

A COMPARISON OF TREATMENT IMPACTS BETWEEN INVISALIGN AND
FIXED APPLIANCE THERAPY DURING THE FIRST SEVEN DAYS OF
TREATMENT

By

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Abstract of Thesis Presented to the Graduate School
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The aim of this study was to evaluate the differences in quality of life impacts between patients treated with Invisalign® and with fixed appliances during the first seven days of orthodontic treatment. A prospective, longitudinal study involving 60 adult orthodontic patients was completed using a daily diary to measure treatment impacts including functional, psychosocial, and pain-related outcomes. Thirty-three patients were treated with Invisalign and 27 with fixed appliances. Subjects were recruited from the University of Florida Orthodontic Clinics and four private practices located in Florida, Arizona, Kentucky, and Texas. Both overall and category-specific quality of life impacts were measured using 23 items with Likert response sets. Pain experience was assessed using a visual analog scale. A baseline survey was completed prior to the initiation of treatment; diary entries were made for seven consecutive days in order to measure various impacts of the patients' orthodontic treatment over time. The baseline and diary

data were then analyzed for differences between treatment modalities in terms of the patients' reported impacts from their orthodontic treatment. The baseline data revealed that there were no differences between groups for baseline pain reports ($p=0.42$) or for overall quality of life measures ($p=0.59$). From day one through day seven the Invisalign group reported fewer negative impacts on their overall quality of life ($p<0.001$). The Invisalign group also recorded less impact in each quality of life category evaluated (functional, psycho-social, and pain-related) with $p<0.0002$. The visual analog scale pain reports revealed that the Invisalign group experienced less pain from day one through day seven ($p<0.001$). The fixed appliance group took more pain medication than the Invisalign group at days 2 and 3 ($p<0.006$). Adult patients treated with Invisalign experienced less pain and less negative impact on their lives during the first week of treatment.

INTRODUCTION

The body of literature addressing the orthodontic patients' experience during treatment is relatively small. Most of the studies in this area have focused on delineating the pain experience of the orthodontic patient throughout treatment. Pain resulting from orthodontic treatment has been shown to be very significant. Jones¹ found that the pain experienced after initial archwire insertion is much greater than pain after extractions. The pain progression after initial archwire insertion is well established in the literature. The level of pain increases four hours after insertion of the initial archwire, peaks at 24 hours, and decreases to almost baseline levels at seven days.^{1,2,3,4} Stewart et al⁵ found that the first four to seven days after initial wire placement are the most critical for the patient in terms of general discomfort. Sergl et al⁶ found that patients adapt to new appliances within seven days after appliance insertion. From these studies it can be concluded that the first seven days after archwire insertion is a crucial time for the patient's adaptation to appliances and the period in which most orthodontic pain is experienced.

Past studies have examined the differences in the pain response between different modalities of treatment. Stewart et al⁵ observed that subjects with fixed appliances had more problems with comfort, tension, pressure, tightness, pain and sensitivity than did subjects with removable appliances. He found that the functional appliances disturbed speech and swallowing more than fixed appliances. Sergl et al^{7,8} corroborated these results in two separate studies. He found that patients treated with fixed appliances

reported more pain and discomfort than did patients wearing removable plates, while patients treated with functional or removable appliances reported more problems with impaired speech, swallowing, and feeling of oral constraint than patients treated with fixed appliances. These studies suggest that fixed appliances have more of an impact on the patient's pain response during the initial stages of treatment than do removable appliances, while removable appliances have more of an effect on functional response variables such as speech and swallowing.

Over the past decade Invisalign® has emerged as a popular new treatment modality. The technology and fabrication process have been described elsewhere.⁹ While the impact-related effects for fixed appliances have been studied, no studies have evaluated the effect of Invisalign treatment on the patient. Patients who elect to be treated with Invisalign are seeking an appliance that is less obtrusive in their everyday lives. These patients often incur a greater treatment fee in hopes that the appliance will have less negative impact on their quality of life. In order for the patient and clinician to make more informed decisions regarding treatment modality, studies are needed to evaluate the differences between Invisalign and fixed appliance therapy in their impacts on patients' quality of life.

To that end, the objective of this study was to evaluate the relationship between modality of treatment, Invisalign or fixed appliances, and the various quality of life effects experienced during the first seven days of orthodontic treatment.

MATERIALS AND METHODS

A prospective, longitudinal study involving 60 adult orthodontic patients was completed using a daily diary to measure the various treatment impacts. Patients accepted into the study were required to be at least 18 years of age, in good general health, and received treatment in both the upper and lower dental arches. The fixed appliances group was treated with wires and brackets only. Premolar and incisor extraction cases were acceptable. The study was approved by the Institutional Review Board, and participants completed a written informed consent form.

The study sample was largely representative of adult patients seen in private orthodontic offices and consisted of 33 Invisalign patients and 27 patients treated with pre-adjusted, fixed appliances [Table 1]. Seventy-two percent of the subjects were female, with each treatment group containing similar numbers of females. Most of the subjects had at least some level of college education. Sixty-four percent of the patients used in this study were drawn from private practices located in Florida, Arizona, Kentucky and Texas. The remaining patients were drawn from the University of Florida Orthodontic Clinics. The mean pretreatment age of the Invisalign subjects was 38 years (range= 19.5-64.1) and 28 years (range= 18-53) for the fixed appliance subjects.

