An investigation into the rationale and treatment impact of removable and fixed appliances in adults: A qualitative study

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Abstract

Introduction: There is limited evidence available that focuses on the experiences of adult patients during orthodontic treatment. A better understanding of the adult patient's rationale and preferences will allow orthodontists to provide more relevant information to patients and likely to facilitate the development of a patient-centred approach to providing better care. The aim of the current study was to understand why adult patients, undergo orthodontic treatment, in particular their reasoning and overall experience with their choice of appliance.

Materials: A qualitative study was conducted on adult participants recruited from four different London-based orthodontic private practises. Participants wearing fixed ceramic labial appliances (FC), removable aligner appliances (RA), and fixed lingual appliances (FL) were invited to take part in one-to-one, semi-structured interviews. Qualitative data were collected using a topic guide, until saturation was reached. Interviews were audio-recorded and transcribed verbatim and analysed using framework methodology.

Results: In total, 22 participants (13 females; FC = 8, RA = 8 and FL=6), were interviewed. The data was presented under three objectives, with 2 themes for each objective and 15 overall sub-themes developed.

Objective one, the reasons that lead adults to seek orthodontic treatment: theme A: psychosocial influence; theme B: health related issues. Objective two, the rationale for selecting specific treatment options: theme C: social influence and theme D: appliance

features and finally, objective three, the impact of different orthodontic appliances on the quality of life of participants: theme E: functional impairment and F: psychosocial impact.

Conclusions: The present research identified a number of factors influence adults in their decision-making process and treatment experiences. It is important for both orthodontists and patients to understand these findings. It is particularly important to facilitate the development of a patient-centred approach to providing better care.

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List of Abbreviations

CAT	Clear aligner therapy
CAD/CAM	Computer-assisted design and/ or manufacturer
QoL	Quality of life
OHRQoL	Oral health related quality of life
FC	Fixed labial ceramic appliances
RA	Removable aligner appliances
FL	Fixed lingual appliances

1. Introduction:

Throughout the last decade, it has been recognized that oral health, disease, appearance, malocclusion, along with the treatment and correction of these malocclusions, play a critical role in determining one's mental well-being (Alanko et al., 2014). Orthodontic appliances can be used to treat and correct a range of malocclusion traits (Khanehmasjedi et al., 2007). Since orthodontic treatment can directly affect a patient's appearance and facial features, orthodontists need to understand the underlying issues pertaining to social psychology as well as the theory of facial attractiveness before engaging in orthodontic treatment (Alanko et al., 2014). Interestingly, it has been reported that one of the primary reasons why patients undergo orthodontic treatment was to improve their appearance and self-esteem (Bennett et al., 1997).

Patients seeking orthodontic treatment are concerned by the aesthetics of the appliance being offered (Rosvall et al., 2009). Traditionally, patients and providers had limited choices regarding bracket styles or appliance designs. However, a phenomenal growth has been experienced in the orthodontic market in recent years in terms of the development and production of orthodontic appliances that are designed to appeal to the adult consumer (Walton et al., 2010).There have been several factors contributing to the development of alternative orthodontic appliances and bracket styles, which include an increasing demand for orthodontic treatment, higher demand for aesthetic treatment alternatives (Sarvera and Ackermanb, 2000), and a competitive orthodontic industry and specialty (Willems and Carels, 2000; Russell, 2005; Johal and Bondemark, 2021). Patients and orthodontist now have access to a wide range of

treatment options that were previously unavailable. It is clear that orthodontic appliances have evolved as public demand and technology improved, with the underlying goal being to provide more aesthetically acceptable appliances for use in (Willems and Carels, 2000).

Ceramic brackets have developed to provide a relatively clear and aesthetic alternative to metal appliances. Moreover, clear aligners and lingual braces have been developed to offer patients more invisible options, however, they present unique clinical obstacles as well as treatment limitations (Joffe, 2003; Ling, 2005; Johal and Bondemark, 2021). Notwithstanding this, there is relatively little understanding of the factors that adults consider in the decision-making process of whether to undergo orthodontic treatment and/or the determinant factors in the type of appliance they choose.

Moreover, there is a relatively small body of literature that focuses on the experiences of adult orthodontic patients during treatment (Miller et al., 2007; Johal et al., 2015). The majority of studies conducted in this area focused on the pain associated with orthodontic treatment and primarily in relation to labial fixed appliances (Abdelrahman et al., 2015; Johal et al., 2018) According to Brown and Moerenhout, adolescents generally experience greater levels of pain than adults due to their stage of psychological development (Brown and Moerenhout, 1991). Others demonstrated that age does not influence pain perception (Scott et al., 2008; Ngan et al., 1989).

A positive outcome of orthodontic treatment depends significantly on the cooperation of the patient (McNair et al., 2006). An orthodontic appliance may hinder cooperation

by causing considerable discomfort, such as an unpleasant tactile sensation, feeling of constraint in the oral cavity, stretching of the soft tissues, and pressure on the mucosa (Sergl et al., 2000; Egolf et al., 1990). In addition, it has been reported that patient's self-confidence is negatively affected by speech impairment and the visibility of the orthodontic appliance, especially during social interaction when attention is placed on the face, eyes and mouth of the patient (Lewis and Brown; 1973; Zentner et al., 1996). A better understanding of the adult patient's rationale and preferences will allow orthodontists to provide more relevant information and likely to facilitate the development of a patient-centred approach to providing better care.

2. Literature review:

2.1. Orthodontic appliances:

2.1.1. Removable Clear Aligners

In 1946, Kesling was the first to introduce the possibility of using clear removable orthodontic appliances through a series of thermoplastic tooth positioners to move misaligned teeth to a better position gradually (KESLING, 1946). It was Align Technology (Santa Clara, Calif) who first realized their commercial potential in 1997. Through the adaptation and incorporation of modern technologies, they made Kesling's concept of clear aligners treatment (CAT) possible. A series of custom-made aligners can be fabricated using three-dimensional computer-assisted design and/or manufacture CAD/CAM stereolithography using a single silicone or digital impression as a pre-treatment tool (Kuo and Miller, 2003)

One of the novel features of CAT is the digital scanning and imaging of casts of patients' teeth, which subsequently enables the orthodontist to modify on-screen the treatment goals and tooth movements (Scott et al., 2007).Several advancements have been made since its introduction, from the design of the attachments to the materials, and to the addition of new auxiliary devices such as "Precision Cuts" and "Power Ridges," all designed for enhancing treatment biomechanics (Johal and Bondemark, 2021) . CAT are designed to move teeth approximately 0.25 to 0.3 mm over a period of one to two weeks and are worn in a prescribed sequence. The appliance must be worn daily for a minimum of 20 to 22 hours (Malik et al., 2013). In general, it is only recommended to remove them when eating as well as when drinking hot, stain-causing beverages that contain sugar and for brushing, making excellent compliance

imperative to their success (Phan and Ling, 2007). CAT are becoming more common in orthodontic practices as a significant aesthetic alternative to conventional appliances (Ojima and Kau, 2016). Although its clinical potency remains a topic of debate among professionals, with advocates remaining optimistic of their treatment, while opponents argue that it has significant limitations, particularly with complex malocclusions (Womack, 2006; Womack and Day, 2008).

Based on multiple systemic reviews from the literature on CAT effectiveness, Johal and Bondemark, (2021), published an evidence-based guide for clinicians to assist in their decision making process to manage different types of malocclusions that often occur in adults (Johal and Bondemark, 2021). As part of the assessment of clinical practice, two aspects were considered: treatment duration and chair-side clinical time. When CAT was compared with conventional fixed appliances, mild malocclusions showed significantly reduced treatment time duration (range of 3–6 months) with CAT (Djeu et al., 2005; Buschang et al. 2013; Grunheid et al., 2016; Gu et al., 2017). However, the findings should be interrupted with a degree of caution, as these studies, carry a moderate risk of bias due to their retrospective nature, variability in outcome measures and the lack of randomization.

For individuals with more severe malocclusions, especially those requiring premolar extractions, traditional fixed appliance therapy was shown to have shorter treatment times, better outcomes and advised as the preferred treatment approach (Baldwin et al., 2008; Li et al., 2015). In accordance with this recommendation, there is low bias

associated with the evidence, as the study ensured randomisation and blinding of both participants and assessors.

In a study conducted by Buschang et al., (2014), the researchers compared aligner therapy with conventional Edgewise braces according to their time efficiency. Based on their findings, aligner therapy was more clinically time-efficient than conventional treatments. This was based on the reduced clinical time with follow-up appointments and emergency appointments as well as quicker chair-side adjustments (Buschang et al., 2014). However, the evidence in this study was retrospectively collected and considered to be moderately biased.

In relation to orthodontic tooth movement, CAT were reported to be beneficial in producing tooth tipping movement in non-extraction cases (Kassas et al., 2013). They can also be used to deliver effective maxillary molar distalisation without considerable molar tipping or extrusion, and with minimal impact on vertical skeletal relations (Ravera et al., 2016). Additionally, they were found to be as effective for achieving mild amounts of maxillary incisor intrusion as continuous fixed arch mechanics (Kravitz et al., 2009). In contrast, a number of studies have suggested that the relative limitations of CAT include: achieving bodily tooth movement at extraction sites, torque control; root approximation and contact point relationships (Djeu et al., 2005; Gu et al., 2017). Furthermore, their rotational correction does not seem to be clinically effective, with low degree of predictability regarding the response of canines and premolars in particular (Kravitz et al., 2009; Simon et al., 2014)

2.1.2. Aesthetic labial fixed appliances

2.1.2.1. Brackets

A conventional orthodontic bracket is made of stainless-steel due to its superior mechanical properties, including strength and durability. However, the appearance of orthodontic appliances has become more important in recent years, and tooth-coloured bracket materials have been developed to accommodate demand from adult patients (Ali et al., 2012). In the early 1970s, brackets made of transparent or translucent non-metallic materials were introduced. Initially, plastic transparent brackets were made of unfilled polycarbonate and had superior aesthetic to conventional stainless-steel brackets. Despite this, they lacked strength and stiffness, resulting in tie-wing fractures and slot distortion. Additionally, these brackets demonstrated increased slot roughness and become stained as a result of absorption of intraoral fluids (Eliades et al., 2004; Zinelis et al., 2005). In order to overcome these limitations, polyurethane brackets and polycarbonate brackets reinforced with ceramic or fibreglass fillers have been developed, as well as brackets with metal reinforced slots (Kakadiya et al., 2017). Furthermore, the shape of the brackets was altered in order to increase resin bonding without the use of primers. This in turn facilitated easy removal at the end of the treatment, minimising the risk oft of enamel damage (Arici and Regan, 1997).

In the 1980s, ceramic monocrystalline sapphire and polycrystalline brackets were developed as an alternative to plastic brackets. Compared to plastic brackets, these brackets are able to endure orthodontic forces and were resistant to staining in the oral cavity (Winchester, 1991; Harris et al., 1992). There are two different types of ceramic

brackets, polycrystalline and monocrystalline, depending on how they are manufactured. Monocrystalline brackets are manufactured from single crystals of sapphire, while polycrystalline brackets are formed by thermally fusing particles together (Kusy, 1988), making them comparably inexpensive and easy to mass-produce (Kakadiya et al., 2017).

The most noticeable distinction between monocrystalline and polycrystalline brackets is that the former has higher optical clarity. Brackets made of monocrystalline materials are more translucent than brackets made of polycrystalline materials. However, In the oral cavity, both types of materials are resistant to staining and discoloration (Jen et al., 2007). The following drawbacks have been reported regarding ceramic brackets; low fracture toughness and friction between the arch wire and bracket slot (Angolkar et al., 1990; Pratten et al., 1990). Additionally, ceramic brackets are considerably harder than enamel as a consequence they can cause enamel abrasion and possible damage to opposing tooth structure when they come into contact (Birnie, 1990; Viazis et al., 1990). In case of an increased overbite, the danger of enamel deterioration may be mitigated by using polycarbonate or metal brackets in the lower arch, since the bottom teeth are seldom visible, and this is often acceptable among adult patients.

In recent years, manufacturers have attempted to address these issues by the following means: the use of metal-lined/reinforced archwire slots, which have been shown to reduce friction. Other approaches were the use of silica-lined slots to reduce friction (Kusy and Whitley, 2001).By shifting to a mechanically retentive base over the use of chemical bonding with saline coupling agents, the issues of high bond strength

and possible enamel damage have been resolved, reducing the risk of enamel fracture upon debonding (Scott et al., 2007).

2.1.2.2. Arch-wires

Similar to advances in bracket materials, archwire technology has evolved since orthodontic treatment became popular. As an alternative to traditional stainless steel archwires, clear optical fiber (Optiflex), Teflon coated, epoxy coated, titanium plastic coated, and Bioforce wires have been developed (Kaur et al., 2018). Teflon-coated wires are tooth-coloured, as well as being corrosion-resistance. The coatings enhance wire aesthetics and reduce friction (Philip et al., 2016). There is limited evidence that nickel-titanium wires that are coated are less likely to accumulate microbial plaques than wires that are not coated (Raji et al., 2014). On the other hand, it was also concluded in another study that the Teflon coating on wires may not be able to withstand masticatory forces and enzyme activity within the oral cavity, resulting in increased friction. Furthermore, these coatings are not durable in intraoral environments, leading to low aesthetic value and great surface roughness in comparison to conventional stainless steel and nickel-titanium wires (Rakesh et al., 2015). However, conclusive evidence to-date comparing these aspects remains unknown.

Typically, epoxy coated wires are made from Epoxy resin, which is widely used for coatings due to its excellent adhesion, chemical resistance, electrical insulation, and dimensional stability (Rakesh et al., 2015). A study published by Elayyan et al, reported that epoxy coated ultraesthetic wires have lower loading and unloading forces compared to nickel titanium wires of the same diameter (Elayyan et al., 2010). Nickel

Titanium plastic coated wires appear to blend well with the colour of the teeth as well as ceramic, plastic, and composite brackets enhancing the aesthetics of brackets. Additionally, they are stain and crack resistant (Malik et al., 2015; Singh, 2016).

