Republic of Iraq Ministry of Higher Education and Scientific Research University of Baghdad College of Dentistry

Relation of Problem Recognition Timing and Orthodontic Treatment Onset

A Project Submitted to

The College of Dentistry, University of Baghdad,

Department of Orthodontic in Partial Fulfillment for the

Bachelor of Dental Surgery

By:

Zahraa Hamid Hassan

Supervised by:

Asst. Prof. Dr. Harraa Sabah Mohammed-Salih

B.D.S., M.Sc., Ph.D. Orthodontic

April, 2023

Certification of the Supervisor

I certify that this project entitled **"Relation of Problem Recognition Timing and Orthodontic Treatment Onset"** was prepared by the fifth-year student **Zahraa Hamid Hassan** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Supervisor's name:

Asst. Prof. Dr. Harraa Sabah Mohammed-Salih

Date: 25 /4/ 2023

Dedication

I would like to dedicate this work to everyone who wants to Know the right time to start orthodontic treatment, to get most beautiful smile and everyone who participated to make this project.

Zahraa

Acknowledgements

Table of Contents

List of Tables

List of Figures

Introduction

The global prevalence of malocclusion is reported to be approximately 50-80% **(Singh et al., 2016; Shen et al., 2018)**. Not all malocclusions need orthodontic treatment, the need for orthodontic treatment is influenced by the malocclusion's severity, its effect on the stomatognathic system, and the request of the patient. The goals of orthodontic therapy are the perfection of oral and dental health state and, as a consequence, well facial aesthetic and appearance, which are the reasons of increasing request of treatment by individuals **(Murakami et al., 2016)**.

Malocclusion is often conspicuous, so it might lead to adverse social reactions and a deficient self-concept. In addition, because social and psychological effects are the key motives for seeking orthodontic treatment. The term self-esteem is used to describe a person's overall sense of self-worth or personal value. Self-esteem can involve a variety of beliefs about the self, such as the appraisal of one's own appearance, beliefs, emotions, and behaviors. Malocclusions could have a negative effect on patient's psychological well-being and quality of life including self-esteem and self-image so, the absence of negative impacts of oral conditions on social life and a positive sense of dentofacial essential for self-confidence **(Kiyak and Reichmuth , 2002)**. For adolescents and young adults, malocclusion can become a burden. The main reason for seeking orthodontic treatment is dissatisfaction with dental aesthetics **(Pabari et al., 2011; Isiekwe et al., 2016)**. The strongest motivation and malocclusion recognition by patient to undergo treatment seems to be the urge to fulfil existing social norms regarding dental aesthetics (Demirovic et al., 2019). Thus, it could be argued that apart from correcting malocclusions that could constitute a health risk in the oral environment **(Ruf *et al*., 2021)**, benefits from orthodontic treatment are mainly psychosocial **(Tristão *et al*.,2020)**.

A large focus has been placed on determining the appropriate time for orthodontic treatment, and there has been considerable debate between researchers regarding the optimal time for the onset of orthodontic treatment and its clinical effectiveness **(Gianelly, 1995)**. The most important areas of disagreement include clinical effectiveness, the outcomes of early treatment, the orthodontists' preference, psychological influences, treatment of crowding, treatment of Class II malocclusions, and treatment of Class III malocclusions **(Wheeler *et al*., 2006)**. It is possible to formulate an effective treatment path by identifying the prevalence of malocclusions and their appropriate treatment time **(Grippaudo *et al*., 2019)**.

Time of malocclusion recognition by the patient and its relation to the onset of orthodontic treatment could be another factor that affects the effectiveness of orthodontic treatment results and duration. With an increasing number of orthodontic patients now seeking orthodontic treatment, there is a growing need for such research in orthodontics. Therefore, this study conducted to identify relation of patient's problem recognition timing and orthodontic treatment onset.

Null hypothesis

There is no relation between patient's problem recognition timing and orthodontic treatment onset.

Aim of the Study

The aim of this interview study is to evaluate the relation of problem recognition timing and orthodontic treatment onset in orthodontically treated patient.

Primary objectives:

1. Evaluate awareness of patient to malocclusion and orthodontic consultation.

2. Identify appropriate timing for seeking orthodontic treatment.

3. Effect of patient age when starting orthodontic treatment on outcome.

4. Evaluate satisfaction of patient on treatment plan and outcome.

5. Evaluate duration of orthodontic treatment and its effect on patient.

Chapter One: Review of Literature

1.1. Appropriate Timing for Correction of Malocclusion

The appropriate timing for the commonly seen orthodontic problems from primary dentition to permanent dentition was divided according to the type of malocclusion as follow:

1.1.1. Pseudo-Class III

Children should be treated early due to the negative impact on facial growth and development **(Almeida *et al*., 2011)**. The treatment can be started as early as 5 to 6 years old in the primary dentition to correct the anterior crossbite and eliminate the functional shift. This correction helps to establish normal function and allows normal growth and development of the maxilla and mandible **(Chung *et al*., 2001)**.

1.1.2. Skeletal Class III Malocclusion

For a skeletal Class III malocclusion, treatment with orthopedic appliances should be started in the early mixed dentition (age 6 to 8) to obtain optimal results. The orthopedic skeletal changes from treatment diminish when the child enters adolescence, However, studies have shown that some skeletal modification can still be accomplished using orthopedic appliances in the early permanent dentition but not be effective long-term because the adolescent mandibular growth spurt is very significant and the skeletal Class III can return **(Baccetti *et al*,.2011).**

1.1.3. Class II Malocclusion

Recent randomized clinical trials have suggested that skeletal effects of early treatment using headgear or functional appliances at age 9 generally are positively impacted; however, this improvement cannot be sustained over time. They found that by the end of Phase II orthodontic treatment, the differences between those who had received Phase I treatment and those who had not were indistinguishable. Thus, they suggested that moderate to severe Class II

malocclusions do not benefit more from two-phase treatment than from one-phase treatment started in the late mixed dentition. The timing of treatment often must be adjusted because skeletal and dental developments are not synchronized **(O'Brien *et al*., 2001)**.

Children requiring Class II skeletal correction need treatment with growth modification, which is most successful if started at the beginning of the adolescent growth spurt and ended about the time rapid growth subsides. There is considerable individual variation, but puberty and the adolescent growth spurt occur on average nearly 2 years earlier in females than in males. This has an important impact on the timing of orthodontic treatment, which should be initiated earlier in females than in males to take advantage of the adolescent growth spurt **(Buschang *et al*., 2013)**.

If treatment for skeletal modification for a girl starts at age 10 when her growth spurt initiates, a first phase would be needed for about 1 year and then continue with a second phase of treatment. It should be noted that treatment of Class II malocclusion should typically be delayed until the initiation of the growth spurt, but a Phase I (7 to 9 years old) treatment is indicated if the child has a psychosocial issue due to the malocclusion. Parents should know the later Phase II treatment is very possible and that this two-stage treatment will be more costly and time consuming **(Fleming *et al*., 2008)**.

