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Adolescent and parent perceptions of expected benefits of orthodontic treatment: A mixed-methods study

Thesis presented by

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Thesis submitted to University College Cork in partial fulfilment of the requirements of the Doctorate in Clinical Dentistry (Orthodontics)

University College Cork

Postgraduate Orthodontic Unit

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ABSTRACT

Aims:

1: To investigate expected benefits of orthodontic treatment from both an adolescent and parent perspective.

2: To rank the expected benefits of orthodontic treatment identified by adolescents and parents in order of perceived importance.

Materials and Methods:

Ethical approval was granted to carry out both parts of this study.

Part 1 used qualitative methodology with one-to-one semi-structured interviews by a trained interviewer. Twenty adolescents (10 males; 10 females) referred for orthodontic assessment and their parents (8 males; 12 females) were interviewed independently to explore expectations of the benefits of orthodontic treatment. Interviews were transcribed verbatim and interpretive phenomenological analysis carried out.

Part 2 quantitatively assessed the benefits identified in Part 1. Twelve additional adolescents (6 males; 6 females) who were referred for orthodontic assessment and a parent (6 males; 6 females), completed a card ranking exercise to determine the rank order of the perceived importance of each benefit. The mean rank was then calculated and a two-sample t-test, with the level of significance set at $P < 0.05$, used to determine if a difference existed between adolescents and parents for the mean rank of any of the expected benefits.

Results:

The expected benefits of orthodontic treatment from both adolescent and parent perspectives included 11 benefits which could be grouped into four categories: oral health (improved appearance of teeth; ease of maintaining good oral health; improved jaw alignment; aiding dental development), psychosocial (improved self-confidence; improved perception of dental appearance by others), functional (improved ability to chew food; improved speech) and behavioural change (improved oral hygiene habits; improved diet; cessation of bad habits). Adolescents and parents placed a similar level of importance on these benefits with “improved self-confidence” ranked highest and “improved speech” ranked lowest. The only benefit where the mean rank differed

significantly between adolescents and parents was “improved ability to chew food” (two-sample t-test; $P = 0.042$) which was ranked higher by adolescents.

Conclusions:

Adolescents and parents perceived 11 expected benefits from orthodontic treatment affecting oral health, psycho-social, functional and behavioural categories.

Adolescents and parents ranked the expected benefits similarly with psycho-social ranked highest. Within functional benefits, speech improvement was ranked lowest by both but improved masticatory function was ranked of significantly greater importance by adolescents.

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DECLARATION

This is to certify that the work I am submitting is my own and has not been submitted for another degree, either at University College Cork or elsewhere. All external references and sources are clearly acknowledged and identified within the contents. I have read and understood the regulations of University College Cork concerning plagiarism and intellectual property.



Joshua Peter Richard Smyth

CHAPTER ONE

INTRODUCTION

1 Introduction

Orthodontic treatment is undertaken to correct malocclusion and research into its benefits has traditionally used clinical indices and quantitative measures (de Almeida Anderson et al., 2018). Recently, there has been a drive towards researching patient-centred outcomes in orthodontics and the use of qualitative methodologies (Yitschaky et al., 2015). Qualitative research is "in-depth" by nature and can provide answers to questions that cannot be satisfactorily answered using quantitative measures, for example highlighting aspects of orthodontic treatment of everyday importance to patients and exploring changes in practice which may enhance orthodontist-patient rapport.

Perceptions of the benefits of orthodontic treatment have been evaluated from the perspectives of general dental practitioners (GDPs), orthodontists (Hunt et al., 2001), patients who have completed treatment (AlQuraini et al., 2019) and parents (Shah et al., 2019). It is possible that information given to patients by orthodontic professionals may influence their expectations of the benefits of orthodontic treatment and to date the perceived benefits of orthodontic treatment from the perspective of adolescents and their parents have not been investigated prior to orthodontic assessment.

This project addresses these deficiencies utilising both qualitative and quantitative methods.

CHAPTER TWO

LITERATURE REVIEW

2 Literature Review

This literature review was conducted using Pub Med, Medline, Science Direct, Web of Knowledge and Google Scholar with no language restriction but confined to full text articles only. The following search terms were used: 'orthodontic treatment benefits', 'perceptions of orthodontic treatment' and 'mixed-methods research'. Bibliographies of pertinent papers were screened for further relevant publications, which were then retrieved.

This narrative, non-systematic review of the literature is divided into five sections. The first section gives an overview of the proposed benefits of orthodontic treatment. The second section examines perceptions and expectations of orthodontic treatment. The final three sections focus on relevant research methodologies used to investigate orthodontic treatment benefits: qualitative research, ranking exercises and mixed-methods research.

2.1 Overview of proposed benefits of orthodontic treatment

Orthodontics is the specialty of dentistry that is concerned with facial growth, the development of the occlusion and dentition as well as with the diagnosis, interception and treatment of occlusal anomalies (Littlewood and Mitchell, 2019). The beneficial outcomes that result from orthodontic treatment have been defined in terms of improvements in dental health and psycho-social well-being (Benson et al., 2015) (Table 1). In the past, claims have been made that orthodontic treatment confers benefits beyond simply improving dental appearance. It is acknowledged that psycho-social benefits are conferred through having orthodontic treatment and that it may allow individuals to cope better with social situations without worrying about the appearance of their teeth (Benson et al., 2015).

Table 1: Proposed dental health & psycho-social benefits of orthodontic treatment

Proposed dental health benefits of orthodontic treatment	**Proposed psycho-social benefits of orthodontic treatment**
• Reduced caries risk • Reduced periodontal disease risk • Reduced tooth wear risk • Prevention of dental trauma • Prevention of temporomandibular disorders • Management of tooth impaction • Improved speech • Improved masticatory function • Reduced difficulty with tooth cleaning • Reduced oral discomfort	• Reduced teasing/ bullying • Improved self-esteem • Improved self-confidence • Social attractiveness • Positive stereotyping • Improved Oral Health-Related Quality of Life • Positive behaviour changes

Each of these proposed benefits will now be considered, dental health followed by psycho-social benefits.

2.1.1 Dental health benefits

2.1.1.1 Caries

Classically it has been considered that four factors must be present in order for caries to occur and progress (Figure 1).

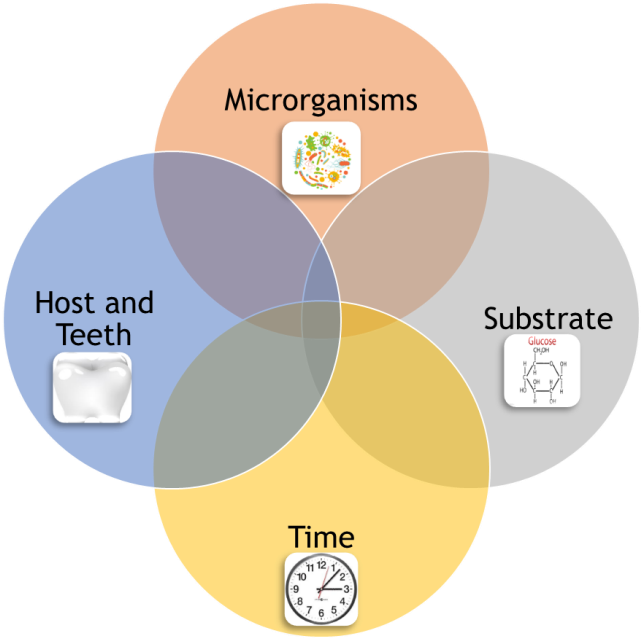


Figure 1: Four factors required for caries to occur and progress

Malocclusion has been considered as a potential risk factor for dental caries as it allows the build-up of plaque and hinders its removal (Pitts and Rimmer, 1992; Allison and Schwartz, 2003; Warren et al., 2003; Gábris et al., 2006; Hafez et al., 2012).

The development of dental caries can be prevented with good diet and oral hygiene and it has been found that uncrowded teeth make plaque control easier (El-Mangoury et al., 1987; Addy et al., 1988). It is uncertain, however, whether this is due to the alignment of the teeth or behaviour change brought about by undergoing orthodontic treatment. Positive change in oral hygiene and dietary habits was noted as a perceived benefit by adolescents who had recently undergone orthodontic treatment (AlQuraini et al., 2019).

A recent systematic review concluded that malocclusion is associated with dental caries (Sa-Pinto et al., 2018) which is at odds to the findings of a previous review (Hafez et al., 2012). Socio-economic status has been associated with increased prevalence of caries

(Piovesan et al., 2010; Ramos-Jorge et al., 2014; de Almeida Pinto-Sarmento et al., 2016) and it is possible that malocclusion and socio-economic status act synergistically as risk factors but for individuals who maintain a good level of oral hygiene there seems to be no association between dental crowding and susceptibility to dental caries (Hafez et al., 2012). Individuals who received orthodontic treatment were no less likely to develop caries compared to those who did not have treatment regardless of initial malocclusion, socio-demographic status and oral health behaviours (Doğramacı and Brennan, 2019).

2.1.1.2 Periodontal disease

Some malocclusions may harm the periodontal tissues, such as an anterior deep bite, which may cause gingival stripping on the maxillary incisors, or an anterior crossbite, which may lead to recession and mobility of a lower incisor (Eismann and Prusas, 1990). Orthodontic treatment for these malocclusions is most likely to be beneficial for periodontal health (Seehra et al., 2009), though these conditions are relatively uncommon with the prevalence of gingival recession in 7 to 15 year-olds ranging from 7% to 10% (Parfitt and Mjör, 1964; El Samad Younes and El Angbawi, 1983; Ainamo et al., 1986).

Straight teeth have been shown to be easier to clean (Addy et al., 1988) but other studies suggested that a greater benefit to periodontal health may be obtained by improving oral hygiene techniques and motivation than from undertaking orthodontic treatment. Indeed, going through the process of undertaking orthodontic treatment and having the concept of good oral hygiene reinforced at regular intervals has been shown to lower plaque scores (Davies et al., 1991). Adolescent patients and their parents perceived this as a benefit of orthodontic treatment (AlQuraini et al., 2019; Shah et al., 2019).

Orthodontic treatment has been associated with 0.03mm of gingival recession, 0.13mm of alveolar bone loss and 0.23mm of increase in periodontal pocket depth, when compared to no treatment (Bollen, 2008). The length of follow-up in the studies included in that systematic review was short and no effect of orthodontic treatment on specific malocclusions could be made. In the absence of reliable evidence on the effects that orthodontic treatment may have on periodontal health, available evidence suggests a small detriment to periodontal health, in the short term.

2.1.1.3 Tooth wear

Tooth wear can be described as non-carious tooth surface loss (NCTSL) and the three main mechanisms by which it can occur are erosion, attrition and abrasion (Yip and Smales, 2012) as shown in Figure 2.



Mechanism	Definition
Erosion	Chemical dissolution of tooth substance without the presence of dental plaque
Attrition	Wear occurring from tooth-to-tooth contact without the presence of food
Abrasion	Wear occurring by the friction of exogenous material that is forced over the surfaces of the tooth

Figure 2: Graphical representation of the three causes of tooth wear

A U.K. cross-sectional study found no differences in tooth wear between individuals who had previously received orthodontic treatment and those who did not (Mwangi et al., 2009). Additionally, no differences were seen between those who exhibited a need for orthodontic treatment and those who did not, suggesting that aberrant occlusal factors are not associated with increased tooth wear (Rugh et al., 1984; Seligman et al., 1988).

Furthermore, a North American study found that tooth wear was more prevalent among older patients and males (Cunha-Cruz et al., 2010). They noted that, in adults, there were no associations between tooth wear and Angle malocclusion, posterior or anterior open bites, history of orthodontic treatment or missing teeth. For adolescents, on the other hand, Class II malocclusion was associated with a higher prevalence than Class I, and posterior or anterior open bites were associated with a 40% lower prevalence of tooth wear compared to individuals without open bite. Orthodontic treatment and missing teeth, however, were not associated with the prevalence of tooth wear. The authors postulated that with increased wear seen in Class II adolescents may be due to lack of posterior disclusion in excursive jaw movements resulting in greater posterior tooth wear and that in individuals with Class II division 2 malocclusions there is greater anterior vertical overlap and increased contact of anterior teeth during parafunction. Information, however, on subdivisions of Class II malocclusions was not collected and this reasoning would not explain why Class II malocclusion was not associated with increased tooth wear in adults.

Overall it would seem that orthodontic treatment is not associated with reduced levels of tooth wear.

2.1.1.4 Trauma

The risk of trauma to the upper incisors is elevated when the overjet is increased (Järvinen, 1978), with an overjet greater than 9 mm increasing the risk by 45% (Todd and Dodd, 1985). It has also been noted that trauma is more common in boys and that the incidence increases with age, being 5% in 8 year olds, 11% in 13 year olds and 13% in 15 year olds (Chadwick et al., 2006). It has been found that 10% of new patients attending for orthodontic treatment had evidence of trauma (Bauss et al., 2004).

It has been suggested that interceptive treatment, for example with a functional appliance, is justified for those individuals who are at elevated risk of trauma (Brin et al., 2000). Other authors, however, have suggested that the cost of providing early, two-phase, treatment outweighs the cost of managing minor trauma that may occur in the absence of early treatment (Koroluk et al., 2003). Indeed, the proposed disadvantages to early treatment include increased demand on patient compliance, longer overall treatment time along with increased cost of treatment (Livieratos and Johnston Jr, 1995).

A Cochrane review of orthodontic treatment for Class II malocclusion in children and adolescents included a comparison of trauma incidence for two-stage, early treatment and one-stage, late treatment using functional appliances or headgear (Batista et al., 2018). Early treatment with a functional appliance was found to reduce the incidence of incisal trauma when compared to late treatment with 19% of participants receiving early treatment reporting new trauma compared to 30% of participants receiving late treatment. Similarly, early treatment with headgear resulted in almost half the incidence of new incisal trauma when compared to late treatment. The review concluded that there is low to moderate quality evidence to suggest that providing early orthodontic treatment for children with prominent upper incisors is more effective for reducing incisal trauma than a single course of orthodontic treatment provided in adolescence (Batista et al., 2018).

2.1.1.5 Temporomandibular joint dysfunction

The term temporomandibular joint dysfunction (TMD) encompasses a group of related disorders with common signs and symptoms affecting the temporomandibular joint, facial muscles or both. The signs and symptoms include (Riolo et al., 1987):

- Limited mandibular opening
    - <40 mm in males
    - <35 mm in females (Harris et al., 1993)
- Reduced lateral mandibular excursions of <1 incisor width
- Joint noise and pain
- Popping or tinnitus of the ears
- Headaches

Symptoms of TMD arise from two main causes: internal joint pathology, and muscle spasm and fatigue due to excessive clenching and grinding in response to stress (Proffit et al., 2019). A number of occlusal features have been correlated with TMD (Table 2), but the correlation is weak (Egermark-Eriksson et al., 1983).

Table 2: Occlusal features associated with TMD

Occlusal features associated with TMD	
• Anterior open bite • Deep overbite	• Class II and III molars • Posterior crossbite with displacement

No difference in signs and symptoms of TMD have been identified among orthodontically treated individuals compared to those who never received orthodontic treatment (Egermark et al., 2003). Although extraction treatment has been proposed to predispose an individual to TMD due to the condyle being displaced distally as the incisors are retracted into the extraction spaces (Bowbeer, 1987), no increase in the frequency of TMD symptoms has been identified (Paquette et al., 1992; Mohlin et al., 2004).

Proffit et al. (2019) suggested that undergoing orthodontic treatment was likely to reduce symptoms of TMD due to intermittent periodontal discomfort. But following orthodontic treatment symptoms are likely to recur in the presence of stress (Proffit et al., 2019).

There is no evidence to prove that orthodontic treatment either causes or cures TMD and there is no evidence that occlusal adjustment will prevent or treat TMD (Luther et al., 2010).

2.1.1.6 Tooth impaction

The most commonly impacted teeth are third molars, followed by permanent maxillary canines, permanent maxillary central incisors, mandibular second premolars, and permanent mandibular second molars (Kokich and Mathews, 1993), though it is possible for any tooth in the dental arch to be impacted (Shapira et al., 1998).

Third molars account for 76.1% to 98% of impactions (Mead, 1930; Kramer and Williams, 1970; Aitasalo et al., 1972; Grover and Lorton, 1985) but will not be discussed further here as they do not represent a reason for referral in the context of this project.

Mandibular second molar impaction is rare and is reported to have an incidence of around 0.03% (Johnsen, 1977; Varpio and Wellfelt, 1988). It is almost always associated with arch length deficiency and moving first permanent molars posteriorly in the mixed

dentition (Shapira et al., 1998). A number of management strategies have been utilised (Shapira et al., 1998) including: placement of a separator between the first and second molars, surgical repositioning of the second molar, transplantation of the second molar into the correct position, extraction of the second molar, and surgical uncovering and orthodontic uprighting of the second molar. A possible benefit of orthodontic treatment in these cases is the reduction of caries risk and periodontal pathology with the first permanent molar.

First permanent molars (FPM) can become impacted and their eruption blocked by the distal aspect of the primary second molar, which usually becomes resorbed. Impaction of the FPM is often indicative of crowding in the posterior maxilla (Kurol and Bjerklin, 1982a) and can be categorised as reversible, where the FPM will spontaneously erupt within 6 months, or irreversible, where the FPM will not erupt and some intervention will be indicated (Seehra et al., 2011b). The incidence of FPM impaction is between 2-6% (Bjerklin, 1994) with 66% of these being reversible. The aetiology is multifactorial and includes increased mesio-distal width of the FPM (Bjerklin, 1994), increased mesial eruption angle of the FPM (Chintakanon and Boonpinon, 1998), small maxillary size (Canut and Raga, 1983) and association with other developmental anomalies including ectopic canines, suggesting a common genetic aetiology (Mooney et al., 2007). Management options include a period of observation to monitor for spontaneous eruption (3-6 months), discing the distal surface of the primary second molar, separator placement or extraction of the primary second molar if it has significant resorption, mobility or is symptomatic. The benefits of orthodontic management of the impacted FPM include eruption of the FPM into the normal position and cessation of resorption of the primary second molar (Kurol and Bjerklin, 1982b).

Impaction of the mandibular second premolar accounts for 24% of all impactions (excluding third molars) (Collett, 2000). Premolar impaction may be caused by local factors such as mesial drift of teeth and may also be associated with retained or infra-occluded primary molars (Burch et al., 1994; Takagi and Koyama, 1998; Yawaka et al., 2002; Rubin et al., 2003; McNamara and McNamara, 2005). Treatment options for impacted premolars include observation, intervention, relocation and extraction (McNamara and McNamara, 2005). Benefits of orthodontic management include eruption of the premolar into the normal position and maintenance of the alveolar ridge (McNamara and McNamara, 2005).

Permanent maxillary canines fail to erupt in around 2% of Caucasian children (Ferguson, 1990) and these can be positioned palatally (61%), buccally (4.5%), or in the line of the arch (34%) (Stivaros and Mandall, 2000). Adverse outcomes from not undergoing treatment for ectopic canines include resorption of adjacent teeth, pathological changes associated with the canine follicle and poor aesthetic outcomes. Treatment options include no active treatment and monitoring (Mittal et al., 2018), interceptive treatment (Parkin et al., 2012), exposure and orthodontic alignment (Parkin et al., 2017), surgical removal (Husain et al., 2010), transalveolar transplantation (Thomas et al., 1998) and surgical repositioning (McKay, 1978).

