

Preface and Acknowledgements

This thesis concludes my Master's Degree in Entrepreneurship and Innovation at the Norwegian University of Life Sciences. For the last three years, I have been very focused on learning more about my field of study. I have been lucky enough to combine my studies with working for the American start-up company OrthoAccel, which has enabled me to learn and experienced a great deal. This thesis is written in collaboration with OrthoAccel, and it is a contribution to the knowledge about the diffusion of their product, AcceleDent.

Writing this thesis has been a challenging task. I have had to separate between my duties as an employee, and my responsibilities as a researcher and student. Although complicated, I believe I have handled this situation well. I would like to thank my supervisors and coworkers at OrthoAccel for giving me the opportunity to develop myself professionally, and for assisting me in the process of writing my thesis.

I would like to show my gratitude for the opportunities I have been given as a student at NMBU. If it was not for the international exchange program coordinated by the university, I would not have been able to achieve nearly as much as I have done the last years.

I would like to thank my advisor, Anders Lunnan, for providing constructive guidance throughout this process. Your support and valuable input has been essential in the progress of this thesis. Also, thank you for being flexible in the arrangement of meetings, as we have been in completely different time zones most of the time.

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Kristoffer Karlsen

Abstract

This thesis examines the factors that affect the diffusion of the medical device innovation AcceleDent. The *objective* of the thesis is to make strategic recommendations that may drive the adoption of AcceleDent. These recommendations will be presented to the company, OrthoAccel.

According to established research and theory about diffusion, the *perceived* attributes and qualities of an innovation are among the most important factors affecting the rate of adoption. Diffusion theory also suggest that any given market consists of five different consumer segment: *innovators, early adopters, early majority, late majority and laggards*. Consumers are segmented based on their characteristics and values, which again determines *when* each consumer segment is likely to adopt an innovation.

The study was conducted using both quantitative and qualitative data about the consumers of AcceleDent, namely orthodontists. Secondary data from two surveys form the basis of the results, while primary data from observations and interviews allowed for a better understanding of the quantitative results. The purpose of the data collection was to examine the consumers' perceptions of the benefits of AcceleDent, their interest in the device, and their method of implementing and using it. The data was also used to determine which of the above mentioned consumer segments we are dealing with, since my recommendations had to be based on the needs of the consumers.

My findings indicate that we are currently dealing with the early adopter and early majority segments. Reported concerns among orthodontists coincide with the theoretical characteristics of these segments, which suggests that consumers value established references when deciding whether to adopt an innovation. I found that orthodontists perceive a lack of established references, such as clinical evidence and detailed information about the device. Furthermore, orthodontists seem to perceive and value the product's benefits differently. This has led to a variety of methods of implementing and using AcceleDent.

I recommend that the company conduct an in-depth study of the clinical and economic impact of AcceleDent. The results of the study should be used to educate orthodontists about the effects and benefits of AcceleDent, as well as how best to implement and use the device. This may decrease the uncertainty related to the device, and may increase the rate of adoption.

Sammendrag

Denne studien undersøker hvilke faktorer som påvirker diffusjonen av den medisinske produktinnovasjonen AcceleDent. *Formålet* med oppgaven er å danne strategiske anbefalinger som kan bidra til å øke produktets adopsjonsrate. Disse anbefalingene vil bli presentert for selskapet, OrthoAccel.

I følge forskning og etablert teori om diffusjon, er de *oppfattede* egenskapene og kvalitetene ved en innovasjon blant de viktigste faktorene som påvirker dens adopsjonsrate. Teori om diffusjon sier at et hvert marked består av fem forskjellige kundesegmenter: *innovatører, tidlige brukere, tidlig majoritet, sen majoritet og etternølere*. Kundene er segmentert på bakgrunn av deres karakteristikk og verdier, som igjen avgjør *når* det er sannsynlig at hvert segment vil gå til anskaffelse av innovasjonen.

Studien ble gjennomført ved bruk av både kvantitative og kvalitative data om AcceleDent's kunder, nemlig kjeveortopeder. Sekundærdata fra to spørreundersøkelser danner grunnlaget for resultatet, mens primærdata fra observasjoner og intervju gav en bedre forståelse av de kvantitative resultatene. Formålet med dataene var å undersøke hvilken oppfatninger kundene har av AcceleDent's egenskaper, deres interesse for produktet, og deres metoder for implementering og bruk. Dataene ble også brukt til å bestemme hvilken av de nevnte kundesegmentene vi har med å gjøre, da mine anbefalinger måtte tilpasses kundenes behov.

Mine funn indikerer at produktet er mest relevant blant segmentene tidlige brukere og tidlig majoritet. Kjeveortopederne i spørreundersøkelsene uttrykte behov som sammenfaller med de teoretiske beskrivelsene av disse segmentene, som sier at kunder verdsetter etablerte referanser når de vurderer å gå til anskaffelse av en innovasjon. Resultatene viser at kjeveortopeder oppfatter en mangel på etablerte referanser, som kliniske bevis og inngående informasjon om produktet. Videre viste resultatene at kjeveortopeder oppfatter og verdsetter forskjellige fordeler ved AcceleDent, noe som har ført til en stor variasjon av metoder for implementering og bruk av produktet.

Jeg anbefaler at selskapet gjennomfører grundige studier av de kliniske og økonomiske effektene av AcceleDent. Studienes resultat bør brukes til å undervise kjeveortopeder om fordelene og virkningene av AcceleDent, samt hvordan man best kan implementere og bruke produktet. Dette kan redusere usikkerheten rundt produktet, og kan øke adopsjonsraten.

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1. Introduction

In this chapter, I will present the context of this study. I will explain the rationale behind my choice of overall research question, the study objective, as well as how I have proceeded in order to achieve this objective.

1.1 Background

While participating in the Gründerskolen exchange program in 2013, I worked as a marketing intern at an American start-up company called OrthoAccel Technologies, Inc. I returned to OrthoAccel in 2014, this time as a Strategic Marketing Associate. Learning about the challenges of a young and developing company was interesting. However, one specific subject really caught my interest, namely the diffusion of innovations. I found that there is a variety of factors affecting the diffusion of an innovation, but more importantly, I gained an interest in understanding which factors were affecting the diffusion of AcceleDent.

The Company

OrthoAccel Technologies is a privately owned medical device company founded in 2006. Located in Houston, Texas, the company is engaged in the development of products to enhance dental care and orthodontic treatment¹. In 2009 the company launched its first product internationally, and after obtaining FDA approval in North America in late 2011, they launched in the US and Canada the following year.

The Product

The product, AcceleDent, is a medical device designed to provide faster orthodontic treatment. AcceleDent is clinically proven to decrease an orthodontic patient treatment time by up to 50% (OrthoAccel 2015). For Instance, a teenager using AcceleDent while undergoing orthodontic treatment may shorten treatment time from two to one year. To use AcceleDent, the patient bites down on a mouthpiece that is connected to a small vibrating engine called the activator. By using the hands-free device 20 minutes daily while undergoing orthodontic treatment,



Figure 1: AcceleDent (OrthoAccel 2015).

¹ Treatment of patients with irregular positioning of teeth.

AcceleDent safely speeds up the process of remodeling the bone tissue surrounding the teeth - allowing for faster teeth movement and reduced treatment time (OrthoAccel 2015).

The Market

OrthoAccel² sells AcceleDent³ to orthodontists only. The orthodontists then offer the device to patients as a part of their treatment package or as a complementary product to orthodontic treatment. AD is currently a unique device, and many orthodontists and patients are yet not familiar with it. Because of this, OA's sales representatives perform product presentations with orthodontists and their staff to educate them about the device. Although orthodontists are the primary customers, the end-users (the patients) also have to be educated about the device. Without any interest from patients, orthodontists may not see the necessity of offering AD. Therefore, OA seeks to educate both groups through their marketing.

1.2 The Issue

The orthodontic industry is not very innovative. Many aspects of the business has not changed in decades, therefore; orthodontists may perceive new technology as a threat to their traditional business model because of the changes it requires. By running a private orthodontic practice⁴, orthodontists are small business owners - seeking a positive return on investment when making decisions affecting their practice (Bentson 2012).

AD is an innovation that shakes the foundation of the orthodontic business model. It allows patients to finish treatment faster, reducing the months or years patients spend with their orthodontist, and thus the number of appointments needed. For the patient, the clinical benefits of AD are documented, however; the economic impact it may have on the orthodontic practice is not fully understood. Because of this, some orthodontists are hesitant to invest in a new technology without being completely aware of its impact. Even so, Bentson (2012) argues that orthodontists cannot completely ignore the development within the industry. To stay competitive and clinically relevant, orthodontists have to learn, adapt and implement new ideas, strategies and products.

² Hereafter referred to as OA.

³ Hereafter referred to as AD.

⁴ A small business where one or more orthodontists perform orthodontic services (Medical News Today 2014).

1.3 Overall Research Question and Objective of the Study

Based on existing theory on diffusion and relevant data about consumers, I aim to get an understanding of the status of diffusion of AD as well as the factors that hinder or assist the diffusion process. My overall research question is:

How can the diffusion process of AD be facilitated to promote the rate of adoption?

The *objective* of the study is to provide OA with essential information and strategic recommendations that can increase the diffusion rate of AD. After completing the study, the results will be presented to the company.

Because this study is primarily focused around a particular product in a specific context, the *relevance* of the study is mainly confined to the company. Yet the general results may be relevant in similar situations involving the diffusion of medical devices in a professional environment. The results may assist OA in increasing market penetration, but they may also provide OA with important information that supports other activities that the company is engaged in, like the development of marketing campaigns or even new products.

1.4 Composition of the Study

In the following chapter, I will give a brief introduction to the orthodontic industry in order to establish a basic understanding of the context of this study.

In chapter three, I will present the theoretical framework. To best serve the objective of the study, I have created a set of research questions that may assist in reaching an accurate conclusion. The chapter will conclude with the introduction of these research questions.

Chapter four will provide a description of the research method and the applied data sources that form the basis of the results and analyses presented in chapter five. In chapter six, the data results are discussed in light of the theoretical framework, and the chapter concludes with my recommendations for the company.

1.5 Limitations

As a part of this study, I will examine the economic benefits that AD offers the orthodontist. This is an important issue that I would prefer to study closely, however; orthodontic treatment takes months or years. In order to see how AD may affect the economy of an orthodontic

practice, it would be necessary to spend a lot of time collecting relevant data to reach a solid conclusion. As the timeframe for this thesis restrains me from achieving this, I will instead try to gain an indication as to which benefits the users of AD believe to be most relevant. I am aware that this study may primarily be used as an orientation tool as to what OA should focus more on, and how they should proceed if they choose to study this further.

2. Introduction to the Orthodontic Industry

There are about 136,000 general dentists working in the United States. About 9,500 of these are orthodontists, making orthodontists the largest dental specialty group (American Dental Association 2009).

An orthodontist in a private practice is either an independent orthodontist or a non-owner orthodontist. Opposite of non-owners, independent orthodontists can own a private practice or share the ownership with partners. These partners can be shareholders or other orthodontists working in the same practice. According to a study done by the American Association of Orthodontists (2006), the average orthodontist sees patients 30 hours per week. The study reports that orthodontists on average employ five full-time staff and two part-time staff.

Private practice orthodontic ownership is and will continue to be one of the best income producing professions in all of dentistry and medicine in the United States (Bentson 2012).

Referrals and Consults

The main market segment for orthodontists are adolescent patients. Orthodontic treatment most often starts within the ages of 9 – 14, but dentists normally refer their adolescent patients to an orthodontist before this age if it appears the child may need treatment. These orthodontist recommendations from dentists are called dentist referrals. Dentist referrals influence many patients' decisions, and they are considered the main source of new patients. In addition to dentist referrals, there is another key source of referrals, called patient referrals. Patient referrals are made by current or prior patients (or parents of patients) who recommend their orthodontist to family or friends. Overall, referrals play an important role in generating new business for orthodontists.

Most orthodontists offer free first time consults. During these consults, the prospective patient is taken care of by a treatment coordinator. The treatment coordinator provides information and answers any questions the patient might have. During the consult, an orthodontist examines the patient and gives his or her professional opinion regarding treatment. The job of the treatment coordinator is then to close a sale and schedule the patient's treatment.

Development and Current Distribution of Referrals

Referrals from dentists accounted for more than 50 % of *total referrals* for orthodontic practice owners during the years 1983-1999. Since this period, referrals from general dentists has declined to 40 % of total referrals in 2011. This is primarily a result of dentists bringing orthodontic treatment into their own practices, and thereby being able to treat adolescent patients instead of referring them to an orthodontist. Because of this decline in referrals from dentists, practices have had to employ strategies to generate internal referrals from existing or prior patients. As a result, patient referrals have increased from 30 % in 2007 to 35 % in 2011, making patient referrals almost as important as dentist referrals (Keim et al. 2013).

The section above explains the distribution between dentist referrals and patient referrals, but it does not explain how many of these referrals turn into paying patients for the orthodontist. According to Haeger (2013), 89 % of *actual patients* come from referrals. The distribution is very even, with 45 % of patients deriving from dentist referrals and 44 % from patient referrals.

Reduced Treatment Time

For many years, the average treatment time for full treatments was 24 months. This length allowed for a payment plan that suited the family budget well. However, due to the adoption of technologies such as AD and other treatment procedures, the average treatment time has decreased over the last years. In 2009 the average treatment time had been reduced to 22 months, yet many practices using certain newer treatment procedures has reported treatment times of 15-18 months on average (Bentson 2012). Some of these newer treatment procedures will be presented alongside AD in chapter 5.

New Payment Methods

Practice studies reported that the treatment fees increased by only three percent between 2009 and 2011, which is the smallest increase in 30 years, being a consequence of decreased treatment time in recent years. The use of automatic monthly payment services has become more popular over the last years. It is however difficult to justify an increase in treatment fees while asking the patient to pay the fee in a shorter amount of time or a lower number of monthly payments. As a solution, some practices allow patients to extend the payment period beyond the length of the treatment period (Bentson 2012).

Marketing

Apart from dentist referrals and patient referrals, six percent of patients come from the internet, while all other marketing activities only provide five percent of new patients. (Haeger 2013) These marketing activities only account for 11 % percent of new patients.

