Z = -1.038, p = 0.299$).

Table 1: Perceived confidence for the treatment dimension.

Table 1.

	Remote		In-Clinic		Total	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Assessment accuracy	8,43 (1,29)	9 (1)	6,62 (1,5)	6 (1)	7,52 (1,66)	7,5 (3)
Clarifications / Questions	8,71 (1,23)	9 (2)	7,62 (1,16)	7 (1)	8,17 (1,31)	8 (2)
Treatment Plan Satisfaction	9,19 (0,81)	9 (1)	7,33 (1,24)	7 (2)	8,26 (1,4)	8,5 (2)
Brace insertion / Fit	8,71 (1,31)	9 (2)	6,62 (1,12)	7 (2)	7,67 (1,6)	8 (3)
Tooth Movement Progress	8,57 (1,54)	9 (3)	7,43 (1,33)	8 (1)	8 (1,53)	8 (2)
Dentist Supervision	8,1 (1,87)	8 (2)	7,86 (1,24)	8 (1)	7,98 (1,57)	8 (2)
Treatment Satisfaction	9,24 (1)	10 (1)	7,1 (1)	7 (0)	8,17 (1,46)	8 (3)
Total satisfaction scale	8,71 (0,94)	8,86 (1,29)	7,22 (0,99)	7,14 (0,86)	7,97 (1,21)	7,86 (2,14)

SUMMARY OF RESULTS

The ROS group overall exhibited a higher perceived confidence in the solution working for and also showed a more polarized result with a quarter of people not sure if the solution would work for them. The TICO group showed half the people not sure if the in-clinic solution would work for them (Figure 1).

The ROS assessment group overall were more positive about their assessment. The TICO group had high ratings of confidence in the assessment but 37% of them had a middle rating of confidence (Figure 2).

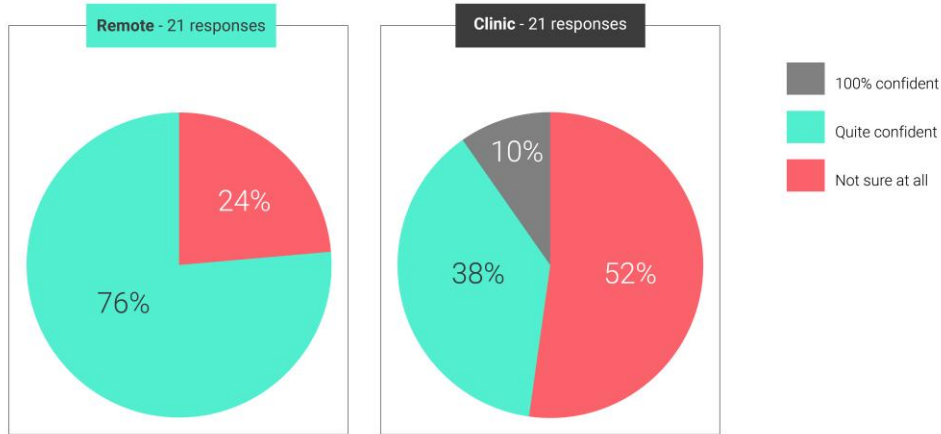


Figure 1 - Patients' confidence about braces treatment

Figure 1: How confident were you the braces could work for you?.

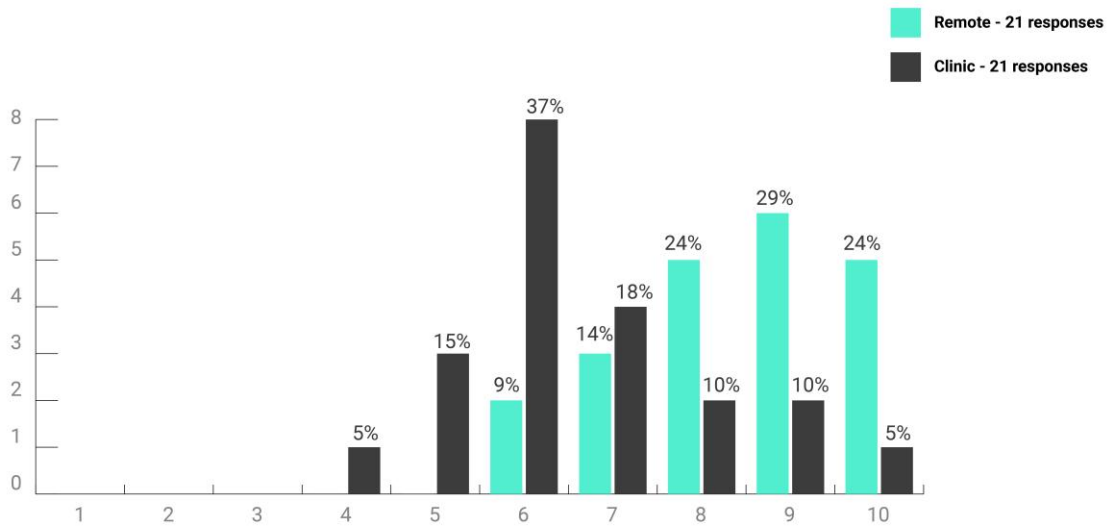


Figure 2 – Patients' assessment confidence

Figure 2: How confident did you feel in your assessment?.