Unerupted permanent maxillary incisors have an incidence of 0.04% (Grover and Lorton, 1985), or 2.6% of the population referred for orthodontic treatment (Di Biase, 1969). Failure to erupt is most commonly due to the presence of a supernumerary tooth (Yaqoob et al., 2010). A missing and unerupted maxillary incisor may have a major impact on dental and facial aesthetics and speech difficulties with 'S' sounds have been reported (Snow, 1961; Bankson and Byrne, 1962; Weinberg, 1968). As it is possible that it may affect self-esteem it is therefore important to detect and manage as early as possible (Yaqoob et al., 2010).

2.1.2 Aesthetic benefits

2.1.2.1 Smiling

A fundamental aim of orthodontic treatment is to create a pleasing smile and eight key components of a balanced smile have been described (Sabri, 2005): lip line, smile arc, upper lip curvature, lateral negative space, smile symmetry, occlusal frontal plane, dental components and gingival components. The effects of orthodontic treatment on smile aesthetics have been investigated. Regardless of the severity of presenting malocclusion, both minor and severe malocclusions benefit equally from orthodontic treatment (Maganzini et al., 2013).

There was no difference in smile aesthetics between orthodontically treated subjects and untreated individuals with well-balanced faces and good occlusion. For non-extraction and premolar extraction cases no difference existed either in smile aesthetics.

2.1.2.2 Profile change

Facial profile is determined by the skeletal foundation, dental support, and the soft tissue components of the nose and chin, lip tone and lip thickness (Ackerman and Proffit, 1997). What is judged to be an attractive profile differs between laypersons and dental professionals, with lay persons being less critical of facial profile (Kerr and O'donnell, 1990). When the mandible is at an average position relative to the cranial base (SNB = 78^{o}) it is considered most attractive (Johnston et al., 2005a). Similarly, when LAFH/TAFH deviates from 55% the attractiveness rating progressively decreases (Johnston et al., 2005b). Changes in facial profile occur with age and the way society judges beauty has changed over time (Peck, 1970; Nguyen and Turley, 1998).

There has long been a debate in orthodontics over whether extractions lead to flattening of the profile and retrusive lips (DiBiase and Sandler, 2001a). While there is a relationship between incisor retraction and distal movement of the upper lip, it is complex and difficult to accurately predict and does not follow a one-to-one ratio (Park and Burstone, 1986; Talass et al., 1987). Lip retraction must be substantial before it is considered unattractive by professionals or laypersons (Bowman and Johnston Jr, 2000). In Class I cases, extraction compared to non-extraction treatment seemed to have minimal effect on the aesthetics of the profile (Konstantonis, 2012). Extractions, if based on sound clinical diagnosis, can actually improve the profile (Drobocky and Smith, 1989; Paquette et al., 1992; Luppanapornlarp and Johnston Jr, 1993; Young and Smith, 1993; Bishara et al., 1997; Bowman and Johnston Jr, 2000).

Overall it would seem that orthodontic treatment involving premolar extractions has a small effect on the profile but that this is not necessarily detrimental. Other factors such as growth and soft tissue anatomy play a larger role (Paquette et al., 1992) and individual variation in response is large.

2.1.3 Functional benefits

2.1.3.1 Mastication

Several factors have been noted to influence masticatory performance, these include body size, bite force (Fontijn-Tekamp et al., 2000), number of functional tooth units (Hatch et al., 2001), occlusal contact area (Owens et al., 2002) and malocclusion (Buschang, 2006). Malocclusion type and severity has been shown to decrease masticatory performance (Magalhães et al., 2010).

Functional issues such as crossbites with mandibular displacement have been shown to result in asymmetric muscular activity during mastication and a reduction in bite force (Sonnesen and Bakke, 2001; Thilander and Bjerklin, 2011). Whether this has an impact on individuals' daily activities is questionable, but a reduction in oral health-related quality of life in terms of function is reported by individuals with malocclusion when compared to those with normal occlusion (Masood et al., 2014). Specific occlusal characteristics, such as anterior open bite, can make eating socially embarrassing or difficult as it is impossible to fully incise certain foods, orthodontic treatment in these cases can lead to an improvement in function (Benson et al., 2015).

2.1.3.2 Speech

Speech patterns are developed early in life, usually long before the permanent occlusion has developed. Given that the production of consonants, particularly 't' and 'd', requires articulation, with the tongue contacting the palatal surfaces of the maxillary incisors, it would seem reasonable that malocclusion could cause speech problems. Normal speech, however, can occur in the presence of severe anatomic distortions, so the relationship between malocclusion and speech is not as straightforward as cause and effect (Johnson and Sandy, 1999). Specific speech problems are shown in Table 3. In a child with a speech problem and a related malocclusion, orthodontics and speech therapy may lead to improvement (Proffit et al., 2019).

Table 3: Speech difficulties related to malocclusion

Speech sound	Problem	Related malocclusion
/s/, /z/ (sibilants)	Lisp	Anterior openbite Large gap between incisors
/t/, /d/ (linguo-alveolar stops)	Difficulty in production	Irregular incisors, particularly lingual position of maxillary incisors
/f/, /v/ (labio-dental fricatives)	Distortion	Skeletal Class III
th, sh, ch (linguo-dental fricatives [voiced or voiceless])	Distortion	Anterior openbite

2.1.3.3 Obstructive sleep apnoea (OSA)

OSA/ hypopnoea syndrome can be defined as the co-existence of excessive daytime sleepiness and irregular breathing at night (Jordan et al., 2014). The management of OSA is multidisciplinary. Non-surgical management options include mandibular advancement appliances (MAA) similar in action to functional appliances.

2.1.4 Psycho-social benefits

2.1.4.1 Teasing

Bullying among school children has been defined as 'a specific form of aggressive behaviour and can be described as a situation when a student is exposed repeatedly and over time, to negative actions on the part of one or more students' (Olweus, 1994). Teasing is considered to be a milder form of aggression than bullying, though if it causes harm or distress it should be considered bullying (Pearce, 1991). The frequency of teasing related to dental features has been reported to be 7% among school children aged 9 to 13 years (Shaw et al., 1980) and teeth were the fourth most common feature that children were teased about (Shaw et al., 1980). Certain occlusal traits have been associated with teasing (Table 4), though background facial attractiveness appears to play a more influential role than the individual's dental condition (Shaw et al., 1985).

Table 4: Occlusal features associated with teasing

Occlusal features associated with teasing (Shaw et al., 1980; Helm et al., 1985; Gosney, 1986; Seehra et al., 2011a; Watkinson et al., 2013)
• Class II division 1 incisors • Increased overjet • Deep overbite • Crowding • High orthodontic treatment need on Aesthetic Component IOTN • Class III incisors

Studies have looked at the effects of orthodontic treatment on teasing. Orthodontic appliances, particularly fixed appliances, attract comments and nicknames (Shaw et al., 1980) with parents seeming to have a more negative perception of both removable and fixed appliances than patients (Prove et al., 1997). On the other hand, following commencement of interceptive orthodontic treatment for patients experiencing bullying,

78% reported they were no longer being bullied about their malocclusion (Seehra et al., 2012).

It is not fully clear whether orthodontic treatment improves, worsens, or makes no difference to teasing/ bullying episodes and whether there is any psycho-social benefit, though it does seem that the persistently bullied child represents a certain psychological type (DiBiase and Sandler, 2001b). In individuals, however, who did not receive orthodontic treatment, awareness of malocclusion increases with age (Helm et al., 1985). It seems probable that providing orthodontic treatment for the bullied child may help them to develop into a psychologically healthier adult with a better body image (DiBiase and Sandler, 2001b).

2.1.4.2 Self-esteem

Self-esteem (SE) has been described as the subjective ability, of an individual, to deal with the environment and is impacted by the interactions with others (Tung and Kiyak, 1998).

Correcting a malocclusion may have a positive effect on an individual's SE. Orthodontic treatment is undertaken during adolescence. SE is least stable during early adolescence though it progressively stabilises during early adulthood (Trzesniewski et al., 2003; Orth et al., 2010). Concerns regarding the appearance of the teeth likely plays only a small role in the complex inter-relationships of life factors and SE for most people. As a result, it may be unrealistic to expect significant long-term changes in SE to come about from orthodontic treatment (Benson et al., 2015) and a number of studies have demonstrated that orthodontic treatment has no effect on SE over the long term (Kenealy et al., 2007; Shaw et al., 2007; Arrow et al., 2011).

An individual's psychological make-up, however, is an important factor in determining how they respond to new circumstances or challenges, someone with low SE being more concerned about their malocclusion than someone with high SE. This may explain why some individuals may be very upset about minor abnormalities, while others are not concerned about much more severe conditions (Benson et al., 2015).

2.1.4.3 Stereotyping

Physical appearance and social attractiveness share a close relationship (Hutson, 2013; Bale and Archer, 2013; Montemurro and Gillen, 2013; Seidman and Miller, 2013; Ferreira et al., 2013) and the face is considered to be the most important part of the body when it comes to attraction and interpersonal communication (Tatarunaite et al., 2005; Meyer-Marcotty and Stellzig-Eisenhauer, 2009). The most observed characteristics of an individual during social interaction are the eyes, followed by the smile (Palomares et al., 2012).

When evaluating facial attractiveness, various factors are taken into account, including expression, symmetry and appearance of the teeth (Ng et al., 2012; Yu et al., 2013; Eichenberger et al., 2013; Kościński, 2013). Skeletal Class I faces are typically perceived as more attractive that Class II or Class III faces (Johnston et al., 2005a; Hönn et al., 2008; Sinko et al., 2012).

Attractive individuals are seen as being more capable, intelligent, responsible and socially well integrated, they have more prestige and are happier and more successful than those who are less attractive (Davis et al., 1998; Eli et al., 2001). Pithon et al. (2014) suggested that individuals with an ideal smile are considered more intelligent and that employers would be more likely to select them for a job. Aspects, however, related to honesty and efficiency showed no significant differences between orthodontically treated individuals and those with malocclusions, showing that perceptions of character and ability are not measured only by appearance.

2.1.4.4 Oral health-related quality of life

The term “oral health-related quality of life” (OHRQoL) can be defined as “the absence of negative impacts of oral conditions on social life and a positive sense of dento-facial self-confidence” (Inglehart and Bagramian, 2002). It is used to describe a conceptualised patient-reported outcome measure on oral health (Locker et al., 2000) and can be assessed using quantitative evaluations such as questionnaires. These investigate oral health in the functional, emotional and social well-being domains to measure the influence of oral health on quality of life in general (Locker and Allen, 2007; Sischo and Broder, 2011).

Individuals with malocclusion can feel self-conscious in social situations and may have self-concept issues related to their facial and dental appearance (Shaw, 1981; Klages et

al., 2004). It would seem logical, therefore, to suggest that a benefit of orthodontic treatment would be increased self-esteem and reduced anxiety in social situations (Albino et al., 1994; Birkeland et al., 1997). A systematic review and meta-analysis of studies using the Oral Health Impact Profile – 14 (OHIP-14), a questionnaire commonly used to assess OHRQoL in orthodontics, found that OHRQoL improved following orthodontic treatment (Andiappan et al., 2014).

2.1.5 Behaviour change benefits

Behavioural changes that may have a positive effect on the health of the dentition, following orthodontic treatment, have been reported (AlQuraini et al., 2019; Shah et al., 2019). Adolescent patients report that they have a greater awareness of the importance of oral hygiene and a desire to maintain good oral hygiene following orthodontic treatment. Possible reasons for this include the regular reinforcement of oral hygiene and dental education during orthodontic appointments and improved dental appearance increasing their motivation to maintain a high standard of hygiene. Oral hygiene has been shown to improve following orthodontic treatment (Feliu, 1982). Adolescents also report dietary changes in the form of an awareness of the need to reduce sugar intake and a desire to do so to avoid compromising the orthodontic result (AlQuraini et al., 2019).

Parents of adolescents who have completed orthodontic treatment also report that their child has a greater awareness of the importance of oral hygiene and dietary factors on oral health. Additionally, cessation of habits such as digit sucking and nail biting have been reported by parents (Shah et al., 2019).

2.2 Perceptions and expectations of orthodontic treatment

A patient's expectation of orthodontic treatment has been found to influence their evaluation of the quality of the treatment result and satisfaction (Carr et al., 2001). If patient expectations remain unfulfilled it can lead to dissatisfaction and poor compliance (Bowbeer, 1987; Ross et al., 1987). The main expectations of orthodontic treatment outcomes are improved facial and dental appearance, dental health and oral function (Bennett et al., 1997; Bos et al., 2003). Furthermore, improved social competitiveness, psychological confidence and attractiveness have been identified as perceived beneficial

outcomes of treatment (Phillips et al., 1997; Kenealy et al., 2007; Prabakaran et al., 2012a; Yao et al., 2016). Factors that influenced patient expectation included age, severity of malocclusion and subjective self-concept.

2.3 Research methodologies

This study evaluated adolescent and parental perceptions of expected benefits of orthodontic treatment using a mixed methods approach. This section of the literature review will focus on qualitative studies, quantitative ranking exercises and mixed-methods studies in orthodontics.

2.3.1 Qualitative research in general

It is difficult to define qualitative research as it has no theory or paradigm that is distinctly its own and it does not have a distinct set of practices or methods (Denzin and Lincoln, 2018). On a broader level, qualitative research has been described as a naturalistic, interpretative approach, concerned with exploring phenomena 'from the interior' (Flick, 2019). Qualitative research may be associated with 'what' 'why' and 'how' questions rather than 'how many' and may be distinguished from quantitative methods by the fact that hypotheses may be generated from analysis of the data rather than stated at the outset (Silverman, 2015). Table 5 gives a comparison of quantitative and qualitative research.

Table 5: Comparison of qualitative and quantitative research

Qualitative Research	RESEARCH ASPECT	Quantitative Research
Discover ideas, with general research objects	**COMMON PURPOSE**	Test hypotheses or specific research questions
Observe and interpret	**APPROACH**	Measure and test
Unstructured, free form	**DATA COLLECTION APPROACH**	Structured response categories provided
Researcher is intimately involved, results are subjective	**RESEARCHER INDEPENDENCE**	Researcher uninvolved observer, results are objective
Small samples, often in natural setting	**SAMPLES**	Larger samples to produce generalisable results

Traditionally, research in orthodontics has followed a positivist approach based on the direct relationship between cause and effect for diseases and their specific aetiological factors. This means that quantitative research has been dominant in the orthodontic literature (Newton, 2000). The foundations of evidence-based dentistry stem from clinical epidemiology. In contrast, qualitative methods have emerged from the social sciences. Both quantitative and qualitative methodologies should be viewed as complementary as each addresses a particular type of research question.

Quantitative methods possess objectivity and statistical procedures offer great potential, but it can be challenging for these to encompass the multifactorial nature of health-disease processes. Given the acceptance that malocclusion is multifactorial in nature (Lundström, 1984), it is important also to consider functional, behavioural, emotional and psycho-social aspects. It has been stated that the results of orthodontic research are confined to values and differences that are much more relevant to the orthodontist than to the patient (O'Brien, 2013), leading to speculation that planning actions based primarily on quantitative data may not meet the needs of the individuals involved. Qualitative methods can explore the complexity of behavioural contexts related to health and can identify

subjective meanings of social phenomena and processes involved in healthcare. This can overcome the difficulties of studying complex, multifactorial phenomena using quantitative methodology.

2.3.1.1 Sample selection

Sample selection for qualitative research is often criterion-based or purposive (Mason, 2002; Quinn Patton, 2002). The participants are chosen because they have particular features or characteristics which will allow detailed exploration of the central themes of the study.

2.3.1.2 Data collection

Data collection methods exhibit diversity though the semi-structured interview is the most commonly used. These involve asking participants a pre-defined set of open-ended questions and allow the interviewer to deepen the discussion of topics of interest. This is aided by the use of a topic guide which is produced following reviewing the appropriate literature. Another collection method commonly used is the focus group, a group interview, usually with six to ten participants. It is based on the interaction among the participants as they respond to topics raised by the researcher, thus influencing the ideas expressed to one another.

2.3.1.3 Topic guides

A topic guide is an aide-memoire used by an interviewer to ensure that all relevant issues are explored with the participant (Marshall and Rossman, 2014). Topic guides are used to steer the conversation but are not intended to be prescriptive and do not dictate that the questions must always be asked in a particular way. It allows flexibility to pursue the information that is salient to each participant. If used as a specific questionnaire script it limits the ability of the interviewer to be responsive to the participant and would prevent the exploration of unforeseen, but highly relevant, themes emerging from the interview. In research where interviews are being conducted by multiple researchers, a topic guide improves the consistency and common understanding of the approach desired.

Designing a topic guide usually begins with reviewing the relevant literature surrounding the topic under investigation, study participants and study objectives and protocol. This enables the development of an initial picture of the key elements to be covered in the data gathering and how to order and group them. Ordering of topics is important to allow a smooth progression of the conversation and avoid jumping back and forth between topics.

A flaw that can become apparent during the designing of the topic guide is "scope-creep", where more and more topics are added and it becomes difficult to explore them all to an appropriate level of detail. To prevent this the researcher must remain aware of the objectives of the study. Within this study there was the temptation to explore the adverse effects of orthodontic treatment despite not being an objective of the study. A disciplined approach was maintained in the design of the topic guide to prevent this scope-creep.

2.3.1.4 Data analysis

Regardless of whether semi-structured interviews or focus groups are used, the discussion is audio recorded and transcribed verbatim to allow analyses to be carried out. The interview transcriptions are uploaded into a computer-aided qualitative-data-analysis software (CAQDAS), such as Nvivo (QSR International Pty Ltd.). The use of computer assisted data analysis has replaced the use of manually drawn up matrices on paper and allows visualisation, indexing, sorting, summary and display of data. The pros and cons of using CAQDAS are given in Table 6.

Table 6: Advantages & disadvantages of CAQDAS

Advantages	Disadvantages
• Allows thorough analysis • Project file can be shared between researchers • Renders analytical process traceable and transparent • Produces comprehensive audit trail	• Time-consuming • Expensive • Hard to analyse with others synchronously • Requires extensive training in use of the software • Can feel restrictive

Various approaches to qualitative data analysis have been described including:

- Interpretive Phenomenological Analysis (IPA) (Smith and Shinebourne, 2012),
- Grounded Theory (Straw and Corbin, 1990)
- Thematic Analysis (Joffe, 2012)

Thematic Analysis is not tied to any particular set of theoretical constructs and has been widely adopted, the process, however, of thematic coding is used in many different analytic traditions (such as IPA) and it has been argued that it is a generic method rather than an approach in its own right (Ryan and Bernard, 2000).

The data analysis methodology for this study was based on phenomenology, a disciplinary field of Philosophy, using Interpretive Phenomenological Analysis (IPA) (Smith and Shinebourne, 2012). This is a holistic approach, taking into account the contexts in which human experiences occur and is concerned with learning from instances or cases. This method begins with a focus of enquiry and follows an iterative approach to data analysis, rather than beginning with an *a priori* hypothesis to be tested. IPA involves understanding the participant's lived, conscious experience and adopting a psychological focus on personal meaning-making in specific contexts (the double hermeneutic, where the researcher aims to make sense of the participant, who in turn is trying to make sense of their own experiences using memory and language) (Smith, 2011). IPA is phenomenological in attempting to understand and elucidate the human lived conscious experience of phenomena but psychological in its analysis of meaning-making and hermeneutic interpretation.