Bioforce wires have been reported to have the unique property of having a variable transition temperature. In addition to their low-reflectivity rhodium coating, these arch wires are able to deliver differential forces according to the needs of the individual segments of the dental arch, providing low gentle force on anterior teeth, while greater force is applied on posterior teeth. These manufacturer claims are relatively unproven. According to the size of the teeth, the force level is determined throughout the arch length (Iijima et al., 2012; Philip et al., 2016)

2.1.3. Lingual orthodontics

The concept of lingual orthodontics was introduced in 1726, when Pierre Fauchard suggested the possibility of using appliances on the lingual surfaces of the teeth, followed by P.J.Lee Foulon who designed the first lingual arch for expansion and alignment of the teeth (Husain et al., 2013). However, the true lingual appliance system was developed simultaneously in two countries, it was first documented around 1975 when two orthodontists working independently in Japan and the United States developed their own methods.

It was developed in Japan by Kinja Fujita as a way to satisfy the orthodontic needs of patients who practiced martial arts, thereby reducing the potential impact of brackets on the lips and cheeks. The lingual multibracket technique was introduced by Fujita

using mushroom shaped arch wires to compensate for the difference in labio-lingual thickness of the anterior and posterior teeth (Fujita, 1978, Fujita, 1982)

In the United States, Craven Kurz, an orthodontist, observed that adult patients were increasingly dominating his private orthodontic practice. As many of his patients were public figures, aesthetics became an important consideration. In 1975, Craven Kurz and Jim Mulick began using plastic brackets that were bonded to the lingual surfaces of the teeth (Kurz et al., 1982). At first, lingual orthodontics gained popularity in the United States but declined rapidly after the advent of superior ceramic brackets (Craven and Rafi, 1998). Recently, however, lingual orthodontics has regained popularity as appliance design has evolved and placement became easier with indirect techniques (Scott et al., 2007).

There are a number of notable advantages of lingual appliances over conventional labial appliances, aside from their aesthetic features that meet the increasing demand for invisible appliances, a potential benefit of this method is the accuracy of the outcome of the treatment due to the complex laboratory process involving a target set-up (Wiechmann, 2002) and the precision of the bracket slot-archwire combination (Grauer and Proffit, 2011; Lossdoerfer et al., 2013). Additionally, decalcification rates were reported to be reduced (Van Der Veen et al., 2010).

However, the major challenges with lingual orthodontics include: the difficulty in bracket installation and adjustments because of anatomical variations of the lingual surface; the narrow distance between brackets, which restricts tooth movement flexibility; the possibilities for speech impairment; cleaning challenges and irritation to

the tongue and soft tissues due to the thickness of the brackets (Geron, 2008). From the clinician perspective, operators may be discouraged by the physical challenges associated with back pain and related discomfort due to posture challenges (Ling, 2005). The patient should expect to spend substantially more time in the chair during the adjustment appointment (Gorman et al., 1983).

It has been recommended to place lingual appliances one arch at a time with an interval of two months, so that the patient can adjust to the brackets (Fillion, 1997). Lower arch adaptation tends to take longer, with tongue irritation usually resolving within two to three weeks for most patients (Sinclair et al., 1986). Several attempts have been made to overcome problems associated with lingual appliances, such as the use of custom-made lower-profile lingual brackets this has been found to enhance patient comfort significantly, as well as decrease speech impairment (Hohoff et al., 2003b; Stamm et al., 2005). In order to minimize discomfort to patients, another approach has been suggested, that is the combination of maxillary lingual appliances and the mandibular labial appliances. Another benefit of this, that the patient fee is reduced, however, an additional challenge is presented with inter-arch mechanics, since the appliance will be attached to the maxillary palatal surface and the mandibular labial surface (Ling, 2005).

2.2. Adult Orthodontics

2.2.1. Overview

In a Dental Health Survey conducted by Todd and Ladder, some statistics relating to the orthodontic status of adults were provided, but no objective assessment of the need for orthodontic treatment was made (Todd and Lader, 1988). According to their

findings, 6 percent of adults have an overjet of 7 mm or more, 9 percent have an overbite complete to the palate, 56 percent have one or more maxillary teeth out of alignment and 69 percent have at least one mandibular tooth out of alignment. These results suggested that orthodontic treatment may be beneficial to some adults (Todd and Lader, 1988). However, a recent a survey conducted by the British Orthodontic Society (2018), reported that orthodontists were treating 5 percent more adult patients in private practice than in 2016 (War, 2018). Among adults in the United States, reported orthodontic cases has grown from 15.4 percent to 21.0 percent between 1981 and 2017 (Keim et al., 2017).

As the practice of adult orthodontics has grown steadily over the past three decades, it is important for orthodontists to recognize the differences between adults and adolescents' orthodontics. Several factors may complicate adult orthodontic treatment, including lack of growth, periodontal considerations, reduced periodontal vascularity, a restored dentition or missing teeth, and psychological consideration (Scott et al., 2007). Johal and Ide, provided a summary of some of the most important aspects involved in the treatment of adult patients to address the previous complications (Johal and Ide, 1999). Unlike adolescents, growth and development have largely ceased in adults. It is therefore believed that the correction of a deep overbite and the levelling of the arch is unstable in non-growing patients through molar extrusion, since vertical condylar growth and alveolar growth are unlikely to compensate. In light of this, it has been recommended that incisor intrusion be achieved using segmental arch mechanics, by applying light forces (Burstone, 1977).

Prior to any orthodontic treatment, periodontal health should be stabilised, as advanced periodontal breakdown may have several important consequences later (Johal and Ide, 1999), for example, periodontally compromised dentition results in apical movement of the centre of resistance, resulting in a greater tendency for the teeth to tip rather than move bodily (Williams et al., 1982). In patients with a history of periodontal disease, any appliance used should facilitate optimal oral hygiene. An easier way to accomplish this goal is to ensure that the excess adhesive around the bracket margins is removed, and that molar teeth are bonded rather than banded, as banding has been reported to stimulate the growth of periodontopathic organisms (Diamanti‐Kipioti et al., 1987). In addition, elastomeric ligatures have been shown to be more plaque-retentive than stainless steel ties, and as such are preferred (Forsberg et al., 1991).

Moreover, the use of intrusive forces with adult patient has been recommended as there is evidence that using intrusive forces in conjunction with periodontal treatment improves reduced periodontal conditions (Melsen et al., 1988). However, root resorption of 1 to 3 mm has been associated with the intrusion of incisors in adult patients with marginal bone loss. In view of this, it has been proposed that light forces between 5 and 15 g per tooth are used when the periodontium is healthy (Melsen et al., 1989). In contrast to what is observed in adolescents, the response of the tissues to orthodontic forces is slower in adults due to reduced cellular activity and the increased levels of collagen in the tissues (Graber, 1985). As a consequence, it is necessary to use light, controlled orthodontic forces in adults (Johal and Ide, 1999). In patients with restored teeth with crowns, bracket placement usually presents some

difficulty, firstly from the perspective of seeing the long axis of the tooth and secondly, bond strength. Similarly, in adult cases requiring extraction, the choice of teeth may be dictated by a compromised dentition, with anchorage commonly posing a problem (Scott et al., 2007).

From psychological aspect in most cases, children receive orthodontic treatment at the request of their parents (Story, 1966), Alternatively, adult patients are more likely to seek treatment independently (McKiernan et al., 1992). Often, adults have high expectations of treatment and hide their true motives (Christensen and Luther, 2015, Lew, 1993). It is unfortunate that some patients may have unrealistic expectations. These patients should be identified from the start and referred for counselling as orthodontic treatments alone will not be able to resolve psychological problems (Scott et al., 2007).

2.2.2. Reasons to seek orthodontic treatment

Treatment is typically sought by adults in one of two forms either as an adjunctive orthodontic treatment designed to improve the occlusion in order to facilitate other dental procedures or control a disease, the other is comprehensive orthodontic treatment, designed to correct all aspects of the malocclusion (Johal and Ide, 1999).

In light of the significant increase in the number of adult patients seeking orthodontic treatment, this trend has been linked to a number of explanations in the literature. Johal and Joury (2015), reported on the factors influencing adult orthodontic treatment

uptake. A variety of questionnaires were used, including the Rosenberg Self-Esteem Scale, the Oral Health Impact Profile, as well as socioeconomic characteristics and an index of treatment need, to assess the severity of the malocclusion (Johal and Joury, 2015). They found that, subjects without partners were more likely to undertake orthodontic treatment than subjects with partners. In addition, they found that self-esteem and demographic and socioeconomic position characteristics did not significantly affect the uptake of orthodontic treatment. However, one of the limitations was the cross-sectional nature of the study and; therefore, a temporal relationship between independent variables could not be established.

Other questionnaire-based studies on adult orthodontics, (McKiernan et al., 1992; Sergl and Zentner, 1997) have identified the most significant motivation to seek orthodontic treatment was improving dental appearance, followed by improving facial appearance. It was also noted by Sergl and Zentner (1997), that a functional benefit was a key motivator for seeking treatment. Sadat-Marashi et al. (2015), undertook a qualitative study to examine the subjective perceptions and values of young adults who had combined orthodontic and orthognathic surgery to correct a dentofacial deformity. The authors found that two main factors may influence the interaction and decision-making process; first, individuals need to be aware of their disease condition and the different types of therapeutic options available and secondly, the therapist needs to be aware of patients' expectations and attitudes toward themselves and their treatment options (Sadat-Marashi et al., 2015).

In the past, it has been reported that many adults avoid orthodontic treatment as a result of perceived embarrassment (Breece and Nieberg, 1986). However, with the emergence of modern aesthetic orthodontic appliances and treatment mechanics, some of the reasons to seek orthodontic treatment were the higher visual appeal of fixed appliances; fixed appliances are becoming more socially acceptable and increased awareness of orthodontic treatment options (Zachrisson, 2005).

A study by Chow et al., compared adult patients seeking orthodontic treatment for the first time with those seeking retreatment (Chow et al., 2020). Adults mainly sought orthodontic treatment for aesthetic reasons, and the vast majority were female. However, orthodontic retreatment was commonly attributed to poor treatment quality. (Chow et al., 2020). Similarly, Burgersdijk et al. (1991) found that previous orthodontic treatments that did not meet patients expectations and as such was one of the reasons that adult seek orthodontic treatment (Burgersdijk et al., 1991).

Although some research is available in regard to adults, the majority of research conducted to date has focused on the factors affecting orthodontic treatment uptake among adolescents. In a qualitative study by Imani et al. (2018) in which they investigated the factors influencing the decision to undergo orthodontic interventions among Iranian adolescents and young adults between the ages of 14 and 27 years and their families. According to this study, orthodontic decisions are affected by a wide range of factors, such as distorted mental self-image, the desire to appear more attractive, family views toward the problem, social interactions and financial constraints. In this regard, hope for a better future was the most important factor.

Additionally, due to the significance of having attractive teeth and satisfying their sense of satisfaction, families also accepted many challenges, including high costs and repeated follow-up visits (Imani et al., 2018).

2.2.3. Impact on quality of life

2.2.3.1. Physiological

Adult patients' experiences during orthodontic treatment have not been explored in great depth within the literature. Research in this area focuses primarily on patients' perceptions of pain during orthodontic treatment (Miller et al., 2007) or are limited to single appliance only (Johal et al., 2015; Johal et al., 2018). Pain is one of the most common unpleasant experiences encountered, which may significantly impair compliance, which can result in treatment being avoided or ended (Salmassian et al., 2009). Furthermore, the majority of the research available evaluating pain with orthodontic treatment focused on experiences within the first week of appliances placement (Scott et al., 2008; Abdelrahman et al., 2015; Rahman et al., 2016; Miller et al., 2007). Literature has shown that pain progresses after initial archwire placement. At four hours after placement of the first archwire, there is a noticeable increase in pain, which peaks at 24 hours, and decreases to almost baseline levels by seven days after placement (Jones and Chan, 1992; Ngan et al., 1989; Wilson et al., 1989).

In a longitudinal study by Johal et al. (2018), the effects of fixed labial orthodontics on pain and discomfort were evaluated. In their study, they followed adult patients from initial appliance placement through the third adjustment appointment at 4-months and

concluded that the most discomfort usually occurs within one to three days following each adjustment (Johal et al., 2018). As this study focused solely on the evaluation of fixed labial appliances, the archwires used were limited to round nickel-titanium, which does not express the bracket torque prescription, and thus may be less painful than rectangular wires. Ideally, pain should be assessed throughout all stages of treatment

In terms of patient experience, there are limited studies comparing fixed labial appliances with removable appliances. There has been evidence that the former causes higher levels of pain and discomfort whereas the latter causes greater functional impairment, in terms of speech and mastication, during the initial treatment period (Stewart et al., 1997; Sergl et al., 2000). In light of this, it is not surprising that there is limited research on the experiences of patients with more recent removable orthodontic appliances, such as CAT. A cohort of Invisalign patients were followed up for a 6-month period by Nedwed and Miethke (2005), in which they found 35 percent reported no pain and 54 percent experienced mild pain, which lasted two to three days after each new aligner was inserted. This same cohort reported 54 percent experienced some speech difficulties, while 44 percent reported difficulty chewing. There was no fixed appliance control group to compare their results with and the authors selected a convenience sample, with an associated risk of bias (Nedwed and Miethke, 2005).

A study was conducted to compare the levels of pain experienced during initial alignment of three different orthodontic appliances and to establish a correlation between pain levels experienced by males and females (Diddige et al., 2020). Three

groups of orthodontic patients were enrolled in this prospective, randomized three-arm parallel trial: MBT (Mini Twin; Ormco, Glendora, USA), self-ligating (Damon 3MX; Ormco, Glendora, USA), and clear aligners (Smile align, Mumbai, India). The level of discomfort was assessed using a questionnaire based on the visual analogue scale at four, twenty-four hours, three and seven days after the appliance was placed. The pain levels reported by patients treated with clear aligners during the first week of treatment were lower than those reported by patients treated with conventional and self-ligating appliances (Diddige et al., 2020). There were some limitations to the study, including a small sample size and a limited time period for pain monitoring. Better results may be achieved by implementing a continuous monitoring system.