Systems designed to maintain patient satisfaction and seek patient referrals are forms of internal marketing that have increased over the last years (Bentson 2012). The importance of maintaining patient satisfaction is clear (Haeger 2013):

1. Surveys show that patient satisfaction the main concern for the dentist when referring their patient to an orthodontist.
2. Satisfied patients will generate more patient referrals.

Accordingly, satisfied patients is likely to be the best source of new patients. Since dentist referrals and patient referrals together provide for 89 % of new patients, it appears that orthodontists focus more on internal marketing than external marketing (Hughes et al. 1996).

Competition

There are four major factors of rivalry in the orthodontic industry: industry growth, overhead percentage, product differentiation, and concentration of competitors. For any orthodontic practice⁵, low growth, high overhead, undifferentiated products and a high concentration of competitors will intensify the level of rivalry. (Hughes et al. 1996).

New entrants into the orthodontic industry will reduce the market share of existing orthodontic practices, however; the demand for dental services was some years ago at an is at an all-time high (Solomon & Ceen 2006).

⁵ The term *orthodontic practice* will sometimes be referred to as *practice*.

3. Theoretical Framework

This chapter presents existing theory and literature on the diffusion of innovations, as well as relevant ideas and terminology. The theoretical framework forms a basis from which I have created a set of research questions that will conclude this chapter.

3.1 Innovations

Before describing the *diffusion* of innovations, we should first get an understanding of the term *innovation*, and how this relates to AD and diffusion theory. There is an extensive amount of literature about innovations, but as the focus in this study is on the *diffusion* of innovations rather than the *creation* of innovations, the term will be described briefly.

“An innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption” (Rogers 2003:12). Notice that the element of novelty or *newness* is central in this definition. Rogers (2003) defines newness by stating that if an idea is *perceived* new to the individual or unit *adopting* it, it is an innovation.

Smith (2010) refers to the definition above in his book; yet, he argues that it does not focus enough on the commercial aspect of innovations, namely that *“innovation is about the commercial exploitation and application of ideas and inventions, so that they can be traded in the marketplace”* (Smith 2010:5). This states that innovation, in addition to involving something new, also involves commercialization to make an innovation into something that is available in the market for consumers to purchase.

We can separate between *continuous innovations* and *discontinuous innovations*. In short, the term *continuous innovations*, describes the upgrading and improvement of products that do not require the consumer to change behavior (Moore 2002). For instance, stereo speakers can be improved to deliver better sound quality, but it does not require the consumer to change behavior in order to use the product.

On the other side, we have *discontinuous innovations*. These innovations require significant change from the consumer, and they might be incompatible with the consumer’s current infrastructure or supporting products or components (Moore 2002). The Blu-ray high definition DVD player is an example of this. When it was released almost ten years ago, the consumer could only utilize its features if he or she had a HD television and Blu-ray DVD discs. At the time

of release, HD televisions were not as common as today, and not many movies were yet made available for Blu-ray DVD discs. Because of this, the Blu-ray DVD player required many people to change their supporting components, like television and DVD discs, in order to fully utilize the innovation. It also required a change in behavior as the consumer had to put extra effort into finding and buying Blu-ray DVD discs.

3.2 What is Diffusion?

I have based my description of diffusion on two definitions of the term. The first definition is narrow and does not include many elements, while second definition is far more complex, however; I believe the combination of the definitions provide a more detailed understanding of the term diffusion.

Smith (2010:16) gives the following definition of diffusion: *“Diffusion is the process by which innovations are adopted and used by consumers (...)”*. He continues with the conclusion that diffusion is the rate at which innovations are adopted. In this definition, *rate of adoption* is the fundamental element, whereas *adoption* refers to the action of a consumer *using* an innovation.

Rogers (2003:11) definition is more nuanced: *“Diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system”*. There are four main elements to this definition, namely *innovation, communication, channels, time, and social system*.

Below I will explain the meaning of the five elements in the Roger’s (2003) definition, as well as *rate of adoption* which is central to Smith’s (2010) definition.

3.2.1 Elements of Diffusion

Communication and Communication Channels

Communication can be defined as the process where people create and share information with each other with the goal of reaching a mutual understanding (Rogers 2003). Diffusion is a kind of communication where the content of the message is mainly about a new idea, and the essence of the diffusion process is the communication of a new idea to one person or many people. Here the term communication channel is relevant. A communication channel is the method a message gets from one person to another. Mass media is the most efficient method

of informing a big audience of potential adopters about the existence of an innovation. However, interpersonal communication channels (face-to-face) are more effective in persuading an individual to accept a new idea, especially if this interpersonal channel connects people who are similar in socioeconomic status, education or field of profession. According to Rogers (2003), diffusion investigations show that most people depend mostly on subjective evaluation of an innovation, where the evaluation is communicated by other individuals like themselves who have experience with the innovation.

Innovation-Decision Process

Rogers (2003) explains that the element of time is related to the *innovation-decision process*. The innovation-decision process is focused on gathering and processing information about an innovation in order to decrease the *uncertainty* related to it. This process of information-seeking and information-processing consists of five steps: *knowledge, persuasion, decision, implementation and confirmation*. *Knowledge* is gained when a person learns about the existence and functions of an innovation and thereby obtains information about how it works. *Persuasion* is related to the person's attitude towards the innovation, which can be either favorable and unfavorable. *Decision* takes place when the person makes the choice between adopting and rejecting the innovation. *Implementation* is the action of putting an innovation to use, and *confirmation* occurs when the person seeks to strengthen his innovation-decision. During the confirmation step, the person can also change his or her decision about innovation and choose to reject it even after implementing it, should he or she find conflicting information about the innovation. This action is called *discontinuance* (Rogers 2003).

Overall, the process can lead to adopting the innovation and making full use of it, or rejecting the innovation and thereby deciding not to make use of it. The innovation-decision *period* is the amount of time needed to pass through the whole process. The length of this period varies from person to person and can span from days to months or even years (Rogers 2003).

Social Systems

A *social system* is described as a set of connected members that are involved in problem solving with the purpose of achieving a common goal. These members of a social system can be individuals, groups or organizations. For instance, the orthodontists in an American city is an example of a social system because all members of the system seek to solve a common problem. This common purpose is what binds the social system together (Rogers 2003).

The diffusion of an innovation happens within a social system, and the social and communication structure of that system may affect the diffusion. *Norms* play an important role here. Norms are established behavior guidelines for the members of a social system and tell individuals how they are expected to behave. Norms can operate within a community, an organization or an industry like the orthodontic industry. The norms within a system can be a barrier to change if the established norms are challenged by the implementation of an innovation. (Rogers 2003)

Often, some members of a system function as *opinion leaders*. Opinion leaders give advice and provide information regarding innovations to many other members of a system. *Opinion leadership* is about influencing other people's attitudes or behavior in a preferred way. This is an informal type of leadership which is not a function of the person's formal position or status. Opinion leadership is earned by the person's professional competence, social availability, and compliance to the system's norms. Through their compliance to the system norms, opinion leaders function as a role model for the innovation behavior of the other members of a system. If a social system, and its norms, is open to change, opinion leaders are innovative. On the other hand, if the norms of a system are not open to change, opinion leaders support this norm (Rogers 2003)

Another factor in a social system that influences the diffusion of innovations are the different types of *innovation-decision*. An innovation can be adopted or rejected by either individuals or complete social systems. It can be adopted by a complete system when there is an agreement between the members of the system, or when the authorities of a system makes the decision to adopt an innovation (Rogers 2003).

However, most relevant for this study is an innovation-decision called *optional innovation-decision*. Optional innovation-decisions are made by individuals, independent of the decisions other members of the system might make. Although this is an individual decision that does not directly affect the other members of the system, the decision-maker may be influenced by the norms of the system and communication with colleagues or friends (Rogers 2003).

The adoption or rejection of an innovation result in *consequences* for the individual or the social system. Rogers (2003) categorizes the consequences as follows:

1. *Desirable vs. undesirable* consequences, varying on whether the innovation's effects in the social system are positive or negative.
2. *Direct vs. indirect* consequences, varying on whether the changes to the individual or the social system happens directly related to the innovation, or as a secondary result of the direct consequence of the innovation.
3. *Anticipated vs. unanticipated* consequences, varying on whether or not the changes are acknowledged and anticipated by the members of the system.

3.2.2 Rate of Adoption

As mentioned earlier, Smith (2010) focuses his description of diffusion on the *rate of adoption* which is a central element of diffusion. Sometimes the can be slow, while in the cases of many Internet-related services or products, it can be very fast. However, Rogers (2003) states that the rate of adoption is normally measured in the number of people in a given market who adopt the innovation in a given time period (Rogers 2003).

Above I described an innovation decision called optional innovation-decision, where individuals make decisions independent of the other members of a system. Rogers (2003) states that innovations that require an optional innovation-decision are generally adopted more quickly than when an innovation is adopted by a whole system like an organization. He argues that the more people involved in the decision making process, the slower the rate of adoption.

The perceived *attributes* or qualities of an innovation are an important reason for the rate of adoption. The majority of variances in the rate of adoption (from 48 to 87%) is explained by five attributes: *relative advantage, compatibility, complexity, trialability and lastly observability*. An individual's perception of these attributes can somewhat predict an innovation's rate of adoption (Rogers 2003).

Relative Advantage

Relative advantage is to what extent an innovation is perceived as better than the idea it seeks to replace. In other words, does the innovation perform better than the existing product or does it enhance a procedure? Potential adopters seek information to answer this question in order to decrease uncertainty about the relative advantage of an innovation. Therefore, information about relative advantage is an important part of the message regarding an

innovation, and the exchange of this information among colleagues or friends is the essence of the diffusion process (Rogers 2003).

Relative advantage is perceived as a relation between the anticipated benefits and the costs of adoption of an innovation. Some elements that are taken into consideration are economic profitability, low initial cost, a decrease in discomfort, social prestige, saving time/effort, and if a potential reward from an adoption is in the near future or far away. According to Rogers (2003), diffusion scholars have found that an innovation's relative advantage is one of the strongest predictors of its rate of adoption.

The extent of relative advantage is regularly expressed as *economic profitability* or *social prestige* (Rogers 2003). Regarding economic factors, the initial price of an innovation may of course affect its rate of adoption. If the price of an innovation decreases during the diffusion, a more rapid rate of adoption is expected. Another important factor is the cost related to implementing the innovation. In addition to the initial cost, are there expenses related to training personnel or changing routines? Regarding economic reward, how likely is it that the innovation will pay off, how well, and when? All of this needs to be taken into account.

Furthermore, we have the aspect of social prestige. For many individuals, the desire to gain social status is a motivation factor when it comes to deciding whether to adopt an innovation. Seeking status may be a primary reason for imitating the innovation behavior of other people (Rogers 2003).

Compatibility

Compatibility describes to which degree an innovation is compatible with the needs, existing values, and previous experiences the potential adopter might have. Relevant to my study is the innovation's compatibility with *previously adopted ideas*. If an innovation is compatible with existing ideas, it may speed up the rate of adoption. This is because the more compatible the innovation is with existing ideas, the less change in behavior it requires from the adopter. On the other hand, if the innovation is almost similar to existing ideas, it may not be perceived as new and different enough to pass as an innovation (Rogers 2003).

Complexity

Complexity is about how much an innovation is perceived as difficult to both understand and use. Some innovations have an obvious meaning to potential adopters, while others are much

harder to grasp. Hence, if an innovation is perceived as too complex by potential adopters, it may have a negative effect on the rate of adoption (Rogers 2003).

Trialability

Trialability refers to the degree to which an innovation can be experimented with on installment level. Trying out an innovation under one's own conditions, is one way for an individual to give meaning to the innovation by figuring out how it actually works. Personal trials can decrease uncertainty regarding an innovation because the innovation can be improved to meet the individuals' conditions (Rogers 2003).

Observability

Observability describes how visible an innovations' results are to other people. If the results are easily observed and communicated to others, it may have a positive effect on the rate of adoption (Rogers 2003).

In addition to these five attributes, we have the earlier mentioned variables as *communication channels*, the nature of *social systems*, as well as the effect of *opinion leaders'* promotion effort. All these variables also affect the rate of adoption of an innovation.

3.3 Innovation Adoption Life Cycle



Figure 2: Innovation Adoption life cycle, based on a figure by Rogers (2003).

The figure above is commonly used to explain the *adoption life cycle* of an innovation. There are five consumer segments represented in this figure, illustrating *when* each segment is likely to adopt an innovation. The figure is to be studied from left to right, from when an innovation

is released and adopted by a few, until it has gone through the whole adoption process and has been adopted by the majority of the market. The size of the segments in the figure are meant to be representative for the number of consumers in each segment, hence; the early majority and the late majority segments include the greater parts of the market (Moore 2002).

Both Rogers (2003) and Moore (2002) use slightly modified versions of this figure to describe the innovation adoption life cycle⁶, however; the two authors differ on one area - described by Moore (2002) as the “chasm”. When Moore (2002) refers to the “chasm”, he describes a break between the *early adopters* and the *early majority* segments. He argues that the most difficult step in the adoption cycle is making the transition between these two segments. Rogers (2003) on the other hand, does not agree with this argument. He states that no previous research shows any support for this claim of a chasm between certain consumer segments. He argues, to the contrary, that although each segment has differences between them, there are no breaks between one segment and the next. Since I am referring to both authors, I found it beneficial to clarify the different standpoints of the authors. In this study, I am focusing on the adoption life cycle as a whole, and I will not go into further discussion regarding the “chasm”.

Below, I will describe the ideal types in each of the five consumer segments that represent the adoption life cycle.

Innovators

Innovators have a great interest in new ideas, and are very passionate about pursuing innovations. They often seek out innovations at a very early stage. As evident from the figure above, there are not many innovators in a given market. Yet, they play an important role in the diffusion of an innovation, because their approval of an innovation proves to other consumers in the market that the product does actually work (Moore 2002). Rogers (2003) also claims that innovators play an important role in the diffusion process. Although innovators may not be highly respected by other members of a social system, they work as importers of an innovation into that system.

