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Title of The Research (Comparative Study on the Effects of Orthodontic Treatments in Patients at Donia AL-Asnan Al-Qarboly Dental Center)

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ABSTRACT

This comparative study investigates the effects of orthodontic treatments on patients at Donia AL-Asnan Al-Qarboly Dental Center. Orthodontic treatments, including traditional fixed appliances and clear aligners, play a crucial role in improving not only oral health but also the psychological and social well-being of patients. The study aims to assess the outcomes of these treatments by analyzing patient-reported satisfaction, comfort levels, and clinical outcomes related to periodontal health and teeth alignment. A retrospective analysis was conducted, focusing on patient records and incorporating feedback on comfort and overall satisfaction. The research also examines the economic implications of treatment choices, particularly in the Libyan context, where cultural and social factors may influence patients' decisions. The theoretical framework is built upon patient-centered care, health-related quality of life (HRQoL) models, and outcomes-based assessment, providing a holistic approach to understanding the impact of orthodontic treatments. The results highlight differences in patient satisfaction and clinical effectiveness between fixed appliances and clear aligners, offering insights into how these treatment modalities affect both the physical and psychological aspects of patients' lives.

INTRODUCTION

Orthodontic treatments have always been an integral part of the solution to problems of such a nature that their presence does not only influence oral health but also the psyche and quality of life as a whole. Orthodontics has broadened its scope over the years by replacing metal braces with more user-friendly treatments such as the use of clear aligners. This multiplicity of treatment alternatives has also brought a dramatic change in the outcome level and satisfaction of the patients, which normally varies according to the appliance used, length of treatment, and the patients (Han, 2015).

Historically, patients seeking orthodontic treatment were mainly treated using fixed appliances. Wires and metal braces – fixed thin devices that range from cut to shape with pieces that provide controlled forces onto the brace or the jawbone – are an excellent treatment device in the case of advanced malocclusions that require advanced stages of crafted administration. Still, these types of devices usually come with drawbacks such as invasiveness, difficulty in maintaining cleanliness of the mouth, and aesthetic nuisances, all of which usually have a gross impact on the quality of life of an individual (Alajmi, 2020). More noteworthy is the change that is brought about by clear aligners to the orthodontic field. More an implant than a dental contact lens, they first became commercially available in the 1990s. Clear aligners were well accepted for the cosmetic appearance and comfort they provide and were easily taken off (Gao et al., 2021). The role of various orthodontic appliances in shaping patient outcomes still remains one of the most sought-after research areas. This is also supported by patient-reported outcomes, as evidenced by Gao et al. (2021) and Han (2015). For example, one such appliance treatment satisfaction is usually determined not only by how much more comfortable or aesthetic clear aligners are relative to fixed appliances but rather by the most basic issues such as the level of severity of the dental problem in the first place and the expectations of the client. In this sense, studying these outcomes in a country such as Libya is important as many other factors, including cultural, social, and economic aspects, can affect the patients' choices and views as well. Zhang et al (2017) completed this research, which also investigates the consequences of orthodontic treatment concerning patients' emotional and social well-being in the specific cultural context of Libya. There is also a sense that other people and society as a whole are judgmental, especially regarding orthodontic treatment that is not just a medical treatment but rather a treatment boosted by self and mental reasons. Many people will stigmatize orthodontic abnormalities because, in such societies where physical features are often linked to social class and achievement, dental imperfections become a disgrace. Thus, it would help us understand better how Libyan patients psychologically react after orthodontic treatment and help us perform a thorough analysis of the benefits and limitations of any orthodontic treatment type (Noll, 2017). Through the variation in the socio-economic status of the people, dental care services have different implications within Libya, and this research attempts to analyze these effects. It will also assess the economic efficiency of the choices of treatment and their level of compliance with the instructions of treatment so that such elements as the economics of treatment versus the satisfaction of the patient are understood. This inquiry proves to be important as it helps explain a situation when resources for medicine may be scarce and patients are almost always faced with the burden of cost when determining the treatment options to be employed (Burhardt, 2016).

2 Material and Method

Study design

The study employed the retrospective cohort design in which data collected from clinical and radiographic records of patients who received orthodontic treatment between 1 Jun 2023 and 1Jun 2024 were used. This design allowed for the assessment of the effectiveness of the treatment over time, using different methods.