A systematic approach to qualitative data collection through semi-structured interviews using open ended questions allows participants to articulate their thoughts, perceptions and experiences freely. In analysing this data, responses are not grouped according to pre-defined categories, instead salient categories of meaning and relationships between categories are derived from the data itself through a process of inductive reasoning known as coding. A code is a word, or phrase, which acts as a summative, salient and essence-capturing label for a segment of text and provides a shorthand for more complex information (Saldaña, 2021). The process of coding attempts to apply meaning to the raw data and the codes may act as signposts to relevant portions of data (Seale, 1999). Once

codes have been assigned to the interview transcripts it is then necessary to identify and compare sections of text that are discussing the same thing. This allows the researcher to identify similarities, differences and relationships among the interview transcripts. This then aids with the understanding of the overall themes, which are a refinement of the core ideas within the coding and are developed at a later stage. Themes represent higher order categories and attempt to explain patterns within the data.

2.3.2 Qualitative research in orthodontics

The number of orthodontic publications using qualitative methodology has increased in recent years (de Almeida Anderson et al., 2018) and a selection of studies that have used qualitative methodology in orthodontics are given in Table 7.

A wide variety of topics have been assessed using interviews including perceptions of orthodontic treatment outcomes (Shah et al., 2019; AlQuraini et al., 2019), patient experiences with treatment (Cirgic et al., 2015) and decision-making (Barber et al., 2019). Focus groups have been utilised to investigate motivations for, and expectations of orthodontic treatment (Pabari et al., 2011), perceptions of risks of orthodontic treatment (Perry et al., 2018) and the effects of malocclusion on daily life (Taghavi Bayat et al., 2013). Other studies have combined qualitative and quantitative methods (mixed-methods) to assess various areas which will be discussed later. The diverse nature of the studies demonstrates the potential of qualitative research to enrich knowledge and to address research questions that may be impossible to evaluate using quantitative research methodology alone.

One of the earlier qualitative orthodontic studies investigated the perceptions of orthognathic patients about referral to a mental health professional (Ryan et al., 2009). Semi-structured interviews with 20 participants revealed two main themes: service provision and perceptions of mental health professionals and the information gathered was used to develop a questionnaire for use with orthognathic patients regarding views on referral to a clinical psychologist.

Subsequently, motivations for undergoing orthognathic treatment were investigated (Ryan et al., 2012) and it was noted that a complex of factors such as personality, education and personal relationships played a role alongside the impact of the condition.

Patient experiences during orthodontic treatment have been investigated using qualitative methodology. Cirgic et al. (2015) conducted interviews to explore and describe the experiences of adolescents undergoing treatment with removable functional appliances in Sweden. They noted a highly diverse range of experiences but that the clinician plays an important role in the patient experience. They suggested that clinicians should listen to the patients' needs and expectations before the start of treatment.

Patient and parent perceptions of outcomes following orthodontic treatment have been evaluated (Shah et al., 2019; AlQuraini et al., 2019). These studies used semi-structured interviews with participants after the completion of orthodontic treatment. Thematic analysis identified three main themes: health-related behavioural changes, dental health and psycho-social influences. Health-related behavioural changes included a perceived ability to maintain good oral hygiene and a better diet. Dental health changes included enhanced aesthetics and function and a reduction in plaque accumulation. Psycho-social influences included improved confidence, self-esteem and better social interactions. The authors of these studies concluded that although patients and parents revealed similar themes in the interviews, differences in emphasis placed by each group meant that also considering the parental perceptions is of significant value.

Perceptions of the risks of orthodontic treatment, among adolescents, have been studied using focus groups (Perry et al., 2018). Four themes were identified from the data: day-to-day risks of orthodontic treatment, important orthodontic risk information, engaging with orthodontic risk information and managing the risks of orthodontic treatment. The participants in this study included individuals who were currently undergoing orthodontic treatment, those who had completed treatment and those who declined to undergo orthodontic treatment.

Other work has looked at the practice of orthodontics and its impact on the personal lives of those working in the profession (Soma et al., 2012a; Soma et al., 2012b). These studies involved semi-structured interviews with 19 orthodontists practicing in New Zealand and the results demonstrated that, although orthodontists were aware of the need to balance work and family commitments, a number of barriers to achieving this appeared recurrently including impossibility of reducing workload and stress related to the profession.

Table 7: Summary of qualitative research in orthodontics

Authors (year)	Subject Area	Methodology	Sample Characteristics	Conclusions
Ryan et al. (2009)	Perceptions of orthognathic patients about referral to a mental health professional	• Qualitative ○ S-SI	• 20 Adults	Patient views divided into two themes: • Service provision • Perceptions of mental health professionals

Pabari et al. (2011)	Motivations and expectations of orthodontic treatment	• Mixed-methods
		  ○ FG
		  ○ Questionnaire
			Qualitative:
			• 25 Adults (FG)
			Quantitative:
			• 172 Adults (Questionnaire)
				Motivations:
				• Desire for aligned teeth
				• Social pressure

Abed Al Jawad et al. (2011)	Dietary changes during orthodontic treatment	• Qualitative ○ S-SI	• 10 Adolescents	Two themes presented: • Experience with pain • Behavioural changes in response to the use of braces
Meaney et al. (2011)	Hypodontia effects on psych-osocial and functional well-being	• Qualitative ○ S-SI	• 10 Adolescents	Two themes presented: • Difficulty understanding condition and implications • Delays between diagnosis and treatment problematic
Ryan et al. (2012)	Motivations for seeking orthognathic treatment	• Qualitative ○ S-SI	• 18 Adolescents	Motivating factors: • Impact of the condition • Personality • Education • Personal relationships

Authors (year)	Subject Area	Methodology	Sample Characteristics	Conclusions

Prabakaran et al. (2012a)	Motivations for orthodontic treatment	• Mixed-methods
		  ○ UnSI
		  ○ Q-method
			• 24 Adolescents (UnSI)
			• 60 Adolescents (Q-method)
			• 60 Adults (Q-method)
				• For adolescents, aesthetics was most significant factor in seeking treatment
				• For parents it was concerns about possible future problems

Soma et al. (2012a)	Daily practice routine of orthodontists	• Qualitative ○ S-SI	• 19 Adults	• Demonstrated how orthodontists develop in response to changes in society in New Zealand
Soma et al. (2012b)	Balance between personal and professional life of orthodontists	• Qualitative ○ S-SI	• 19 Adults	• Orthodontists aware of need for balance between personal and professional life • Factors such as the impossibility of reducing workload and stress hinder this process

Stephens et al. (2013)	How adolescent patients find information about orthodontic treatment and why they seek such information	• Mixed-methods
		  ○ S-SI
		  ○ Questionnaire
			Qualitative:
			• 15 Adolescents (S-SI)
			Quantitative:
			• 50 Adolescents (Questionnaire)
				Main sources of information:
				• Conversation with orthodontist
				• Reading pamphlets

Taghavi Bayat et al. (2013)	Effects of malocclusion on daily life	• Qualitative ○ FG	• 12 Adolescents	• Patients repeatedly reminded of their dental conditions • Low self-esteem reinforced by media influences

Authors (year)	Subject Area	Methodology	Sample Characteristics	Conclusions
Stanford et al. (2014)	Examine orthodontic patients concept of dentofacial normality	• Qualitative ○ S-SI	• 15 Adolescents	Constructs of normality: • Personal experiences • Professionals • Friends • Media Normal appearance seems to include biological and social elements
Cirgic et al. (2015)	Experiences of adolescents with removable functional appliances	• Qualitative ○ UnSI	• 21 Adolescents	• Highly diversified experiences • Dentist plays important role in this process

Davis et al. (2015)	Motivations for orthodontic treatment	• Mixed-Methods
		  ○ S-SI
		  ○ Questionnaire
			Qualitative:
			• 10 Adults (S-SI)
			Quantitative:
			• 70 Adults (Questionnaire)
				Four motivations identified:
				• Sense of responsibility
				• Need for oral health care
				• Prevent future problems
				• Improve self-image

Twigge et al. (2016a)	Treatment expectations, malocclusion severity and OHRQoL	• Mixed-Methods
		  ○ S-SI
		  ○ Questionnaire
			Qualitative:
			• 100 Adolescents (S-SI)
			Quantitative:
			• 105 Adolescents (Questionnaire)
				• Females experience worse psycho-social impacts related to their malocclusion
				• Patients seek to improve dental appearance and aspects of their QoL

Twigge et al. (2016b)	Orthodontic concerns which are incorporated into treatment planning and consent	• Mixed-Methods
		  ○ S-SI
		  ○ Questionnaire
			Qualitative:
			• 100 Adolescents (S-SI)
			Quantitative:
				Adolescents concerned with:
				• Appearance of crowding and gaps in front teeth
				• Difficulty of cleaning these teeth

Authors (year)	Subject Area	Methodology	Sample Characteristics	Conclusions
			• 105 Adolescents (Questionnaire)	
O'Keeffe et al. (2016)	Experiences of patients with hypodontia and satisfaction with orthodontic care	• Qualitative ○ UnSI & S-SI	• 20 Adolescents	Areas for improvement: • Communication for multidisciplinary treatment
Hardwick et al. (2017)	Expectations of lingual orthodontic treatment	• Qualitative ○ UnSI	• 15 Adolescents & Adults	• Expectations are similar in quality but greater in extent than those seeking labial orthodontics
Wong et al. (2018)	Satisfaction with the process of orthodontic treatment	• Qualitative ○ UnSI	• 26 Adults	Five themes: • Communication • Staff • Physical environment • Appointments • Impact of appliance treatment
Perry et al. (2018)	Perceptions of orthodontic treatment risks and risk information	• Qualitative ○ FG	• 32 Adolescents	Four themes: • Day-to-day risks of treatment • Important risk information • Engaging with orthodontic risk information • Managing risks of treatment
Shah et al. (2019)	Perceptions of orthodontic treatment outcomes	• Qualitative ○ S-SI	• 22 Adults	Three themes: • Health-related behavioural change • Dental health • Psycho-social influences

Authors (year)	Subject Area	Methodology	Sample Characteristics	Conclusions
AlQuraini et al. (2019)	Perceptions of orthodontic treatment outcomes	• Qualitative ○ S-SI	• 20 Adolescents	Three themes: (1) • Health-related behavioural change • Dental health • Psycho-social influences
El-Huni et al. (2019)	Factors influencing compliance in adolescents with Twin-block appliance	• Qualitative ○ S-SI	• 22 Adolescents	Factors influencing compliance: • Self-motivation • Peer and authority influence • QoL impairment and adaptability • Perceived treatment progress • Pragmatic and recall issues

Barbosa de Almeida et al. (2019)	Perception of the orthodontic treatment	• Qualitative
		  ○ Word association technique
		  ○ FG
			• 142 Adolescents (WAT)
			• 71 Adolescents (FG)
				Themes identified:
				• Aesthetic benefit of orthodontic treatment
				• Aesthetic impact of appliances
				• Pain associated with treatment
				• discomfort and trauma caused by appliances

Barber et al. (2019)	Hypodontia care pathway and shared decision-making (SDM)	• Qualitative
		  ○ Observation
		  ○ SI
			• 5 Adolescents (Observation)
			• 8 Adolescents (SI)
			• 8 Adults (SI)
				• Little evidence of SDM
				• Participants satisfied with treatment

Al-Moghrabi et al. (2019)	Factors influencing adherence to vacuum-formed retainer (VFR) wear	• Qualitative ○ S-SI	• 15 Adults	Six influencers of adherence with VFR wear identified:

Authors (year)	Subject Area	Methodology	Sample Characteristics	Conclusions
				• Beliefs concerning retention • Perceived negative impact of relapse • Effect on quality of life • Self-directed wear • Network support • Pragmatic issues
Abualfaraj et al. (2019)	Patient knowledge CLP and experiences with information about treatment options and outcomes	• Qualitative ○ S-SI	• 28 Adults	Mismatch between: • Information provided to families • Levels of knowledge about condition and options available to them
Sayers et al. (2019)	Patient expectations before starting fixed appliance treatment	• Qualitative ○ S-SI	• 13 Adolescents	Two themes identified: • Expectation of orthodontic treatment • Expectation of themselves during and after treatment
Kettle et al. (2020)	Experiences of wearing orthodontic appliances	• Qualitative ○ S-SI	• 26 Adolescents	• Reported physical, practical and emotional impacts from appliances

SI: Structured interview; S-SI: Semi-structured interview; UnSI: Unstructured interview; FG: Focus Group

2.3.3 Quantitative ranking exercises in orthodontics

Ranking items in order of perceived importance can be done using a variety of methods: Likert scale, visual analogue scale (VAS) and card sorting exercises (including Q-methodology).

A Likert scale is a 5- or 7-point scale that is used to allow an individual to express how much they agree or disagree with a statement (Likert, 1932). A Likert scale assumes that the strength or intensity of an attitude is linear, i.e. on a continuum from strongly agree to strongly disagree, and makes the assumption that attitudes can be measured. The response categories in Likert scales have a rank order, but the intervals between values cannot be presumed equal. Therefore, the mean (and standard deviation) are inappropriate as this is ordinal data (Jamieson, 2004). Appropriate statistics include median and mode.

A Likert scale has been used in the evaluation of orthodontic treatment benefits by Bennett et al. (1997) who investigated parent and orthodontist perceptions of the likelihood of various proposed benefits occurring for a child undergoing orthodontic treatment. The top scoring items for parents were 'better bite', 'better smile', and 'look better' while orthodontists scored similar items highly with 'better smile', 'teeth easy to brush', and 'better bite' being placed at the top.

A VAS is a measurement instrument that attempts to measure a characteristic that ranges across a continuum of values and cannot easily be directly measured (Crichton, 2001). The VAS is a straight horizontal line of fixed length, usually 100 mm. The ends are defined as the extreme limits of the parameter to be measured orientated from the left (worst) to the right (best) (Streiner et al., 2015). The participant marks a point on the line that they feel represents their perception of their current state; the VAS score is determined by measuring in millimetres from the left hand end of the line to the point that the patient marks. The VAS is widely used due to its simplicity and adaptability to a broad range of populations and settings.

Hunt et al. (2001) used a VAS to assess the level of importance attached to proposed orthodontic benefits by general dental practitioners (GDPs) and orthodontists. Improved self-esteem, improved physical attractiveness and improved self-confidence

were the three highest ranked benefits by both GDPs and orthodontists, while at the opposite end of the spectrum, they found that a reduction in temporomandibular dysfunction (TMD) problems was the lowest ranked item.

Card ranking has been used in medical research, for example investigating quality of life. Ratcliffe et al. (2017) used this methodology to compare older and younger individuals' preferences for attributes of quality of life and found older individuals placed greater emphasis on the ability to be independent while younger individuals considered mental health most important. A similar card ranking method is utilised in this present study, but has not been adopted in former studies in orthodontics.

Q-methodology is an alternative ranking technique that incorporates benefits of both quantitative and qualitative research methodologies (Dziopa and Ahern, 2011) and as such has been described as "qualiquantilogical" (Todd, 2004). Q-methodology is concerned with the individual viewpoint of participants (Donner, 2001) and it aims to give participants the opportunity to express their opinions on a topic that has not been hypothesised by the researcher.

To date there are five studies in the orthodontic literature that have used Q-methodology. Prabakaran et al. (2012a) used Q-methodology following interviews, with adolescents and their parents, to investigate the motivating factors for undergoing orthodontic treatment. Factor analysis of the adolescents Q-sorts identified 3 factors, all of which included aesthetics, as important. The remaining respondents had more individual viewpoints and did not map to any of the 3 factors. For the parents, factor analysis identified 4 factors, all of which included treatment in adolescence to prevent future problems, as important. A similar study conducted in China (Tang et al., 2015) looked at the motivations, of adult females, for seeking orthodontic treatment and aimed to classify participants according to their motivations. Four main factors were identified which, similarly, were heavily weighted towards aesthetics. These factors included: patients who focus on their self-perception of their appearance; patients who are concerned about the aesthetics and function of their teeth; patients who are easily influenced by others; patients who want to improve their confidence and avoid negative thoughts caused by their teeth.

Differences in motivations between different cultural groups were investigated by Davis et al. (2015). Four motivational profiles were described for both the Hispanic/

Latino and the non-Hispanic/ Latino White parent. The four themes were: well-timed treatment that prevents future dental problems, parental responsibility, perceived benefits and perceived need instilled by the dentist.

Q-methodology has also been used to examine concerns regarding orthodontic treatment with Lin et al. (2017) and Tang et al. (2015) finding a complex and diverse array of concerns among individuals regarding orthodontic treatment and suggesting that individualised interventions may reduce anxiety levels for patients.

2.3.4 Mixed-methods research in orthodontics

Mixed-methods research is an approach involving the integration of qualitative and quantitative research methodologies to attempt to understand a research problem by capitalising on their complementary strengths and differences (Creswell and Clark, 2017). The synergistic combination of different aspects of quantitative and qualitative research includes the different perspectives, intents, research questions, data sources, analytic techniques and interpretations associated with these two approaches.

Mixed-methods research can follow either a sequential or simultaneous approach to combining qualitative and quantitative methods of data collection and/or data analysis techniques. In a sequential approach the order in which the methodologies are employed depends on the object of study and the research question. Examples where qualitative research could precede quantitative research include studies where the subject matter is new or complex and qualitative methods can help define terminology or concepts. Qualitative research could be used to generate hypotheses which can subsequently be subject to statistical testing (Figure 3). On the other hand, qualitative research can be used to follow-up quantitative research where the findings need further explanation. This can be particularly useful where subgroups are too small for detailed statistical analysis. The simultaneous use of qualitative and quantitative methods can be useful when there is a need to examine both the number and nature of the same phenomenon or where different types of information are needed about a particular phenomenon.



Figure 3: Sequential mixed-methods process.

Mixed-methods research has been used in orthodontics to investigate a variety of areas of study including motivations for orthodontic treatment (Pabari et al., 2011; Prabakaran et al., 2012b; Davis et al., 2015), expectations of orthodontic treatment (Gassem et al., 2016; Twigge et al., 2016b), how patients find information regarding orthodontics (Stephens et al., 2013), use of inter-maxillary elastics (Veeroo et al., 2014) and orthodontic trainee experiences (Mulgrew et al., 2009).

Pabari et al. (2011) used focus groups to investigate the motivations and expectations of adults for undergoing orthodontic treatment followed by a questionnaire. It was found that a desire for well aligned teeth was a primary factor in seeking orthodontic treatment but that social pressures also played a role. The results of this study were used to develop a measure to evaluate motivational factors and psychological traits of adults presenting for orthodontic treatment.

Stephens et al. (2013) used semi-structured interviews of 15 adolescents followed by a questionnaire distributed to 50 adolescents to investigate how patients find information about orthodontic treatment and why they seek such information. They noted that that information was mainly derived from discussion with their orthodontist and from reading patient information pamphlets which were provided to them.

With regards to expectation of orthodontic treatment from the perspective of patients with hypodontia, Gassem et al. (2016) used interviews, of 25 adolescent patients and 16 parents, followed by a questionnaire given to 32 patients to develop a patient-based measure for the care pathway. Three main themes were revealed relating to treatment outcome: ‘changes in appearance’, ‘psychosocial changes’ and ‘functional changes’.

CHAPTER THREE

AIMS AND NULL HYPOTHESIS

3 Aims and Null Hypothesis

The aims of the study were:

1. To investigate expected benefits of orthodontic treatment from both an adolescent and parent perspective.
2. To rank the expected benefits of orthodontic treatment identified by adolescents and parents in order of perceived importance.

The following null hypothesis was tested:

1. There is no difference in the level of importance attached to the expected benefits of orthodontic treatment by adolescents and their parents.