According to Rogers (2003), there are some requirements to being an innovator. One of which is the control of sufficient funds, which is relevant because an innovator has to be able to overcome a potential financial loss from an unprofitable innovation. Another requirement is

⁶ Hereafter referred to as *adoption life cycle*.

the ability to understand technology and how it works, as well as being able to deal with a high degree of uncertainty related to an innovation that has not yet been completely tested in the market.

Early Adopters

Early adopters also adopt an innovation early on in the cycle. They are not technologists like the innovators, but they are consumers who easily identify and understand the benefits of a new technology. Early adopters relate these identified benefits to their own concerns, and are willing to base their buying decision on it. Instead of relying on established references from other people, early adopters rely on their own intuition, making them essential to initiating a market segment (Moore 2002). This is partly because early adopters are more integrated in a social system than innovators. Early adopters have the highest degree of opinion leadership in any system, making them a reference source for advice and information for potential adopters (Rogers 2003).

Early adopters are respected by others in the social system, and they are prime examples of successful use of innovations. To continue to earn the respect of others, early adopters have to make careful innovation decisions. By adopting an innovation, an early adopter decreases the uncertainty related to the product by conveying a subjective evaluation to other members of the system (Rogers 2003).

Early Majority

The early majority is driven by a sense of practicality. They are aware that innovations can fail, so they are comfortable with waiting to see how the innovations end up, before adopting them. The early majority require well-established references before really investing in an innovation (Moore 2002). The innovation-decision period of early majority is consequently longer than that of the previous two segments (Rogers 2003). Still, because the early majority segment consists of roughly 1/3 of all consumers in the entire adoption life cycle, gaining access to this segment is an important step towards achieving extensive growth and profit (Moore 2002).

Contrary to the early adopters, the early majority rarely act as opinion leaders in a social system. However, due to their position between the early adopters and late majority, they act as an important link between the two segments by providing a relation in the system's interpersonal networks (Rogers 2003).

Late Majority

Like the early majority, the late majority consists of about 1/3 of the consumers. The late majority adopt innovations a somewhat later than the average consumer does. This is partly because the late majority does not adopt an innovation until most members of their social system have done so. The decision to adopt may be a result of pressure from colleagues or partners, or a result of economic necessity. An important requirement of the late majority is that the system's norms must correspond with an innovation before they are convinced to adopt (Rogers 2003).

Laggards

In the end of the adoption life cycle, we have the laggards. They are the last to adopt an innovation, and do not really care much about new technology or innovations. Laggards base their decisions on what has been done in the past, and they normally interact with individuals who have relatively traditional values (Rogers 2003). Moore (2002) states that laggards are generally regarded as not worth pursuing.

3.4 Research Questions

In light of the theoretical framework, I have created three research questions that will facilitate my understanding of the issue I am studying. The objective of each research questions is to examine different aspects of the main issue. In the end, the questions will form the basis of my recommendations for the company.

3.4.1 Research Question 1

Based on what we know about the adoption life cycle, an innovation appeals to different consumer segments at different stages of the diffusion process. In order to examine the factors *currently* influencing the diffusion of AD, we first have to determine which of the consumer segment(s) we are dealing with. This is essential, because each consumer segment has certain characteristics and values, meaning they differ in how they relate to an innovation. In order to make strategic recommendations with the aim of reaching more consumers, we must now get to know the consumers. This leads us to the first research question:

What position does AD currently have in the market?

3.4.2 Research Question 2

The second research question is related to consumers who have already adopted AD. These consumers are a valuable source of information because they have first-hand experience with AD. By understanding the current users' experience with the product, we may compare real experiences with the expectations and perceptions of non-users. We may then determine whether the skepticism of non-users is justified.

Furthermore, the two final steps of Rogers (2003) innovation-decision process are related to the *implementation* and *confirmation* of an innovation. Implementation is the action of putting an innovation to use, and during the confirmation step, the consumer may change his or her decision about the innovation. Current users of AD are a reference source for non-users. Based on their experience with AD, they will communicate a positive or negative message to other members of the social system. In a best-case scenario, users may serve as opinion leaders, supporting the diffusion of AD. In a worst-case scenario, users may hinder the diffusion of AD due to their negative experience with AD.

Overall, I want to test the authenticity of the expectations and perceptions that non-users have of AD. I also want to understand how AD is implemented by current users, and their experience with AD. This leads us to the second research question:

How is AD implemented and used by orthodontists?

3.4.3 Research Question 3

The theoretical framework explains diffusion based on a number of factors that affect the diffusion process and the *rate of adoption*. Yet, Rogers (2003) argue that the perception of an innovations qualities is among the most important factors affecting diffusion. By evaluating orthodontists' perception of AD, I aim to gain an understanding that can form the basis for further recommendations. This is the rationale behind the third and last research question:

How do orthodontists perceive AD?

4. Research Method

In order to determine how to proceed when researching a subject, several decisions have to be made. We must decide *what* to examine and *who* to consult, as well as *how* the research should be conducted in order to get valid and reliable results. In this chapter, I will present the research method used to examine the study's research questions, hereunder data collection, analysis, ethics in research, validity and reliability.

4.1 Method for Data Collection

4.1.1 Data Sources for Theoretical Framework

The data used to create the theoretical framework has primarily been obtained from scientific articles and books. In order to find suitable theoretical literature, I have used several databases such as Google Scholar and PubMed. However, the American Journal of Orthodontics & Dentofacial Orthopedics and the Journal of Clinical Orthodontics has been my main source for relevant scientific articles. My supervisor, Anders Lunnan, also provided useful inputs on relevant literature.

4.1.2 Quantitative and Qualitative Data

Once we have decided what we want to investigate, as well as which research design we want to use, we can begin to discuss what methodical approach is most suitable in order to examine the research questions. We may use quantitative and qualitative methods of data collection. While quantitative methods put measurable results in context with a topic or research question, qualitative methods are used to gain greater insight. Furthermore, quantitative methods aim to explain the relationship between variables, usually in terms of numerical data, while qualitative methods aim to explain the background of this relationship, usually in the form of transcript (Jacobsen 2005).

In this study, both qualitative primary data and quantitative secondary data has been applied. The qualitative data was collected by conducting interviews, while the quantitative data was extracted from two different surveys. Based on the nature of my research questions, quantitative data was used to get an accurate representation of specific tendencies in the market. By using surveys with a large selection of relevant participants, we may reach conclusions based on precise and measurable results.

A numerical presentation of data results is a clear way to communicate findings. For instance, a survey asking the question: “Are you interested in adopting AD” will provide a measurable result that can be presented numerically: “X % of participants are interested/not interested”. This result may tell us something about the tendencies in the market, however; it does not say anything about *why* participants are interested or not interested in adopting AD. In order to explain the reason behind this result, we may use a qualitative method of data collection.

Based on the above, I used interviews to gain insight into specific aspects of my research questions. Some of my research questions cannot be comprehended solely from a survey that contains a set of *predefined* questions. The surveys are the primary sources of data for this study, but I was able to gain a deeper understanding by conducting interviews. Below is an overview of the data sources used.

Data Sources	Details
Personal experience and observation	<p>Relevant information I have obtained while working for OA for nine months. This includes participation in strategic management meetings, sales meetings, corporate presentations and insight into company procedures. This information is solely used to explain contexts in this study, where a person without knowledge about the orthodontic industry would have problems understanding the situation. Hence, this information is not used to form the basis of any conclusions.</p>

Primary Data	<p>Interviews</p> <p>Phone interviews of orthodontists and treatment coordinators, examining the implementation and potential economic benefits of AD.</p> <p>Participants:</p> <ul style="list-style-type: none">- 6 orthodontists.- 2 treatment coordinators. <p>Inclusion criteria:</p> <ul style="list-style-type: none">- Orthodontist in the US or Canada.- Current user of AD.- Interviewees were selected from both densely and sparsely populated areas, from different regions of the US and Canada. <p>Exclusion criteria:</p> <ul style="list-style-type: none">- Orthodontists who have not yet finished any orthodontic treatment cases with AD. <p>Execution:</p> <ul style="list-style-type: none">- Orthodontists were contacted by email with a request to participate in a qualitative phone interview regarding the use, implementation and potential benefits of AD.- The orthodontists were not given access to the interview questions beforehand.- The interviews were conducted on speakerphone in order to be recorded.- The interviews were conducted during the period April - May 2014.
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Secondary Data

Survey conducted by Fletcher Spaght, Inc.⁷ (Fletcher Spaght 2013).

A survey involving patients, parents and orthodontic professionals, focusing on a number of strategic imperatives regarding AD.

Participants:

- 200 orthodontists surveyed online:
 - 36 AD users and 164 non-users.
- 600 consumers surveyed online:
 - 400 who had started treatment (200 adults and 200 parents of patients).
 - 200 potential patients or parents of patients who had an orthodontic consult including a price quote within the last year.
- Phone interview data from >50 orthodontic practices.

Inclusion criteria:

- Respondents were geographically representative of the four US Census regions (Northeast, Midwest, West, South).
- Respondents must have been/will be financially responsible for treatment.

Exclusion criteria:

- Were “speeders”, meaning they finished the survey in <9 minutes.
- Were “straight-liners”, meaning they always choose the first or last answer option.
- Were under 18 years old.

Execution:

- The survey was conducted in late 2013.

Secondary Data	<p>Survey conducted by The American Journal of Orthodontics and Dentofacial Orthopedics⁸ (Uribe et al. 2014).</p> <p>A survey evaluating patients', parents', and orthodontists' perceptions of the need for, and cost of, additional techniques to reduce treatment time.</p> <p>Participants:</p> <ul style="list-style-type: none"> - 683 orthodontists surveyed online. - 450 consumers personally surveyed: <ul style="list-style-type: none"> - 200 adolescent patients (13 - 17 years of age), and their parents (n=200). - 50 adult patients (18 years and older). <p>Inclusion criteria:</p> <ul style="list-style-type: none"> - Currently in orthodontic treatment or initiating treatment soon. - The ability to read and speak English. <p>Exclusion criteria:</p> <ul style="list-style-type: none"> - Active or potential patients less than 13 years of age. - Patients and parents of patients with craniofacial deformities or medically handicapped conditions. <p>Execution:</p> <ul style="list-style-type: none"> - All active orthodontic members of the American Association of Orthodontists (9160 members) in the US and Canada received an email invitation to participate in the Survey. A reminder email was sent after three weeks. The response rate was 7.5%. - No identifiable information of respondents was collected, however; the survey consisted closed-ended questions regarding demographics. - The survey was conducted among orthodontists from May to June 2011, and among consumers from October 2011 to February 2012.
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Table 1: Overview of data sources.

⁷ Hereafter referred to as FS.

⁸ Hereafter referred to as AJO.

4.1.3 The Surveys

Both surveys are relevant for this study, but furthermore; they complement one another as they are aimed at researching different aspects of relevant topics, in addition to researching matching topics. Furthermore, while the FS survey uses *AD* as the *reference* of accelerated treatment, the AJO survey is a more general survey - evaluating participants' perceptions of *accelerated treatment* as a *benefit*, hereunder comparing different procedures and techniques that accelerate treatment. For instance, the FS survey uses the name *AD* in the survey questions, while the AJO uses the term accelerated treatment.

Analyzing both surveys allows for a more in depth analysis of *AD*, as well as the actual need and demand for the benefit that *AD* offers. Lastly, the surveys have somewhat similar characteristics: they include similar groups of participants, they were conducted online and they focus on many of the same topics.

4.1.4 The Interviews

As previously mentioned, I decided to conduct qualitative interviews to get a deeper understanding of the findings in the surveys, and to gather data that may better explain some of my research questions. In short, the objective of the interviews is to explain what the surveys cannot explain, namely how users of *AD* implement and use the device, as well as how they perceive the benefits of *AD*. To make sure the interviews would best serve this objective, I had to make several decisions on how to prepare and conduct the interviews.

The structure of qualitative interviews may vary. There are structured, semi-structured and unstructured interviews. While a structured interview contains a set of standardized questions where the thematization and sequence is predetermined, an unstructured interview is an informal interview with open questions regarding a predefined topic. In a semi-structured interview on the other hand, we operate with a general interview guide as a foundation, but the interview questions, thematization and sequence of questions may vary (Johannessen et al. 2004). I decided that that a semi-structured interview would best serve the purpose of my data collection, because I was looking to get many different perspectives from the interviewees. At the same time I wanted to keep the conversation somewhat within the lines of specific topics and questions, in order to acquire relevant data. For instance, if interviewees mentioned new and relevant information that I was not familiar with, I could change the sequence of questions

and follow it up with other relevant questions from my interview guide, or in other cases I would simply ask them to elaborate.

An interview guide is a tool that contains a list of topics and questions that will be discussed during the interview. Prior to the interviews, I created an interview guide by formulating relevant questions that I categorized, in order to create a natural structure in the interview. Since I represented OA at the time, the questions were approved by my supervisor at OA. My supervisor suggested that I included some questions that were of relevance to the company, which I did⁹.

The selection of interviewees is critical because this greatly determines what information we may be able to obtain (Johannessen et al. 2004). In an orthodontic practice, the orthodontist decides whether to adopt AD. Still, the orthodontist may seek advice from coworkers such as his or her treatment coordinator. Treatment coordinators are highly involved in the sale of orthodontic treatment, and they spend a lot of time with potential patients in the decision making process. I therefore decided that it would be beneficial to interview both orthodontists and treatment coordinators.

In cooperation with my supervisor and the vice president of professional relations, a group of potential interviewees was put together. This group consisted of a mix of orthodontists and treatment coordinators from different parts of the country, from both densely and sparsely populated areas. On my behalf, the vice president of professional relations reached out to a total of nine orthodontists and three treatment coordinators. He emailed them and invited them to participate in the interviews, and I followed up to schedule interview dates and times. Six orthodontists and two treatment coordinators agreed to participate. This number of participants turned out to be sufficient, as I did not get much new information towards the end of the nine interviews.