A daily diary form [see appendix] was used to measure the effect of appliance type on the subjects' quality of life. The daily diary has been shown to be a more valid instrument for recording pain than those which rely on retrospective pain memory.¹⁰ The diary was composed three main sections: 1) 13 items measuring functional,

psychosocial, and pain-related treatment impacts using a five-point Likert scale; 2) one pain item using a visual analog scale; 3) one item asking what (if any) pain medications were taken. Data about subjects' sociodemographic characteristics were also collected.

The first diary section described above was adapted from the well-validated Geriatric Oral Health Assessment Index (GOHAI)¹¹ which was originally designed to measure patient-reported oral function problems involving physical function, psychosocial function, pain and discomfort. The questions were modified to address impacts relevant to orthodontic treatment. The responses to the first 13 questions were combined in order to give an overall impact score for each patient at each time point. The impact score is a reflection of the patient's overall reported quality of life. A higher impact score signifies fewer reported impacts while a low score signifies a negative response. These first 13 questions were also broken down into three sub-categories for analysis: 1) functional impacts (questions a, b, c, d); 2) pain-related impacts (questions e, h, l, m); and 3) psycho-social impacts (questions f, g, i, j, k). The visual analog scale was used as an additional measure of pain experience. The visual analog scale has been shown to be a valid instrument for measuring orthodontic pain.¹² Pain medication information was recorded in order to test for any possible interactions with the orthodontic treatment effect.

Subjects completed a baseline, pretreatment diary form immediately before initial fixed appliances were placed or aligners were delivered. Pretreatment models and demographic data were collected at this appointment. Treatment related information such as archwire size and type (for the fixed group), whether extractions were done, and which teeth were extracted was recorded at this appointment. The patient was then sent home

with a study packet which included instructions to complete identical diary forms for seven consecutive days. At the end of the seven day period the study packet was mailed back to the principal investigator in a pre-addressed envelope.

STATISTICAL ANALYSIS

Repeated measure mixed models were used to evaluate differences due to treatment group, day in treatment, baseline outcome measures, and treatment group by day interaction. The following variables were evaluated for their effect on the above mentioned models: sex, age, previous treatment, income, education and use of pain medication. The primary outcome measures evaluated in the models were overall and category-impact scores, and pain scores as recorded on a visual analog scale. Baseline demographic differences were evaluated using chi-square and Wilcoxon rank sum tests. Significance level was set at $p < 0.05$. Standard error is illustrated in each figure.

Pretreatment models were scored by the same investigator using the PAR index.^{13,14} Pretreatment models were collected in order to compare the initial severity of malocclusion between the Invisalign and fixed appliance groups. One investigator was calibrated to a gold-standard for the PAR index using ten separate stone models. Once this investigator was calibrated to stone models, he then was trained in using the PAR index on Orthocad[®] (digital) and Invisalign Clincheck[®] (digital) models. All Invisalign patients' models were in Clincheck format, while all fixed appliance patients' were in stone or Orthocad format. In order to test for measurement reproducibility between formats, one investigator scored three sets of 10 identical models. One set of models was stone, one OrthoCad[®], and one Invisalign Clincheck[®]. The reliability estimates between each format were all ≥ 0.95 . These findings are in agreement with those of

Quimby et al¹⁵ who found the accuracy of measurements between two anatomical points on digital models to be equal to that made on stone models.

RESULTS

Sample Characteristics

Pretreatment models were obtained in order to compare the groups for the severity of their initial malocclusion. As table 1 illustrates, both the Invisalign and the fixed appliance groups had a similar severity of malocclusion as rated by the PAR Index.

Table 1: Pretreatment PAR Scores

	PAR Score	Significance [*]
Invisalign	20.04 ±9.56	NS
Fixed Appliances	20.46 ±7.67	

^{*} $\alpha = .05$

There was no significant difference between groups in gender composition, racial composition, level of education, self-reported health status or reports of prior orthodontic treatment (Table 2). Although not reaching statistical significance at $p=0.06$, more Invisalign patients reported seeking treatment ‘to improve my appearance,’ while more fixed appliance patients reported seeing treatment ‘because my dentist referred me.’ The Invisalign group was significantly older and had higher incomes than the fixed appliance group.

Overall Impact Scores

Figure 1 illustrates the overall impact scores for the two groups during the first week of treatment. The overall pattern of impact for both groups is an initial decrease in

quality of life followed by a return to baseline levels. The overall impact scores of the Invisalign and fixed appliance groups were not significantly different at baseline. The groups differed in their reported impact scores beginning on day 1 and continuing through day seven. At each of these time points, the fixed appliance group reported significantly lower impact scores with $p < 0.0001$. In addition, the impact scores at each time point, independent of treatment group, are each statistically different from each other at $p < 0.0001$.

The overall impact score progression from baseline levels for each group was different. The Invisalign group reported a negative overall impact on their daily lives from day 1-3, but from days 4-7 reported an increase in quality of life compared with baseline levels. The fixed appliance group reported a drastic initial drop in quality of life at day 1. From days 2-7 the overall quality of life scores for the fixed group improved but never reached baseline levels indicating an overall negative impact for all seven days.

