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Implicit Racial Bias among Orthodontists and its Influence on Treatment Recommendations

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Dedication

To my family and friends for their unconditional love, unwavering support and staying by my side through every tear and smile.
To “my guys” for taking care of me as their “queen of the class”
And to the best big sib, Rany for his genuine heart and continued guidance

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ABSTRACT

Introduction: The aim of this study was to utilize an implicit association test to explore if orthodontists display implicit racial bias and whether the magnitude of bias predicts treatment recommendations of fixed appliances or clear aligners for orthodontic patients.

Methods: Respondents participated in a web- based survey, comprised of two clinical vignettes depicting a black or white patient associated with an anterior open bite or moderate crowding malocclusion, followed by a questionnaire evaluating the participant's treatment recommendation of fixed appliances or clear aligners. The Race Implicit Association Test was used to measure unconscious bias. One hundred and seven participants completed the entire study and met the inclusion criteria.

Results: Orthodontist and orthodontic residents showed no explicit preference for black versus white patients in the clinical vignette when recommending treatment. In contrast, IATs revealed slight, yet statistically significant implicit bias against African Americans (mean d-score=.18, p=.000). Implicit biases were associated with recommending treatment for both patients in the anterior open bite case (p=.049, Pearson correlation=.191) but not associated with the option between fixed appliances and clear aligners.

Conclusion: Implicit bias is associated with recommending treatment. Further research is needed to clarify and extend the present findings and to determine how implicit bias affect different treatment options.

Keywords: implicit bias, orthodontics, treatment recommendations, health disparities

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Review of Literature

1- Racial Health Disparities and Provider Attitudes

In the United States, racial health disparities create barriers in the quality of health care provided to African Americans and other ethnic minorities compared to the majority white population, even when factors such as insurance and income are controlled. The source of these disparities is deeply rooted in historic and present-day inequities. According to the report, *Unequal Treatment*, disparities in health care is defined as "racial or ethnic differences in quality of healthcare that are not due to access-related factors or clinical needs, preferences, and appropriateness of intervention." [1,2]

Possible factors that contribute to this problem include patient behaviors, health systems, and health care providers. Patient behaviors have shown little impact on health disparities yet, there is evidence that racial bias, provider racial stereotype beliefs, and provider uncertainty in different clinical scenarios all contribute to unequal treatment.[1]

A broad spectrum of health conditions associated with racial disparities have been well documented. According to Weinick et al., African Americans have higher death rates from heart disease, breast cancer, and diabetes compared to White Americans.[3] Furthermore, according to the U.S. Department of Health and Human Services, in 2017 African Americans were 20 percent more likely to die prematurely from heart disease and twice as likely to die from a stroke as white Americans. [4,5]

While the infant mortality rate has decreased by almost 14% from 2006-2017 [6], research has shown that African American mothers continue to experience an increased rate of infant deaths in comparison to any other race. African American mothers have also

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faced death themselves from preventable pregnancy-related complications at a rate 4 times higher than of white mothers. African American women have even been denied healthcare when seeking help for pain or simply not shown dignity or respect by health care providers. Moreover, college-educated black women have experienced 11.5 infant deaths per 1000 live birth compared to 4.2 infant deaths for white women with similar education.[7–9]

Health disparities are not limited to the medical field, patients have also experienced similar issues in the dental field with oral health disparities. Despite the considerable reduction in dental caries, and the progress made in the prevention, diagnosis, and treatment of oral diseases, oral health disparities (oral cancer, tooth loss, & periodontal disease) remain prevalent among socially disadvantaged societies in the United States. The burden of these diseases continue to be experienced at a disproportionate rate across all segments of societies. [10,11]

Orthodontic treatment prevalence data proposes that significant barriers exist in orthodontic utilization based on race and socioeconomic status.[12] Data from the 1900s NHANES study reported severe malocclusions were more frequently seen among African Americas patients, yet they had the lowest percentage for receiving treatment. [13] A study by Laniado et al. showed consistent results with black children having the highest diagnostic visits and fewest orthodontic visits compared to white and Asian children. [12]

A similar study among high school students, showed that a substantial disparity exists in receiving orthodontic treatment. Of 2,808 students, the orthodontic utilization rate was 37 percent. [14] The likelihood of having orthodontic treatment was 8.7 times greater among students who had visited the dentist within the last year than among those who did

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not, and 3 times greater in Caucasians than other ethnic groups. Out of 29 percent with unmet needs, as measured by the Dental Aesthetic Index, minorities had 2.6 greater odds of needing treatment than Caucasians. [10,14]

Overcoming the barriers of health disparities should be a top priority for our health system. The Kaiser Family Foundation found that one in three residents of the United States identifies as African American, American Indian/ Alaska Native, Asian, Native Hawaiian/Pacific Islander, Hispanic/Latino, or multiracial. However, the number is expected to increase to one in two by the year 2050. [8]

The attitudes of health care providers have also been identified as one of the many factors that contribute to health disparities. In addition, researchers have targeted provider behavior to address inequitable health care treatment that may influence treatment choices. The way in which a provider treats a patient may be driven partially or fully by positive or negative attitudes that the provider may hold toward a different racial or ethnic group. Negative attitudes toward certain social groups by providers often exist and are not easily recognized by the providers. For this reason, social psychology scholars believe prejudicial attitudes or biases to be implicit and explicit. [2]

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2-Attitudes, Biases and Stereotypes

In recent years, a substantial amount of attention has been paid to the possibility that unconscious or implicit biases among health care professionals contribute to health disparities[15]. Studies suggest that health care providers' perception of the patient varies depending on the patient's race and that patients perceive discrimination from their providers which suggest the presence of provider biases. [16]

Attitude, defined as a settled way of thinking or feeling about a person, thing, or situation, can significantly impact one's behavior. Existing biases and attitudes help to subjectively organize one's perceived environment. However, people in general are not always aware that attitudes can be influential in shaping one's existing biases. [17]

Bias is an inclination in favor of or against a person or a group compared to another, allowing for one's personal opinion to influence judgment. [18] They are often based on stereotypes, rather than facts or knowledge of an individual, group or circumstance. Attitudes and biases can be divided into two categories, implicit and explicit. Explicit biases are made with conscious awareness and are openly expressed, whereas implicit biases arise from the subconscious mind.[19] Implicit biases are involuntary attitudes that lie below consciousness but can influence or affect behavior, and cognitive processes.[16] Implicit biases can also be persuaded and are often not associated with a persons declared belief or expressed explicitly. [20]

Implicit attitudes influence responses that are hard to control and often associated with nonverbal behaviors whereas explicit attitudes shape deliberative responses and

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actions. A 1995 study by Fazio et al. examined explicit and implicit racial attitudes revealing that attitudes shape everyday behavior between African Americans and Caucasians. They further demonstrated that these influences can potentially create mixed messages, interfering with the communication and trust that is critical to developing long-term positive relations between Black and White Americans. [21] This often contradictory behavior of White people toward Black people in interracial interactions can contribute to the climate of miscommunication, misperception, and distrust that characterizes contemporary Black-White relationships. [17]

Negative implicit attitudes about other races, particularly people of color, can contribute to the behavior of healthcare providers toward patients in a clinical setting. Bias attitudes toward one race, such as feeling Caucasians are nicer, more cooperative, or smarter than African Americans, conscious or not, can lead to prejudicial behaviors.[2] This could lead to practitioners spending more time with certain patients and putting more effort into their treatment plans or options provided. In a systematic review of 15 articles, W. Hall et al., found low to moderate levels of implicit racial biases among health care providers against Black, Hispanic/Latino/Latina, and dark-skinned people. Some white healthcare providers openly displayed explicit beliefs when treating African American patients as less intelligent and less likely to adhere to treatment regimens thus influencing their render of care. [2]

Stereotypes are major contributors to health outcome disparities. Stereotypes are defined as the process by which people use social categories such as race, age or gender in

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obtaining, processing and recalling information about others. [22] Stereotypes can be beneficial by helping people navigate through the social world more efficiently. For example, stereotypes of the elderly as hard of hearing may signal us to speak loud and clear. However, stereotypes become problematic when they are driven by social judgments or biases.

A significant amount of research has shown that providers tend to allow stereotypes to affect clinical decisions regarding diagnosis and course of treatment. According to van Ryn et al., perception of patients are influenced by demographic characteristics.[23] Physicians tend to perceive African Americans more negatively than White Americans, and belief them to be less intelligent and noncompliant. [23]

A more worrying stereotype is the assumption that certain racial groups feel less pain than Caucasians. African American have routinely been undertreated for pain relative to white Americans. [24] In 2016, Researchers at the University of Virginia examined whether racial bias was associated with false biological differences (ex. Black people have thicker skin and less sensitive nerve ending) between African American and White Americans. Participants who agreed with the false beliefs made less accurate treatment recommendations compared to participants who did not endorse these beliefs.[24]

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3- Measuring Implicit bias (Implicit Association Test)

While many studies have reported on implicit bias, it cannot be measured with self-report questionnaires or surveys. There are a number of measures used to identify implicit bias, yet the most common validated tool used is the Implicit Association Test (IAT). [18] Since its creation in 1998 by Greenwald et al., researchers have published thousands of peer-reviewed articles utilizing this tool in an array of disciplines including, psychology, health, political science, and market research. The IAT is a computerized test that measures the speed at which participants match certain target groups with positive or negative attributes. It works on the principle that one makes quicker matches with fewer errors in pairs they strongly associate based on beliefs or experiences stored in the unconscious mind. For example, in the racial IAT, people that respond more quickly to good attributes paired with a white person and bad attributes paired with a black person have a stronger pro-white association and vice versa.[15,16,18]

IAT scoring uses the D- algorithm which takes the average difference in response time across trials to produce a continuous measure ranging from −2 to +2, representing an estimate of effect size. Scores from 0 to 0.14 suggest no racial bias; 0.15–0.34, slight pro-White bias; 0.35–0.64, moderate pro-White bias; and >0.65, strong pro-White bias. Pro-black bias is represented by negative scores of the same degree in similar groupings [16] Studies examining the general American population have consistently revealed implicit pro white/anti- black bias. [25]

The IAT measurements have displayed good internal consistency, ranging from .7-.9, which is the consistency of the participants' responses across concepts on a multiple-

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concept measure and are not influenced by the familiarity with the test.[25] The measures are typically insensitive to variations such as number of trials, number of examples per concept, and the time interval between trials. Also, compared to explicit self-reporting tests, the sensitivity of the IAT measure to automatic associations is often attributed to making the scores resistant and less prone to faking. For example, Banse et al, Asendorf et al, and Kim et al all had similar findings that subjects instructed to fake positive attitudes in explicit self-reporting tests were not able to do so on their respective implicit association test. [26]

