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# The World Wide Web of orthodontics- A comprehensive narrative on teledentistry pertaining to the orthodontics of the 21<sup>st</sup> century

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## Abstract

Teledentistry has proven effective in practically all dental fields. It also allows access to inaccessible and underdeveloped locations. Better treatment outcomes were documented in patients treated by an orthodontist supervised by teledentistry than by a general dentist with minimal orthodontic experience alone. It may also help to focus referrals to specialists and weed out those who do not need them. But, on a critical note, a doctor-patient relationship is much more than a business transaction. A face-to-face initial consultation instills trust that a remote session cannot. Teledentistry includes professional networking of doctors. This contact includes digital information exchange, CPD programs, case discussions, and analysis that bring dentists from all around the world together to improve patient care. Teledentistry has not only spanned the distance between dentists worldwide, but has also served as a conduit between customer (patient) and manufacturer. This spawned Direct to Consumer (DTC) dentistry, sparking substantial debate among dentists worldwide. In DTC dentistry, inadequately trained customers conduct complex procedures on themselves with minimal guidance of a dentist. One of the major issues today is the general availability of clear aligners to patients without the requirement for an intermediary skilled orthodontist. The American Association of Orthodontists (AAO) has publicly questioned the validity of Smile Direct Club, a private firm that dominates the DTC industry. European Federation of Orthodontic Specialists Association, on the other hand, has sponsored a joint declaration with the representative orthodontic associations in Europe to highlight and alert patients about the potential risks of DTC products. Unfortunately, public shaming hasn't slowed commercialization of DTC firms. Teledentistry has been a boon for healthcare, but a nightmare for our profession, raising fundamental questions like what is the difference between a customer and a patient? Is dentistry a just another discipline of cosmetics? Is teledentistry making us less connected with our patients?

## Keywords:

Orthodontics, teledentistry, teleorthodontics

*“We’re seeing an interesting convergence of technology, medicine, social issues, and human progress.” -John Nosta,<sup>[1]</sup> Digital Health Philosopher*

## Evolution of Teledentistry

Teledentistry is a specialized form of telemedicine that is being widely recognized

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as an exciting trend in the modern era of dentistry. The earliest notable usage of teledentistry was in 1994, wherein 15 patients received follow-up periodontal care by sending their intraoral pictures from a dental clinic in Fort McPherson to Fort Gordon 120 miles away under the US Army initiative called the “Total Dental Access (TDA) Project.” Following mass usage of this new approach, web-based teledentistry was first executed as part of TDA in 1997.<sup>[2,3]</sup>

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Teledentistry has definitely proved beneficial in almost all disciplines of dentistry. Moreover, it provides access to inaccessible and underserved areas.<sup>[4]</sup> Teledentistry has the ability to improve access to oral health care and lower its costs. A recent study by Mohamed Estai *et al.*<sup>[5]</sup> provided a model that had the potential to save up to 40 million dollars per year with the use of teledentistry to screen children from low-risk areas, thereby allocating more resources and funds for high-risk children.<sup>[6]</sup>

Possible applications of teledentistry may include:

1. Live, synchronous video consultations.<sup>[7]</sup>
2. Data storage (intra and extraoral photographs, health charts, patient-related videos, reports, radiographs, digital impressions) and transmission over secure electronic communication systems.<sup>[8]</sup>
3. Dental hygienists who provide onsite preventive care or screenings could gather data that can be digitally delivered to the dentist onsite for diagnosis and necessary follow-up care protocols.<sup>[9]</sup>
4. Remote monitoring of treatment progress and follow-up checkups in the event a physical checkup is not possible.<sup>[10]</sup>
5. Digital conferences, webinars, and social media groups, as continuing dental education programs allow many dentists to access information from their homes.

With the current crisis of the pandemic, we have seen an upsurge in academic literature pertaining to *teledentistry and telemedicine* [Figures 1 and 2]. With the help of this narrative review, we would like to throw light on the upsides and downsides of such an innovation, so that the end and intermediate users have clarity while partaking in it.