Due to the geographical location of the interviewees, and the fact that orthodontists have a very tight time schedule, I decided to do the interviews by phone. The participants did not get access to the interview questions before the interview, because I did not want participants to investigate the benefits of AD beforehand. I used the privacy of a meeting room to conduct the phone interviews, which took between 20 to 30 minutes each. A company phone with speakers

⁹ See appendix 1 for interview guide.

was used to make the phonecalls, so that I could record the interviews. All interviews were recorded, with permission from the interviewees. I also wrote interview transcripts during and after each interview, while the information was still fresh in my mind.

4.2 Data Analysis

Analysis is the act of diving something into bits or elements. The subject we want to examine is normally made up of different elements, and the object is to uncover a pattern in the data material. The act of analyzing data is therefore the process of reducing the amount of information, so that we may extract the essential information and convey it in a way that is understandable. The results should be described, categorized and bound together in a way that makes sense, and for the results to make sense - they have to be interpreted. (Johannessen et al. 2004). Below I will describe how the data analysis and interpretation was carried out. Both the primary and secondary data had to be analyzed. Together, these data sources create the foundation for the *results* presented in chapter five.

4.2.1 Survey Analysis

The AJO survey is narrow compared to the FS survey. Because of this, the analysis of the AJO survey was relatively straightforward. I identified the questions and responses that I believed to be of relevance to my study, and then proceeded to extract the numerical data and put it in context with topics relevant to my research questions. Because the survey provided many response alternatives for each question, some of the tables presented in the survey were very complex. In some cases, I chose to do my own calculations based on the numerical data in the survey, in order to explain results that were not easy to grasp by looking at the original tables. For instance, when respondents were asked to rate their *interest* in adopting techniques that reduce treatment time, there were five alternatives to choose from, ranging from “very interested” to “not interested at all”. For this to make sense, and to be able to communicate this in a clear way, it was sometimes necessary to combine groups of alternatives, for example combining the respondents who were *interested* to some degree, and those who to some degree were *not interested*. Note that when presenting results like these in chapter five, I mention that they are based on my own calculations.

The FS survey was very extensive. It required me to reduce the amount of information significantly, based on what was relevant to this study. The survey contains many relevant

graphs that had to be analyzed in order to be presented textually. After extracting the most important data, I tried to gain an overview of the data from both surveys, while looking for connections and differences between the two. At the same time, I categorized the data into relevant topics that would more or less form the structure of the following chapter.

4.2.2 Interview Analysis

During the analysis of the interviews, I had to examine the meaning of the raw data from the transcript that consisted of a large amount of pages. First, I tried to gain an impression of all the transcripts. I removed the information that was not relevant to me, due to the fact that I had included some questions that were of relevance to the company and not to this study. I then color-coded the most important information from each interview, giving each interviewee a different color. After color-coding all the transcripts, the most important responses were compiled into one document, where they were categorized under their respective questions from the interview guide. Since I had used the same interview guide for all the interviews, this was an effective way to organize the information. Additional important information that was not directly related to any question was categorized in a separate section. By doing this, I could more easily get an impression of the responses to each question, and I could compare the responses from each interviewee. I tried to find similarities and common tendencies in the responses, and wrote summaries based on these. During this process, I also identified quotes that I intended to use to present the results. The quotes represent common views and results.

4.3 Ethical Considerations

When collecting and processing data, some ethical considerations have to be made. Before conducting the interviews, I explained the purpose of the interview to the interviewee, and I made sure the participants understood this. They were then asked to confirm if they wanted to participate in the interview.

Consideration was done concerning confidentiality. Although I was not looking to gather sensitive information about orthodontists and their practices, I had to be aware that I could come across sensitive information. In addition, because the interviews were semi-structured, the conversation could take a turn towards sensitive information. Therefore, interviewees were informed about their right to remain anonymous before the interview started. Furthermore, by presenting interviewees with this option before the interview starts, interviewees may feel

more open towards sharing information that would otherwise be kept secret. Some interviewees did request to remain anonymous, so I chose to keep all interviewees anonymous, just citing them by title and initials.

Another aspect of confidentiality is the use of audio recordings. All interviews were recorded after gaining approval from the interviewee. The interviewees were informed that they could stop the recordings at any time, and that they could demand to have the recordings deleted. Finally, the interviewees were informed that the recordings would be deleted after serving their purpose, and that the recordings would not be kept beyond May 2015.

Interviewees were offered the transcripts of their interviews to ensure that they approved the information that I had obtained, as well as the opportunity to correct the information in case it included errors. None of the interviewees requested transcripts.

4.4 Validity and Reliability

Validity and reliability may say something about the quality of a study. Here I will evaluate the validity and reliability of my data sources, to determine if they support the objective of my study.

Validity

Validity describes whether the data collected is truly relevant for the research questions and the objective of the study (Yin 2003). Furthermore, we separate between internal and external validity. Internal validity describes whether the results are valid for our study, while external validity describes whether the results of the study is transferable to other similar situations (Johannessen et al. 2004).

Concerning internal validity, we have to evaluate the data sources in this study separately. The FS survey is altogether focused around AD, so the data results are highly relevant for this study. In addition, because the survey was quite broad, I had to extract the most relevant data. The AJO survey focused on general tendencies in the market of orthodontists and patients, making it highly relevant as well. It evaluated the demand for the benefit that AD offers, which is a central part of my research questions. Although the interviews are not the primary source of data, they are essential for understanding some aspects of the interview questions.

Concerning external validity, the results may be transferable to similar situations where a medical device or a medical innovation is released. Although the features and benefits of AD are relatively distinctive, we may evaluate the results in a bigger picture by generalizing and defining AD as a medical device that enhances medical procedures. By doing this, we may compare AD to other medical devices, and may make use of some results in similar situations. For instance, during the study it became evident that orthodontists want to see more clinical evidence¹⁰ before adopting AD. It is likely that this is also important for other medical professionals when they make decisions regarding the adoption of medical devices.

Reliability

Reliability refers to the trustworthiness of the data, thus whether the method of data collection contains potential errors and inaccuracies (Yin 2003). Reliability is more relevant for the evaluation of quantitative data than qualitative data, because the well-defined structure of quantitative methods makes it possible to test and repeat the research at a later point in time (Johannessen et al. 2004).

There is not a lot of information available regarding the execution of the FS survey. The survey's response rate is not mentioned, only the number of participants. However, based on the number of participants, there is a high response rate for each survey question. This means that participants have taken their time to answer all the questions, and they did not only answer the questions of interest to them. As described in table 1, the survey also used a set of exclusion criteria to eliminate participants who were likely to provide inaccurate answers.

The FS survey separates between non-users and users of AD. This may be beneficial in some contexts because the views of users and non-users may be different, and by separating between the two groups, we may achieve results that are more reliable.

The response rate for the AJO survey was 7.5%. The response rate is not very high, but due to the high number of people invited to participate (9160), the total number of participants is quite high. The fact that the study has been published means it has passed a peer review. This may imply that the survey is more likely to be reliable.

¹⁰ Such as clinical reports and scientific evidence that support the effect of AD.

5. Result and Analysis

Here I will present the results from the surveys and interviews. The results are presented based on more or less common topics in each of the data sources. Statistical data and tables will form the basis for explanations and will be subject to further discussion.

5.1 Demand for Accelerated Orthodontics

The demand for accelerated orthodontics can be evaluated as either orthodontist demand or patient demand. I am focusing on the orthodontist market in this study, however; a certain patient demand is fundamental for orthodontists to see a need for AD. Therefore, I will examine the demand for accelerated orthodontics among both orthodontists and patients.

5.1.1 Orthodontist Familiarity with AD

Both the AJO survey and the FS survey examine the demand for accelerated treatment, as well as how familiar orthodontists are with techniques that may reduce treatment time.

Regarding the *familiarity* of AD, the results from the two surveys contradict. Of the orthodontists participating in the FS survey, 63% of *non-users*¹¹ were familiar with AD. However, only 27% of orthodontists in the AJO survey were familiar with intraoral vibrating devices, so there is a significant deviation between the two surveys.

<i>Technique</i>	<i>n (%) of responders who are familiar with technique</i>
Custom-made appliances	470 (68%)
Piezocision	173 (25.3%)
Corticotomies	502 (73.5%)
Intraoral tooth vibrators	182 (26.6%)
Locally injected drugs	111 (16.3%)

Table 2: Orthodontists’ familiarity with techniques for reducing treatment time (Uribe et al. 2014)

It is worth noticing that unlike the FS survey, the AJO survey does not separate between users and non-users. This means that among the 27% of orthodontists in the AJO survey who are familiar with intraoral vibrating devices, there may be orthodontists who have already adopted AD, meaning they are obviously familiar with the device. The share of orthodontists who are familiar with AD in the FS survey is much higher than in the AJO survey, and yet these respondents are only non-users. This does not justify the deviation in the surveys, to the

¹¹ Non-users: orthodontists who have not adopted AD.

contrary – it argues that the percentage in the AJO survey may be artificially high when comparing it to the FS survey, and that the percentage could in fact be lower if only non-users were surveyed.

On the other hand, a reason for this deviation may be the fact that the AJO survey was conducted from October 2011 to February 2012 (consumers) and from May to June 2011 (orthodontists), while the FS survey was conducted in late 2013. Marketing efforts and diffusion of the product may have increased its familiarity from the first to the second survey, given that more than two years passed from the first to the second orthodontist survey. Additionally, the fact that the phrasing in the survey questions are different may help explain the significant deviation. While the FS survey uses the name “AcceleDent”, the AJO survey uses the less obvious term “intraoral vibrating devices”. Because the *AcceleDent* is a brand name that has been marketed, it may be easier to recall than the general term *intraoral vibrating devices*.

Interestingly, as evident in the figure below, orthodontists who are more familiar with AD project more use of AD than those who are not familiar with the device. Users of AD project the highest percentage of use. In other words, those who are familiar with AD expect to use it more than those who are unfamiliar with it. This implies that more knowledge about AD leads to a more positive perception about its function.

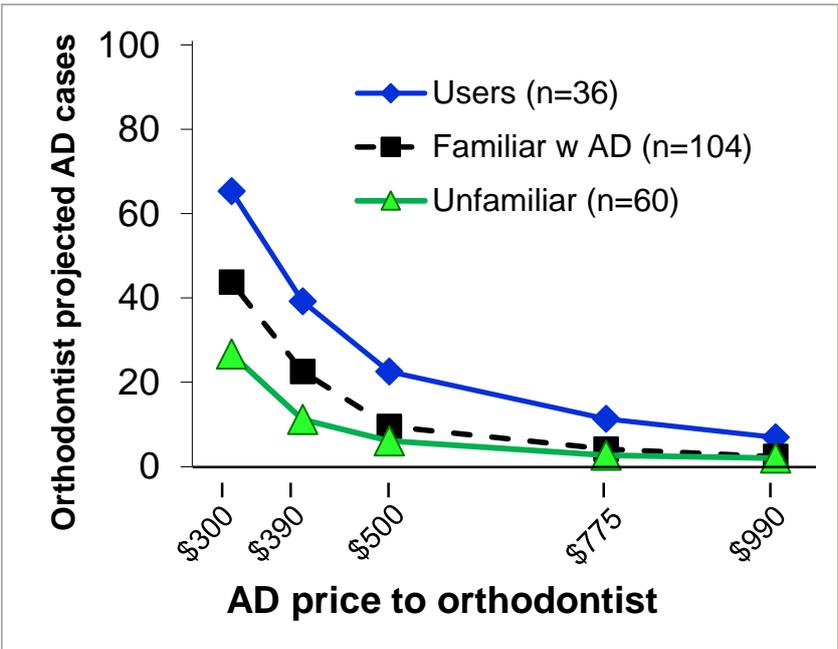


Figure 3: Orthodontist projected use of AD, based on familiarity (Fletcher Spaght 2013).

5.1.2 Orthodontist Demand for AD

The section above explains orthodontists' familiarity with AD. Familiarity may be an indicator of how well the product has spread in the market, but it can also be a result of marketing efforts. However, familiarity does not say much about the *demand* for accelerated treatment. Below I will analyze the survey data regarding the need and demand for AD among orthodontists.

Orthodontists' perception of treatment time may influence their opinion of the actual need for accelerated treatment and AD. In both the FS and the AJO surveys, the majority of orthodontists are *satisfied* with their patients' treatment time. In the AJO survey, 93% were neutral or satisfied with their patients' treatment time. One reason why so many orthodontists are satisfied might be that about 63% of orthodontists thought that a reduction in treatment time could pose a problem regarding fee collection, since patients normally pay monthly fees during the duration of their treatment. A shorter treatment duration may lead to patients having to pay higher monthly amounts, or that they have to pay during some months after completed treatment.

In spite of this 93% being neutral or satisfied with the treatment duration, the survey states that as many as 70% of orthodontists are interested in techniques or devices that reduce treatment time. When the different techniques were evaluated together, they were assumed able to reduce treatment time by 25% to 30%. However, most orthodontists were even more interested in adopting these techniques if the rate of tooth movement was increased to 40%. Interestingly, AD is proven to increase the rate of tooth movement by up to 50%.

The survey mentions five different techniques that are more or less common today. I will not define each technique here, but it is normal to separate between invasive or non-invasive techniques. Invasive techniques require the entry of a needle or other instruments into a part of the body, making this technique more extensive and risky than non-invasive techniques. An example of an invasive technique is *corticotomy*, a comprehensive surgical procedure intended to reduce treatment time. On the other hand, we have non-invasive techniques like AD. To be clear: the AJO survey does not mention the name AcceleDent, but instead mention the more general term "intraoral vibrating devices". However, AD is currently the only FDA-approved intraoral vibrating device on the market. Regarding invasive and non-invasive techniques, when surveying the willingness to undergo treatment using any of these techniques, the survey

concludes that *orthodontists*, patients and parents prefer non-invasive techniques to invasive techniques. Intraoral vibrating devices were one of the most favored techniques among orthodontists, as 37% of orthodontists would pay for the use of intraoral vibrating devices.

The table below from the FS survey shows that almost 1/4 of orthodontists are *not* interested in trying AD, and only 6% definitely want to try. If we divide the figure into two, based on the respondents that answered ≤ 5 and >5 , we see that 60% of respondents are less likely to try AD, while 40% are more likely to try AD. The amount of orthodontists who are interested or likely to try intraoral vibrating devices or AD are similar in both surveys, with 37% and 40% respectively.