Although the reliability and validity of the IAT arise from a variety of content domains, the majority show moderate consistency and that race IAT scores can predict interracial behavior. [25,27] A meta-analysis, investigating discrimination toward social groups by Greenwald et al. revealed the IAT measures were superior in its' prediction of behavior compared to explicit tests. [27] Nosek and Hasen investigated 158 samples of the implicit association test concluding the IAT was "reliable and variably related to explicit attitudes". In contrast, a few studies on the reliability of the IAT suggest that the results could be subjective to one's personal, situational, and environmental changes. Nonetheless, the authors suggest that the IAT shows good reliability compared to other implicit measures and it is a prerequisite for determining individual differences related to bias. [28]

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4- Implicit Racial Bias in Healthcare

Over the last decade numerous studies have examined implicit bias using the implicit association test in various settings, to gain knowledge of the role of implicit bias in healthcare disparities. Several studies have concluded that health care provider's bias has led to poor patient-provider communication which in turn can negatively affect treatment decisions, lower patient compliance/treatment adherence and decrease positive patient perception of their health care provider. [2]

Sabin et al measured the implicit and explicit attitudes about race among 404,277 people, of which 2,535 were medical doctors. The medical doctors, similar to the entire study sample showed an implicit preference for White Americans compared to Black Americans. The effects were examined among White, African American, Hispanic, and Asian medical physicians and by gender. The study revealed that African American doctors did not show an implicit preference for either race, black or white. Women physicians overall showed less implicit biases than men. [29]

The systematic review on implicit racial/ethnic biases in health care providers by Maina et al. using the IAT concluded that similar to the general population, most health care providers across multiple levels of training have implicit biases against black, Hispanic, Indian and darker-skinned individuals.[16] Out of the 35 studies interpreting bias through association tests, 26 of the studies demonstrated slight to strong pro-white/ anti-black bias. [16]

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Cooper et al examined the associations of clinicians' implicit attitudes about race with medical visit communication and patient ratings of care. [30] They examined the relationship between audiotaped visit communications and patient ratings using the Roter Interaction Analysis System to two implicit association tests. The mean score indicated moderate bias against African American patients. Among the African American patients, racial bias was associated with doctors taking a more dominant tone, providing a poorer rating of interpersonal care and using slower speech compared to white patients who were presented with less verbal dominance, faster speech, more patient centeredness and a better rating of interpersonal care. [30] These interactions can diminish the patients' trust in their providers further influencing the type of care they may receive.

Green et al. measured physician unconscious bias to test if the IAT scores would predict clinical decisions.[18] Treatment of cardiovascular disease has been well documented as a health condition associated with racial disparities. Therefore, the aim was to explore whether such bias would predict thrombolysis recommendations for black and white patients enduring acute coronary syndromes. Respondents participated in a clinical vignette of a patient with an acute coronary syndrome and three implicit association tests. IATs revealed physicians had preference favoring white patients and deemed black patients as less cooperative. Parallel to the prowhite implicit preference increase, was the increase of thrombolysis recommendation to white patients compared to black. Therefore, the higher preference for white patients affected their clinical decision resulting in higher recommendation of thrombolysis for white patients compared to the black patients. This study was the first to link the presence of implicit biases to predicted patterns of treatment

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recommendations. Although it was suggested that if these biases are recognized, they can be adjusted to prevent its effect on treatment decisions, and the race-based disparity that can potentially worsen health outcomes. [18]

Amongst many systematic reviews, findings continue to highlight the need to further address the roles unconscious bias and stereotypes play in disparities. [2,16,31] With primary care physicians being the gatekeepers and front-liners in the healthcare systems these findings warrant concerns related to the quality and access to care, given to patients. [32] It is noted that not only adults experience such bias but children are affected as well. Johnson et al showed that residents in the pediatric emergency department displayed moderate pro-white/anti-black bias towards both children and adults thus adding to the growing body of research showing the vulnerability of people of color in health settings. [33]

Among pediatricians, Sabin et al found that implicit attitudes about certain ethnic groups affected pain management.[34] The recorded responses from the vignettes showed the ideal management of pain was at a lower rate for black patients opposed to white patients. As a provider's pro-white implicit preference increased, there was a significant difference in prescribing narcotics for pain between white and black patients. [34]

Other findings suggested that providers' implicitly associated specific stereotypes, like non-compliance and low treatment adherence are leading to different treatments based on race.[16] Clinical decision making is not always an easy task and often stereotypes and heuristics are used to help with these decisions. Implicit racial biases rise more frequently when decisions on treatments are not clear cut, especially when a provider is under a heavy

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work load or stressful circumstances. [35] According to Bogart et al., treatment recommendations are often reasonably based on the assessment of whether they believe the patient to be compliant or not. [36] In this study, it was found that African American men were expected to have low compliance and in return had an effect on treatment recommendations.[35,36] Similar to Bogart, three other studies using the race compliance IAT and found slight bias favoring white patients including identifying them to be more cooperative than black patients. [16,30,34,35]

Although many studies have examined implicit bias in medical health outcomes, few have examined the impact of implicit bias in dentistry. Patel et al concluded that clinicians' decisions were affected by race. [19] When presented with a broken-down tooth and symptoms of irreversible pulpitis, dentists showed a greater likelihood of extractions than root canal therapy for African American patients compared to white patients. [19] Garg et al concluded that African American, Hispanic, and Asian patients who suffered from sleep apnea were significantly less likely to receive jaw surgery. [37] These findings amongst others led to the question, "Does a patient's race and provider bias have similar effects on treatment recommendations in orthodontics?".

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5 -Do Orthodontists exhibit similar behaviors and bias'?

To date there is no published evidence in orthodontics relating implicit bias to treatment outcome or recommendations. Medical healthcare data has revealed that most providers consistently show implicit bias, but the correlation between bias and treatment recommendation in different specialties needs more exploration. [34]

We do know race has been shown to affect the quality of the doctor-patient relationship and orthodontics is a specialty that communication is significant due to the importance of patient compliance with successful treatment. [38] Koerber et al confirmed that orthodontic residents communicate differently with patients from different ethnic backgrounds. [38]

Also, in orthodontics there are numerous treatment modalities to treat a malocclusion and many factors play a vital role in choosing the appropriate treatment plan. Is race or implicit bias one? Huang et al. listed many proposed treatment modalities to treat an anterior open bite, which included fixed appliances, extraction of teeth, clear aligners, temporary anchorage devices (TADs), occlusal equilibrium and orthognathic surgery.[39] To date, this is the first study to evaluate treatment recommendations and what other factors may influence orthodontist decisions. [39] The majority of the patient sample were females but male patients received a higher percentage of TADS and surgery recommendations. Compared to other ethnicities, white males were more likely to be recommended surgery. In addition, white and Asian patients were offered aligner therapy and TADS, three times as often as Black or Hispanic patients. Undeniably, practitioners should offer the most ideal treatment to all of their patients, yet this study revealed significant factors unrelated to the

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patients' malocclusion were associated with the recommended treatment (demographics of patient and provider). [39]

With similar findings in medical health care altering treatment recommendations based on demographics such as race of patient, expected cooperation of patient and provider bias [2,32,37] ,orthodontists may not be exempt considering most treatment modalities require some form of patient compliance.

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Thesis Objective

The aim of this study was to

1. Utilize an implicit association test to explore if orthodontists display implicit racial bias
2. Use clinical vignettes to evaluate if orthodontists' treatment recommendations varied by the patient's ethnicity
3. Correlate the two and determine if implicit racial biases influence treatment recommendations of fixed appliances or clear aligners for orthodontic patients.

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Hypotheses

Null Hypothesis 1: Orthodontists do not exhibit implicit racial biases

Alternative Hypothesis 1: Orthodontists exhibit significant implicit racial biases.

Null Hypothesis 2: Orthodontists do not provide different treatment recommendations for black and white patients.

Alternative Hypothesis 2: Orthodontists provide different treatment recommendations for black and white patients.

Null Hypothesis 3: Implicit Racial biases are not associated with orthodontic treatment recommendations.

Alternative Hypothesis 3: Implicit racial biases are associated with orthodontic treatment recommendations.

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Manuscript for Publication

Implicit Racial Bias among Orthodontists and its Influence on Treatment Recommendations

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Abstract

Introduction: The aim of this study was to utilize an implicit association test to explore if orthodontists show implicit racial bias and whether the magnitude of bias predicts treatment recommendations of fixed appliances or clear aligners for orthodontic patients.

Methods: Respondents participated in a web- based survey, comprised of two clinical vignettes depicting a black or white patient associated with an anterior open bite or moderate crowding malocclusion, followed by a questionnaire evaluating the participant's treatment recommendation of fixed appliances or clear aligners. The Race Implicit Association Test was used to measure unconscious bias. One hundred and seven participants completed the entire study and met the inclusion criteria.

Results: Orthodontist and orthodontic residents showed no explicit preference for black versus white patients in the clinical vignette when recommending treatment. In contrast, IATs revealed slight, yet significant implicit bias against African Americans (mean d-score=.18, p=.000). Implicit biases were associated with recommending treatment for both patients in the anterior open bite case (p=.049, Pearson correlation=.191) but not associated with the option between fixed appliances and clear aligners.

Conclusion: Implicit bias is associated with recommending orthodontic treatment. Further research is needed to expound on our findings and to determine how implicit bias affect different treatment options.

Keywords: implicit bias, orthodontics, treatment recommendations, health disparities

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Introduction

In the United States, racial health disparities create barriers in the quality of health care provided to African Americans and other ethnic minorities compared to the majority white population, even when factors such as insurance and income are controlled. The source of these disparities is deeply rooted in historic and present-day inequities. [2] According to the Institute of Medicine, bias, stereotyping, prejudice, and clinical uncertainty on the part of healthcare providers may contribute to racial/ethnic disparities in health care and unequal treatment.[1]

Bias is an inclination in favor of or against a person or a group compared to another, allowing for one's personal opinion to influence judgment. [18] They are often based on stereotypes, rather than facts or knowledge of an individual, group or circumstance. Explicit biases are made with conscious awareness and are openly expressed, whereas implicit biases arise from the subconscious mind.[19] Implicit biases are involuntary attitudes that lie below consciousness but can influence/ affect behavior, and cognitive processes.[16] Implicit biases can also be persuaded and can markedly differ from a person's explicit and declared beliefs.[20] As a consequence bias and implicit prejudices can be observed in the absence of intention to discriminate.[29]

Multiple studies have reported the presence of implicit biases among healthcare providers and some evidence that the provider's implicit bias impacts the treatment decisions. [2,18,40–42] Negative implicit attitudes about other races, particularly people of color, has displayed significant associations related to poor patient- provider interactions, treatment decisions, treatment adherence/compliance and patient health outcomes. [2,15] For

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example, Green et al. concluded that physicians showed higher negative implicit bias toward African American patients and held implicit stereotypes that African Americans were less cooperative. As the positive implicit preferences for white patients increased, the likelihood of recommending thrombolysis to white patients increased compared to black patients. [18]

Over the last decade numerous studies have examined implicit bias using the implicit association test in various settings, to gain knowledge on the role of implicit bias in healthcare disparities. [16] The Implicit Association Test (IAT) is a validated and reliable tool created by Greenwald et al, that has been used in numerous studies to identify implicit bias. [26,43] It is a computerized test that measures the speed at which participants match certain target groups with positive or negative attributes. It works on the principle that one makes quicker matches with fewer errors in pairs they strongly associate based on beliefs or experiences stored in the unconscious mind. For example, in the racial IAT, people that respond more quickly to a good attribute with a white person and a bad attribute with a black person have a stronger pro-white association and vice versa.[15,16,18]

Although many studies have examined implicit bias in medical health outcomes, there is a significant gap in dental literature. Patel et al concluded that clinicians' decisions were affected by race. [19] When presented with a broken-down tooth and symptoms of irreversible pulpitis, dentists showed a greater likelihood of extractions than root canal therapy for African American patients compared to white patients. [19]

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To date there is no published evidence in orthodontics relating implicit bias to treatment outcome or recommendations. However, Koerber et al. confirmed that orthodontic residents communicate differently with patients from different ethnic backgrounds. [38] In addition, Huang et al. evaluated treatment recommendations and what factors may influence orthodontist decisions. [39] It was concluded that not only dentofacial characteristics, but both doctor and patient demographics factors were significantly associated with treatment recommendations for anterior open bite. [39]

Therefore, the aim of this study utilize an implicit association test to explore if orthodontists display implicit racial bias, use clinical vignettes to evaluate if orthodontists' treatment recommendations vary by the patient's ethnicity and correlate the two and determine if implicit racial biases influence treatment recommendations of fixed appliances or clear aligners for orthodontic patients.