Aside of pain and discomfort (Bartlett et al., 2005), other side effects have been reported to be associated with orthodontic treatment, including soreness, ulceration (Sinclair et al., 1986), speech impairment, impact of diet and effect on daily living and quality of life (Mandall et al., 2006). In recent years, research has focused on patient experiences regarding lingual fixed appliances (Fritz et al., 2002; Hohoff et al., 2003a; Hohoff et al., 2003b; Stamm et al., 2005). In a study of patient experiences with lingual appliances, the majority of patients reported masticatory and speech difficulties during the first three weeks of treatment, with 50-75% reporting tongue soreness, masticatory difficulties and speech difficulties. The majority concluded that the appliance was tolerable after this initial period (Fritz et al., 2002; Hohoff et al., 2003a; Hohoff et al., 2003b; Stamm et al., 2005).

According to Canikkioglu & Ozturk, lingual appliances result in higher levels of tongue soreness and speech impairment compared to fixed labial appliances (Canikliogl u and Oztürk, 2005). The results of their study were based on subjective measurements as opposed to those of Hohaff et al. (2003c) , who objectively evaluated the effects of lingual appliances through the use of voice recordings and blinded speech professionals (Hohoff et al., 2003c).

It is well known that oral health status is correlated with diet, since good oral health is essential for chewing and eating without causing dietary restrictions (Acs et al., 1992). Being aware of the potential negative consequences of such side effects is a key component to ensuring the quality of orthodontic care provided by orthodontists. Only a limited number of studies have investigated this topic, however, they focused primarily on adolescents.

2.2.3.2. Psychological

More recently, there has been an increasing interest in the relationship between malocclusion/orthodontic treatment need and health-related quality of life (Hamdan et al., 2007; Mahmood and Kareem, 2013). In accordance with recommendations of the World Health Organization, patient-centred assessments of quality of life have been incorporated into clinical research (Cunningham and Hunt, 2001). To obtain a more accurate picture of an individual's overall health, it is helpful to consider the psychological, social, and physical consequences of malocclusion and their effects on quality of life QoL; (Brook and Shaw, 1989; Inglehart and Bagramian, 2002). It has been reported that orthodontic treatment is more likely to improve QoL in cases with

mild to moderate disorders compared with those suffering from severe malocclusions (Bernabé et al., 2008; Borzabadi-Farahani, 2012)

In a study of adult patients with fixed labial orthodontic appliances, (Johal et al., 2015) investigated whether fixed labial orthodontic appliances affected self-esteem and QoL. During the initial three months of treatment, they found that their cohort of patients experienced a negative impact on their oral health-related quality of life (OHRQoL), but this was reverted to pre-treatment levels after this period. In addition, orthodontic treatment was shown to increase the self-esteem of these patients once treatment was completed. However, this study evaluated only fixed labial orthodontic appliances. A comparison of fixed orthodontic appliances and clear aligners is lacking in research.

Miller et al., (2007), conducted a study to compare QoL between patients following the placement of Invisalign aligners® and labial fixed appliances, over seven consecutive days. They found that patients treated with Invisalign® reported significantly fewer negative impacts on their quality of life and experienced less pain than those treated with fixed labial appliances (Miller et al., 2007). As this study had a very short follow-up period, longitudinal information regarding patient impact cannot be obtained. In addition, the questionnaire used has not validated, so it is important to interpret their findings caution.

A recent systematic review was conducted by Mandava et al., (2021), aimed to determine whether there is a correlation between oral health-related QoL and self-esteem in patients following orthodontic treatment. Based on their review, it was

concluded that orthodontic treatment utilizing fixed appliances results in a significant improvement in oral health-related QoL (Mandava et al., 2021). However, the evidence is unclear whether self- esteem has increased or decreased in adults by the end of the treatment.

2.3. Qualitative research

2.3.1. Overview

In orthodontics, research has traditionally been based on the belief that direct causal relationships exist between diseases and aetiology (Newton, 2000). The focus of the majority of dental research, has been on the application of quantitative methods with no reflection of patient's perspective (Tsichlaki and O'Brien, 2014). Dolan (1993), defined oral health as having comfortable and functional dentition that allows individuals to continue to engage in the social roles they desire (Dolan, 1993). According to this, whenever we are attempting to measure the extent to which an intervention returns an individual to an optimal state of oral health, we should use outcomes that are relevant to this definition (O'Brien, 2013). Therefore, research should be designed to include outcomes that are relevant to both providers and consumers, the author proposed the need for other research methods in order to gain a deeper understanding of orthodontic treatment's multifaceted nature (O'Brien, 2013). Qualitative research is the most effective method for accomplishing this.

The acceptance of qualitative research studies by scientific journals has improved dramatically; with a positive move away from the initial perceived view that this form of research was non-scientific in nature (Almeida et al., 2018). The primary objective of qualitative research is to provide a deeper, contextualized understanding of social

phenomena through intense studies of specific cases within natural environments, as opposed to quantitative research which seeks to establish generalizable facts under controlled experimental settings (Polit and Beck, 2010). Therefore, qualitative research methodology is ideally suited to investigating areas where little information is available or understood, or to gain access to unique opinions that cannot be assessed through quantitative methods (Silverman, 2016). Within qualitative research, data can be collected by different methods such as focus groups, in-depth interviews, and observations. The decision to use one method over another is based on a number of factors, such as the research topic, the study population, the nature of the data, and practical considerations such as accessibility, social context, and the subject matter's sensitivity (Ritchie et al., 2013).

2.3.2. Qualitative interviews

Interviews in qualitative research can be classified into either in-depth interviews or focus groups. A focus group gathers data from a large number of participants at the same time, discussions are held on a particular topic for research purposes. During this discussion, a researcher sometimes called a facilitator guides, monitors and records the conversation (Kitzinger, 1994; Morgan, 1998). They are useful for gathering information generated through group interaction or for displaying social context. As part of a focus group, participants are encouraged to interact with each other in a collective setting. In this dynamic interactive process, participants can come up with new ideas and discuss the research topic in greater depth (Stewart and Shamdasani, 2014).

In contrast, in-depth interviews are the most commonly used and a long-established qualitative data collection methods in the healthcare sector (Stewart et al., 2008). They can be classified as structured, semi-structured, and unstructured (Gill et al., 2008). In structured interviews, a list of predetermined questions are asked, without much variation and without any opportunity for follow-up questions. They therefore have the advantage of being relatively quick and easy to administer, particularly if clarification of certain questions is needed or if the respondents may encounter problems with literacy or numeracy. They are, however, limited in their ability to allow participants to provide extensive responses and, as a result, they are of little value when it comes to providing a in-depth analysis (Gill et al., 2008).

Contrary to structured interviews, unstructured interviews are performed with little or no organization and are not influenced by preconceived ideas or theories (May, 1991). An interview of this type typically begins with an opening question and proceeds according to the response(s) received. A typical unstructured interview can take several hours and can be difficult to manage. There are usually no predetermined questions to provide guidance as to what to talk about during the interview. Therefore, their use is generally limited to situations where significant "depth" is required, or where little is known about the topic to be studied (Gill et al., 2008).

The semi-structured interview involves several key questions that help define the areas to be explored, but they also give the interviewer &/or interviewee the opportunity to delve deeper into an idea or response if they choose (Britten, 2006). In the healthcare setting, this format is most commonly used because participants receive some guidance on what to discuss, which many find helpful. In addition to its flexibility,

this approach is also useful for the discovery or elaboration of information that is important to participants but may not be perceived by the research team as relevant at the time of the interview (Gill et al., 2008).

In light of the growing popularity of adult orthodontics and the availability of alternative aesthetic appliances, there is a need for further research in this area. In the last two decades, qualitative research has become a widely accepted and popular method for gaining a more in-depth understanding of the relevant topic of interest (Feldmann et al., 2007; Ryan et al., 2009) When a study seeks to understand the experience and feelings of individuals, qualitative methodology is highly appropriate (Draper, 2004). In respect of adult orthodontics treatment, there is a lack of well-designed qualitative studies in the literature. In this context, a qualitative approach would be invaluable in exploring the factors that adults consider when making their decision to seek not only orthodontic treatment but also the type of appliance and their subsequent experiences.

3. Aim, objectives:

3.1. Aim:

To understand why adult patients, undergo orthodontic treatment, in particular their reasoning and overall experience with their choice of appliance.

3.2. Objectives:

1. To explore the reasons why adults seek to undergo orthodontic treatment.
2. To explore the specific reason(s) for why adults choose different treatment modalities.
3. To explore adults' perspectives about how clear aligners, fixed labial and lingual appliances, impact on their aesthetic, functional and psychological perspectives.

4. Materials and methods:

4.1. Study design

This is a qualitative study involving semi-structured interviews, conducted on adult participants recruited from four different London-based orthodontic private practises.

4.2. Ethical approval

Ethical approval for this study was obtained from Queen Mary University of London's Research Ethics Committee (REC Reference: QMERC2019/60, Appendix 1).

4.3. Participants

4.3.1. Recruitment

The study recruited adult participants from private orthodontic practice settings. Participants who meet the eligibility criteria were invited to take part in the study, and a written informed consent was obtained (Appendix 2). An anonymous code was assigned and no identifiable information was gathered. A list of the eligibility criteria for the study is provided in (Table 1).

Eight different private practices that provide orthodontic treatment were invited via email to participate; four of those practices expressed willingness to participate in this study. Following identification of appropriate participants by the treating clinician, they were invited to take part in the present study at their routine appointment; an explanation of the purpose and nature of the study was presented to them in both verbal and written formats.

Each participant in the study received an information sheet regarding the research project (Appendix 3). This informed them that the interview would discuss their orthodontic

treatment experience and if that affected their quality of life, self-esteem, appearance. Participants were provided with an opportunity to ask questions and time to consider their responses. In accordance with Good Clinical Practice guidelines, participants were reassured that participation was voluntary. If they chose not to participate, their treatment will not be adversely affected, and they are free to withdraw from the interview at any time.

Table 1: Inclusion and Exclusion criteria

Inclusion criteria	• Adults at least 18 years old at the time of interview. • Orthodontic treatment with clear aligners, fixed ceramic labial or lingual appliances (single or double arches) • Undergoing treatment for at least two months to assess the effect of appliance in their quality of life. • Willingness to participate in the study
Exclusion criteria	• Malocclusions with craniofacial syndromes or dental anomalies. • Subjects who exhibit temporomandibular dysfunction. • Patients who were prescribed analgesics or antidepressant medication for psychiatric disease. • Patients with chronic medical conditions.

4.3.2. Sampling technique

In order to achieve maximum variation, a purposive homogenous sampling technique was employed to allow comparison between participants having different treatment modalities. For the recruitment of participants, a sample matrix was created based on their assigned appliance and stage of treatment at the time of the interview (Table 2).

Arbitrarily, an early treatment group was defined as those who were two to six months into treatment, a late treatment group as those who were beyond six months of treatment, and a post treatment group for those who had removed their appliances.

Table 2: Distribution of participants by appliance group and stage of treatment

Appliance group	Treatment stage			Total participants
	Early	Late	Post	
FC		3,6,7,8	1,2,4,5	8
RA	9,10,11,12	13,14,16	15	8
FL	17,18,22	19,20	21	6

*FC= Fixed labial ceramic appliances, RA= Removable Aligner, FL= Fixed lingual appliances, * (1-22, participants identification number) distributed according to treatment stage.

4.4. Interview setting

4.4.1. Location

The interviews were conducted by a post-graduate student (SD), who had completed formal qualitative research training prior to commencing the study. In order to conduct the interviews, the participants were invited to participate in an online platform using Microsoft® Teams (Redmond, USA) software, which both the interviewer and participants were familiar with. The justification for incorporating an online platform is that data collection for this study was initiated during the COVID-19 (SARS-CoV2) pandemic, when access to face-to-face meetings was restricted. Therefore, the online format was adapted to comply with the government guidelines.

4.4.2. Interview process

In order to achieve the required depth of answers, an interactive approach was used, utilizing simple language to obtain reasons, opinions, feelings, and beliefs. Interviews were conducted in a manner that balanced structure and flexibility. Interviews were conducted without any time constraints. Interviews lasted generally between 40 and 70 minutes, with an average of 50 minutes duration.

4.4.3. Stages of interview

The Interviews were staged by the interviewer based on (Ritchie et al., 2013) recommendations:

- Stage 1 (Arrival):

  The interview officially begun when the participant meets the interviewer. The interviewer greets the participant informally during the first few minutes to develop a rapport. Once the participant is relaxed and comfortable, the next stage was taken.

- Stage 2 (Introducing the research):

  This stage includes explaining the research idea to participants, allowing them to ask questions regarding the study, and confirming their participation. Participants were assured at this stage that all of their information is confidential, and they do not need to worry about right or wrong answers.

- Stage 3 (beginning the interview):

  At this point, the audio recording begun. Interviewer started by asking participants a few questions to gather some basic information about them, including their personal background (such as their age and profession). In

addition, participants were asked about the type of appliances they had each of these questions is intended to contribute to the study goals. Consequently, the interviewer was able to proceed smoothly to the main interview.

- Stage 4 (During the interview):

  The interview was dominated by this stage. There is a topic guide with predetermined themes (see Appendix 3). The guide contains a list of open-ended questions in a semi-structured format designed to explore why adults undergo orthodontic treatment, and the impact orthodontic appliances have on them. According to the participants responses, the interviewer may ask additional questions.