Subcomponent Impact Scores

Figure 2, Figure 3, and Figure 4 illustrate the impact scores for the two groups when the survey questions were subcategorized into functional, psycho-social, and pain-related subcomponents. For all three subcomponents, beginning at day one and extending through day seven, the Invisalign treatment group reported less negative impact than the fixed group at each time point with $p < 0.002$. Also, the impact scores at each time point, independent of treatment group, were statistically different from each other.

For the functional subcomponent (Figure 2), both groups reported a negative effect on function at day one with the fixed appliance group reporting a much more drastic drop in function. By day seven in the Invisalign group's functional impact scores had

returned almost back to baseline levels, whereas the fixed appliance group's function was well below baseline levels. Analysis of the functional subcomponent questions also showed that patients' baseline impact scores has an effect on their impact scores from days one through seven at a significance level of $p=0.047$.

For the psycho-social subcomponent (Figure 3), the fixed appliance group reported a drop in psycho-social well-being on days one through three compared with baseline levels, while the Invisalign group reported an increase beginning at day one and continuing through day seven. The fixed group's psycho-social impact scores returned to baseline levels at day five and showed a slight increase at day seven.

For the pain-related subcomponent (Figure 4), the fixed group reported a sharp increase in discomfort at day one and a gradual decline in discomfort from days two through seven. The fixed group's pain reports never improved to baseline levels, indicating an overall negative impact of pain for all seven days. The Invisalign group reported an increase in discomfort at days one and two, returned to baseline level at day three, and reported an improvement over baseline levels from days four through seven.

Visual Analog Scale Pain Reports

Figure 5 illustrates the pain reports of the two groups during the first week of treatment as recorded on a visual analog scale. At baseline there was no difference in pain reports between the groups. From days one through seven the fixed appliance patients reported significantly more pain than the Invisalign patients with $p<0.0001$. Independent of treatment group, the pain reports at each time point were significantly different from each other with $p<0.0001$. The overall pain progression is an initial increase in pain at day one followed by a gradual return to near baseline levels over days two through seven. The Invisalign group's pain level returned to baseline at day five,

and decreased slightly below baseline levels at days six and seven. The fixed appliance group's pain reports do not return to baseline levels by day seven, indicating an overall negative pain experience during the first week of treatment.

Pain Medication

Figure 6 illustrates how the groups differed in their pain medication intake during the study period. Patients reported using only over-the-counter pain medications. Examples of medications taken were Advil, Tylenol, Ibuprofen, Motrin, and Aleve. At baseline there was no difference between the groups in pain medications reports. At day one, the difference between groups approached significance with the fixed appliance group taking more pain medication. On days two and three the fixed appliance group took more pain medication with $p < 0.006$. From days four through seven there was no difference between the groups.

Influence of Covariates

The influence of the following variables were evaluated for their impact on the outcome measures: gender, age, income, education, intake of pain medication and previous orthodontic treatment. Sex, age, income and the intake of pain medication during treatment were shown to effect the overall impact score over the study period at a significance level of $p < 0.03$. The results showed that the following characteristics were associated with lower quality of life scores during the study period: female gender, younger age, lower income and pain medication intake during the study period.

Archwire Size

For the fixed appliance group, the effect of the archwire size on patients' overall impact scores and pain reports on the visual analog scale was evaluated. The .012" archwires were grouped with the .014" wires, and the .016" wires were grouped with the

.018” wires. Forty-four percent of the archwires were .014”, and 37 percent of the archwires were .016”. Archwire size with material type was not evaluated since there were too many combinations of size and type for analysis. Archwire material type was not evaluated since the sample sizes of the two groups were not balanced. Sixty-seven percent of the archwires were nickel titanium, and 33 percent were copper nickel titanium.

Statistics for the influence of archwire size are not shown here. These results are observational as this study was not designed to test for archwire size. The patients with smaller archwires reported less overall impact on their quality of lives beginning at day one and continuing through day seven. The shape of the curves for each group mirror each other through the entire week, with the larger archwire group reporting a lower quality of life. The pain reports as recorded on a visual analog revealed that patients with larger archwires reported higher levels of pain from day one through day five.

Table 2. Demographic Data

	Invisalign n (%)	Fixed Appliances n (%)	Significance*
Gender			NS
Male	11 (33%)	6 (22%)	
Female	22 (67%)	21(78%)	
Age (years)			p=0.002
Mean ± SD	38.03±12.40	28.18±9.00	
Race			
White	24 (73%)	13 (48%)	
Black	1 (3%)	5 (18%)	
Asian	2 (6%)	1 (4%)	
Hispanic	5 (15%)	7 (26%)	
Other	1 (3%)	1 (4%)	
Education			NS
<HS Graduate	0 (0%)	1 (4%)	
HS Graduate	2 (6%)	2 (7%)	
Some College	8 (24%)	10 (37%)	
College Graduate	23 (70%)	14 (52%)	
Income			p=0.015
Under \$10,000	2 (6%)	5 (19%)	
10,000-25,000	3 (9%)	4 (15%)	
25,000-50,000	5 (15%)	6 (22%)	
50,000-75,000	7 (21%)	6 (22%)	
75,000-100,000	3 (9%)	3 (11%)	
100,000+	13 (40%)	3 (11%)	
Health Status			NS
Excellent	21 (64%)	13 (48%)	
Very Good	11 (33%)	11 (41%)	
Good	1 (3%)	3 (11%)	
Fair	0 (0%)	0 (0%)	
Poor	0 (0%)	0 (0%)	
Reason Seeking Treatment			NS**
To improve appearance	28 (85%)	18 (67%)	
Difficulty eating	0 (0%)	0 (0%)	
Dental or facial pain	3 (9%)	2 (7%)	
Dentist referral	1 (3%)	7 (26%)	
Other	1 (3%)	0 (0%)	
Previous Treatment			NS
Yes	16 (48%)	9 (33%)	
No	17 (52%)	18 (67%)	