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Materials and Methods

This cross-sectional study was approved by the Case Western Reserve University Institutional Review Board. Inclusion criteria included practicing orthodontist and orthodontic residents in the United States, excluding general dentist providing orthodontic treatment and providers outside the United States.

Participants

Recruitment was conducted from June 2020 to August 2020 and participation was voluntary. Orthodontists were recruited via an email invitation and all program directors of the United States Orthodontic residency programs were contacted via email and were asked to share the study link to their residents and colleagues. Some orthodontists were contacted by phone and asked to participate in the study. An invitation to participate in the study was also posted on orthodontic study groups on the social media platform, Facebook. The study groups included Orthodontic Pearls, Orthodontic Mastery Group, and Women in Orthodontics Study Group. All members of the groups were vetted and provided proof as working orthodontists or acceptance into an orthodontic residency program.

The email included a link to a website that sponsored the research survey. For completing the survey, the first 100 participants we offered a $10 Amazon gift card. All data was collected anonymously. A separate link was provided for email submission to claim the gift to maintain confidentiality of survey answers. Informed consent was obtained on the first web-page prior to the survey. Participants were notified of their ability to withdraw from the research study at any point during the survey.

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Test Design

After agreeing to participate in the study, participants were asked for demographic information which included age, gender, state, race/ethnic background, resident year and/or years practicing.

Vignette

A web-based survey via Qualtrics XM [44] was designed to randomly illustrate a black or white patient with two clinical vignettes. The first vignette depicted a white or black patient with an anterior open bite. If the respondent received a vignette with the white patient first, then the second vignette was a black patient with moderate crowding and vice versa. (Case 1A- Black open bite, Case 1B- White open bite, Case 2A- White crowding, Case 2B & Black crowding) For each vignette race was indicated by using an extra- oral frontal photo in repose. Malocclusions were shown with 3D images of scanned models (Figure I&II) for intra-oral analysis to avoid bias by gingiva color. Intra- orals were the same in each case, only depicting different patient photos. The vignette was created to allow variation of treatment recommendations, which included fixed appliances or clear aligners.

Examiners were asked to assess the likelihood that they would recommend orthodontic treatment on a 5-point scale (extremely likely- extremely unlikely) and with the limited information given if they would recommend fixed or clear aligners. Participants went on to answer additional questions about how effective aligners were to treat the case shown, perceived compliance/cooperativeness, usage of additional appliances, and estimated treatment time. At the end of the clinical survey, the participants were automatically directed to the race IAT hosted on Inquisit by millisecond.[45]

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Implicit Association Test (IAT)

The race implicit association test was used to measure unconscious biases. Inquisit Millisecond Software [45] – Web-version- was used to design, host, and collect data for the test. Sixteen patient photos were collected from the orthodontic department. The test included 8 non-smiling pictures of White faces (Target A), and 8 non-smiling pictures of African American faces (Target B), along with eight positive adjectives (Attribute A) and eight negatives ones (Attribute B). The positive adjectives included "positive, successful, loveable, friendly, intelligent, accomplished, happy and pleasant" and the negative adjectives included "negative, failure, miserable, angry, mean, bitter, ignorant and awful". The test contained seven "blocks". The first 2 blocks are practice trials allowing the participant to familiarize themselves with the selected keys. The third, fourth, sixth and seventh block were scored for the final results. In between the two scoring blocks was an additional practice trial, block five. The algorithm then compares the differences in the speed of the test blocks in milliseconds and generates a final D-score. A positive D-score would indicate a pro-White preference, while a negative D-score would indicate a pro-African American preference.

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Statistical Design

Statistical analysis was conducted using IBM SPSS analysis software. A One Sample t-Test was used to compare the mean d- scores of the entire sample of orthodontist and orthodontic residents to a hypothesized control score of zero. Independent t-test was used to compare the mean d-scores of orthodontist and orthodontic residents. ANOVA test compared the mean d– scores among demographics of gender, age, ethnicity and provider percentage of African American patients. Vignette results were compared using crosstabs Chi-square test. Pearson correlation measured the strength of association between the IAT scores and vignette answers.

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Results

A total of 213 practitioners were recruited from June -August 2020. Out of 213 participants, 195 people completed the clinical vignette. Eighty-nine people failed to complete the IAT after the clinical vignette.

The participants exhibited an age range from 25- 65 years of age, with 56 orthodontic residents and 158 practicing orthodontists. The participants were primarily Caucasian American (55%). Fifteen percent were African American and thirteen percent Asian. There were 134 female participants and 78 males.

OPEN BITE

Majority of the participants were "extremely likely" to recommend orthodontic treatment regardless if the patient was black (82%) or white (87.5%). Two practitioners were "extremely unlikely" to recommended treatment when presented the African American patient. Practitioners were more likely to recommend clear aligners (67%) compared to fixed appliances as the treatment modality for the open bite malocclusion, however there was no significant differences in treatment recommendation between fixed appliances and clear aligners associated with the race of the patient. When asked to characterize how likely they were to recommend aligners, 83% of providers were "extremely or somewhat likely". In addition, on a 5-point scale (extremely effective – not effective at all) 47% of providers believed aligners were "very effective" in treating anterior open bites. Black and white patient both were perceived to be cooperative with providers estimating the patient to be "somewhat" (~47%) to "very" (~40%) cooperative. Although there was no significant difference between race and estimated treatment time,

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providers were twice as likely to estimate a shorter treatment duration (>12 months) when presented the white patient compared to the black patient.

Overall, the race of the patient did not show any significant associations with practitioners' strength of recommendation, prediction of perceived compliance /cooperativeness, usage of additional appliances, and estimated treatment time.

CROWDING

On a scale from extremely likely to extremely unlikely, 68% (62/91) of providers were "extremely likely" to recommend orthodontic treatment when presented the black patient and 65% (64/99) for the white patient. There was no significant difference in recommending treatment associated with the patient's race (p=.81). When presented the African American patient, 56% of providers recommended fixed appliances versus when shown the white patient 48% chose fixed appliances over clear aligners. Overall, providers were less likely to recommend clears aligners for the crowding case compared to the open bite malocclusion. Black patients were estimated to be significantly (p=.041) more compliant than white patients. Race was not significantly associated with estimated treatment duration, 70% of providers estimated treatment to range between 12-24 months.

IAT

One hundred and seven results were recorded from the racial Implicit Association Test. Practicing orthodontist and orthodontic residents overall responded faster when African American faces were paired with negative attributes compared to white faces. A One-Sample t- Test showed orthodontist and orthodontic residents exhibited slight, yet significant implicit bias against African American patients (Mean d score= .182, p=.000)

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(Table I). ANOVA testing showed bias increased with age, with participants 55 and up having strong pro-white implicit bias preferences. Men (Mean d score= .2472) also showed more bias preferences than women (Mean d score=.1540). There were no significant differences between age (p=.30) and gender (p=.48) associated with implicit bias however there was a statistically significance between ethnicities. White (Mean d score= .2958, MD=.51, p=.000) and Asian (Mean d score= .3350, MD=.55, p=.002) providers showed higher implicit preferences favoring white patients compared to African Americans (Mean d score= -.2125), who showed slight implicit preferences for African Americans. Mixed race providers showed the highest pro-white implicit bias with a mean d-score of .41. In addition, providers with a lower percentage of African American patients (20-40%) showed higher implicit preferences for white patients (MD=.62, p=.05) than providers with an African American patient population above 80%. In all, there was no significant difference between residents and practicing orthodontist, both showed slight pro-white preferences. Race IAT scores by demographics are displayed in Table II .

Vignette and IAT Correlations

Using the Pearson correlations there was a small positive, yet significant association between implicit measures (d-score) and recommending treatment for the open bite case (p=.049, Pearson correlation=.191) (Table III). Also, there was a negative and significant association with the percentage of African American patients the orthodontist treated and d-scores (p=.011, Pearson correlation=-.245). Last although insignificant, there were small positive correlations in recommending aligners associated with implicit measures for both cases (Table III).

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Discussion

The aim of this study was to utilize an implicit association test to explore if orthodontists display implicit racial bias, use clinical vignettes to evaluate if orthodontists' treatment recommendations vary by the patient's ethnicity and correlate the two and determine if implicit racial biases influence treatment recommendations of fixed appliances or clear aligners for orthodontic patients.

Most people display unconscious favoritism toward people who they perceive to be similar or like them ("ingroup") and show bias towards others they identify as different ("outgroup"). [46] Orthodontists, similarly to the general population hold varying attitudes toward members of different racial groups. Our findings showed that orthodontist and orthodontics residents exhibited slight levels of implicit bias against African Americans by commonly associating African Americans with negative attributes and positive attributes with White Americans. Orthodontists that identified as Caucasian or White had higher implicit preferences for White faces and Black orthodontists showed slight pro- Black implicit preferences.