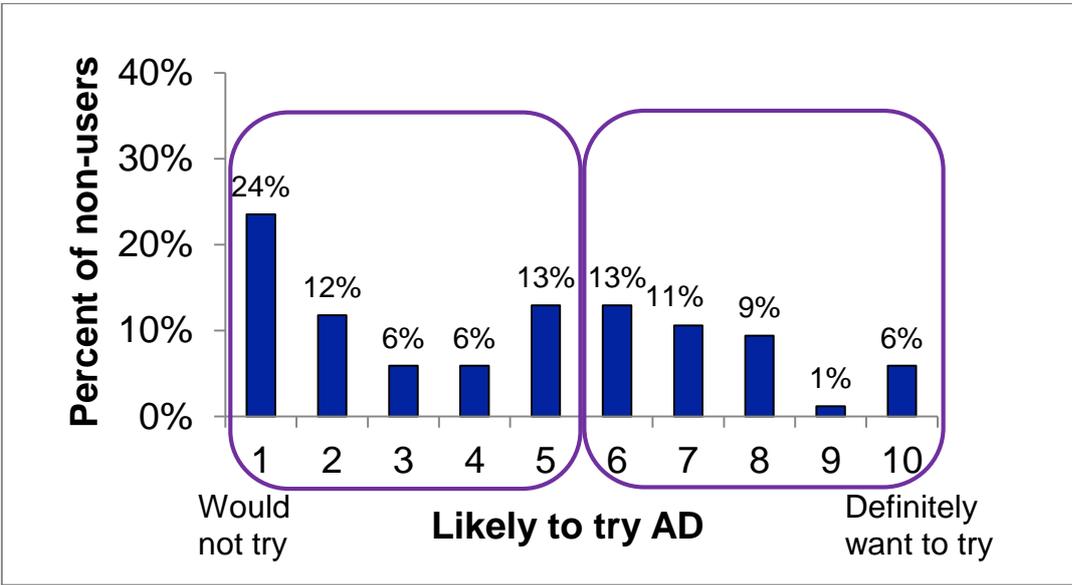


Figure 4: Orthodontists’ likelihood of trying AD (Fletcher Spaght 2013).

5.1.3 Orthodontist Characteristics

Whereas the AJO survey did not find any significant relation between practice characteristics and willingness to adopt techniques to reduce treatment time, the FS survey reported some interesting trends that suggest there may be a connection between the two.

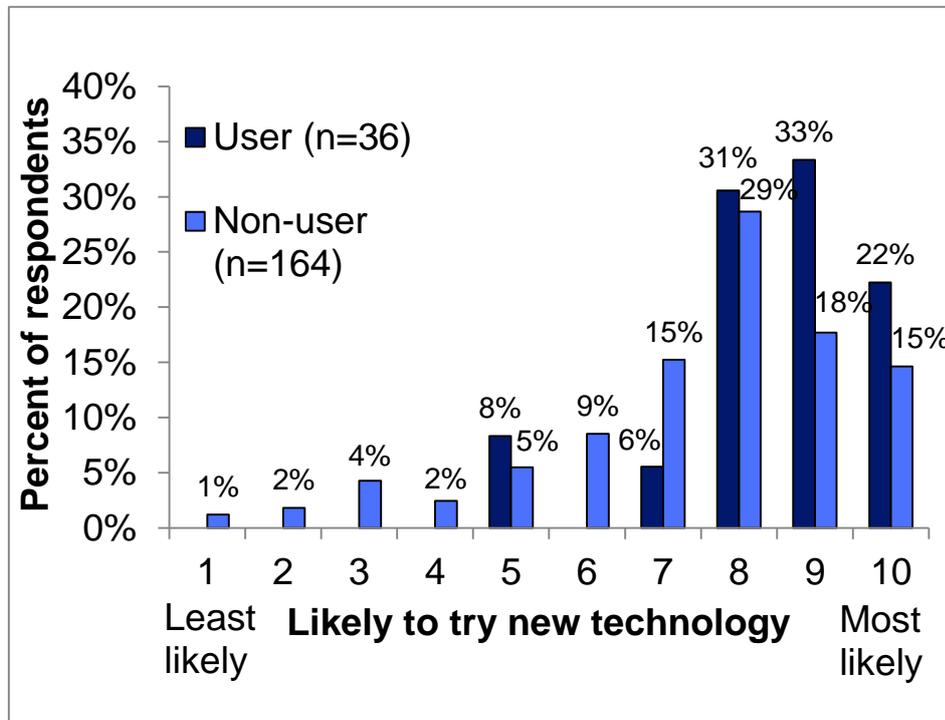


Figure 5: Orthodontists' likelihood of trying new technology (Fletcher Spaght 2013).

AD users report that they are more likely to try new technology than non-users. When asked how likely they were to try a new technology, most orthodontists rated themselves at 8 to 10, with 10 being "most likely". As many as 86% of AD users rated themselves at 8 to 10, while only 52% of non-users did the same. This suggests that those who have adopted AD seem to be more open towards trying new technology than non-users.

5.1.4 Patient Demand

The AJO survey shows that patients are interested in techniques that can reduce treatment time, and they favor non-invasive techniques such as intraoral vibrating devices. For intraoral vibrating devices specifically, adult patients, adolescent patients, and parents were neutral or positive by 78%, 87% and 70%, respectively.

When it comes to patients and parents' perception of treatment time, adult patients and parents were dominantly neutral regarding the duration of treatment. Among adolescent

patients, the majority agrees that orthodontic treatment takes too long. Knowing that the average orthodontic treatment time is 24 months (Gündüz et al. 2004), it is noteworthy that the majority of adult patients and parents were neutral regarding the treatment duration, while wishing it would last between 6-12 months and 12-18 months, a duration that is *significantly* lower than the average treatment time of 24 months. With this in mind, it may seem like all groups may lean towards wanting shorter treatment time than what is normal with regular orthodontic treatment today. By looking closer into the survey responses and combining the responses from all respondent groups, my calculations make it more evident that respondents lean towards believing treatment time takes too long. See table and further explanation below:

Response	Adult Patients (n=50)	Adolescent Patients (n=200)	Parents (n=200)	Total
Strongly Agree	3	26	6	8%
Somewhat Agree	13	83	44	31%
Neutral	25	68	107	44%
Somewhat Disagree	7	20	35	14%
Strongly Disagree	0	2	6	2%

Table 3: Perception that treatment takes too long. Own calculations, based on AJO survey (Uribe et al. 2014).

When excluding the neutral group, 39% of the respondents agree¹² that orthodontic treatment takes too long, whereas only 16% disagree¹³. To sum up, while many patients think orthodontic treatment takes too long, the majority of orthodontists think otherwise: namely that they are satisfied with the treatment duration.

When it comes to choosing an orthodontist, the FS survey states that *half* of consumers select the *first* orthodontist they visit. Since we already know that dentists normally refer their patients to orthodontists for treatment, having many referral sources can be important to orthodontists in order to attract patients. For patients who seek multiple consults instead of choosing the first orthodontist they visit, several factors play a role in their decision-making. The figure below explains this further.

¹² When combining somewhat agree (31%) and strongly agree (8%).
¹³ When combining somewhat disagree (14%) and strongly disagree (2%).

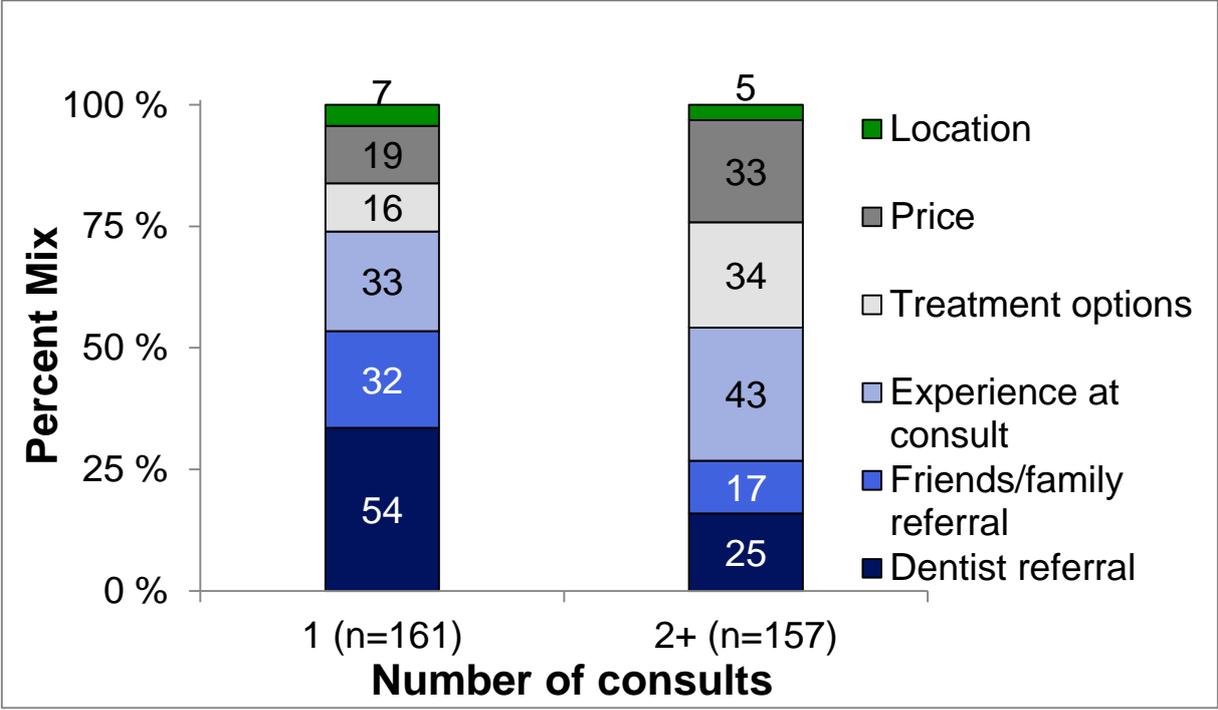


Figure 6: Patients' top ranked criteria for practice selection (Fletcher Spaght 2013).

Consumers who consult more than one orthodontists¹⁴ are represented in the column to the right. Here we can see that referrals from friends or family are far less important than to the consumers who choose the first orthodontist consulted. Other important factors to the shoppers are price, treatment options and their experience at consult. It is worth noticing that treatment options is the second highest valued factor here. AD falls into this category, because an orthodontist who offer AD can be considered to have more treatment options than an orthodontist who does not offer it. The survey also states that patients who selected their orthodontist based on treatment options have a higher interest in AD. Price is also an important factor for the shoppers, which implies that shoppers are more price sensitive. When comparing the two columns, we can see that price and treatment options are the factors that increase the most.

The FS survey ranks patient referrals as the third most important criteria for patients when selecting an orthodontist, right behind "experience at consult". A referral may lead to a consult but not necessarily to a new paying patient. Yet, the FS survey shows that 50% of prospective patients choose the first orthodontist consulted. Consequently, referrals play an important role in generating new business for orthodontists.

¹⁴ Hereafter referred to as shoppers.

The FS study shows that there is a slightly higher demand for AD among *adult* patients, compared to *parents* of child patients. However, as much as 87% of patient treatments are paid by parents, making parents the most important decision makers in the market.

5.2 Benefits of AD

AD may offer benefits to both patients and orthodontists. As a medical device, AD offers benefits to patients undergoing orthodontic treatment. As a commercial product and utility, it may offer benefits to orthodontists and orthodontic practices. I will now present the data results describing the benefits AD offers both groups.

5.2.1 Practice Building Benefits

The AJO survey did not examine the potential benefits that accelerated treatment may have to the orthodontic practice. FS survey examined this subject by asking questions about the practice building benefits of AD. Note that the orthodontists were presented with a set of proposed benefits in the survey, hence; orthodontists did not report the benefits. In order to get more open and detailed responses, I followed up on this subject in my interviews with orthodontists. Instead of presenting the interviewees with potential practice building benefits, they were given the opportunity to respond freely on the matter.

Ranking of Benefits

The chart below shows how orthodontists value potential benefits of AD. Orthodontists were asked to rank the two most important benefits of AD. The most highly ranked benefit were *clinical benefits*, which is related to the improvement of orthodontic treatment. Hence, most orthodontists value the clinical benefit that AD is clinically proven to offer. Besides the clinical benefit, *attracting new patients* and *decreasing patient visits per case*¹⁵ are benefits that are highly valued by orthodontists. I would argue that some of the benefits formulated in the survey overlap, or are somewhat difficult to separate, making them less likely to be clearly understood by the survey participants. For instance, *attracting new patients* is a consequence of *increased referrals*. I also believe that only having the choice between two alternatives might give a less accurate picture of the situation, because orthodontists may value other benefits almost as highly as the first two. However, because the top three benefits are significantly higher ranked

¹⁵ Case: short for orthodontic treatment case.

than the rest of the benefits, it is reason to believe that they are the most important benefits among orthodontists.