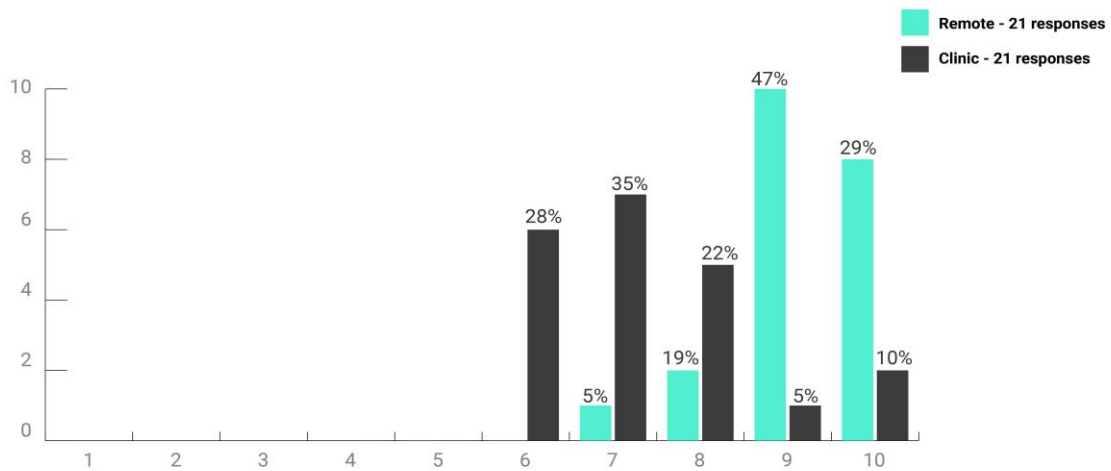


Figure 3 – Patients' satisfaction with treatment plan

Figure 3: How satisfied did you feel with your treatment plan, result agreement & guarantee?.

The ROS group showed overall higher satisfaction with the communication of their treatment plan and result agreement. The TICO group communication of these

elements was verbal whilst the ROS group was in written and video form through the platform (Figure 3).

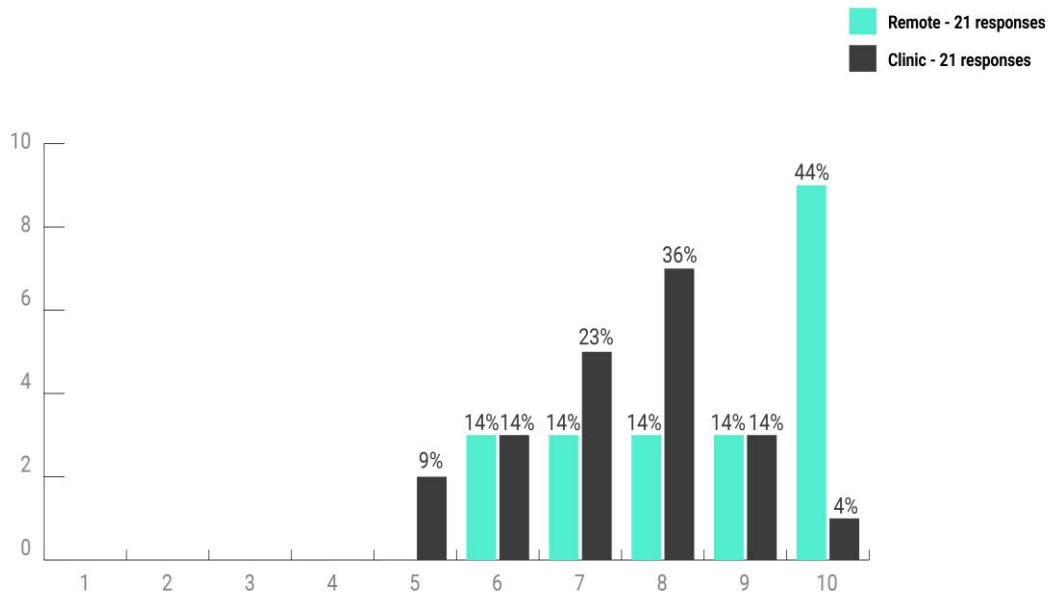


Figure 4 – Patients' satisfaction with movement progress

Figure 4: How satisfied do you feel with your tooth movement progress?.

Both modalities of treatment provided high satisfaction with tooth movement progress.

The ROS group showed 44% at the highest level of satisfaction with progress (Figure 4).