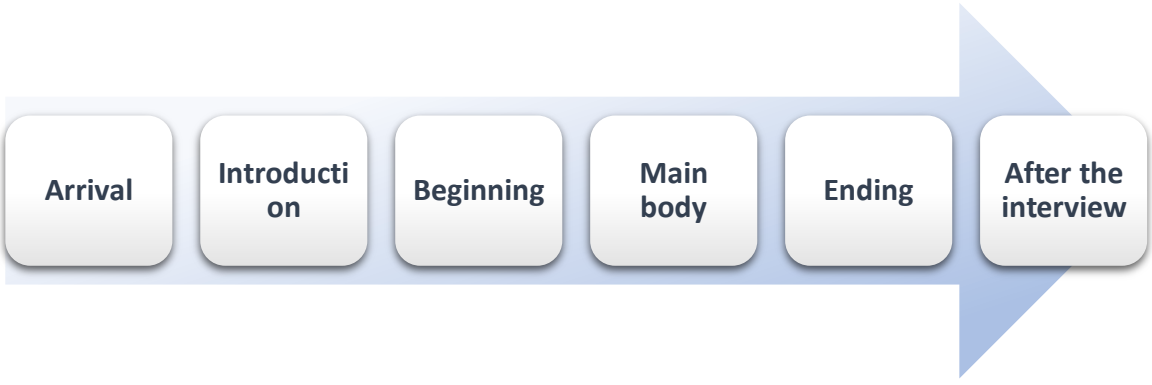
- Stage 5 (Ending the interview):

  Toward the end of the interview, the interviewer asked participants if there were any topics that they wanted to expand on.

- Stage 6 (After the interview):

  In closing, the recorders were turned off, and participants were thanked for their time and contributions.

Figure1: Stages of interview conduction



4.5. Instruments

4.5.1. Topic guide

A Topic guide was formulated and revised by the research team (AJ; SD) based on prior experience, literature review and study objectives. The guide provided questions on the following topics:

- Exploring participants' reasons for choosing orthodontic treatment.
- Exploring participants' reasons for choosing one treatment modality over another.
- Exploring participants' views on the impact of various appliances on quality of life (function, aesthetics, self-esteem and social life).

4.5.2. Piloting the topic guide

After the research team had agreed on conducting semi-structured interviews. Two pilot interviews were conducted to examine the clarity and scope of the guide, as well as to determine the depth of information being collected (Eberle et al., 2016). The pilot study included two participants each undergoing clear aligner and fixed ceramic labial appliance treatment. The data from those participants were not included in the final data analysis. Consequently, the topic guide was revised; the main structure of the topic preserved throughout the study.

4.5.3. Field notes

Using field notes, provides the opportunity to record any observation outside the interview context which could not be captured by the recorder, a notebook was used

by the interviewer to note additional information. This included facial expressions and body language.

4.5.4. Data recording and conversion

In order to record interviews, two recorders were used- a digital recorder (WS-831, Olympus Corporation) and Microsoft Teams platform recorder without inclusion of any personal identifiable information. Subsequently, the files were sent to an external company (Essential Secretary Ltd, UK) for verbatim transcription.

4.6. Data analysis

4.6.1. Participants' Demographic and Clinical Data

Data concerning the demographic and clinical characteristics of interview participants were compiled in a descriptive manner (age, gender, occupation, type of appliance and stage of treatment).

4.6.2. Framework methodology

After the interviews were recorded and transcribed, the principle of framework methodology was adopted in data analysis. The framework analysis is a qualitative data analysis method used to organize and manage research through summarization of findings. The methodology entails reading through the interviews and identifying recurrent themes, followed by independent coding of the information derived from the data. Using this approach, themes can be constructed comprehensively and compared between participants and groups (Gale et al., 2013).

Major themes were identified and highlighted in a specific colour. Once the research team (AJ; SD; FC) had agreed upon the main themes, quotes were extracted from

the transcripts and inserted into a Microsoft Excel spreadsheet to enable easy data management. There was a separate worksheet assigned to each objective, which was then divided into themes and subthemes identified and assigned columns. For each participant, a row was generated, and data from the transcripts was entered into the appropriate cell. For each comment added from the transcripts, the line numbers in the transcripts were included to allow easy identification and referencing.

An early stage of data analysis (interpretation) was undertaken. Regular meetings were held to cross-examine each other's analyses, ensuring there were no biases associated with individual researchers. The parties discussed their differences, and if necessary, a third researcher was consulted to reach agreement.

4.6.2.1. Sequence of Framework methodology:

- Familiarisation: Acquiring a thorough understanding of the entire interview by listening to the recording and going through the transcript. This is regarded as an essential step in interpretation.
- Identifying framework: An initial coding framework derived from prior issues and emerging issues from the familiarisation stage. The thematic framework should be developed and refined during successive stages.
- Indexing (Coding): The process of applying the thematic framework to the data using numerical or textual codes (this is the first step in coding an interview transcript).
- Charting data into the framework matrix: The process of charting involves summarising the data from each transcript. For an effective chart to be constructed, a balance must be struck between reducing the data on one hand

and maintaining the meaning and 'feel' of what the interviewees said on the other.

- Interpreting the data: It usually involves mapping connections between categories to discover relationships between them. It is useful to begin interpreting the data early by recording findings and exploring interesting ideas or theme (Ritchie et al., 1994).

Figure 2: Process of framework analysis, based on Ritchie and Spencer (1994)

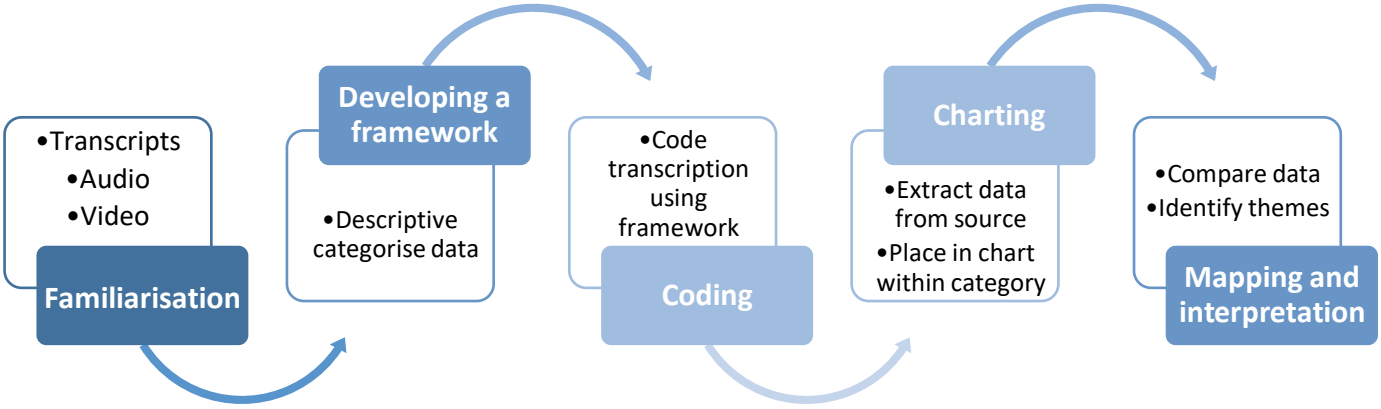


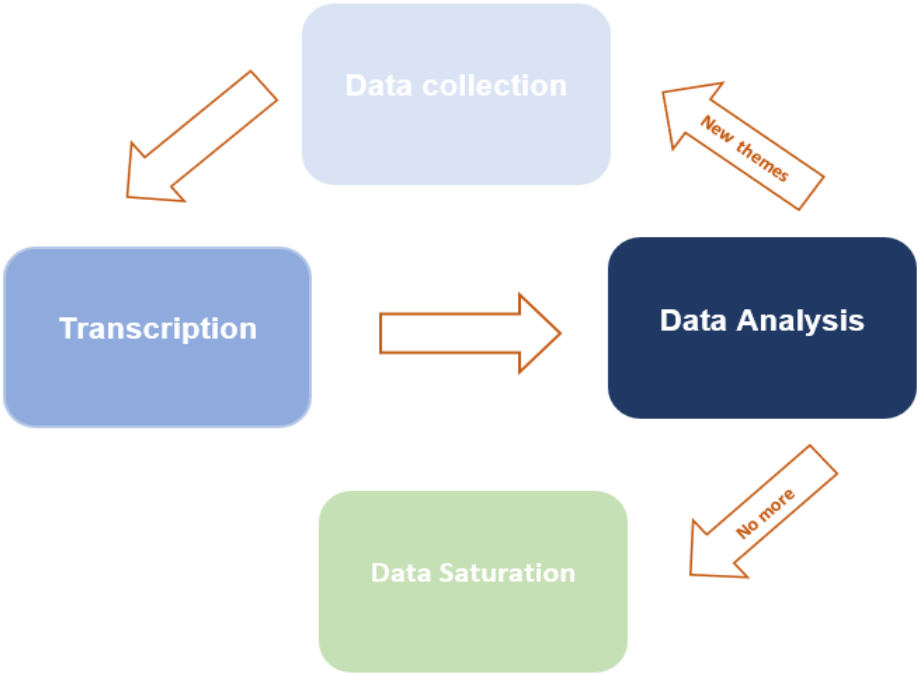
Figure 3: Theme generation (Microsoft Excel ™)

	A	B	C	D	E	F	G	H
1								
2					Rational			
3					Psycosocial impairment		Health related issues	
4	ID	Gender	Age	Stage of treatment	Self image / perception	Social acceptance	Fear of further deterioration of their dental he	Functional impairment
5	Interview 1	F	66	Post treatment	when you have grandchildren, they said oh is that your angry tooth, nana? I thought oh no. So, that was a part of it. I didn't want to have an angry tooth.			I think quite simply it was what was recommended to me, in the long-term, going to be the better solution for my teeth
6	Interview 2	F	52	Post treatment		jaw problem, inability to eat , appearance of teeth, i have hundred percent trust on my orthodontist	my jaw was kind of out of line, i don't have a correct bite which has caused all my dental problems it was either have my jaw broken and reset or have braces and try to align the bite, and also i could only ever eat properly on one side of my mouth, and my teeth also were very crowded and overlapped	so i based my decision based on the consultation with the orthodontist he is an expert i trust what he says
7	Interview 3	F	46	Late treatment	I remember my brothers commenting on his teeth and I remember looking at his teeth and just thinking, that's how my teeth look, And I became a bit more conscious of it.	realised I was starting to look more awkward in photographs, also i used to go to hygienist like every two or three months, it's expensive, I may as well try and get braces to make it a bit easier to clean		orthodontist told me he thought that was better for me and I would get a better outcome with this brace and it would be on for less time, I trusted him to guide me in the best, if they seem l
8	Interview 4	F	34	Post treatment		I did my research, picked him because could see t he was a professor I was like he study and know what he's doing, and built up the trust throughout the treatment.	I had an underbite it was getting worse and worse, and I was having some real jaw pain and and I was worried at one point if my chin would be out here	I was doing my research , it seemed like for underbites train tracks were the best way to go and having my mouth in the proper place was more important to me than like the aesthetics of it
9	Interview 5	M	38	Post treatment	I had an appointment with my hygienist and I am very friendly with her, I remember she said if you are focusing on your teeth have you ever thought of straightened them she also mentioned that it looked like you shaved your teeth from erosion and it panicked me	recommended by general dentist, inability to clean, getting worse, bite will cause futher problems	i noticed erosions and i was told because my teeth are joining and it is going to be worse because they are grinding on each other	I have a stomach disorder so I have periods when I a am hungry and I have to take advantages of those otherwise I won't eat something for 2- 3 days so the thought of having to take the braces out ,

4.6.3. Data Saturation

According to Glasser, theoretical saturation is defined as the point at which all variations of the data have been identified, and further research does not yield additional information (Glaser and Strauss 2009). Qualitative research does not aim for statistical significance, so a particular type of data only needs to appear once in the analysis for inclusion into the analysis. Initially, a list of codes is generated from the first round of interviews, which then grows with each additional interview. Throughout the process, codes have begun to repeat more frequently and the number of new codes has begun to decrease. Eventually a phase is reached in which all codes in an interview have appeared in previous interviews, and no new codes are produced. The data saturation point is reached when there have been no new codes produced from the last two interviews conducted.

Figure 4: illustration of data saturation



5. Results

5.1. Characteristics of participants

Twenty-two participants were invited to participate in the study (13 females and 9 males; mean age of 38.9 years old, SD = 11.66) all of whom agreed to take part in the semi-structured interview. Eight participants were from the fixed ceramic labial appliance group (4 females and 4 males; mean age of 42.7 years old), eight participants were from the removable aligner group (4 females and 4 males; mean age of 34.5 years old), and six participants were from the fixed lingual appliance group (5 female and 1 male; mean age of 39.4 years old). Data saturation was reached after interviewing participant twenty; no new themes or subthemes were generated for the subsequent two interviews, (Table 4) summarizes participants' demographic characteristics, appliance groups, and stages of treatment.

Table 3: Participants' characteristics

Participant number	Gender	Age	Occupation	Appliance group	Treatment stage
1	F	66	Retired	FC	Post treatment
2	F	52	Recruitment consultant	FC	Post treatment
3	F	46	Specialist vet	FC	Late treatment
4	F	34	IT specialist	FC	Post treatment
5	M	38	Financial advisor	FC	Post treatment
6	M	30	IT specialist	FC	Late treatment
7	M	44	Business man	FC	Late treatment
8	M	32	Dentist	FC	Late treatment
9	F	25	Receptionist	RA	Early treatment
10	F	24	University student	RA	Early treatment
11	F	47	Entrepreneur	RA	Early treatment

12	F	28	IT specialist	RA	Early treatment
13	M	57	Salesman	RA	Late treatment
14	M	48	Researcher	RA	Late treatment
15	M	18	University student	RA	Post treatment
16	M	29	Regulatory risk officer	RA	Late treatment
17	F	49	Teacher	FL	Early treatment
18	F	40	Virologist	FL	Early treatment
19	F	40	Executive assistant	FL	Late treatment
20	F	42	Performer/ teacher	FL	Late treatment
21	F	31	Civil engineer	FL	Post-treatment
22	M	37	Financial advisor	FL	Early treatment

5.2. Themes and subthemes

Using the framework methodology, the data have been divided into three distinct sections, each corresponding to one of the study objectives. Firstly, to identify reasons that influence adults to seek orthodontic treatment (5.2.1). Secondly, the rationale for choosing specific treatment options (5.2.1), and finally, the impact of different orthodontic appliances on participants' quality of life (5.2.3). In general, six main themes and fifteen subthemes were identified in relation to the study objectives, (Table 4) illustrate detailed descriptions of each theme and subthemes.