1.1.4. Posterior Crossbite with A Lateral Functional Shift

It should be treated as soon as it is diagnosed to prevent the possible asymmetrical positioning and growth of the condyles. Treatment can be initiated as early as the primary dentition 5 to 6 years old **(Pirttiniemi *et al*., 1990).**

1.1.5. Bilateral Posterior Crossbite without A Functional Shift

treatment can be started in the early mixed dentition stage (8 to 9 years), although it can also be successfully treated in the late mixed dentition or early

permanent dentition. There is no evidence to support that treatment in the early mixed dentition results in greater stability than in late mixed dentition (**Liu *et al*., 2010**).

1.1.6. Skeletal Open Bite

The condition should be treated early to be successful and if indicated can be initiated in the mixed dentition (age 7 to 9 years). If a skeletal open-bite patient is left untreated until the permanent dentition, the opportunity for growth modification could be lost and correction of the open bite may be compromised. Control of the vertical dimension is the key to successful treatment of patients with a skeletal open bite (**Cangialosi, 1984**).

1.1.7. Digit-Sucking Habit

A digit-sucking habit is common in children in the primary dentition, and the habit can have a short-term effect on facial and dental development. If a prolonged digit-sucking habit continues after the permanent incisors begin to erupt, a significant malocclusion would develop. The best prognosis is when the habit is stopped before the eruption of permanent incisors (age 6 to 7). For children in the mixed dentition or permanent dentition, the habit should be treated once the problem is detected. An 80% spontaneous correction of the anterior open bite caused by the digit sucking has been reported in patients from age 7 to 12 after they discontinued the habit (**Proffit *et al.*, 2015**).

1.1.8. Anterior Crowding

Mild crowding of the lower incisors is considered normal in the early mixed dentition stage of development, because the permanent incisors are normally wider than the primary incisors. Moderate crowding should begin treatment by the late mixed dentition to utilize the leeway space. Studies have shown that approximately 70% of the crowding cases in the mixed dentition can be treated successfully with maintaining the leeway space. Procedures performed in the mixed dentition to expand or to develop arches to gain space for alignment may be unnecessary and not stable long term. For severe

crowding without skeletal problems, serial extraction should be considered. It is usually initiated in the early mixed dentition and involves a sequence of extraction of primary and permanent teeth. This allows the remaining permanent teeth to erupt within the alveolus and through keratinized tissue, and it simplifies later orthodontic treatment **(Proffit *et al*., 2015)**.

1.1.9. Impacted Teeth and Supernumerary Teeth

Teeth may be impacted due to either soft-tissue or hard tissue obstruction or an ectopic eruption pathway, and this requires early orthodontic intervention in the mixed dentition. Spontaneous eruption is more likely to occur once the obstruction factor is removed. Occasionally space needs to be created for the impacted tooth, and the tooth needs to be brought into the arch orthodontically. Maxillary permanent canines are the second most frequently impacted tooth that occurs in 2% of the population. When identified in the mixed dentition, extraction of primary canines may be indicated to correct the path of ectopic eruption and possibly avoid surgical and/or orthodontic intervention. If the canine position does not improve 1 year after removal of the primary canine, then orthodontic and surgical intervention should commence in the late mixed dentition. The presence of supernumerary teeth may disrupt normal occlusal development, and they should be removed soon after detection **(Bedoya *et al*., 2009)**.

1.1.10. Orthognathic Surgery

Generally, it is best to perform orthognathic surgery of excessive jaw structures when growth is completed. Conversely, it is appropriate to treat jaw deficiencies before growth is complete but rarely before the adolescent growth spurt **(Proffit *et al*., 2015).**

1.2. Age Factor in Orthodontic Treatment

An important consideration in orthodontic diagnosis and treatment planning is the age of the patient. In addition, age factors influence the treatment mechanics and prognosis.

1.2.1. Diagnosis and Age

Diagnosis forms a vital part of successful orthodontic therapy. In order to diagnose abnormalities of the dentofacial complex, the orthodontist should know what constitutes normalcy. Normalcy in the dentofacial region differs from age to age. There are certain features of the developing dentofacial complex, which are normal in a child, however if present in an adult would constitute malocclusion. These are referred to as self- correcting malocclusions or transient malocclusions **(Varkkola *et al*.,2011)**. Some of the transient malocclusions are:

a. Open bite seen in the gum pads

b. Spacing in deciduous dentition

d. Flush terminal plane

e. Ugly duckling stage

These malocclusions are considered normal for that age and need no treatment as they get corrected automatically as the age advances. The chronological age of the patient may sometimes be misleading and may not reflect the exact growth status. Skeletal and dental ages of the patient should be ascertained for a more accurate diagnosis. The skeletal age or bone age as it is sometimes called is determined by studying a hand-wrist radiograph. The dental age of an individual is determined by assessing the stage of calcification and root development. Considering the fact that orthodontic and dentofacial orthopedic appliances are most effective during growth, the assessment of skeletal maturation in young patients is of utmost importance for the success of the therapy **(Dimberg *et al*., 2015)**.

1.2.2. Treatment and Age

1.2.2.1. Early Treatment

Most orthodontists believe in the concept of 'catch them young'. Treating a patient at an early age when dentofacial growth is active has numerous benefits. Skeletal malocclusion that occurs as a result of altered growth direction and amount can be intercepted by modulating further growth. These procedures that modify growth should be initiated at an early age before craniofacial growth ceases **(King *et al*., 2010).**

It offers the possibility of preventing or intercepting a malocclusion. Even if the malocclusion cannot be totally eliminated, its severity can be reduced so that complex orthodontic treatment involving extraction and surgery can be minimized. The human dentition has a natural tendency to move in a mesial and occlusal direction. These natural tendencies can be used to guide the erupting teeth to more favorable positions. Treatment carried out at an early age avoids psychological disturbances as a result of coping with a full- fledged malocclusion **(Bahreman, 2013)**.

1.2.2.2. Late Treatment

Orthodontic treatment carried out during adolescence or still later in adults cannot make use of the growth potential. Although working with growth potential has numerous advantages as enlisted earlier, certain malocclusions are best treated after growth completion **(Kluemper *et al*., 2000)**. Most skeletal malocclusions indicated for orthognathic surgery are to be treated after growth completion so as to avoid recurrent growth changes associated with continuation of abnormal growth pattern. In a growing patient, the orthodontist has a number of options that include growth modulation, guidance of eruption, use of natural forces etc**. (Palomares *et al*., 2012)**.However, in an adult patient the treatment options are limited to moving teeth and surgery **(Ren *et al*., 2006)**. In an adult patient in whom growth has ceased, it may not be possible to achieve

all the objectives of function, esthetics and stability that represent ideal dentition and occlusion. In many adult patients' compromises might have to be made in the treatment. While setting treatment objectives for adult patients the orthodontist should set goals that are realistic, attainable and which strike the best possible balance in function, esthetics and treatment stability (**Benson *et al*., 2015**).