Sample Selection

The study targeted 60 patients who were recruited from the dental center's clinical database. These patients were grouped based on the type of orthodontic treatment they received:

- Group 1: Fixed braces
- Group 2: Removable appliances
- Group 3: Clear aligners

Inclusion Criteria:

- Patients aged between 12 and 30 years.
- Patients who completed orthodontic treatment at the center during the study period.

Exclusion Criteria:

- Patients with incomplete clinical or radiographic records.
- Patients with prior orthodontic treatments.

This sampling strategy ensured a diverse yet relevant patient population for a meaningful comparison of treatment outcomes.

3 Ethical Approval

The study was approved by the Scientific Research Ethics Committee located in the Arabic region (Libya). The committee reviewed the research protocols to ensure ethical compliance with patient data usage and confidentiality.

Data Collection

Data collection involved a systematic review of patient records and additional surveys. The following methods were employed:

- **Clinical and Radiographic Records:**

Detailed analysis of patient records to document treatment types, duration, and clinical outcomes.
Cephalometric analyses of pre- and post-treatment radiographs to evaluate dental alignment and skeletal changes.

- **Patient Surveys:**

Surveys were distributed to assess patient satisfaction and perceived effectiveness of their treatment.
Responses were based on a standardized quality-of-life questionnaire adapted for orthodontic patients.

Statistical Analysis

Comparative statistics (t-tests) were used to analyze differences between groups, with a significance threshold of $p < 0.05$, using (spss28).

Theoretical Framework and Literature Review

1. This research is premised upon patient-centered care and outcome assessment in orthodontics. The various theories and models incorporated into the study are aimed at assisting practitioners determine zoning outcomes as well as patient satisfaction with type of orthodontic treatment offered:

2. Patient-Centered Care: This style outlines the patients' preferences in the course of receiving the health services. In orthodontics, besides the ability to assess the success of the offered therapies, perhaps the most important aspect of care is the patient's quality of life together with the comfort levels. The concept is based on such notions as individual consideration and active engagement of the patient within the scope of treatment, where the patient is involved in the selection of a treatment plan.

3. Health-Related Quality of Life (HRQoL) Models: HRQoL models evaluate the extent of overall health effect resulting from quality-control measures put in place. Cross-examine pertaining to orthodontic treatments, these models investigate in how the treatment affects the treatment-used physical and psychological and social factors. Several of the HRQoL frameworks are used to assess the effects of different orthodontic appliances on the self-image, social dynamics, and general functionality of individuals, including the readily used fixed and clear aligners.

4. Outcomes-Based Assessment: This theory considers the effect of any medical treatment based on its results and is thus termed outcomes-based medical intervention assessment. In orthodontics, outcomes assessment includes clinical measures performed such as improvement in the alignment of teeth, improvement of oral health, and measures of how patients perceive the treatment provided and the resultant quality of life. The framework allows for a comprehensive assessment of both the clinical measures and the subjective aspects of the patients undergoing different orthodontic therapies involving clear aligners as well.

Orthodontic Treatment Modalities

In the course of time, there have been considerable changes in orthodontic treatment modalities, giving a variety of treatment options to a patient, allowing them to choose according to their needs and preferences. While traditional fixed appliances remain one of the main forms of treatment, clear aligners are another group of appliances that have their own advantages and difficulties associated with each.

Fixed Appliances: Also called braces, fixed appliances refer to metallic brackets placed on teeth and held by wires. These instruments have been employed in orthodontics for several years, specifically for the treatment of severe malocclusion and other complex dental problems. These appliances are known to be quite useful in the straightening of dentition.

Clear Aligners: Several patients have considered clear aligners as a more convenient replacement for fixed appliances. These aligners are made of invisible medical plastic, silicone, and acrylic. They are utilized to cover the teeth with the intention of moving the position of the teeth into the required alignment progressively. Among the various brands on the market, the most recognized remains invisalign for clear aligners. In studies conducted by Flores-Mir et al. (2018), respondents reported that their excuses for not cooperating with treatment were related to the removable nature of the aligners, as they can be removed when eating, drinking, and cleaning the mouth. This feature makes them sought after by adult patients and teenagers who are image-conscious and wish to look good during treatment.