Table 4: List of themes and subthemes

Objective	Main themes	Subthemes		
1.Reasons for undertaking orthodontic treatment	A. Psychosocial influence	A1. Self-image and perception	A2. Social acceptance	
	B. Dental health related issues	B1. Avoidance of further deterioration of their dental health	B2. Functional impairment	
2.Reasons for selecting an orthodontic appliance	C. Social influence	C1. Patient-orthodontist professional relationship	C2. Past orthodontic treatment experience of family/ friends	
	D. Appliance features	D1. Aesthetic appearance	D2. Perceived effectiveness of orthodontic	D3. Pragmatic consideration
3.Impact of the orthodontic appliance on participants' quality of life	E. Functional impairment and symptoms	E1. Pain and discomfort experience	E2. Functional changes	E3. Changes in dietary habits and routine
	F. Psychosocial impact	F1. Self-image	F2. Self-consciousness/ Self-confidence	F3: Social interaction

5.2.1. Reasons for undertaking orthodontic treatment

This section reports the findings which addressed the first study objective: to explore the reasons why adults seek to undergo orthodontic treatment. Overall, psychosocial and health related factors influenced participants' decision to undertake orthodontic treatment. (Table 5) illustrates the two themes and four subthemes that emerged from the data analysis. Each of them is presented below.

5.2.1.1. Theme A: Psychosocial influence

Psychosocial influences were cited as a major reason for seeking orthodontic treatment by participants. This included people commenting on the appearance of their teeth, their appearance in pictures, and past teasing experiences. Participants discussed in detail the significance of these issues; psychosocial influences were cited as a major reason for seeking orthodontic treatment by participants. The poor appearance of their teeth affected the way how participants felt about themselves and resulted in them generally feeling less comfortable and more conscious about their teeth; thus, leading to seek for professional help.

5.2.1.1.1. Subtheme A1: Self-image and perception

There was a universal agreement that the appearance of their teeth affected participants' perception of themselves and self-image; resulting in undergoing orthodontic treatment. Participants talked about their desire to enhance their dental appearance and have a more aesthetic smile. For some participants, seeking treatment meant, being able to smile naturally and feeling better about themselves afterwards.

"I did it to have straight teeth. So, just to have a nice smile, and a part of it is how I look in pictures" (Participant 13: Male,57, Salesman, RA)

"Primarily aesthetic my teeth became very wonky, the thing that bothered me the most when I smile" (Participant 21: Female, 31, Civil engineer, FL)

A number of participants discussed the effect of dental appearance on self- image. The importance of photographs and social media were highlighted by several participants across the treatment groups. Some went further to explain that they used to avoid smiling and purposively hid their smile prior to treatment. Their dissatisfaction with their dental appearance or inability to smile in photos prompted them to seek orthodontic treatment:

"I realised I was starting to look more awkward in photographs" (Participant 3: Female, 46, Specialist vet, FC)

"I found it really upsetting to look at pictures of myself, where my mouth was open, I felt like I couldn't smile" (Participant 21: Female, 31, Civil engineer, FL)

Along the same lines, the importance of self-image in photographs was explained more in some instances because of the widespread use of social media nowadays and comparing their appearance with that of their peers, as reported below:

"The thing with social media, that you just constantly see photos of yourself, like with other people who've got straight teeth. It's like oh my teeth look ridiculous" (Participant 17: Female, 49, Teacher, FL)

Furthermore, some participants highlighted that their working environment of being photographed or filmed most of the time made them more aware of their appearance in photos and caused some self-conscious issues as follows:

"I was watching myself on video, because I always cut them into clips and I hated my wonky smile, when you see yourself on video, you see yourself how others see you "(Participant 11, Female, 47, Entrepreneur, RA)

"I was feeling more self-conscious about my teeth especially I had a lot of speaking in public at conferences and on video so obviously in those situations you feel more self-conscious" (Participant 14: Male, Freelance researcher, RA)

According to some participants, seeking orthodontic treatment was attributed to growing older or reaching certain milestones, but in those instances, it was merely a secondary motive and not the primary motivation for undergoing treatment, as mentioned below:

"I think subconsciously turning 40 maybe made me want to sort my teeth out. I don't know. It's a big milestone" (Participant 18: Female, 40, Virologist, FL).

"I guess part of it I'm in my early forties, I probably wanted to feel as confident as I could with my teeth" (Participant 20, Female, 40, Performer/ teacher, FL).

In addition, one individual from FL group, reported that she wanted appliance that provide maximum discretion to remain anonymity not to disclose her treatment to others.

"Appearance was very important, I was very clear that I wanted something very discreet, because I don't like the appearance of braces, also the vanity of not

necessarily wanting to tell people that I was having it done" (Participant 20, Female, 40, Performer/ teacher, FL)

5.2.1.1.2. Subtheme A2: Social acceptance

Social acceptance emerged from the data analysis as a significant factor in participants' decision-making process to undergo orthodontic treatment. Participants discussed how their dental appearance had an impact on their social acceptance and the way that people perceived them. Situations such as talking with friends and family, social interactions at school, university and work were commonly discussed among participants. The importance of fitting in a social group better and feeling similar to others was commonly reported by some:

" I guess as you get older the more you notice things about it like all the people around you have got straight teeth" (Participant 17: Female, 49, Teacher, FL)

There was an internal motivation to enhance dental and facial aesthetics to avoid negative comments from people around them, as reported below:

"My grandchildren said oh is that your angry tooth, nana? I thought oh no. so, that was a part of having the treatment done, I didn't want to have an angry tooth" (Participant 1: Female,66, Retired, FC)

Moreover, the desire to cease teasing along with the impact of negative experiences such as childhood bullying led some participants to undergo orthodontic treatment, for example.

"It's probably psychological, from a very young age, my front two teeth were very prominent. I was teased at school they used to call me Bugs Bunny" (Participant 13: Male,57, Salesman, RA)

5.2.1.2. Theme B: Dental health related issues

One of the most commonly reported factors to undertake orthodontic treatment was related to dental health-related issues. This was discussed in relation to avoidance of the deterioration of dental and oral health, and functional impairment which limited their ability to carry out normal functions, such as eating and cleaning their teeth.

5.2.1.2.1. Subtheme B1: Avoidance of further deterioration of their dental health

Avoidance of further deterioration of dental and oral health that could arise if treatment had not been undertaken was expressed in many different ways as a major motivating factor to seek orthodontic treatment. The prevention of worsening of their bite or further erosions of their teeth, some examples discussed among participants.

> *"I had an underbite it was getting worse and worse, I was worried at one point if my chin would be out here" (Participant 4: Female,34, IT specialist, FC).*

> *"I noticed erosions in my teeth and I was told by my dentist because my teeth are grinding on each other it is going to get worse, so I panicked and said immediately sign me up for treatment" (Participant 5: Male, 38, Financial advisor, FC).*

Some believing that the health and appearance of their dentition are deteriorating as they are getting older, as highlighted below:

> *"My teeth were pretty wonky, all over the place, and I think they were just getting worse with age" (Participant 6: Male, 30, IT specialist, FC).*

In addition, other individuals attributed this problem to their failure to adhere to the wearing of orthodontic retainers following their previous orthodontic treatment as teenagers, for example:

"My teeth became worse after my previous treatment and it was just to get them back to where they were once" (Participant 9, Female, 25, Receptionist at dental practice, RA)

"I noticed they were becoming more and more crooked, I never had a retainer when I had braces as a teenager, so was quite a lot of slippages" (Participant 20, Female, 40, Performer/ teacher, FL).

5.2.1.2.2. Subtheme B2: Functional impairment

Participants reported that one of the primary reasons for undergoing orthodontic treatment was to enhance functionality, which would improve their ability to eat and clean their teeth properly. They provided examples of the difficulties experienced when eating and cleaning their teeth prior to treatment, as mentioned below:

"I could only eat properly on one side of my mouth" (Participant 2: Female,52, Recruitment consultant, FC)

"The main reason why I'm doing it is because I've had a lot of issues with my gums, I've had three gum graphs, and just having straight teeth, enables you to floss better" (Participant 12: Female,28, IT specialist, RA)

Interestingly, one participant went further and pointed out, her inability to clean her teeth had led to financial implications due to more regular visits to the hygienist; thus, reporting that having orthodontic treatment would benefit her in that regard.

"I thought I might get braces to make my teeth a bit easier to clean, because I used to go to the hygienist every two or three months, and it's expensive" (Participant 3: Female, 46, Specialist vet, FC).

5.2.2. Reasons for selecting an orthodontic appliance

This section presents the findings in relation to the second objective of the study: to explore the specific reasons for choosing different treatment modality by adult patients. A combination of social influence and appliance features were found to influence participants' decision to select different appliances. (Table 5) illustrates the two major themes and five sub-themes that emerged from the analysis of the data. In the following paragraphs, each is described in more detail.

5.2.2.1. Theme C: Social influence

Participants' motivation to choose of different orthodontic appliances were strongly influenced by those they interacted with prior to the treatment including their clinicians, family members, and friends.

5.2.2.1.1. Subtheme C1: Patient-orthodontist professional relationship

The data analysis suggests that the strong professional relationship between participants and their orthodontists was an influential factor for selecting their orthodontic appliances. Some participants went further and reported that the good rapport and trust in their clinician's guidance and recommendations as well as judgment and abilities were imperative to make their decisions.

> *" I based my decision on the consultation with the orthodontist he is an expert I trust what he says" (Participant 2: Female,52, Recruitment consultant, FC)*

> *"I trusted him to guide me in the best, if they seem to be confident if they give me a recommendation that seems sensible" (Participant 3: Female, 46, Specialist vet, FC)*

In adhering to the orthodontist's recommendation, some participants attributed this to their clinician’s higher level of knowledge

“I could see that he was a professor, I was like he knows what he's doing” (Participant 4: Female,34, IT specialist, FC)

5.2.2.1.2. Subtheme C2: Past orthodontic treatment experience of family and friends

Past orthodontic treatment experience of family and friends was reported by many as either positive or negative motivational factor for selecting a particular appliance. Successful past orthodontic treatment of family and friends experience described as being pain free and effective influenced participant’s decision to select removable aligners as reported below:

“Because my sister had it and she had a good experience, and her teeth are similar to mine” (Participant 10: Female,24, University student, RA)

In contrast, experiences involving unpleasant aesthetics and eating difficulties were mentioned by fixed appliances group as a negative motivational factor to select removable aligners, as mentioned below:

“I saw a friend with Invisalign there were bubbles everywhere personally I did not see the appeal” (Participant 5: Male, 38, Financial advisor, FC)

“My friend had Invisalign, he was taking it out to eat. I just remember thinking, oh God I couldn’t do that, definitely not” (Participant 17: Female, 49, Teacher, FL)

5.2.2.2. Theme D: Appliance features

As participants were asked to articulate their reasoning behind their choice of treatment modality, different aspects of the appliances' features were reported, including the aesthetic appearance, perceived effectiveness of the appliance and pragmatic considerations. A more detailed discussion is given below.

5.2.2.2.1. Subtheme D1: Aesthetic appearance

Participants across the three groups stated that the appliance aesthetics played a significant role in determining the type of appliances they chose. Few participants stated that they preferred an orthodontic appliance to be as blended as possible not to compromise their facial appearance, as highlighted below:

> *"One thing about ceramic braces is that you know, it's much harder to see" (Participant 6: Male, 30, IT specialist, FC).*

Some participants from RA and FL appliance groups went further to explain that the nature of their work required an appliance that were less visible; constant interaction with people was noted as a decisive factor to select a more aesthetic appliance, as mentioned below:

> *" The appearance of the brace was very important especially being patient facing all the time with my job it makes a difference, the more discrete they are" (Participant 9, Female, 25, Receptionist at dental practice, RA)*

> *"As a teacher, kids in school would be like, oh Miss, you've got braces, it's not my friends because they'd just be normal about it, it's that I'm with 100 teenagers at work" (Participant 17: Female, 49, Teacher, FL)*

"Because of my job it requires being in front of the camera so it was very important to me to have them as masked as possible" (Participant 18: Female, 40, Virologist, FL)

In addition, participants talked about the impact of the selection of the appliance on their self-image. They felt that they would be able to smile more and naturally if chosen a less visible orthodontic appliance:

" I'm a person who smiles a lot, so if, the braces that are visible, were the only option, I would not have done it" (Participant 12: Female,28, IT specialist, RA)

The long-term requirement for fixed orthodontic appliances, was viewed as unrealistic by few participants of RA group.

"I didn't really feel comfortable going a visible brace because I thought if it's going to be a two- year process" (Participant 15: Male, 18, University Student, RA)

5.2.2.2.2. Subtheme D2: Perceived effectiveness of orthodontic appliances

Perceived effectiveness of orthodontic appliances was primarily reported as the reason to select their orthodontic appliances by participants in the fixed appliances groups (FC, FL). Among the reasons explained, some participants reported how a particular orthodontic appliance would be effective in treating their malocclusion, leading to a successful treatment outcome. For some of them, the appearance of the appliance was irrelevant, as reported below:

"I was doing my research, it seemed like for underbites train tracks were the best way to go and having my mouth in the proper place was more important to me than the aesthetics of the braces" (Participant 3: Female, 46, Specialist vet, FC).