1.2.3. Tooth Movement and Age

Orthodontic tooth movement is most effectively carried out in young patients. Young patients exhibit increased vascularity and cellularity of the periodontal membrane and bone as compared to older patients. Patients of younger age are hence more responsive to orthodontic forces which makes is possible to move teeth faster.

Most orthodontic and orthopedic corrections are effectively carried out during the growth period (**Meikle, 2006**). This is due to the fact that younger growing patients react more favorably to orthodontic and orthopedic forces (**Krishnan and Davidovitch, 2006**). Although it is desirable to carry out orthodontic treatment at a younger age, it is nevertheless possible to move teeth in older patients by altering the force magnitude and duration (**Kantarci *et al*., 2016**).

In an adult patient the apical foramen is narrow. Force application during treatment may pose a greater chance of non-vitality, root resorption and ankylosis of teeth occurring. In a young patient, the apical foramen is wider thus there is lesser chance of pulpal damage. As adults exhibit greater density of bone, orthodontic tooth movement is much slower (**Nanekrungsan *et al*., 2012**).

1.2.4. Orthodontic Treatment in Young *versus* Adult Patients

In recent times there has been an increase in the number of adult patients who desire orthodontic correction of their malocclusion (). Numerous differences exist between adult orthodontics and orthodontics for the young

child. One of the important differences in treating a child and an adult is the fact that in a child the orthodontist has growth to work with **(Sunnak *et al*., 2015)**. Most orthodontic and orthopedic treatment is efficiently carried out using the growth potential of the patient. In comparison, an adult lacks growth. Thus, the orthodontist merely relies on tooth movement or surgery. Most of the routine diagnostic aids can be used in both young as well as adult patients. An adult patient shows greater possibility of dormant pathosis, impaction, periodontal problems, wear of dentition, etc. The diagnostic exercise in an adult should hence consider these factors as some of them may hamper the success of the orthodontic therapy **(Muir *et al*., 1986)**.

Younger patients who are growing can benefit from orthopedic and myofunctional appliances that help modulate growth in case of abnormal growth amount and direction. In an adult patient the options are restricted to orthodontic tooth movement and surgery**(Papageorgiou *et al*., 2017)**. It is a fact that younger patients tolerate most appliances and are not bothered by the appearance of the appliance. In case of adults, the appliance tolerance is much lesser than a child. Adults are often bothered by the looks of the appliance. In such patients, removable appliances and fixed appliances that are more esthetic or inconspicuous are advocated whenever feasible **(Jeremiah *et al*., 2011)**.
Presence of periodontal involvement and bone loss is more common in an adult patient. Periodontally compromised teeth move more readily and offer poor anchorage **(Bollen *et al*., 2008)**. Most adult patients seeking orthodontic therapy are well motivated as compared to children. Thus, the orthodontist can expect more cooperation in an adult patient **(Pabari *et al*., 2011).** The tissue vitality and responsiveness to force is much greater in a child than in an adult patient. This is because of reduced vascularity and cellularity in an adult patient. Adult patients are more appreciative of the treatment results than a child patient **(Afroz *et al*., 2013)**.

1.3. A Decision-Making Process to Undergo Orthodontic Treatment

Today, orthodontics is greatly considered as a successful and appropriate treatment to improve the adjusted position of the teeth and increase physical attractiveness in communities (**Avinash *et al*., 2013**). Two factors can influence interactions and decision making to opt for a treatment; first, how individuals can become aware of their disease conditions and various types of effective therapies available; and second, therapists' awareness of expectations and attitudes in clients toward themselves as well as treatments (**Sadat-Marashi *et al*., 2015**).

According to (**Kazanci *et al*., 2016**) family members, especially mothers, can play a very important role in deciding whether orthodontics is carried out or not; however, parents' and clients' concerns about orthodontic treatment as well as its effects on self-esteem, attitudes, beauty, and oral health should also be taken into account. In addition, family support and influence of opinions and attitudes by family members are recognized as very important factors that can affect the decision-making process to receive such a treatment. Among other factors that can affect this type of treatment is clients' cultural and economic status (**Xie *et al*., 2010**).

Besides, orthodontics has been accepted among individuals as a cosmetic treatment while, in many cases, this type of treatment can contribute to improving the quality of life in individuals and lead to their better nutrition. In order to implement the best decision, you have to understand the views of relevant people as well as important factors influencing their decision making (**Johansson, 2013**). Expectations, views, and attitudes of clients and parents are also of utmost importance in deciding whether to perform orthodontics or not. Hence, the best method to understand the reasons behind the selection of this therapeutic approach is the clarification of this issue from the words of the people involved (**Strauss *et al*., 2012**).

1.4. Factors Influencing Treatment Duration in Orthodontic Patients

The putative determinants of orthodontic treatment time can be divided into 4 broad categories: sociodemographic characteristics, malocclusion characteristics, treatment method, and patient cooperation. The influence of sociodemographic characteristics including age, sex, and socioeconomic status on treatment time is unclear. Although some studies have reported that chronological age was not significantly associated with treatment time (**Beckwith *et al*., 1999**), others have found the opposite (**Vig *et al*., 1994**), and it has been asserted that stage of dental development (rather than age) at treatment onset might affect treatment time (**Gianelly, 1995**).

Age is associated with patient cooperation; younger patients are more cooperative than older ones (**von Bremen *et al*., 2002**). Longer treatment times for boys have been a common finding, if not a consistent one. Controversy exists over the influence of socioeconomic status on cooperation and treatment time, with no clear consensus on whether a lower socioeconomic status is associated with a shorter or longer treatment time (**Graber *et al*., 1972**). Malocclusion characteristics have been suggested to influence treatment time, **Vig *et al*., (1994)** found not only that Class II or Class III malocclusions took longer to treat, but also that there are interactions between malocclusion type and other variables: the effect of missed appointments was twice as great in Class II patients, patient cooperation reduced treatment time for Class II but not Class I patients and more experienced clinicians treated Class II malocclusions in less time than Class I patients**.**

Wenger *et al*, (1996) observed that treatment time for Class I malocclusions was less than that for Class II or Class III malocclusions. Although differences in anatomy and malocclusion have been reported to influence treatment duration, the relationship of longer treatment time and

greater difficulty has not been well studied (**Turbill** *et al***., 2001**). The treatment method chosen (extraction vs non extraction) has been reported to influence treatment time. Extractions have been linked to longer treatment times, and premolar extractions appear to be particularly significant, although the influence of extraction and non-extraction approaches on treatment time remains controversial, with some studies reporting no difference (**Ong andWoods,2001**).