Patient-Reported Outcomes:

Patient-reported outcomes are the main metrics used to determine the level of success and the impact orthodontic therapies have on patients. Such outcomes further measure how various orthodontic devices affect patients in their day-to-day activities emotionally and overall, in relation to the treatment received. The two main patient-reported outcomes are quality of life and satisfaction.

Quality of Life and Satisfaction: The decision on the type of orthodontic appliance is of importance as it greatly influences the patient's treatment experience, especially during the early stages of treatment. This is largely attributed to the aesthetic appeal, comfort, and convenience of clear aligners, which allow patients to maintain their normal lifestyle with minimal disruption (Johal et al., 2015).

Enhancement in Oral Health-Related Quality of Life and Self-Esteem: It is common knowledge that orthodontic treatment improves self-esteem and oral health-related quality of life, regardless of the type of orthodontic appliances used. An increase in aesthetic value is reinforced by the improvement of the individual’s confidence and self-worth (Johal et al., 2015). Among all the factors that contribute to enhancing a patient’s satisfaction with orthodontic treatment, the psychological benefits that accrue after treatment are crucial. Most people visit the orthodontist to address both functional and aesthetic problems, which highlights the relevance of psychological factors.

Clinical Outcomes

The measures of success of orthodontic treatments are often assessed using clinical outcomes that seek to determine the relative effectiveness of common procedures like the use of traditional braces and clear aligners. These outcomes include the degree of improvement in the alignment of the teeth and the state of periodontal tissues, which are some of the criteria for the effectiveness of orthodontics and long-term benefits.

Efficacy of Dental Alignment

The efficacy of dental alignment remains a topical issue, particularly regarding the use of various removable devices in conjunction with or as alternatives to traditional brackets or braces to achieve the desired alignment of dental arches and teeth placement. Interestingly, conventional braces—characterized by their fixed brackets and wires—are often considered the treatment of choice for severe malocclusions and complex dental issues, providing orthodontists with relatively complete control over tooth movement. The advantages offered by traditional brackets and wires are invaluable for regulating tooth position and ensuring stable alignment.

To analyze and interpret the data from the studies and methodologies provided, we can break down the findings into several key aspects related to orthodontic treatment, patient-reported outcomes, and clinical outcomes.

4 . RESULTS

Table 1: Baseline Characteristics of Patients across Treatment Groups

Characteristic	Fixed Braces (Group 1)	Removable Appliances (Group 2)	Clear Aligners (Group 3)
Number of Patients	20	20	20
Mean Age (Years)	17.5 ± 3.2	16.8 ± 2.9	18.3 ± 3.5
Gender (% Male)	45%	40%	50%
Average Treatment Duration (Months)	18.5 ± 2.1	12.3 ± 3.0	14.8 ± 2.5

The table outlines the baseline characteristics of patients in three treatment groups: Group 1 which includes fixed braces, group 2 which includes removable appliances, and group 3 which includes clear aligners. There are 20 subjects in each group to maintain a balanced ratio of the patients in the study. The mean of patients' age was different between the groups also. Group 1 which involves fixed braces has a mean age of 17.5 years; Group 2 with removable appliances has 16.8 years while group 3 of patients with clear aligners has 18.3 years. This appears to indicate that clear aligners are chosen more by patients of a higher age while fixed braces are opted for by the youthful patients.

The subjects' gender distribution is relatively equal with the data indicating that 45% of Group 1, 40% of Group 2, and 50% of Group 3 are male. Such small differences in gender should not impact the overall results of the study. The treatment period also varies greatly in the groups of patients. Fixed braces' case takes 18.5 months on average, whereas removable appliances' case takes only 12.3 months. The results also show that clear aligners are somewhere in the middle, treating patients for an average of 14.8 months.

