9-25-2020

PATIENT AND PARENT PERCEPTIONS ON OUTCOMES IN EARLY ORTHODONTIC TREATMENT

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by

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A Thesis submitted to the

Graduate Orthodontic Program

In partial Fulfillment of the

Requirements for the Degree of

MASTER OF SCIENCE IN

DENTISTRY

Arthur A. Dugoni School of Dentistry

University of the Pacific
Arthur A. Dugoni School of Dentistry
San Francisco, California

2020

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ACKNOWLEDGEMENTS

The author would like his mentors Dr. Heesoo Oh and Dr. James Chen for their support and guidance, and the private practice orthodontists who provided the subjects in this study.

DEDICATION

The author would like to dedicate his work to his wife and children for their unending support and love.

ABSTRACT

Introduction: Orthodontics has clinical benefits, however, the psychosocial outcomes are not well understood. These soft benefits are often classified as aesthetic, functional, and psychosocial, however, there is limited work understanding these outcomes as reported directly from the patient. By better understanding the patient's perspectives, we can continually refine our clinical model to be patient-centric and more appropriately manage the patient's expectations and experiences.

Materials and Methods: This is a cross-sectional qualitative study of 20 parents of 24 children ages 8-11 years. Participants were remotely interviewed using a semi-structured chronologically based line of questioning to elucidate their perceived outcomes of early orthodontic treatment or phase one. A content thematic analysis using a framework approach was used to analyze the resulting data.

Results: The thematic analysis uncovered four major themes and associated subthemes as follows (1) dental health including functional changes, aesthetic improvement, and improved cleansability; (2) opportunity cost: meaning harnessing growth for lasting change, avoidance of future orthodontic treatment, avoidance of future dental treatment, and supervision of growth; (3) social outcomes: encompassing external perception and acceptance, self-perception, parental perception, and reduced dental anxiety; and (4) behavioral changes: including the correction of bad habits, development of good oral hygiene, and an increase in responsibility of the patient.

Conclusions:This study highlights the depth of psychosocial benefit perceived by patients undergoing early orthodontic treatment, with the main outcome being functional improvement, followed by an advantage to treatment at a young age, and an improvement in aesthetics. Patients

did not recognize an increase in self-perception which is contrary to outcomes previously found in other age groups.

INTRODUCTION

Dental professionals appreciate the psychosocial benefits of orthodontic treatment (Hunt 2001). However, orthodontists are limited in the available qualitative surveys and validated studies that support the understanding of the psychosocial outcomes of these treatments from the patient's perspective.

There are many studies aimed to understand the clinical implications of early orthodontic treatment. For example, the effectiveness of early treatment (2005, Mirabelli et al), the reduction in dental trauma (Arraj et al), and comprehensive treatment philosophies addressing the adult dentition starting from the primary malocclusion (Dugoni). In parallel, there are many studies on the psychosocial aspects of orthodontic treatment as well including factors that motivate patients to undergo orthodontic treatment. This research however is limited when we focus on the psychosocial aspects relative to a course of orthodontic treatment in the primary dentition.

This qualitative research is often done through quality of life and validated questionnaire studies that attempt to quantify and compare some of the softer aspects of orthodontic treatment. Developing a validated study involves multiples steps. If a validated questionnaire doesn't exist already for what you aim to understand then one must be developed by experts in a rigorous process. One step in that is to determine the items in question in an inclusive process via a qualitative survey of the sample population. Such a validated questionnaire has not been developed for specifically early orthodontic treatment

The International Association for Medical Education or AMEE internationally has outlined a seven-step process that synthesizes multiple survey design techniques and organizes them into a cohesive process for questionnaire development. Within this development outline, the term survey is used to include multiple techniques such as the questions used in a phone interview, the set of items employed in a focus group, or the questions on a self-administered survey (a traditional "questionnaire"). Surveys are good for gathering data about abstract ideas or concepts that are otherwise difficult to quantify, such as opinions, attitudes, and beliefs. Because of the benefits of assessing these types of psychological constructs, the AMEE recommends the following 7 steps. It is important to note that although these steps can be followed in order, it is an iterative process where if the process is complete and the survey remains problematic that some steps may be repeated until the result is satisfactory.

