

# Changing Professional Boundaries: The Case of Digitalization in Dentistry

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## Introduction

Recent studies indicate that digital technologies have the potential to transform work processes, tasks and responsibilities and thereby fundamentally change the nature of entire professions (e.g. Nelson & Irwin, 2014; Susskind & Susskind, 2015; Strich et al., 2021). For instance, Strich et al. (2021) revealed that the introduction of an AI system for decision-making in the loan consultancy resulted in the deskilling of loan consultants whose expert knowledge was replaced by the technology. Similarly, Clarke (2020) showed how smart telemedicine diagnosis systems change the work of doctors by enabling patient treatment independent of specialized physicians. These findings echo popular discussions about the future of professions in which it is often suggested that traditional professions such as doctors or lawyers may either become obsolete or at least radically transformed as the result of advances in digital technologies (Susskind & Susskind, 2015).

Our case focuses on “teleorthodontics” that similarly aimed to radically transform the profession of traditional orthodontics. Teleorthodontics relies on the combination of 3D printing, intraoral scanning and digital platforms for remote diagnosis to offer orthodontic treatment radically reducing the involvement of professionals. Our findings follow how the concept of teleorthodontics emerged and what effect it had on the professions of orthodontists and dentists. Our analysis finds that the unexpected result of the emergence of teleorthodontics was not the change in the orthodontist profession, as the literature would predict, but rather the shift in traditional boundaries between the professions of orthodontists and dentists. Specifically, dentists were able to perform tasks that used to be reserved exclusively for orthodontists.

We build on qualitative data following a grounded theory approach (Strauss & Corbin, 1990). Our preliminary data set comprises 22 semi-structured interviews, including 14 orthodontists, 5 dentists, 1 managing director of one of the leading teleorthodontics companies, 1 leading member of the German Orthodontist Association and 1 member of the German Dental Chamber. In addition, we analyzed 10 articles of specialist magazines for orthodontists and dentists, 7 newspaper articles, and several websites from dentists who collaborate with teleorthodontics companies. For data collection, we particularly focused on teleorthodontics companies operating in Germany because in Germany the legal boundaries between orthodontists and dentists are very formal, making it an exemplary case to examine the transformation of professional boundaries as a result of new technological developments.

## Research Setting - The emergence of teleorthodontics

The history of teleorthodontics begins in 1997 when Align Technology as the first company started to use 3D printing to enable the production of aligners (aligner system called Invisalign). Clear aligners, which are a plastic transparent form of dental braces, have been

introduced as an alternative to metal braces because “they can be removed at any time by the patient, the treatment time is much shorter and they are much cheaper than braces” (Interview, Orthodontist 1). Align Technology primarily targeted orthodontists as the main profession employing this technology because using aligners still required to take care of the diagnosis, implementation and monitoring. As a leading member of the German Orthodontist Association mentioned: “Primarily orthodontists made use of this technology and only a very, very few dentists used Invisalign. Because the entire process was too complex and risky for dentists who had no special training in orthodontics.”

From 1998 to 2017, Align Technology had patents on the aligner technology and retained the monopoly position on the market. However, once in 2017 their patents expired, teleorthodontics companies emerged that used the same clear aligner technology, but combined it with the more advanced digital scanning capability and the digital platform. The digital ecosystem they created allowed to directly target the patient with only little involvement of the professional. The business model of teleorthodontics companies is as follows: If patients wish to correct their teeth, they can sign up for a free 3D scan of their teeth via a website. Patients then get an appointment at a dental practice of a so-called “partner dentist” or a shop at the nearest location. At a dental practice, patients get their teeth digitally scanned by a “professional”, who in practice is often a dental assistant. These images are then uploaded on the platform where a company’s “expert” (who is according to a company, either a dentist or an orthodontist) remotely evaluates the scans and decides if the patients’ current teeth position is suitable for a treatment via teleorthodontics. If yes, the company manufactures and sends the individual aligner to the patient with a manual of how to use them. Whereas braces usually take about two to three years, teleorthodontics companies promise to have a final result already after six months. During this process, the patient only has one physical contact with a dental professional who can be either an orthodontist, dentist or a dental assistant.

## **Preliminary Findings**

Each country has its own regulations that determine who can work as an orthodontist or dentist and who can call themselves as such. In Germany the following legal and formal requirements apply: For both professions, it is necessary to successfully complete the studies of dentistry which usually takes six years. Upon completion of this study, the title of a dentist is granted to this person. The very best graduates from the dentistry school are then invited to continue with an orthodontics study that takes additional three years. Only if this extra study is completed successfully, the person can call themselves an orthodontist. Apart from this strict legal distinction between both professions, there is also a less clearly defined title of a “dentist with focus on orthodontics”. This professional title is non-protected meaning that every dentist is allowed to use it. However, before teleorthodontics emerged, this title was not commonly used among dentists.