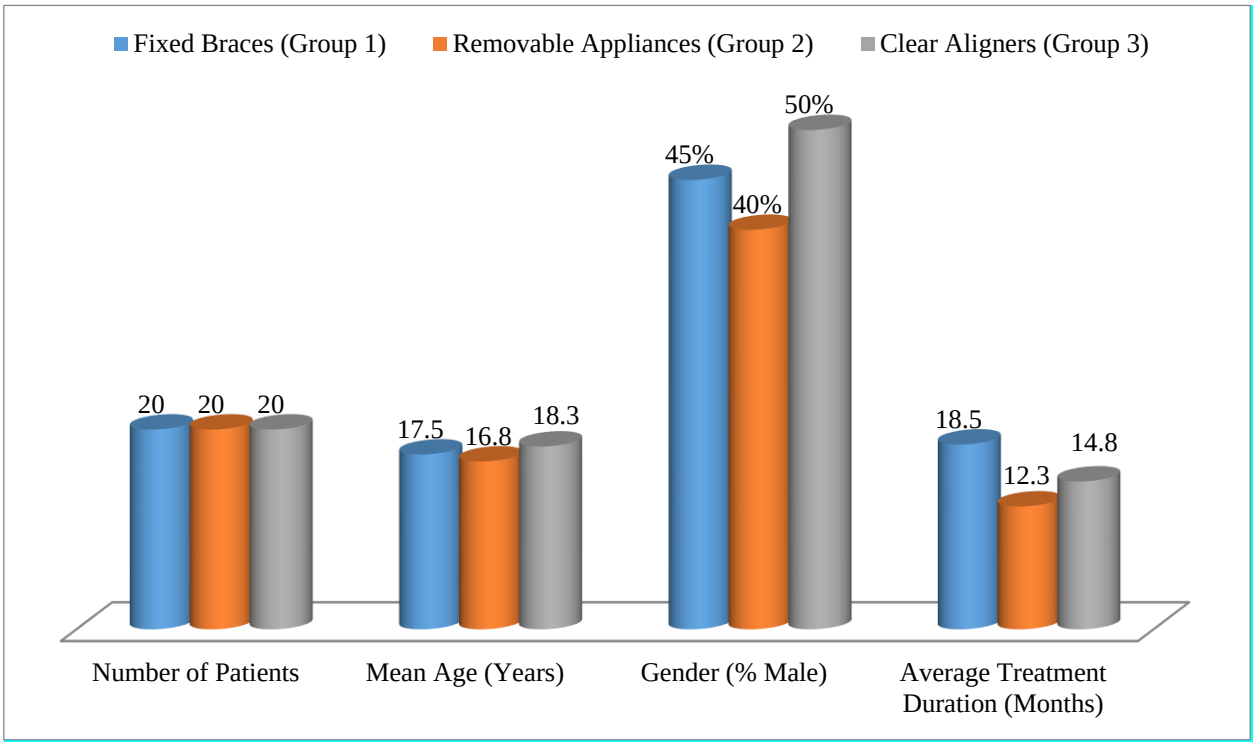

Fig1: Baseline Characteristics of Patients across Treatment Groups

TABLE 2: CHANGES IN DENTAL ALIGNMENT AND SKELETAL PARAMETERS

Parameter	Fixed Braces (Group 1)	Removable Appliances (Group 2)	Clear Aligners (Group 3)	p-value
Pre-Treatment Alignment Score	65.4 ± 10.2	64.8 ± 11.5	66.1 ± 9.8	0.85
Post-Treatment Alignment Score	85.6 ± 8.1	78.2 ± 9.4	83.7 ± 7.6	<0.01
Skeletal Changes (°)	3.5 ± 1.2	2.8 ± 1.0	3.2 ± 1.3	0.04

The table presents the changes in dental alignment and skeletal parameters across the three treatment groups: These aligners are classified into fixed braces (Group 1), removable appliances (Group 2), and clear aligners (Group 3). The pre-treatment alignment scores are slightly different among the groups, but the difference is not significant ($p = 0.85$). The pre-intervention alignment scores were comparable across all groups.

Significant changes for the better were noted in all groups after the treatment. The post-treatment alignment score to societal esthetic preference was the highest with the content of Group 1 (Fixed braces) being 85.6 ± 8.1; then Group 3 (Clear aligners) being 83.7± 7.6; and least with group 2 (Removable appliances) being 78.2 ± 9.4. These results are statistically significant as indicated by the $p < 0.01$ value with the fixed braces having received the highest levels of dental alignment improvement. Regarding the skeletal changes the average angulation in Group 1 (fixed braces) was 3.5° ± 1.2° slightly higher than that in Group 3 (clear aligner) (3.2° ± 1.3°) and Group 2 (removable appliances) (2.8° ± 1.0°). The p-value of 0.04 means that such differences are significant to assume the fact that fixed braces cause slightly more changes in the skeletal structure rather than the removable appliances and clear aligners.