1. Conduct a literature review

   Ensure that the construct definition aligns with relevant prior research and theory and to identify existing survey scales or items that might be used or adapted

2. Conduct interviews and/or focus groups

   Learn how the population of interest conceptualizes and describes the construct of interest

3. Synthesize the literature review and interviews/focus groups

   Ensure that the conceptualization of the construct makes theoretical sense to scholars in the field and uses language that the population of interest understands

4. Develop items

Ensure items are clear, understandable, and written following current best practices in survey design

5. Conduct expert validation

   Assess how clear and relevant the items are for the construct of interest

6. Conduct cognitive interviews

   Ensure that respondents interpret items in the manner that the survey designer intends

7. Conduct pilot testing

   Check for adequate item variance, reliability, and convergent/discriminant validity concerning other measures

With the current focus in healthcare to address Patient-Reported Outcomes of medical interventions to develop a patient-centric health delivery model (*Deshpande et al*), the need for patients to report the outcome of the results of early orthodontic treatment in an open and comprehensive format is paramount. Many groups have been done studies to understand the psychosocial aspects of orthodontic treatment for all ages. The UK National Health Service has recently been highlighting the importance of delivering high-quality care with input from patients. Successive policies have increasingly emphasized improving quality of care and the evaluation of treatments from the patient's perspective with patient-reported outcomes. One example is Patel et al.'s work in developing the Malocclusion Impact Questionnaire. While not globally applicable, this study highlights the process of developing a validated questionnaire and elicits valuable insights into the patient's perception of the appearance of their teeth affect their everyday life.

They found three main themes being concern with appearance, the effect on social interactions, and oral health/function.

Many quality of life studies have also been completed. A group from Brazil including dos Santos et al. used multiple validated quality of life surveys to elicit the influence of quality of life, self-perception, and self-esteem on orthodontic treatment need. Looking at a group of 248 schoolchildren age 12 yrs they found self-perception and self-esteem were statistically significant concerning the perceived need for treatment and were not confounded by other independent variables like sex or impact on quality of life. The factors that motivate patients to undergo orthodontic treatment have been well studied, Prabakaran et al. assessed and categorized the relative importance of treatment-seeking motivational factors for adolescent patients and their parents. In a two-part study involving open interviews and Q-methodology surveys, they found that aesthetics was the most cited motivational factor, along with the prevention of future problems.

Understanding of the psychosocial benefits of early orthodontic treatment in the primary and mixed dentition has received very little attention. The foundational work for this topic is a validated quality of life questionnaire developed by Jokovic et al. in 2004. By adopting a previously validated questionnaire for ages 11-14, Jokovic developed the Child Perception Questionnaire for ages 6-7, and 8-10 (CPQ6-7 and CPQ8-10 respectively). This questionnaire was developed by drawing from literature, input from parents, a child psychologist, and a teacher of grades 3 and 4. This questionnaire is used widely to understand all the dental effects possible including caries, missing teeth, appearance, and orthodontic treatment. For example, recently a single-blind

randomized controlled trial by Piassi et al. 2019 utilized this survey in early orthodontic treatment to correct anterior open bites. By assigning one group of 8-10 yr. olds with open bites to the use of a fixed palatal crib and a nontreatment control they determined the correction of anterior open bites had a positive impact on oral health-related quality of life, and failure to correct had a negative impact. Utilizing a quality of life questionnaire as part of a survey can be powerful, but as reported by Zhang et al. the results can also be equivocal.

This level of validated study is the strongest available questionnaire and can be seen by its wide use across a variety of dental disciplines and an extended period of use. However, given our focus only on early orthodontic treatment, it is valuable and important to understand our patient's understanding of the outcomes of treatments specifically with phase one. While the majority of work done in this field or research employs methods such as a questionnaire-based, by allowing subjects the ability to report their outcomes the results are as comprehensive and unbiased as possible. An open interview technique allows a full exploration of patients' perceptions in-depth. This study aims to identify patients' and parents' perceived outcomes of early orthodontic treatment using a qualitative approach. Additionally, by utilizing this an open interview as our survey technique this study effectively completes steps 1-4 of the 7 steps to complete a validated survey.