CHAPTER FOUR

MATERIALS AND METHODS

4 Materials and Methods

4.1 Ethical approval

Approval was granted for both parts of the study by the Clinical Research Ethics Committee of the Cork Teaching Hospitals (Reference number: ECM 4 (z) 10/09/19 & ECM 3 (u) 22/10/19). (Appendix 1)

4.2 Part 1: Qualitative

4.2.1 Formal qualitative training

The lead investigator undertook a three-day formal training course in qualitative research methodologies, provided by the Social Research Association (SRA) London in June 2019. The SRA is a membership organization for social researchers in the U.K. and Ireland who provide training and produce guidance to aid social researchers to conduct their work to high ethical and methodological standards. The courses attended included didactic lectures, small group practical exercises and practice interviews and covered all aspects of qualitative research including study design, methodology, data collection, analysis, interpretation and presentation of results.

4.2.2 Interview topic guides

To provide a logical structure for the interview the topic guide was divided into four stages (Table 8).

Table 8: Stages of interview discussion

Stage	
1	• Introduction • Context setting
2	• Opening questions • Background information
3	• Core of interview discussion • Moving from general to specific coverage
4	• Winding down • Summarising discussion

Topic guides for both adolescents and parents were drawn up initially and discussed by the researchers (postgraduate student and supervisor) to alter and refine the content and structure. Following this they were reviewed by another qualitative researcher. Both topic guides explored the same areas but the adolescent guide was written in language suitable for a 12-year-old reading age, and checked using a readability index (Gunning Fog Index, 1952). Flexibility was allowed for modification of the topic guide following interviews if necessary following interviews if new relevant themes emerged.

4.2.3 Practice interviews

In advance of beginning interviews for the main study, two sets of practice interviews were conducted with volunteers. The first set was with two members of staff from CUDSH, and their children, with the aim of building familiarity with the topic guides and getting feedback on the process. The second set of practice interviews was with two researchers from a private research company based in Dublin (QDA Training)

who specialise in qualitative methods. This was to allow a detailed appraisal of interview technique and the topic guide format. All practice interviews were recorded and transcribed verbatim. These practice interviews also had value in allowing the lead researcher to consolidate the skills learned from the formal training courses undertaken previously. The topic guides and participant interview "journey" were modified and refined accordingly following feedback from the practice interviews.

4.2.4 Inclusion and exclusion criteria

Selection criteria for the adolescent study participants are given in Table 9. A parent of each adolescent also took part.

Table 9: Inclusion & exclusion criteria for adolescents for Part 1 interviews

Inclusion Criteria	Exclusion Criteria
• Age 12-18 years • Have been referred for orthodontic consultation at CUDSH • No previous orthodontic assessment • Fluent in English language	• Less than 12 years of age • History of orthodontic treatment • Craniofacial anomalies • Not fluent in English language

4.2.5 Participants

The referral waiting list for orthodontic assessment at CUDSH was screened and adolescents who met the inclusion criteria (Table 9) were purposively selected with the aid of a sampling matrix, based on gender and malocclusion..

Referring dentists are trained in the range of malocclusions that are accepted for state-funded orthodontic treatment, based on the Index of Orthodontic Treatment Need (IOTN), and when it is appropriate to refer a patient for orthodontic consultation based on eligibility criteria adopted by the Health Service Executive (HSE) (Table 10). This

means that patients who have been referred, but not yet seen by an orthodontist, could be expected to fall into a high treatment need category.

Upon being selected the participants' parent was contacted by telephone to provide information regarding the nature of the study and asked regarding their willingness to participate. It was made clear to all participants that taking part in the study had no bearing on their eligibility for state-funded orthodontic treatment or their position on any waiting lists associated with treatment. Those aspects would be evaluated separately by an orthodontist. Written informed consent was obtained from all participants in advance of being interviewed. The interviews were undertaken on the day of the initial orthodontic assessment, prior to their appointment, to minimise disruption to the participants' personal schedule for school or work. Recruitment continued until data saturation was achieved, the point at which no new themes emerged during the interviews.

Table 10: HSE orthodontic eligibility guidelines

Grade 5	Treatment Required
5.a	Increased overjet > 9 mm
5.h	Extensive hypodontia (2 or more teeth missing in any quadrant excluding third molars) requiring pre-restorative orthodontics. Amelogenesis imperfecta and other dental anomalies which require pre-prosthetic orthodontic care. Incisors lost due to trauma assessed on a case by case basis
5.i	Impeded eruption of teeth (apart from 3rd molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth, and any pathological cause
5.m	Reverse overjet > 3.5 mm with reported masticatory and speech difficulties
5.p	Defects of cleft lip and palate
5.s	Submerged deciduous teeth – arrange removal of teeth but orthodontic treatment not necessarily provided
Grade 4	**Treatment Required**
4.b	Reverse overjet > 3.5 mm with no masticatory or speech difficulties
4.c	Anterior or posterior crossbites with > 2 mm discrepancy between the retruded contact position and intercuspal position
4.d	Severe displacements of anterior teeth > 4 mm but only with Aesthetic Component of 8 to 10
4.e	Extreme lateral or anterior open bites > 4 mm
4.f	Increased and complete overbite with gingival or palatal trauma
4.l	Posterior lingual crossbite with no functional occlusal contact in an entire buccal segment
4.m	Reverse overjet > 1 mm but < 3.5 mm with recorded masticatory and speech difficulties

4.2.6 Participant interviews and consent

One-to-one semi-structured interviews were conducted by one interviewer (J.S.) in an office away from the clinical environment. The interview room was quiet and maintained at a comfortable temperature throughout. A chaperone was present at all times during the interviews but did not participate actively. Written informed consent was obtained from all participants in advance of the interviews, where they were given information about the project, any questions they had were answered and they were again informed that participation in the interviews had no impact on their eligibility for state funded orthodontic treatment. It was also made clear to the participants that the interviews were voluntary and that they could choose not to answer any questions if they so wished and that they could withdraw from the study at any time without consequence.

Individual interviews were conducted for the parent and adolescent separately with no time constraints set. Two separate digital Dictaphones (ICD-PX370, SONY Corp.) were used to record the interviews (one acting as a backup). Following the interviews, each participant was taken to their scheduled orthodontic assessment appointment. The audio recordings were transcribed into a Word document by a transcriptionist at QDA training. All audio files and transcriptions were uploaded and transferred using a secure file sharing method which could only be accessed by the qualitative researcher at QDA training or by the lead researcher. All audio files were permanently deleted from the digital Dictaphones.

Each participant was assigned an anonymous research code and data were stored on a software encrypted, password protected computer using this anonymous code.

4.2.7 Researcher and reflexivity

The interviewer was introduced to participants as a “research student” and no reference was made to a clinical role. Doing so aimed to achieve empathetic neutrality and avoid obvious or conscious bias in the collection of data. This is in line with standards for the conduct and reporting of qualitative research (O’Brien et al, 2014).

4.2.8 Analysis of data

The data analysis methodology for this study was based on phenomenology, a disciplinary field of Philosophy, using IPA (Smith and Shinebourne, 2012), which was applied through eight discrete cycles of analysis. This included three cycles of coding, two cycles of managing codes, one for initial categorisation of open codes, one for data reduction through consolidation of codes into subordinate themes and one using writing as a tool to prompt deeper thinking of the data (Bazeley, 2009). These cycles (Table 11) then led to conclusions being drawn.

Table 11: Eight cycles of qualitative data analysis

Cycle	Action
1	Reading
2	Initial noting
3	Initial coding
4	Developing subordinate themes
5	Developing superordinate themes (data reduction and consolidation)
6	Analysis and write up
7	Validation
8	Synthesis of analytical memos

4.2.9 Reporting of findings

The findings of Part 1 will be reported in line with internationally accepted standards for the reporting of qualitative research (O'Brien et al, 2014).

4.3 Part 2: Quantitative

4.3.1 Ranking exercise statement generation

Analysis of Part 1 data identified 11 expected benefits of orthodontic treatment. These were written as short statements on cards which could then be placed in rank order of importance by participants of Part 2. The statements were checked for clarity of language using a readability index (Gunning Fog Index, 1952) to ensure they could be understood by a 12-year-old. The statements and the domain to which they belong are shown in

Table 12.

Table 12: Ranking exercise benefit statements

Benefit Domain	Statements
Dental Health	My teeth will look better
	It will be easier to keep my teeth and gums healthy
	My jaw will be better aligned And I will not grind my teeth when sleeping
	It will help my teeth to develop (grow) better
Psychosocial Health	I will have more self-confidence
	Other people will think my teeth look better
Functional (Behavioural)	It will be easier to chew food
	I will be able to speak more clearly
Behavioural	I will look after my teeth better For example: brushing my teeth
	I will eat and drink healthier things
	I will stop bad habits For example: biting my fingernails

4.3.2 Pilot ranking exercise

A pilot study of the ranking exercise was conducted to test the method and gain feedback from participants on the process. Eight volunteers were included in this stage, four adolescents and their parents who met the inclusion criteria (Table 13). Participants were met before their scheduled orthodontic appointment and consented to participate. The parent and adolescent were taken separately to a non-clinical environment for the exercise and each was asked to place the eleven statements regarding benefits in order of importance on a ranking grid from "Most Important" to "Least Important". For the parents, they were asked to consider the benefit for their child, not what they themselves would expect if they were to have orthodontic treatment. The cards were arranged on a desk in no particular order initially. The participants were timed during the exercise, taking on average two minutes (ranging from one minute to three minutes). Comments received regarding the process were positive and no participants had any difficulty understanding and completing this exercise; thus no changes in protocol were implemented for the main study.

4.3.3 Sample size calculation

A statistician provided a sample size calculation based on the numbers of Part 1 participants who mentioned each benefit. A sample of 12 participants was needed to show the rank order of importance of the benefits with a precision of 1.00 (i.e. to show any stated benefit to within one rank position of its true position).

4.3.4 Participants

Participants were recruited from the same referral waiting list for orthodontic assessment at CUDSH and a convenience sample of adolescents was selected who met the inclusion criteria as laid out for Part 1. One parent attending with each adolescent for their orthodontic assessment was recruited.

4.3.5 Inclusion and exclusion criteria

Selection criteria for the adolescent study participants are given in Table 13. A parent of each adolescent also took part.

Table 13: Inclusion & exclusion criteria for Part 2 ranking exercise

Inclusion Criteria	Exclusion Criteria
• Age 12-18 years • Have been referred for orthodontic consultation at CUDSH • No previous orthodontic assessment • Fluent in English language	• Less than 12 years of age • History of orthodontic treatment • Craniofacial anomalies • Not fluent in English language

4.3.6 Ranking exercise

Following the pilot study for Part 2, 12 adolescents and their parents were recruited for the ranking exercise. They were consented prior to their orthodontic appointment and were taken separately to a non-clinical environment to conduct the exercise in an identical manner to the pilot study.

4.3.7 Analysis of data

The mean rank for each benefit was calculated and the overall rank order for adolescents and parents could then be determined. A two-sample t-test, with the level of significance set at $P < 0.05$, was used to determine if a difference existed between the adolescent and parent mean ranks for any of the expected benefits.

CHAPTER FIVE

RESULTS

5 Results

5.1 Part 1: Qualitative

5.1.1 Participants

Data were collected in spring and autumn of 2020, interrupted by COVID-19 restrictions. There were 40 interviews conducted in total comprising 20 adolescents and 20 parents. Selection of participants was conducted purposively based on their referred malocclusion (Table 14). Transcription of interview audio recordings was conducted immediately following the interviews and IPA undertaken. Recruitment continued until data saturation had been achieved (the point at which no new themes were revealed following analysis of the interview transcripts).

There was a 1:1 gender balance for adolescent participants and a 3:2 ratio of female to male parents at the study population level as more mothers attended clinic appointments with their child than was the case for fathers. All participating adolescents were aged between 12 and 16 years of age.

Table 14: Purposive sampling matrix

Sample Matrix		***Adolescent Number***	***Parent Number***
Gender	Male	10	8
	Female	10	12
Age (Years)	12	5	
	13	8	
	14	4	
	15	1	
	16	2	
Malocclusion	Class I	11	
	Class II division 1	5	
	Class II division 2	2	
	Class III	2	
	Ectopic canine	3	
	Hypodontia	2	
	Anterior open bite	1	
	Anterior cross bite	2	
	Posterior cross bite	3	
Participants		20	20

5.1.2 Expected benefits of orthodontic treatment

Analysis of the interviews identified expected benefits falling under four categories:

1. Oral health
2. Psychosocial
3. Functional
4. Behavioural change

5.1.3 Results reporting mechanism

For each of the categories the results will be presented in the following sequence;

- Table of findings followed by selected excerpts from the transcripts regarding the most salient aspects denoted by participant code (e.g. Pxxa indicates an adolescent and Pxxp indicates a parent).
- Table showing the impact of gender followed by relevant excerpt examples.
- Table showing the impact of malocclusion (where relevant).
- Table showing the impact of age (where relevant).
- Dendrogram illustrating the overlap and clustering between codes.

An example Table and description of how it is structured is given below.

Table 15: Example of reporting mechanism

Category Name	Comments Coded	Female Parents	Male Parents	Proportional Representation	Female Adolescents	Male Adolescents	Proportional Representation
Code	77	25	34		8	10	
Code	45	18	4		16	7	
Totals	122	43	38		24	17	

Column 1 – code names listed in a group of codes known as a category or subordinate theme.

Column 2 – number of comments coded against each code.

Columns 3 & 4 – male and female representation for parents.

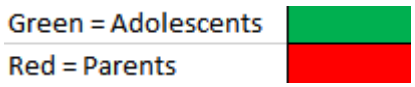
Column 5 – proportional representation of males and females in the code adjusted for study population. Female led codes are indicated by a pink marker and male led codes are marked in blue.

Columns 6 & 7 – show the number of comments coded against each code for adolescents.

Column 8 – shows proportional representation of adolescent males and females in the code. The length of the marker relative to the cell indicates the degree of emphasis placed by either group.

The proportional representation column adjusts for the study population ratio of 3:2 males to female respondents in the case of parents and equal representation of adolescents. Row 1 shows the 77 comments recorded at the code, 25 came from females and 34 from males and is flagged in the proportional representation column in blue to show that males placed a greater emphasis on the code even when adjusted for the 3:2 ratio in the study. Row 2 has 44 comments, 18 from females and four from males and notwithstanding there being a greater proportion of females in the study, is flagged in pink in the proportional representation column to show females were proportionally overrepresented in the code. Row 3 (Totals) shows that males were proportionately overrepresented in the overall category of codes amongst parents, but female adolescents were more dominant amongst their cohort.

A similar visual representation is used when comparing parents and adolescents coding with green indicating proportional overrepresentation or emphasis by adolescents and red indicating greater emphasis from parents:



It is noteworthy that the matrices used when reporting on numbers of comments coded may show the sum of the parts to be a greater number than the whole. This is because a comment, or part thereof, may be coded to more than one code. For example, the comment below in Figure 4 was coded to five codes meaning that if one added up the comments in the category of codes to which these codes belong, there would be more comments than the total number of comments received. This, however, is common in qualitative data analysis coding and reporting because each code contains coded ‘units of meaning’ and a comment may contain several units of meaning and therefore be legitimately coded in several codes.

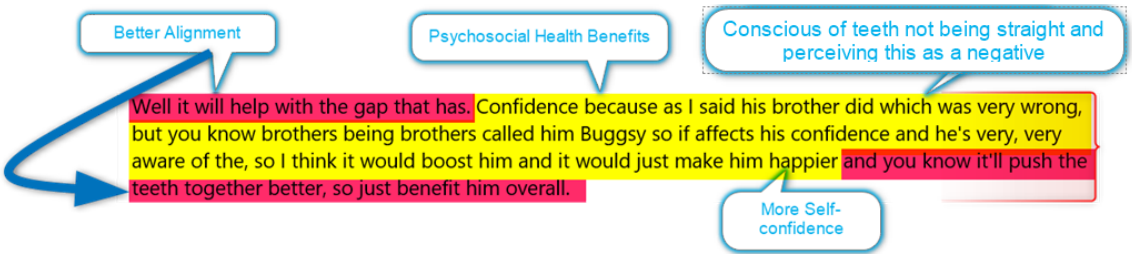


Figure 4: Example of qualitative coding process

A dendrogram is a diagrammatic tree, in this instance used to show the clustering of codes mentioned by participants. In the example (Figure 5) it can be seen that the fear of something going wrong and negative affect on jaw are linked by the same stem and also share a common stem with no perceived benefit. None of these codes, however, share a stem with braces can cause discomfort or concerns over staining of teeth, indicating that these codes were not shared by the same participants.

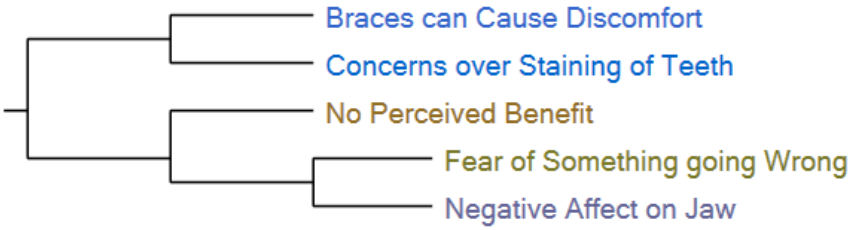


Figure 5: Example dendrogram

5.1.4 Oral Health Benefits

All 40 participants made comments in the context of benefits to oral health arising from orthodontic treatment in response to questioning from the interviewer. Table 16 shows the nature of the responses from adolescents and parents.

Table 16: Expected oral health benefits

Perceived Oral Health Benefits	Comments Coded	Adolescents	Parents	Emphasis
Teeth will Have Better Alignment	63	34	29	
Mainly Aesthetic Benefit	33	15	18	
Easier to Care for Teeth and Gums	28	11	17	
Possibility of Better Jaw Alignment	26	9	17	
Straighter Teeth Develop Better	21	8	13	
Better to Get Braces Young	17	1	16	
No Affect on Jaw	10	5	5	
Stop Grinding teeth During Sleep	8	0	8	
Stop Pain in Teeth	5	1	4	
Get Rid of Gaps in Teeth	5	1	4	
Negative Effect on Jaw	4	3	1	
Fear of Something going Wrong	2	2	0	
No Downside	1	0	1	
Totals	223	90	133	

Obtaining better alignment of the teeth was the most commonly cited benefit by participants with adolescents placing a proportionally greater emphasis on this benefit.

> *They might help straighten my teeth maybe and help my adult teeth to grow better.*

P06a

Indeed, one parent explained that it was her child that pushed her to seek orthodontic advice rather than the other way around.

> *I said they're grand and I had cancelled the original appointment and he actually got very annoyed over it because he said at the end of the day, I wasn't; I couldn't decide whether his teeth needed to be fixed alignment wise or not because they were worried about*

the alignment of them so...because there was an issue with his baby tooth coming down. So, when that came down and I said, it would it be a waste of time? What does he say? that I shouldn't have done it, that…which he was right. So, we are here now.

P01p

Thirty-three of 40 participants believed the benefits such as alignment of teeth were mainly aesthetic in nature and these comments were evenly split between parents and young people with a slight bias in favour of parents (18 of 20).

I suppose only other thing about braces really is the visual. I don't see any kind of downside. I don't know of any downside and that's... but, yeah; nothing more than that really.

P04p

My idea of the braces would be that cosmetic would be a huge improvement. Yeah.

P17p

Adolescents also articulated this view with 15 of 20 recognising the aesthetic benefit over oral health, or not equating the two as being linked. The following dialogue between the interviewer and adolescent 10a illustrates this belief.