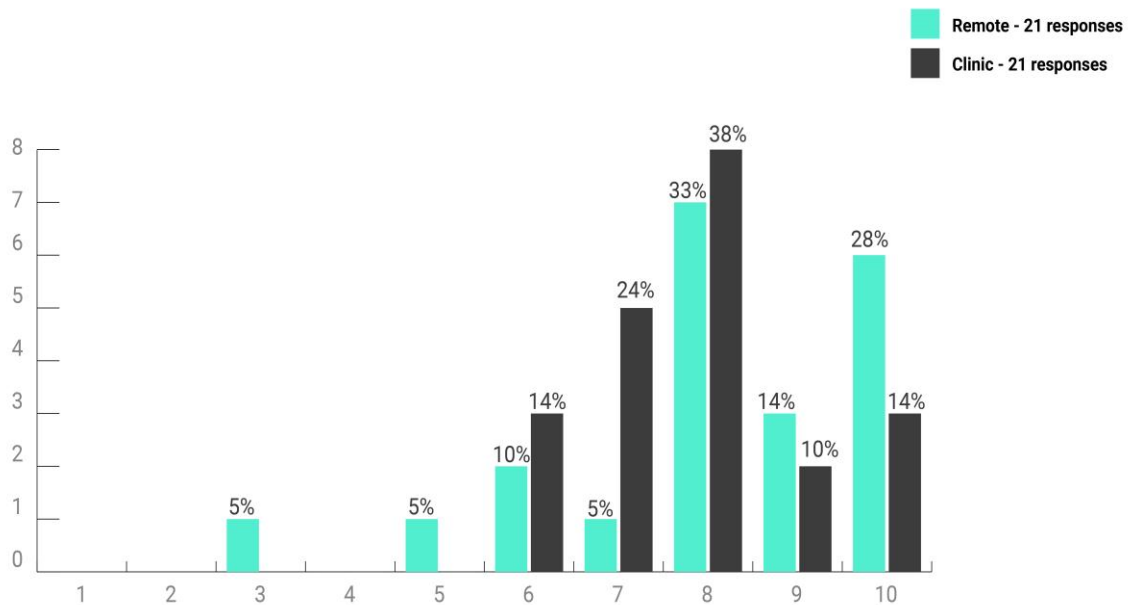


Figure 5 – Patient satisfaction with clinical supervision

Figure 5: How satisfied do you feel with your dentist supervision / monthly appts?.

Monthly monitoring showed the most similar distribution between the two modalities. For the ROS group it also showed a greater range of satisfaction than the TICO group (Figure 5).

DISCUSSION

To our knowledge, this is the first published research that compares perceived quality of remote teledentistry with aligners and in office orthodontic treatment with fixed appliances. In fact, the literature is scarce regarding orthodontic patient's experiences. The few papers

available on this matter are mainly concerned in pain experience which seems to be more pronounced with fixed appliances when compared to removable ones.^[8,11] Miller et al. additionally reported fewer negative functional and psychological impact in patients' lives with removable aligners vs fixed appliances.^[8]

In the present study, the satisfaction levels reported by the ROS group were significantly higher when compared to TICO patients. Though the results of remote orthodontics seem to be promising, there are some variables that can mislead conclusions. One of the most significant problems with our study is the limited number of participants. The different nature of the treatments in both groups can be considered a factor of bias. To assess this discrepancy, it would be important to understand if the ROS group higher patient satisfaction is actually due to the remote nature of the treatment or is it because the treatment is made with clear aligners which is proven to have less negative impact in patient's quality of life. One possibility would be to redo the study with clear aligners in clinic versus clear aligners remotely. Ideally to overcome this would be to conduct the study with the same patients experiencing both in clinic treatment and then remote treatment.

Since the remote orthodontic is performed with clear aligners, is important to address that many orthodontists question the exact range of applicability of this system.^[4] It is also important to note that orthodontic success is largely judged by patient satisfaction with their smile's appearance. The analysis of several studies regarding the outcomes of clear aligners vs conventional orthodontic treatment is consensual and shows that clear aligners present more limitations and are suited for very specific situations.^[4,12,13] However, for a lay person, these limitations are not important in determining a negative perception of the treatment since patients perceive the results of their treatment in the immediate short term and certainly more favorable than the respective practitioners. In the ROS model, the patient is much more participative and compliant as they are determining how much they wear their appliances so the increased involvement of the patient in the therapeutic process may have significantly influenced the results obtained in our pilot study.

CONCLUSIONS

Our pilot study provides initial views that remote, professionally supervised orthodontic treatments may provide more positive patient perception than in-office fixed appliances. More studies and data are needed to confirm and better understand these initial findings with a larger sample and specific efforts to reduce the inevitable bias of limiting the treatment type for each participant. This subject is an important area of research due to rapid changing patient perspectives and trust towards mobile technology and remote communication in teledentistry.

Data Availability Statement: The results and statistics data used to support the findings of this study are included within the article.

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