Treatment acceptance in adult anterior open bite patients: a national network study

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A thesis

submitted in partial fulfillment of the

requirements for the degree of

Master of Science in Dentistry

University of Washington

2021

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Program Authorized to Offer Degree:

Orthodontics

University of Washington

ABSTRACT

Treatment Acceptance in Adult Anterior Open Bite Patients: A National Network Study

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Introduction: Modern orthodontists have a variety of treatment techniques and appliances at their disposal to treat anterior open bite malocclusions. Patients are often involved in decisions regarding their treatment. It is largely unknown which aspects patients take into consideration when choosing an orthodontic treatment plan. The aim of this study is to investigate orthodontic treatment plan acceptance by adults with anterior open bite in the United States and to identify associations between treatment plan acceptance and practitioner demographics, patient demographics, and dentofacial characteristics.

Methods: A prospective, observational 3.5-year cohort study enrolled the patients of 91 National Dental Practice-based Research Network orthodontists and dentists who routinely perform orthodontic treatment. 345 adult patients were ultimately included in the sample population. Practitioners filled out forms regarding their personal and practice demographics. They also recorded patient dentofacial characteristics and listed their recommended treatment plans. Patients answered survey questions regarding their demographics, treatment goals, treatment plan accepted, and if applicable, reasons for not accepting the most highly recommended treatment plan. Univariate and regression models were performed to see if there were any associations between the responses and likelihood of accepting the most highly recommended treatment plan.

Results: Overall, the most highly recommended treatment plan for adult patients with anterior open bite was accepted 78% of the time. Of the patients recommended to have surgery, 60% accepted the plan. Patients with a history of prior orthodontic treatment ($p=0.01$) and a concave profile ($p=0.02$) were more likely to accept the most highly recommended overall treatment plan. When a patient had insurance covering orthognathic surgery, they were more likely to accept a surgical treatment option ($p=0.002$). Patients with severe crowding were less likely to accept a surgical treatment plan ($p=0.006$). The most common reasons for declining the most recommended plans were not wanting jaw surgery, and considering the treatment to be too invasive, risky, and/or costly.

Conclusions: Generally, patient acceptance decreases with increasing invasiveness of the proposed options. Prior orthodontic treatment, concave profile, and insurance covering orthognathic surgery were significant predictors of accepting the most highly recommended treatment plan. About 40% of patients who were recommended orthognathic surgery as the best treatment plan declined that option.

Table of Contents

List of Tables

Acknowledgements

Research was supported and funded by The National Dental Practice-Based Research Network (NDBRN) and the University of Washington Department of Orthodontics Alumni Association. This study was funded by NIDCR grant U19-DE-22516. I would like to thank Ellen Funkhouser for statistical support. I would also like to thank my committee members Geoff Greenlee, Greg Huang, and Ellen Funkhouser for your ideas, feedback, and support.

Chapter 1: Introduction

Anterior open bite is a vertical problem commonly defined as the absence of contact between the maxillary and mandibular incisors (Moyers 1963). Several options exist for treating this malocclusion. Current research does not provide substantial evidence as to which techniques, if any, are superior to others in successfully correcting this malocclusion and decreasing the likelihood of relapse. The anterior open bite study conducted through the National Dental Practice-Based Research Network served to gather information regarding treatment of this malocclusion in U.S. adults (Choi 2018, Finkleman 2019, Huang 2019, Todoki 2019). Data collected from practices across the country will help researchers identify trends that may inform future treatment decisions of orthodontic providers around the world. Presently, there is little research on factors influencing treatment plan acceptance, especially in anterior open bite cases. It is largely unknown which aspects patients take into consideration, consciously or subconsciously, when choosing an orthodontic treatment plan. The aim of this study is to investigate orthodontic treatment plan acceptance by adults with anterior open bite in the United States and to identify associations between treatment plan acceptance and practitioner demographics, patient demographics, and dentofacial characteristics.

When developing and carrying out a treatment plan, oral health care providers of past decades had a more paternalistic approach. The patient had little say in choice of treatment, and often followed the doctor's recommendations. Today, the patient-doctor relationship is seen as a two-way street. The trend towards patient participation in treatment decisions is changing the way dentistry is practiced and the culture surrounding dental care.

A component of the ethical principle of autonomy is the "right of the patient to determine what will be done with his or her own person" (ADA 1999). The ADA suggests that the dentist needs to meaningfully involve the patient when making treatment decisions and consider the patient's needs and desires in order to follow this principle. Now that patient involvement in decision making is more commonplace, there is a need for research into this dynamic relationship. This is vital for the field of orthodontics where treatment plans may last years and involve multiple areas of dentistry. While not much is known specifically about patient acceptance of treatment, patient satisfaction with treatment and factors influencing communication quality are now being studied. Results from these investigations may correlate with trends in treatment plan acceptance.

Researchers have investigated which factors influence purchase behavior and patient satisfaction following orthodontic treatment. For example, the American Association of Orthodontics conducted research via focus groups and an online survey to see if there is a difference in how mothers born from 1981-1996 versus mothers born from 1964-1980 chose orthodontists. Members of the older generation were found to rely more on recommendation, while millennials made their decision based on the comfort of their child with the office, doctor, and staff. Patients over the age of twenty-five were found to be more likely to seek treatment for improved oral function and health as opposed to betterment of self-image and appearance (Phillips 1997).

A study examining the differences in motivation for orthognathic surgery with respect to sex found that females tend to seek treatment in hopes of improving their appearance and self-confidence. However, males were more motivated by the expected improvement of their social well-being (Kiyak 1981). When looking at satisfaction with orthodontic treatment for anterior open bite, females were more likely to be dissatisfied. Authors reasoned this difference in sex was due to females having higher expectations for dentofacial improvement (Finkleman 2019).

Education level may also influence the likelihood of treatment acceptance. Patients with higher education levels were found to have a higher rate of dissatisfaction with an aspect of their treatment for anterior open bite (Finkleman 2019). These patients may be more discerning when evaluating treatment outcomes. A study done in 2014 by the American Society of Clinical Oncology looked at Hospital Consumer Assessments of Healthcare Providers and Systems surveys to assess patient satisfaction with doctor and nurse communication. Investigators found that having a bachelor's degree was the strongest predictor for patients' satisfaction with doctor communication. The results illuminated a disparity in perceived communication quality for those who are less educated, non-white, elderly, non-English speaking, and female (Mcfarland 2014). If patients cannot comprehend the treatment plan being presented, or if the practitioner does not consider the patient's background when explaining, there may fewer acceptances due to miscommunication or a lack of understanding.

Practitioner demographics may also play a role in whether a patient accepts the doctor's most recommended treatment plan or decides to go with an alternative. With more women entering the dental field, more thought is being given to the role of gender in the dentist-patient relationship. A paper published in the Journal of Dental Education in May 2008 found that male practitioners are thought to prioritize their careers more than females. Patients may believe they will have better care from someone "less likely to be distracted by family demands and more likely to stay current with the latest advancements." 40 percent of respondents viewed men as being more "in charge." In terms of patient demographics, 15% of males and 22% of females said they would prefer a male dentist, while only 5% of males and 19% of females said they preferred a female dentist. Those who preferred a female dentist said they were more likely to make the patient feel relaxed and to discuss their ailment rather than just solving it. Other research has found that female health care providers are more effective communicators than males, as they tend to interrupt less frequently, are more attuned to nonverbal cues, and spend more time with patients (Smith 2008).

A study conducted in London and published in the International Dental Journal in 2011 looked at patient preference for dentists based on demographics and experience. Patients were found to be partial to locally-trained dentists, which was explained as a function of preference for practitioners with a similar cultural background to the study participants. Foreign dentists received more negative ratings, which the researchers believe is a result of negative stereotypes about oral health care or level of training offered in the providers' respective countries. The results of this research also showed that dentists with greater experience were preferred over those with moderate experience (Swami 2011).

An article published in the Journal of General Internal Medicine says that effective communication with patients is influenced by the physician's cultural competence. It was found that patients were 2.4 times more likely to feel that their doctor gave them some control over treatment decisions if they believed the physician was aware of their cultural beliefs. White patients felt that they had this autonomy 2.3 times as often compared to their African-American and Hispanic counterparts. The study concluded that even though educating physicians in cultural competence may help improve communication, minority patients may still feel a lack of control over treatment decisions, especially if the doctor-patient relationship is race-discordant (Rencic 2005). Because the patient and doctor may not always come from the same background, understanding this and enhancing communication is of utmost importance. A study published in AJODO in March 2018 found that thorough discussion of treatment plan options and effective communication helped patients feel like they were more likely to get a good outcome (Wong

2018). The study on patient satisfaction with anterior open bite treatment echoed this, concluding that there was high value in having a positive patient-provider relationship (Finkleman 2019).

Anterior open bite is defined as the absence of contact between the maxillary and mandibular incisors at centric relation (Moyers 1963). Reported incidence of anterior open bite in literature ranges from 1.5 to 11 percent. Occurrence also tends to vary with age and between races (Ng 2008). Due to the multipart etiology of this malocclusion, an anterior open bite can be difficult to treat and tends to relapse (Greenlee 2011).

Orthodontists employ several methods and techniques to treat anterior open bite in children, adolescents, and adults. Common treatment modalities include, but are not limited to, habit appliances, myofunctional therapy, mastication exercises, headgear, chin cups, posterior bite blocks, removable functional appliances, fixed appliances, clear aligners, TADs, miniplates, extractions, and orthognathic surgery (Lin 2013). Until recently, there were no large-scale studies to evaluate these treatment options and their frequency of prescription, justification for use, and efficacy.