This study aims to elucidate the patients' perspectives of early orthodontic treatment outcomes to develop such a validated questionnaire. Additionally, this work will provide insights into our patients' concerns and priorities with early orthodontic treatment so treating doctors can manage those concerns and positively influence treatment success and satisfaction.

MATERIALS AND METHODS

A qualitative design involving semi-structured interviews was used. This study was approved by the Institutional Review Board at the University of the Pacific in Stockton, California #20-78.

Patients who completed early orthodontic treatment (phase one treatment) from the private practice of five orthodontic practitioners in the San Francisco bay area were included in this study. Inclusion criteria were; 8-11 years of age, completion of treatment within the most recent twelve months, and a willingness to participate. Those with a history of previous orthodontics and with craniofacial syndromes were excluded.

Interviews were done using a chronologically organized topic guide to explore perceived outcomes associated with early orthodontic treatment. Participants were taken from the private practices of five orthodontic practitioners in the San Francisco Bay Area. They represent a diversity of treatment experience and demographic, though this information was not explicitly collected during the interview.

Subjects were identified by practitioners to meet the inclusion criteria and only parents name and phone number was supplied to the researcher. This was then placed in random order to be contacted and rolling sampling was used by response rate. This was done to reduce any bias from the treating practitioner and enhance the generalizability of the results as much as possible. Participants were contacted phone calls, voicemail, or text message initially. Once the patient showed interest they were either interviewed immediately or scheduled to be interviewed. All interviews were

completed through phone calls or internet video conference call. Parents were always directly interviewed; and when possible, patients were interviewed directly as well. All interviews and analysis were completed by one researcher.

Participants were verbally consented through the approved process by the IRB. No record was made of the interview other than hand taken notes by the same researcher performing the interview. Confidentiality and anonymity were stressed to the participants of this study. As notes were taken in a word processing document during the interview, only pronouns were used. It was important that participants felt it was a safe space where they could speak freely. As such, they were told there were no right or wrong answers. There would be no benefit or consequence to their participation and they could opt out of the process at any time without it affecting their care.

Interviews were guided by the researcher but participants were allowed and encouraged to deviate from the topics to discuss any aspects of relevance. Questions followed chronologically starting with presenting malocclusion and their experience leading up to orthodontic treatment. This led to what it was like for them during treatment, and finally what the outcomes were once early orthodontic treatment had been completed from their perspective. This line of questions was developed to more fully understand the motivations of treatment, which would naturally lead to a discussion of the treatment outcomes. A summary of the questions asked to participants can be found in Table 1. After an interview was complete the resulting notes were reviewed by the researcher and lightly edited for clarity.

The concept of a ‘theoretical saturation’ is found in this research in two ways. First, a parent/patient group was interviewed using our topic guide until they stopped giving new ideas. Second, the interview process continued to be performed until all ideas presented by an interviewee had been reported by a previous interviewee. As this is a qualitative study, no effort was made to calculate the statistical testing or sample size calculation was performed. It was anticipated that approximately 20 interviews would be required to achieve sufficient saturation of data to perform valid analysis based on previous studies. This sample size was also chosen to have an inclusive look at all responses. It is important to remember that an idea need only arise once for it to be valid.

The analysis did not start until all interviews had been completed. Data was analyzed using a content thematic analysis using a framework approach. As Gale 2013 states, this method identifies commonalities and differences in qualitative data, before focusing on relationships between different parts of the data, thereby seeking to draw descriptive and/or explanatory conclusions clustered around themes. Major themes were created in a separate document, and supporting data for each theme was coded for each major theme. Data was then organized by subtheme and reviewed for clarity and additional themes. Raw data was then reviewed once again and tested for different themes or subthemes. Finally, quotations to support each theme were extracted to a separate document.

RESULTS

Semi-structured interviews were conducted for 20 parent/patient groups. Four of these parent/patient groups had 2 children that fit the inclusion criteria for a total of 24 patients. Patients had completed a range of treatment from problem-focused limited treatment with one appliance to comprehensive one phase treatment not requiring a second phase. At the time of the interview, the duration since appliance removal ranged from 1 to 12 months and interviews were up to 30 minutes in duration. Of the patients 10 were male and 14 were female, with a range of 8 to 11 years of age. Patients had a variety of self-reported malocclusions, with all skeletal classifications represented.