The lower levels of bias may be attributed to the sample population, which consisted of 63% females who completed the clinical vignette and 65 % females for IAT. Research has concluded that women show less implicit bias compared to men [29] and with association to race, white women hold lower levels of implicit bias against black people than white men. [47] The sample was also compromised of 20% African Americans , when only 3.3% of the US population consist of African American dentist.[48] Furthermore, when examining

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IAT scores, studies have shown similar trends that Black physicians and medical students show low or no implicit preferences. [29,49]

Although the overall sample showed pro-white implicit preferences, in the clinical vignette we found no significant differential treatment recommendations related to patient race. Patient gender (female) in the scenario could have played a role in the level of racial bias, as males are more subject to bias. In particular, Black men in the United States experience the highest levels of discrimination. [47] According to Assari et al., race and gender are interrelated when it comes to implicit biases against African Americans. They suggest this pattern may explain the mass discriminatory practices that are disproportionately perpetrated by White men against Black men. [47,50] It has also been observed that black women experience less discrimination than black men.[47] In addition, compared to their white counterparts, black males are often stereotyped negatively, as aggressive, lazy , non-compliant and anti- intellectual. [36,47,51]

In the clinical vignette, orthodontists were just as likely to recommend treatment for the open bite and the crowding case regardless of the patient's race. The similarity of treatment recommendations for both races could be explained by orthodontist simply treating the malocclusion, as dentofacial characteristics are noted as the largest factors in recommending treatment. [39] Participants, however did show a preference for clear aligners when treating the open bite malocclusion. Clear aligners were characterized to be more effective and the preferred option to treat the anterior open bite compared to the crowding case. Although research shows aligners have similarly effectiveness in treating anterior

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crowding as fixed appliances [52] , more orthodontists recommended fixed appliances for African Americans compared to the Caucasian patient. There was no significant difference in this observation, but other studies have confirmed that having the belief that "African Americans are less cooperative " can affect treatment decisions [16,31,40] , and the use of clear aligners are 100% reliant on patient compliance for effective treatment.

Throughout the study there was different levels of estimated patient compliance. There was no significant difference in perceived cooperativeness in the open bite case. However in the crowding case , contrary to previous studies[16], in which African Americans were estimated to be significantly more compliant (p=.04). This significant difference could be due to participant awareness of the nature of the study. Although the study was anonymous, Persell et al., suggests that even knowledge of participating in a study can induce a Hawthorne effect, influencing answer choices. [53,54] Another explanation for this unexpected result may be a psychological defense mechanism known as reaction formation, in which a person overcompensates and takes an overly favorable stance opposite of the "unacceptable " unconscious dislike they feel.[55] Hence, one strength of the IAT is its indirect method, which reduces the likelihood of deliberate alterations. [25]

On the basis of previous research,[36] we expected that orthodontists implicit pro-white and cooperation biases might be related to orthodontists recommending less treatment and clear aligners to African American patients . Using the Pearson correlation coefficient, we found positive but insignificant correlations of implicit measures and recommending aligners, showing orthodontists with higher d-scores were less likely to

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recommend clear aligners. However, there was a small, yet significant, positive correlation with recommending overall treatment in the open bite case. Orthodontists with higher d-scores were less likely to recommend treatment for both patients (black and white). A negative and significant association between the percentage of African American patients the orthodontists treated and d-scores was also observed. Orthodontist who treated less African Americans displayed higher implicit preferences for white patients than those who had a higher percentage of African American patients. This finding could be explained by the contact hypothesis, a theory that proposes contact between two groups can promote acceptance and reduce prejudices if that contact is positive and meets certain requirements that include cooperation and a common goal. [16,56]

Significant inequities of orthodontic utilization, orthodontic visits and need for treatment persist among minority and socially disadvantaged groups [12,57] This study along with Huang et al , show that orthodontists and orthodontic residents display some level of bias toward African Americans. In addition to dentofacial characteristics, and other factors such as patient and provider demographics played a role in treatment decisions.[39] Acknowledging implicit biases are important to avoid their influence on orthodontic treatment decisions as well as for long term patient-interactions. The average orthodontic treatment time ranges between 12 and 36 months [58], meaning several visits and interactions between the patient and doctor. Research has shown, the doctor-patient relationship is one of the most important factors in satisfaction with orthodontic treatment. [59] Patients were more satisfied with their orthodontic treatment when they liked the orthodontist, felt

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respected and treated with compassion [59,60] Additionally, positive relationships have shown to increase levels of patient compliance and adherence, improving the success of orthodontic treatment.[58,60]

With the expected increase of people who identify as African American, American Indian/ Alaska Native, Asian, Native Hawaiian/Pacific Islander, Hispanic/Latino, or multiracial in the United States, [8] studies like this current research are needed to continue to raise awareness of racial bias, encourage providers to identify their own implicit biases and takes steps to eliminate them. Implicit biases are changeable and with appropriate intervention/ training new attitudes can be learned to replace negative associations. [20,61]

Limitations

There were several limitations for this study. The response rate for completing all measures of the survey and IAT was less than 50%. The dropout rate could be attributed to participant burnout, length of survey and request to download a phone application for the IAT. In addition, the sample was also overrepresented by females and a less than accurate representation of the orthodontic population. Our study also did not assess real world patient-provider interactions; instead clinical vignettes were used to simulate this interaction. Lastly, a post -survey could have been used to assess the participant's awareness of the study's nature. Future studies should examine real patient- provider interactions or clinical vignettes picturing male patients. Also, future studies should include more accurate representations of the current orthodontic population.

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Conclusion

Orthodontists and orthodontic residents show slight levels of implicit bias against African Americans. However, there were no significant differences found in the clinical vignettes between recommended treatment of fixed appliances or clear aligners and patient race. Nevertheless, a small, yet significant positive correlation was found between racial implicit bias and recommendation of overall orthodontic treatment. Variations in survey answers and previous studies continue to show patterns that implicit racial bias and other demographic factors might influence treatment recommendations. Further research is needed to expand on the present findings to determine how implicit bias may affect different treatment options and to what extent these biases contribute to health care disparities.

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IRB A PPROVAL

IRB Administration Offices
UH IRB Phone: 216.844.1529
CWRU IRB Phone: 216.368.6925

EXEMPT DETERMINATION

Principal Investigator:	Juan Palomo
Title:	Implicit Racial Bias among Orthodontists and its Influence on Treatment Recommendations
IRB Number:	STUDY20200227
IRB Office:	CWRU IRB
Approval Date:	4/23/2020
Exemption Category:	(3)(i)(A) Benign behavioral interventions (non-identifiable)
Documents Reviewed:	• recruitment email.pdf, Category: Recruitment Materials; • Thesis consent-update.pdf, Category: Consent Form; • demographic survey-update .pdf, Category: Other; • vignette survey update .pdf, Category: Other; • IAT Update .pdf, Category: Other; • Exemption Protocol - RAVEN update.pdf, Category: IRB Protocol;

The IRB determined that this protocol meets the criteria for exemption from IRB review.

Ongoing IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If you wish to make changes to this protocol, please submit a modification.

The UH IRB operates under HHS Federalwide Assurance (FWA) number 00003937 and IRB registration numbers 00000684, 00001691 and 00008600. The CWRU IRB operates under DHHS FWA00004428 and IRB registration number 00000683.

HRP-518

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Table I: One sample t-test comparing the entire sample to a hypothesized control s

	Mean	St. Deviation	Minimum	Maximum	95% Confidence interval Difference		Sig. P-value
					Lower	Upper	
Entire Sample[1]	.1829	.44254	-.95	1.13	.0981	.2677	<.000
H^0	0	0					

[1] = One-sample t-test
H^0 = Hypothesized control set at 0, where 0 = no bias toward any group

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Table II: Race IAT Scores by Demographics

Characteristic	N	Mean D-Score	Std. Deviation	Sig. (P-value)
Overall	107	0.1829	0.44254	.000*
GENDER				
male	36	0.2472	0.43468	0.478
female	70	0.154	0.44808	
prefer not to answer	1	-0.1084		
AGE				
25-29	28	0.2408	0.43279	0.300
30-34	25	0.1577	0.48376	
35-44	25	0.0403	0.39993	
45-54	14	0.1809	0.40125	
55-64	12	0.3107	0.50531	
65+	3	0.5378	0.27657	
ETHNICITY				
White	56	0.2958	0.38486	0.000*
African American	20	-0.2125	0.37975	
Hispanic	6	-0.1339	0.41142	
Asian or Pacific Islander	14	0.335	0.39279	
Mixed race	5	0.4097	0.37599	
Other	6	0.2199	0.53357	
PRACTICING ORTHODONTIS VS RESIDENTS				
Resident	36	0.1622	0.5039	0.661
Practicing	70	0.2022	0.4076	
PERCENTAGE OF AFRICAN AMERICAN PATIENTS				
<20	48	0.226	0.41884	0.031*
21-40%	32	0.2461	0.45247	
41-60%	18	0.1728	0.452	
61-80%	5	-0.1511	0.35772	
>80%	4	-0.3772	0.22451	

* = Statistically Significant at a p-value of <.05

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Table III: Pearson Correlation between D- scores and Orthodontic treatment Recommendations

	Case 1- Anterior Open Bite		Case 2 – Moderate Crowding	
	Correlation to D-score (Pearson Correlation)	Sig. P=value	Correlation to D- score (Pearson Correlation)	Sig. P=value
Recommend Tx	.191	.049*	0.146	.132
Fixed appliance vs aligner	-.095	.33	-0.045	0.648
Estimated cooperation	-.027	.781	-0.009	.93
% of African American Patients	-.245	.011*		

* = Statistically Significant at a p-value of <.05

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Figure I: Case 1 – Anterior Open bite 3D digital models