A 2019 study utilizing the National Dental Practice-Based Research Network assessed the influence of patient and practitioner characteristics on the orthodontists' treatment recommendations for anterior open bite. Results showed that recommendation of aligners was increasingly associated with Caucasian and Asian patients, the presence of tongue habits, and female practitioners. Academic settings saw more frequent recommendation of TADs. Demographic factors associated with recommendation of orthognathic surgery included availability of insurance coverage and practitioner race and ethnicity. Surgery was also recommended on the basis of dentofacial characteristics: anteroposterior discrepancies, more severe open bites, and steeper mandibular plane angles. It was found that an extraction treatment plan was offered when the patient presented with severe crowding and incisor proclination (Huang 2019).

Following the examination of factors influencing treatment recommendations, this study aims to identify how patient and practitioner characteristics influence the acceptance of treatment plans most highly recommended by practitioners. Dentofacial characteristics to be evaluated include profile, molar classification, maxillary arch length, mandibular arch length, posterior cross-bite, severity of open bite, facial pattern, and presence of habit. Patient characteristics to be evaluated include age, sex, race/ethnicity, insurance, education, and treatment goals. Practitioner characteristics to be evaluated include age, sex, race/ethnicity, year orthodontic training was received, and type of practice.

Chapter 2: Materials and Methods

This research represents part of a larger study. *Anterior Openbite Malocclusions in Adults: Recommendations, Treatment, and Stability* is a prospective, observational 3.5-year cohort study that enrolled the patients of 91 National Dental Practice-based Research Network orthodontists and dentists who routinely perform orthodontic treatment.

Orthodontists and dentists of the National Dental PBRN were asked to participate in the study by Regional Coordinators from the six Regional Administrative Sites. Members of the American Association of Orthodontists were also invited by e-mail to participate in the National Dental PBRN. Enrolled practitioners then created a list of their adult patients currently in active treatment for anterior open bite and invited them to participate at their routine visit or by phone call. Each practitioner could enroll up to fifteen patients with preference to those who have been in treatment the longest. Following inclusion and exclusion criteria, a total of ninety-one practitioners and 345 adult patients were ultimately included in the sample population.

Inclusion Criteria

To be eligible to participate in this study, a practitioner must have met all of the following criteria:

- Is enrolled in the National Dental PBRN as a practitioner who is licensed in the United States (US) and treats patients in the US on a recurring basis.
- Is a "full" participation level member, or willing to change from "information only" or "limited" to "full".
- Is trained and certified in Human Subjects Protection Training.
- Is willing to complete study-specific training.
- Has attended or viewed a National Dental PBRN orientation session or has attended at least one annual regional meeting of practitioners.
- Is an orthodontist or a dentist that routinely performs orthodontic treatment.
- Has a sufficiently large patient population such that the practitioner estimates he/she can recruit approximately 3 - 8 adult patients in active treatment for AOB and expect to have treatment completed within 24 months of enrollment into the study.
- Routinely takes cephalometric x-rays before and after treatment.
- Has the ability to upload (via internet) de-identified cephalometric x-ray and digital intra-oral frontal photographs to a central repository.
- Affirms that the practice can devote sufficient time in patient scheduling to allow focused recording of all data required for the study.
- Does not anticipate retiring, selling the practice, or moving during the study.

To be eligible to participate in this study, a patient must have met all of the following criteria:

- Must be at least 18 years of age.
- Must have AOB that is defined as one or more incisors that do not have vertical overlap with teeth in the opposing arch. The remaining incisors may have minimal incisor overlap, but none of them can contact teeth in the opposing arch.
  This will be determined by examining the patient's initial cephalometric x-ray, intra-oral photographs, and/or initial plaster or digital casts.
- Must be in active treatment for AOB and expect to have treatment completed within 24 months of enrollment into the study.
- Must have an initial cephalometric x-ray (taken prior to the beginning of treatment). A cephalometric x-ray created from a cone-beam CT scan is acceptable.
- Willing to comply with all study procedures and be available for the approximate 3-year duration of the study.
- Allow the use of his/her x-rays and photographs that are obtained as part of normal treatment (i.e. before treatment began and at the time of appliance removal) for this research.
- Agrees to receive text messages, emails, and/or phone calls related to the study visits from the practice per the practice's routine contact method.

- Willing to be contacted as needed by each of these entities: the practice, Regional Coordinator (RC), and the Westat CC (the patient's preferred method of contact will be ascertained).
- Willing to provide contact information for at least one other person who will know the patient's whereabouts in the event the patient cannot be reached.

Exclusion Criteria

Practitioner: No adult AOB patients in active treatment.

A patient who meets any of the following criteria was excluded from participation in this study:

- Adults with clefts, craniofacial conditions or syndromes.
- Patients who have significant physical, mental, or medical conditions that would affect their treatment compliance, cooperation, or outcome.
- Patients expecting to move before the completion of the study.
- Patients with initial treatment plans estimated at more than 36 months.

Practitioners and eligible patients who consented to participation in the study filled out initial data collection forms upon enrollment. These forms gathered information related to practitioner demographics, patient demographics, dentofacial characteristics, proposed treatment plans, and reasons for treatment plan declination.

Practitioners provided information regarding their country of training, gender, race/ethnicity, age, years since dental degree, type of practice, and region of practice. Patients answered survey questions about their gender, age, race/ethnicity, insurance coverage, education level, and history of orthodontic treatment. Practitioners recorded information regarding their patient's profile, molar classification (most severe of right and left), arch length (most severe of maxillary or mandibular), posterior transverse dimension, and facial pattern. The Photographic openbite severity index (POSI) score was used to evaluate severity of anterior open bite. Practitioners also noted if their patient had a tongue thrust, tongue posture habit, or digit habit. Any history of parafunction, biting habits, or bruxism was included as well.

Answers provided to these survey questions were used to assess the rate of treatment acceptance and its associated factors. Practices de-identified case report forms, as well as other patient records, and submitted them to staff at the Regional Administrative Sites. The staff made sure that the forms were complete and that any issues or discrepancies were addressed. All collected data was entered into a Web-based data collection system to be stored in the study database.

Researchers at the University of Alabama Birmingham and the University of Washington were sent the de-identified data necessary to complete this portion of the larger study. A chi-square test was used to find any associations between practitioner demographics, patient demographics, and patient dentofacial characteristics with acceptance of overall treatment plans. Treatment plans were then divided into four categories: aligners, full-fixed appliances, TADs, and orthognathic surgery and evaluated as well. Whether or not patients were recommended to have extractions was looked at for overall acceptance rate and with respect to the four treatment categories.

The group of patients who were recommended orthognathic surgery as the most recommended treatment plan was examined in further detail. Despite there being 91 practitioners, practitioner demographics were examined in relation to patient acceptance of surgery for each of the 129 patients. This means that practitioners would be counted more than once if an orthodontist had multiple patients enrolled in the study who were recommended to have surgery.

A multivariable model was created that used a generalized estimating equation (GEE) to adjust for the clustering of patients within the practice, implemented with the command PROC GENMOD in SAS with the CORR=EXCH option. An indicator of the severity of the open bite

(POSI 1-3 vs. 4-6) and the mandibular plane angle (vertical facial pattern, i.e. low, normal, high angle) were included in the overall model. Other factors with $p<0.10$ after adjusting only for the clustering of patients within the practice were entered into a full model. This was followed with backward elimination to identify independent associations, removing variables until all remaining variables had $p<0.05$. All odds ratios and p-values reported were adjusted for the clustering of patients within practitioners with GEE. A surgical model was developed in a similar manner. All analysis were performed using SAS software (SASv9.4, SAS Institute Inc., Cary NC).

In addition to practitioner and patient characteristics, treatment goals, specific treatments recommended, prior orthodontic treatment, and reasons for not accepting treatment were evaluated. Data on prior orthodontic treatment and reasons for not accepting orthognathic treatment are descriptive in nature. Insurance covering orthognathic surgery versus no insurance or insurance not covering surgery, and severe crowding versus no, mild, or moderate crowding was looked at dichotomously. Additionally, for those not accepting the most recommended treatment plan, the plans that were accepted were assessed.

Chapter 3: Results

A total of 91 practitioners and 345 adult patients were included in this study. 71% of participating practitioners were male, and 54% were between the ages of 45 and 64. A majority of the providers were white (62%) and were solo practitioners in a private practice (54%). More practitioner demographics can be found in Choi 2019. Patients participating in this study were 74% female, and the largest age group was from 21 to 30 years old (45%). 55% of the patients were white. Most patients had either an Associate's or a Bachelor's degree (32% and 31%, respectively).

78% of the patients accepted the most highly recommended treatment plan proposed by their orthodontist. We then divided up these patients according to the treatment modality of the initial plan (Table 1). Treatment plan acceptance decreased with increasing invasiveness of modality.

Table 1. Rate of most recommended treatment plan acceptance according to treatment modality

Treatment Modality											
Aligners only (N=35, 10%)			Fixed appliances (N=146, 42%)			TADs (N=35, 10%)			Og Surgery (N=129, 37%)		
	Accepted			Accepted			Accepted			Accepted	
N	N	Row%	N	N	Row%	N	N	Row%	N	N	Row%
35	33	94%	146	133	91%	35	26	74%	129	78	60%

After examining the accepted plans of those that declined the most recommended treatment, several patients that declined initial plan still maintained the primary treatment modality. Each patient's most recommended treatment and alternative options given by their provider, along with their reasons for declining the initial plan, were assessed. Patients were then categorized into groups reflecting the component of their treatment plan that they actually declined. Two patients declined clear aligners, ten patients declined fixed appliances, six patients declined TADs, three patients declined extractions, 51 patients declined surgery, and three patients declined "other" aspects of their most recommended plan. All three patients declining extractions and two of the patients declining "other" had fixed appliances included in the initial plan, and still accepted a plan with fixed appliances. Therefore, they were counted in the category as accepting fixed appliances. The component of the plan they declined was either extractions, a glossectomy, corticotomy, or an implant. See appendix all options offered to each patients who declined the most recommended plan.