The outcomes of early orthodontic treatment identified were in four themes:

- Dental Health
- Opportunity Cost
- Social Outcomes
- Behavioral Change

Each theme had several subthemes which are shown in table 1. The main themes and subthemes are described in this section. Quotes of patients and parents from interviews are given to support each theme and have been edited to remove any identifying factors.

Theme 1: DENTAL HEALTH

FUNCTIONAL CHANGE

Patients and parents perceived some **functional improvement as the main goal** and outcome of early orthodontic treatment. These corrections ranged from **masticatory** (crossbite, chewing efficiency, occlusal trauma), **speech-related changes** (speaking/swallowing/tongue position), **periodontal** corrections, **errors in tooth eruption**, and less commonly a correction of **underlying skeleton**. Parents recognize that early orthodontic treatment or phase one was done in a **problem-focused** method. Without this improper function being the motivating factor they would not have initiated treatment at the start.

Some patients reported a **decrease in pain** with eating, and an increase in the teeth feeling more comfortable as their jaws now could find a place where **their teeth fit together naturally**. Participants found their **smile to be more comfortable and natural** after treatment due to the positioning of the teeth and some coaching by the treating orthodontist.

"The crossbite is fixed. We have been told by previous dentists that it would cause more problems other than cosmetic if we haven't fixed it, I'm glad we fixed it early because it would have caused more issues for him as he grew up."

"I felt like the hard thing was I really couldn't smile that good. I could not smile at all it was so hard for me. My smile got better because I was taught how to do one, it's more natural now."

AESTHETIC IMPROVEMENT

Improved dental and facial aesthetics were discussed throughout the interviewing process. Participants equated an improvement in the alignment of the teeth to be an **improvement in the aesthetics of the smile**. Also, as the appliances corrected negative effects of bad habits (i.e. crowding/narrow arches from sucking fingers), the perceived aesthetics improved. This visual improvement was reported as a benefit **secondary in importance to the functional improvements** after treatment and was never the primary motivating factor for initially seeking treatment.

"It's nice to have straight teeth to have a beautiful smile and look good. Teeth are such a big deal, you don't want to be afraid to smile."

IMPROVED CLEANSABILITY

Patients reported that the teeth were **easier to keep clean due to an improvement in the alignment** or reduction of teeth overlapping, along with a **reduction in the plaque or food accumulation of teeth** prior to early orthodontic treatment. Several participants referring dentists also reported an improvement in oral hygiene and physical access to the teeth after alignment.

"When I had to brush the front bottom teeth they were too far inside. There were some hard spots to reach because of the crowding."

Theme 2: OPPORTUNITY COST

HARNESSING GROWTH FOR LASTING CHANGE

The majority of parents cited the timing of treatment in conjunction with the patients' rate of growth to be a factor in receiving early orthodontic treatment. They perceive treatment at this stage to take advantage of dynamic growth, and treatment will **direct growth while the skeleton is more malleable**. Parents consider guiding the teeth while they are growing to their adult position to be easier and more healthy. They also feel that orthodontic treatment where growth modification is used or correction is made to a poorly growing dentition to be an **interception of improper growth and development**. This is considered more natural and optimal, and a **maximization of a child's potential**.

Participants also considered the correction of malocclusion to be a lasting effect. By allowing the adult teeth to grow in properly, the crowding would be much less than it would be without treatment. By doing this at a younger age during growth the **improvement in the health of teeth and gums would remain for the foreseeable future**.

"It makes sense to me that since the mouth isn't fully developed yet things would be easier to move around. I'm very happy that I did it young given what I know of her genes and how crooked her teeth will be later on."

AVOIDANCE OF FUTURE ORTHODONTIC TREATMENT

While considering the benefits of early treatment participants reported a **decreased need for future orthodontic treatment or a complete elimination of the need for future treatment**. The

range for the perception of need for future orthodontic treatment ranged from unnecessary to an absolute need. However, there was a general notion that future orthodontic treatment would be **faster, less painful, and less expensive** when treated again in adolescence.

Participants also considered themselves at **lower risk for dental extractions** in conjunction with later orthodontic treatment because they addressed the crowding and growth before final growth of the adult teeth.