Among the studies that reported a difference, treatment time for patients treated with an extraction modality averaged at least a month longer. **Shia, (1986)** reported that altering the treatment approach in mid treatment was a significant cause of time overruns, specifically when non extraction treatment was started, but extractions were done later during treatment (delayed extractions). Another important treatment-method variable might be differences among clinicians in the time spent in detailed finishing procedures, although this is also controversial (**Fleming** *et al***., 2015).**

Patient cooperation accounts for much treatment time variation; the major considerations are keeping scheduled appointments, cooperation in wearing elastics adequate oral hygiene ect. Laxity in following instructions might lead not only to a compromised result but also to slow treatment progress, "wasted" clinic time, and frustration (**Mavreas and Athanasiou,2008**). Patients with good oral hygiene have also been described as more likely to cooperate with other aspects of treatment (**El-Mangoury, 1981**). **Beckwith** *et al***., (1999)** reported that the number of brackets and bands replaced during treatment was the second largest contributor to treatment-time variance.

1.5. Satisfaction with Orthodontic Treatment Outcome

Few research projects have looked at patient satisfaction with treatment outcome and the factors contributing to satisfaction (**Al-Omiri and Abu Alhaija, 2006**). No correlations have been found between gender and satisfaction with treatment outcome. Correlations between treatment satisfaction

and other background factors such as age, pretreatment need, severity of malocclusion, and objective treatment outcome have also not been found. Previous studies, however, have revealed correlations between personality traits and treatment satisfaction. Quality of care and attention positively affects satisfaction with treatment **(Maia *et al*., 2010).**

There was a tendency toward significant correlations between treatment motivation and overall satisfaction with treatment. Although correlations between treatment motivation and satisfaction with changes made and satisfaction with one's appearance posttreatment were more fragmented. No correlation was found between the patient's own decision to start treatment and satisfaction with treatment outcome. Expectations and worries for future treatment did not correlate with treatment satisfaction **(Anderson *et al*., 2009).**

There was an overall negative significant correlation between the patients' perceptions of pain and discomfort during treatment and satisfaction with treatment, although pain and discomfort during the first week with braces and pain and discomfort from the stabilization appliance did not correlate with overall treatment satisfaction. Pain and discomfort during surgical placement of a skeletal anchoring device did not correlate with any of the treatment satisfaction items. The more perceived pain and discomfort was associated with procedures or treatment phases, the less satisfaction there was with regard to treatment outcome **(Feldmann *et al*., 2012)**.

There was a strong correlation between treatment satisfaction and patients' ratings of how well they had been informed during treatment and how well they had been cared for during scheduled and acute visits. There were no differences between the two treating orthodontists regarding this factor **(Keles and Bos, 2013).**

Chapter Two: Material and Methods

2.1. Participants

In this study, participants are patients who undergoing orthodontic treatment with fixed orthodontic appliance at post-graduate clinic in Orthodontic Department/ College of Dentistry, University of Baghdad. As well as, some orthodontic private clinics in Baghdad city.

2.2. Selection Criteria and Sample Size

A total of 110 participants with age range 11 and 30 years and both gender who have already orthodontic treatment were allocated to this interview study. All participants should have an appropriate physical and psychological conditions which was evaluated by history collection from their orthodontists and during interview appointment. Also, participants have willingness to participate in the study and have the ability to speak. In addition, important and influential family members were interviewed and asked 10 questions in a semi-structured interview to evaluate the relation of problem recognition timing and orthodontic treatment onset.

2.3. Data Collection and Arrangement

The data needed in this study were collected using a semi-structured and in-depth interview containing open-ended questions. The main interviews were conducted by places decided by patient that they deemed were proper and calm. The interviews were also recorded upon the participants' agreement. In addition, note-taking during interviews were used in a way that voice tone, word pronunciations, laughs, cries, and pauses produced by the participants were considered during the interviews. The average time considered for each interview was 10-15 minutes. To facilitate the data collection, guided questions were used during the interviews.

Guided questions included were as follows:

1. When was the first time you noticed a problem in your teeth?

2. How did you notice that there was a problem in your teeth and the need to go to the dentist?

3. Is it your own decision to undergo orthodontic treatment?

4. How long did it take between discovering the problem and seeing the dentist?

5. Are you satisfied with the diagnosis and treatment plan presented by your dentist?

6. How was your experience at the orthodontic treatment onset?

7. How long did the treatment take yet ?

9. Are you satisfied with the condition of your teeth after treatment and the result you got?

10. In your opinion, do you think the age of a person when starting orthodontic treatment can affect the treatment outcome?

2.4. Statistical Analysis

To analyze the data in this study, this interviews were listened carefully and repeatedly. Then, they were manually transcribed verbatim to the Microsoft Excel worksheet. As for the descriptive statistic; number, percentages with pie and bar charts were used to illustrate the results.

Chapter Three: Results

3.1. Demographic Characteristics

Sociodemographic variables of the study population show a total of 100 participants (10 participations were excluded from the analysis because they didn't fulfilled the required criteria). They were comprising of females (80%) and males (20%) orthodontic patients. Nearly, 22% of the study sample had age range 11-15years while ≃46% were 16-19 years and 31% of the sample were aged above 20years., as shown in Table 3.1.

Table 3.1: Sociodemographic variables of the study population.

Variables	Frequency, n (%)
Gender	Female (80%)
	Male (20%)
Ages range (years)	11-15 (22%)
	16-19 (46%)
	20-30 (31%)

3.2. Problem Recognition Timing and Interview Interpretation

Problem recognition timing by orthodontic patient showed a wide range of variety in this study. It was found that in age range (11-15years), the higher percentage (40.9%) of patients recognized their malocclusion in (12-13years), while patients with age range (16-19years), were noticed their problem in (14-17years) in a percentage of (47.8%). Whereas, the adult patient were aged above 20 years, 48.3%% were noticed problem in (16-18years).

Increased percentage of notice problem by mirror with age and decreased percentage of notice problem by parents with age. Also, Increased rate of self-esteem to seek the treatment with age.

Increased percentage of seek treatment directly in younger ages while low percentages in adult patient above 20 years. Percentage of satisfaction in

orthodontic patients in different age is high. Percentages of orthodontic patient with good experience at the orthodontic onset is high in comparison with percentage of patient with bad experience in different ages as shown in Table 3.2.

Tables 3.2: Problem Recognition Interview Interpretation.