For 67 of the 345 patients in this study, practitioners included anterior or premolar extractions in their most recommended treatment plan. Our data shows that 46 of these patients accepted this most recommended plan, which included extractions. After evaluating each of the 21 patients who declined the most recommended plan and the treatment plans they ultimately chose, we found that 14 of these patients still chose a plan including extractions. Therefore, seven patients did not accept a plan with extractions. Overall, there were only three patients that were initially recommended to have fixed appliances and extractions that could not be put into any other more invasive treatment category. All three of these patients specifically stated that they declined the initial plan because they did not want extractions. The remaining four patients not accepting a plan with extractions were initially offered surgery and extractions. They declined they surgery component, and were not offered an alternative plan including extractions.

Overall acceptance according to practitioner characteristics

Acceptance of the most highly recommended treatment plan by patients was assessed according to practitioner and practice demographics and characteristics (Table 2). Practitioners provided information regarding their country of training, gender, race/ethnicity, age, years since dental degree, type of practice, and region of practice. Practitioners in the South Central region had a 100% acceptance rate, and those in the Northeast had an 85% acceptance rate. Because there was a 100% acceptance rate, statistical models become non-estimable.

Table 2. Practitioner/practice demographics according to whether accepted most recommended treatment

Practitioner characteristics	N	All Col %[2]	N	Accepted Row[3] %	p
ALL	345	100%	270	78%	
Country trained in					0.4
United States	279	81%	221	79%	
Other	66	19%	49	74%	
Gender					0.5
Male	254	74%	201	79%	
Female	91	26%	69	76%	
Race/ethnicity					0.6
White/Caucasian	200	58%	155	78%	
Asian	101	29%	76	75%	
Hispanic	38	11%	34	89%	
Other/unknown	6	2%	5	83%	
Age					0.7
< 45 years	134	39%	104	78%	
45 - 54 years	78	23%	60	77%	
55 - 64 years	110	32%	86	78%	
65+ years	23	7%	20	87%	
Years since dental degree					0.2
< 10 years	37	11%	22	59%	
10 - 19 years	129	37%	99	77%	
20 - 29 years	85	25%	68	80%	
30+ years	93	27%	77	83%	
Type of practice					0.9
Solo, private practice	154	45%	120	78%	
Owner, non-solo private practice	72	21%	57	79%	
Associate/employee private practice	35	10%	27	77%	
Preferred provider practice	15	4%	10	67%	
Academic	64	19%	52	81%	
Region					NE
Western	161	47%	121	75%	
Midwest	33	10%	23	70%	
Southwest	38	11%	30	79%	
South Central	20	6%	20	100%	
South Atlantic	38	11%	29	76%	
Northeast	55	16%	47	85%	

*NE = non-estimable

Overall acceptance according to patient demographics

Patient demographics were also considered when evaluating overall treatment plan acceptance rates (Table 3). Patients answered survey questions about their gender, age, race/ethnicity, insurance coverage, education level, and history of orthodontic treatment. If patients had no prior orthodontic treatment, treatment plan acceptance rate was 75%. 134 patients in this study had prior orthodontic treatment, and 111 (83%) of them accepted the orthodontist's most recommended treatment plan. Prior orthodontic treatment had a p-value of 0.06.

Table 3. Patient demographics according to whether patients accepted most recommended treatment

	All		Accepted		
Patient demographics	N	Col %[2]	N	Row[3] %	p
ALL	345	100%	270	78%	
Gender					0.8
Male	91	26%	74	81%	
Female	253	74%	196	77%	
Age (years)					0.3
18-20 years	57	17%	46	81%	
21-30 years	155	45%	116	75%	
31-40 years	76	22%	64	84%	
41 and older	56	16%	43	77%	
Race					0.7
White/Caucasian	188	55%	144	77%	
Black/African-American	34	10%	29	85%	
Asian	29	8%	23	79%	
Multi, other	12	4%	10	83%	
Hispanic ethnicity	78	23%	62	79%	
Dental or medical insurance					0.7
None	78	22%	60	77%	
Yes - not cover ortho or Og surgery	87	25%	68	78%	
Yes - covers ortho, but not Og surgery	93	27%	71	76%	
Yes - covers Og surgery	87	25%	71	82%	
Education level: Bachelor's degree or higher					0.5
High school/GED or less	71	21%	54	76%	
Some college/AD	109	32%	87	80%	
Bachelor's degree	105	31%	80	76%	
Graduate degree	57	17%	48	84%	
Prior orthodontic treatment					0.06
No	210	61%	158	75%	
Yes	134	39%	111	83%	

Overall acceptance according to patient dentofacial characteristics

The dentofacial characteristics of patients in this study were examined with respect to rate of treatment plan acceptance (Table 4). Practitioners recorded information regarding their patient's profile, molar classification (most severe of right and left), arch length (most severe of maxillary or mandibular), posterior transverse dimension, and vertical facial pattern. The POSI score (Huang 2019) was used to evaluate severity of anterior open bite. Practitioners also noted if their patient had a tongue thrust, tongue posture habit, or digit habit. Any history of parafunction, biting habits, or bruxism was included as well. Having a concave profile (p=0.10) or a high angle vertical facial pattern (p=0.02) were associated with trends for a higher likelihood of accepting the most recommended treatment plan. Patients with a posterior crossbite (p=0.008) had a decreased rate of acceptance.

Table 4. Patient dentofacial characteristics according to whether patients accepted most recommended treatment

	All		Accepted		
Patient dentofacial characteristics	N	Col %[2]	N	Row[3] %	p
ALL	345	100%	270	78%	
Profile					0.2
Convex	187	54%	143	76%	
Straight	129	37%	101	78%	
Concave	29	8%	26	90%	
Molar class (severest of right/left)					0.07
I: Half or full cusp	142	41%	119	84%	
II: Half or full cusp	106	31%	73	69%	
III: Half or full cusp	95	28%	76	80%	
Arch length (severest of maxillary or mandibular)					0.04
No crowding	70	20%	53	76%	
Mild crowding (1-3mm)	122	35%	104	85%	
Moderate crowding (4-6mm)	106	31%	79	75%	
Severe crowding (>6mm)	47	14%	33	70%	
Posterior crossbite					0.04
None	201	58%	167	83%	
Unilateral	68	20%	49	72%	
Bilateral	76	22%	54	71%	
Vertical facial pattern					0.06
High angle	202	59%	150	74%	
Normal	123	36%	103	84%	
Low angle	19	6%	16	84%	
Patient habits					
Tongue thrust					0.6
No	237	69%	189	80%	
Yes	108	31%	81	75%	
Tongue posture					0.2
No	261	74%	210	80%	
Yes	84	26%	60	71%	
Digit					0.2
No	319	92%	251	79%	
Yes	26	8%	19	73%	
Function/biting/bruxing					0.9
No	330	96%	258	78%	
Yes	15	4%	12	80%	
AOB score 4 to 6					0.2
No (1-3)	111	32%	90	81%	
Yes (4-6)	234	68%	180	77%	

Multivariate analysis for overall acceptance rates

Characteristics with $p<0.10$ after adjusting for clustering were entered into a full model (Table 5). POSI score and vertical facial pattern were kept in the model as a proxy for initial severity. Treatment categories were significantly associated with the rate of acceptance, with more invasive plans having lower acceptances rates. A patient having had prior orthodontic treatment was more likely to accept the most recommended plan ($p=0.01$). Patients with a concave profile ($p=0.02$) were also associated with higher rates of acceptance.

Table 5. Regression model for overall acceptance rates

	Univariable		Full model		Final Reduced Model		
Initial condition	**OR**	**P**	**OR**	**P**	**OR**	**95% CI**	**P**
4-treatment group*	category	<0.001	category	<0.001	category		<0.001
Molar class	category	0.0457	category	.7	X	X	X
Prior ortho Tx	1.6	0.06	1.8	0.01	1.8	1.1 - 2.9	0.01
Concave	2.2	0.10	3.1	0.02	3.3	1.0 - 10.7	0.02
Crossbite	0.47	0.008	0.80	.5	X	X	X
High angle vertical facial pattern	2.0	0.02	1.2	.6	1.3	0.68-2.53	0.4
POSI score of 4-6	0.7	0.2	1.1	.7	1.2	0.7 - 2.05	0.6

Reasons for not accepting most highly recommended treatment plans (excluding surgery)

Part of the enrollment questionnaire allowed patients to provide reasons for not accepting treatment (Table 6). The results are presented here for the non-surgical categories of treatment, and then later for the surgical category. These results are descriptive in nature, as the sample size is too small for statistics. For the 35 patients recommended aligners as their primary form of treatment, two patients declined this option. Both indicated that treatment was too costly. Out of the 146 patients recommended fixed appliances as their main treatment modality, only 10 declined the most highly recommended plan. All of these patients had esthetic concerns or stated they did not want braces. For the 35 patients who were offered TADs as part of their most highly recommended treatment plan, six declined. Five of the patients declining TADs said treatment was too invasive or two risky. One believed it was too costly. One patient also said treatment time was too long.

Table 6. Patient reasons for not accepting ideal plan according to treatment category (descriptive)

	Treatment Category		
Reason	Aligners 2 declined	Fixed, no TADS, no surgery 10 declined	TADs, no surgery 6 declined
Treatment too invasive or too risky	0	0	5
Treatment too costly	2	0	1
Did not want extractions	0	0	0
Did not want jaw surgery	0	0	0
Treatment time too long	0	0	1
Esthetics/Did not want braces	0	10	0
Other	0	0	0

Acceptance of surgical treatment plan according to practitioner/practice characteristics

Patient acceptance rate of orthognathic surgery as part of the most highly recommended plan was examined with respect to the characteristics of their practitioner (Table 7). The categories examined here are the same ones we evaluated for overall treatment acceptance. Similar to the results for overall treatment plan acceptance, none of these practitioner or practice factors had a significant influence on acceptance rate of surgical treatment.

Practitioners were also asked to answer the frequency with which they prescribed treatments (Table 8). The differences in rate of acceptance was not statistically significant with respect to regularity of treatment recommendation.