"I don't have to worry. I feel a sense of relief that it was caught early on, working within specialists to get the best treatment. [Parents should] get it done when you're younger and no one cares how you look. Financially having it taken care of early is best as well. I feel a weight lifted off my shoulders, now I can consider my son getting braces and only have one kid in treatment at a time."

AVOIDANCE OF FUTURE DENTAL PROBLEMS

Parents identified themselves or family members to have had negative dental experiences as a consequence of poor or no orthodontic treatment. This included multiple experiences like surgery due to poor growth or periodontal treatment from functional problems. As a result of the functional benefit or orthodontic treatment, the risk for these negative dental experiences was lower and thus **the patient would not have to endure the anxiety or pain associated with these dental treatments**. It was often reported that this reduction of negative dental experiences was the motivation provided by referring dentists for orthodontic treatment.

“If we didn’t fix his underbite early, the teeth weren’t going to grow in right and there is a chance they were going to have to break his jaw to fix it."

SUPERVISION OF GROWTH

Parents perceive a benefit of treatment is the supervision of growth of the dentition and jaws, and experience with the growth of children in similar growth phases. Using this knowledge and experience the treating physician is expected to provide an **evaluation of growth and additional interceptive treatment as needed**. Parents expected continued use of growth modification appliances like facemask as needed throughout supervision. **Retainers were also perceived to guide the eruption of adult teeth** and aid in the preservation of current alignment.

“The doctor said she wants us to come back every 6 months to check how the teeth, and will assess the need for treatment as we grow. Which is good, because I don’t want all that work to go to waste.”

Theme 3: SOCIAL OUTCOMES

EXTERNAL PERCEPTION AND ACCEPTANCE

Patients and parents discussed the perception others had on their smile to be more positive due to increased aesthetics which lead to **an overall positive perception of their whole self**. Some patients reported that prior to orthodontic treatment they would be teased or others would make

comments about their teeth being crooked, and since treatment that is no longer the case. Changes as a result of orthodontic treatment had an impact on their **social 'acceptance'** and the way that people perceive them.

Some parents and patients considered braces as a right of passage as other kids of the same age also received orthodontic treatment. Patients frequently talked about their peers at school having braces at the same time as them and this **shared experience bringing them closer together**. Patients and their peers were most excited about choosing the color of their braces. There was a perceived **'cool' factor of being the first in their social circle to get braces** or to get a retainer. Patients often liked the braces so much they reported that being **disappointed to remove them.**

After treatment they felt comfortable **approaching new social interactions that they otherwise would avoid**; hanging out with new friends, being on camera, or in some other circumstance where they were highly visible. Several parents also reported that a beautiful smile is perceived as being from a **higher socioeconomic** status which would in turn benefit the child throughout their life. Patients agreed that the increased esthetics gave them a higher status in their social interactions.

"I think society values straight teeth."

"People would laugh at me about my smile being funny. But now, everyone talks about how beautiful my teeth are, how perfect they are."

“We’ve received a lot of compliments on his smile like, “Wow, your teeth are straight!” He was really excited to get them off and a lot of people notice. He feels good about the compliment.”

SELF-PERCEPTION

Patients consider the increase in aesthetics to translate into a **better self-perception**. Patients notice this increase most when smiling, and recall avoiding smiling or hiding a smile in pictures before treatment. Through the interviews, it became apparent that after treatment, the dentally focused thoughts of poor esthetics gave way to a **sense of generally feeling more comfortable or self-positive**. Or in other words, specific tooth-related perceptions were replaced by a beautiful smile which in turn was considered to be part of a positive whole self-image. Patients report that early orthodontic treatment was done to make things “right” and **removed the concept that “something was wrong with me.”**

Interestingly, **patients did not report an improvement in self-esteem or self-confidence.** Similarly, parents do not recall patients having a negative sense of self-image before treatment or any improvement after treatment. They considered this lack of perception to be because the **patient was too young to notice** and if they did notice it didn’t bother them.

“When we went in she was thinking that there was something wrong with her, which we knew wasn’t the case. But that’s how it felt.”