* $\alpha = .05$

** Approached significance, p=0.06

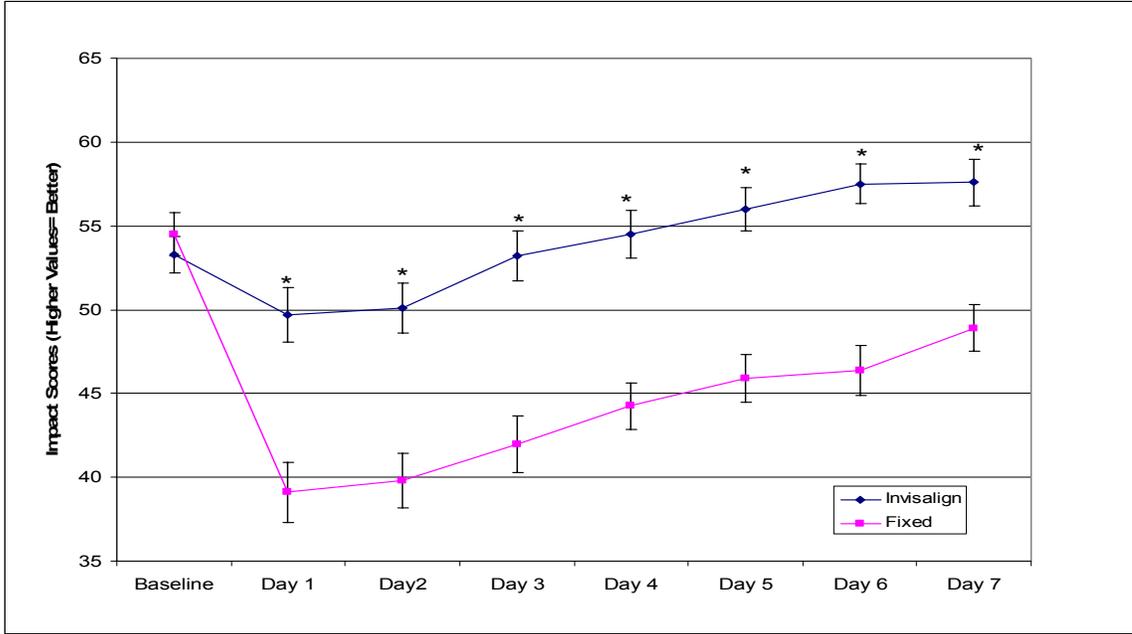


Figure 1. Mean overall impact scores for Invisalign and fixed appliance groups. Higher impact scores on the y-axis indicate a more positive quality of life. (* p<0.05)

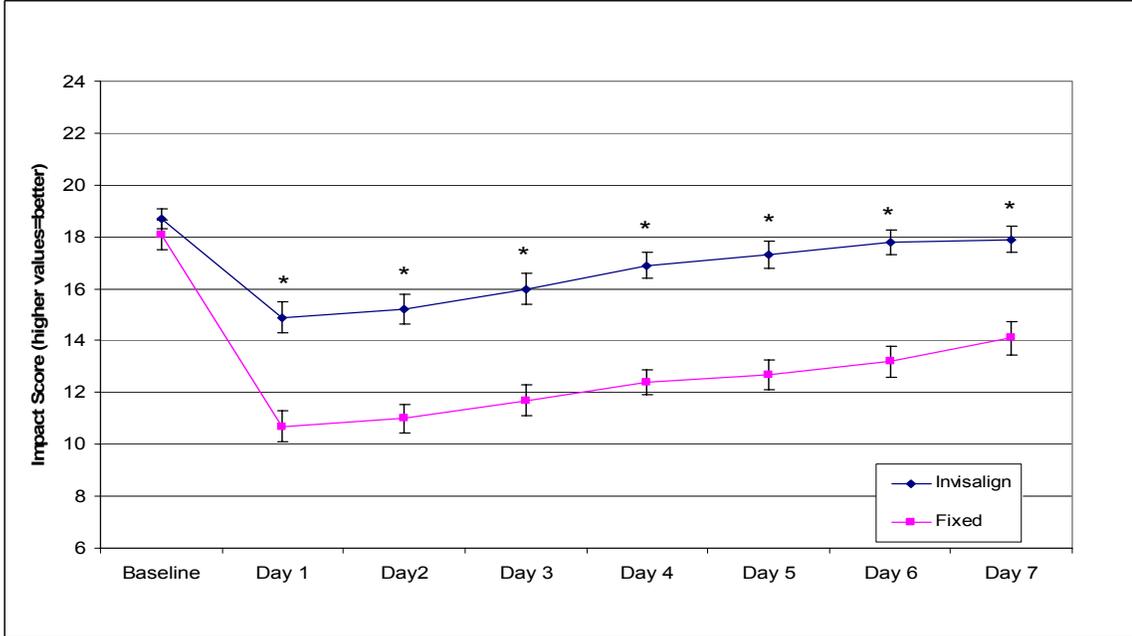


Figure 2. Mean functional subcomponent impact scores for Invisalign and fixed appliance groups. (* p<0.05)