## Applications

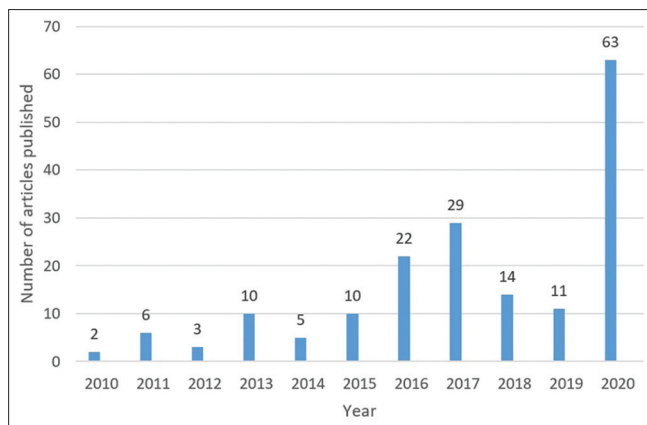
### Remote consultation and monitoring

Various studies have shown that the majority of orthodontists and general dentists favored the use

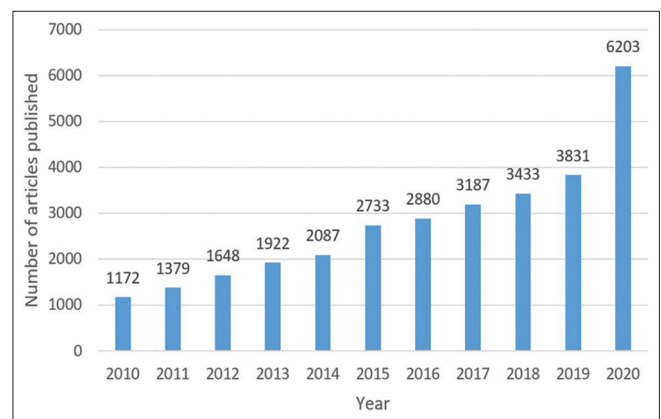
of teledentistry for routine orthodontic consultations to benefit patients and dentists.<sup>[11-13]</sup> Better treatment outcomes were reported in patients wherein teledentistry was used for an orthodontist’s supervision of the treatment rendered by a general dentist when compared to being treated by a general dentist with limited orthodontic training alone without any supervision.<sup>[14,15]</sup> Another benefit may be to narrow down the referrals to the specialist and screen out the ones that do not require specialist care.<sup>[15]</sup>

A trial carried out by Mandall NA<sup>[16]</sup> tested the validity of records taken for teledentistry wherein patients were referred through a “store and forward” teledentistry link. These “records” were later evaluated clinically to assess whether the same decision to accept the referral was made. It was concluded that clinician agreement for screening and accepting orthodontic referrals based on clinical photographs was comparable to that reported for the same decision-making in a clinical setting. A recent study<sup>[17]</sup> evaluated the difference in outcomes using Invisalign® with and without the use of Dental Monitoring™ (DM). The authors found that DM with Invisalign therapy resulted in a reduced number of appointments by 3.5 visits. The DM group also achieved a clinically similar accuracy in obtaining predicted tooth movements compared with the control group in 1.7 fewer months, indicating improved aligner tracking in the DM group.

On a critical note, a doctor-patient relationship has traditionally been much more than just transactional. A face-to-face initial consultation instills a kind of *trust* that would otherwise be impossible to gain with just a mere remote consultation.<sup>[18]</sup> It would also be questionable as to how many patients given such pricey methods to take “suspect quality” intraoral selfies would follow through? Compliance has always been a concern in orthodontic treatment and has been one of the most important factors determining treatment success.<sup>[19]</sup>



**Figure 1:** Number of articles published in the past decade with one of the keywords: Teledentistry (Source: PubMed)



**Figure 2:** Number of articles published in the past decade with one of the keywords: Telemedicine (Source: PubMed)

Orthodontics presents a very different situation wherein cooperation is highest at the start of treatment and that may be true with these “monitoring” devices and procedures.<sup>[18]</sup> When compliance fades and we may need the help from “tele-ortho,” odds are tilting away from our favor that we will get it.