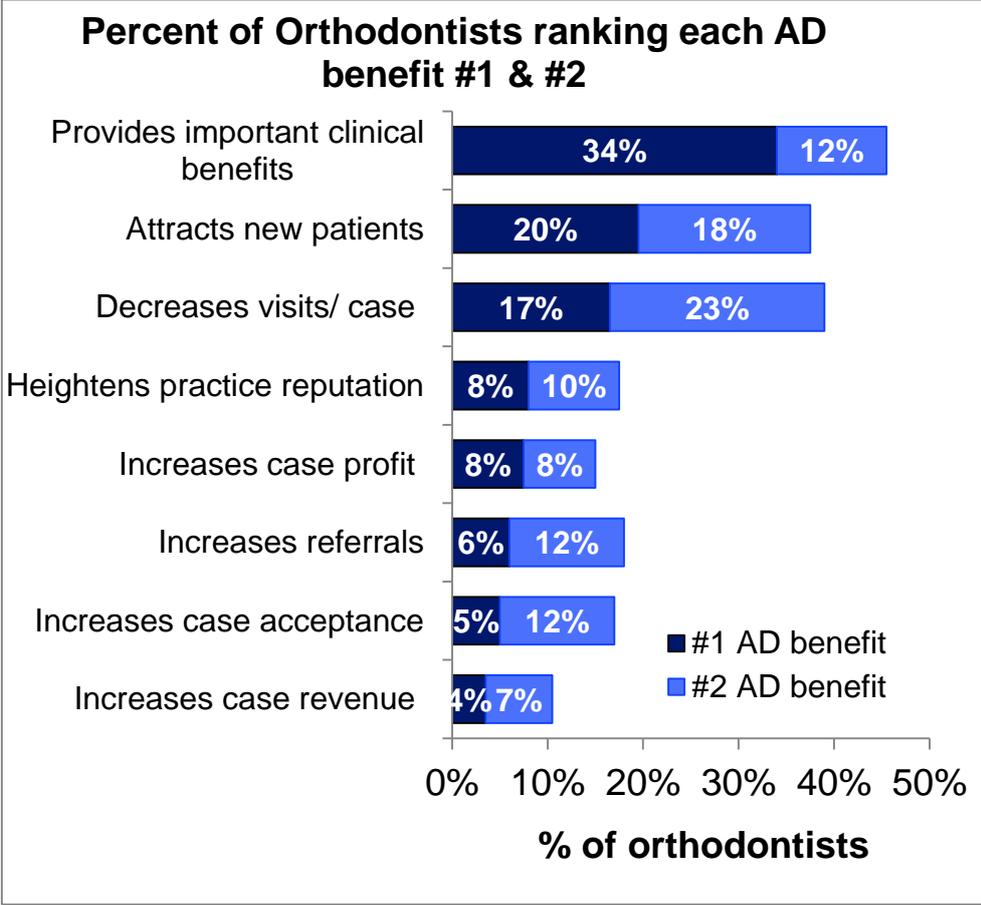


Figure 7: Orthodontists' ranking of #1 and #2 most important AD benefit (Fletcher Spaght 2013).

Management Issues

While figure 7 shows how orthodontists rank the benefits of AD, the figure below shows how orthodontists rank the importance of management issues. These issues are not related to AD, but are general management issues that are relevant to orthodontists.

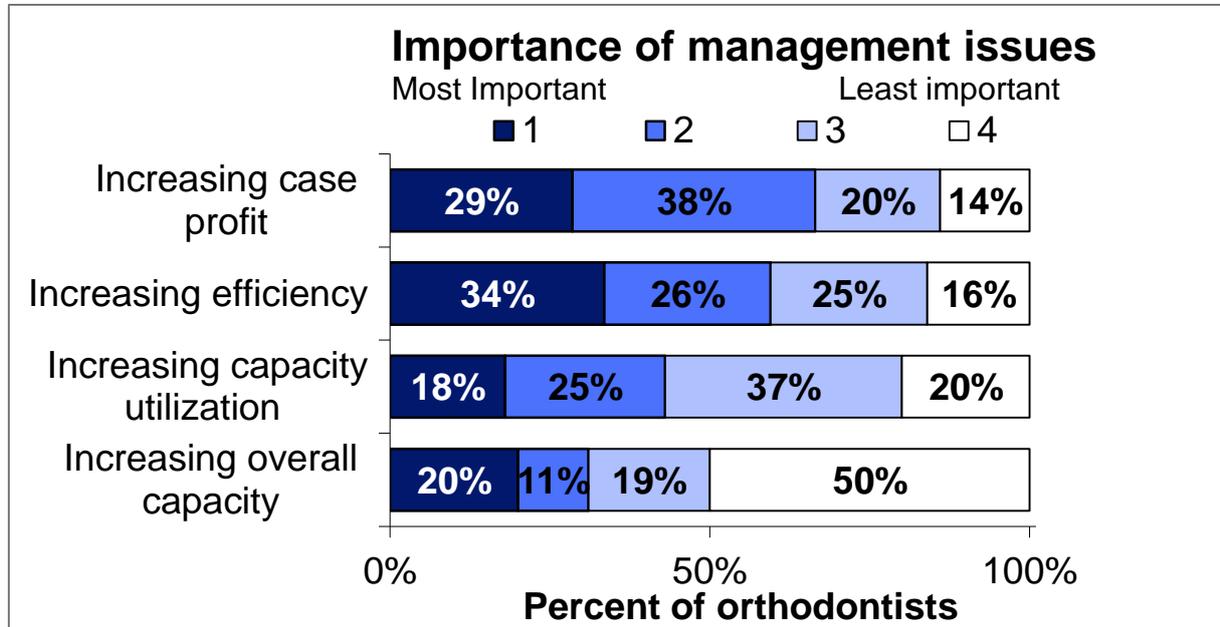


Figure 8: Orthodontists' ranking of Importance of management issues (Fletcher Spaght 2013).

As we can see from the figure, increasing case profit and increasing efficiency are the most important management issues. If we compare figure 7 and 8, one thing becomes evident: orthodontists have prioritized differently when answering the two questions. While orthodontists rank *increasing case profit* as most important in the second figure, this issue is far down on the ranking of important benefits of AD in the first figure. A reason for this may be that orthodontists are not confident that AD is able to deliver *increased case profit*, and that they therefore value the benefits they are perceive as more probable.

At the bottom of the figure, we have *increasing overall capacity*. The survey states that orthodontic practices on average operate at 73%, and that only 4% of participants in the survey operate close to full capacity. These two fact imply that *increased overall capacity* is not a big concern with orthodontists. The interviews also suggest that increasing overall capacity is not a primary focus, at least not if the practice is not running at full capacity:

"We're not running at full capacity so we don't have an issue with letting more patients into the practice." – TC K

Still, *increasing capacity utilization* is still an important concern with orthodontists. This means that orthodontists wish to utilize their current capacity in a better way. The ranking of AD benefits (figure 7) supports this, because attracting new patients and decreasing the number of visits per case can be seen as a way of better utilizing capacity.

Validity and Valuation of Benefits

One of the main purposes of the interviews was to understand how users of AD value the benefits of AD, in order to see how this compares to the surveys. During my interviews, I discovered that orthodontists differ regarding which AD benefits they value, as well as which potential benefits they actually consider valid.

In the question of *whether AD has affected their practice economics*, most orthodontists were convinced that AD has a positive effect, either through cost profitability or through revenue from sales of the device.

*“We can finish cases in fewer visits and fewer months, so the economic benefit is obvious in that less doctor time means **more profit per case**. Every time you increase the productivity of the practice, it’s a good move.”* – Dr. S

*“As an example: if you have a \$5000 treatment and they come in 20 times, we make X amount each time. If they come in 10 times and we still make \$5000, **that means we have doubled the amount we make each time the patient comes in.**”* – TC S

Some orthodontists were not sure about the effects of AD, because they had not yet had time to study the effects over time, or they had not used AD on enough cases to notice any difference. While some orthodontists were paying close attention to the economic effects of AD, others did not seem so concerned with this.

*“Not sure about the effects yet. **We make money per unit at least.** We may soon be able to determine if we are able to skip an arch wire¹⁶ or two in our accelerated treatment cases.”*

– TC K

¹⁶ The arch wire is the part of braces that inflict force on the teeth, resulting in tooth movement. The arch wires have to be changed by the orthodontist every few weeks.

“With the number of AD we put out there, I don’t think it affects anything at my practice. We start the same number of cases whether we have AD or not.” – Dr. W

Lastly, there were orthodontists who did not see any relevant economic benefits of AD, but instead use it because of the clinical benefits it offers.

“From my standpoint it’s not a question of whether or not it is going to make my practice grow, because I don’t think that’s what it’s going to do. It just makes what we do go better.” – Dr. W

As evident above, the interviewees have different opinions regarding the economic benefits of AD. In addition to revenue from sales of the device, cost profitability from decreased visits may be a benefit to orthodontists. Although the treatment time is normally reduced, it is the *number of visits* that is important to orthodontists. However, some orthodontists are not convinced about their ability to save visits when using AD:

*“In most cases, we are seeing around the **same number of appointments** – we are just doing it in a **shorter period of time**.” – TC K*

*“It’s the **same amount of visits**, it’s just that I can get through the visits even quicker.” – Dr. P*

The interviewees valued additional benefits like competitive advantage and the ability to close sales and start more cases. A majority valued the competitive advantage AD offers through marketing¹⁷.

*“I think AD is a good thing from a marketing perspective. If we are one of the few practices in the area that offer it, that’s a **definite competitive advantage** for us in terms of attracting patients.” – Dr. S*

*“We have gotten a lot of **patient referrals** from patients that are using AD and are recommending it to their friends.” – TC K*

¹⁷ In this context, marketing includes word-of-mouth marketing and referrals from friends and family.

When the interviewed orthodontists talk about closing sales, they refer to the sale of orthodontic treatment, not the sale of AD. They believe that the benefits of AD make orthodontic treatment more appealing to patients who are skeptical towards undergoing treatment.

“It (AD) has the ability to help us close sales better.” – Dr. W

“It (AD) has allowed us to start a higher percentage of the exams because we are offering it.” – Dr. S

The latter statement is directly related to AD’s ability to support the sale of orthodontic treatment. When Dr. S mentions exams, he refers to the first time consult, where potential patients get a free consult by an orthodontic in order to determine if orthodontic treatment is necessary. This is a free consult designed to attract more patients. Dr. S states that with AD, a higher share of these consults become actual patients.

Based on the interviews with orthodontists, I have identified the benefits presented in the table below. The table includes all the benefits mentioned in the interviews. Therefore, these benefits does not necessarily occur simultaneously.

Benefits	Details
Economic Benefits	<ul style="list-style-type: none"> - Saved cost through increased efficiency. - Revenue from sale of AD. - Close more sales/increased case starts.
Competitive Advantage	<ul style="list-style-type: none"> - Differentiation from competitors. - Increased number of patient referrals.
Clinical Benefits	<ul style="list-style-type: none"> - Offer higher quality treatment. - Stay clinically relevant.

Table 4: Interview-reported benefits of AD.

The orthodontists value these benefits quite differently. While some focus on the revenue from sales, others simply want to offer their patients the best treatment. In chapter five, I will describe how some of these benefits are related to the way orthodontists implement and use AD.

Increased Case Starts

Similar to the interview results, the FS survey shows that orthodontists who have adopted AD had more case starts than non-users per year¹⁸. Because the difference in case starts between AD users and non-user is significant, it may imply that AD is actually a contributing factor to the variety in the number of case starts.

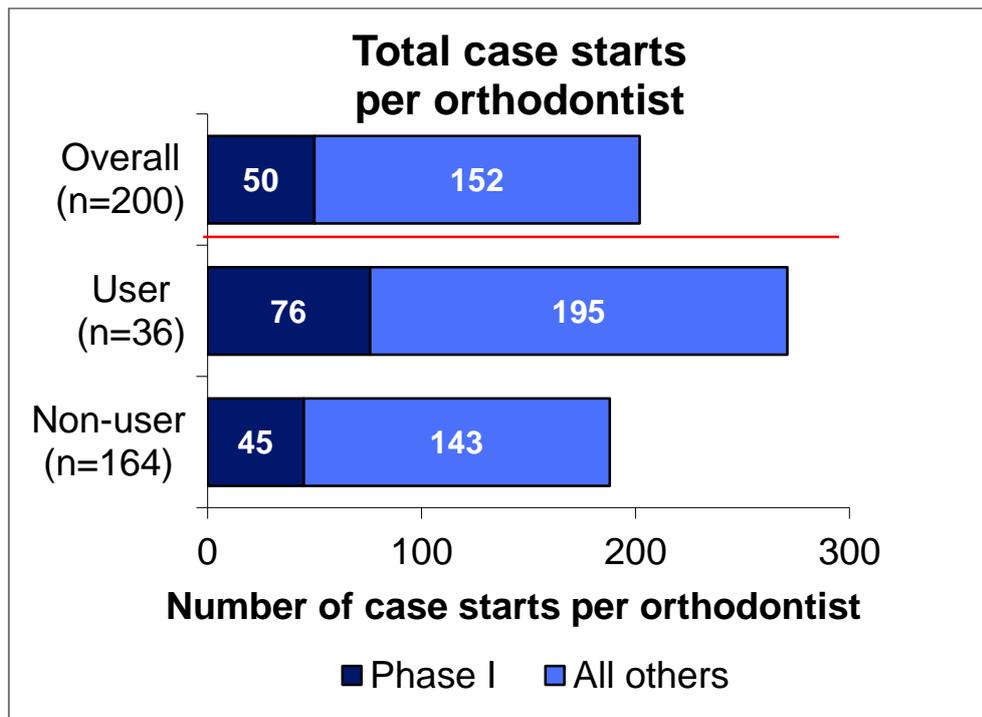


Figure 9: Total annual case starts per orthodontist (Fletcher Spaght 2013).

Based on the results, we know how orthodontists perceive and rank the potential benefits of AD, as well as which general management issues that are important to the orthodontic industry. I will now go into the concerns orthodontists have regarding AD. These are obstacles that might delay or even stand in the way of adoption. Therefore, recognizing the concerns of orthodontist is a crucial part of the process of understanding the status of the adoption process of AD.

¹⁸ Phase 1: Orthodontic treatment that is normally done at a young age in order to prevent severe orthodontic problems. Others: The most common types of orthodontic treatment.

5.3 Concerns among Orthodontists

5.3.1 Price

Respondents in the AJO survey were questioned regarding their willingness to pay for reduced treatment time. The survey was examining whether the respondents would pay different amounts for different techniques, or if they would pay more for a higher reduction in treatment time. Interestingly, regardless of which technique used to reduce treatment time, and regardless of the reduction in treatment time, the majority of both consumers and orthodontists were only willing to pay up to 20% more in orthodontic fees. This means that they are only willing to pay up to 20% on top of the orthodontic treatment fee. With a reported average treatment fee of \$5,150 for children and \$5,500 for adults (Fletcher Spaght 2013), 20% of these fees equals \$1030 for children and \$1100 for adults. The retail price of AD is \$990, so it is within the desired price range of consumers and orthodontists. However, according to the FS survey, 1/4 of non-users said that price was a concern in an open response section. At current pricing, 68% of orthodontists were not receptive to using AD.