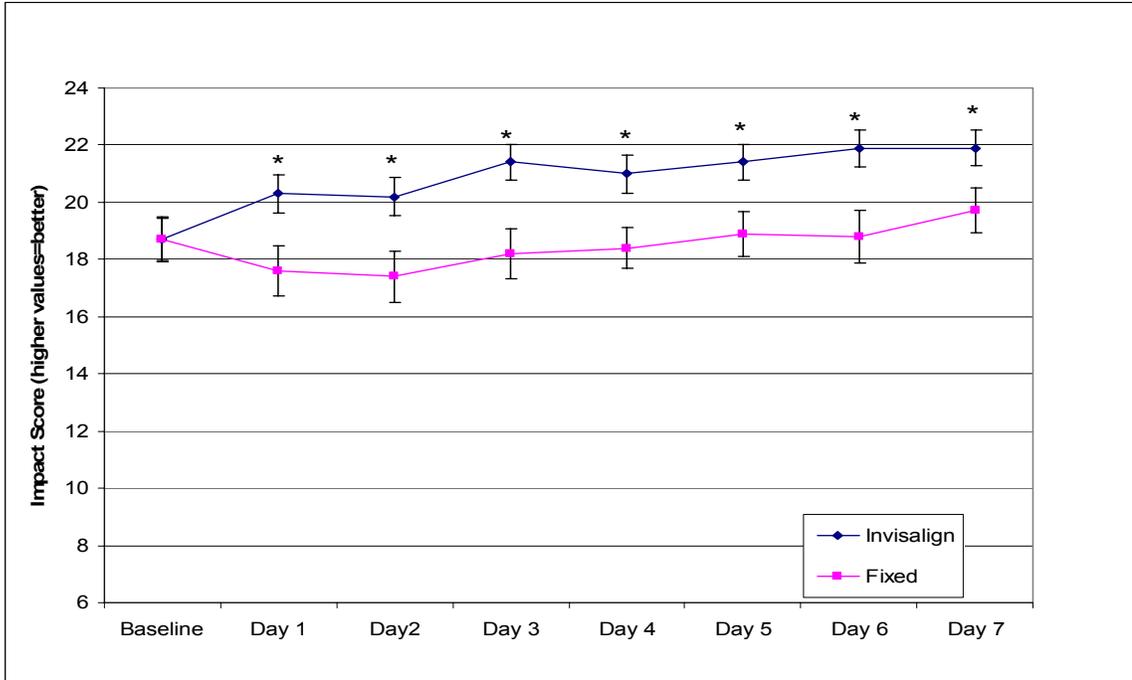


Figure 3. Mean psychosocial subcomponent impact scores for Invisalign and fixed appliance groups. (* p<0.05)

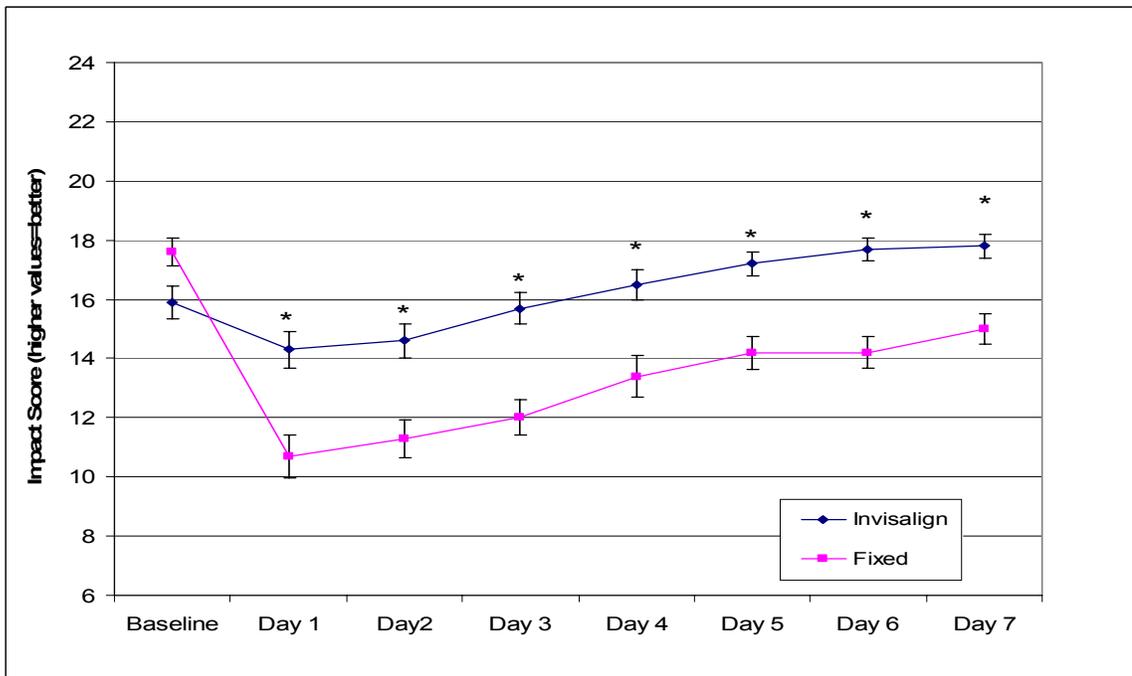


Figure 4. Mean pain-related subcomponent impact scores for Invisalign and fixed appliance groups. (* p<0.05)