Table 7. Practitioner/practice demographics according to whether patients accepted surgery recommendation

	ALL (N=129)		Accepted (N=78; 60%)		
Practitioner demographics	N	Col%	N	Row[3] %	p
Country trained in					0.9
United States	103	80%	62	60%	
Other	26	20%	16	62%	
Gender					0.3
Male	98	76%	62	63%	
Female	31	24%	16	52%	
Race/ethnicity					0.6
White/Caucasian	94	73%	58	62%	
Asian	30	23%	19	63%	
Hispanic	4	3%	1	25%	
missing n=1					
Age enrolled in network					0.9
< 45 years	37	29%	22	59%	
45 - 54 years	35	27%	22	63%	
55 - 64 years	49	38%	29	59%	
65+ years	8	6%	5	62%	
Years since dental degree					0.3
< 10 years	7	5%	2	29%	
10 - 19 years	46	36%	24	52%	
20 - 29 years	39	30%	27	69%	
30+ years	36	28%	24	67%	
Type of practice					0.4
Solo, private practice	66	52%	41	62%	
Owner, non-solo private practice	24	19%	11	46%	
Associate/employee private practice	4	3%	1	25%	
Preferred provider practice	6	5%	3	50%	
Academic	26	21%	20	77%	
Region					NE*
Western	67	52%	37	55%	
Midwest	14	11%	8	57%	
Southwest	15	12%	10	67%	
South Central	10	8%	10	100%	
South Atlantic	10	8%	5	50%	
Northeast	13	10%	8	62%	

*NE = non-estimable

Table 8. Frequency with which a practitioner prescribes treatment modalities according to whether patients accepted surgery recommendation

	ALL (N=129)		Accepted (N=78; 60%)		
Treatment Modality and Frequency	N	Col%	N	Row[3] %	p
Clear aligners - often					0.9
Yes	51	40%	31	61%	
No	78	60%	47	60%	
TADs - often					0.98
Yes	13	10%	8	62%	
No	116	90%	70	60%	
Extraction - often					0.07
Yes	31	24%	23	74%	
No	98	76%	55	56%	
Jaw surgery - often					0.07
Yes	19	15%	15	79%	
No	110	85%	63	57%	

Acceptance of surgical treatment plan according to patient demographics

Acceptance rate of an orthognathic surgical treatment plan was also examined with respect to patient demographics (Table 9). The patient demographics used to evaluate overall treatment acceptance was also assessed for the surgery subgroup. 37 male patients were recommended a treatment plan including surgery, and 26 (70%) accepted this plan. 92 female patients were also given surgery as the most recommended plan, but only 52 (56%) accepted. Univariate analysis yielded a significant p-value of 0.03 for gender.

Patients were also surveyed for dental and medical insurance and their effect on acceptance of surgical treatment recommendations. Insurance was a significant factor in determining surgical treatment plan acceptance rate (p=0.015). When this data was looked at dichotomously, i.e., coverage of orthognathic surgery versus no coverage of orthognathic surgery, the p-value was also significant at 0.002.

Table 9. Patient demographics according to whether patients accepted surgery recommendation

	ALL (N=129)		Accepted (N=78, 60%)			
Patient demographics	N	Col %	N	Row[3] %	p	
Gender					0.03	
Male	37	29%	26	70%		
Female	92	71%	52	56%		
Age (years)					0.4	
18-20 years	27	21%	19	70%		
21-30 years	58	45%	33	57%		
31-40 years	21	16%	12	57%		
41 and older	23	18%	14	61%		
Race					0.6	
White/Caucasian	92	71%	59	64%		
Black/African-American	9	7%	6	67%		
Asian	7	5%	4	57%		
Multi, other	4	3%	3	75%		
Hispanic ethnicity	17	13%	6	35%		
Dental or medical insurance					**0.015**	
None	18	14%	9	50%		
Yes - not cover ortho or Og surgery	28	22%	14	50%		
Yes - covers ortho, but not Og surgery	24	19%	9	38%		
Yes - covers Og surgery	59	46%	46	78%	**0.002**	***IF DICHOTOMOUS**
Education level: Bachelor's degree or higher					0.3	
High school/GED or less	25	19%	12	48%		
Some college/AD	41	32%	28	68%		
Bachelor's degree	42	33%	24	57%		
Graduate degree	21	16%	14	67%		
Prior orthodontic treatment					0.2	
No	77	60%	40	52%		
Yes	51	40%	37	73%		
missing n=1						

History of prior orthodontic treatment in patients offered surgery

51 of the patients recommended to have orthognathic surgery reported having prior orthodontic treatment. Information regarding past treatment is descriptive and is summarized in Table 10. Nine patients had extractions in the maxillary arch, and eight had extractions in the mandibular arch. One patient underwent maxillary jaw surgery and one patient underwent mandibular jaw surgery. One patient indicated having TAD mini-screws, and one reported having TAD mini-plates. Five patients had a tongue or thumb crib. Three reported utilizing speech or myofunctional therapy. When asked if correction of the open bite was a goal of previous treatment, 16 patients said yes, 22 said no, and 13 indicated that they did not know. Prior orthodontic treatment was not found to be a significant predictor of acceptance when the most highly recommended plan included orthognathic surgery.

Table 10. History of prior orthodontic treatment in patients offered orthognathic surgery

	Patients with previous orthodontic treatment (N=51)	
Prior treatment provided	N	Col%
Fixed appliances	48	96%
Clear aligners	0	0%
Maxillary arch extraction(s)	9	18%
Mandibular arch extraction(s)	8	16%
TAD mini-screws	1	2%
TAD mini-plates	1	2%
Jaw surgery (Maxilla)	1	2%
Jaw surgery (Mandible)	1	2%
Tongue or thumb crib	5	10%
Speech or myofunctional therapy	3	6%
Occlusal equilibration	1	2%
Elastics	25	49%
Interproximal reduction	0	0%
Maxillary expansion	14	27%
Headgear	11	22%
Corticotomy (e.g., Wilckodontics)	0	0%
Vibration therapy (e.g., Acceledent)	0	0%
Correction of open bite goal of previous treatment?		
No	22	43%
Yes	16	31%
Don’t know	13	25%

Acceptance of surgical treatment plan according to patient dentofacial characteristics

The dentofacial characteristics of patients who had surgery recommended to them as the most highly recommended treatment plan were evaluated (Table 11). Profile, molar classification, vertical facial pattern, posterior transverse dimension, anterior open bite severity, and habits were assessed and determined to not have a significant influence on patient acceptance of surgery. Arch length deficiency was reported as the severest of either the maxillary or mandibular arch. Arch length was a significant factor displaying a lower rate of acceptance of surgery ($p=0.04$) in univariate analyses. When looked at dichotomously, severe crowding versus less than severe crowding, the p-value was 0.02.

Table 11. Patient dentofacial characteristics according to whether patients accepted surgery

	ALL (N=129)		Accepted (N=78; 60%)			
Patient dentofacial characteristics	N	Col %	N	Row[3] %	p	
Profile					0.4	
Convex	74	57%	45	61%		
Straight	42	33%	23	55%		
Concave	13	10%	10	77%		
Molar class (severest of right/left)					0.2	
I: Half or full cusp	30	23%	18	60%		
II: Half or full cusp	61	47%	34	56%		
III: Half or full cusp	38	29%	26	68%		
Arch length (severest of maxillary or mandibular)					**0.04**	
No crowding	24	19%	15	62%		
Mild crowding (1-3mm)	44	34%	33	75%		
Moderate crowding (4-6mm)	43	33%	24	56%		
Severe crowding (>6mm)	18	14%	6	33%	**0.02**	***IF DICHOTOMOUS**
Posterior crossbite					0.16	
None	49	38%	32	65%		
Unilateral	32	25%	16	50%		
Bilateral	48	37%	30	62%		
Facial pattern					0.6	
High angle	97	76%	58	60%		
Normal	28	22%	18	64%		
Low angle	3	2%	1	33%		
Patient habits						
Tongue thrust					0.9	
No	95	74%	60	63%		
Yes	34	26%	18	53%		
Tongue posture					0.3	
No	101	78%	62	61%		
Yes	28	22%	16	57%		
Digit					0.14	
No	121	94%	76	65%		
Yes	8	6%	2	25%		
Function/biting/bruxing					0.5	
No	122	95%	73	60%		
Yes	7	5%	5	71%		
AOB score 4 to 6					0.2	
No (1-3)	25	19%	13	52%		
Yes (4-6)	104	81%	65	62%		

Multivariate analysis for acceptance rate of treatment plans involving orthognathic surgery

Characteristics with $p<0.10$ after adjusting for clustering were entered into a full model (Table 12). POSI score and vertical facial pattern were kept in the model as a proxy for initial severity. After developing a regression model, the significance of male patients accepting treatment at a higher rate was not retained. The significance of having insurance covering orthognathic surgery was maintained with a p-value of 0.002. Severe crowding also kept its significance with a p-value of 0.006.

Table 12. Multivariate model for factors affecting acceptance rate of treatment plans involving surgery

	Univariable		Full model		Final Reduced Model		
Initial Condition	**OR**	**P**	**OR**	**P**	**OR**	**95% CI**	**P**
Male patient	2.0	0.03	2.0	0.06	X	X	X
Insurance for jaw surgery	2.7	0.002	3.1	0.003	3.4	1.6 - 7.1	0.002
Severe crowding	0.34	0.02	0.22	0.006	0.22	0.09 - 0.51	0.006
High angle vertical facial pattern	1.4	0.4	1.3	0.6	1.2	0.5 - 2.5	0.7
POSI score of 4-6	1.7	0.2	1.1	0.5	1.2	0.5 -3.3	0.7

Reasons for seeking orthodontic treatment in patients offered orthognathic surgery

When enrolling patients, practitioners recorded patient's main reason for seeking orthodontic treatment (Table 13). For 85 patients in the group offered surgery, anterior open bite correction was their most important reason for seeking treatment. Crowding or crooked teeth was indicated by 24 people as the primary reason. Fewer patients chose overjet, underbite, crossbite, function/bite/bruxing, protrusion, and TMJ as main reasons for treatment.