In the case of other participants, effectiveness was important to facilitate achieving the best outcome possible

"My orthodontist said go with ceramic braces, if you wanted the best results and I wanted the best results" (Participant 6: Male, 30, IT specialist, FC)

"I got the aesthetic through the ceramic braces and controlling tooth movement which will give me the result I want" (Participant 8: Male, 32, dentist, FC)

"It was described that train tracks would have a better outcome, and potentially faster outcome" (Participant 18: Female, 40, Virologist, FL)

In contrast, few participants explained their reluctance to use removable appliances as a result of their lack of confidence in their effectiveness

"Invisalign was not an option because my mouth was too complicated" (Participant 2: Female,52, Recruitment consultant, FC)

"We were looking at train tracks, basically, we were only looking at fixed appliances because all of the orthodontists had said to me, "Yeah, don't do Invisalign, it's not going to work for you" (Participant 21: Female, 31, Civil engineer, FL)

5.2.2.2.3. Subtheme D3: Pragmatic considerations

Only one group – RA – of participants discussed pragmatic considerations as the main reason for selecting a particular type of appliance. The examples provided included the ability to remove the appliances at any time; the lack of restrictions on the types of foods consumed; and remote monitoring which required fewer visits to the dentist while on holidays, as reported below:

"The convenience factors the fact that had I gone back to New York, the orthodontist was able to still monitor me from New York and worst-case scenario, he would ship me stuff so it was a doable option" (Participant 11, Female, 47, Entrepreneur, RA).

"I don't have to worry about what type of food to eat" (Participant 13: Male,57, Salesman, RA)

"The ability to take it out was very attractive to me, you can retain complete freedom while also going through this process" (Participant 18: Female, 40, Virologist, FL).

5.2.3. Impact of the orthodontic appliance on participants' quality of life

The purpose of this section is to present the findings in relation to the third study objective. This is to explore adults' perspectives about how clear aligners, fixed labial and lingual appliances, impact on their aesthetic, functional and psychological perspectives. A functional impact as well as a psychosocial impact influenced patrician's experiences throughout their orthodontic treatment. A summary of the data analysis is presented in (Table 5). The data analysis revealed two major themes and six subthemes. Each of these is described in more detail in the following paragraphs.

5.2.3.1. Theme E: Functional impairment and symptom

The data analysis revealed that participants experienced various functional impairments and symptoms while wearing the FC, RA, and FL appliances, particularly during the initial stages of treatment. The most commonly reported examples included pain and discomfort, speech impairment, excessive salivation, masticatory difficulty and dietary habit changes. Nonetheless, the initial stages of treatment characterised by negative experiences were followed by a period of adjustment and adaptability.

5.2.3.1.1. Subtheme E1: Pain and discomfort experience

Symptoms were perceived differently by participants across the appliance groups. An unexpected degree of pain was expressed by many participants during the initial stages of treatment after having the appliances fitted. These experiences were mainly reported by participants wearing fixed appliance (FC, FL), as illustrated below:

> *"I remember being quite shocked on the first day, from how it felt, more than how it looked" (Participant 3: Female, 46, Specialist vet, FC)*

> *"I didn't prepare myself for that first week, it was shocking, I wanted to rip them out, they were so painful" (Participant 17: Female, 49, Teacher, FL)*

There was a general agreement that participants experienced discomfort during the early stages of treatment. Participants went further and discussed this negative experience in terms of severity, timing and location. There was some variation in relation to the level of severity of discomfort experienced by participants. Some participants from the RA group reported it as being mild, while others in the same group experienced a greater degree of discomfort.

"In terms of discomfort it was very minimal" (Participant 9, Female, 25, Receptionist at dental practice, RA)

"I guess it feels very bruised and tender, like someone's punched you somewhere, I expected that" (Participant 11, Female, 47, Entrepreneur, RA)

As for timing, the majority of participants noticed discomfort during the first few days following fixed appliances adjustments or having new removable aligner fitted.

"Mainly, when you first put that new aligner in for first few hours then the pain I'd say effectively goes" (Participant 15: Male, 18, University Student, RA)

"Pain was horrible at the beginning then after regular adjustment, I would say discomfort" (Participant 21: Female, 31, Civil engineer, FL)

Other participants reported experiencing discomfort primarily during mealtimes or when chewing food.

" It was just sensitive you know, biting on certain types of food, it became a little discomfort. Not painful" (Participant 13: Male,57, Salesman, RA)

"I remember it was quite bad when I had some yogurt and cold liquid it did sting" (Participant 16: Male, 29, Regulatory risk officer, RA)

In relation to the location of discomfort, some participants in FC group described sharp wires protruding from the appliances causing significant amounts of soft tissue pain mainly on gums, lips and cheeks.

"I did have times there were bits of metal that kind of rub against my gum and my gums were bleeding a couple of times if I had those sorts of events, it was quite painful" (Participant 2: Female,52, Recruitment consultant, FC).

"At the beginning I remember lifting my lips one day they looked like I had sandpapered them" (Participant 5: Male, 38, Financial advisor, FC)

"Cutting the inside of your cheek which I didn't really enjoy much, that would have been the first three to four months" (Participant 7: Male,44, Business man, FC).

While in the FL group, soft tissue discomfort was primarily related to the tongue, like:

"I would say pain was nine out of ten, but not for the teeth, it was the tongue mainly the tongue" (Participant 17: Female, 49, Teacher, FL)

"Initially it was really uncomfortable, I found it quite difficult to eat, my tongue was very unhappy" (Participant 20, Female, 40, Performer/ teacher, FL)

Following the initial negative experience of wearing the orthodontic appliances, most participants of the three groups demonstrated substantial improvement as time progressed and after they had adapted to their new appliances

"After a while I couldn't feel much pressure when I put the new aligners in" (Participant 16: Male, 29, Regulatory risk officer, RA)

"It's definitely improving with time" (Participant 18: Female, 40, Virologist, FL)

Participants were asked to determine how they adapted with their symptoms and what wear their coping strategies. Some reported taking painkillers, others using wax that was either effective or of not much assistance.

"Pain was five out of ten, and when you take some paracetamol, you're fine" (Participant 12: Female,28, IT specialist, RA)

"I was very fastidious with the wax, and very cautious so it stays there all day" (Participant 5: Male, 38, Financial advisor, FC)

"So, I used the wax, but it did not really help it came off" (Participant 7: Male,44, Business man, FC).

For some, more actions had to be taken. They felt the need to book an emergency appointment to resolve the issue.

"I had trauma from sharp wire I used ortho wax that gave me some time, but I had to go back as an emergency appointment and trimmed it" (Participant 8: Male, 32, dentist, FC)

5.2.3.1.2. Subtheme E2: Functional changes

When discussed about functional changes, participants mainly reported speech-related and masticatory issues. Several examples were provided by participants and described below.

"Especially sibilant sounds where the position of your teeth and your tongue changed and you can't compensate for that it" (Participant 14: Male, 48, Researcher, RA).

"I had a bit of a lisp. I suppose somebody else would not notice but for me I can feel like on Ss sounds I know that it's a little bit, mispronounced" (Participant 17: Female, 49, Teacher, FL).

While some felt that the change in speaking was only noticeable to themselves, others talked about the comments on the way how the spoke by family and friends.

" I think it affected speech a little bit yeah, but from my perspective, whether other people could pick it up I don't think so" (Participant 1: Female,66, Retired, FC).

"It was quite funny when people would talk to me and they'd go you sound funny, you're talking a bit lisp" (Participant 7: Male,44, Business man, FC)

Another change in their speech noticed by some of the participants across the different groups was the increased salivation and the feeling of spitting while speaking:

"I had a bit of a lisp with it and, and I felt like I was spitting" (Participant 2: Female,52, Recruitment consultant, FC).

"I noticed I had a bit of a lisp or slurred speech; it sounded like I had a mouth full of saliva which I did not" (Participant 5: Male, 38, Financial advisor, FC)

Participants also commented on the changes to their speech over time. While several participants reported that their speech clarity improved naturally with time; others felt that the change in speech remained constant throughout the course of the treatment.

"I was expecting to find it a little bit difficult to make some sounds but I would say I adapted to that really quickly" (Participant 20, Female, 40, Performer/ teacher, FL).

"I have been able to adjust my speech and make the effort to say things properly, but I still think my speech is not exactly the same as it is when I don't have aligner in" (Participant 10: Female,24, University student, RA)

The negative impact on eating during the initial stages of treatment was discussed extensively among all groups. The primary challenge shared by all three groups was tenderness upon eating; they reported taking further action to address this issue:

"When I was eating, it was excruciating when I was catching my tongue, it would be a nightmare, I'm really into food. So, for me that was a huge problem, I really struggled to eat normally" (Participant 18: Female, 40, Virologist, FL).

"Initially, I could not be bothered because I knew it was too painful, I drunk more fluids or I would have soup" (Participant 2: Female,52, Recruitment consultant, FC).

5.2.3.1.3. Subtheme E3: Changes in dietary habits and routine

Changes in dietary habits and routine were discussed differently in all three groups. Participants have discussed various aspects, such as frequency, duration, and type of food consumed.

Some participants discussed the impact of some pragmatic issues around their FC appliances on their dietary routine and habits. They reduced the frequency of eating with a few of them stopping eating or snacking during the day, as reported below:

"At the start I probably ate less because I just couldn't be bothered something stuck in your teeth and you're going to have to go the bathroom and clean it all out" (Participant 7: Male,44, Business man, FC)

Moreover, frequency was discussed extensively by RA group modifications were primarily by not snacking and having large meals at once.

"Invisalign was actually more constraining than the normal braces, you could eat when you want, whereas now, I have to think ten times, before I want to have a snack, because normally, before Invisalign, I was like a baby, I had to eat every two hours" (Participant 12: Female,28, IT specialist, RA).

"So, forget it. for snacking it's brilliant. It's good for your diet, it's good for losing weight "(Participant 13: Male,57, Salesman, RA)

Taking longer to finish meals was another aspect that was affected among Fixed appliances groups (FC, FL), for example:

"I was eating a lot more slowly than other people. So, that was the biggest factor for me" (Participant 1: Female,66, Retired, FC).

"It affected how quickly I am able to eat so efficiency" (Participant 8: Male, 32, dentist, FC).

Regarding type of food consumed, for participants in the FC group, modification wear phenomenality to prevent food sticking to the appliance or staining it.

"I struggled with quite a few foods they were things that I just didn't imagine I would struggle with like salad, things like spaghetti, I certainly wouldn't even attempt to eat it in public" (Participant 1: Female,66, Retired, FC).

" Because of my white bands, avoiding turmeric and anything that potentially, might stain it, which is really upsetting, cos I love things like curry and spices" (Participant 6: Male, 30, IT specialist, FC).

One participant expanded on how cleaning his FC appliances after having a meal, has negatively affected his ability to enjoy the taste of food.

> *"I hated the fact when I ate lunch while I was still enjoying the flavour of my lunch I had to go and brush and getting fresh toothpaste" (Participant 5: Male, 38, Financial advisor, FC)*

Two participants also discussed how orthodontic treatment affected their eating habits and consequently change in their weight

> *"In the first weeks, I was just having like soup, really fantastic because I lost like three kilos" (Participant 17: Female, 49, Teacher, FL)*

> *" I put on half a stone, since having my braces fitted because I changed my diet to having softer, mushy things I would never have eaten them before And, that really frustrated me" (Participant 18: Female, 40, Virologist, FL)*

5.2.3.2. Theme F: Psychosocial impact:

In reflecting on the experiences and events related to the use of different orthodontic appliances, a number of participants expressed their feelings regarding the impact of appliance appearance on their self-image (Subtheme F1), as well as the psychological impact on self-consciousness and self- confidence of their treatment experience (Subtheme F2), it also included in-depth discussion of how their treatment experience influenced their social interactions (Subtheme F3).

5.2.3.2.1. Subtheme F1: Self image

Since the aesthetic appearance of the appliance played a significant role in adults seeking treatment, data analysis showed that participants had different opinions

regarding perceived aesthetic of each appliance. In the FC group, participants responses were divided into three area based on their perception of appliance appearance; some participants felt positively about the appliance appearance explained in the following quotes:

"They looked a lot better than I was expecting them to look and pleasantly surprised on how much they blended in" (Participant 5: Male, 38, Financial advisor, FC).

"I was reassured by other people, because they had seen me and spoken to me and had no idea I had braces on" (Participant 8: Male, 32, dentist, FC).

Others felt neutrally about the appliance appearance, and found that wearing a mask during COVID-19 (SARS-CoV2) had a positive impact on hiding the appliance.

"The fact that we were wearing a COVID mask for a year and a bit, it didn't really make any difference" (Participant 7: Male,44, Business man, FC)

Few participants had negative feelings from FC appliance appearance, especially while taking photos, for example:

"My worst experience when I had a photograph done for my passport, it doesn't even look like me, you know, horrific so, I've got that for ten years now" (Participant 1: Female,66, Retired, FC).

" It affected me, in the sense that I don't smile as broadly as I used to, I think, mainly with new people" (Participant 6: Male, 30, IT specialist, FC).

In the RA group, in general, participants had better feelings toward the appearance of the appliances in comparison to FC group; for example:

> *"I have certainly been surprised how few people notice it aesthetically" (Participant 14: Male, 48, Researcher, RA)*

> *"I felt good because it already changed the appearance of my teeth, I preferred the appearance when they were in than when they were out because it would hide the gaps in my teeth" (Participant 16: Male, 29, Regulatory risk officer, RA).*

However, two of the participants were surprised by the fact they had to have attachments fixed to their teeth.

> *"I'll be honest I thought it would be just a gum shield over your teeth and people wouldn't see it. It was only until I went for the fitting and I had the attachments put on the front of the teeth, I came out and thought: 'Oh, my God, I didn't expect that.' I was a little shocked" (Participant 13: Male,57, Salesman, RA)*

> *"When I went for the fitting, I had not really absorbed the information you are having actually stuff fixed to you, I had in my head you just got these things you can remove whenever you want" (Participant 14: Male, 48, Researcher, RA)*

Regarding the FL group, since appliance are not visible most participants have not mentioned any impact from this aspect, for example:

> *"it's not really showing, no one can see it" (Participant 17: Female, 49, Teacher, FL)*

5.2.3.2.2. Code F2: Self-consciousness, self-confidence

Participants described being emotionally affected both positively and negatively by different appliance. A number of positive feelings were experienced among all three groups, including happiness and more comfortable smiling. Positive feelings ware most often noted in late or post-treatment groups during which patients started to observe changes in their teeth.