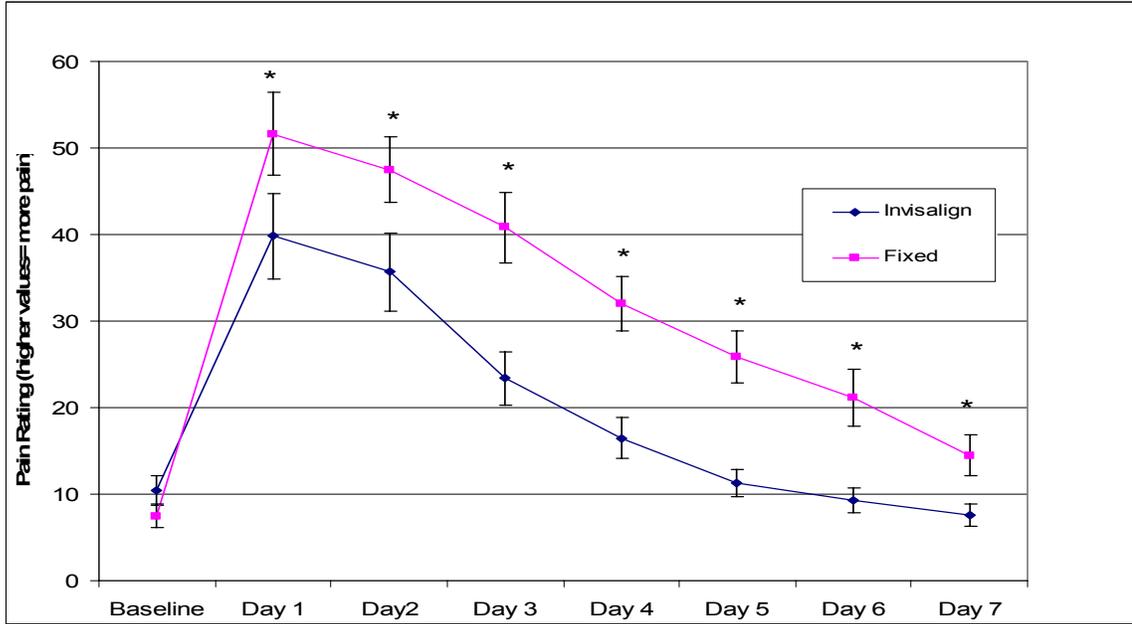


Figure 5. Mean pain scores as recorded on a visual analog scale for Invisalign and fixed appliance groups. Higher values on the y-axis indicate more pain was experienced. (* p<0.05)

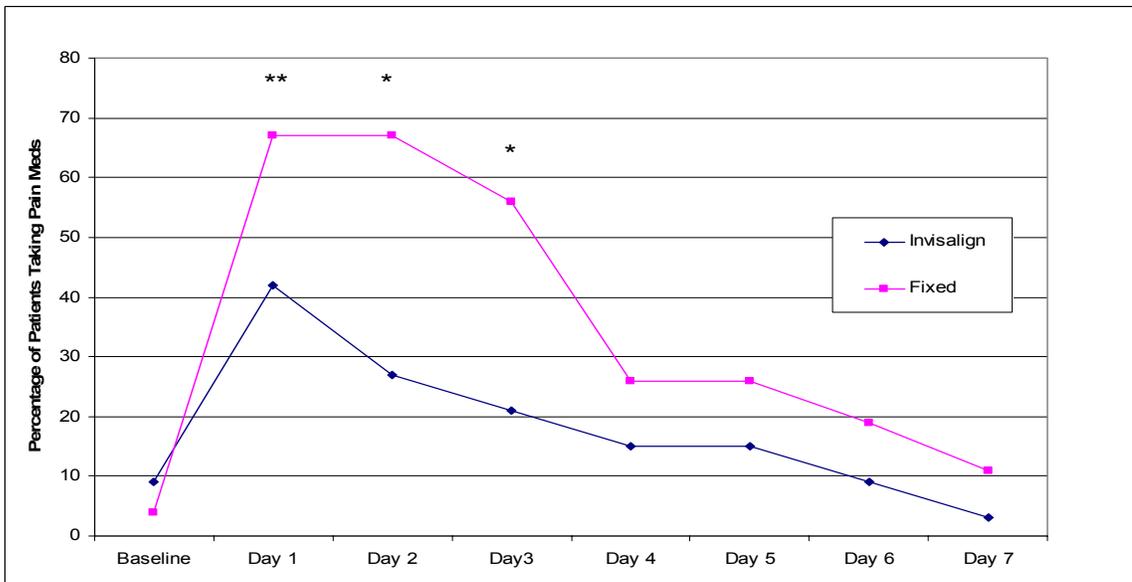


Figure 6. Percentage of patients in Invisalign and fixed appliance groups who took pain medication. (** p=0.06, * p<0.05)

DISCUSSION

This study's objective was to evaluate how appliance type, Invisalign or fixed appliances, can impact the patient's quality of life during the first seven days of orthodontic treatment. A seven day diary was used to record the impact the appliance had on the patient. The patient recorded the impact of the appliance as the impact was being experienced. This daily record of impact assessment is seen as a more valid and reliable measure when compared to retrospective response data which relies on patient recall.¹⁶ Pretreatment models were scored using the PAR index in order to compare the initial severity of malocclusion between the groups. The results revealed no significant difference between the groups in their initial malocclusion as scored using the PAR index (Table 2).