Practitioners also indicated additional reasons their patients had for seeking orthodontic treatment (Table 13). They were able to select multiple answers for this prompt, including anterior open bite, crowding or crooked teeth, overjet, underbite, crossbite, esthetics, function/bite/bruxing, habit, missing/impacted tooth, periodontal concerns, spacing, speech, TMJ, airway, or other.

Table 13. Reasons for seeking orthodontic treatment in patients recommended to have orthognathic surgery (Recorded by practitioners, descriptive)

	ALL (N=129)	
Reasons	N	Col %
Most important reason for treatment		
Anterior open bite	85	66%
Crowding or crooked teeth	24	19%
Overjet	2	2%
Underbite	5	4%
Crossbite	1	1%
Function/bite/bruxing	8	6%
Protrusion	1	1%
TMJ	2	2%
Other	1	1%
Other reasons for orthodontic treatment		
Anterior open bite	48	37%
Crowding or crooked teeth	48	37%
Overjet	17	13%
Underbite	15	12%
Crossbite	25	19%
Esthetics	9	7%
Function/bite/bruxing	13	10%
Habit	1	1%
Missing/Impacted tooth	4	3%
Periodontal concerns	2	2%
Spacing	4	3%
Speech	1	1%
TMJ	15	12%
Airway	5	4%
Other reason	4	3%
No other reason	13	10%

Patients and practitioners were asked on their individual forms if fixing open bite was a specific treatment goal. Practitioners said "Yes" for 128 patients and "No" for one (Table 12). However, on the forms that patients filled out themselves, 126 patients said "Yes" and three said "No."

In addition to the patient's reasons for seeking care, the practitioners outlined other goals of orthodontic treatment (Table 14). The providers were allowed to select all goals that were applicable. Options included were alignment of teeth, anterior-posterior correction of posterior teeth, transverse correction of posterior teeth, overjet correction, underbite correction, profile correction, breathing/airway, esthetics, function/bite/bruxing, habits, pre-restorative, protrusion, spacing, TMJ, or other.

Patients also responded to a prompt, "Has your anterior open bite caused any of the following problems?" (Table 15). 98 patients said they were unable to bite food with their front teeth. For 45 people, inability to speak clearly was a concern. 83 patients indicated that they had problems with the fit or function of their bite. Jaw joint problems were a concern for 70 patients. 62 of people said they were embarrassed about the appearance of their teeth. "Other" was selected by seven patients, and "none" was selected by six patients.

Table 14. Goals of orthodontic treatment in patients recommended to have orthognathic surgery (Recorded by practitioners, descriptive)

	ALL (N=129)	
Goals	N	Col %
Fixing open bite a specific treatment goal?		
No	1	1%
Yes	128	99%
Other goals of treatment		
Alignment of teeth	113	88%
Anterior-posterior correction of posterior teeth	80	62%
Transverse correction of posterior teeth	77	60%
Overjet correction	68	53%
Underbite correction	30	23%
Profile correction	63	49%
Breathing/Airway	7	5%
Esthetics	4	3%
Function/bite/bruxing	6	5%
Habits	1	1%
Pre-Restorative	3	2%
Protrusion	0	0%
Spacing	3	2%
TMJ	9	7%
Other	7	5%
No other goal	2	2%

Table 15. Reported problems associated with anterior open bite in patients recommended to have orthognathic surgery (Recorded by patients, descriptive)

	ALL (N=129)	
Problems associated with anterior open bite	N	Col %
Unable to bite food with your front teeth	98	76%
Unable to speak clearly	45	35%
Problems with the fit or function of your bite	83	64%
Problems with your jaw joint	70	54%
Embarrassment about appearance of teeth	62	48%
Other	7	5%
None	6	5%

Other treatments recommended to patients in addition to surgery and their acceptance rate

Treatments recommended along with orthognathic surgery were also examined (Table 16). There was no significant difference between the acceptance rates of surgery for maxilla only, mandible only, or two-jaw surgery. With orthognathic surgery, patients could have fixed appliances or clear aligners. Neither of these options had a significant influence on treatment acceptance.

The recommended treatment plan also included extractions for 27 of the patients recommended to have orthognathic surgery. Regardless of extractions being in the upper arch, lower arch, or both, there was no significant difference in acceptance rate. Expansion, speech or myofunctional therapy, occlusal equilibration, and interproximal reduction were also included in the treatment plans for these patients but were non-significant.

Evaluation of other treatments included in the plans along with surgery is descriptive, as the numbers are too low to perform statistical analyses. TAD mini-screws were offered to two patients. A tongue or thumb crib was offered to six patients. Gum surgery techniques (i.e., Wilckodontics) were offered to two patients. Vibration therapy (i.e., Acceledent) was offered to one person. “Other” was indicated as an additional procedure for seven patients.

16. Other treatments recommended to patients in addition to surgery and their acceptance rate.

	ALL (N=129)		**Accepted** (N=78, 60%)		
Treatments Recommended	N	Col %	N	Row[3] %	p
<u>Primary treatments recommended</u>					
Jaw surgery					0.09
Maxillary only	40	31%	19	48%	
Mandibular only	16	12%	12	75%	
Both	73	57%	47	64%	
Either - the study population	129	100%	78	60%	
Extractions					0.5
None	102	79%	65	64%	
Maxillary only	2	5%	1	50%	
Mandibular only	6	2%	2	33%	
Both	19	15%	10	53%	
Either (vs none)	27	21%	13	48%	0.6
Fixed appliances	122	95%	73	60%	0.2
Clear aligners	9	7%	6	67%	0.14
TAD mini-screws	2	2%			
TAD mini-plates	0	0%			
TADS - either	2	2%			
<u>Additional procedures recommended</u>					
Speech or myofunctional therapy	28	22%	18	64%	0.99
Occlusal equilibration	19	15%	15	79%	0.3
Rubber bands (elastics)	77	60%	55	71%	0.006
Interproximal reduction	18	14%	14	78%	0.2
Expander	28	22%	13	46%	0.3
Descriptive - too small for statistics					
Tongue or thumb crib	6	5%			
Headgear	0	0%			
Gum surgery techniques (e.g., Wilckodontics)	2	2%			
Vibration therapy (e.g., Acceledent)	1	1%			
Other	7	5%			

Reasons for not accepting most highly recommended plan of surgery

Out of the 129 patients whose most recommended plan involved orthognathic surgery, 51 did not accept their most recommended option. Analysis of the survey responses for reasons patients did not accept the most recommended treatment plan is descriptive due to the small size of the group (Table 17). 45 members of this group indicated that they did not accept their practitioner's most recommended plan because they did not want surgery. 30 of these patients said that they felt treatment was too invasive or too risky. The third most common reason, chosen by 22 people, for not accepting the most recommended plan of surgery was cost of treatment. Two patients said that they did not want extractions, one indicated that treatment time was too long, and three checked "other."

Table 17. Reasons for not accepting the most recommended plan including orthognathic surgery (descriptive)

	Patients declining surgery (N=51)	
Reasons for not accepting treatment plan	N	Col %
Did not want jaw surgery	45	88%
Treatment too invasive or too risky	30	59%
Treatment too costly	22	43%
Other	3	6%
Did not want extractions	2	4%
Treatment time too long	1	2%

Of the patients recommended to have orthognathic surgery, 18 had severe crowding, and 6 of this group accepted surgery as a treatment option. Reasons for not accepting the most recommended treatment plan were evaluated for the 12 that declined surgery (Table 18). All of these patients indicated that they did not want jaw surgery. Six patients said it was too risky, and four said it was too costly. One patient in this group indicated that treatment would be too long. None of the patients said that it was because they did not want extractions.

Five of these patients were recommended surgery and extractions initially, and three still accepted a plan with extractions. For the remaining two in this group, one was not given an alternative that included extractions. The other patient was given a second option which included clear aligners and IPR, which they ended up selecting. The third most recommended plan presented by the provider included extractions. Three patients did not have extractions included in the most recommended plan along with surgery, but accepted a second option with extractions. Four of these patients with severe crowding were never presented with extractions as a first, second, or third option. Ultimately, six out of the 12 patients with severe crowding declining the most recommended plan including surgery had treatment with extractions.