Although the AJO survey suggests that orthodontists would increase their fees by the same amount as the price of the technique they would adopt, my interviews and observations imply that many orthodontists intend to sell AD at increased price. Orthodontists who want to sell AD at increased price are then likely to exceed the price range of consumers. This may be a reason why the FS respondents are negative to the current price, while the current price seems to be within the desired price range of respondents in the AJO survey. A high retail price leaves less room for orthodontists to increase the price, especially when we know that orthodontists perceive consumers as more price sensitive than they are¹⁹.

¹⁹ See figure 10.

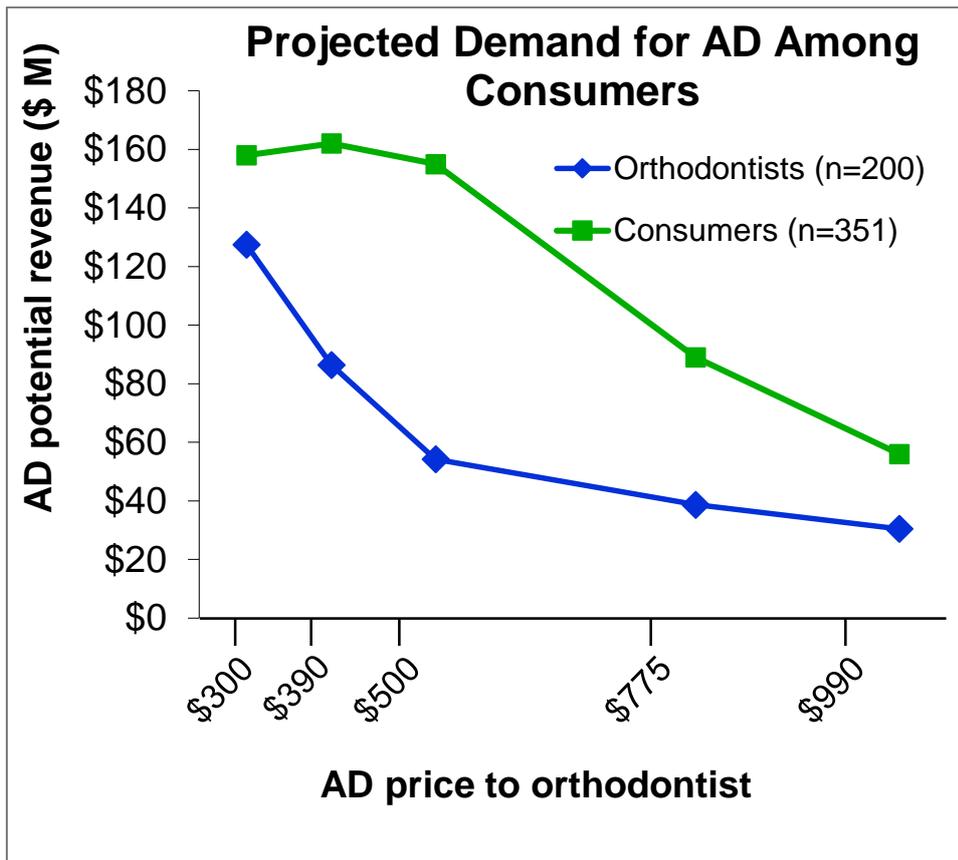


Figure 10: Orthodontist projected demand for AD among consumers (Fletcher Spaght 2013).

Orthodontists project less demand and a higher price sensitivity among consumers, compared to what consumers report. This means that orthodontists underestimate the actual consumer demand for AD, as well as consumers' willingness to pay. The deviance between the orthodontist estimated demand and the consumer reported demand vary according to price. We can see in the model that the biggest deviation is at a price of around \$500. Yet, the standard price of AD is \$990. At this price point, the deviation is not as big.

The FS survey contains detailed pricing information regarding AD, but since this is sensitive information to the company, I will not go any further into price discussion in this study. I have discovered both compliance and concerns regarding the retail price of AD. While the majority of participants in the AJO survey, orthodontists as well as consumers, seem to be willing to pay the price of AD for accelerated treatment, a majority of orthodontists in the FS survey are not receptive to adopting AD at current pricing.

5.3.2 Other Concerns

In addition to price being a concern to orthodontists, some other issues may affect the adoption process of AD. One of the most important issues is the need for more clinical evidence. In the AJO survey, about 25% of non-users’ unprompted comments included the need for clinical data and publications. The survey did not attempt to characterize the type of clinical evidence needed, but the message came through that orthodontists want to see additional clinical data regarding the use and effect of AD.

Related to the need for more clinical data, some orthodontists report a need for general information about AD, and some report that they have general questions about the device.

According to the FS survey, an essential issue is the fact that some orthodontists are concerned with how to implement and sell the device. Correspondingly, the question on how to implement AD varied among the orthodontists interviewed, making it even more likely that this is a relevant question or concern among orthodontists. In my interviews, I identified four different methods of implementing AD. This is mainly a question of how the device is *offered* or *sold* to the patient. I have categorized the methods and their benefits as follows:

Method	Implementation	Benefits
Charge Premium	The orthodontist charges a premium when selling AD.	- Revenue from sale. - Potential to increase patient compliance ²⁰
Pass Cost Through	The orthodontist sells AD at zero profit.	- Make no additional cost for practice. - Potential to increase patient compliance.
Split Cost	The orthodontist bears half the cost of AD, selling the device for half the purchase price.	- Broader patient acceptance. - Potential to increase patient compliance.
Offer Complimentary	The orthodontist bears the whole cost of AD, offering the device free.	- Broadest patient acceptance.

Table 5: Methods of implementing AD.

After consulting salespeople at OA with these methods, it became evident that charging premium and passing the cost through are the most common ways of implementing AD. In addition, they were not aware of any other methods than the ones described above.

²⁰ Compliance refers to the patient’s willingness or ability to use the device as intended.

The reason compliance is an important factor here is that it plays an essential role in the reduction in treatment time, and consequently potential saved visits. If the orthodontist expect to save visits with AD, they depend on their patients to use AD as intended. If the patient is not compliant, the reduction in treatment time and the number of visits may not be adequate to save money. Orthodontists interviewed believed that compliance were likely to be lower among patients who got AD free or purchased it for a low cost. They believed that patients that bought the device at a high cost were likely to be more compliant.

There are several reasons why orthodontists have chosen different ways of implementing AD. It depends on which benefit they value, for example: revenue from sales, saved visits or clinical benefits. In some cases, the orthodontist do not expect to profit on the sale of the device, but they expect to save money on saved visits. Then they might choose to pass cost through or even split cost, instead of charging a premium. Orthodontists who use AD for its clinical benefits or competitive advantage may want to split cost or offer it complimentary.

6. Discussion and Conclusion

The objective of this study was to examine the diffusion of AD in the US market. To achieve this, I sought to answer three relevant research questions. Here I will discuss these research questions based on the study's theoretical framework and main result. The chapter will conclude with my recommendations for the company, and my suggestions for further research.

6.1. Discussion of Research Questions

6.1.1 Research Question 1

What position does the product currently have in the orthodontic market?

The surveys and interviews provide information about the *familiarity* and *demand* for AD and accelerated treatment. Based on the survey results and existing theory on the subject, I will evaluate AD's current position in the orthodontic market by determining where it is located along the adoption life cycle. By doing this, we may better understand the consumers we are dealing with. Note that in this case, the adoption life cycle represents the orthodontic market where orthodontists are the consumers.

Familiarity

Both the FS survey and the AJO survey address the subject of familiarity with AD, and familiarity with techniques for reducing treatment time, respectively. Regardless of the fact that the following values are not fully comparable²¹, 63% of non-users in the FS survey were familiar with AD, while only 27% of orthodontists in the AJO survey were familiar with intraoral tooth vibrators. It is reason to believe that actual value is somewhere in between these two values, indicating that around half of the orthodontic market may be familiar with AD.

Solely based on the familiarity of AD, we can determine that AD is likely to be in the early stages of the adoption life cycle, roughly somewhere between the innovators and the early majority segments. Although half the population of orthodontists may be familiar with AD, the number of orthodontists who have adopted AD is much lower.

However, familiarity does not really say much about the *demand* for a product. For instance, in recent years, many people in the western world may have become familiar with the car brand

²¹ Due to the time difference between surveys, as well as the difference in questioning and selection of participants. See chapter four for more information about this.

name Tesla Motors. Still, the price of a Tesla may be too high for many consumers, and many consumers may not be looking for the features that the car offers. Hence, familiarity is not an indicator for demand, but in order to move towards adoption of a product, one must first be familiar with it. This is supported by Rogers (2003) theory on the innovation-decision process. The first step of the process is about *knowledge*, which is gained when a person learns about the *existence* and functions of an innovation.

Demand

The second step on the innovation-decision process is about *persuasion*. Persuasion is related to a person's attitude towards the innovation, which can be either favorable or unfavorable (Rogers 2003). Related to this, the surveys examined people's attitude towards AD and accelerated treatment.

The AJO survey examined the *interest* in adopting techniques. The survey states that 37% of orthodontists are interested in intraoral tooth vibrators. The interest may be an indicator for demand. In the FS survey on the other hand, orthodontists are questioned regarding their *likelihood* to try AD. Note that there are two significant differences in the phrasing in the two surveys; the FS survey uses the term *likelihood*, and focuses directly on AD. Hence, the result here is likely to be a better indicator for the demand for AD. In this survey, 40% of orthodontists rank themselves as likely to try AD.

Price is an essential factor in the question of demand or attitude towards the product. According to the AJO survey, the price of AD is within the price range of both orthodontists and consumers, but the FS survey states that 68% of orthodontists are not receptive to using AD.

Based on the discussion above, we may determine that the majority of orthodontists are not interested in adopting AD at present time. However, the demand is nonetheless significant, and it may increase (or decrease) as factors surrounding AD change, hereunder price and clinical evidence. Based on the survey results, we know that there are certain factors that concern orthodontists. These factors will be discussed further under research question 3.

Adoption Life Cycle

Consumer Segments

In the adoption life cycle, the different consumer segments are divided based on *when* each segment is likely to adopt an innovation (Moore 2002). By comparing the consumer characteristics with the characteristics of the consumer segments in the adoption life cycle, we may be able to determine where AD is currently located along the cycle.

Based on familiarity, we determined that AD is likely to be in the early stages of the adoption life cycle. Secondly, although it is somewhat difficult to pinpoint the demand for AD, we found that the majority of orthodontists are not interested in adopting AD. We know that during the early stages of the adoption life cycle, familiarity and demand for an innovation is likely to be low (Moore 2002).

The FS survey found that users of AD consider themselves as *more likely* to try new technology than non-users. This is interesting, because it relates to what we know about certain segments in the cycle: the innovators, early adopters, and to some degree the early majority.

Rogers (2003) states that *innovators* have a great interest in new ideas, and that they often seek out innovations very early on. He also states that there are not many innovators in a given market. However, given what we know about the relatively high familiarity and demand for AD, it is likely that AD has gained a foothold in one or more of the subsequent consumer segments.

Regarding the next segment, the *early adopters*, Moore (2002) states that these consumers easily identify and understand the benefits of new technology. The results from the interviews and surveys showed that the benefits of AD are somewhat difficult to understand, yet; those who have adopted AD have most likely done this based their perceptions of the benefits that AD offers. Hence, the ability to identify and understand an innovation's benefits are important for its adoption.

Moore (2002) continues to explain that early adopters are willing to base their buying decision on their intuition instead of relying on established references from others. Unlike the early adopters, the *early majority* require more-well established references before investing in an innovation. The early majority is comfortable with waiting to see how innovations end up before adopting (Moore 2002). The FS survey showed that orthodontists had a great interest in additional clinical evidence. Clinical evidence can be seen as a form of established reference.

This means that orthodontists, like early adopters, rely or value established references from others. Yet again, those who have already adopted AD have relied on their own intuition when adopting AD. The interviews support this, as I identified a variety of methods of implementing AD. This matches Moore's (2002) claim that early adopters follow their own intuition, because users of AD have used their own intuition when deciding how to implement AD. They could not rely on established methods, but instead had to experiment on their own.

Based on the above, we see that the established characteristics of early adopters correspond with the characteristics of users of AD. In addition, it shows that the characteristics of non-users somewhat correspond with the characteristics of the early majority.

Position in Market

The goal was to determine AD's position in market, based on its location along the adoption life cycle. Based on what we know about the familiarity of AD, the demand, and the characteristics of users and non-users, AD seems to be most appealing to the early adopters at this time. There are mainly two factors keeping AD from gaining traction in among the early majority, namely the consumers need for well-established references, and their difficulties with identifying and understanding the benefits of AD.

6.1.2 Research Question 2

How is the product implemented and used by orthodontists?

The two last steps of Rogers' (2003) innovation-decision process are about *implementation* and *confirmation*. Implementation is the action of putting an innovation to use, and confirmation occurs when a person seeks to strengthen his or her innovation-decision. A person can choose to reject the innovation even after implementing it, should he or she find conflicting information (Rogers 2003). Hence, orthodontists may reject AD after implementing it, if their experience with the product is different from their initial ideas or expectations.

By interviewing users of AD about how they implement and use AD, I got an understanding of which benefits AD actually provides. We may then compare the survey and the interviews, in order to see if there is a mismatch between the benefits that orthodontists value or expect, and the benefits reported by the interviewees. This is important because the valuation of benefits in the survey is mostly based on *perceptions*, as the majority of participants in the survey were non-users.

Implementation of AD

During my interviews, I identified four different ways of implementing AD. The reason for the different methods is mostly due to the uncertainties related to the benefits of AD, as well as which benefits orthodontists value. This has led to orthodontists experimenting with ways of implementing the device. While some orthodontists had a clear reason for their method of implementing AD, other interviewed orthodontists were experimenting with it in order to find the solution that would best serve their practice.