1. Onset of Malocclusion Recognition Timing		
Ages ranges (years)	**Age range (years) of onset**	**Percentage (%)**
11-15	7-9	18.1
	10-11	36
	12-13	40.9
16-19	7-9	2.3
	10-11	15.2
	12-13	23.9
	14-17	47.8
20-30	12-13	16.1
	14-15	29
	16-18	48.3

2. Mode of Recognition				
Ages Ranges	**Mirror**	**Parents**	**Pain**	**Dentist**
11-15	2 (9.09%)	18 (81.8%)	1 (4.5%)	1 (4.5%)
16-19	20 (43,4%)	16 (34.7%)	2 (4.3%)	3 (6.5%)
20-30	24 (77.4%)	6 (19.3%)	0	1 (3.2%)

3. Self-esteem		
Age Ranges	**Yes**	**No**
11-15	8 (36.3%)	14 (63.6%)
16-19	32 (69.5%)	14 (30.4%)
20-30	27 (87.09%)	4 (12.9%)

Continued...

4. Duration between discovering the problem and onset orthodontic treatment			
Age range	**Immediately**	**Months**	**Years**
11-15	12 (54.4%)	2 (9%)	8 (36.3%)
16-19	20 (43.4%)	1(2%)	24 (52.1%)
20-30	4 (12.9%)	1 (3%)	7 (22.5%)
5. Satisfaction with the diagnosis and treatment plan			
Age range	**Yes**		**No**
11-15	21 (95.4%)		1 (4.5%)
16-19	43 (93.4%)		3 (9.6%)
20-30	31 (100%)		0
6. The experience at the orthodontic treatment onset			
Age range	**Good**		**Bad**
11-15	17 (77.2%)		5 (22.7%)
16-19	28 (60.8%)		18 (39.1%)
20-30	19 (55.8%)		12 (38.7%)

The duration of orthodontic treatment, through the percentages that appeared, the possibility of increasing the duration of orthodontic treatment with advanced age as shown in Table 3.3.

Table 3.3: Percentage of the duration of orthodontic treatment.

Age range (years)	Treatment time range (month, m)	Percentage n (%)
11-15	4-10m	9 (40.9%)
	12-24m	8 (36.3%)
	>24m	5 (22.6%)
16-19	6-10m	11 (23.9%)
	12-24m	18 (39.1%)
	>24m	17 (39.6%)
20-30	4-8m	3 (9.6%)
	12-24m	14 (45.2%)
	>24m	13 (41.9%)

Increased percentage of satisfaction with result after treatment for age range as shown in Figure 3.1.
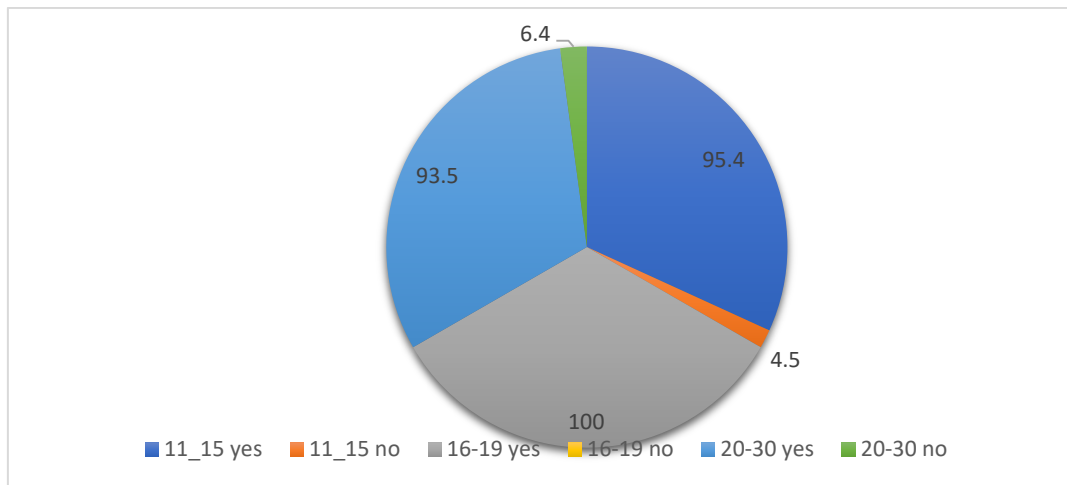
Figure 3.1: Pie chart showed the percentage of patient satisfaction with the condition of teeth after treatment and the result.

The age effect on outcome, 89.1-93.5% of the participating in agreed that a person's age when beginning orthodontic treatment could affect the treatment outcome.as shown in Figure 3.2.
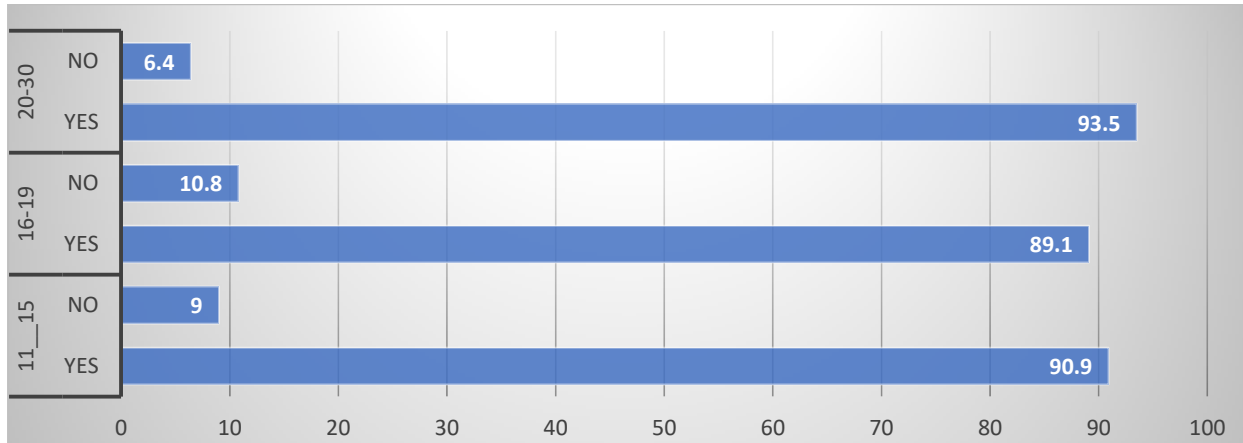
Figure 3.2: Bar chart showing the percentage of age of a person when starting orthodontic treatment can affect the treatment outcome.

Chapter Four: Discussion

In determining the optimal timing for orthodontic treatment, two considerations are important: effectiveness (how well does it work?) and efficiency (what is the cost-benefit ratio?). Both must be kept in mind when deciding when to treat various orthodontic problems (**Proffit** *et al.***,2015**). Studies have reported children and adolescents are the important category of the target group who look for orthodontic treatment **(Tessarollo** *et al.***, 2012; Abeleira** *et al.***, 2014; Alhummayani** *et al.***, 2018).** In this study,46% participants late adolescent age and 16% of them noticed a problem in teeth in age rang (14-15years).

In this study, 81.8% participant notice that there was a problem in teeth by parents, this was similar to the findings of previous studies **(Dogan** *et al.***, 2010; Moshkelgosha** *et al.***, 2017; Alnaafa** *et al.***, 2020; Basri** *et al.***, 2021)**.