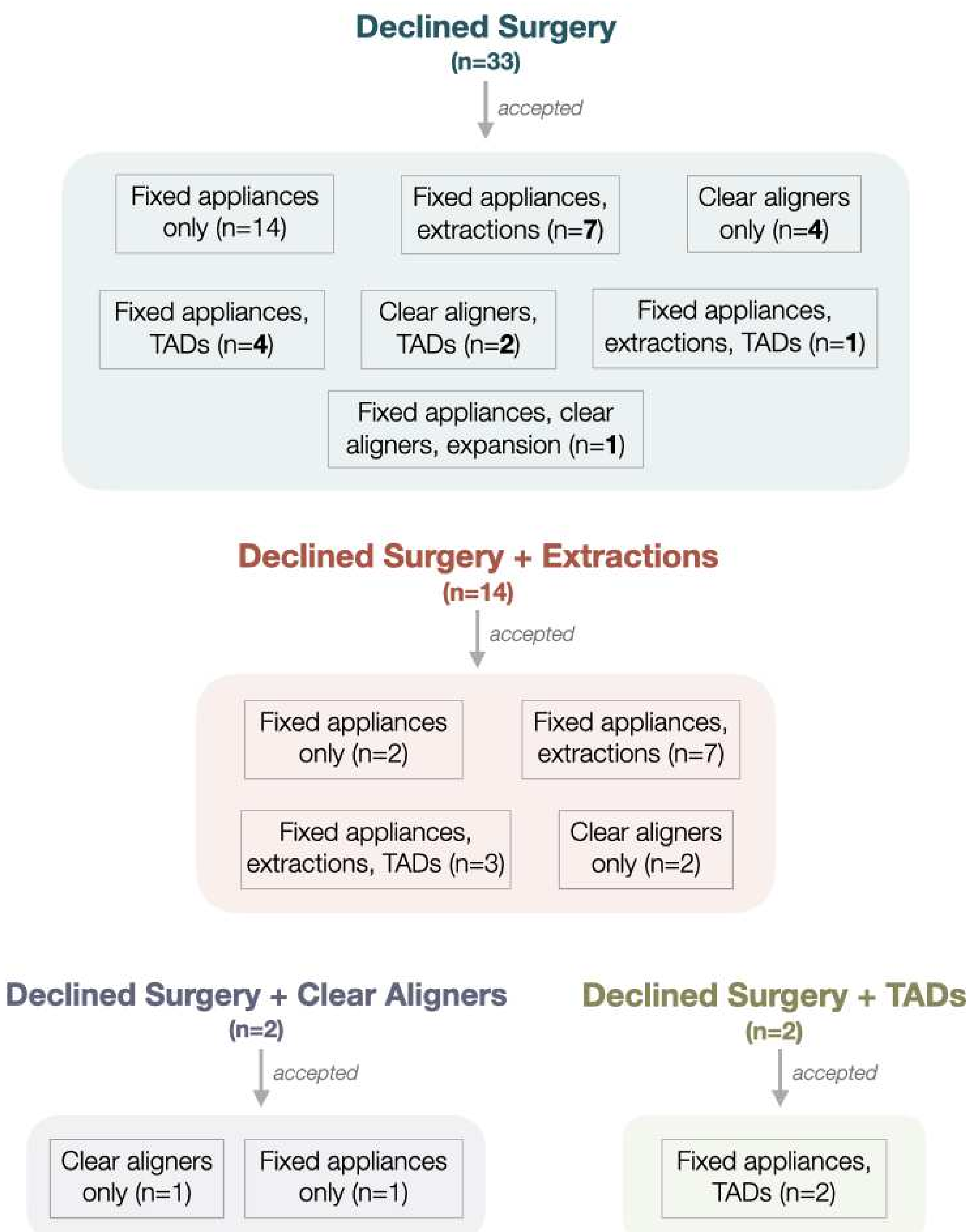
Table 18. Reasons for not accepting the ideal plan including orthognathic surgery for patients with severe crowding (descriptive)

	Patients with severe crowding, denying surgery (N=12)	
Reasons for not accepting treatment plan	N	Col %
Treatment too invasive or too risky	6	50%
Treatment too costly	4	33%
Did not want extractions	0	0%
Did not want jaw surgery	12	100%
Treatment time too long	1	1%
Other	0	0%

Treatment plans accepted by patients declining the most recommended plan of surgery

The 51 patients declining surgery were looked at individually to see the exact plan declined and what they chose instead. Subgroups were then created (Table 19). For the 33 patients declining a plan of surgery with fixed appliances, most opted for treatment with just fixed appliances or fixed appliances and extractions. 14 patients declined a plan of surgery and extractions, and eight of them opted for fixed appliances and extractions. For the two patients who declined a surgery with a clear aligner option, one chose clear aligners only and the other chose fixed appliances only. The two patients who declined to have surgery and TADs opted for a plan with fixed appliances and TADs.

Table 19. Treatment plans accepted by patients declining orthognathic surgery



Chapter 4: Discussion

In this study, dentofacial characteristics and practitioner and patient demographics were examined to determine if any associations with treatment plan acceptance exist. There is currently no literature that demonstrates trends for acceptance of recommended plans as prescribed by an orthodontist, especially for treating anterior open bite malocclusions. Overall, acceptance rates for clear aligner therapy and fixed appliances were high. Acceptance rates decreased as proposed treatments became more invasive, i.e. TADs and orthognathic surgery. For patients declining clear aligner therapy, cost of treatment was specified as the reason why. We can assume that if patients are offered Invisalign, they will accept it if they can afford it. Patients declined treatment plans with fixed appliances if they were concerned about esthetics and did not want braces. Those declining treatment plans involving TADs most often indicated invasiveness and riskiness of treatment, as well as cost, as reasons for refusal of the presented plan.

Past studies on patient satisfaction and provider preference hint that gender, age, race, and education may influence a patient's relationship with their doctor. Therefore, associations were expected amongst practitioner and patient demographics and rate of treatment plan acceptance. Surprisingly, no significant association was found between practitioner demographics and the likelihood of a patient accepting the proposed treatment. Studies have shown that patients may have a preference for locally trained providers and dentists with more experience (Swami 2011), but there were no differences in treatment plan acceptance rate for country of training or years since dental degree. While research has illustrated patient preference for either male or female providers for various reasons (Smith 2008), no significant differences in acceptance of treatment plans based on provider gender were found. For the most part, patients have options when it comes to selecting an orthodontist. When choosing to begin care at a particular office, the adult patients in our study may have already selected practitioners along the preferences they may have regarding practitioner demographics. This could explain why no practitioner demographics seemed to significantly influence a patient's likelihood of accepting their provider's most recommended treatment plan.

Similarly, most patient demographic features proved to be non-significant for determining whether or not a patient will accept the most highly recommended plan for the treatment of open bite. Patient age can influence provider choice (Phillips 1997), yet it did not have a significant impact on rate of treatment plan acceptance in our study. It may be true that a patient's age and generation may guide their selection of orthodontist, however patients already had the opportunity to choose their provider based personal preference before enrolling in this study. Therefore, those preferences may not be reflected in whether or not a patient chooses their provider's most recommended plan. Male and female patients may have different reasons for seeking treatment (Kiyak 1981) and different levels of satisfaction following treatment (Finkleman 2019), but no significant differences in treatment plan acceptance rates were found based on patient gender.

Patients with higher levels of education were previously found to have an increased likelihood of dissatisfaction with orthodontic treatment for anterior open bite (Finkleman 2019). A study reviewing provider-patient relationships found that patients with Bachelors degrees were more satisfied with the communication between themselves and their doctor (Mcfarland 2014). Conversely, this research illuminated potential issues regarding communication between doctors and patients who are less educated, elderly, or of a minority background. Despite these trends, patient age, gender, education level, and race/ethnicity were not found to have a significant effect on treatment plan acceptance rate.

A significant association was found for prior orthodontic treatment. Among the entire patient population, those who had previous orthodontic treatment (83% rate of acceptance) were more likely to accept the treatments recommended than those who did not have prior orthodontic treatment (75% rate of acceptance). Patients with a history of past treatment may want to ensure that their second round of orthodontics is successful. Therefore, they agree to their provider's choice of treatment at a higher rate, even if the recommended plan may be more invasive or costly.

Patient dentofacial characteristics were evaluated, as one may assume that patients with more severe presentations and malocclusions are more likely to go with the orthodontist's most recommended plan. However, a majority of the surveyed characteristics were not significant determinates for likelihood of treatment plan acceptance. Through multivariate analysis, concave profile was the only characteristic that was significant. Concave profiles may not be considered esthetically desirable. These patients may be more aware of their appearance and seek out treatment to improve it. Additionally, patients who have a Class III molar relationship with an open bite may be more likely to accept surgery, as Class III malocclusions often require surgical correction in adults. However, neither concave profile or Class III molar relationship in patients who were recommended plans including surgery satisfied our p-value requirement to be included in multivariate modeling. This could be due to the small sample size of surgery patients.

Patients who were offered orthognathic surgery as the ideal treatment option to treat their open bite malocclusion were examined more critically for any possible associations with treatment acceptance rates. Again, we found no practitioner demographics to be significant in determining whether a patient was more likely to accept or decline a plan. When examining patient demographics, presence of dental or medical insurance was a significant factor. Patients with insurance that covered orthognathic surgery were more likely to accept the surgical treatment plan compared to those with no insurance, insurance not covering orthodontics or surgery, and insurance covering orthodontics, but not surgery. When orthognathic surgery is involved, procedures can cost tens of thousands of dollars. It is not surprising that patients are more likely to accept this plan if it is covered by their insurance. Like overall treatment, we expected a history of prior orthodontic treatment to be a factor for accepting the most recommended plan in this group of patients. However, no significance was found. Again, this could be due to the issue of the reduced sample size of patients recommended to have surgery.

Arch length deficiency was also a significant dentofacial characteristic influencing the acceptance of treatment for the subgroup offered surgery. If a patient had severe crowding, they were less likely to accept the orthognathic surgery plan when compared to a patient that had no, mild, or moderate crowding. The lower acceptance of surgical-orthodontic treatment for patients with severe crowding might be explained by a secondary plan for premolar extractions only. Practitioners may believe that an open bite may close without surgery due to the assumed bite deepening effect of space closure. If extractions were presented as a second option, an alternative to surgery, patients might have agreed to this plan, as it is less risky than orthognathic surgery. This idea remains speculation, since extractions were not found to be significantly associated with treatment acceptance.

To explore this concept, the subset of patients with severe arch length deficiency who were recommended surgery was further examined. Out of the 18 patients with severe crowding, six accepted surgery. All six patients had a high angle vertical facial pattern and a POSI score of

4-6, so we can assume that the severity of their malocclusion may have influenced the decision of the practitioner to recommend surgery and the patient to accept it. In the group of 12 that declined surgery, 11 were high angle and 8 had a POSI score of 4-6. Of the four patients with a POSI score of 1-3, only one patient was offered extractions as an alternative treatment. The other three never had extractions as part of their treatment plan. This could be because their practitioner felt that the anterior open bite was not severe enough to justify extractions for a bite deepening effect to help obtain overbite. Of the six patients with severe crowding that were not treated with extractions, five were not given extractions as an alternative option. We are unable to determine if they would have chosen a treatment plan with extractions instead of surgery if they were presented with the option. The 12 patients provided reasons for not accepting the plan. Reasons included not wanting jaw surgery, or that the plan was too risky or too costly. Even though "did not want extractions" was an option, none of these patients selected it. Seven patients were given an alternative treatment option to surgery which included extractions, and six of them were ultimately treated with extractions. This pattern follows the overall trend of patients choosing a less invasive treatment if one is available.