For some, this flexibility may reflect something positive, while for others it may give the impression that AD is a complex device. Thus, the FS survey identified concern regarding how to implement and sell the device. Based on what we discussed about the early adopters and early majority in research question 1, we know that the early majority value well-established references (Rogers 2003). These references can be feedback from orthodontists and opinion leaders regarding the use of AD. Rogers (2003) states that *communication* is the essence of diffusion, and that opinion leaders influence other people's attitudes or behavior in a preferred way, by communicating information regarding innovations to other members of a system. Opinion leaders have a positive effect on diffusion process of an innovation, but due to the variety in methods of implementing AD and the uncertainty related to the methods, it might be that opinion leaders will have difficulties in communicating correct advice and information. Non-users may get confused and have trouble deciding which information to rely on if they receive mixed messages from various sources.

Furthermore, when there is a relatively wide range of behavior among consumers, the benefits and results are likely to vary from consumer to consumer. This means that some orthodontists may have positive experiences, while others may have less positive experiences. Like opinion leaders who promote the diffusion of AD, orthodontists who have a less positive experience with AD will also communicate their opinion of AD to other members.

Evaluation of Benefits

The adoption of an innovation may have *anticipated* or *unanticipated* consequences, varying on whether or not the changes are acknowledged and anticipated by the members of the system (Rogers 2003). By comparing the proposed benefits of AD with the interview-reported benefits, we may see if AD is likely to lead to many unanticipated consequences. In other words, we want to see if the actual results of AD are similar to the results that are expected or desired

by orthodontists. We have reason to believe that a great deviation between expected result and real result may have a negative effect on the diffusion.

In the FS survey, orthodontists ranked a set of benefits based on which ones they valued the most. The following benefits were ranked significantly higher than the rest:

1. AD provides important clinical benefits.
2. AD attracts new patients.
3. AD decreases patient visits.

This is somewhat similar to the responses from the interviewees, although there are some differences. Interviewees, like survey participants, value the *clinical benefits* AD offers. Note that this was the *most* valued benefit in the survey.

Furthermore, both groups value the benefit of *attracting new patients*. Interviewees focus on AD's ability to increase patient referrals, which is a way of attracting new patients. Regarding the third most valued benefit in the survey, interviewees disagreed about AD's ability to decrease patient visits. Some interviewees were not convinced that AD does in fact decrease the number of patient visits. They did however agree that orthodontic treatment would take less time.

In addition to the benefits mentioned in the survey, interviewees emphasized AD's ability to differentiate their practice from competitors. Interviewees also valued AD's ability to help close sales. This benefit is also mentioned in the survey, as the ability to "increase case acceptance", however, it is not highly valued among participants. Interestingly, the survey showed that orthodontists using AD do *in fact* start more cases than non-users.

Lastly, interviewees valued the benefit of revenue from sales of the device, but due to the different methods of implementing AD, we know that not all methods will provide increased revenue.

6.1.3 Research Question 3

How do orthodontists perceive AD?

Based on the previous research questions, we have learned some important facts about the consumers. We know the characteristics of the consumer segments we are dealing with, like their values and interest in AD and its benefits. Here I will discuss the orthodontists' perception of AD.

Perception

As stated by Rogers (2003), the *perception* of attributes or qualities is among the most important reasons for the rate of adoption, hereunder the perception of: relative advantage, compatibility, complexity, trialability and observability.

Relative Advantage

Rogers (2003) states that relative advantage is one of the strongest predictors of its rate of adoption. An important question related to relative advantage is whether the innovation outperforms the existing product, or if it enhances a procedure. From a patient's perspective, AD is likely to enhance the procedure. For an orthodontist however, there are more aspects to this question. Throughout the surveys and interviews, I have found evidence that AD does offer benefits to the orthodontists. We know that orthodontists value benefits differently; meaning the perception of AD will vary depending on the interests of the orthodontists.

All potential benefits are not easily identified and perceived until the orthodontist have gained a certain knowledge about the product. Orthodontists stated that they wanted to see more clinical evidence and that they have general questions about the product. This means that there is a degree of uncertainty surrounding the product. Rogers (2003) mentions that consumers seek to decrease the level of uncertainty when deciding whether to adopt a product. Hence, the perception of relative advantage is very important. The results in this study imply that orthodontists are not fully able to perceive the relative advantage of AD. Even the interviewees that have already adopted AD were not entirely sure about its potential benefits.

Furthermore, relative advantage is a relation between the anticipated benefits and the costs of adoption of an innovation (Rogers 2003). This means that in order to be willing to adopt AD, orthodontists have to value its benefits as greater than the price they pay for the product. While AD is within the price range set by orthodontists in the AJO survey, a majority of orthodontists

in the FS survey were not willing to adopt AD at the current price. Regarding price, since the FS survey is directly related to AD, it is reason to believe that these results are more true to reality than the results in the AJO survey.

Lastly, the FS survey found that orthodontists underestimate the demand for AD among patients. It is likely that orthodontists would perceive AD as more advantageous if they were aware of the demand among patients.

Compatibility

The perception of *compatibility* is important as well. An innovation that is compatible with existing ideas may achieve a faster rate of adoption, because it requires less change in behavior from the adopter. The innovation should also be compatible with the needs and existing values in the market. (Rogers 2003).

First, AD is compatible with *existing ideas* because it does not require any big changes to the way orthodontists operate. Interviewees only stated that they had to make changes to the routines on when to schedule appointments with patients. Some orthodontists would lower the intervals between each patient visit, compared to patients not using AD.

Next, AD is compatible with the needs of patients and orthodontists. Both surveys showed an interest in adopting techniques that reduce treatment time. This is also a question about the orthodontists' general needs. Independent of AD, the FS survey examined which general management issues that are important to the orthodontic industry. It found that orthodontists are mostly concerned with increasing case profit and efficiency. According to the interviews, AD may help with these issues. This implies that AD is very compatible with the needs of orthodontists.

Lastly, the existing values in the market should not differ radically from the changes that an innovation represent. Because we are dealing with a medical device and the treatment of patients, I believe the aspect of *values* is very relevant in order to understand the perception of AD. Although the topic of market values is not greatly discussed in the surveys or interviews, my interaction with professionals within the industry has given me the impression that orthodontists are primarily concerned with patient's safety and satisfaction. Hence, I believe the values in the market revolve around professionalism and care of patients.

We know from the surveys that orthodontists want to see additional clinical evidence regarding the use of AD. This is in all probability because they want to ensure that the product is safe and that it delivers the benefits it claims to offer. This need to confirm that the product is safe may relate to the existing values in the market. Overall, this may suggest that there is a slight incompatibility between the values of orthodontists and the current perception of AD, which is based on the available clinical evidence.

Rogers' (2003) description of the *optional innovation-decision* is also relevant when discussing compatibility. The optional innovation-decision that is made by individuals and not by groups or entire social systems. Although it does not affect the social system, the decision-maker may be influenced by the norms in the social system. This is somewhat similar to what I described above, namely that an innovation should be compatible with existing values in the market. If the innovation is not compatible with the norms of the social system, the decision-maker can be influenced in a way that he does not want to adopt the innovation.

However, the question about AD's compatibility with values and norms has to be seen in context with orthodontists' familiarity and knowledge of AD. Rogers (2003) stated that the acquisition of *knowledge* is an element of the innovation-decision process. Knowing that some survey participants were not very familiar with AD, I would argue that their knowledge of the product is likely to vary. More importantly, I would argue the likelihood that some participants are not fully familiar with existing clinical evidence. Still, the fact remains that many survey participants have requested additional clinical evidence. This proves that lack of clinical evidence is a relevant issue affecting the innovation-decision process and hence the diffusion of AD.

Yet, some interviewees stated that they use AD for its clinical benefits, and that it improves treatment. The orthodontists who stated this were not concerned with the economic benefit of AD, meaning they adopted AD in order to be able to offer better treatment. This is similarly a question about existing values in the market. On one side, we have the ones who are skeptical of the device because they, based on values in the industry, want to make sure the product is safe. On the other side, we have those who have adopted the device in order to, based on values in the industry, offer better treatment. This may imply that the more knowledge one has about AD, the more it corresponds with values in the orthodontic market. This is because those who have adopted AD have more knowledge of the device.

Complexity, Trialability and Observability

Except the uncertainty regarding the benefits for the orthodontists, no feedback implies that AD is a complex product to understand or use, although some orthodontists in the FS survey reported that they had general questions about the device

Regarding trialability, there are no opportunity for orthodontists to experiment with AD prior to adopting it. Due to the timeframe and complexity of orthodontic treatment, it is difficult to experiment with AD prior to adoption. For instance, orthodontists cannot experience the benefits of AD without implementing it and using it during actual treatment. This may be a reason why orthodontists have to experiment with how to use AD after adopting it, as interviewees stated.

Lastly, regarding observability, the clinical results of AD are easily observed by the use of pictures that can be distributed in marketing and in sales meetings. However, more importantly, the observability of the results/benefits for the orthodontists are not easily observed without orthodontists actively communicating the results to others.

6.2. Recommendations

A number of factors affect the diffusion process of AD. We know that the familiarity of AD is relatively high. The majority of orthodontists are interested in accelerated treatment, and the demand for AD is significant. The found that users of AD *do* start more cases than non-users, still; the majority of orthodontists are not interested in adopting AD.

Based on the results and discussion of the research questions, I will provide my strategic recommendations that I believe may assist the diffusion of AD.

I have stated that AD is currently mostly relevant for the early adopters and early majority consumer segments. Based on the theoretical characteristics of these consumer segments, OA should seek to establish more references. This was also a request from orthodontists. To do this, the company should first address the orthodontists' request for clinical evidence. OA should initiate additional clinical research to reinforce the clinical evidence regarding the use of AD. They should also promote existing clinical reports and scientific evidence to make it more recognized in the orthodontic market. Overall, this may have the potential of making AD more compatible with the values and norms in the orthodontic market.

Next, OA should establish references that proves AD's benefits for orthodontic practices. The results showed that orthodontists in general are most concerned with increasing case profit and efficiency. To prove AD's ability to help with these concerns, OA should conduct an *in-depth* study of the effects AD may have on the economy of orthodontic practices. The study should seek to examine metrics that relate to the proposed benefits in this survey, in order to determine their authenticity. It is essential that the study produce measurable results that can be presented numerically, for instance as the amount of dollars or patient visits saved. These results can be used in marketing and may decrease the uncertainty related to the benefits of the product.

Furthermore, the study should examine the effects of the different *methods* of implementing AD. We know that orthodontists implement AD differently, and each method is likely to produce different results. Therefore, OA should work with early adopters to determine how best to implement AD. There are three reasons for this: first, because certain methods are likely to produce better results. The *best* results from the study may then be used when marketing AD. Second, if the study concludes that some methods are less likely to produce positive results, OA sales people can eliminate these methods by educating orthodontists on how to implement AD. Less negative experiences may lead to more satisfied consumers, which again may establish more references that may drive adoption. Third, if more than one method proves to have positive effects on a practice, OA can educate orthodontists on the method that may best suit their interests. This may be beneficial, as we know that orthodontists have different values and preferences.

The purpose of the study should be to educate orthodontists about AD. By educating orthodontists, we may decrease the uncertainty related to the product. We may also better communicate the benefits of AD. To do this, OA should create guidelines and recommendations on how to implement AD. OA should create marketing material that can be distributed to existing and potential AD customers, and the sales force should be educated about the results in the study. This may enable salespeople to better meet adapt their sales pitch when meeting with specific orthodontists.

Many orthodontists are not receptive to using AD at current price. To address this, orthodontists should be educated about patient demand and willingness to pay. The results show that orthodontists underestimate the patient demand for AD, and they perceive a higher

price sensitivity among patients than what is real. If orthodontists get to know the real demand among patients, as well as their willingness to pay, it may increase the orthodontists' acceptance towards the price.

Furthermore, orthodontists should be educated about patient trends. My results show that the majority of patients select the first orthodontists they visit, and patients normally visit orthodontists based on *referrals*. Therefore, OA should demonstrate AD's ability to increase the number of patient referrals. Most interviewees value this benefit, but it should be examined through the in-depth study I have proposed. We also know, based on the data results, that treatment options are important for patients who consult multiple orthodontists. Orthodontists should be made aware of this, because adopting AD is a way of improving the practice's treatment options.

Lastly, the data results implied that familiarity with AD is likely to lead to a more positive perception about its function. By educating orthodontists, based on accurate study results, OA may increase familiarity with AD. Familiarity relates with likelihood to try AD, and may increase demand.

6.3 Further Research

In addition to my recommendations for OA regarding further research, this thesis may lead to other studies on the subject of diffusion of innovations in the medical industry. In this thesis, the characteristics and concerns of orthodontists (as consumers) seem to correspond with existing theory describing the characteristics and values of different consumer segments. However, during my literature search, I found that new theory is often focused around the diffusion of *high-tech innovations*, particularly within the field of advanced computer electronics. It may be interesting to study the degree to which this theory is applicable within the medical industry. The use of medical devices may have more severe consequences than the personal use of technological innovations. Therefore, there may be other elements that affect consumers' innovation-decision process. With the technological advancements that are taking place in the medical industry today, I believe further diffusion-research within this field may be an important contribution to existing theory.

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Appendixes

Appendix 1: Interview Guide

Thank the interviewee for participating.

Inform about the purpose of the interviews.

Confirm willingness to participate.

Ask about anonymity and permission to record the interview.

Implementing AD

- What is your experience with AD?
- How do you implement AD into your practice?
- What is the price of AD/accelerated treatment at your practice?
- How is AD offered/presented to the patient?
- What percentage of your patients is offered AD?
- Rate of AD acceptance?
- How would you describe patients' reaction when they learn about AD?

Practice Economics

- Has AD affected your practice economics? How?
- Supported new growth? Number of patients / new consults / new starts?
- Do you think AD offer a competitive advantage?
- Do you see a benefit in saving money/cost when reducing the number of visits?
- Does AD affect the number of referrals to your practice? From who?

Efficiency

- Does AD affect the number of patient visits needed?
- What are your scheduling protocol? Did this change after implementing AD?
- Do you provide other methods for accelerated treatment? What are they?
- Why have you chosen to offer AD the way you have?

Ask about transcripts.

Thank the participant again.



Norwegian University
of Life Sciences

Postboks 5003
NO-1432 Ås, Norway
+47 67 23 00 00
www.nmbu.no