P10(a): It would make them like in a better position.
Interviewer: In a better position. So that might be useful in any way, would it?
P10(a): Not really ..... but like looks.
Interviewer: Looks, the way things look? And do you think it might

have any effect on the gums that are around the teeth?
P10(a): No.
Interviewer: Not really. And what about the jaw joint or the jaw hinge where your mouth and jaw can move?
P10(a): No, not really.

P10a

Improved oral hygiene and dietary habits were cited by 28 of 40 participants. Seventeen parents recognised this benefit, but just above half (11) of adolescents mentioned an expectation of positive changes in this regard.

Well, I presume that he should have better, healthier ... because there'd be less chance of trapping food residually and stuff like that, and causing decay and stuff like that, definitely.

P14p

It would definitely help me get at a lot of my teeth, because it's really hard to reach some of them… they'd definitely be a lot whiter, and you'd be able to see them a lot more better than you can now.

P14a

Twenty-six participants cited improved jaw alignment and a reduction in jaw joint symptoms as an expected benefit of treatment. This view was predominantly parent-led with 17 parents and nine adolescents raising this benefit.

He actually does a little bit, his jaw pops. And I often see him, and I don't think he even notices, but I see him moving his jaw. So, I

remember back to when I was his age, there were similar things. It was very mild, didn't seem to be anything but, as I got older it started to get worse.

P05p

Well, I feel like they could straighten up and my jaw could be aligned properly.

P01a

Both parents (13) and young people (eight) believed that straightening teeth would result in better dental development as the young person gets older.

I suppose again that if she gets them earlier, her teeth, there won't be the overcrowding or any pain or uncomfortable and I don't want her self-conscious later on. So, I think hopefully it'll solve future problems.

P20p

They'd be able to grow better, instead of having, in the way of each other.

P01a

Well, they'd be growing properly and maybe wouldn't affect the other teeth.

P18a

Getting treated at a younger age was almost exclusively a parental view as 16 of 20 parents raised this point along with one adolescent.

> *Yeah, I'm quite happy for her to have braces. You can see the gap is quite noticeable and I think she's better off getting it done at an earlier age rather than later.*

P07p

The expected oral health benefits by gender are given in Table 17.

Table 17: Expected oral health benefits by gender

Perceived Oral Health Benefits	Comments Coded	Female Parents	Male Parents	Proportional Representation	Female Adolescents	Male Adolescents	Proportional Representation
Teeth will Have Better Alignment	63	13	16		16	18	
Mainly Aesthetic Benefit	33	6	12		7	8	
Easier to Care for Teeth and Gums	28	6	11		5	6	
Possibility of Better Jaw Alignment	26	6	11		5	4	
Straighter teeth Develop Better	21	4	9		5	3	
Better to Get Braces Young	17	6	10		0	1	
No Affect on Jaw	10	2	3		1	4	
Stop Grinding teeth During Sleep	8	0	8		0	0	
Stop Pain in Teeth	5	0	4		1	0	
Get Rid of Gaps in Teeth	5	1	3		1	0	
Negative Affect on Jaw	4	0	1		2	1	
Fear of Something going Wrong	2	0	0		1	1	
No Downside	1	1	0		0	0	
Totals	**223**	**45**	**88**		**44**	**46**	

Male parents were proportionately more vocal when discussing their perceptions of oral health benefits. Despite the mothers to father ratio of 3:2 in favour of mothers, there were 88 comments recorded against fathers compared to 45 from mothers. Adolescents showed an almost perfect gender balance in this topic at global level but

when broken down, girls placed greater emphasis on better jaw alignment, development of the teeth, pain reduction, getting rid of gaps and concern there may be a negative effect on their jaw. Boys emphasised the teeth being better aligned, the benefits being principally aesthetic, easier after care in terms of oral hygiene, benefits of getting braces when younger and believing there were no positive or negative implications for their jaws as a result of orthodontic treatment.

Expected oral health benefits by malocclusion are given in Table 18.

Table 18: Expected oral health benefits by malocclusion

Perceived Oral Health Benefits by Malocclusions	Class I (10)	Class II/2 (2)	Class I, Ectopic Canine (4)	Class II/1, AOB, Thumb sucking (2)	Class III (2)	Class I, Hypodontia L5's (2)	Class II/1 (4)	Class I, Anterior X-bite, Posterior X-bite (2)	Class III, Posterior X-bite (4)	Class I, Anterior X-bite (2)	Class I, Hypodontia L5 (2)	Class II/1, Posterior X-bite (2)	Class II/1, Ectopic canine (2)	Totals
Teeth will Have Better Alignment	5	1	2	0	1	1	2	1	2	1	1	1	1	19
Mainly Aesthetic Benefit	4	0	0	1	0	0	1	0	1	1	0	1	0	9
Easier to Care for Teeth and Gums	1	0	1	0	1	0	1	0	2	0	0	0	1	7
Possibility of Better Jaw Alignment	4	0	1	0	0	0	1	0	1	0	0	0	0	7
Straighter teeth Develop Better	3	0	1	0	0	0	0	0	1	0	0	0	1	6
Better to Get Braces Young	1	0	0	0	0	0	0	0	0	0	0	0	0	1
No Affect on Jaw	2	1	0	0	0	0	1	0	1	0	0	0	0	5
Stop Grinding teeth During Sleep	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stop Pain in Teeth	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Get Rid of Gaps in Teeth	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Negative Affect on Jaw	0	0	0	0	0	1	0	0	0	0	0	1	1	3
Fear of Something going Wrong	1	0	0	0	0	0	0	0	0	0	0	1	0	2
No Downside	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	5	1	2	1	1	1	2	1	2	1	1	1	1	20

Teeth alignment was most represented oral health benefit amongst young people across the full range of malocclusions of which Class I being the single most represented individual malocclusion.

Figure 6 shows overlap in discourse coded to the topic of oral health benefits. Linked items in the dendrogram indicate overlap. For example, people who expressed a fear of something going wrong, also discussed negative effects on the jaw.

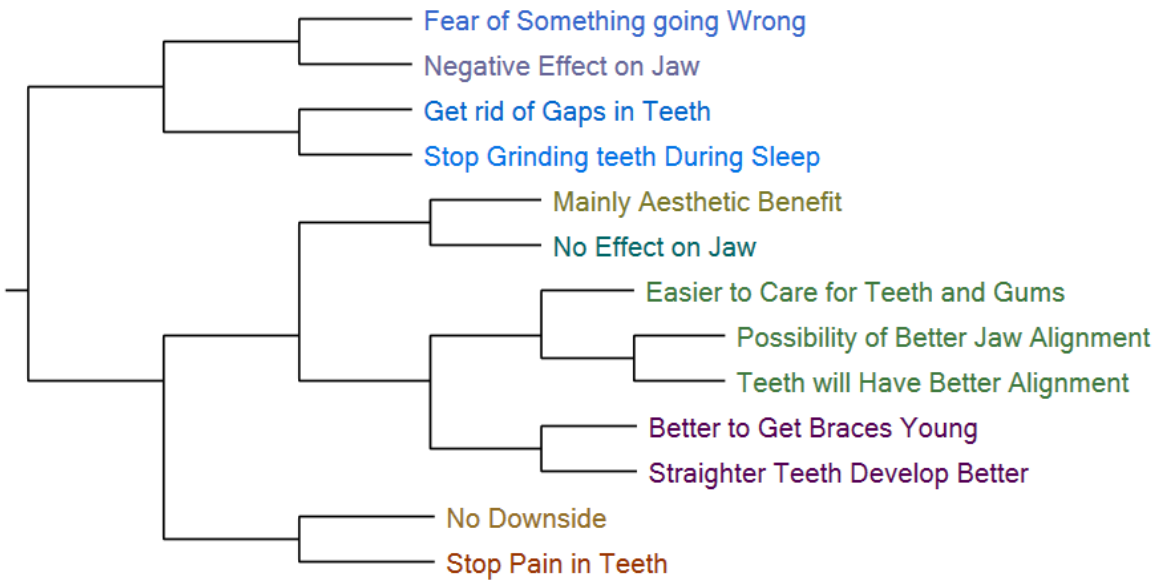


Figure 6: Overlap in oral health benefits discourse

A small number of participants (12 of 40) included anxieties when responding to probes concerning oral health benefits. There were 16 comments coded from the 12 contributing participants. Table 19 shows the coding distribution for this category.

Table 19: Oral health anxieties

Oral Health Anxieties	Comments Coded	Adolescents	Parents	Emphasis
Braces can Cause Discomfort	5	2	3	
Concerns over Staining of Teeth	4	0	4	
Negative Affect on Jaw	4	3	1	
Fear of Something going Wrong	2	2	0	
No Perceived Benefit	1	1	0	
Totals	**16**	**8**	**8**	

Discomfort from braces was of concern for three parents and two adolescents.

> *I think, I know she'll have discomfort. I don't know whether she realises that yet, but I think because the process I know is done over such a long time, it's not going to cause anything major and it gets checked up on anyway.*

P07p

This fear of discomfort was mitigated by the length of time over which the treatment is administered in many comments.

> *I suppose it would, a little, wouldn't there be a bit of soreness if things are moved? But it's such a slow progression thing that maybe it wouldn't make such a difference.*

P18p

> *Well, maybe they might be sore for a bit.*

P06a

Parents were uniquely concerned about staining of teeth.

> *After, whenever they come off. Okay. So, you'd be thinking about staining that might be caused by the brace after they come off.*

P10p

Conversely, braces having a negative effect on the jaw was almost exclusively an adolescent led anxiety as demonstrated in the following dialogue with P17a.

Interviewer: And do you think that that'd be in a good way or a bad way?

P17(a): Bad way.

Interviewer: In a bad way. And so, what sort of effects do you think that might have for you?

P17(a): They make it [jaw]... It's stiffer.

Interviewer: Maybe a bit stiffer. And do you think that would stay after the braces come off or would it just be...

P17(a): After a while it would probably get better.

Interviewer: Do you think it would come back to normal eventually afterwards?

P17(a): Yeah, eventually.

P17a

Other anxieties included general fears about something going wrong from two adolescents and another adolescent who saw no benefits in getting orthodontic treatment. The gender balance in oral health anxieties by gender are given in Table 20.

Table 20: Oral health anxieties by gender

Oral Health Anxieties	Comments Coded	Female Parents	Male Parents	Proportional Representation	Female Adolescents	Male Adolescents	Proportional Representation
Negative Affect on Jaw	4	1	0		2	1	
Concerns over Staining of Teeth	4	3	1		0	0	
No Perceived Benefit	1	0	0		0	1	
Braces can Cause Discomfort	5	3	0		1	1	
Fear of Something going Wrong	2	0	0		1	1	
Totals	**16**	**7**	**1**		**4**	**4**	

All documented anxieties were female-led except for one comment from an adolescent male who perceived there to be no dental health benefits arising from his treatment. Parents demonstrated similar levels of anxiety to their adolescent children. Those who spoke of fear of something going wrong also worried about treatment having a

negative effect on their jaw and participants who feared discomfort also feared staining of teeth after braces come off (Figure 7).

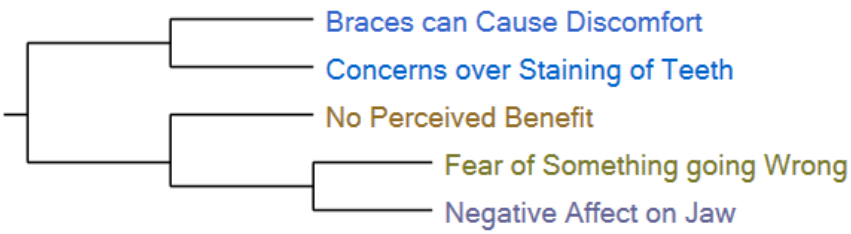


Figure 7: Overlap in codes of oral health anxieties

5.1.5 Psycho-social Benefits

Participants were probed to reveal their perceptions of psycho-social benefits. These were open probes where no benefits were put to participants as they were merely asked to list any benefits they perceived may accrue from treatment. These benefits are now reported under two headings:

- Self-confidence
- Perception of others

5.1.5.1 Self-confidence

Thirty-seven of forty participants made contributions in this context in the form of 101 comments Table 21.

Table 21: Comments in relation to self-confidence

Self Confidence	Comments Coded	Adolescents	Parents	Emphasis
Conscious of Teeth not being Straight and perceiving it as a Negative	36	21	15	
Currently not Self-Conscious	25	19	6	
Straight Teeth Look Better	15	9	6	
Mocked Over Teeth	14	3	11	
A lot of Peers getting Braces Treatment	6	1	5	
Perceiving Braces as Unattractive	5	4	1	
Totals	**101**	**57**	**44**	

Self-consciousness about teeth not being straight was most cited by both parents and adolescents in response to probes. Adolescents were proportionately more vocal on this issue.

> *Well, my front two are very... they stick out a lot. I'm a little bit embarrassed about it, even though I know not many people actually care about it. I'm always really scared about it.*

P14a

Yeah, I suppose the moment I would find myself a bit insecure about my teeth.

P13a

In today's world it's a very superficial world so it is, and now it's the first thing you see in a person being truthful about it, your teeth is the first thing you do see, so he's uncomfortable and he's a bit embarrassed about his teeth at the moment

P08p

I do see myself, even when he's out he's inclined to cover his smile, but yes, he mightn't think he does, but it's different when you're looking right?

P11p

There was a cohort of nine of 20 adolescents and five of 20 parents who said they or their child were not self-conscious about the appearance of their teeth. In some instances, this was because the reason for referral for orthodontic treatment was not obvious or effecting the child's appearance.

I suppose she's never complained about her teeth. Even the dentist who referred her said that it was very well camouflaged, the way her mouth was. So, it wasn't something that ever bothered her, and I would have to say it was something I hadn't noticed either.

P17p

In other cases, it was simply that the young person was not feeling self-conscious in any way as evidenced in the conversion below with P02a.

Interviewer: 01:13 And how do you feel about your teeth?

P002(a) 01:16 Grand.

Interviewer: 01:17 And is there anything that you don't like about them?

P002(a) 01:21 No.

Interviewer: 01:22 Maybe you never think much about your teeth at all?

P002(a) 01:23 No

P02a

It is noteworthy that the age of adolescents that were not self-conscious were at the lower end of the age range. Of the nine adolescents and five parents who made this contribution, the adolescents involved ranged from five 12-year-olds, five 13-year-olds, two 14-year-olds and one 16-year-old.

Positive, yeah. In the positive way yeah, definitely. Now everybody, all the girls want to look at me on Tik-Tok and all that.

P16a

Suppose you have more self confidence in yourself that you look better now.

P01a

Conversely, being mocked proved to be a motivator to complete treatment that participants believed would be addressed as a beneficial outcome of treatment.

I hope it would do good for her confidence, because [P19(a)] won't smile or anything. Because obviously older girls and whatever would slag her and call her a vampire, these two teeth that were sticking down here. It's cruel.

P19p

It'll be a confidence boost, because if your conscious of something you're going to put your hand over your mouth, like I said, his brother [name], my son is not nice but boys being boys and as I said, to pick a weakness and there'll be none of that and it'll just boost his self-esteem.

P02p

Comments in relation to self-confidence by gender are given in Table 22.

Table 22: Comments in relation to self-confidence by gender

Behavioural Changes in Dental Care	Comments Coded	Female Parents	Male Parents	Proportional Representation	Female Adolescents	Male Adolescents	Proportional Representation
Conscious of teeth not being straight and perceiving it as a negative	36	10	5		11	10	
Currently not self-conscious	25	6	0		4	15	
Straight teeth look better	15	2	4		4	5	
Mocked over teeth	14	8	3		1	2	
A lot of peers getting brace treatment	6	4	1		1	0	
Perceiving braces as unattractive	5	1	0		1	3	
Totals	101	31	13		22	35	

Female parents dominated the discourse on self-confidence while male adolescents were more vocal proportionately on this topic. Data were skewed in favour of male contributions mainly because of their disproportionate representation in one code: 'Currently not self-conscious'. Fifteen comments in this code were recorded from adolescent males who at least claimed not to be self-conscious against just four from adolescent females. Mothers dominated all areas of discussion in this domain.

For adolescents, most discussions concerning self-confidence took place amongst the younger cohorts of 12 to 14 years of age (Table 23), with the overlap across self-confidence codes shown in Figure 8:

Table 23: Comments in relation to self-confidence by age of adolescent

Self Confidence Codes by Age by Adolescent	12	13	14	15	16
Conscious of Teeth not being Straight and perceiving it as a Negative	1	5	3	1	1
Currently not Self-Conscious	3	4	1	0	1
Straight Teeth Look Better	0	4	2	0	1
Mocked Over Teeth	1	0	2	0	0
A lot of Peers getting Braces Treatment	1	0	0	0	0
Perceiving Braces as Unattractive	1	1	1	0	0
Totals (Unique Cases)	5	8	4	1	2

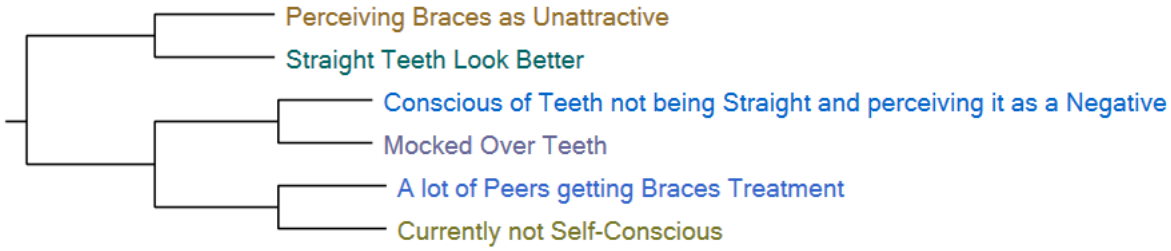


Figure 8: Overlap in self-conscious codes

Figure 8 demonstrates that there was overlap in comments regarding peers receiving brace treatment and not being self-conscious. On the other hand, those who were conscious of their teeth not being straight reported being mocked about their teeth.

5.1.5.2 Perception of others

Participants were probed as to their beliefs regarding the perceptions of others concerning their treatment. Thirty-three of 40 participants offered opinions in this context comprising 43 comments. Table 24 below the nature of responses:

Table 24: Comments in relation to perceptions of others

Perceptions of Others	Comments Coded	Adolescents	Parents	Emphasis
No Effect on what Others Think	22	16	6	
Some People Notice Teeth	12	3	9	
More Popular	6	3	3	
Well Kempt	3	1	2	
Totals	**43**	**23**	**20**	

The dominant view was that participants did not think that wearing braces would impact on what others would think of them. This discussion was adolescent led as 16 of 20 young people offered this opinion against just six parents.

> *I wouldn't really think so as long as they're cleaner. You brush them or whatever like...*

P05a

> *I don't know, but I think my appearance would kind of look better.*

P20a

> *It shouldn't make them think... She'll still be the same person she is. It's not what other people think of*

P19p

Parents were more animated amongst those that thought other people really notice teeth as nine parents made such comments against just three adolescents.

It's the first thing you see with a person, is their smile when they are talking, and I think the teeth are hugely important.

P03p

Six of 40 participants expressed the view that straighter teeth would make them or their child more popular amongst their per group (three parents and three adolescents).

Yes, because if you have straight teeth you could have maybe a nicer smile and they think you're a very nice person.

P06a

Well, yeah, I suppose in the Instagram world. If that's the kind of world he's growing up in, yeah.

P14p

Table 25 shows the 'perceptions of others' codes by gender.