For patients who declined a surgical treatment plan, 88% indicated that they did not want jaw surgery. The next two most selected reasons for not accepting the most recommended plan were "treatment too invasive or too risky" and "treatment too costly." These results are not surprising given the nature of orthognathic surgery. Morbidity and insurance coverage are clearly very important considerations for patients. Surgery is expensive, especially when both jaws are involved, and patients may not have the finances to pay for such treatment without insurance.

When patients declined a treatment plan involving orthognathic surgery, we looked at the actual plan that was chosen for these 51 individuals. Most of these patients had non-surgical treatment with fixed appliances. Having extractions instead of surgery or maintaining an extraction plan, but declining the surgical portion of it, were the next most popular second options.

Six patients declined TADs, with most of them citing risk of treatment as the reason why. In general, these patients accepted a treatment plan similar to the initial one but without the use of TADs. One patient opted for maxillary extractions and one chose a plan with a tongue crib. The three patients declining an extraction treatment plan had non extraction plans with fixed appliances. One of these patients also added a tongue-crib and speech therapy to their treatment. Ten patients declined plans utilizing fixed appliances, and each said they did not want braces or were concerned about esthetics. Unsurprisingly, all these patients opted for clear aligner therapy. Two patients declined clear aligners, both citing cost as the reason why. They chose plans with fixed appliances. Three patients were placed into a category of "declining other," as the aspects of treatment they did not want were not part of the main categories. These individuals declined corticotomy, glossectomy, and implants. The patient declining corticotomy selected a plan utilizing clear aligners and Propel osteoperforation. The others maintained the remainder of the initial treatment plan.

While 21 patients did not accept an initial plan that included extractions, it may not have been the extraction component that they were declining. One patient wanted to modify which teeth were being extracted. One patient did not want treatment with clear aligners and extractions, but chose to have fixed appliances and extractions. Two patients were recommended to have fixed appliances and extractions, but they wanted clear aligners and extractions. 14 patients were recommended to have orthognathic surgery along with extractions. Ten of these patients still had extractions included in their selected treatment plan, but declined to have surgery. Of the four remaining patients in the surgery category, three did not want surgery and were given an alternative plan that did not include surgery or extractions. Therefore, they did not have the option to choose extractions as an alternative. While it may look like they also declined extractions in addition to surgery because it was included in the initial plan, none of these three patients selected “did not want extractions” as their reason for declining the most recommended treatment. The remaining patient who was recommended to have surgery and extractions was given a second option which just included fixed appliances and extractions. They declined this option as well and went with the third treatment plan which only included fixed appliances. The provider of this patient entered a note saying “patient was pleased with result during treatment and did not want extractions.” Three patients were identified that had been recommended fixed appliances and extractions and were not included in any other treatment modality group. Ultimately, these three were only patients that specifically stated that they declined the most recommended treatment plan because they did not want extractions.

During initial categorization of patients, there was a strict separation between patients accepting the first plan offered and those accepting the second or third option. Upon closer examination of the individuals declining the initial plan, three patients were identified who actually accepted the initial plan but added modifications. One patient wanted second premolars extracted instead of first premolars, as they did not want the extraction space to be obvious. While this patient wanted a different option for teeth to be extracted, they still accepted an extraction treatment plan. Two of these patients were concerned about length of treatment as they had a wedding coming up. One added Acceledent to their plan, and the other added clear aligners in addition to fixed appliances. These three patients were included in the group that accepted treatment for statistical analyses.

Previous studies emphasize the value patients place on communication, stating that explanations before and throughout treatment help to make patients feel like they are involved in their own care (Wong 2018). The patients in this study had a 96% satisfaction rate, when considering the treatment provided, as well as esthetic and functional results (Finkleman 2019). With 98% of the patients stating they would recommend the treatment they received to a friend, it can be concluded that even though patients may not have always accepted the most recommended plan by their orthodontist, they were able to work with their provider to establish a treatment that worked for them.

Strengths

A strength of this study is that it is one of the largest samples ever collected across the United States for evaluating open bite treatment in non-growing patients. The large number of patients and practitioners included in this study makes the results generalizable. Therefore, it is fairly reasonable to think that these outcomes could be expected in a general orthodontic practice.

Limitations

Patient acceptance of treatment plans is multifactorial. There could be reasons for acceptance or declination that are unable to be elucidated by the questions included in the practitioner and patient surveys. Each patient has a unique background, dental history, and set of values that may contribute to their decision making.

Practitioners enrolled in this study are members of the National Dental Practice-Based Research Network. Their participation in this organization, as well as this study, may indicate that they are of a certain demographic and employ a method of practice that may not be wholly representative of orthodontists and general dentists practicing orthodontics across the United States. For example, most practitioners enrolled this study are male, white, and solo owners of a private practice.

Patients were asked to participate in this study by the practitioners and/or their office personnel. This may introduce bias in several ways. The manner in which patients were approached (in person versus phone call, and provider versus staff) may have influenced desire to enroll. Patients wanting to participate in a research study may tend to be more compliant or answer questionnaires in a different manner. For example, they may answer to please the practitioner or give the study a positive outcome. Additionally, practitioners were told to prioritize enrolling patients with less time in treatment remaining. Patients nearing the end of treatment may have different attitudes from those who have yet to start or have just begun. Also, treatment may be progressing in a timely manner for those patients who are more compliant. However, selecting patients to enroll in the study before treatment ended helped to prevent selection bias based on final results.

Another limitation to this study is that patients could be enrolled after they already started treatment. The practitioner and patient enrollment visit forms may contain errors and be subject to recall bias, as it may have been months since treatment plans and patient desires and goals were discussed.

Chapter 5: Conclusions

This research was conducted to evaluate practitioner and patient demographics and dentofacial characteristics for any associations with treatment plan acceptance rates. Doctors participating in the National Dental Practice-Based Research Network enrolled themselves and their open bite patients in this study. Surveys given to practitioners and patients served to collect relevant information. The data received was then analyzed, and the following conclusions were made:

1. In general, it was observed that treatment plan acceptance decreased with increasing invasiveness of treatment modality.
2. History of prior orthodontic treatment was a significant predictor of a patient's likelihood to accept the most recommended treatment plan.
3. Patients with a concave profile are more likely to accept the most recommended treatment plan.
4. Patients with insurance covering orthognathic surgery were significantly more likely to accept the orthognathic surgery treatment plan compared to those with no insurance, or insurance that did not cover surgery.
5. Patients with severe crowding (>6mm) were significantly less likely to accept an orthognathic surgery treatment plan, which may be explained by the availability of a less invasive alternative plan including extractions.
6. The most common reasons for not accepting the most highly recommended treatment plan included concerns about safety of the procedure and cost.

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Table 1. Patients declining surgery

Patient	Most Recommended	2nd Option	3rd Option	Reason
13198H0001	- Fixed appliances - Maxillary surgery - Mandibular surgery - Maxillary expansion	**- Fixed appliances - Mn extractions - Elastics - Maxillary expansion**		- Too costly - Did not want surgery
13198H0002	- Fixed appliances - Maxillary surgery - Maxillary expansion	**- Fixed appliances - Mn extractions - Maxillary expansion**		- Too risky - Too costly - Did not want surgery
14763H0002	- Fixed appliances - Maxillary surgery - Mandibular surgery	**- Fixed appliances - Mx extractions - Mn extractions**		- Did not want surgery
19102H0003	- Fixed appliances - Maxillary surgery - Mandibular surgery	**- Fixed appliances - Elastics**		- Too risky - Too costly
19157H0005	- Fixed appliances - Maxillary surgery - Elastics	**- Fixed appliances - Elastics**		- Too risky - Too costly - Did not want surgery
19318H0001	- Fixed appliances - TADs (screws) - Mandibular surgery - Tongue crib - Occlusal equilibration	**- Fixed appliances - TADs (screws) - Tongue crib - Elastics**		- Too risky - Too costly - Did not want surgery
19351H0002	- Fixed appliances - Maxillary surgery - Mandibular surgery - Elastics	**- Fixed appliances - Elastics**		- Too risky - Did not want surgery
19351H0003	- Fixed appliances - Maxillary surgery - Mandibular surgery	**- Fixed appliances**		- Did not want surgery
19427H0004	- Fixed appliances - Maxillary surgery - Mandibular surgery - Speech therapy - Elastics - IPR - Maxillary expansion	**- Fixed appliances - Mx extractions - Speech therapy - Elastics - IPR - Maxillary expansion**		- Too risky - Did not want surgery

Patient	Most Recommended	2nd Option	3rd Option	Reason
19427H0006	- Fixed appliances - Maxillary surgery - Mandibular surgery - Speech therapy - Elastics - IPR	**- Fixed appliances** **- Speech therapy** **- Elastics** **- IPR**		- Too risky - Too costly - Did not want surgery
19427H0008	- Fixed appliances - Maxillary surgery - Mandibular surgery - Speech therapy - Elastics - IPR - Maxillary expansion	**- Fixed appliances** **- Speech therapy** **- Elastics** **- IPR** **- Maxillary expansion**		- Too risky
19433H0001	- Fixed appliances - Mx extractions - Mn extractions - Maxillary surgery - Mandibular surgery - Elastics	**- Fixed appliances** **- Mx extractions** **- Mn extractions** **- Elastics**		- Too risky - Too costly - Did not want surgery
19449H0003	- Fixed appliances - Maxillary surgery	**- Fixed appliances** **- Elastics**		- Too costly - “Separating from army- surgical services not available”
19506H0003	- Fixed appliances - Maxillary surgery - Mandibular surgery - Elastics	**- Fixed appliances** **- Mn extractions** **- Elastics**		- Did not want surgery
19517H0002	- Fixed appliances - Maxillary surgery - Mandibular surgery	**- Fixed appliances** **- Mx extractions** **- Mn extractions** **- TADs (screws)** **- Elastics**		- Did not want surgery
19526H0004	- Fixed appliances - Maxillary surgery - Speech therapy - Maxillary expansion	**- Fixed appliances** **- Speech therapy** **- Elastics**		- Too risky - Too costly - Did not want surgery
19549H0008	- Fixed appliances - Maxillary surgery	**- Fixed appliances** **- Elastics**		- Did not want surgery
19549H0011	- Fixed appliances - Mn extractions - Mandibular surgery - Elastics	**- Fixed appliances** **- Mx extractions** **- Elastics**		- Too risky - Too costly - Did not want surgery