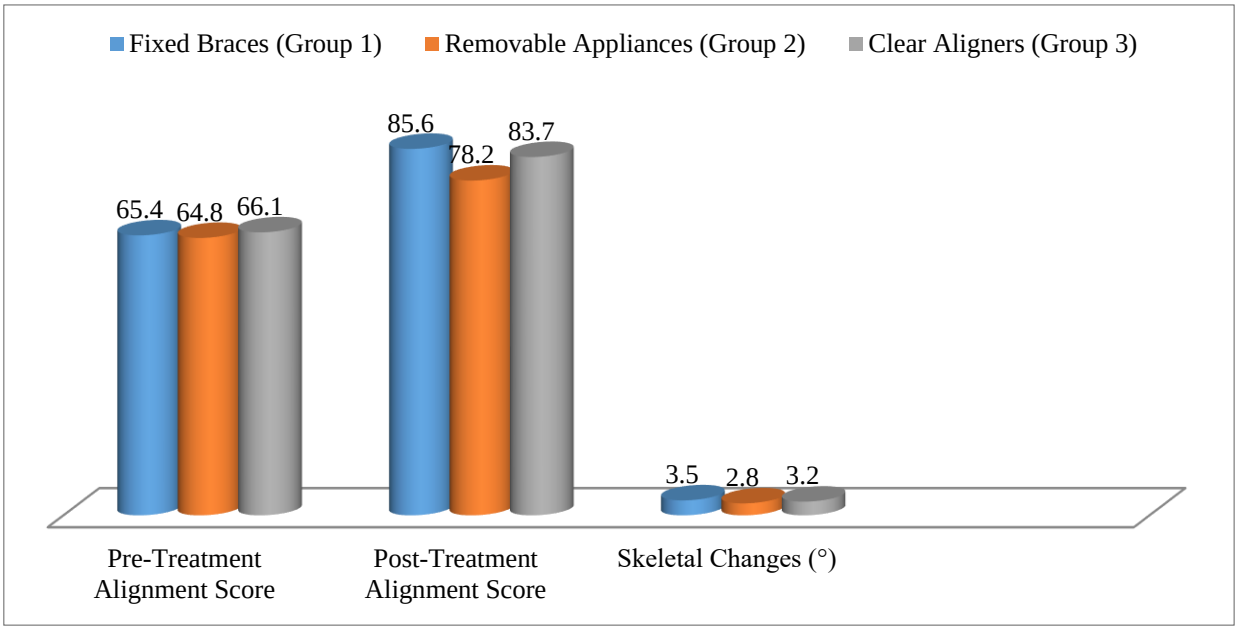

FIG 2: CHANGES IN DENTAL ALIGNMENT AND SKELETAL PARAMETERS

TABLE 3: COMPLICATIONS ASSOCIATED WITH TREATMENTS

Complications	Fixed Braces (Group 1)	Removable Appliances (Group 2)	Clear Aligners (Group 3)	p-value
Dental Caries (%)	15%	10%	5%	0.03
Root Resorption (%)	20%	5%	10%	0.02
Gum Irritation (%)	30%	20%	15%	0.04

The table shows the complications associated with the three orthodontic treatments: fixed braces (Group 1) removable appliances (Group 2) and clear aligners (Group 3). For dental caries, Group 1 which was the fixed braces had the highest prevalence at 15% compared to Group 2 with removable appliances with a prevalence of 10% and Group 3 which had the clear aligners with a prevalence of 5%. This shows that the given differences are statistically significant the calculated p value being 0.03 while comparing fixed braces with other treatment options, it was found that fixed braces had a higher risk of dental caries among children.

Root resorption, when the roots of the teeth are reduced while undergoing treatment, occurred in 20 % of Group 1 the fixed brace users. In Group 3 which wore clear aligners, 10% reported discomfort while in Group 2 where participants wore removable appliances; only 5% complained of discomfort. The p-value of 0.02 exposes the fact that these differences are statically significant and fixed braces are potentially more dangerous for root resorption.