PARENTAL PERCEPTION

While patients may not notice the poor aesthetics of their smile before treatment, the initial malocclusion did bother some parents and they considered orthodontic treatment to be a way for the patient to graduate out of their 'ugly duckling phase'. **Parents did value the improved esthetics** when contrasting the patient's smile before and after treatment.

Parents **consider their child to be more resilient at this young age** and the timing of early orthodontic treatment to be more optimal because they are less affected by it; less social pressures than later in life, and more adaptable to changing dentition or treatment circumstances. Parents often **discussed their own experience with orthodontics in their youth in contrast with the ease of receiving modern orthodontic** treatment and the ease of receiving treatment at their child's young age. Parents also have an underlying desire to do what is best for their children and give them every chance for betterment possible. Given the perceived nature of the social benefits and expectations of a beautiful smile, **missing out on early orthodontic treatment is seen as a lost opportunity.**

"I'm always looking out for the health of my kids, and I want them to have every chance possible for success and to fit in. I wouldn't want them to have braces as an adult, that's tough."

DENTAL EXPERIENCE

Both patients and parents often spoke of the positive experiences they had with their orthodontist, and now after they have developed a relationship, **the changed stereotype of a dental**

professional. Parents appreciate that the **trust developed with the orthodontist**, and the patient recognizes that they have become more comfortable in a dental situation. Some patients reported that before starting treatment they had a significant amount of dental anxiety that in some cases prevented them from receiving the dental treatment recommended by their dentists. After repeated positive exposure to the sights, sounds, and smells of a dental treatment scenario the **patients felt much more comfortable and willing to have someone working in their mouth**, stating that dental experiences are now normal.

"She was a little dramatic in the beginning and didn't like it when people touched her mouth. But now she has a lot of experience having people work on her teeth and she can go to the dentist with confidence."

Theme 4: BEHAVIORAL CHANGE

CORRECTION OF BAD HABITS

Patients reported the reduction in negative habits that occurred after or during orthodontic treatment. When a finger habit, like **thumb sucking**, was present at the beginning of treatment, it was often the solitary goal of orthodontic treatment to correct this issue through appliance use and verbal coaching. **Resolution of speech-related problems, improvement of tongue posture, and challenges with swallowing** through also reported through treatment. This was sometimes done while coordinating with speech therapy. Patients also noticed an increase in the awareness of their

teeth in general during treatment which in turn lead to a **decrease in some other common oral habits** widely accepted as negative, like nail biting and chewing on pens or ice.

"She had braces early because she had a pacifier for too long, her teeth didn't have room and they were coming in wonky."

DEVELOPMENT OF GOOD ORAL HYGIENE

Habits that contribute to oral health were developed by patients throughout orthodontic treatment and coaching. Patients were taught to **floss and brush with improved technique** and frequency by the orthodontist and staff. Through repeated monitoring of gum health, patients perceived the immediate need and benefit of oral health routines and developed the ability to discern healthy gums through visual cues like puffiness or bleeding. Patients and parents also developed a resilience in their oral health by **overcoming barriers to routine home care**. For example, if using string floss was too difficult they now look for a workaround to achieve good oral health by trying a different technique (i.e. floss holders or a water flosser). Patients also discussed the value of a **retainer in reinforcing good habits**, and the retainer gave some patients a sense of comfort after having developed and continued these good habits. Given the fact that after treatment the alignment of the teeth is idealized, patients found it easier to brush and floss.

"I used to brush my teeth really, really good with the braces because I could see some buildup on my teeth. The bottom of my teeth started to get yellow so I started to brush more."

INCREASE IN RESPONSIBILITY

Parents noticed an increase in the ability of the patient to handle the **responsibilities of home care with less oversight** by the parent. This included at home appliance use during treatment, brushing and flossing, and retainer use after treatment. Some patients recognized an improvement in oral health as the motivating factor behind keeping the teeth clean.

"Throughout the treatment, she got really good at self-care. She brushes better, started flossing, and cleans her retainer every night. She's more responsible about remembering what she needs to do."

"He loved getting braces; loved all the attention and felt like he was doing hard work.
He did the headgear all by himself. I really think he developed a sense of ownership and accomplishment."