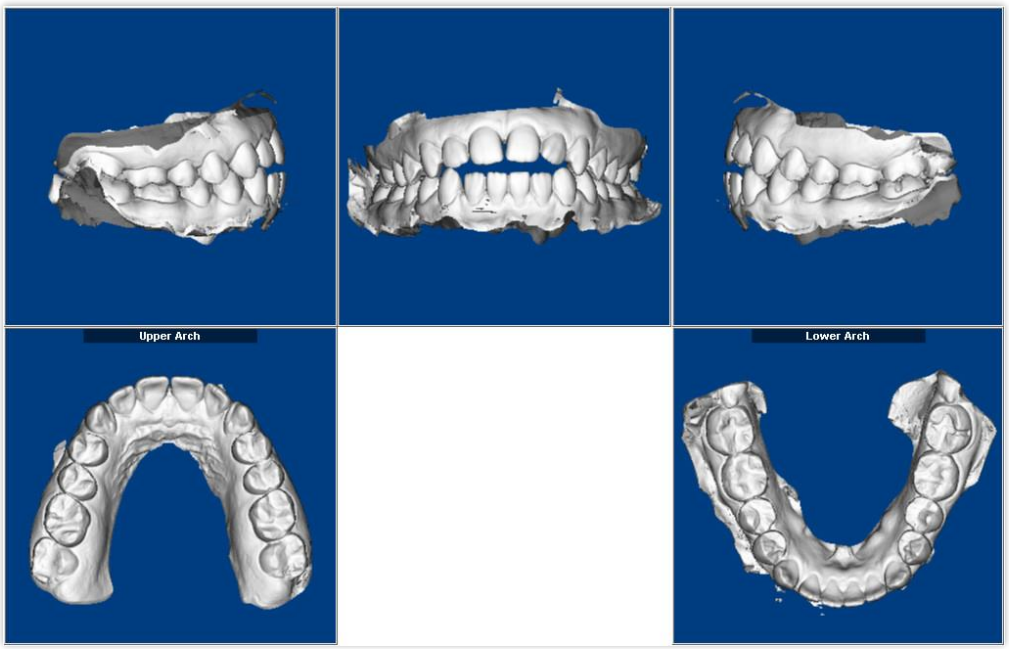
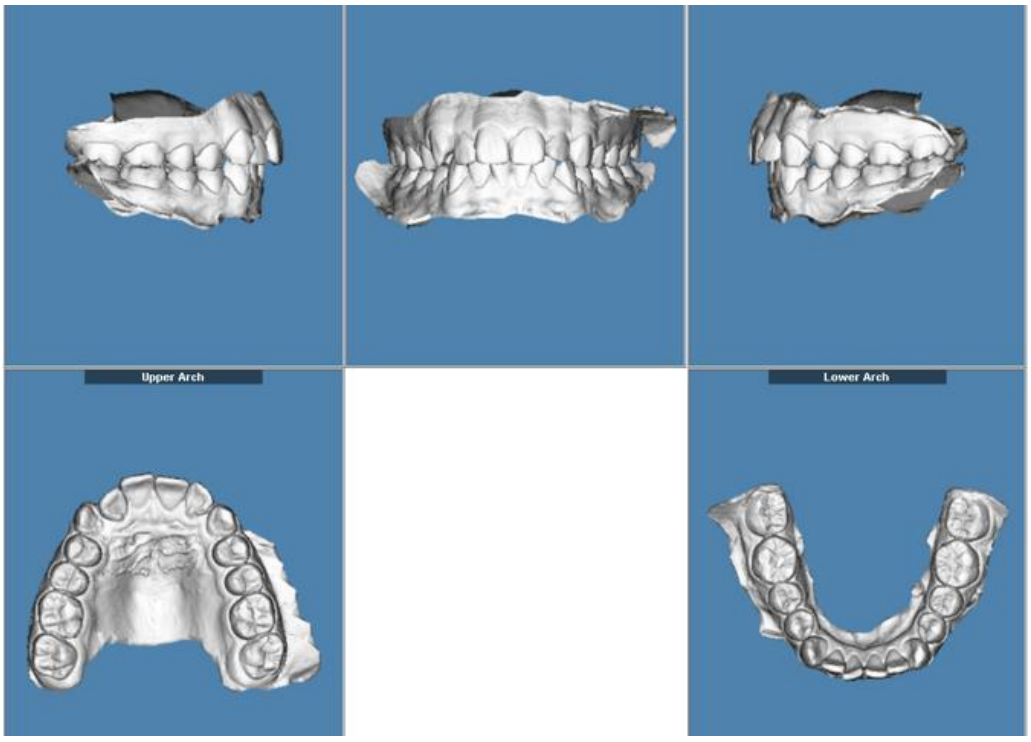


Figure II: Case 2- Moderate Crowding 3D digital model



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Survey Questions and Responses

1. What is your age in years?

Age	N	Percentage
25 -29	48.000	22.535%
30- 34	47.000	22.066%
35 - 44	55.000	25.822%
45 - 54	31.000	14.554%
55 - 64	24.000	11.268%
>65	8.000	3.756%

2. What is your gender?

Gender	N	Percentage
Male	78	36.62%
Female	134	62.91%
Prefer not to say	1	.47%

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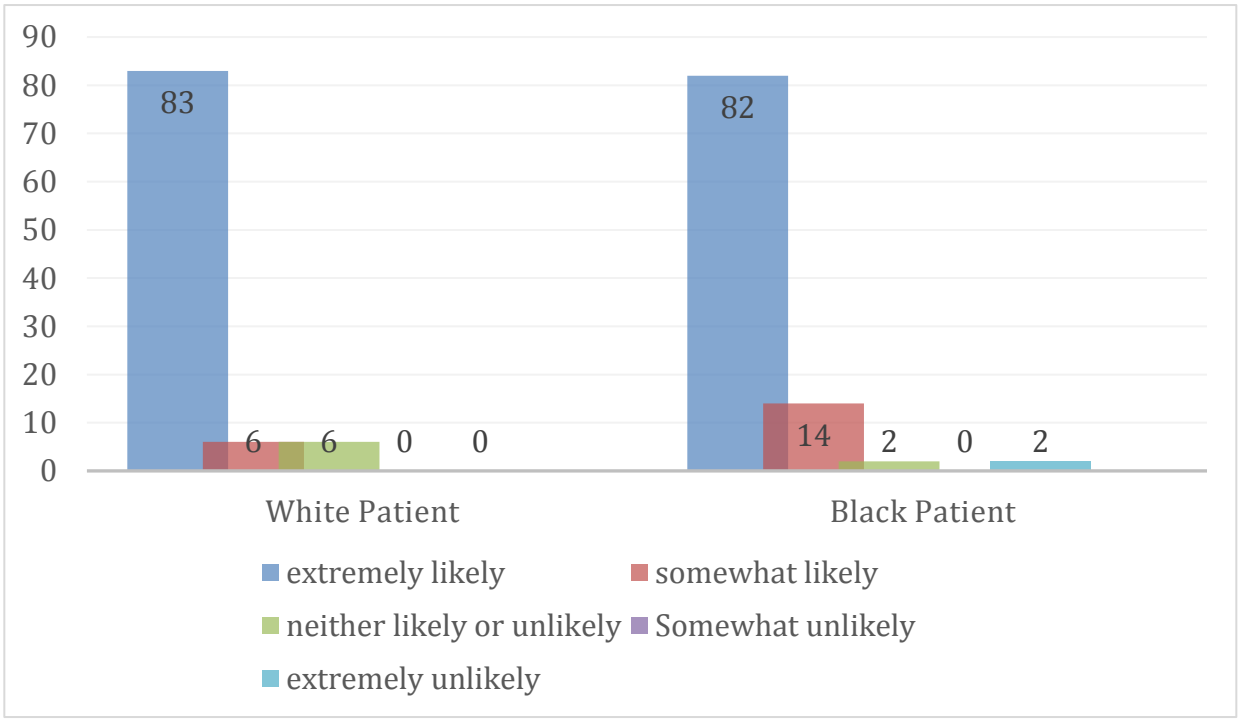
3. How would you describe your racial/ethnic background?

Race/ Ethnicity	N	Percentage
European American or White	117.000	54.930%
African-American or Black (non-Hispanic)	32.000	15.023%
Hispanic or Latino	10.000	4.695%
Asian or Pacific Islander	29.000	13.615%
Native American or Alaskan Native	0.000	0.000%
Mixed	8.000	3.756%
Other	17.000	7.981%

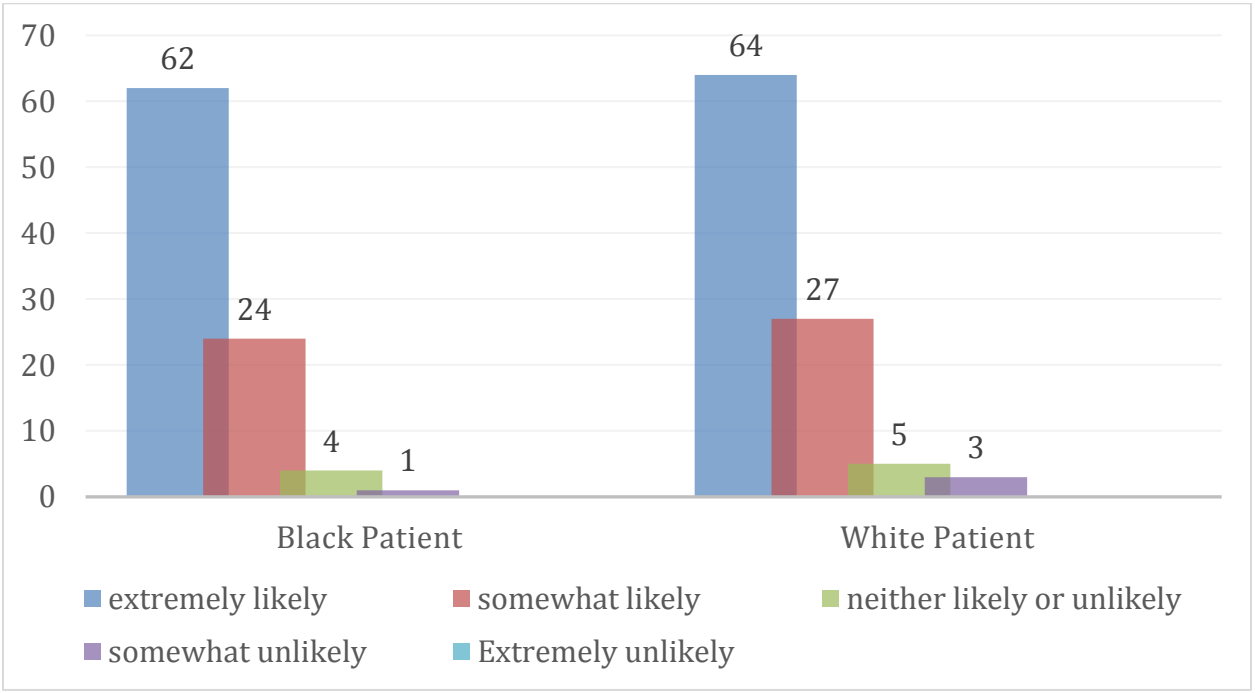
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4. Please assess the likelihood that you would recommend orthodontic treatment.