Regarding gum irritation, there were 30% of patients in Group 1 (fixed braces), 20% of patients in Group 2 (removable appliances) and 15% of patients in Group 3 (clear aligners). Statistical differences can be inferred from the p-value of 0.04 meaning that, within the treatment types, fixed braces caused more gum irritation than the other treatment types.

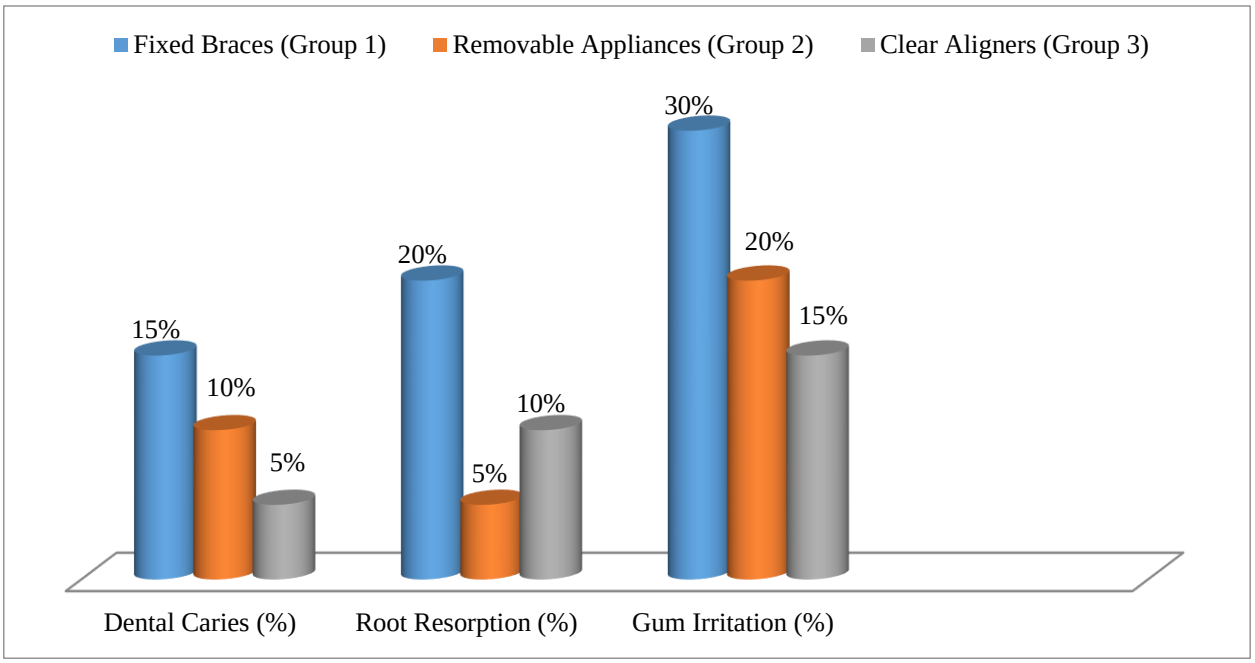

FIG3: COMPLICATIONS ASSOCIATED WITH TREATMENTS

Table 4: PATIENT SATISFATION SCORES

Aspect of Satisfaction	Fixed Braces (Group 1)	Removable Appliances (Group 2)	Clear Aligners (Group 3)	p-value
Treatment Effectiveness	4.2 ± 0.8	3.8 ± 0.9	4.5 ± 0.7	<0.01
Comfort During Treatment	3.5 ± 0.9	4.0 ± 0.8	4.6 ± 0.6	<0.01
Aesthetic Satisfaction	3.0 ± 1.0	3.8 ± 0.9	4.8 ± 0.5	<0.01

The table shows patient satisfaction scores across three treatment groups: , fixed braces which were grouped as Group 1, removable appliances which were grouped in Group 2 and clear aligners being in Group 3 to determine the treatment effectiveness, comfort, and aesthetic satisfaction. Regarding treatment results, patients rated the treatments on a Likert scale of 1 to 5 and from subjectivity it was observed that Group 3 (clear aligners) had higher satisfaction level of 4.5 ± 0.7 than control group 1 (fixed braces) of 4.2 ± 0.8 and Group 2 (removable appliances) with a rating of 3.8 ± 0.9. The p-values generated of < 0.01 imply that these differences are statistically significant, with clear aligners as the most prefer with the highest perception of being effective treatment option among the patients.