DISCUSSION

There are many ways to collect qualitative data including written questionnaires, in-person interviews, group interviews, phone interviews, and digital questionnaires. There are benefits and drawbacks to each of these techniques. While questionnaires provide efficient and valid data, they limit the responses of the participants and as such do not collect a comprehensive view of a patient's perceptions. Group interviews provide an opportunity to gather a large amount of information quickly through synergistic conversation and refined conversation, but participants may feel uncomfortable sharing sensitive information in a group setting (*Bloor*).

While remote interviews create some barriers in communication like the inability to read body language and less fluid conversation, they also decrease some of the barriers experienced in an interview. People in discussion without making eye contact are more likely to share their thoughts more freely without inhibition, phone interviews are done when the subject is in a comfortable situation on a timeline that has been scheduled previously, and they create a platform that decreases the authority perceived by the subject (*Opdenakker*).

As this study followed standard qualitative methodology, there are several key strengths of this study. The first being that each interview was performed by one researcher which allowed for consistency and no analysis was performed until all interviews were complete. The same researcher performed both all interviews and all thematic analysis in two iterations which allowed for a comprehensive understanding of themes. Another is the diversity of populations that participants were drawn from providing a wide variety of responses which is more representative

of a private practice orthodontist. Having interviews via phone calls or internet calls from an unknown-to-the-patient party allows for the patient to speak their mind freely without fear of repercussions.

It is acknowledged that there are also limitations to this study. There is debate on the ability for wider inferences to be drawn from this type of qualitative research given the patient demographics and sample size. While the demographic and subsequent results are representative of private practices in the San Francisco bay area, it may not be possible to assume this is the same for other global locations. However, this study may provide a starting point for other work to be done, or highlight additional needs for psychosocial investigation (*Ritchie*).

In this study, as with many survey studies, there is a risk for bias from both the researcher and the participant. Bias from the participant can originate from the respondents assuming there is a correct way to act. This means when asked a question they may give what they think is the right answer based on what is socially acceptable rather than what they truly feel. Additionally, as results in this study relied on a subject's ability to remember what occurred, recall bias is an important consideration given the inaccuracies of our memories. In contrast, bias from the researcher may be introduced as they interpret data. While completely avoiding bias is impossible, the results of this study include themes that may not routinely be included as benefits of treatment. This indicates that the interview process was sufficiently robust to identify all the perceived outcomes of early orthodontic treatment. Through the process of interpreting data, the researcher must be careful not to create results that confirm their hypothesis or only include data they think are relevant. The results and main themes of this study are well aligned with those done in studies in adolescent

patients, which indicates an objective interpretation by the researcher (*AlQuraini et al*). There is a selection bias as participants were only included if they had completed orthodontic treatment. This only includes the grouping of people who would seek orthodontic treatment in the first place. This may explain why the vast majority of findings were positive. There were many recorded perceptions on the process or need for early orthodontic treatment which were not included in this study in an effort to focus solely on outcomes.

An additional challenge was the age of the patients being studied. With the target of 8-11 years of age, patients demonstrate a somewhat limited ability for self-perception and reflection, which is why in this study we relied on the perceptions of the parents and supplemented those perceptions with those of the patients themselves. This introduces the complication that the outcomes are not truly patient-reported. Rather, they are outcomes perceived by the parent. This is an indirect measurement, but may be the most accurate and reliable perspective on young patient outcomes.

Throughout the interview, process participants would at times use vernacular specific to the orthodontic field such as “crossbite,” or “growth potential.” The idea that early treatment may be longer-lasting or correct a developing malocclusion is a complicated conclusion for parents to develop on their own. While possible these concepts developed independently, it is more likely that this finding highlights the influence the orthodontist’s perception and training of malocclusion and the need for treatment influence the parents and patients. This, in combination with selection bias, may explain why the majority of the findings were positive in nature. This is an interesting finding in itself that patients do absorb the scientific basis for treatment, and may be considered as an opportunity for further research.