The tasks of dentists and orthodontists differ in the following way. Dentists are typically responsible for teeth health which includes the tasks of preventing, diagnosing and treating mouth and teeth diseases and performing dentures. Orthodontists are specialized in teeth correction including diagnosing and treating malfunctions and ensuring a healthy jaw position and bite. Although both professions had clearly defined task jurisdictions, some of the

interviewees interestingly reported that there has always been a certain competition between both professions. As one orthodontist explained:

It is also true that the orthodontist is the natural enemy of the dentist. Why? Because he can do nicer things, because he can bill better, because he bears less risk, because nothing bleeds, squirts, no anesthesia. And this is why also the dentist would like to have a piece of this cake. And [teleorthodontics companies] suggest that this is now possible and not a big deal. (Interview, Orthodontist 4)

This quote also shows how the emergence of teleorthodontics has intensified the competition between both professions by enabling dentists to perform the tasks that have been within the jurisdiction of orthodontists. Whereas the legal boundaries remain in place, the work boundaries started to shift. Teleorthodontics enable dentists to perform tasks formerly restricted to orthodontists, such as offering aesthetic teeth treatment or teeth correction. This change is perceived as problematic by orthodontists who emphasize the importance of profound orthodontic knowledge to carry out teeth correcting procedures:

A dentist is unable to make a qualified orthodontic diagnosis without proper training. It is important that the patient is properly examined and informed beforehand. And that on a medically high level. Yes, and not just because someone is standing there who once studied dentistry and says yes, it is possible, although he does not even know whether it is really not possible because he has no orthodontic experience at all. (Interview, Orthodontist 1)

In what follows, we offer some first explanations why and how this development occurred. Before the emergence of teleorthodontics, Align Technology targeted primarily orthodontists. While previously, aligner therapy involved diagnosing, introducing, and monitoring in order to provide aligners for patients, with teleorthodontics much of those hassles were removed. By partnering with a teleorthodontics company, dentists received a last generation intraoral scanner for free for their practice, got access to the 3D scanning and modelling software that simulates the teeth movement over time and shows the final result, and benefitted from the platform that takes care of the automatic order of aligners and the direct shipment to patients. Moreover, the legally responsible party was the teleorthodontics company which meant that the company took on the accountability risk in case of any issues:

It's very convenient for the dentist: The [teleorthodontics company] takes over all the marketing and customer communication, they set up the digital platform where patients can register, then the patient visits the dentist, the dentist or mostly just an assistant uses the intraoral scanner provided by [teleorthodontics company] to scan the teeth, the scan is uploaded and then assessed by some dentists online and then the [teleorthodontics company] takes care of the aligner production and the shipping to the patient. The dentist is only involved once or twice if at all. (Interview, Orthodontist 8)

The increasing engagement of dentists in orthodontics tasks was also beneficial for the company. By employing dentists as an “expert” they could on the one hand, satisfy the legal requirement of having a “professional” involved for the medical evaluation. On the other hand, because dentists were easily attracted to partner with them, teleorthodontics companies could

bypass the orthodontists as a higher-status professional who have traditionally claimed the jurisdiction over aligner therapy. Interestingly, however, while dentists were formally part of the therapy, their tasks and involvement were in fact minimal, basically reduced to doing the scans and evaluating whether the patient is suitable for aligners. Moreover, teleorthodontics companies benefitted from engaging dentists as experts, because dentists could still be considered as a relevant professional, but were significantly cheaper to employ and attract than orthodontists. In this context, the non-protected title of “dentists with focus on orthodontics” gave a possibility for those companies to advertise and promote that they actually make use of orthodontic expertise:

[Teleorthodontics company] says on their website: ‘We work together with specialists in orthodontics’ but then you can see the list of partner dentists and these are only general dentists. The patient thinks ‘Ah great, these partner dentists are orthodontists’ because they read the word orthodontics both on [company’s] website and also on the website of the partner dentists. So [company] actually helps dentists to promote themselves as specialists in orthodontics and the other way around, too – because the business model of [company] helps dentists to promote themselves as specialists in orthodontics and to perform orthodontics tasks. And it’s a win-win situation for both. Dentists are cheaper than orthodontists but they still can be sold as orthodontics specialists and dentists can increase their portfolio. (Interview, Leading Member, German Orthodontist Association)

Furthermore, although teleorthodontics companies promote that they collaborate with orthodontists to ensure expert monitoring and high quality, the majority of orthodontists refused to collaborate with them because of contradicting work ethics and the believe of the need of specialized orthodontic expertise when offering aligner therapy: “I could never do that – this is just not ethically correct. These companies promise things that are just not realistic. And teeth correction should only be carried out by orthodontists and not by dentists without special training because it’s not only about a nice smile but also about the bite.” (Interview, Orthodontist 3)

## **Conclusion**

Our research reveals that the emergence of teleorthodontics contributed to an increasing blurring of boundaries between the professions of orthodontists and dentists. Before these companies entered the market, the boundaries between the two professions were strictly and clearly defined. However, the emergence of teleorthodontics enabled dentists to expand their tasks and thus, increasingly enter the areas of work that used to be performed exclusively by orthodontists. Our findings extend prior research on the consequences of new technologies for professions in the following ways. First, in contrast to the popular discussions of digitalization that implies an inevitable force coming onto professions (Susskind & Susskind, 2015), we show a much more complicated process where both the development in technology and responses of professions jointly participate in shaping the outcomes for professions. In particular, although teleorthodontics started initially with the vision of removing the need for orthodontists, the process eventually led to an unintentional change in boundaries, as a result of interactions between companies, orthodontists’ responses and dentists’ practices. Thereby, our case

illustrates the importance of examining the complex interplay between different actors in the professional landscape.

Second, our focus on two neighboring professions complements previous research that examined the responses of one occupational group to the newly introduced technology. For example, previous literature reported how particular groups such as librarians (Nelson & Irwin, 2014) or loan consultants (Strich et al., 2021) had to cope with the new technology that could perform some of their work tasks and thus, presenting a certain risk to their occupation. By expanding our analysis to include the adjacent occupational group, we contribute to the “relating” perspective on occupation, recognizing how new technologies may result in a redistribution and change of boundaries in the established occupational system (Anteby et al., 2016).

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