Certainly, if patients have questions about a potential problem like a broken wire or braces or other types of anomalies like infections or other damage to oral tissues or appliances, then the utility of getting a cell phone selfie could be quite useful. This would be akin to triage for “emergency” in-office visits (what needs to be seen now vs repairs that can be accomplished at another follow-up appointment).<sup>[20]</sup>

Telemedicine, on the other hand, is quite a different matter where screening questions can be gathered in a video interview, perhaps allowing a differential diagnosis that could necessitate calling in a prescription. However, it may be stressed that from a diagnostic perspective, telemedicine may be beneficial in obtaining a differential diagnosis but from a treatment perspective, the benefits may be overrated. If a personal examination or treatment is necessary, then an office visit is still required.

Two tested channels have been used for teleconsultations in teledentistry<sup>[4]</sup>:

- a. Real-time consultation
- b. Store and forward method.

Real-time consultations involve the doctor and the patient, at different locations, having a face-to-face conversation through a digital medium that is more synchronous in

nature [Figure 3]. The store and forward method is more commercial in which the patient record is collected and stored by the dental practitioner and forwards them, usually to a specialist, for consultations and further treatment planning [Figure 4]. Electronic medical records have already replaced most of the conventional charts in most of the medical and dental centers across the globe.<sup>[21]</sup> Such a model may benefit underserved areas with less access to specialist care. A remote monitoring system (mobile applications/websites) may now be put in place to keep track of the treatment rendered and at times to monitor routine follow-up visits.<sup>[10]</sup>

### Consumer health care benefit

Apart from monitoring patients or remotely treating them, teledentistry also helps with second opinions, insurance authorizations, drug delivery, etc., as most of the records and prescriptions can instantaneously go online instead of the previously used dental analog films, charts, and written prescriptions.<sup>[22,23]</sup>

### Digital networking amongst professionals

A key aspect of teledentistry also involves the professional networking of doctors. This interaction involves digital information sharing, continuing professional development (CPD) programs, case discussions, and analysis that bring dentists from different parts of the world under one umbrella, for the single purpose of providing better patient care.<sup>[23,24]</sup>

Countless webinars in the past year alone have provided dentists with a huge platform to showcase their work and share knowledge with others sitting on the other side of the globe, mostly for free of