An impact score was derived from the responses to the first section of the diary form. This impact score is an indication of overall quality of life. The fixed appliance group reported a significantly poorer quality of life than the Invisalign group beginning at day one and continuing through day seven. A separate measure of pain experience was recorded using a visual analog scale. The fixed appliance patients reported significantly more pain than the Invisalign group beginning at day one and continuing through day seven.

Since Invisalign is a new appliance type, no studies have evaluated its impact on patients. Prior studies have looked at the impact of fixed appliances compared with removable plates. Sergl et al¹⁶ and Steward et al¹⁹ found that fixed appliances caused

more discomfort for the patient than removable appliances. Serogl and Zentner²⁰ also found that appliances which take up minimal space in the mouth are the most readily accepted by patients. These studies are consistent with the findings of this study. The fact that Invisalign is removable likely adds substantially to the quality of life of the patient. The patient is able to remove the appliance for eating and hygiene. The small size of the Invisalign aligners and lack of sharp edges also likely adds substantially to the quality of life of the patient compared with fixed appliances.

This study also found a significant time effect on the outcome measures. Patients in both groups reported a peak in impact/pain at day one followed by a decrease to near baseline levels at day seven (see Figures 1 and 5). This pain progression following the initiation of treatment is well validated in the literature for fixed appliances.^{21,22,23,24} The impact/pain progression of Invisalign treatment is similar to that which has been already demonstrated for fixed appliances. From days one to seven the impact/pain progression for the Invisalign and fixed appliances were similar in that pain levels peaked at 24 hours and decreased to near baseline levels by day seven. The key difference is that at each time point the fixed appliance patients experience a more intense decrease in quality of life and a more intense increase in pain. In support of these findings, as Figure 6 shows, both groups' pain medication intake peaked at day one and decreased to near baseline levels by day seven. As would be expected, pain medication intake correlated with pain report levels throughout the week. The curves in Figure 6 mirror the curves illustrated in Figure 5. Both groups took more pain medication during the first three days of treatment (when pain levels are highest), and the fixed appliance group (whose pain levels are higher) took more pain medication than the Invisalign group during the first three days.

From days four through seven as both groups pain reports decreased, so did their pain medication intake. Both groups' medication intake returned to near baseline levels by day seven. These findings are in agreement with Erdinc and Dincer²⁵ who also found a correlation between pain intensity scores and consumption of pain medication during orthodontic treatment.

In addition to looking at the overall quality of life impact, the functional, psycho-social and pain-related impact of the two appliances were also evaluated (Figures 2-4). For each of these quality of life categories, from day one through day seven, the fixed appliance group reported more negative impact than the Invisalign group. These findings are agreement with prior studies. Scheurer et al²³ found that for fixed appliance patients eating is the greatest challenge to quality of daily life. Oliver and Knapman²⁶ found that patients report pain caused by and the appearance of fixed appliances to be the major discouraging factors during treatment. The esthetics, removability and small size of the Invisalign appliance likely account for the functional and psycho-social differences between the appliances. The pain-related category impact scores are in agreement with the pain scores recorded on the visual analog scale. The two separate outcome measures showed that the Invisalign group experienced less pain from days one through seven. The two separate measures also illustrated a similar pain progression with pain peaking at day one and gradually returning to baseline at day seven.

The statistical models also suggested that the patient's baseline reports in the functional category could affect future reports. A patient's pretreatment functional ability could be a predictor of functional ability during treatment. Future studies using larger sample sizes could better evaluate the direction of effect the patient's baseline functional

reports have on future reports. In this study there was no statistical difference between the groups' baseline functional impact reports, therefore any baseline effect should be equally distributed between the groups.

For the fixed appliance patients, the effect of initial archwire size was also evaluated. There was a trend towards patients starting treatment with larger archwires reporting more negative impact on quality of life and more pain experienced. These results conflict with those of prior studies that found no correlation between initial archwire size and pain experience.^{1,25} Since this study was not designed to evaluate archwire size effects, various combinations of archwire size and material were used on the fixed appliance patients. The inability to standardize which archwire size and material each subject received may explain why this study's findings conflict with the literature.

The treatment groups in this study were not balanced for all demographic components. The treatment groups in the study differed in that the Invisalign group was older and had higher incomes than the fixed appliance group (Table 1). In addition, the statistical models used in this study suggest that female patients, younger patients and lower income patients tend to report a poorer quality of life during treatment. The weight that should be given to these covariate effects is questionable due to the small sample sizes that were used to break down the data into the various covariate groups for analysis. A larger study designed to test gender, age and income effects is needed to better evaluate these factors.