Table 25: Comments in relation to perceptions of others by gender

Perceptions of Others	Comments Coded	Female Parents	Male Parents	Proportional Representation	Female Adolescents	Male Adolescents	Proportional Representation
No Effect on what Others Think	22	4	2		9	7	
Some People Notice Teeth	12	4	5		1	2	
More Popular	6	1	2		1	2	
Well Kempt	3	1	1		0	1	
Totals	43	10	10		11	12	

Comments (22) pertaining to those who did not think wearing braces would impact on what others thought were primarily female-led, particularly in the case of adolescents. All other codes in this category of codes were marginally male-led. Table 26 shows that discourse on the perception of others was not unduly influenced by age as comments coded in this category spanned all adolescents' ages and were broadly in line with the study population.

Table 26: Comments in relation to perceptions of others by age

Perceptions of Others Codes by Age by Adolescent	12	13	14	15	16
No Effect on what Others Think	2	6	2	1	2
Some People Notice Teeth	1	2	0	0	0
More Popular	1	0	2	0	0
Well Kempt	0	0	1	0	0
Totals	5	8	4	1	2

There was no significant overlap between codes in the perception of others category of codes.

5.1.6 Functional Benefits

Functional benefits are reported across two domains:

1. Impacts on Chewing
2. Impacts on Speech

5.1.6.1 Impacts on chewing

Participants were probed to describe the impacts, if any, that having braces would have on their ability to chew food. Thirty-nine of 40 participants made contributions in this category amounting to 50 comments. Table 27 below shows the nature of these comments:

Table 27: Expected impacts on chewing food

Impacts on Chewing Food	Comments Coded	Adolescents	Parents	Emphasis
No Change in Chewing	18	11	7	
Improve Chewing	16	2	14	
Certain Foods could Damage Retainer or Brace	5	1	4	
Would get used to any Change in Chewing	5	4	1	
Unaware of any Potential for Change	5	3	2	
Make Chewing more Difficult	1	1	0	
Totals	50	22	28	

It is apparent that, while stated impacts of chewing food were marginally skewed in favour of parents, there were divisions at the level of individual codes. Opinions were evenly divided between those that perceived there would be no change in chewing (18 comments) after braces were fitted and those that believed braces would lead to improved chewing (16 comments). More adolescents believed there would be no impact on chewing (11 adolescents to seven parents).

> *Well at the moment, I have no problems or issues chewing food. So, I'd imagine it to be the same.*

P13a

I think it'll be the same.

P15a

Eating... it wouldn't affect that, or it'd be the same, we'd be thinking?

P18p

When it came to those that thought braces would enhance chewing, such comments came almost exclusively from parents (14 parents to two adolescents).

I'd imagine it would if the teeth are lined up and it would improve your bite.

P03p

Well, yeah. I would imagine, if the teeth are straighter and are growing, or not growing, but if they're straighter and more, I suppose less crowded and stuff, I would imagine teeth would benefit from every kind of thing, really, especially eating, yeah I do, I do believe it.

P05p

I chew the food on the right side of my mouth. I don't know why, but I think my teeth are better aligned on the right side of my mouth.

P14a

Four parents and one adolescent believed certain foods would damage the retainer or brace.

> *I think it does. It does change. Like your mouth is for chewing stuff. Well I hope he wouldn't be eating sweets and stuff. But I think the bite, the bite does change, so it would do, yeah, but I take it you are trained as well? if you have them, you learn what you need to be careful of; yeah.*

P01p

While parents were dominant concerning food choices, adolescents were equally assertive on becoming used to such changes (four adolescents to one parent).

> *Well I suppose you could try to adapt to what it's like because you now know that they're better and that.*

P01a

There were five comments that demonstrated a lower expectation or awareness of potential for changes in chewing food.

> *I can't say, I wouldn't know. I wouldn't have a clue to be honest with you. I don't know because I don't know if she'd chews correctly now*

P06p

The expected ‘impacts on chewing’ by gender are shown in Table 28.

Table 28: Expected impacts on chewing food by gender

Impacts on Chewing Food	Comments Coded	Female Parents	Male Parents	Proportional Representation	Female Adolescents	Male Adolescents	Proportional Representation
No Change in Chewing	18	4	3		6	5	
Improve Chewing	16	9	5		0	2	
Certain Foods could Damage Retainer or Brace	5	4	0		0	1	
Would get used to any Change in Chewing	5	0	1		1	3	
Unaware of any Potential for Change	5	1	1		2	1	
Make Chewing more Difficult	1	0	0		1	0	
Totals	50	18	10		9	12	

Discussions on how participants perceived the impact on chewing food were dominated by female parents and male adolescents. Male parents were dominant in one code: 'Getting used to Changes in Chewing' while female adolescents were marginally overrepresented amongst those that believed there would be no major change to chewing food.

There were no particular patterns in the context of age or malocclusions in this category.

Figure 9 below shows overlap between codes in this category.

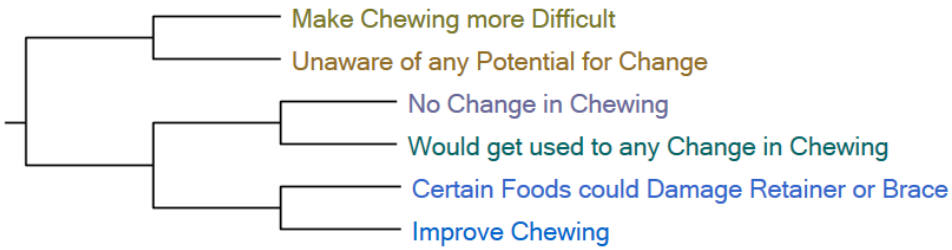


Figure 9: Overlap in impacts on chewing food

Those individuals who thought there would be no change in chewing also expressed that they thought they would get used to any changes brought about through orthodontic treatment. Individuals who were unaware of the potential for any change also tended to express a perception that chewing may become more difficult.

5.1.6.2 Impact on speech

Participants were asked if they anticipated any change in speech arising from having braces fitted. Thirty-nine of 40 participating parents and adolescents offered opinions in this regard making 42 comments (Table 29).

Table 29: Expected impact on speech

Impact on Speech	Comments Coded	Adolescents	Parents	Emphasis
No Change in Speech	20	10	10	
Only Temporary Change	8	5	3	
Improve Speech	8	3	5	
Small Change in Speech	6	3	3	
Totals	42	21	21	

The most held perception was that there were no implications for speech by having orthodontic treatment. Half of all participants held this view and were split evenly with ten adolescents and ten parents asserting this perception.

> *I wouldn't think so. No, Speech isn't an issue.*

P02p

> *It shouldn't. From my experience of seeing people with braces it doesn't make any difference*

P04p

> *It [speech] would stay the same.*

P12a

A further eight participants (five adolescents and three parents) thought there would be an effect on speech but only temporarily.

Yeah, probably because my Dad at the start, he wasn't able to talk properly.

P05a

Well, I know when they have the braces on, obviously it changes a little bit for a while, but I haven't noticed any problem with her speech at the moment. But, possibly, when they do come off, then I suppose is when you'd really notice it if there was a difference between the two.

P15p

Five parents and three adolescents thought braces would improve speech.

Maybe it would. Maybe it would improve his speech.

P03p

I suppose, because at the moment, my teeth the way they are aligned now, it's a small group, like an overbite that I have. So, I would imagine that I'd be able to speak a bit clearer or better.

P13a

Three parents and three adolescents thought any changes would be small.

Yes, maybe if when you had the braces, if you spoke a small bit differently than when the braces are off, you probably stay

speaking the same way that you were speaking when you had braces.

P06a

I don't know…because he kind of has a kind of very, very, very slight lisp. But I don't know... Not even a lisp, but you know, you can kind of hear it. It's his teeth. It does have an effect on his voice. Whether it would change or not, I don't know.

P10p

The impact on speech codes by gender for parents and adolescents is shown in Table 30.

Table 30: Expected impact on speech by gender

Impact on Speech	Comments Coded	Female Parents	Male Parents	Proportional Representation	Female Adolescents	Male Adolescents	Proportional Representation
No Change in Speech	20	6	4		3	7	
Only Temporary Change	8	3	0		2	3	
Improve Speech	8	2	3		2	1	
Small Change in Speech	6	2	1		3	0	
Totals	42	13	8		10	11	

An equal number of male and female parents perceived there would be no change in speech during or after treatment. Male adolescents, however, were overrepresented amongst their peers in this belief. Female parents were dominant amongst those that thought changes would be temporary with males having a stronger conviction that speech would improve. Improvements to speech and small changes in speech were female-led perceptions amongst adolescents. Figure 10 shows overlap for codes in this category.

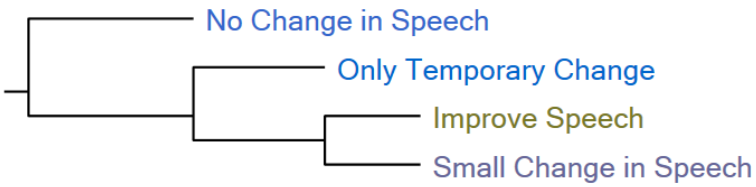


Figure 10: Overlap in codes in impact on speech

Participants who felt there would be an improvement in speech also noted that any change that occurred was likely to be small. Other views expressed by different individuals were that there would be no change in speech or that any change would be temporary in nature.

5.1.7 Behavioural Change Benefits

Participants were encouraged to discuss their perceptions of their own, or their child's likely beneficial behavioural changes following orthodontic treatment. Such perceptions are reported under four categories:

1. Behavioural changes in public or private settings
2. Behavioural changes in dental care
3. Behavioural changes concerning dietary intake
4. Behavioural changes concerning bad habits

5.1.7.1 Behavioural Changes in Public or Private Settings

Thirty-nine participating parents and children made multiple contributions to this topic totalling 150 comments (Table 31).

Table 31: Comments related to behavioural changes in public or private settings

Behavioural Changes in Public or Private Settings	Comments Coded	Adolescents	Parents	Emphasis
More Self Confidence	77	18	59	
More Comfortable Smiling	42	22	20	
No Change in Public or Private Behaviour	31	17	14	
Totals	150	57	93	

There were 77 comments, of which 59 came from parents, who believed that whereas being self-confident in and of itself is not a behavioural change, it is indeed the antecedent for multiple behavioural changes they believed would follow orthodontic treatment.

> *I'd say he'd smile at himself more in the mirror, I'd say he'd be a week staring at himself in the mirror, and he might look after his teeth better, because he is little rogue, so he might be better with the teeth, and he might just be more confident in himself.*

P02p

I don't know, like I said, I would like to think that he'd become a bit more confident that he would stop hiding away and different things like that... I think that and smiling more... I know teenagers aren't great for that anyway, but you can see it in him myself, I can see it in him that he does feel it because there is a couple of, they are protruding to the sides and he's always saying his teeth are very crooked... When he's conscious of it, I think that if they were rectified, he would, give him the boost.

P08p

I hope it would do good for her confidence, because [P19(a)] won't smile or anything. Because obviously older girls and whatever would slag her and call her a vampire, these two teeth that were sticking down here. It's cruel… Well, her confidence, number one. That's the main thing, because [P19(a)]'s not a confident girl anyway. She's very shy and quiet. Now, she can be loud as well, but confidence-wise, she's not. So, she's always on about her looks.

P19p

Interviewer: 02:48 What way might you feel differently?
P004(a) 02:49 More confident.

P04a

Clearly, confidence was significant to both stakeholder types, particularly from parents' perspectives; participants perceived that the enactment of greater self-confidence would manifest itself in a behavioural change concerning smiling. There were 42 comments citing smiling that were almost equally distributed between parents and children in discussions concerning behavioural changes accruing from treatment.

Yeah. Might be scared to show them and then when you get braces and I guess straighter teeth; it's just not on your mind when you're smiling or anything.

P03a

Yeah, because you could be able to... if you didn't like smiling because your teeth were unstraight, then your teeth could be more straight and you'd much prefer to smile.

P06a

Maybe he'd be...confidence l suppose. Yeah, that's most people, they would be conscious, like if they, if they're not happy with their teeth, they tend to hide them or not smile or stuff. So yeah, I know people might say it's cosmetic, but I think it's more than that sometimes.

P01p

He might start smiling for photographs anyway, which would be a start.

P11p

There were 17 comments from adolescents and 14 from parents who believed there would be no change in public or private behaviour.

I'd say I'd just be the same.

P14a

I wouldn't think so. She's very grounded. She's not a girl that would put herself up on a pedestal. So, she'd be still the same girl.

P13p

Behavioural change codes by gender are shown in Table 32.

Table 32: Comments related to behavioural changes in public or private settings by gender

Behavioural Changes in Public or Private Settings	Comments Coded	Female Parents	Male Parents	Proportional Representation	Female Adolescents	Male Adolescents	Proportional Representation
More Self Confidence	77	34	25		10	8	
More Comfortable Smiling	42	13	7		11	11	
No Change in Public or Private Behaviour	31	8	6		7	10	
Totals	150	55	38		28	29	

Male parents and female adolescents were proportionately overrepresented amongst those believing participants receiving orthodontic treatment would be more self-confident. Female parents placed proportionately greater emphasis on changes in behaviours concerning smiling, but comments were perfectly balanced amongst adolescents. Those that believed that there would be no behavioural changes in public or private social settings were marginally male-led amongst participating parents and were more male-led amongst adolescents. There were no patterns in the data when compared against age or malocclusions.

Those that believed the outcome of treatment would result in a greater willingness to smile also believed that behaviour would be derived from a growth in confidence. Those that believed there would be no consequential behavioural change were uniquely coded there and did not overlap with the other two codes in this category Figure 11.



Figure 11: Overlap in behavioural changes in public or private settings

5.1.7.2 Behavioural changes in dental care

Thirty-nine of 40 participants made contributions to this topic across 116 comments. Table 33 shows the nature of those responses:

Table 33: Expected behavioural changes regarding dental care

Behavioural Changes in Dental Care	Comments Coded	Adolescents	Parents	Emphasis
More Motivated to take care of teeth	64	23	41	
More Care given to Teeth Because of Time with Orthodontist	15	0	15	
Currently Cleans Teeth Well	14	6	8	
Currently Uses Sports Teeth Guard	10	7	3	
No Change in Oral Care	7	5	2	
More Conscious of Danger Playing Sports	4	2	2	
Influence Others to take Better Care of Teeth	1	0	1	
Relearning how to Brush Teeth after Braces	1	1	0	
Totals	116	44	72	

Sixty-four of the 116 comments related to a perception by both parties that following treatment, the adolescents concerned would be more motivated to take better care of their teeth, mouth and gums in terms of oral hygiene. Parents made almost twice as many comments in this regard than did adolescents.

> *Well if he looks after them while the braces are on, hopefully shouldn't but even at the moment you could tell [name] what...he's not great and I do go out to him with the toothbrush, typical boy, but I think he might become more conscious of his teeth if he has*

braces and look after them more so I think it could be a stepping stone to look after them, appreciate his teeth more.

P02p

I think once they get them on, they'd make more of an effort to keep them clean.

P10p

Well I presumed it would be straighter looking. So, I think that if they are, he'd be more prouder of them, and more comfortable that he'd look after them better. I think at the moment he's just in a bit of a... he's not happy with them, so he doesn't kind of bother with them, which is kind of…

P08p

Because I know what's happened now, so I'd take better care of them.

P08a

Well, I would definitely look after my teeth a lot more if I just given the opportunity that they were perfect. I would like to maintain that.

P13a

Fifteen parents but no adolescents believed that the processes of attending for treatment would, in and of itself, raise awareness of oral hygiene and change practice.

> *It's a little bit about education, isn't it? If you're constantly going somewhere and learning about things, I just think that…that would be the main influence on him*

P05p

> *They do listen. They do listen to them, they did like when he had his own appointments, he did listen to the dentist because all of a sudden there was, he was laying on the table and it was about his mouth. So, he did listen. Yeah.*

P01

Eight parents and six adolescents said their current practice for oral hygiene is up to the requisite standard.

> *I know she does look after them and that; so she'd be very particular with them. She is conscious of the way that they're starting to turn more as she's getting older. So, I suppose now it's starting with the covering her mouth kind of thing, in pictures and stuff like that. So, she's becoming more conscious of it.*

P15p

Anticipated behavioural changes in dental care were more parent than adolescent-led perceptions with 72 of the 116 comments coming from this group. Table 34 shows the gender representation in codes in this category of codes. Both female parents and female adolescents were dominant amongst the most populated code within this category; ‘More Motivated to take care of Teeth’.

Table 34: Expected behavioural changes regarding dental care by gender

Behavioural Changes in Dental Care	Comments Coded	Female Parents	Male Parents	Proportional Representation	Female Adolescents	Male Adolescents	Proportional Representation
More Motivated to take care of Teeth	64	28	13		16	7	
More Care given to Teeth Because of Time with Orthodontist	15	9	6		0	0	
Currently Cleans Teeth Well	14	6	2		2	4	
Currently Uses Sports Teeth Guard	10	1	2		2	5	
No Change in Oral Care	7	1	1		2	3	
More Conscious of Danger Playing Sports	4	0	2		0	2	
Influence Others to take Better Care of Teeth	1	0	1		0	0	
Relearning how to Brush Teeth after Braces	1	0	0		0	1	
Totals	116	45	27		22	22	

Female parents were also proportionately overrepresented amongst those that said their child already practices good oral hygiene. Males were marginally more vocal in all other codes. Globally, responses were skewed somewhat towards female parents but perfectly balanced in the case of adolescents. There were no significant patterns in the data when compared against age or malocclusions. Overlap between codes in this category of codes is shown in Figure 12.

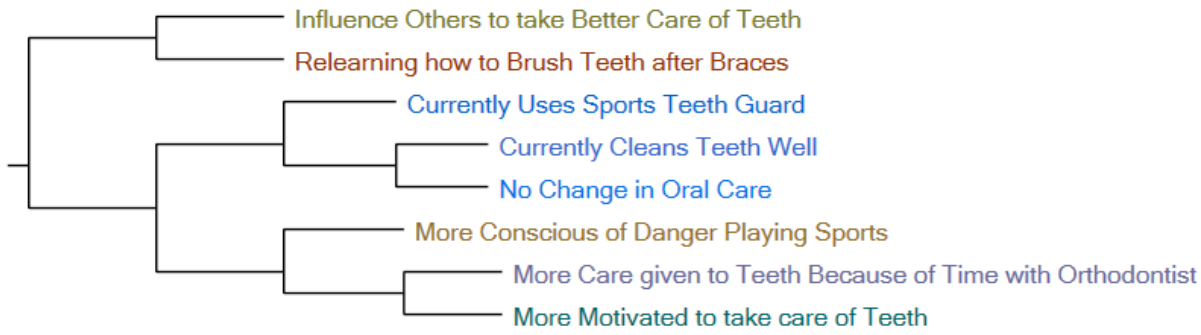


Figure 12: Overlap in behavioural changes in dental care

Participants who thought they would be more motivated to take care of the teeth expressed that this would be due to the influence of the orthodontist. Similarly, it was felt that time spent with the orthodontist would make participants more conscious of the risks, to the teeth, of playing sports.

5.1.7.3 Behavioural changes concerning dietary intake

Thirty-nine of 40 participants made contributions to this topic across 51 comments (Table 35).

Table 35: Expected behavioural changes in dietary intake

Behavioural Changes in Intake	Comments Coded	Adolescents	Parents	Emphasis
Avoid Food and Drinks that Could Damage Teeth	39	24	15	
No Change	12	6	6	
Totals	51	30	21	

The 39 comments where participants said they would avoid food or drink that could damage teeth as a post-treatment behavioural change included 24 comments from adolescents and 15 from parents.