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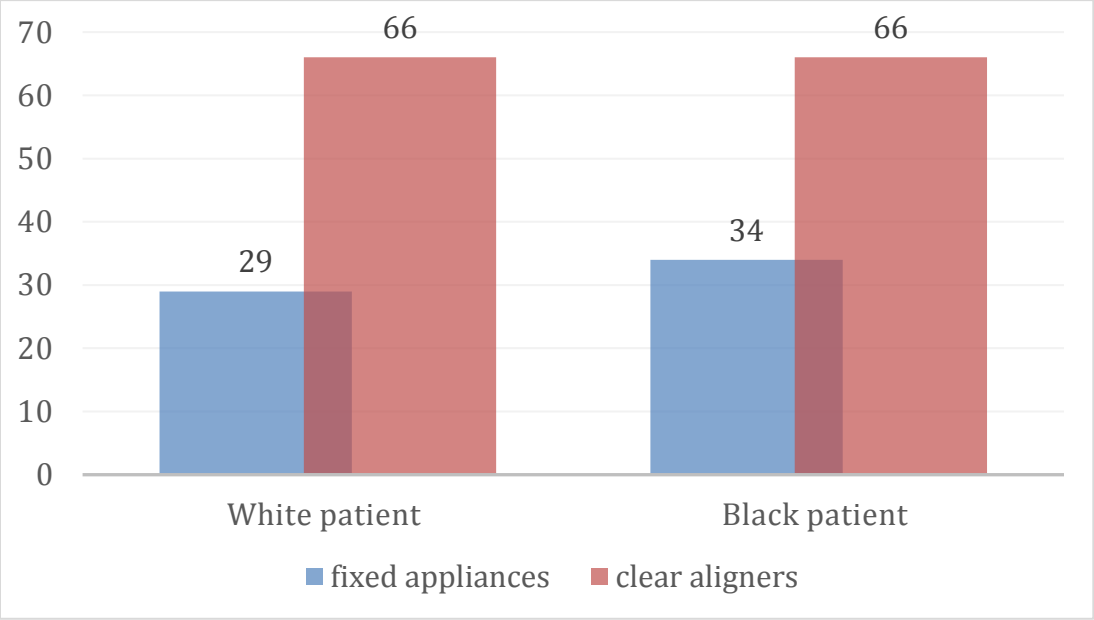
Crowding Case



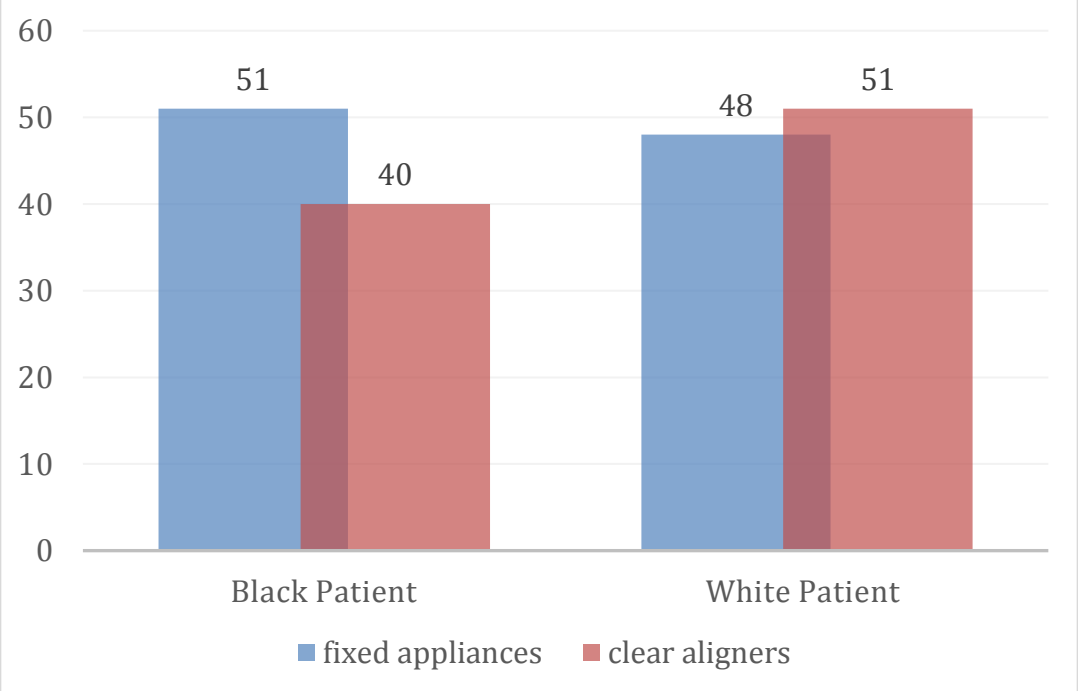
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5. Given the limited information available, would you recommend fixed appliances or clear aligners for this patient?

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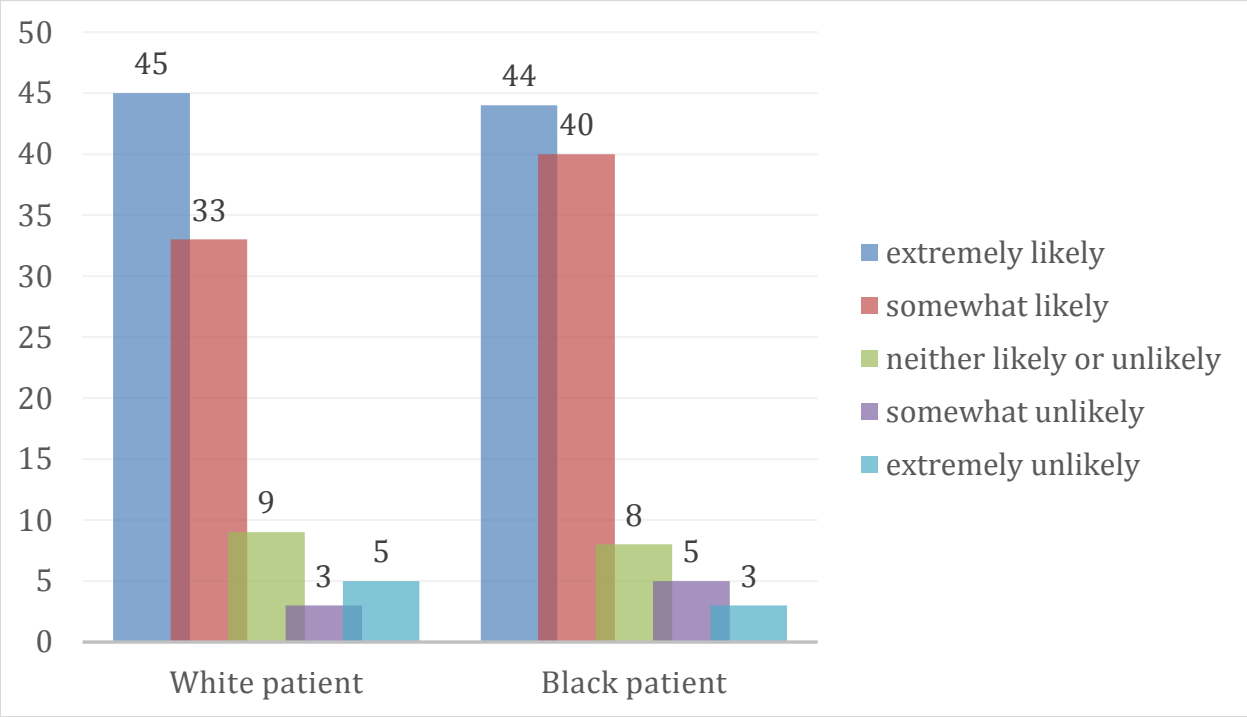
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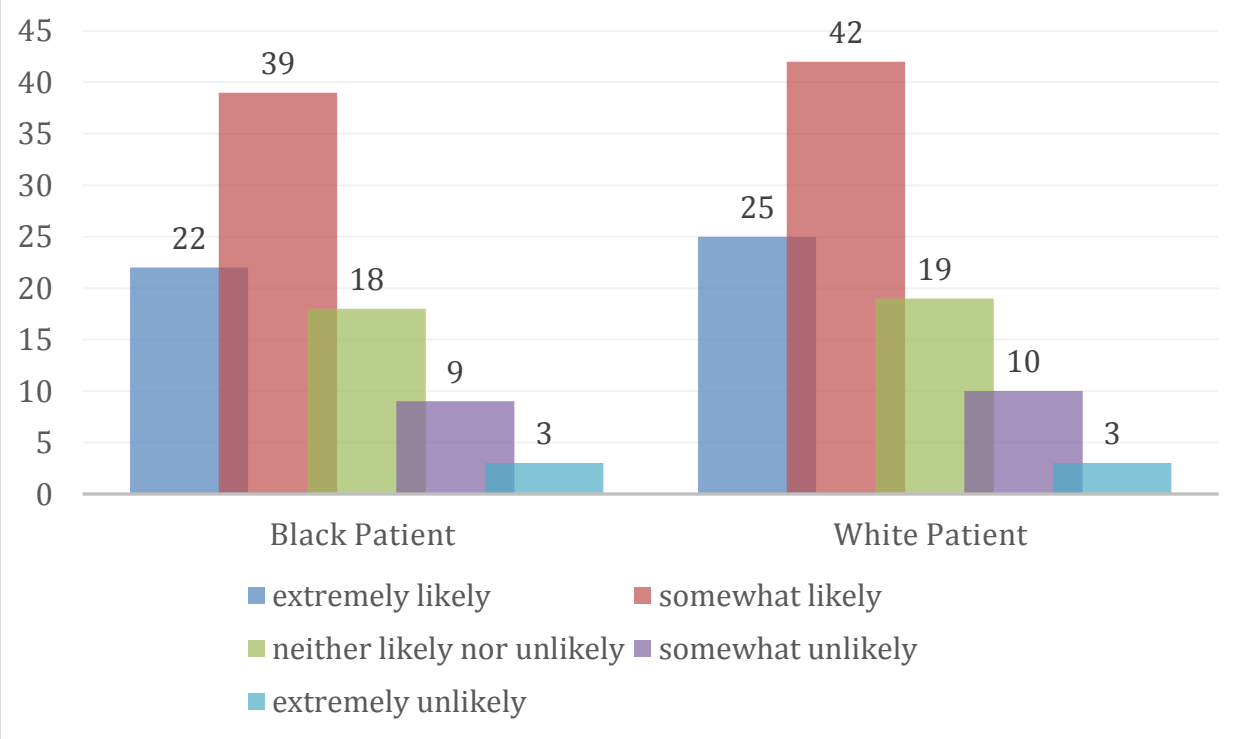
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6. How would you characterize your recommendation regarding clear aligners?