> *"It has improved my self-esteem, because then I know my teeth look better" (Participant 3: Female, 46, Specialist vet, FC)*

> *"I don't think having aligner affected my confidence if anything I think I will feel more confidence once my treatment finished, I know my smile will be better" (Participant 10: Female,24, University student, RA)*

> *"I've always been self-confident, the biggest improvement has been pictures, So, every picture now, it's teeth, before I was smiling, but not showing my teeth" (Participant 13: Male,57, Salesman, RA)*

In contrast, some participants described negative feelings as being self-conscious and anxious or avoiding smiling as a result of appliance wear. In the FC group, participants described feelings of self-consciousness or vulnerability in a variety of situations, including going to work or meeting new people, for example.

> *"I felt a little bit self-conscious, more when you go to people that you don't know at all, and you think all they've seen me with this big brace on now" (Participant 1: Female,66, Retired, FC)*

"I felt vulnerable, in situations that I would already feel a bit more vulnerable, like dealing with management at work because my speech I tried to speak and I just felt really stupid, and also with dating, people will judge it because having the brace is a more a teenager thing" (Participant 3: Female, 46, Specialist vet, FC)

Furthermore, some participants described speech impairment to have as significant impacts on their feelings, and being self-conscious of changes in their speech pattern or excessive salivation, mainly upon meeting new people or at their work place.

"A hundred percent, I felt conscious if I was meeting a new person, presenting something or doing anything that I had attention on me for my speech" (Participant 15: Male, 18, University Student, RA).

"I had them fitted I had to go straight back on to the desk, and I was on the phone, talking with a real lisp, and I really struggled then there was obviously patients coming in, so I was quite conscious, I'd say, for the first week probably" (Participant 9, Female, 25, Receptionist at dental practice, RA).

"I felt a bit conscious because everything was on camera because COVID although, I wasn't in front of people I felt conscious that I was bit dribbly so I used to hide my mouth" (Participant 2: Female,52, Recruitment consultant, FC).

One participant, however, was not concerned about speech impairment as she knew it would be temporary, owing to previous orthodontic treatment experience.

"When I got the braces I was actually lisping quite a bit,I think because I had it as a kid and I knew it will take a little bit of time to get used to it, so I didn't have any concerns about that" (Participant 4: Female,34, IT specialist, FC).

Another participant expressed that her feelings were negatively affected by changes in her dietary habits and weight gain after orthodontic treatment with lingual appliances.

"I think my changes in diet, and putting on weight, has affected myself not in a huge way, but I'm frustrated at that" (Participant 18: Female, 40, Virologist, FL)

5.2.3.2.3. Subtheme F3: Social interaction

The majority of group members discussed in depth the impact of orthodontic appliances on social interactions and work environments.

For FC group, participants were divided some felt that braces had no significant impact on social interactions, while others felt that braces restricted their social interaction, as highlighted below:

"I wouldn't have allowed it to stop me doing stuff, no" (Participant 1: Female,66, Retired, FC)

"I am quite outgoing person in the way that I dress and the way that I am, I kind of shrunk back with braces" (Participant 2: Female,52, Recruitment consultant, FC)

Moreover, one participant attributed a lack of social interaction to the limitation of COVID-19 (SARS-CoV2) pandemic which assessed her during her orthodontic treatment journey.

"I was very like lucky to do it during the pandemic, so that I stayed home and didn't see anyone at all" (Participant 4: Female,34, IT specialist, FC)

Other participants explained that they had to modify their social interaction by picking suitable restaurants in terms of the type of food served or the available facility (toilet) in which they can clean their teeth.

"It did not stop me, but if I was at a restaurant, I would take my pencil case and go to the toilet to brush my teeth so, I bought a pencil case that had spare toothbrush, tooth paste and dental floss and kept that with me" (Participant 5: Male, 38, Financial advisor, FC)

"I will go out for dinners, but then I've got to make sure that the type of place we're going, has a bathroom, where I can then brush my teeth, bring my toothbrush with me, I wouldn't feel comfortable eating at a picnic in the park, for instance, because of the inability to clean" (Participant 6: Male, 30, IT specialist, FC).

For RA group participants the majority described minimal impacts on social interaction. They attributed this to the fact that the appliances are removable.

"I am feeling much more comfortable going to social things now because I don't feel self-conscious about my teeth, actually I am quite proud of having the treatment I quite like talking about it" (Participant 14: Male, 48, Researcher, RA)

"I don't think it affected me socially cos there was so much flexibility around taking them in and out" (Participant 15: Male, 18, University Student, RA)

"My social life and things have carried on" (Participant 16: Male, 29, Regulatory risk officer, RA)

Additionally, participants in FL group felt that the appliances had a minimal impact on the social interaction

"Actually, it's made social interactions better because I already feel less, self-conscious about my teeth" (Participant 17: Female, 49, Teacher, FL)

"I don't think it has been impacted the choice of restaurants and choice of meal but not actually doing the act" (Participant 22: Male, 37, Financial advisor, FL)

In regards to having braces in working environment, participants in FC group also, some of whom appreciated the online nature of the work because it helped them hiding their orthodontic appliances.

"At work a lot of video calls and nobody kind of really noticed on video calls, I was fine with it" (Participant 4: Female,34, IT specialist, FC)

For hygienic reasons, another participant felt the need to avoid contact with collages during lunchtime,

" At work if someone came to me at lunch, I made it clear that I am not available purely of self- conscious I knew there were bits of food everywhere and I wanted to feel clean and fresh" (Participant 5: Male, 38, Financial advisor, FC)

In an interesting comment, one participant stated that orthodontic treatment was very beneficial to him in regards to patient communication due to the nature of his work.

"I will have any issues with it actually it was quite useful when I describe orthodontic treatment to a patient, I can show them my braces it is quite relatable I am like a walking model" (Participant 8: Male, 32, dentist, FC)

In RA group, a participant stated that her aligner did not affect her ability to communicate face-to-face with her colleagues at work; however, when she appeared on camera, that was compromised.

> *"When I take a video for work, I take them out because I don't want to risk lisping and I also don't want the reflection of the plastic, but when I'm in meetings with clients, I'm wearing them all the time" (Participant 11, Female, 47, Entrepreneur, RA)*

6. Discussion

This qualitative study was directed towards gaining a better understanding of an adult's reasons behind seeking orthodontic treatment and a specific treatment modality. As part of this study, participants' experiences and the impact of fixed ceramic labial appliances, removable aligner, and fixed lingual appliances on their QoL were explored. Previous research on the reasons for undergoing orthodontic treatment have focused primarily on adolescents (Trulsson et al., 2002; Imani et al., 2018). Furthermore, studies that evaluated the impact of appliances on QoL of adult patients were limited to one or two types of appliances (Hohoff et al., 2003; Nedwed and Miethke, 2005; Flores-Mir et al., 2018). Thus, the present study represents a unique opportunity to enhance our understanding of adult motivations for orthodontic treatment and to compare participants' experiences regarding fixed ceramic labial appliances, removable aligners and fixed lingual appliances in depth.

6.1. Discussion of research methodology

6.1.1. Researchers profile

The researchers involved in this study (SD, FCS, and AJ), all have dental backgrounds. It can be advantageous to use researchers from the same industry, as they are better qualified to understand the participant's responses. As the researcher involved in interviewing participants (SD) had very little experience (<2 years) at the time of the interviews with the orthodontic appliances being used in this study, it could be considered an advantage, since they would be able to ask questions without prior experience of any appliance type.

6.1.2. Participats selection

The overall sample included a mix of genders, ages and treatment stage across the three main treatment modality groups, in order to facilitate a broad range of thoughts and opinions to facilitate a better understanding of the complex nature of adult rationale for undergoing orthodontic treatment and the impact on their everyday lives.

Interviews were conducted at various stages of treatment. In general, it was expected that participants' perceptions and experiences would vary based on the length of time they have worn their appliances. In the early stages of treatment, participants would usually experience issues relating to adaptation and discomfort symptoms, whereas those at the later stages of treatment may have been able to overcome these difficulties as well as gain a more comprehensive understanding and insight into the appliance's use (Alzoubi et al., 2017). Moreover, participants interviewed after completing orthodontic treatment answering questions required the use of memory recall. An issue of recall bias may arise in the study, resulting in a discrepancy between the actual events and the stories told by participants. This limitation could have been overcome by using a diary in conjunction with an interview, as it might have strengthened the quality of the data.

6.1.3. Rerecruitment

Participants were recruited from four different London-based private dental practices. Thus it was felt that by selecting a range of differnet Specialist practices, a represntative overview of the way clinicians practice orthodontics and manage adult patients would be obtained as this has the potential to differ greatly in terms of treatment protocol, communication style, and behavioural management. Although

recruitment continued until saturation was achieved, the initial target was to recruit 26 participants. This corresponds with a qualitative study that assessed the experiences of patients with removable functional appliances, fixed appliances, and retainers (Kettle et al., 2020). In the present study, a cross-section of participants including fixed ceramic appliances, removable aligners, and fixed lingual appliances were recruited from private orthodontic clinics and saturation was achieved after interviewing 22 individuals.

6.1.4. Interview

A qualitative research approach with one-to-one interviews was conducted in the present study in order to obtain realistic opinions about the experience of wearing the appliances. In spite of the advantage of larger focus groups in providing synergistic conversation and more refined discussion (Bloor, 2001), participants may hesitate to provide sensitive information in a group setting. During the present study, a piloted topic guide was used to direct the interview discussion and open-ended questions were used whenever possible to ensure a comprehensive answer (Liamputtong, 2010). This study used a semi-structured approach with a predetermined topic guide that included specific topics and questions. Where possible, an open questioning technique was employed by the interviewer to allow the interviewees to freely express their opinions and experiences. As new topics emerged, they were added to future interviews for further exploration until saturation was achieved.

Interviews were conducted using an online platform using Microsoft® Teams (Redmond, USA) software. The justification for incorporating an online platform is that data collection for this study was initiated during the COVID-19 (SARS-CoV2)

pandemic, when access to face-to-face meetings was restricted. Additionally, conducting interviews with participants treated at different clinics in London poses practical difficulties. Since, participants are adults, and they are preoccupied with their professional responsibilities. Therefore, finding the right time made it difficult to conduct the interview in person. Therefore, the online format was adapted for this study.

6.1.5. Data collection and analysis

In qualitative research, researchers are responsible for collecting and analysing data. In this regard, findings and conclusions are influenced by the researcher's interests, knowledge, and interview skills, all of which can lead to researcher bias. A triangulation method relies on multiple channels of data collection and analysis in order to overcome this problem (Denzin, 2018). The following triangulations were used in the present study:

- Analysing data using multiple researchers with varying clinical and research backgrounds (investigator triangulation)
- Collecting data from multiple participants (data triangulation)
- Analysis of collected data using multiple theories and perspectives (interdisciplinary triangulation). By regularly meeting, researchers were able to discuss their interpretations and understand each other's perspectives and differences.

And thus, as a result of using these methods, the study ensured the following (Mathison, 1988):

- Incorporation of the findings of the present study into the themes and suthemes.
- That opposing views are included and avoid selective filtering of information.

6.2. Reflexivity and potential bias

The interviewer was interested in orthodontics for a long time, which might have affected the manner in which the interviews were conducted. However, the interviewer had completed formal qualitative research training on the appropriate interview techniques before starting data collection. Furthermore, the interviewer has practiced the interview with the research supervisor on several occasions to ensure that the interview will be conducted satisfactorily to familiarize the interviewer with the interview process and to learn to ask standardized questions in an open and non-leading manner and to minimize risks of bias. As a means of minimizing risk of personal bias, semi-structured interviews were chosen as the method of collecting data. Additionally, a purposive homogenous sampling method was used to ensure that a wide range of perspectives were included. All participants were informed that all information provided would remain confidential and that the content of their discussions would not be shared with their clinicians. This allows them to speak freely about their experiences and views.

6.3. Discussion of findings

6.3.1. **Reasons for undertaking orthodontic treatment**.

In a questionnaire-based study on adult orthodontics, researchers concluded that the most common motivation to seek orthodontic treatment was to improve dental appearance followed by improving facial appearance (McKiernan et al., 1992; Sergl et al., 1998). Additionally, functional benefits were observed to be a key motivator for seeking treatment. These findings are consistent with the present study, as the majority of participants reported seeking orthodontic treatment to improve their

aesthetics as well as concern for the health of their teeth and a desire to improve their functional capability.

A further motivating factor to start orthodontic treatment was stated by some participants of the present study to be the deterioration of their dental health and appearance. These factors were primarily attributed to relapse of previous treatment as a result of poor patient compliance with wearing retainers. However, a study by Chow et al. (2020) revealed that some adults seek orthodontic treatment for a second time as their previous experience did not meet their expectations (Chow et al., 2020).

A qualitative study by Imani et al. (2018), investigated the factors influencing Iranian participants age 14 to 27 years to undergo orthodontic treatment. According to this study, orthodontic decisions are influenced by a wide range of factors, including distorted perceptions of self-image, the desire to appear more attractive, family perceptions of the problem, social interactions, and financial constraints (Imani et al., 2018). Interestingly, similar themes emerged from data analysis in the current study, such as perception of self-image, social pressure. However, participants also emphasized concerns about dental health, functional impairment, and aging. This could be explained by the inclusion of the older age group in the present study.

6.3.2. Reasons for selecting an orthodontic appliance

There has been little research conducted on the reasons behind adult choosing a specific orthodontic appliances over other types. In the current study, participants from different appliance groups discussed various reasons for choosing their orthodontic appliances during the interview process. These reasons included both social influence

and different appliance features including aesthetic appearance of applaince, perceived effectiveness and convenience. According to a qualitative study conducted by Wong et al. (2018), that assessed the factors that influence an adult patients' satisfaction with orthodontic treatment, patients who were treated in a private setting chose ceramic brackets as they considered them to be more aesthetic and comfortable. Furthermore, some participants stated that they would not have gotten braces if the metallic variant was the only choice of treatment (Wong et al., 2018). In a similar manner, the present study emphasized the importance of the aesthetic appearance of appliance in influencing their decision.