As one may expect, the dental knowledge and perceptions of a parent on patients of early orthodontic treatment are at the center of all other perceptions. Parents often externalize their perceived experiences or needs onto the treatment of their children. This can translate to a patient liking their smile now because the parent told them their smile didn't look good before, or it can mean that treatment was initiated for a patient based on the fear they may grow up to have the same dental conditions or experiences as the parent. The role of a parent is to translate personal experiences into protection and guidance for their children. This natural transformation of parental self-perception to external guidance cannot be untangled from the motivations and outcomes of orthodontic treatment. To further complicate the matter patients within this age group go through a significant amount of maturation over the duration of time included in the interview. Then it is a challenge to know if the outcomes reported are a result of the early orthodontic treatment or simply maturation. The results are likely some combination of the two as these factors are difficult to control for in a study such as this.

Four major themes were identified from the thematic content analysis. These outcomes identify the psychosocial benefits largely in line with those of previous studies in adolescent patients and their parents with several significant deviations (*AlQuraini et al, Shah et al*). The major theme of Opportunity Cost is unique to orthodontic treatment in the mixed dentition as there is a general understanding that if treatment were not done at a young age there would be an increasingly negative experience or outcome for the patient. Parents perceive their children to be growing and are faced with a series of opportunities in all aspects of life. They want to take advantage of the

opportunity presented by early orthodontic treatment and growth. This gave parents peace of mind that they were doing the best they could for their children.

Notably, patients and parents viewed treatment to be functionally motivated and problem-focused. This is in stark contrast to previous studies which show the main motivating factor to be an aesthetic improvement, and the most significant psychosocial outcome after treatment to be improved aesthetics and increase in self-perception. This study found that patients of early orthodontic treatment perceived no change in self-perception when comparing pre and post-treatment. This is may be due to two factors. First, before starting treatment patients are at a developmental age where they have not yet assigned their appearance to be a determining factor of their self-worth. Being in the mid to early mixed dentition phase there are often multiple missing teeth which can lead to a less than esthetic smile. Developmentally patients age 7-9 have not yet allowed their self-perception to be influenced by external factors. Second, orthodontists and referring dentists appreciate that the clinical indications of early orthodontic treatment or phase one are specific to functional need and approach early orthodontic treatment as problem-specific for each unique patient. Orthodontists create treatment plans by drawing from a large body of literature that demonstrates the applicability of phase one for a given initial presentation.

CONCLUSIONS

- Parents and patients included in this study identified four major themes as outcomes from early orthodontic treatment: dental health, opportunity cost, social outcomes, and behavioral changes. These findings are important for clinicians to understand to properly address and support patients through treatment.
- The main outcome noted by parents was a functional improvement, followed by an advantage to treatment at a young age, and an improvement in aesthetics. Patients did not perceive an improvement in self-perception with early orthodontic treatment which is a new finding unique to this age group. Patients consider their oral hygiene practice to be improved after treatment due to increased awareness and coaching from the orthodontic team.

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- How long was it since your braces came off?
- Why did you look into orthodontic treatment in the beginning? Concerns? Goals?
- What were your expectations before treatment started?
- For the patient (child)
    - What did you think of your teeth before?
    - Why did you want to get braces?
- What treatment did you receive?
- Was the treatment what you expected? Anything like/dislike?
- For the patient (child)
    - What was it like having braces?
    - What do you remember when you would go in to see the doctor?
- What changes did you see with treatment? How do you feel about those changes?
- If you could change anything what would it be?
- For the patient (child)
    - What do you notice now that you're done?
    - What was your favorite part?
    - What was your least favorite part?
- What were the outcomes of treatment? What does that mean to you?
- What did the referring dentist say after braces?
- Will they need to do phase 2? How do you feel about that?

Table 1. Interview questions flowing chronologically of patient perceptions of treatment. Questions were organized chronologically with overlapping concepts to be as comprehensive and inclusive as possible

Main Theme	Subthemes			
Dental Health	Functional Change	Aesthetic Improvement	Improved Cleansability	
Opportunity Cost	Harnessing Growth for Lasting Change	Avoidance of Future Orthodontic Treatment	Avoidance of Future Dental Treatment	Supervision of Growth
Social Outcomes	External Perception and Acceptance	Self-Perception	Parental Perception	Reduced Dental Anxiety
Behavioral Change	Correction of Bad Habits	Development of Good Oral Hygiene	Increase in Responsibility	

Table 1. Main themes and subthemes of perceived outcomes of early orthodontic treatment from patients and their parents