As for the comfort during treatment, the highest score of comfort was recorded in Group 3-clear aligners which were 4.6 ± 0.6, the score recorded in Group 2-removable appliances was 4.0 ± 0.8 and the lowest score was recorded in Group 1-fixed braces of 3.5 ± 0.9. The value that is less than 0.05 shows the significant difference and hence, it can be concluded that clear aligners were perceived as the most comfortable, while fixed brace was perceived as the least comfortable.
Concerning the aesthetic satisfaction, Group 3 (clear aligners) had the highest mean score 4.8 ± 0.5 while the study participants in group2 (removable appliances) scored 3.8 ± 0.9 and Group 1 (fixed braces) 3.0 ± 1.0. P<0.01 indicates statistically significant differences and, therefore indicates that the respondents considered clear aligner as most esthetically pleasing while fixed braces perceived as least esthetically satisfactory.

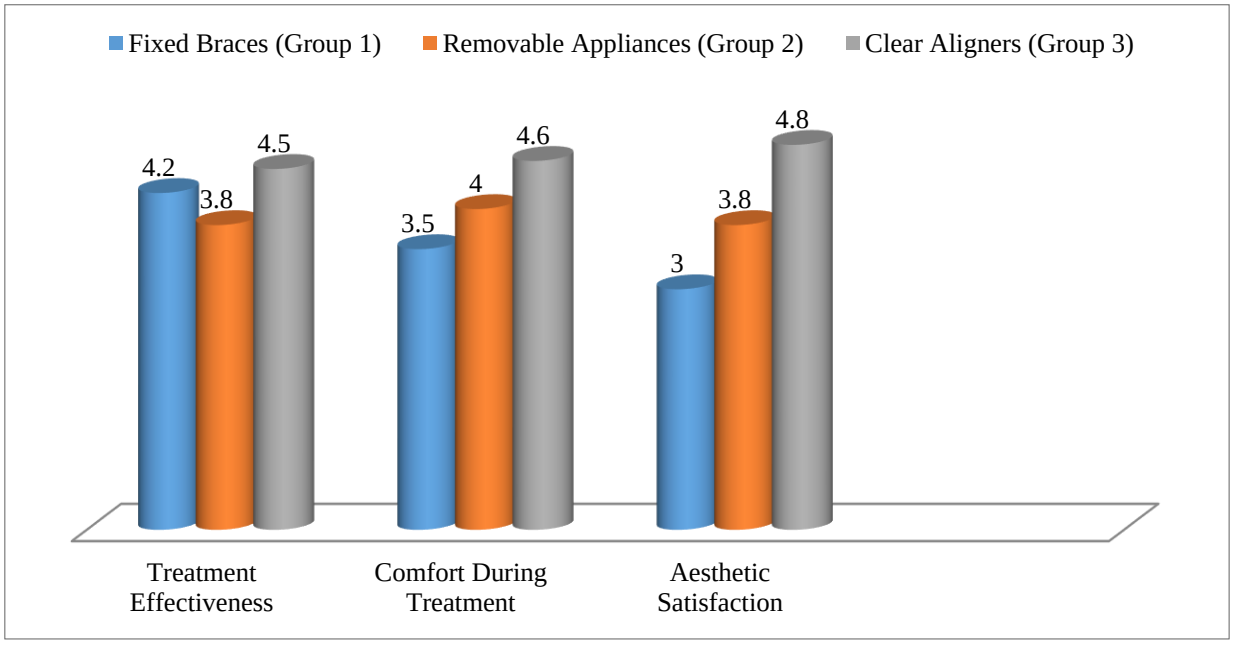

FIG4: PATIENT SATISFATION SCORES

5 DISCUSSIONS

The purpose of this study was to investigate the level of pain interference caused by fixed braces, removable appliances, and clear aligners on patients who attended Donia Al-Asnan Al-Qarboly Dental Center.