In this study, high percentage of self-esteem orthodontic patient (78.6%). This is similar to other studies that demonstrated the decision-making process to undergo orthodontics **(Knapp** *et al.***, 2009; Imani** *et al.***, 2018)**. In study included experience at the orthodontic treatment onset 77.2 %, this is similar to the results of other studies indicated an enhanced sense of being valued in orthodontic patients **(De Baets** *et al.***, 2012; Sadat-Marashi** *et al.***, 2015)**.

In the current study (93.5%) agreed that the age of a person when starting orthodontic treatment can affect the treatment outcome, this is similar to result some studies **(Vig** *et al.***, 1994; Basri** *et al.***, 2021; Alsaggaf** *et al.***, 2022)**, others have found the opposite **(Beckwith** *et al.***, 1999).** The differences in participant's responses between this study and other studies can be attributed to many factors, including the differences in parents' characteristics and the differences in the way the questions were framed in the questionnaire of the studies.

In this study,45.2% had treatment duration of 1 to 2 years, and 41.6% greater than 2 years, predominantly adults. Other study the average duration of comprehensive orthodontic fixed appliance treatment ranges from 2 to 3 years depending on the complexity of malocclusion **(Long *et al*., 2013)**

This finding is at variance with a previous study where adults were neutral to the treatment duration but the adolescents considered it too long (**Uribe *et al*., 2014**). Age differences do not seem to play a role in the duration of the treatment, provided that patients are in the permanent dentition (**Mavreas and Athanasios, 2008**). However, in the previous study reported adult subgroup was significantly more dissatisfied with treatment duration when compared to the adolescents **(Umeh *et al*., 2019)**.

In this study, satisfaction with the diagnosis and treatment plan presented by dentist 100%in different age. There was also no difference in satisfaction between patients with different treating orthodontists **(Keles *et al*., 2013).** In this study, disagree that age has correlated with satisfaction about condition of teeth after treatment, differences with other studies **(Eberting *et al*., 2001; Al-Omiri and Abu Alhaija ,2006; Keles and bos, 2013**).

Chapter Five: Conclusions and Suggestions

5.1. Conclusions

1. There is relation of problem recognition timing and orthodontic treatment onset, therefore the null hypothesis was rejected.

2. Age of the patient and the consulted dentist, play a role in initiating orthodontic treatment.

3. Patient preferred to start orthodontic treatment at an early age to get a faster response to treatment and reduce the duration of orthodontic treatment.

4. A significant improvement was detected in self-esteem.

5. The average treatment duration is 22 and 29 months.

6. Age differences do not seem to play a role in the satisfaction of the treatment outcome.

5.2. Suggestions

1. Extend an interview study include more orthodontic patient at different ages.

2. Cross-section study is suggested instead of interview study.

3. Conducting such studies on malocclusion recognition timing globally rather than locally to compare patients problem recognition timing effects.

4. Studying other factors effect on orthodontic treatment onset.

References

(A)

- Anderson LE, Arruda A, Inglehart MR. (2009) Adolescent patients' treatment motivation and satisfaction with orthodontic treatment. Angle Orthod.;79:821–827.

- Alhummayani, F.M.; Taibah, S.M.(2018) Orthodontic treatment needs in Saudi young adults and manpower requirements. Saudi Med. J., 39, 822–828. [CrossRef].

- Alnaafa, M.; Altamimi, Y.; Alajlan, S.; Alateeq, N.; Almarshedi, A.; Alsaleh, M.; Alsuwailem, R.; Patil, S.; Alam, M.K . (2020) The parental awareness regarding early orthodontic treatment in Hail city. Int. Med. J. , 27, 220–223.

- Avinash B, Avinash BS, Shivalinga BM, Jain S. (2013) Body dysmorphic disorder in orthodontic patients. World J Dent.;4(1):56–59.

- Al-Omiri MK, Abu Alhaija ES. (2006) Factors affecting patient satisfaction after orthodontic treatment. Angle Orthod. ; 76:422–431.

- Abeleira MT, Pazos E, Ramos I, Outumuro M, Limeres J, Seoane-Romero J, Diniz M, Diz P:(2014) Orthodontic treatment for disabled children: a survey of parents' attitudes and overall satisfaction. BMC Oral Health , 14:98.

- Allan TK, Hodgson EW. (1968) The use of personality measurements as a determinant of patient cooperation in an orthodontic practice. Am J Orthod ;54:433-40.

- Almeida MR, Almeida RR, Oltramari-Navarro PV, Conti AC, Navarro RD, Camacho JG. (2011) Early treatment of class III malocclusion: 10-year clinical follow-up. J Appl Oral Sci. ;19(4):431–439.

(B)

- Bahreman A.(2013) *Early-Age Orthodontic Treatment, Introduction.* 1st ed. Quintessence Pub Co.; Berlin, Germany:. [Google Scholar].

- Basri, O.; Alghamdi, E.; Amoudi, A.; Filimban, L.; Darwish, H.; Alsaman, F.; Alzahrani, K. (2021)Evaluation of parent's knowledge and awareness towards early orthodontic treatment for their children among Saudi Arabia. Med. Sci.25, 3409–3416.

- Benson, P.E., Javidi, H. and DiBiase, A.T. (2015) What is the value of orthodontic treatment? British Dental Journal, 218, 185–190.

- Bedoya M, Park J (2009): A review of the diagnosis and management of impacted maxillary canines, J Am Dent Assoc 140:1485–1493.

- Bollen AM, Cunha-Cruz J, Bakko DW, Huang GJ, Hujoel PP.(2008) The effects of orthodontic therapy on periodontal health: a systematic review of controlled evidence. J Am Dent Assoc139:413–22.

- Buschang PH, Schulman JD (2003): Incisor crowding in untreated persons 15-50 years of age: United States, 1988-1994, Angle Orthod 73:502–508.

- Buschang PH, Jacob HB, Demirjian A (2013) : Female adolescent craniofacial growth spurts: real or fiction, Eur J Orthod,(advance access).

- Baccetti T, Franchi L, McNamara Jr. JA (2011): Longitudinal growth changes in subjects with deepbite, Am J Orthod Dentofac Orthop 140:202–209.

- Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz, vol. 64, no. 8, pp. 918–923, 2021.

(C)

- Cangialosi T (1984): Skeletal morphologic features of anterior open bite, Am J Orthod 85:28–36.

- Chung C-H, Hufham DC (2001): A corrected cephalometric tracing technique for diagnosis and treatment planning of anterior crossbite with functional shift, J Clin Orthod 35:500–504.

(D)

- Demirovic K., Habibovic J., Dzemidzic V., Tiro A., and Nakas k., (2019) "Comparison of oral health-related quality of life in treated and non-treated orthodontic patients," Medical Archives, vol. 73, no. 2, pp. 113–117.