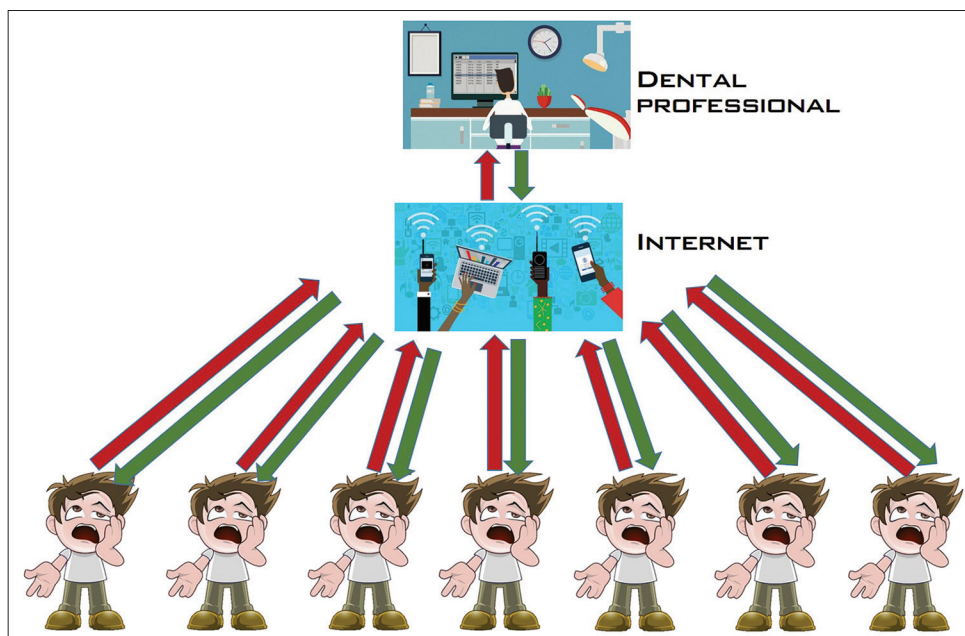


Figure 3: Real-time consultation model

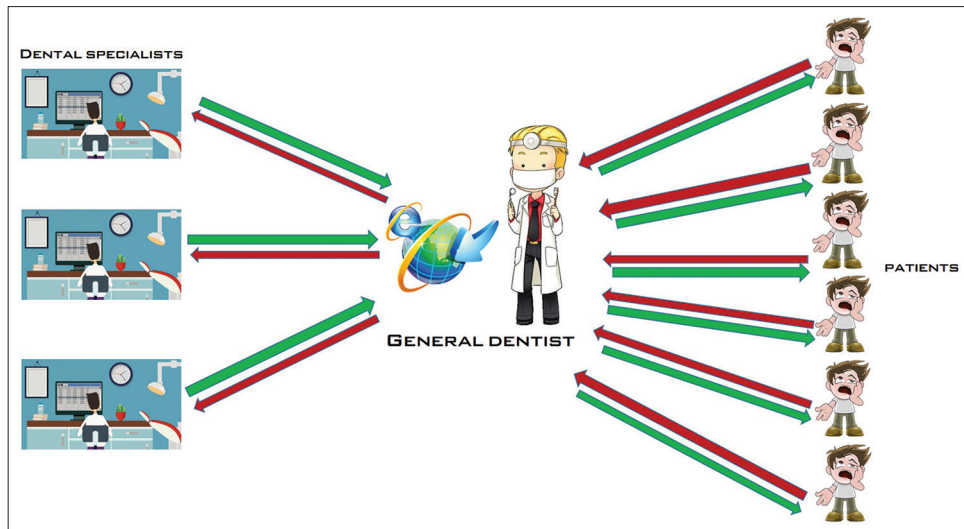


Figure 4: Store and forward method model catering to more patients

cost. In addition, many social media online “groups,” especially on Facebook, such as the Orthodontic Mastery Group (<https://www.facebook.com/search/top?q=orthodontics%20mastery%20group>); The World Orthodontic Study Group (<https://www.facebook.com/groups/328815064794002>); Orthodontic Fundamentals (<https://www.facebook.com/groups/237516297559953>); Simply Ortho (<https://www.facebook.com/groups/simplyORTHO>), etc., to name a few have been instrumental in disseminating orthodontic information and knowledge in the past year.

However, there is an issue here. Amongst the genuine scientific webinars, conferences, and “posts,” there lie many “brand driven,” sponsored ones with hidden agendas, promoting products amongst a plethora of social media “professional” groups. In other words, confirmation bias, where there is a tendency to only consider information that supports one existing beliefs or theories, seems to run unabated. The absence of a qualified scientific committee in many such social media professional groups and conferences may result in inappropriate screening leading to inexperienced speakers, inadequate quality of attendees, and more importantly, the paltry scientific power of lectures.

*Social networks do not teach how to dialogue because it is very easy to avoid controversy... Many people use them, not to unite, not to broaden their horizons, but on the contrary, to close themselves in what I call comfort zones, where the only sound they hear is the echo of their own voices, where the only thing they see is the reflection of their own faces. Social networks are very useful, but often times they are a trap. - Zygmunt Bauman<sup>[25]</sup>*

A usual presenter in such brand-driven conferences appears to have a profile of a clinician talking to his

audiences about his or her success in selected cases with untested, filtered experience confined to his or her private practice alone. In other cases, information is broadcasted on personal websites or web pages portraying the owner’s opinion, only to be believed by a majority of the gullible public as “hard science.”<sup>[26]</sup> Testimonials, case reports, lectures by “clinical experts” given by paid experts; all supplemented with proprietary publications are seemingly enough for many concepts to be tacitly accepted.