In another study conducted by Hardwick et al. (2017), they investigated patients' expectations of lingual orthodontic treatment, in which participants were asked to provide reasons for their preference of lingual orthodontic treatment over labial applainces. It appears that participants felt that due to their age and profession they preferred a less visible brace, and this is the reason behind their decision to go with lingual braces (Hardwick et al., 2017). Similallrly in the present study participants from all groups emphasized the importance of aesthetics and having an appliance that was less visible. This was attributed primarily to their work environment, which involves constant contact with people. This was more common with the FL and RA groups.

6.3.3. Impact of the orthodontic appliance on participants' quality of life

6.3.3.1. Functional impairment and symptoms

In the interview conversations, participants from all appliance groups discussed in detail functional impairment and symptoms. Several symptoms were reported, such as pain, speech impairment, difficulty eating and cleaning, changes in dietary habits.

According to the findings of the current study, pain levels were higher in all three groups during the early stages of treatment and this was reported to be improve over time. This was similar to what was observed by Wu et al. (2008). Were they found no significant differences in pain ratings between those receiving labial or lingual appliances, and that pain decreased for both groups after the three-month period of the study (Wu et al., 2008). Moreover, in the present study all three groups reported similar levels of pain following adjustments to fixed appliances or the fitting of removable aligners. In contrast, Shalish et al. (2012), concluded that pain was most severe in the lingual appliance group when comparing three different treatment modalities (Shalish et al., 2012). Based on the results of the present study, participants in the FC group described soft tissue discomfort primarily related to their gums, lips, and cheeks due to sharp wires, whereas in the FL group, soft tissue discomfort was primarily related to the tongue. This is in agreement with previous research by Wu et al. (2010) who found that lingual appliances created more discomfort in the tongue region, whereas labial appliances caused discomfort to the lips and cheeks (Wu et al., 2010).

As regards the impact of orthodontic treatment on dietary intake and behaviour, in a qualitative study that assessed only dietary intake among fixed appliance patients, the majority reported difficulty in chewing and eating due to pain, leading them to eat softer diet, a further explanation for the dietary change identified was that some foods became ‘trapped’ in the appliance, making it difficult to maintain good oral hygiene (Abed Al Jawad et al., 2012). Similar findings were reported in the present study. However, a variety of diet modifications were also identified in the present study for different groups of appliances, for example in FC group, participants tend to avoid

eating foods which cause staining and discoloration to their white bands. In regards to RA group, modifications were primarily related to frequency of eating, avoiding snacking and eating large meals all at once in order to prevent constant removal of the appliance.

6.3.3.2. Psychosocial impact

There have been several studies that examined the effect of labial appliances on oral health quality of life (OHRQoL) in adults, with variable findings being reported. Psychological impact has been shown to improve with fixed appliance treatment, as early as six months following treatment (González et al., 2019). However, Romero-Maroto et al. (2015) reported significantly higher scores for social impact, psychological impact, and aesthetic concern after 3-6 months of treatment. It should be noted that these studies used metal labial orthodontic brackets, which may have a greater effect on appearance in adult patients. As opposed to the present study, which explored the psychological effects of aesthetic orthodontic appliances (Romero-Maroto et al., 2015).

In the present study, psychological impacts also differed greatly between participants in each appliance group in terms in terms of extent, impact on self-image and self-consciousness. There were a variety of perspectives expressed by participants regarding each of these issues. Some participants described being positively impacted, such as feeling more comfortable smiling. Other participants reported a negative impact of appliance wear on their feelings, such as being self-conscious and avoiding smiling as a result of wearing the appliance. These observations were mainly reported by the FC group.

6.3.4. Implication for clinical practise and future research

The present study explored the reasons for adults choosing to undergo orthodontic treatment, as well as the psychological and functional effects of wearing different appliances. In light of these findings, clinicians should:

- Better understand the needs of adult patients.
- Provide more comprehensive informed consent.
- Ensure that they remain honest and realistic about the outcome that you hope to achieve
- Assist patients at every step of the treatment process by being sensitive to their needs and concerns.

In addition, a comprehensive understanding of patient needs is essential to guide future innovation and development of orthodontic appliances in accordance with patient recommendations and requirements.

Considering that the focus of this study has been on orthodontic treatment from the patient's perspective, it would be worthwhile to conduct a study in which clinicians are interviewed regarding their experiences and perspectives in treating adults with various orthodontic appliances in their clinical practice. This will enable comparisons to be made between clinicians' beliefs and those of patients.

7. Conclusion

1. According to the present study, psychological factors as well as health concerns are important factors that influence the decision-making processes of adults seeking orthodontic treatment. While, in choosing a specific appliance, key factors include social influence and the appliance unique characteristics.
2. Functional impairment and psychosocial impact have been discussed by most interviewees as major impacts on their quality of life. Results have ranged from negative short-term effects to positive long-term benefits.
3. Having an understanding of these findings is important both for orthodontists and for patients. This is particularly true when managing expectations during the informed consent process.

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Appendices:

Appendix 1: Ethical approval.

Queen Mary
University of London

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Queen Mary Ethics of Research Committee
Research Ethics Facilitator
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c/o. Professor Ama Johal
Institute of Dentistry
Queen Mary University of London
Mile End Road
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United Kingdom

13 April 2021

To Whom It May Concern:

Re: QMERC2019/60 - Adult Orthodontics: An investigation into patient rationale, treatment impact and quality of tooth movement with removable and fixed appliances.

The above study was conditionally approved by The Queen Mary Ethics of Research Committee (Review Panel A) on the 4th September 2019; full approval was ratified via Delegated Member on the 12th January 2020.

This approval is valid for two years, (if the study is not started before this date then the applicant will have to reapply to the Committee).*

Amendment

A new amendment to the study was approved via Delegated Member's Action on the 06th April 2021.

Yours faithfully
Mantalena Sotiriadou, QMERC Research Ethics Facilitator

Patron: Her Majesty the Queen

***This application is approved with the following conditions:**

- Any Amendments, minor or major, are declared to the QMERC before implementation of proposedchanges.
- An Annual Progress Report should be submitted on the 12-month anniversary of the QMERC's approval letter and every year after that, until study completion. {Only applicable for studies with a duration of 1 yr+}
- An End of Study Notification Form should be submitted to the QMERC (within 90 days of study completion).
- Approval for study issued as above but all aspects are subject to the QMERC temporary procedure in light of Covid-19 pandemic and the government advice on restriction and so elements that involve face-to-face interaction with human participants should not commence until the government updates it'sguidance.

Please find relevant application forms and further guidance here: http://www.jrmo.org.uk/performing-research/conducting-research-with-human-participants-outside-the-nhs/#Amendments

Appendix 2: Consent form

Queen Mary
University of London

Consent form

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Title of Study: Orthodontic treatment impact in adult patients: a comparison between clear aligners, labial, and lingual fixed appliance therapy

Queen Mary Ethics of Research Committee Ref: _____

- Thank you for considering taking part in this research. The person organizing the research must explain the project to you before you agree to take part.
- If you have any questions arising from the Information Sheet or explanation that was already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.
- *I understand that if I decide at any other time during the research that I no longer wish to participate in this project, I can notify the researchers involved and be withdrawn from it immediately.*
- *I consent to the processing of my personal information for the purposes of this research study. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.*

Participant's Statement:

I _____ agree that the research project named above has been explained to me to my satisfaction and I agree to take part in the study. I have read both the notes written above and the Information Sheet about the project, and understand what the research study involves.

Signed: Date:

Investigator's Statement:

I _____ confirm that I have carefully explained the nature, demands and any foreseeable risks (where applicable) of the proposed research to the volunteer

Appendix 3: Information sheet

Queen Mary
University of London

Information sheet for Participants

An investigation into adult patients' rationale, treatment impact with removable and fixed orthodontic appliances: A qualitative study

We would like to invite you to be part of this research project, if you would like to. You should only agree to take part if you want to, it is entirely up to you. If you choose not to take part there won't be any disadvantages for you and you will hear no more about it. Choosing not to take part will not affect your access to treatment or services in any way.

Please read the following information carefully before you decide to take part; this will tell you why the research is being done and what you will be asked to do if you take part. Please ask if there is anything that is not clear or if you would like more information.

If you decide to take part you will be asked to sign the attached form to say that you agree. You are still free to withdraw at any time and without giving a reason.

Adult patients wishing to undergo orthodontic treatment are increasingly seeking braces which will not only have a minimal impact on their daily lives but that are also viewed as being "aesthetically" acceptable. Orthodontic appliances such as fixed lingual braces (train track braces that onto the inside surfaces are fixed of the top & bottom teeth), fixed clear labial braces (train track braces that made of a clear ceramic material rather than metal attached to the outside surfaces are fixed of the top & bottom teeth) and clear aligners (clear plastic braces that sit over the teeth and are removable) have been developed in an attempt to meet this

demand.

The purpose of our study is to assess the importance and effect on you the patient in comparing these different brace options that are available to adults. This will involve assessing how of these braces affect your quality of life, self-esteem, appearance to you, and any discomfort experienced.

Patients who agree to participate will be invited to take part in a one-to-one interview, with the researcher, which will be recorded and undertaken online, using either Zoom/Teams as a platform. You can request the camera mode to be turned off and only use the voice setting.

All data collected will be entirely anonymous and non-identifiable.

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form.

If you have any questions or concerns about the manner in which the study was conducted please, in the first instance, contact the researcher responsible for the study. If this is unsuccessful, or not appropriate, please contact the Secretary at the Queen Mary Ethics of Research Committee, Room W104, Queen's Building, Mile End Campus, Mile End Road, London, or research-ethics@qmul.ac.uk.

Appendix 4: Topic guide

Qualitative Research Topic Guide

Adult Orthodontics: An investigation into patient rationale, treatment impact and quality of tooth movement with removable and fixed appliance

Introduction

- Presenting myself and my role in the study
- Welcome. Thank you for being here today. We would like to explore the reasons behind you choosing the type of brace you are soon to have fitted. We will also ask you some questions exploring whether or not the brace has affected your quality of life.
- Would you mind reading the consent form and signing it?
- The conversation we are about to start will be recorded with a digital recorder and you will be notified about the start and finish of the recording. However, your name, address or any identification information will be kept confidential and will not be published. Your participation is voluntary and you are free to stop me at any time during the conversation.
- It is important to note that there are no right or wrong answers
- Do you have any questions before we start?

Warm up questions

- Can you please tell me about yourself?
- Do you know of what types of braces are available to straighten your teeth?

Exploring reasons for choosing orthodontic treatment modality over another

- For what reasons did you seek orthodontic treatment?
    - **Prompts:** Aesthetics, Function, Family/Friends, Upcoming events?
- For how long have you thought about undergoing brace treatment?
    - Previous treatment? Why not? Anything recently that made them motivated to seek brace treatment [prompts: friend , family, work colleague]?
- What type of brace have you decided to have in order to straighten your teeth?

Exploring reasons for choosing orthodontic treatment modality over another

- Why did you choose (..) over other options? How did you come up with this decision?
    - **Prompts**: affordability; recommendations, experiences; aesthetic; prescribed by clinician)
- What were the main factors that made you decide NOT to choose other brace options presented to you?
- Did you have any concerns about the brace? How did it influence in your decision when choosing your brace?
- Did you research whether or not the brace could potentially cause discomfort before starting treatment? What were your findings?
- How confident were you with your decision? Why?
- How happy are you now with that decision? Has this view changed over-time? In what way?

Exploring patients' views on the impact on various appliances on QoL (self-esteem, function and aesthetics)

- How long have you been wearing your brace now?
- What has your experience been of wearing the brace? Please elaborate your answer. (Explore feelings – embarrassment; discomfort; painful; etc.)
- In what way, has the brace affected your daily routine/activities/life? Please give me examples?

- Have you ever had any problem with the brace after fitting?
- What was the problem? Please tell me more about it/ Please give me examples.

Function

- Can you describe to me the type of discomfit that you experienced?
- How has this discomfort/speech difficulties affected your daily life/activities? Please give me examples.
- **For patients wearing clear aligners only:** (e.g., pain; impact on your compliance levels; adherence to clinician's prescription?) Please elaborate your answer.
- **For patients wearing clear aligners only:** Did you wear the appliance again? When was it? What motivated you to wear it again?
- Did you have any difficulty with eating
- How did you overcome these issues? (Did you need to take painkillers to control the pain? Did the pain cause you to stop wearing the brace or to wear it less
- Are you still experiencing pain/discomfort/eating and speech difficulties/other? Did you tell the orthodontist about it?

Aesthetics

- Do you have any concerns about the look of your brace? What are they? Please explain.
- How important for you was it that your brace was less noticeable? Was it your primary deciding factor? Why is it so important for you?

Emotional and psychosocial/ Social impact

- How has the brace affected your social life/daily activities/emotional and psychosocial health/well-being? Please give me examples
- How has wearing the brace affected your social life/relationships? Please tell me more about it.
- Have you ever experienced anxiety/apprehension related to the wearing the brace? Why? When did it happen?

- How has wearing your brace affected your university/work attendance/activities/grades? Please elaborate your answer.
- **For patients wearing clear aligners only:** (e.g., do you think it had an impact on your compliance levels; adherence to clinician's prescription?) Please elaborate your answer
- **For patients wearing clear aligners only:** Did you wear the brace again? When was it? What motivated you to wear it again?

Relationship with your orthodontist:

- support? Trust? Frequency of follow-up visits? Clear instructions?
- Who has been your main support in this journey? (Family, peers, orthodontist?)
    - **Prompts:** Does your orthodontist point out improvements in the position of the teeth/bite? Do friends/family members comment on the improvement in your bite or on the way your teeth look with your appliance in?

Conclusion

- Would you recommend this brace option to your friends and family? Why? Please elaborate your answer.
- Would you like to add anything else?

Thank you for your time and valuable contribution to this study.

[Turn off recorder]