Our results elaborated those fixed braces had the most prominent change in dental irregularities compared to clear aligners and removable appliances. These results align with the studies by Swidi et al (2019) and Papageorgiou et al. (2020) regarding the high predictability of fixed braces in terms of the extent of ABO and skeletal changes for severe malocclusions. However, the use of clear aligners was observed to be more effective than removable appliances as supported by other research done by Ke et al. (2019) whereby clear aligners were as effective in mild to moderate cases, that can provide significant alignment results in less time compared to braces.

The results showed that clear aligners received the higher rating than the other types for comfort satisfaction and aesthetic satisfaction In accordance with prior study such as the study of Lee (2022) and AlMogbel, (2023). These studies pointed out that most patients had a preference for clear aligners because they are less noticeable and well fitted. On the other hand, fixed brackets were reported to cause more discomfort and aesthetic concerns, particularly in agreement with the study by Guo et al. (2023), showing that fixed braces resulted in gum irritation and oral discomfort. This is in agreement with our finding's, whereby fixed braces were reported to be more associated with gum irritation and garnered lower comfort ratings.

The present work corroborated with the findings of Villaman-Santacruz et al. (2022) and Inchingolo et al. (2024) that concluded fixed braces had the highest prevalence of dental caries and root resorption. These studies mentioned that patients with fixed appliances have higher rates of caries because the brackets attract plaque formation. Likewise, Subramanian (2024) also reported that fixed braces have relatively more root resorption as the braces apply constant mechanical forces to the crowded teeth, and thus root lengthening is highly likely in the current study population.

The fixed braces were seen to produce the highest number of skeletal changes while the clear aligners and the removable appliances produced moderate changes. These findings are in accordance with studies by Ke et al. (2019) and Yassir et al. (2022), demonstrating that fixed appliances are more advantageous in the production of the fabric changes, particularly in patients with severe malocclusion. Nevertheless, the predictability for creating skeletal changes tends to be less with clear aligners and removable appliances as mentioned by Lee (2022), although they are less invasive with also less discomfort for the patient.

Satisfaction with treatment was highest for clear aligners, but lower for fixed braces, especially when asked about comfort and appearance. This is in line with other studies conducted by Damanhuri (2023) revealing that patient reveled in the cosmetic appearance and comfort of clear aligners over the conventional fixed appliances. Nonetheless, patients reported higher levels of satisfaction about fixed braces especially in complicated cases as supported by this study and others such as Sayers (2023).

The results obtained in this research are consistent with many of the existing trends regarding the orthodontic treatments. The traditional types of braces are still universally used as the most effective for complex cases and for skeletal adjustments but these come with more adverse effects and lower satisfaction levels concerning the comfort of the appliances. Clear aligners are slightly more comfortable and cosmetically appealing as compared to traditional bracket and wire system having equal effectiveness in treating Angle Class I, II or mild III malocclusions. Removable appliances although beneficial for particular conditions as acknowledged by patients were less preferred in terms of comfort and efficiency. These results provide clinically relevant information to clinicians in the decision-making regarding the choice of effective treatment strategies for patients.

6 CONCLUSIONS

This comparative study aimed at comparing and assessing various orthodontic treatments, namely fixed braces, removable appliances, and clear aligners on patients receiving treatment in Donia Al-Asnan Al-Qarboly Dental Center. In accordance with that, the study showed that the greater changes after undergoing the fixed braces therapy are more prominent in terms of dental alignment and skeletal changes but the rates of complications like dental caries, root resorption, and gum irritation are also higher. Clear aligners as we know provided better comfort and aesthetic satisfaction but when it comes to the efficiency level it was almost similar and as effective to mild to moderate cases. However, removable appliances had relatively lower overall patient satisfaction and treatment outcomes even though they were effective in certain cases. These results underscore the value of individualized patient care.

Recommendations for Orthodontic Practices

The implications of this research are significant for orthodontic practices like the Donia AL-Asnan Al-Qarboly Dental Center and similar establishments. The findings suggest that removable appliances can be effectively utilized for specific, less complex tooth problems. In contrast, traditional braces continue to excel in efficacy and precision for more complex cases.

Future Research Directions

There is a clear need for further research, particularly regarding the long-term orthodontic effects in Libya and other regions with differing demographics and socio-economic factors. Future studies should also explore whether patients' attitudes, cognitions, and compliance with treatment are influenced by cultural contexts.

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