- De Baets E, Lambrechts H, Lemiere J, Diya L, Willems G.(2012) Impact of self-esteem on the relationship between orthodontic treatment need and oral health-related quality of life in 11- to 16-year-old children. Eur J Orthod.;34(6):731–737.

- Dimberg, L., Lennartsson, B., Arnrup, K. and Bondemark, L. (2015) Prevalence and change of malocclusions from primary to early permanent dentition: a longitudinal study. The Angle Orthodontist, 85, 728–734.

(E)

- Eberting JJ, Straja SR, Tuncay OC. (2001)Treatment time, outcome and patient satisfaction comparisons of Damon and conventional brackets. Clin Orthod Res.4: 228–234.

- El-Mangoury NH.(1981) Orthodontic cooperation. Am J Orthod 80:604-20.

(F)

- Fink DF, Smith RJ.(1992) The duration of orthodontic treatment. Am J Orthod Dentofacial Orthop 102:45-51.
- Fleming PS.(2017) Timing orthodontic treatment: early or late? Aust Dent J.62(Suppl 1):11–19.
- Fishman L.S. (1982) Radiographic evaluation of skeletal maturation: a clinically oriented method based on hand-wrist films,Angle Orthod.
- Sunnak R, Johal A, Fleming PS. (2015) Is orthodontics prior to 11years of age evidence-based? A systematic review and meta-ana-lysis. J Dent ;43:477–86.
- Fleming PS, Johal A, DiBiase AT.(2008) Managing malocclusion inthe mixed dentition: six keys to success. Part 1. Dental update35:607–10
- Feldmann I, List T, Bondemark L.(2012) Orthodontic anchoring techniques and its influence on pain, discomfort and jaw function—a randomized controlled trial. Eur J Orthod. 34:102–108.

(G)

- Grippaudo C, Paolantonio EG, Luzzi V, Manai A, La Torre G, Polimeni A.(2019) Orthodontic screening and treatment timing in preschoolers. Clin Exp Dent Res5(1):59–66.
- Gianelly AA.(1995) One-phase versus two-phase treatment. Am J Orthod Dentofac Orthop.;108(5):556–559.
- Gianelly AA (1994): Crowding, timing of treatment, Angle Orthod 64:415–418.
- Graber TM, Vanarsdall RL Jr.(1972) Orthodontics: current principles and techniques. 3rd ed. WB Saunders; Philadelphia: p. 488-527.
- Gianelly AA.(1995) One-phase versus two-phase treatment. Am J Orthod Dentofacial Orthop ;108:335-9.

(H)

- Hsieh T-J, Pinskaya Y, Roberts WE.(2005) Assessment of orthodontic treatment outcomes: early treatment versus late treatment. Angle Orthod. 75(2):162–170.

(I)

- Imani M.M., Jalali A, Ebraheim Ezzati, Zeinab Heirani, Mohammadreza Din mohammadi (2018) A decision-making process to undergo orthodontic treatment: a qualitative study, Patient Preference and Adherence ,12, 2243–2251.

- Isiekwe G.I, Sofola O.O., O. O. Onigbogi, I. L. Utomi, O. O. Sanu, and O. O. da Costa,(2016)"Dental esthetics and oral health related quality of life in young adults," American Journal of Orthodontics and Dentofacial Orthopedics, vol. 150, no. 4, pp. 627–636.

(J)

- Johansson L.(2013) Shared decision making and patient involvement in choosing home therapies. J Ren Care. ;39(Suppl 1):9–15.

- Fleming PS, Fedorowicz Z, Johal A, El-Angbawi A, Pandis N.(2015) Surgical adjunctive procedures for accelerating orthodontic treatment. The Cochrane database of systematic reviews.(6):CD010572.

(K)

- Keles F, Bos A. (2013) Satisfaction with orthodontic treatment. Angle Orthod. 2013;83:507–511.

- Kantarci A, Will L, Yen S (eds) (2016): Tooth Movement. Front Oral Biol. Basel, Karger, 2016, vol 18, pp 1–8 DOI: 10.1159/000351894.

- Krishnan V, Davidovitch Z (2006): **Cellular, molecular, and tissue-level reactions to orthodontic force.** *Am J Orthod Dentofacial Orthop* 20**129**(4):469. e461–432 e461-432

- . Kluemper GT, Beeman CS, Hicks EP.(2000) Early orthodontic treatment: what are the imperatives? J Am Dent Assoc. 131(5):613–62.

- King GJ, Brudvik P.(2010) Effectiveness of interceptive orthodontic treatment in reducing malocclusions. Am J Orthod Dentofac Orthop.137(1):18–25.

- King G J, Brudvik P (2010) Effectiveness of interceptive orthodontic treatment in reducing malocclusions. American Journal of Orthodontics and Dentofacial Orthopedics 137: 18–25

- Kiyak, H. and Reichmuth, M. (2002) Body image issues in dental medicine. In Cash, T.F, Pruzinsky, T. (eds), Body Image: A Handbook of Theory,Research, and Clinical Practice. Guilford, New York, NY, pp. 342–350.

- Kluemper GT, Beeman CS, Hicks EP.(2000) Early orthodontic treatment: what are the imperatives? J Am Dent Assoc.131(5):613–620.

(L)

- Liu YP, Behrents RG, Buschang PH(2010): Mandibular growth, remodeling and maturation during infancy and early childhood, Angle Orthod 80:97–105.

- Long H, Pyakurel U, Wang Y, Liao L, Zhou Y, Lai L.(2013) Interventions for accelerating orthodonti c tooth movement. Angl e Orthodontist: 83(1):164-71.

(M)

- Maspero C, Galbiati G, Giannini L, Guenza G, Farronato M. (2018) Class II division 1 malocclusions: comparisons between one- and two-step treatment. Eur J Paediatr Dent. 19(4):295–299.

- Mavreas D, Athanasiou AE.(2008) Factors affecting the duration of orthodontic treatment: a systematic review. European journal of orthodontics. ;30(4):386-95.

- Mavreas D, Athanasios E. Athanasiou.(2008) Factors affecting the duration of orthodontic treatment: a systematic review. European Journal of Orthodontics ,30 ,386–395.

- Moshkelgosha, V.; Kazemi, M.; Pakshir, H.; Safari, R.(2017) Parental knowledge and attitude towards early orthodontic treatment for their primary school children. Iran. J. Orthod. , 12, e7377. [CrossRef].

- Meikle MC(2006): The tissue, cellular, and molecular regulation of orthodontic tooth movement: 100 years after Carl Sandstedt. Eur J Orthod ,28(3):221–40.Article PubMed Google Scholar

- Mohammad Y Tabbaa1, Abdullah R Albarkheel2, Sultan AlMubarak (2022) Parents' Knowledge and Awareness of Orthodontics and Orthodontic Treatment in Saudi Arabia. International Journal of Science and Research (IJSR), 600, 599-605.