*I suppose we might call it the Orthodontic Obscura, wherein filtered experience adversely influence our decision-making. For example, one nice Phase I functional appliance result is seen in a lecture by an “accomplished speaker” gives rise to a nearly unalterable belief that this is “The Way.” Or a parent or a referring dentist refuses extractions because some weekend course director said the patient might die from asphyxiation due to lack of tongue space.- Jay Bowman<sup>[27]</sup>*

### Patient confidentiality and security

Another major issue with the rise of digital networking and data transfer is patient confidentiality. Many a times, data transfer is performed over unsecured networks, and as such, there is an issue with the safety of electronic information stored in computers.<sup>[28]</sup>

Secure Sockets Layer (SSL) encryption, which is commonly used to encrypt e-commerce transactions, can be used to protect data transfer or other confidential communications related to the patient. User authentication can be enforced with user names and passwords or more secure forms of authentication, such as those based on public-key encryption.<sup>[29]</sup>

Obviously, before sharing records of a subject for demonstrating the before and after changes, it must be

mandatory to obtain the necessary written consents from the patient. The same must be followed while posting partial records for discussing the various treatment objectives and plans too. However, it must be emphasized that, although the utmost care may be employed while practicing teledentistry in terms of maintaining security, the possibility that the information may be intercepted by unauthorized entities always exists.<sup>[30,31]</sup>

But then again, just the appropriate permissions to post pictures do not render impossible the possibility of copyright infringements, digital manipulations, and public criticism on the aesthetic features of the patient.<sup>[32]</sup> Here, the role of the *page moderators* is critical. Adequate measures must be taken by them to ensure the protection of patient identity and data protection by constantly monitoring conversations and interactions on related *posts*.

The technical capabilities needed for consumer health applications of teledentistry are modest, largely because the systems developed to date have had to rely on the existing Internet infrastructure. They may be categorized under the following capabilities on a 4-point scale with one plus sign (+) indicating limited needs and 4 plus signs (++++) indicating a significant need.<sup>[29]</sup>

*Bandwidth* ++

*Latency* +

*Availability* ++

*Security* +++++

*Ubiquity* +++++

Whereas, the technical requirements for clinical care and monitoring in teledentistry are more demanding. The need to maintain patient confidentiality needs to be

combined with the need for high bandwidth and low latency to support synchronous remote consultations; high availability is also required to ensure that patient records can be accessed whenever and wherever needed.<sup>[29]</sup>

*Bandwidth* +++++

*Latency* +++

*Availability* +++++

*Security* +++++

*Ubiquity* ++

The dental education sector has seen a rise in the use of teledentistry in the past couple of decades.<sup>[33]</sup> Experts and specialists are now able to share their insights and knowledge routinely through “live” online lectures and surgeries through which the students can have a real-time feel of an actual surgery by just sitting in their lecture rooms.<sup>[34]</sup>

### Direct to consumer dentistry

A report by Fortune Business Insights forecasts the telemedicine industry to be a 185 billion dollar market by 2026.<sup>[35]</sup> Teledentistry has not only bridged the gap amongst dentists from across the globe but in many instances has also formed a duplicitous conduit between the consumer (patient) and manufacturer. This has given birth to direct to consumer (DTC) dentistry causing significant controversies amongst dentists all over.