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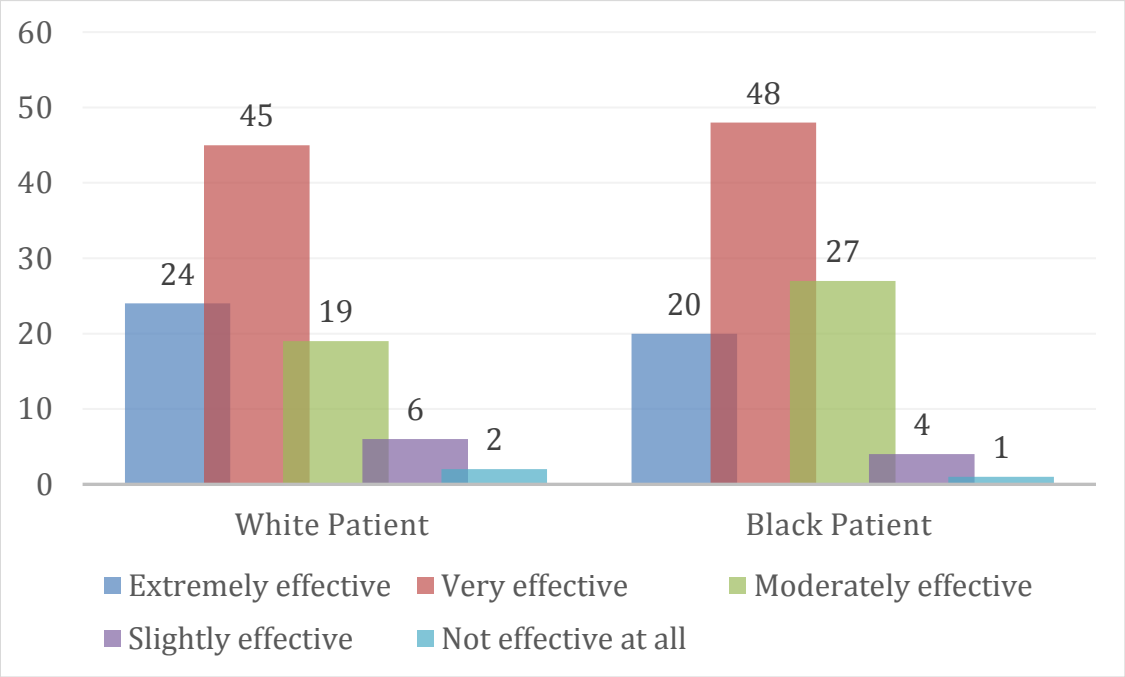
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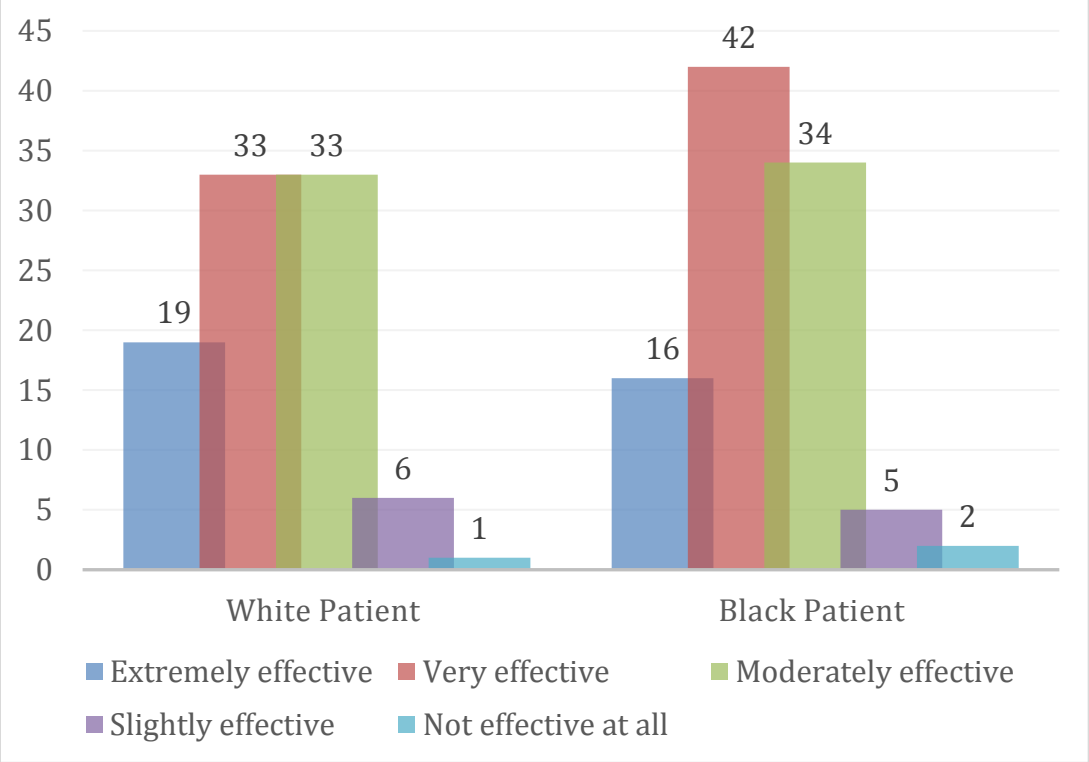
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7. In your opinion, how effective are clear aligners in the treatment for the above malocclusion?

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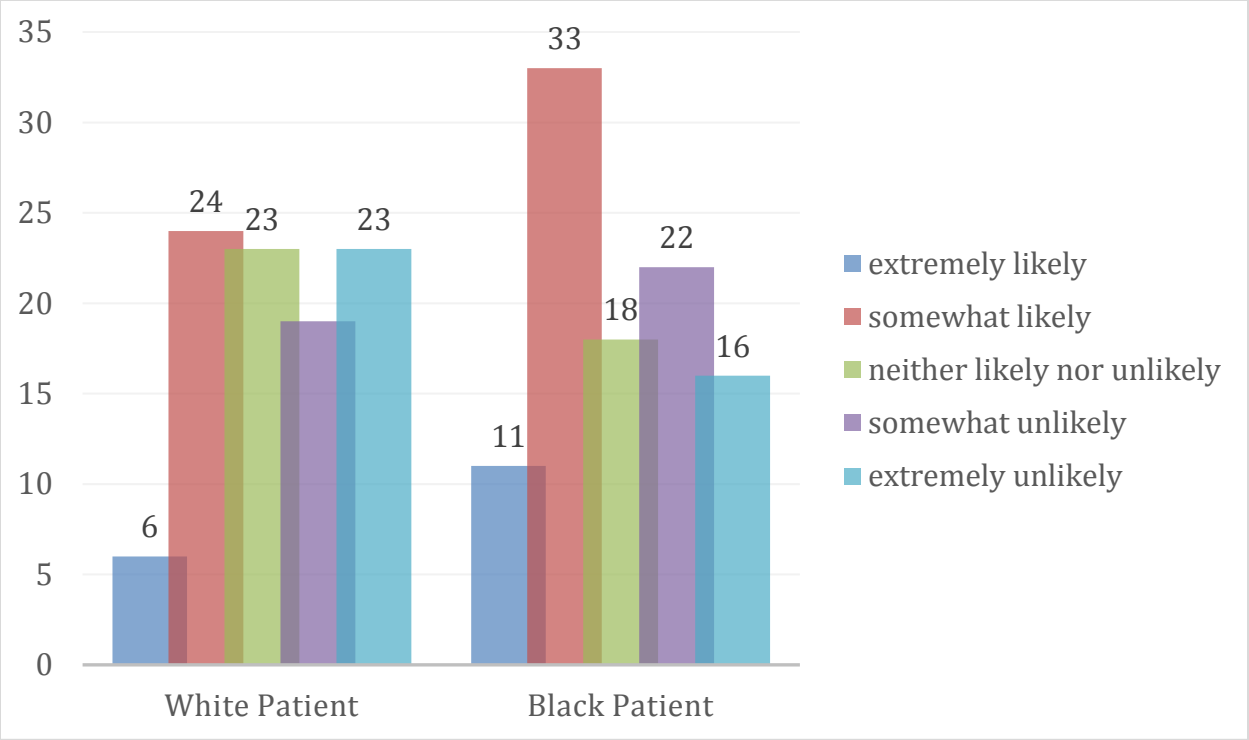
8. What percentage of your patients are currently being treated with clear aligners?

% of patients with aligners	N	Percentage
<20%	114	53.521%
21- 40%	67	31.455%
40- 60%	10	4.695%
60-80%	4	1.878%
80-100%	1	0.469%

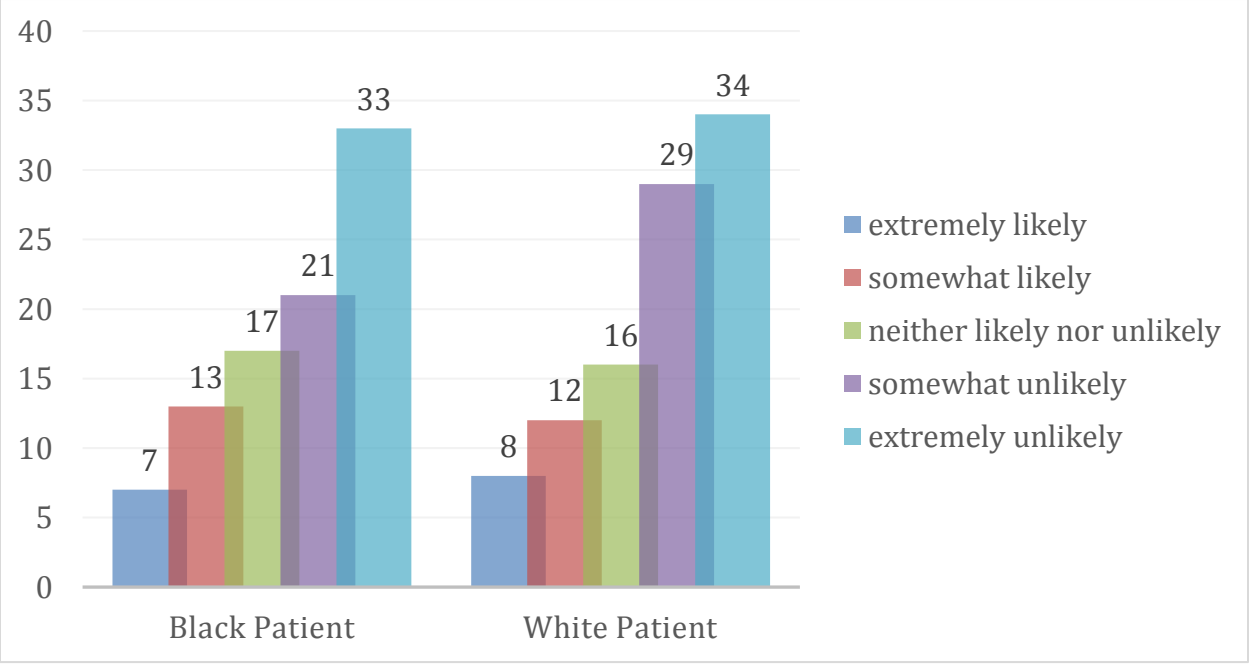
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9. With patient cooperation in mind, how likely are you to use additional treatment options like TADs, surgical intervention, extractions, etc. to treat this malocclusion?