> *You might not be able to eat what you used to eat after them. They might ruin them.*

P03a

> *Yeah, I wouldn't drink as much fizzy drinks, and eat as much sugary foods.*

P08a

> *Possibly. I wouldn't be as inclined to go for a sugary sweet if I taught it would destroy my teeth again because I know what it would have been like, you know...*

P13a

I'd say, if they were all straightened out and everything, I'd say it would encourage him more himself to mind them and look after them. Once they're sorted.

P03p

Notwithstanding this commitment from many participants to affect behavioural change regarding food and drink intake, six adolescents and six parents stated that in all honesty, little would change post-treatment. For some, it was because they already considered their intake to be largely healthy for teeth prior to treatment, while for others, it was more likely to be a lapse in behaviours by reverting to type.

Well, I don't eat too many different foods; kind of keep to the same, and then drinks, I only drink water.

P07a

I think he probably would be better at looking after them and cleaning them and things like that, but I'd say he'd still probably like his sweets and his rubbish.

P08p

The behavioural changes in intake codes by gender are shown in Table 36.

Table 36: Expected behavioural changes in dietary intake by gender

Behavioural Changes in Intake	Comments Coded	Female Parents	Male Parents	Proportional Representation	Female Adolescents	Male Adolescents	Proportional Representation
Avoid Food and Drinks that Could Damage Teeth	39	7	8		10	14	
No Change	12	6	0		3	3	
Totals	51	13	8		13	17	

Promises to affect behavioural change in food intake were male-led for both parents and adolescents and those that thought there would be little change in this context were exclusively female amongst parents and perfectly balanced amongst adolescents. There were no notable patterns in the data when compared against age or malocclusions. Equally, there was no overlap between these two codes.

5.1.7.4 Behavioural changes concerning bad habits

Thirty-three of 40 participants made contributions to this topic across 36 comments (Table 37).

Table 37: Expected behavioural changes concerning bad habits

Behavioural Changes Concerning Bad Habits	Comments Coded	Adolescents	Parents	Emphasis
Break Bad Habits	17	10	7	
Currently no Bad Habits	14	5	9	
Might Continue to Bite Nails	3	1	2	
No Change in Habits	2	1	1	
Totals	36	17	19	

Half of all participating adolescents and seven of 20 parents said they expected to break bad habits post-treatment.

> *I suppose if you don't want to kind of damage the shape of your teeth again from biting on your nails all the time.*

P01a

> *I'm trying to stop biting my nails… I feel like I'd be worried that they might go back if I'm biting my nails.*

P15a

Yeah, because if you had a habit of biting your nails, if you had braces on, it... You might not do it as much. Then when you take them off because you don't do it, you're not used to doing it.

P06a

I think it'll make him more conscious and aware and hopefully in turn then he will change any habits he has then.

P06p

Nine of 20 parents and five of 20 adolescents believed there were currently no bad habits at play.

I suppose, she doesn't do any of those but maybe, I suppose you'd get into...I wear a night guard myself at night for my teeth because I grind a lot, but I suppose you just get into a routine then

P20p

Yeah. no bad habits

P05a

The gender distribution for comments coded in this category of codes showed comments relating to breaking bad habits was largely female adolescent-led. Proportionately more male parents thought their child had no bad habits (Table 38).

Table 38: Expected behavioural changes concerning bad habits by gender

Behavioural Changes Concerning Bad Habits	Comments Coded	Female Parents	Male Parents	Proportional Representation	Female Adolescents	Male Adolescents	Proportional Representation
Break Bad Habits	17	4	3		8	2	
Currently no Bad Habits	14	5	4		2	3	
Might Continue to Bite Nails	3	2	0		0	1	
No Change in Habits	2	1	0		0	1	
Totals	36	12	7		10	5	

There were no significant patterns in the data when compared against age or malocclusions. Overlap between codes in this category of codes is given in Figure 13.



Figure 13: Overlap in behavioural changes concerning bad habits

Those who reported having no bad habits indicated that this would not change following treatment and those with bad habits were uncertain as to whether they would stop or continue following treatment.

5.1.8 Part 1 Benefit Summary

The expected benefits of orthodontic treatment, as perceived by a group of adolescents with high orthodontic treatment need, and their parents were distilled into 11 items under four categories (Table 39). These benefits were adapted, for parents and adolescents, into statements and placed onto individual laminated cards for use in the ranking exercise.

Table 39: Expected benefits of orthodontic treatment

Category	Benefit
Oral Health	Improved appearance of teeth
	Ease of maintaining good oral health
	Improved jaw alignment Cessation of parafunctional habits during sleep
	Aiding correct development of jaws and teeth
Psychosocial Health	Improved self-confidence
	Improved perception of dental appearance by others
Functional	Improvement in ability to chew food
	Improved speech
Behavioural	Improvement in oral hygiene habits
	Improved diet
	Cessation of bad habits

5.2 Part 2: Quantitative

The quantitative part of this project aimed to determine firstly if an order of precedence exists of the perceived importance of the 11 previously identified benefits of orthodontic treatment and secondly to ascertain if a difference existed between adolescents and parents. Participants were asked to rank, in order of importance, cards labelled with a statement pertaining to each of the benefits.

The sample consisted of six male and six female adolescents with a mean age of 13.4 years (range 12 to 16 years), and six male parents and six female parents with a mean age of 41.8 years (range 36 to 48 years). The Index of Orthodontic Treatment Need (IOTN) Dental Health Component (DHC) scores for the adolescent participants is shown in Table 40.

Table 40: IOTN DHC of adolescents

IOTN DHC	No. of Adolescents
5a	3
5i	2
4c	2
4d	5

The mean and median rank for each benefit was calculated along with calculating whether a difference existed between the adolescent and parent mean rank allocated to each benefit (Table 41). The benefit ranked highest by both adolescents and parents was improved self-confidence. This was followed by improvement in the appearance of the teeth and improved development of the teeth. The benefits ranked lowest were improvement in speech, cessation of bad habits and improvement in dietary intake. The only benefit where there was a statistically significant difference between the rank allocated by adolescents and parents was for improvement in ability to chew food (two-sample t-test; $P = 0.042$), with the mean rank by adolescents being 7.1 and by parents of 9.3. The difference in ranking for cessation of bad habits approached statistical significance ($P = 0.050$) with the mean rank by adolescents being 9.6 and by parents of 7.8. For all other benefits there was no statistical difference in the ranks

allocated by adolescents and parents. The mean rank allocations are graphically represented in Figure 14.

Table 41: Mean and median ranks of perceived benefits of orthodontic treatment for adolescents and parents

Statement	*Parent (P)/ Adolescent (A)*	*Mean*	*S.D.*	*Median*	*P-value*
My teeth will look better	A	2.7	1.4	3.0	0.704
	P	2.9	1.7	3.0	
It will be easier to keep my teeth and gums healthy	A	5.5	1.6	5.5	0.652
	P	5.8	1.9	6.0	
My jaw alignment will be better, I won't grind my teeth when sleeping	A	6.7	3.3	7.0	0.738
	P	7.1	2.7	7.5	
It will help my teeth to grow (develop) better	A	4.4	2.9	4.0	0.627
	P	5.0	2.9	5.0	
I will have more self-confidence	A	2.4	1.1	2.5	0.877
	P	2.3	1.5	2.0	
Other people will think my teeth look better	A	5.4	3.4	5.0	0.844
	P	5.2	2.7	4.5	
It will be easier to chew food	A	7.1	2.7	8.0	0.042*
	P	9.3	2.4	10.0	
I will be able to speak more clearly	A	9.7	2.5	11.0	0.931
	P	9.6	2.2	10.0	
I will look after my teeth better, for example: brushing my teeth	A	5.4	1.7	5.0	0.274
	P	4.5	2.2	4.5	
I will eat and drink healthier things	A	7.2	1.6	7.0	0.414
	P	6.5	2.2	7.0	
I will stop bad habits, for example: biting my fingernails	A	9.6	1.4	10.0	0.050
	P	7.8	2.7	8.0	

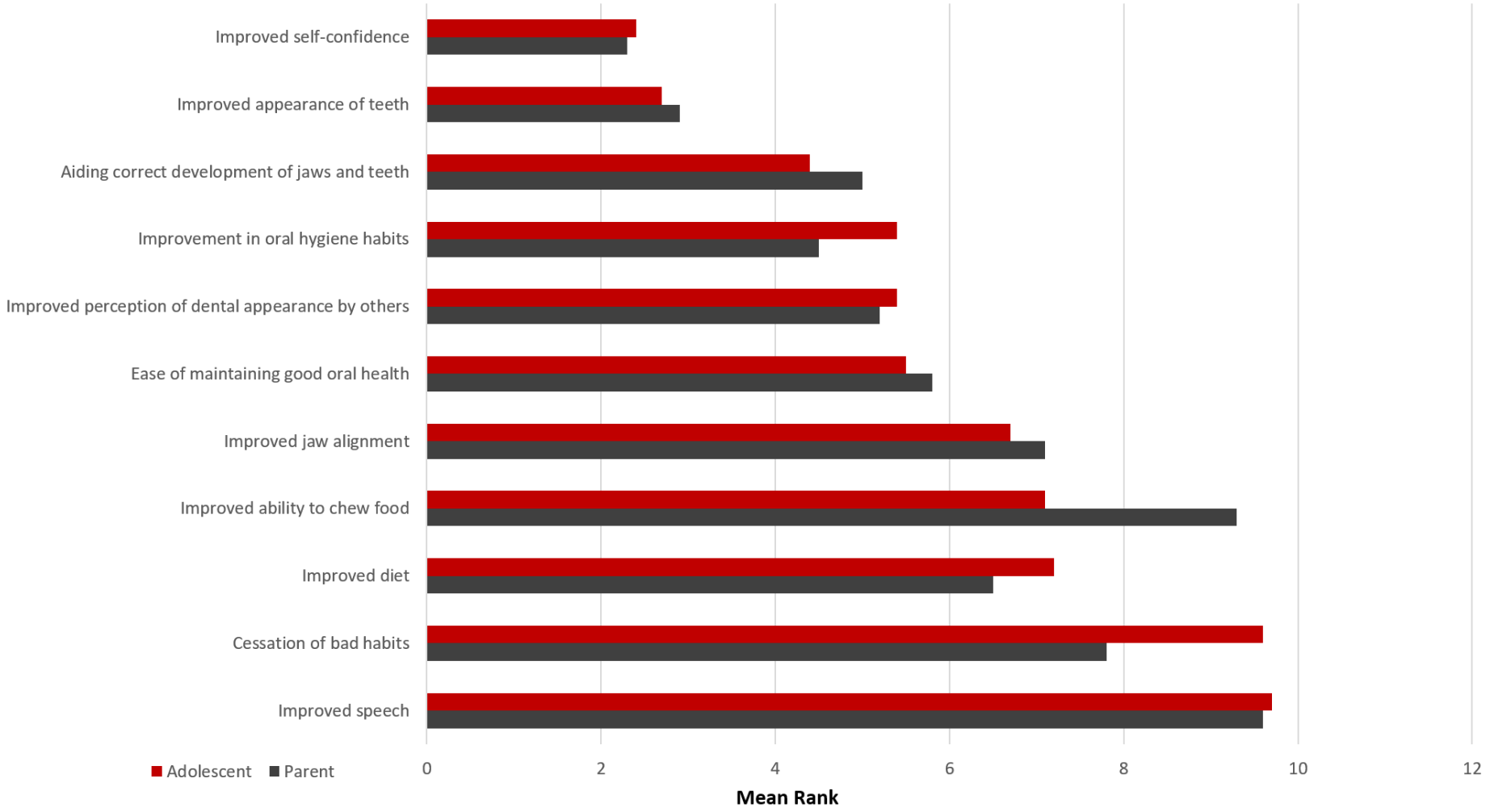


Figure 14: Expected benefits of orthodontic treatment placed in rank order

CHAPTER SIX

DISCUSSION

6 Discussion

6.1 Discussion of methodology

6.1.1 Study design

This study used a mixed-methods approach with the qualitative component preceding the quantitative.

- Part 1 involved one-to-one semi-structured interviews to gather qualitative data regarding perceptions of expected benefits of orthodontic treatment.
- Part 2 utilised this data to provide an insight into the relative level of importance attached to these benefits. This was achieved quantitatively by means of a ranking exercise.

Mixed-methods approaches have been used in orthodontics to explore various areas including; motivations for treatment (Pabari et al., 2011; Prabakaran et al., 2012a; Davis et al., 2015), expectations of treatment (Twigge et al., 2016b; Gassem et al., 2016) and methods used by patients to find information regarding orthodontic treatment (Stephens et al., 2013).

6.1.2 Interviews

Interviews are a core qualitative research method for gathering a description and interpretation of an individual's social world (Rubin and Rubin, 2011). An alternative method is the use of focus groups (Krueger, 2014). Organising focus groups with the population of interest in this case would have presented practical difficulties with participants attending at different times and mixing participants with different malocclusions may have produced contradictory responses regarding potential benefits of orthodontic treatment.

As per previous orthodontic studies (O'Keeffe et al., 2016; AlQuraini et al., 2019; Shah et al., 2019), all of the interviews for the current study were conducted by one individual who had undergone formal interview training and conducted practice

interviews prior to beginning interviews with participants for the main study. This allowed multiple opportunities for interview technique to be assessed and refined along with the topic guide structure. A single interviewer ensured consistency in the nature of the interviews and a key focus on delivery of the research aims.

The interviews were conducted in-person, a method that has also been used in the assessment of expectations of orthodontic treatment (Sayers et al., 2019), hypodontia care pathways (O'Keeffe et al., 2016) and perceptions of outcomes of orthodontic treatment (AlQuraini et al., 2019; Shah et al., 2019). In-person interviews have a number of advantages compared to over-the-telephone interviews; the participant and interviewer are focused only on the conversation at hand and not on other activities that may be happening concurrently if the participant is being interviewed in their own home. In addition, it enables the use of non-verbal communication, such as hand gestures, facial expressions and posture, to enhance the interaction between interviewer and participant and improve interpretation of their responses. This may help in alleviating anxiety associated with the interview environment and speaking to a stranger, allowing the participant to open up more fully about their thoughts and beliefs (Gillham, 2005). It could be argued that over-the-phone interviews have advantages: the participant is in their home environment rather than a clinical environment, reduced time burden and cost to the participant as they do not have to travel and potentially less cost for the researcher in having to compensate the participant for travel and time.

The interviews were conducted in a non-clinical environment, an office within CUDSH, with care taken to ensure physical factors were controlled to make it as comfortable as possible for participants. Noise was kept to a minimum, interruptions were avoided and the temperature was maintained at a comfortable level. The interviewer was not dressed in clinical attire and the participants were not made aware of the clinical role of the interviewer. The issue of burden on participant time and travel was overcome by linking the interviews with the adolescent participants scheduled appointment for orthodontic assessment at CUDSH, for which the attendance of a parent is also required. The interviews were conducted prior to the orthodontic appointment and lasted on average 15 minutes each, thus having minimal impact in terms of time. Participants were telephoned the day before the appointment

to ask if they were happy to participate and informed of the likely time commitment. No remuneration was offered to participants, thus also reducing the cost of the research. Interviews of adolescents and parents were conducted individually and separately. This may have allowed each of the participants to discuss the topic more freely and without influence or prompting. This process of interviewing is similar to studies undertaken in relation to perceptions of outcomes of orthodontic treatment (AlQuraini et al., 2019; Shah et al., 2019).

6.1.3 Qualitative Analyses

Interpretive Phenomenological Analysis (IPA) was the conceptual framework within which the data were analysed (Smith and Shinebourne, 2012). Analyses were conducted by researchers with experience in this method and the use of specialist qualitative software (Nvivo). Similar analyses have been done in qualitative orthodontic studies (AlQuraini et al., 2019; Shah et al., 2019; Perry et al., 2018).

6.1.4 Ranking exercise

Ranking exercises have been utilised in healthcare research, for example when assessing quality of life (Ratcliffe et al., 2017). These allow the ordering of different factors based on their relative perceived importance. Within the field of orthodontics ranking methodologies have been used, for example Q-methodology which has been used to address a number of questions such as motivations for (Prabakaran et al., 2012a; Tang et al., 2015; Davis et al., 2015), and concerns about treatment (Yao et al., 2015; Lin et al., 2017). It is accepted that to use Q-methodology the sample of items, known as a Q set, should number between 40 and 80 (Curt, 1994). Part 1 of this study identified 11 benefits of orthodontic treatment and so the use of Q-methodology was not deemed appropriate. Another ranking methodology involves participants sorting cards from most to least important, followed by calculation of the mean ranks of the items. This method has been utilised in healthcare (Ratcliffe et al., 2017), though would not appear to have been used formerly in orthodontic studies. It is suitable for smaller numbers of items, is straightforward and quick for participants to complete and is simple for the researcher to conduct, making it suitable for this study.

Similar to Part 1, the ranking exercise was conducted in a non-clinical environment to reduce anxiety, and was linked to the participants scheduled appointment for orthodontic assessment so as to minimise any inconvenience. The adolescents and parents each conducted the exercise separately so that they would not influence the other's rankings. The cards were presented in a random arrangement so as to minimise any unconscious bias which may have influenced the participants' choices.

Analysis of the ranking exercise used mean rank for each benefit and comparison between adolescents and parents by way of a two-sample t-test. This allowed for visual graphical presentation of the results as has been utilised in healthcare research previously (Ratcliffe et al., 2017).

6.1.5 Sample size and characteristics

6.1.5.1 Part 1

Based on previous qualitative studies in the orthodontic literature (AlQuraini et al., 2019; Shah et al., 2019; Al-Moghrabi et al., 2019), that utilised a similar methodology, a sample size of between 15-20 participants in each group (adolescents and parents) was anticipated for Part 1. Two factors played a role in determining the final sample size; the purposive sampling method and reaching data saturation from the interviews (the point at which no new themes emerge from the interviews).

Purposive sampling was carried out based on referred malocclusion, age and gender of the adolescent. This is in keeping with previous qualitative studies (AlQuraini et al., 2019; Shah et al., 2019). These factors were used so that views from a diverse sample were collected and because it was thought possible that individuals with different malocclusions may place emphasis on different benefits from treatment. In this regard, the sample included adolescents from all incisor relationships and specific malocclusion features such as anterior open bite, impacted teeth, hypodontia and cross-bites. The adolescent gender ratio was 1:1 but for the parent group was 8 males: 12 females. The reason for this was that parent gender was not included in the purposive sampling matrix and depended purely on which parent attended CUDSH with their child. In this study more mothers than fathers attended. Despite this, the

parent gender ratio still included a good proportion of fathers from whom views were gathered. Previous studies have failed to have a close ratio of mothers to fathers, with the only orthodontic study with a similar design recruiting only 3 fathers to 19 mothers (Shah et al., 2019).

6.1.5.2 Influence of COVID-19

Prior to the COVID-19 pandemic and the first national lockdown in Ireland a total of thirteen adolescents and parents had been interviewed and data saturation had not been achieved. The remaining participants were interviewed using the same protocol, the only difference being that masks were worn by interviewers and participants and there was no physical contact such as hand shaking. One might consider whether participant views on the benefits of treatment may have been affected during the lockdown. With the increased use of video communication platforms for work and school, it is possible that there was a trend towards a greater consciousness of dental appearance as individuals see themselves on screen. With this in mind, it could be argued that this may affect the findings from the interviews. On the contrary, it served to enhance the diversity in the range of views obtained strengthening the value of the research undertaken. In addition, to stop data collection at that point would have meant a lack of data saturation, giving an incomplete picture of the perceptions of expected benefits of treatment and potentially weakening the outcomes.