DTC dentistry often involves untrained consumers performing sophisticated maneuvers on themselves without the supervision of a trained dental professional.<sup>[36,37]</sup> Although DTC dentistry involves certain Do It Yourself (DIY) forms of teeth whitening, teeth straightening, fake veneers etc., the one that has

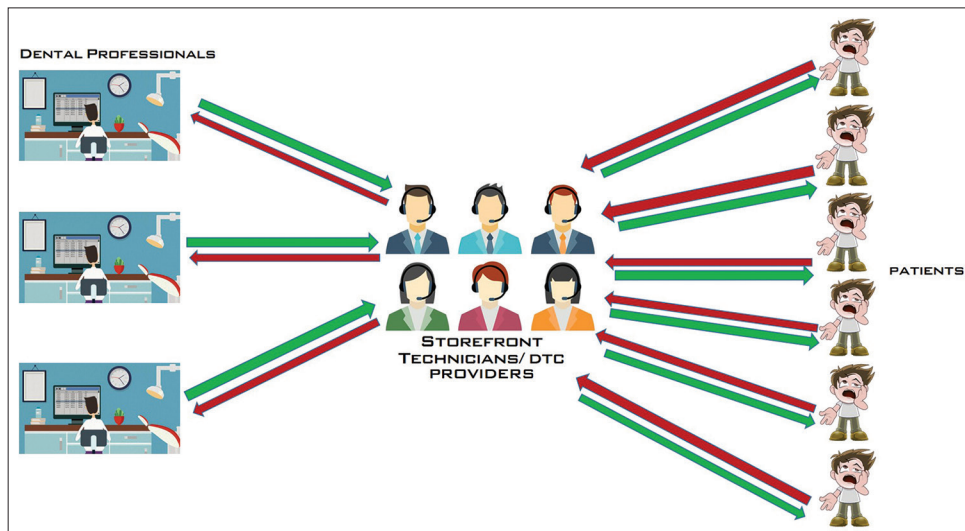


Figure 5: DTC commercial model

stood out has been the widespread access of clear aligners to the patients directly without the intermediary need of a trained orthodontist.<sup>[36,37]</sup>

There are many such companies as of May 2021 that advertise an improvement in smile and teeth alignment directly to the consumer. Such companies either have *storefronts* wherein a technician takes the relevant records, or many a time, the user (patient) takes records such as pictures of his or her teeth and sends them across to the company directly. The clear aligners are shipped back to the patient via mail [Figure 5]. By cutting out the orthodontist in between, the companies could now sell to thousands of more consumers for thousands of dollars lesser.<sup>[36,38]</sup>

One such DTC company is the Smile Direct Club that has preposterously claimed (without evidence) on its website, “*you can get a new smile in as little as 4 months, not years. All for less than \$89 per month with guaranteed financing approval*” to garner attention from and eventually exploit naive customers. One of their many business strategies includes partnering with leading dental conglomerates and dental service organizations in order to widen their reach and access more patients.<sup>[39,40]</sup>

*“Orthodontics gives us so much. We are privileged to serve our patients and blessed to be rewarded in more ways than one. Don’t we in turn deserve to reciprocate with equal respect?”*-James Noble, Director of Orthodontics at the Royal College of Dentists of Canada.

The American Association of Orthodontists (AAO) has publicly disparaged the authenticity and has filed legal complaints with 36 state dental boards against Smile Direct Club,<sup>[41]</sup> a private company, that has the largest share of the DTC market. The European Federation of Orthodontic Specialists Association (EFOSA), on the other hand, has promoted a joint declaration with the representative orthodontic associations in Europe to underline and inform the patients of the possible adverse effects and dangers of DTC products. The public disparagement, however, has not helped slow down the commercialization of such DTC companies.

## Conclusion

Teledentistry, has been a boon for health care, but the bane of its existence has raised fundamental questions that are critical to our professions such as what is the difference between a consumer and a patient? Does dentistry reside in the same realm as cosmetics? Is there a difference between direct-to-consumer business from teledentistry? Does teledentistry steer us to being more *transactional* rather than *personal* towards our patients? Is the world wide web of dentistry a boon or bane?

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## Conflicts of interest

There are no conflicts of interest.

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