- Maia NG, Normando D, Maia FA, Ferreira MA, do Socorra Costa Feitosa Alves M.(2010) Factors associated with long-term patient satisfaction. Angle Orthod. 80:1155–1158.

- Mayerson M.(1996) Management and marketing. J Clin Orthod 30:337-41.

(N)

- Nanekrungsan K, et al.(2012) External apical root resorption in maxillary incisors in orthodontic patients: associated factors and radiographic evaluation. Imaging Science in Dentistry ;42:147-154.

(O)

- O'Brien KD, Robbins ME, Vig KWL, Vig PS, Shnorhokian H, Weyant R. The effectiveness of Class II Division 1 treatment. Am J Orthod Dentofacial Orthop 1995;107:329-34.

- Ong HB, Woods MG. An occlusal and cephalometric analysis of maxillary first and second premolar extraction effects. Angle Orthod 2001;71:90-102.

- O'Brien K, Wright J, Conboy F, et al: Effectiveness of early orthodontic treatment with the Twin-block appliance: a multicenter, randomized, controlled trial. 1. Dental and skeletal effects, Am J Orthod Dentofacial Orthop 124:234–243, 2001.

(P)

- Pirttiniemi P, Kantomaa T, Lahtela P(1990): Relationship between craniofacial and condyle path asymmetry in unilateral crossbite patients, Eur J Orthod 12:408–413.

- Proffit WR: Contemporary orthodontics, ed 5, St Louis, 2015, Mosby.

- Papageorgiou SN, Hochli D, Eliades T.(2017) Outcomes of comprehensive fixed appliance orthodontic treatment: asystematic review with meta-analysis and methodological overview. Korean J Orthod. Nov;47(6):401-13.

- Pabari, S., Moles, D. and Cunningham, S. (2011) Assessment of motivation and psychological characteristics of adult orthodontic patients.American Journal of Orthodontics and Dentofacial Orthopaedics, 140,e263–e272.

- Palomares, N., Celeste, R., de Oliverira, B. and Miguel, J. (2012) How does orthodontic treatment affect young adults' oral health-related qualitof life? American Journal of Orthodontics and Dentofacial Orthopaedics,141, 751–758.

(S)

- Sadat-Marashi Z, Scolozzi P, Antonarakis GS.(2015) Perceptions of Young Adults Having Undergone Combined Orthodontic and Orthognathic Surgical Treatment: A Grounded Theory Approach. J Oral Maxillofac Surg. ;73(12):2391–2398.

- Sunnak R, Johal A, Fleming PS.(2015) Is orthodontics prior to 11years of age evidence-based? A systematic review and meta-ana-lysis. J Dent ;43:477–86.

- Shaw, W.C., O'Brien, K.D. and Richmond, S. (1991) Quality control in orthodontics: factors influencing the receipt of orthodontic treatment. British Dental Journal, 170, 66–68.

- Shen, L., He, F., Zhang, C., Jiang, H., & Wang, J. (2018). Prevalence of malocclusion in primary dentition in mainland China, 1988–2017: a systematic review and metaanalysis. Scientific Reports, 8(1), 1–10.

- Shia GJ. (1986)Treatment overruns. J Clin Orthod ;20:602-4

- Singh, S., Sharma, A., Sandhu, N., & Mehta, K. (2016). The prevalence of malocclusion and orthodontic treatment needs in school going children of Nalagarh, Himachal Pradesh, India. Indian Journal of Dental Research, 27(3), 317.

(T)

- Tristão S. K. P. C., Magno M., Pintor et al.,(2020) "Is there a relationship between malocclusion and bullying? A systematic review," Progress in Orthodontics, vol. 21, no. 1, p. 26.

- Tabbaa, M.Y.; Albarkheel, A.R.; Al Mubarak, S.(2020) Parents' Knowledge and Awareness of Orthodontics and Orthodontic Treatment in Saudi Arabia. Int. J. Sci. Res.9, 599–604. [CrossRef].

- Tessarollo FR, Feldens CA, Closs LQ (2012): The impact of malocclusion on adolescents' dissatisfaction with dental appearance and oral functions. The Angle orthodontist 2012, 82(3):403-409.

- Tulloch JFC, Proffit WR, Phillips C.(2004) Outcomes in a 2-phase randomized clinical trial of early class II treatment. Am J Orthod Dentofac Orthop. 125(6):657–667.

- Turbill EA, Richmond S, Wright J.(2001)The time-factor in orthodontics: what influences the duration of treatments in National Health Service Practices? Community Dent Oral Epidemiol ;29:62-72.

(R)

- Ren A, Lv T, Kang N, Zhao B, Chen Y, Bai D.(2007) Rapid orthodontic tooth movement aided by alveolar surgery in beagles. Am J Orthod Dentofacial Orthop. 131(2):160. e161-110

- Ruf R., Proff P., and Lisson J., "Health relevance of malocclusions and their treatment,"

(U)

- Uribe F, Soumya P, Allareddy V, Ravindra Nanda.(2014) Patients', parents', and orthodontists' perceptions of the need for and costs of additional procedures to reduce treatment time. Am J Orthod Dentofacial Orthop. 145 (4); 65-73.

(V)

- Vig K, O'Brien K, Shnorhokian H, Vayda D, Vig P, Weyant R, et al.(1994) Predictors for Class I and Class II treatment duration differences [abstract]. J Dent Res ;73:273.

- Vig PS, Weintraub JA, Brown C, Kowalski CJ.(1990) The duration of orthodontic treatment with and without extractions: a pilot study of five selected practices. Am J Orthod Dentofacial Orthop 97:45-51.

- Vvon Bremen J, Pancherz H.(2007) Efficiency of early and late Class II Division 1 treatment. Am J Orthod Dentofacial Orthop 121:31-7.

- Varkkola O., et al.(2011)Age assessment by the Greulich and Pyle method compared to other skeletal X-ray and dental methods in data from Finnish child victims of the Southeast Asian Tsunami Forensic Sci Med Pathol.(1990)(1994)(2002)

(W)

- Wenger R, Douangpanya S, Vig K, Beck M, Vig P.(1996) Classes I, II and III differences in severity, duration and orthodontic results [abstract]. J Dent Res;75:437.

- Wheeler TT, McGorray SP, Dolce C, King GJ.(2006) The timing of class II treatment. Am J Orthod Dentofac Orthop. ;129(4):66–70.

- Wiedel AP, Bondemark L. (2015)Fixed versus removable orthodonticappliances to correct anterior crossbite in the mixed dentition–arandomized controlled trial. Eur J Orthod ;37:123–7.

(X)

- Xie X, Wang L, Wang A.(2010) Artificial neural network modeling for deciding if extractions are necessary prior to orthodontic treatment. Angle Orthod. 2010;80(2):262–266.