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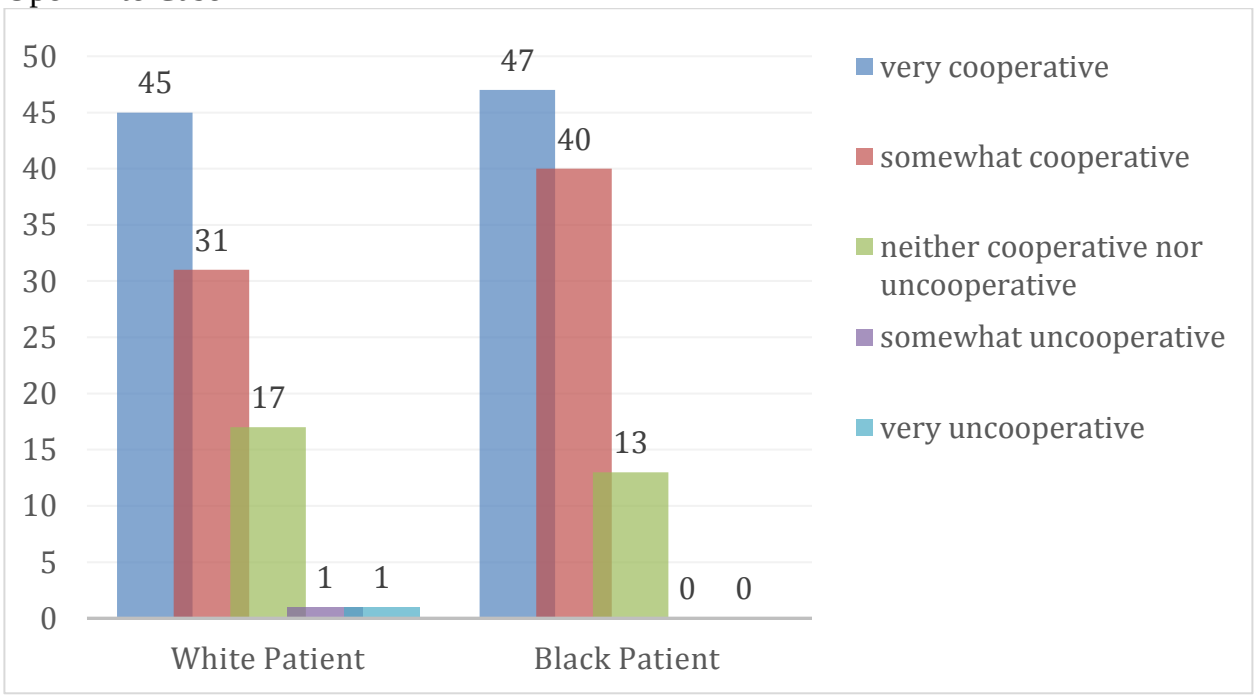
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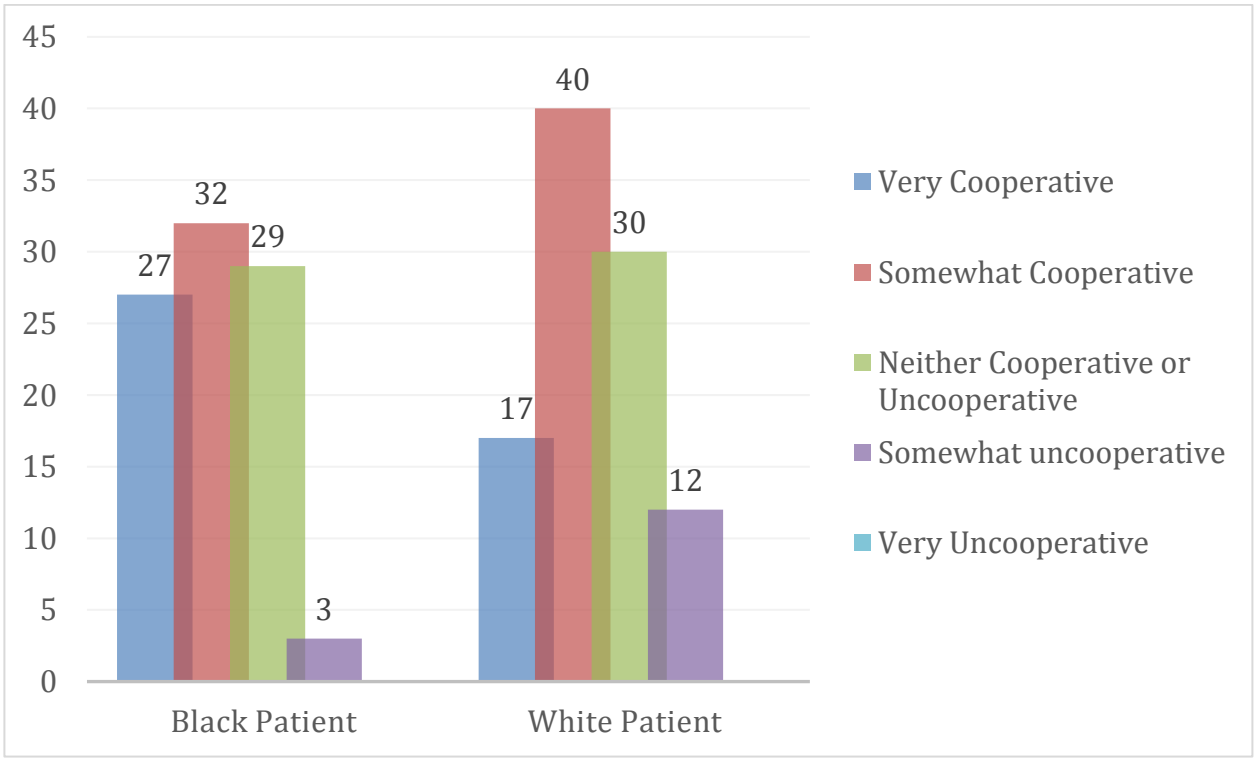
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10. Rate the estimated level of cooperativeness of the patient above.

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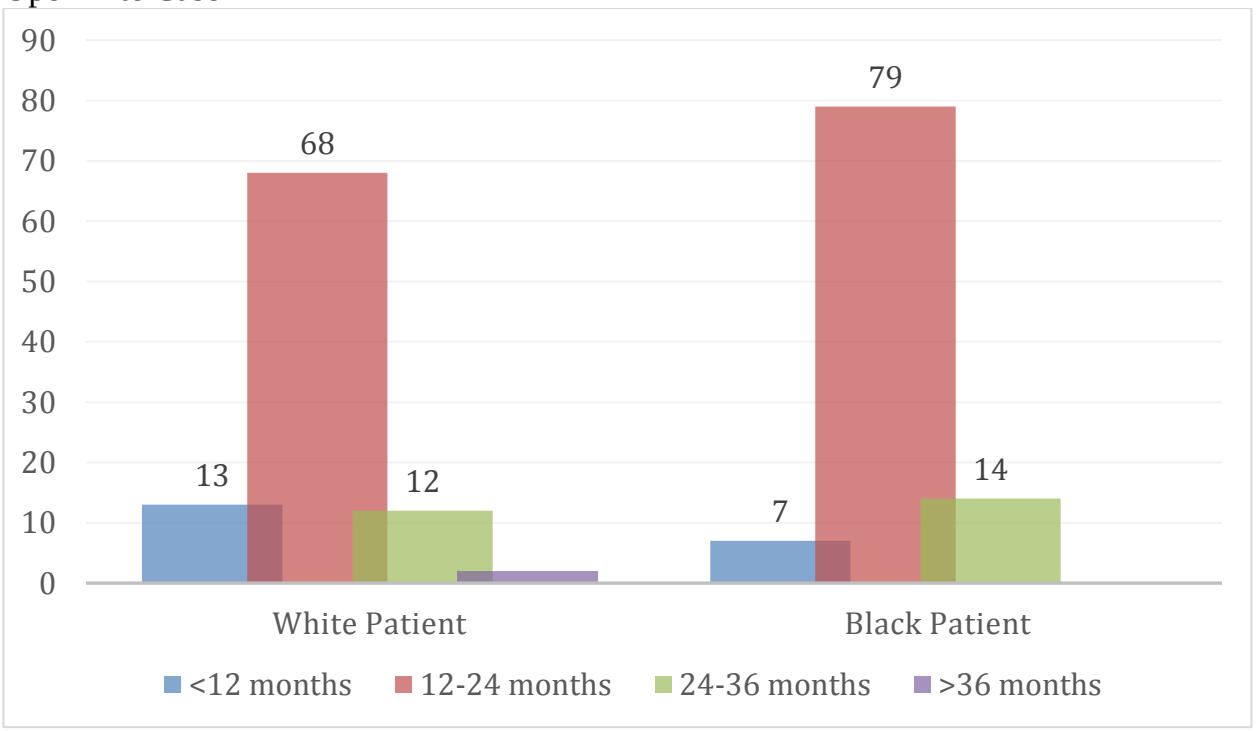
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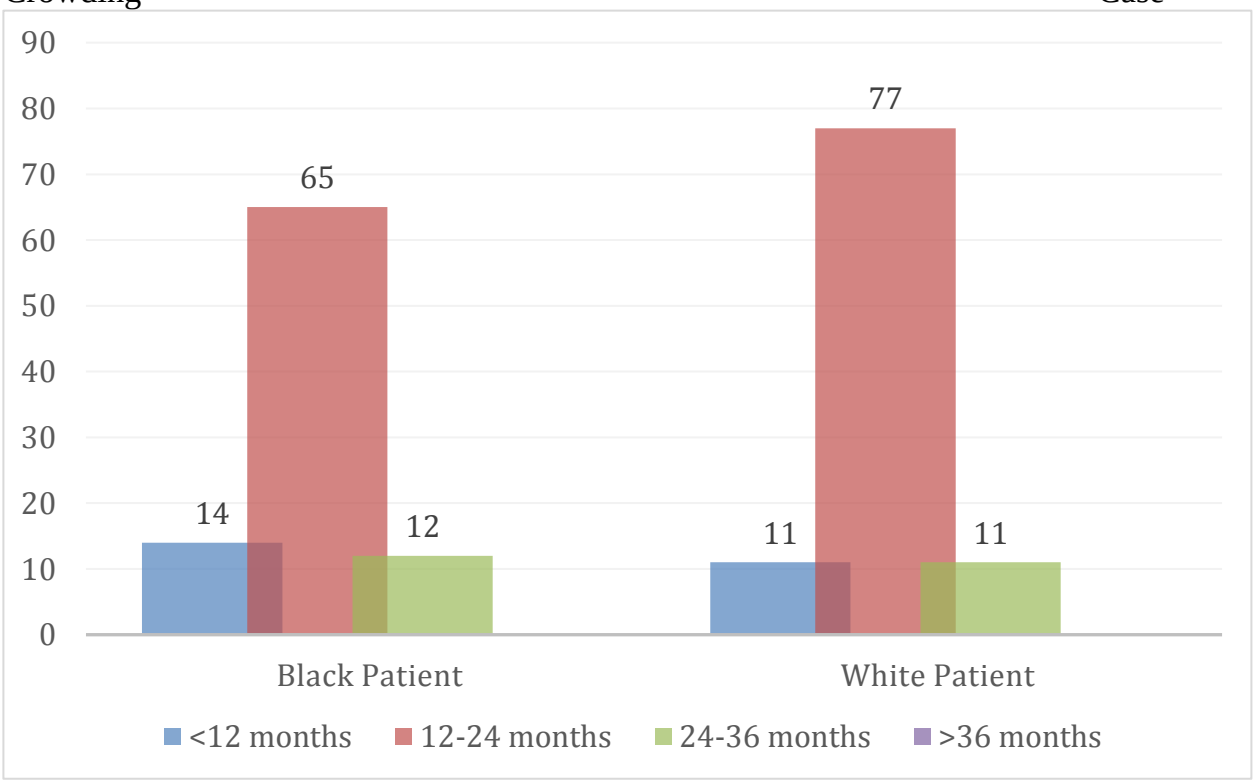
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11. What would you estimate the treatment duration for this patient?

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12. Approximately what percentage of your patients are African-American or Black (non-Hispanic)?

% of African American Patients	N	Percentage
0-20%	84	39.437%
21- 40%	57	26.761%
41-60%	34	15.962%
61-80%	9	4.225%
81- 100%	7	3.286%