Due to the nature of the catchment area of CUDSH, all of the participants live in the North Cork geographical area. In addition, by virtue of having been referred for orthodontic assessment they were of a high orthodontic treatment need. Whilst this may limit the external validity of the findings to the general population, it is certainly relevant to those individuals most in need of, and indeed likely to undergo, treatment within the HSE Orthodontic Service in Southern Ireland. This also pertains to those of high orthodontic treatment need in other jurisdictions.

6.1.5.3 Part 2

Part 2 participants were selected from referrals to CUDSH for orthodontic assessment; however, a convenience sampling method was used. A sample size calculation revealed that 12 participants per group were required. This is smaller than previous studies ranking orthodontic benefits. Hunt et al. (2001) included 28 orthodontists and 139 general dental practitioners and Bennett et al. (1997) included 220 orthodontists and 220 patients. Neither of these studies, however, provided information to justify their sample size. A range of malocclusions were included in the sample reported here allowing a generalized assessment of the rank order of perceived importance of the identified benefits. For similar reasons to Part 1, this may have limited external validity but it does give a valuable insight into the values and beliefs that are held by this cohort of the population.

Expected benefits of orthodontic treatment were divided into four categories: oral health, psycho-social, functional and behavioural change.

6.1.6 Expected oral health benefits

Four expected benefits pertaining to oral health were identified by both adolescents and parents: improved appearance of the teeth, ease of maintaining good oral health, improved jaw alignment and cessation of parafunctional habits, and aiding correct development of the jaws and teeth.

The desire to improve dental appearance plays an important role in patients' desire to seek orthodontic treatment (Gosney, 1986). Improvements in smile aesthetics following treatment have been investigated previously and improvements have been shown for both minor and severe malocclusions (Maganzini et al., 2013). In previous qualitative studies, both adolescents who have completed orthodontic treatment and their parents noted improved dental appearance and alignment of the teeth as a beneficial outcome (AlQuraini et al., 2019; Shah et al., 2019). This gives reassurance that the desire to improve dental appearance is realistic and achievable with orthodontic treatment. It is worth noting that no adolescents or parents in the present study mentioned any expected effects on overall facial appearance or the facial profile. This is a contentious issue within orthodontics, particularly regarding extraction-based

treatment (DiBiase and Sandler, 2001a) though the current evidence would suggest the effects are small and not necessarily detrimental.

The general trend for participants to suggest that, following orthodontic treatment, it would be easier to maintain good oral health is not entirely surprising. Interviews with adolescents who have recently completed treatment have found that changes in oral hygiene and dietary habits were a perceived benefit of treatment (AlQuraini et al., 2019). Looking more objectively at the issue and considering if malocclusion plays a role in dental caries development, the evidence is equivocal with studies finding increased caries incidence (Sa-Pinto et al., 2018) and others finding no clear link (Hafez et al., 2012). Extending the question further to whether or not orthodontic treatment can reduce caries risk, long-term follow-up studies have found that treated patients are no less likely to develop caries than those who have not received treatment (Doğramacı and Brennan, 2019). Although adolescents and parents may see reduced caries risk as a potential benefit of orthodontic treatment, there is no strong evidence base to support this.

Ability to maintain good oral hygiene and periodontal health were proposed as potential benefits. While there is indeed evidence to show that teeth are easier to keep clean following treatment (Addy et al., 1988), this doesn't lead to a clinically significant decrease in gingival disease. There are specific traits of malocclusion which are associated with periodontal damage (e.g. anterior cross bite, deep overbite), the correction of which will be beneficial (Seehra et al., 2009). Following treatment adolescents report that they find it easier to keep their teeth clean and that there is less food trapping (AlQuraini et al., 2019), though parents don't mention this as a perceived outcome (Shah et al., 2019).

There was a suggestion by some participants within this study that symptoms relating to the temporomandibular joint (TMJ) would improve following orthodontic treatment. This was not something that was mentioned as a perceived outcome by adolescents or parents following treatment in previous studies (AlQuraini et al., 2019; Shah et al., 2019) and is another controversial area in orthodontics, with the consensus being that orthodontic treatment is likely to have a neutral effect in this regard (Luther, 1998a; Luther, 1998b).

The expectation that treatment will aid the correct development of the jaws was expressed by both adolescents and parents. This was mirrored by AlQuraini et al. (2019) and Shah et al. (2019) in the perceived outcomes of treatment where the avoidance of future problems was noted as a benefit.

For those individuals with an increased overjet (one quarter of the adolescents included in this study had an overjet > 9mm), there is a significant increase in risk of incisal trauma (Todd and Dodd, 1985) and reduction of the overjet leading to a reduction in incisal trauma incidence is a recognised benefit of early treatment (Batista et al., 2018). Despite attempted prompting through questions about contact sports and use of mouthguards, no participants expressed an expectation of reduced risk of trauma. One possible reason for this could be the requirement in Ireland that all children playing football, hurling, camogie or rugby must wear a mouthguard and so it is possible that the incidence of incisal trauma has reduced. None of the participants may have experienced trauma or had a family member or friend with a history of trauma and this may mean that participants are less aware of the risks of trauma and do not associate it with the arrangement of their teeth.

6.1.7 Expected psycho-social benefits

Two expected psycho-social benefits were identified: improved self-confidence and improved perception of dental appearance by others. Improvement in self-confidence following treatment has been reported by adolescents (AlQuraini et al., 2019) and their parents (Shah et al., 2019). Participants in the present study noted that they expected that they may smile more in public following treatment and that they would be less likely to be teased about their teeth. There have been reports of reduction in bullying following interceptive orthodontic treatment which gives basis to support this perception (Seehra et al., 2012). To expect, however, that orthodontic treatment will have a major impact in the long-term on self-confidence may be unrealistic as the traits associated with self-esteem seem to be relatively stable over time and are influenced by many factors, not merely malocclusion (Chung et al., 2014; Orth et al., 2012).

The expectation that others will have an improved perception of one's dental appearance is important. Improved dental appearance has been linked with greater

intelligence and greater likelihood of success in job interviews (Pithon et al., 2014). Negative stereotyping can occur in malocclusions that deviate from the norm and result in reduced, actual or perceived, peer group acceptance (Shaw et al., 1985). Adolescents have reported that following treatment they feel that they "fit in" better and were confident within themselves and socially (AlQuraini et al., 2019).

6.1.8 Expected functional benefits

Improved speech and improved ability to chew food were the expected functional benefits. These were not considered to be benefits by every participant, largely by those who felt they personally had an issue with speech or chewing. Certain malocclusion traits are associated with specific speech problems and the correction of these could lead to an improvement in speech. Speech patterns, however, develop early in life before the eruption of the permanent teeth and teeth are not the sole players in the production of speech, with higher brain functions and the organs of speech all contributing (Riecker et al., 2005). As a result, the improvement of speech as a result of orthodontic treatment is unpredictable (Johnson and Sandy, 1999) and caution should be exercised when discussing this with patients.

Similar to speech, certain malocclusions such as anterior open bite may be associated with masticatory difficulties and orthodontic treatment may help in these cases (Hoppenreijs et al., 1999). In general, it is difficult to be certain that, for the majority of patients, orthodontic treatment will truly lead to improved ability to chew foods. Despite this parents and adolescents who have completed treatment do subjectively report improved chewing ability (AlQuraini et al., 2019; Shah et al., 2019).

6.1.9 Expected behavioural change benefits

Three expected behavioural change benefits were discussed: improved oral hygiene habits, improved dietary habits and cessation of bad habits. Adolescents and parents both discussed how they expected oral hygiene habits, such as tooth-brushing, to improve and two main reasons were proposed. Firstly, the desire to maintain the result of the orthodontic treatment and avoid negative outcomes following a prolonged period of treatment that required significant time investment from both the adolescent

and the parent. Secondly, the influence of the orthodontic team by reinforcing oral hygiene instructions repeatedly over the course of treatment, thus ingraining the habit. Interestingly this perception was strongly parent-led, with no adolescents suggesting that professional influence would alter their habits in this regard. These reasons mirror the findings of Al Quraini et al, (2019) and Shah et al, (2019) with the exception that following treatment adolescents were acutely aware of the influence that professional oral hygiene instruction had on their habits. In the current study, it is possible that either the parent themselves or someone in the family had previously had orthodontic treatment and so they had seen first-hand how this may influence habits, whereas the adolescent may not have had this experience.

The expectation that dietary habits would improve following treatment was interesting, both being adolescent-led and male-led. It has been found that dietary intake changes during orthodontic treatment (Ozdemir et al., 2021) including a reduction in carbohydrate intake within the first three months. Parents and adolescents have reported that changes in diet are maintained after treatment for similar reasons to the changes in oral hygiene habits, that is following professional advice and through possible fear of compromising the final result (AlQuraini et al., 2019; Shah et al., 2019).

Cessation of bad habits, such as nail biting, was proposed as an expected benefit by both parents and adolescents but only for those where the adolescent currently undertook a bad habit. Parents were more likely to believe that their child did not currently have any bad habits, but adolescents were more likely to admit that they did. This seems to contradict the findings by Shah et al, (2019) where only parents reported that cessation of a bad habit was an outcome following treatment while adolescents did not mention this.

6.2 Part 2 Comparison of results with existing literature

This study represents the first attempt to place the potential benefits of orthodontic treatment in an order of perceived importance, according to adolescents and their parents prior to orthodontic assessment. The views of general dental practitioners (GDPs) and orthodontists have been assessed in this regard (Hunt et al., 2001). They identified 14 potential benefits through a review of the literature, used a visual analogue scale to score them, calculated mean scores and ranked the benefits in order for each group. The top three items for both GDPs and orthodontists were improved self-esteem, improved physical attractiveness and improved self-confidence. This compares very similarly to the findings in the present study which showed that the top two items for both parents and adolescents were improved self-confidence and improved appearance of teeth. At the other end of the spectrum, they found that a reduction in temporomandibular dysfunction (TMD) problems was the lowest ranked item. In this study, the analogous item was improved jaw alignment and reduction in clenching and grinding teeth which adolescents and parents seem to place a greater emphasis on as a potential benefit, ranking seventh out of 11 items. Given the link between TMD and orthodontic treatment or malocclusion is controversial and the consensus currently being that orthodontic treatment has a neutral effect on TMD symptoms (Luther, 1998a; Luther, 1998b), this could explain the low level of importance attached by professionals, whereas adolescents and parents seem to place a greater level of importance on this area.

Orthodontist and parent expectations regarding the likelihood of various benefits of orthodontic treatment have also been investigated (Bennett et al., 1997). In a similar manner they used interviews with parents and orthodontists to identify benefits and also risks of orthodontic treatment. Participants then rated, on a six-point Likert scale, the likelihood of each benefit occurring for their child (or "a child" in the case of the orthodontists). The top scoring items for parents were 'better bite', 'better smile' and 'look better'. Orthodontists scored similar items highly with 'better smile', 'teeth easy to brush' and 'better bite' placed at the top. In the present study parents also ranked 'improved appearance of teeth' highly (second highest), on the other hand, 'ease of keeping teeth clean' ranked lower (sixth). Interestingly Bennett et al, (1997) found that both parents and orthodontists ranked improvement in self-esteem as less likely to

occur than other benefits. It is seemingly difficult to account for this though one possibility, in the case of parents at least, is that their child was currently undergoing treatment at the time of conducting the study which may have had a negative impact on their self-esteem. The present study was conducted at the time of orthodontic assessment, so any transient reduction in self-esteem resulting from orthodontic treatment would not influence their perception of that as a potential longer-term benefit.

6.3 Strengths of this study

- This appears to be the first study to explore, in a qualitative and quantitative manner, perceptions of expected benefits, in adolescents and their parents, at the stage of orthodontic assessment.
- The mixed-methods design allowed both determination of what the expected benefits were and the level of perceived importance of each of the benefits.
- A purposive sampling technique ensured that views from a diverse sample of the population were gathered.
- Pilot interviews allowed refinement of the technique and modification of the topic guide prior to beginning interviews with participants.
- Expert advice was sought and provided by a designated qualitative research company prior to conducting any interviews.
- All interviews were conducted by a single, formally trained interviewer, in a private room away from the clinical area which allowed for consistency and put the participants at ease.
- One-to-one interviews were used, rather than focus groups, which allowed participants to open up more freely about topics that may be sensitive or embarrassing.
- Interviews were undertaken both before and after the national lockdown for COVID-19, creating the potential for a more diverse range of views.

6.4 Weaknesses of this study

- The adolescent participants were selected from a high treatment need group in a specific geographic location (North Cork) which may limit the external validity of the findings.
- The ranking exercise was conducted only after the first national lockdown for COVID-19. This was mitigated by the fact that around one third of the interviews in Part 1 were also conducted after the national lockdown.
- The interviewer was a postgraduate orthodontic trainee, which may have influenced the responses from participants. This was mitigated for by introducing the interviewer as a researcher and ensuring that interview training had been undertaken prior to commencing the study.

6.5 Suggestions for further research

Longitudinal qualitative assessment, using semi-structured interviews, of expectations prior to orthodontic treatment and perceptions of outcome in the same individuals would provide valuable insight into how realistic the expectations are of what orthodontic treatment can achieve.

Views should be gathered on how satisfied patients were with the information given regarding benefits of treatment during the consent process in light of the perceived benefits following treatment.

Exploration of the expected benefits of orthodontic treatment in different populations, from different geographic locations, would allow assessment of similarities and differences between each.

CHAPTER SEVEN

CONCLUSIONS

7 Conclusions

The conclusions related to each of the aims of this project and the impact on the null hypothesis are listed below.

Aim 1: To investigate expected benefits of orthodontic treatment from both an adolescent and parent perspective.

Conclusions:

Adolescents and parents perceived 11 expected benefits from orthodontic treatment affecting oral health, psycho-social, functional and behavioural categories.

Aim 2: To rank the expected benefits of orthodontic treatment identified by adolescents and parents in order of perceived importance.

Conclusions:

Adolescents and parents ranked the expected benefits similarly with psycho-social ranked highest. Within functional benefits, speech improvement was ranked lowest by both but improved masticatory function was ranked of significantly greater importance by adolescents.

Null hypothesis: There is no difference in the level of importance attached to the expected benefits of orthodontic treatment by adolescents and their parents.

This null hypothesis is rejected for “improved ability to chew food”.

CHAPTER EIGHT

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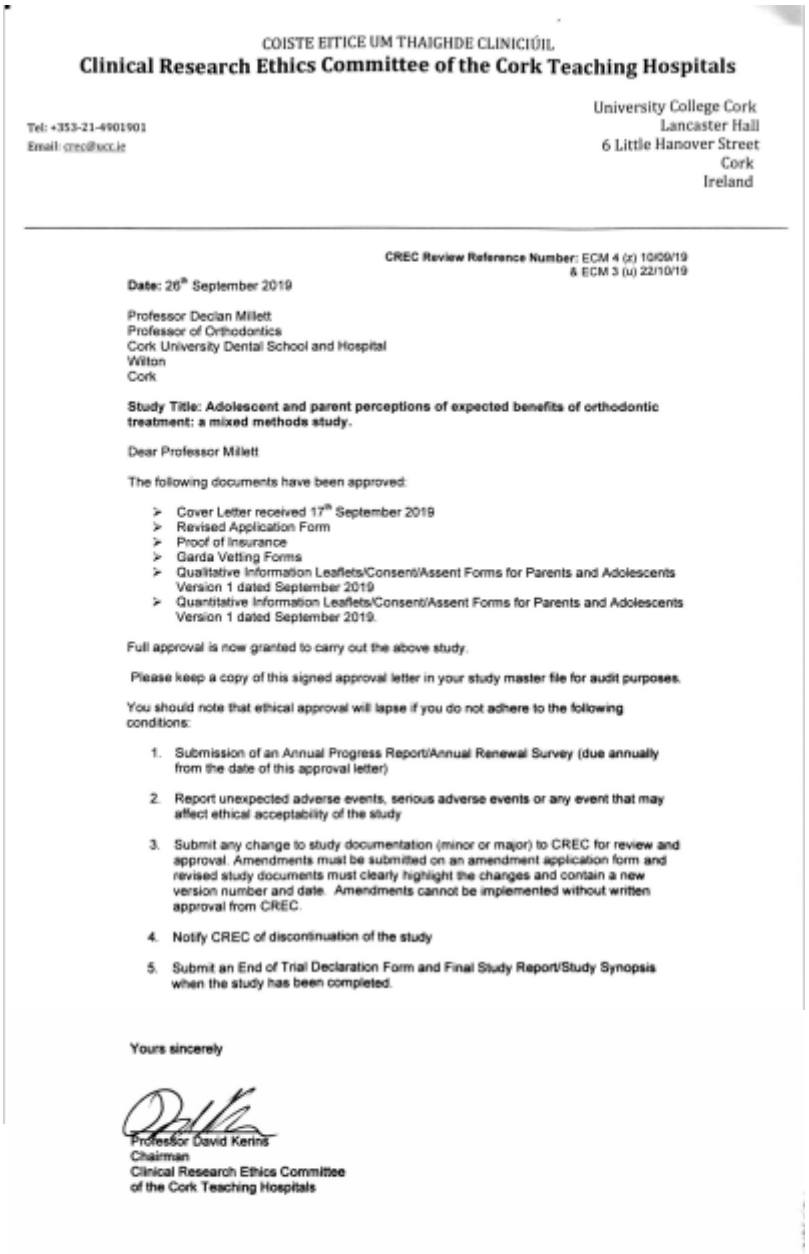
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CHAPTER NINE

APPENDICES

9 Appendices

9.1 Appendix 1 – Ethical Approval



COISTE EITICE UM THAIGHDE CLINICIÚIL
Clinical Research Ethics Committee of the Cork Teaching Hospitals

Tel: +353-21-4901901
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University College Cork
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6 Little Hanover Street
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CREC Review Reference Number: ECM 4 (z) 10/09/19
& ECM 3 (u) 22/10/19

Date: 26th September 2019

Professor Declan Millett
Professor of Orthodontics
Cork University Dental School and Hospital
Wilton
Cork

Study Title: Adolescent and parent perceptions of expected benefits of orthodontic treatment: a mixed methods study.

Dear Professor Millett

The following documents have been approved:

- Cover Letter received 17th September 2019
- Revised Application Form
- Proof of Insurance
- Garda Vetting Forms
- Qualitative Information Leaflets/Consent/Assent Forms for Parents and Adolescents Version 1 dated September 2019
- Quantitative Information Leaflets/Consent/Assent Forms for Parents and Adolescents Version 1 dated September 2019.

Full approval is now granted to carry out the above study.

Please keep a copy of this signed approval letter in your study master file for audit purposes.

You should note that ethical approval will lapse if you do not adhere to the following conditions:

1. Submission of an Annual Progress Report/Annual Renewal Survey (due annually from the date of this approval letter)
2. Report unexpected adverse events, serious adverse events or any event that may affect ethical acceptability of the study
3. Submit any change to study documentation (minor or major) to CREC for review and approval. Amendments must be submitted on an amendment application form and revised study documents must clearly highlight the changes and contain a new version number and date. Amendments cannot be implemented without written approval from CREC.
4. Notify CREC of discontinuation of the study
5. Submit an End of Trial Declaration Form and Final Study Report/Study Synopsis when the study has been completed.

Yours sincerely

Professor David Kerins
Chairman
Clinical Research Ethics Committee
of the Cork Teaching Hospitals