No prior studies have related income to discomfort during orthodontic treatment. With respect to age, Brown and Moerenhout¹⁷ found that adolescents, preadolescents and

adults varied in their pain reports during orthodontic treatment. The literature is inconclusive as to how gender relates to orthodontic pain reports.^{2,4,18} The two treatment groups in this study were well-balanced with respect to gender (Table 1). If age and/or income do play a role in the impact outcome measures, the results of this study could have been strengthened by more evenly distributing these variables between the groups.

The difficulty in balancing the groups for income is exacerbated by the fact that the Invisalign treatment fee is often more expensive for patients due to a substantial lab fee incurred by the doctor. This higher treatment fee may explain why the Invisalign group had higher incomes and were older than the fixed appliance group. In addition, 78 percent of the Invisalign patients were drawn from a private practice setting, while only 44 percent of the fixed appliance patients came from a private practice. The remainder of the patients were drawn from a university clinic setting. The heavier weighting of private practice patients in the Invisalign group could account for the income differential between the groups.

The groups also differed in their stated reason for seeking treatment. More Invisalign patients reported seeking treatment to “improve my appearance,” while more of the fixed appliance patients reported seeking treatment “because my doctor referred me.” Different motivations for treatment between the groups could influence perceived pain during treatment. If Invisalign patients are more motivated for treatment than the fixed appliance group, they may perceive the negative impacts of treatment to be small compared to the expected improvement in appearance. Sergl et al⁶ found that patients with a higher internal locus of control and concern about their malocclusion perceived lower levels of pain during orthodontic treatment.

CONCLUSIONS

The results of this study demonstrated a significant difference between Invisalign and fixed appliance therapy in how they impact the patient during the first week of treatment. The Invisalign patients' overall quality of life was much better than the fixed appliance patients during this time period. Numerous factors influence the selection of an appropriate orthodontic appliance for each patient. Both Invisalign and fixed appliances have specific indications and contraindications for use. The results of this study supply the practitioner as well as the patient with additional information that can be used when choosing appliance type. This information could also be helpful in educating patients for what to expect during their first week of treatment.

The following conclusions can be made:

1. Both Invisalign and fixed appliance groups reported a decrease in quality of life after initiation of treatment. This decrease in quality of life peaked at day one and returned to near baseline levels by day seven.
2. The fixed appliance group reported a more intense decrease in overall quality of life and more a more intense increase in pain beginning at day one and extending through day seven.
3. The fixed appliance group reported a more intense decrease in functional, psycho-social and pain-related aspects of their daily lives.
4. Fixed appliance patients took more pain medication during the first three days of treatment

APPENDIX. EXAMPLE OF DAILY DIARY SURVEY

Instructions: Please complete the following survey about how your teeth or orthodontic appliances (braces or aligners) have affected your life since you started treatment. Answer only what you feel and have experienced, not what you think is the right answer. There are no right or wrong answers to these questions.

1. Please circle one response for each of the following questions.

In the past 24 hours, how often:	Always	Often	Some- times	Seldom	Never
a. did you limit the kinds or amounts of food you eat because of problems with your mouth, teeth, or orthodontic appliances?	1	2	3	4	5
b. did you have trouble biting or chewing any kinds of food, such as firm meat or apples?	1	2	3	4	5
c. were you able to swallow comfortably?	1	2	3	4	5
d. did your teeth or orthodontic appliances prevent you from speaking the way you wanted?	1	2	3	4	5
e. were you able to eat anything without feeling discomfort?	1	2	3	4	5
f. did you limit contact with people because of the condition of your teeth or orthodontic appliances?	1	2	3	4	5
g. were you pleased or happy with the looks of your teeth or orthodontic appliances?	1	2	3	4	5
h. did you use medication to relieve pain or discomfort from around your mouth?	1	2	3	4	5
i. were you worried or concerned about the problems with your teeth or orthodontic appliances?	1	2	3	4	5
j. did you feel nervous or self-conscious because of problems with your teeth or orthodontic appliances?	1	2	3	4	5
k. did you feel uncomfortable eating in front of people because of problems with your teeth or orthodontic appliances?	1	2	3	4	5
l. were your teeth sensitive to hot, cold, or sweets?	1	2	3	4	5
m. did your orthodontic appliances cause discomfort to your cheeks, lips, or tongue	1	2	3	4	5

2. Please mark an "X" on the line below to indicate how severe your discomfort has been within the last 24 hours:

No pain Severe Pain

3. Please indicate what time of the day you are filling out this survey:

_____ : _____ AM/PM
hh mm

4. A) Have you taken any medications today? Y/N (please circle)

B) If so, please write in which medications you took today:

5. Are you having any other problems or concerns about your teeth or orthodontic appliances since your last orthodontic visit? If so, please describe.

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BIOGRAPHICAL SKETCH

Kevin Blaine Miller was born in Louisville, Kentucky, and was raised in Spartanburg, South Carolina. In 1998, he received his Bachelor of Arts degree in psychology with a minor in chemistry from Vanderbilt University in Nashville, Tennessee. He was awarded membership into Phi Beta Kappa during his final year at Vanderbilt. In 2002, he received his Doctor of Dental Medicine degree from the University of Kentucky. Dr. Miller continued his education at the University of Florida receiving his Master of Science degree with a certificate in orthodontics.