Patient	Most Recommended	2nd Option	3rd Option	Reason
19573H0001	- Fixed appliances - Maxillary surgery - Speech therapy	**- Fixed appliances - TADs (screws)**		- Too risky - Too costly - Did not want surgery
19644H0001	- Fixed appliances - Mn extractions - Maxillary surgery - Mandibular surgery - Tongue crib - Maxillary expansion	**- Fixed appliances - Elastics**		- Did not want surgery
19663H0002	- Fixed appliances - Mx extractions - Mn extractions - Maxillary surgery - Elastics	**- Clear aligners - Elastics - IPR - Vibration**		- Did not want surgery
19678H0007	- Fixed appliances - Mn extractions - Maxillary surgery - Mandibular surgery	**- Fixed appliances - Mx extractions - Mn extractions - TADs (screws)**		- Did not want surgery
19734H0004	- Fixed appliances - Clear aligners - Maxillary surgery - Mandibular surgery	**- Clear aligners**		- Too risky - Too costly - Did not want surgery
19767H0002	- Fixed appliances - Mx extractions - Mn extractions - Maxillary surgery - Tongue crib	**- Fixed appliances - Mn extractions - TADs (screws) - Tongue crib - Elastics - Maxillary expansion**		- Too risky - Too costly - Did not want surgery
13172H0001	- Fixed appliances - Maxillary surgery - Mandibular surgery	**- Fixed appliances - TADs (screws) - TADs (plates) - Elastics - IPR**	- Clear aligners	- Did not want surgery
17281H0001	- Fixed appliances - Maxillary surgery - Elastics	**- Fixed appliances - Elastics**	- Fixed appliances - Mx extractions - Mn extractions - Elastics	- Too risky - Too costly - Did not want surgery - Did not want extractions
17281H0005	- Fixed appliances - Maxillary surgery - Elastics	**- Fixed appliances - Mx extractions - Mn extractions - Elastics**	- Fixed appliances - Elastics	- Too risky - Too costly - Did not want surgery

Patient	Most Recommended	2nd Option	3rd Option	Reason
19113H0002	- Fixed appliances - Mx extractions - Mn extractions, maxillary surgery - IPR	**- Fixed appliances** **- Mx extractions** **- Mn extractions** **- Elastics** **- "Right forsus as needed for Class II"**	- Fixed appliances - Mx extractions - Mn extractions - TADs (screws) - Elastics - IPR	- Too risky - Too costly - Did not want surgery
19113H0003	Fixed appliances, Mn extractions, maxillary surgery	**Fixed appliances, Mn extractions, TADs (screws)**	Fixed appliances, Mn extractions	- Too risky - Too costly - Did not want surgery
19234H0001	Fixed appliances, maxillary surgery, maxillary expansion	Clear aligners, vibration	**Clear aligners**	- Too risky - "Openbite and crossbite were not as important to correct for patient"
19234H0003	Fixed appliances, Mx extractions, maxillary surgery, mandibular surgery	**Fixed appliances, Mx extractions, elastics**	Fixed appliances, elastics	- Too risky - Did not want surgery
19329H0002	- Fixed appliances - Maxillary surgery	**- Fixed appliances** **- Elastics** **- IPR**	Clear aligners, IPR	- Too risky - Did not want surgery
19387H0002	Fixed appliances, Mx extractions, Mn extractions, maxillary surgery, mandibular surgery, tongue crib, occlusal equilibration, elastics, maxillary expansion,	**Fixed appliances, Mx extractions, Mn extractions, tongue crib, occlusal equilibration, elastics, maxillary expansion**	Fixed appliances, Mn extractions	- Too costly - Did not want surgery - "Lost insurance and could not afford surgery"
19468H0003	Fixed appliances, maxillary surgery, mandibular surgery	Clear aligners, elastics, IPR, maxillary expansion	**Fixed appliances + clear aligners, elastics, IPR, maxillary expansion**	- Did not want surgery - Treatment too long - "Getting married, wanted quick esthetic improvement"
19517H0012	- Fixed appliances - Maxillary surgery	Fixed appliances, TADs (screws)	**Clear aligners**	"Wanted clear aligners (esthetics)"
19519H0002	Fixed appliances, maxillary surgery, maxillary expansion	Fixed appliances, Mx extractions, Mn extractions,	**Fixed appliances, "possibility of extractions in the future"**	- Did not want surgery

Patient	Most Recommended	2nd Option	3rd Option	Reason
19534H0001	Fixed appliances, maxillary surgery, mandibular surgery, maxillary expansion	**Fixed appliances, occlusal equilibration, maxillary expansion**	Clear aligners, elastics, maxillary expansion	- Did not want surgery
19549H0001	Fixed appliances, maxillary surgery, elastics, maxillary expansion	**Fixed appliances, TADs (plates), elastics**	Fixed appliances, elastics	- Did not want surgery
19549H0002	Fixed appliances, maxillary surgery, speech therapy, elastics, maxillary expansion	**Fixed appliances, TADs (screws), TADs (plates), speech therapy, elastics, maxillary expansion, "possible extraction of premolars"**	Fixed appliances, speech therapy, elastics, maxillary expansion, "possible extraction of premolars"	- Did not want surgery - "Pt thought that mini-plate/TAD option would provide adequate result"
19549H0005	Fixed appliances, Mx extractions, Mn extractions, maxillary surgery, speech therapy, elastics	Fixed appliances, Mx extractions, Mn extractions, TADs (screws or plates), speech therapy, elastics	**Fixed appliances, speech therapy, elastics**	- Did not want extractions - Did not want surgery - "She was pleased with result during tx and did not want ext"
19549H0007	Fixed appliances, mandibular surgery, elastics, "For Class II correction and sleep apnea as confirmed in sleep study"	**Fixed appliances, elastics, "1 ant bite closure, 2 Class II"**	Fixed appliances, "lower arch only to bring #24 into dentoalveolar ridge"	- Too risky - Did not want surgery
19678H0001	Fixed appliances, Mx extractions, Mn extractions, maxillary surgery	Fixed appliances, Mx extractions, maxillary surgery	**Fixed appliances, Mx extractions, Mn extractions, elastics, maxillary expansion**	- Too costly - Did not want surgery
19718H0001	Fixed appliances + clear aligners, maxillary surgery, speech therapy	Fixed appliances + clear aligners, Mx extractions, Mn extractions, speech therapy, elastics, maxillary expansion	**Clear aligners, speech therapy, elastics, IPR, maxillary expansion, vibration**	- Too risky - Did not want surgery

Patient	Most Recommended	2nd Option	3rd Option	Reason
19718H0002	Fixed appliances, Mx extractions, Mn extractions, maxillary surgery, mandibular surgery, elastics, maxillary expansion	**Clear aligners, elastics, IPR, maxillary expansion**	Fixed appliances + clear aligners, Mx extractions, Mn extractions, elastics, IPR	- Too risky - Did not want surgery
19719H0006	Fixed appliances, maxillary surgery, mandibular surgery, occlusal equilibration, elastics, maxillary expansion	**Fixed appliances, Mn extractions**	Fixed appliances, Mn extractions	- Too risky - Did not want surgery
19734H0001	Fixed appliances, maxillary surgery, mandibular surgery	**Clear aligners, TADs (screws), TADs (plates), occlusal equilibration, elastics, IPR**	Clear aligners, TADs (screws), occlusal equilibration, elastics, IPR	- Too risky - Did not want surgery - "She sought out alternatives to surgery"
19734H0002	Clear aligners, maxillary surgery, mandibular surgery	**Clear aligners, elastics, IPR, maxillary expansion, headgear**	Fixed appliances, TADs (plates)	- Too risky - Did not want surgery
19746H0001	Fixed appliances, Mx extractions, Mn extractions, maxillary surgery, mandibular surgery, elastics	Fixed appliances, Mx extractions, Mn extractions, TADs (screws), elastics	**Fixed appliances, Mx extractions, Mn extractions, elastics**	- Too risky - Too costly - Did not want surgery
19746H0002	Fixed appliances, maxillary surgery, mandibular surgery, elastics	Fixed appliances, TADs (screws), elastics	**Clear aligners, TADs (screws), elastics**	- Did not want surgery - "Did not want braces"
19759H0011	Clear aligners, maxillary surgery, mandibular surgery, speech therapy, occlusal equilibration, elastics, maxillary expansion, vibration	**Fixed appliances**	Fixed appliances, TADs (screws), corticotomy	- Too risky - Too costly - Did not want surgery
14383H0001	Fixed appliances, TADs (screws), speech therapy, elastics, IPR, vibration, surgically assisted RPE	**Fixed appliances, TADs (screws), speech therapy, occlusal equilibration, elastics, IPR, vibration**		- Too risky - Too costly

Table 2. Patients declining TADs

Patient	Most Recommended	2nd Option	3rd Option	Reason
13234H0001	Fixed appliances, TADs (screws), speech therapy	**Fixed appliances, speech therapy**		Too risky
13234H0003	Fixed appliances, TADs (plates), speech therapy, elastics, maxillary expansion	**Fixed appliances, tongue crib, elastics, maxillary expansion**		- Too risky - Other: "Attempt without crib and TAD plates initially"
19230H0004	Clear aligners, TADs (screws)	**Clear aligners**		Too risky
13643H0003	Fixed appliances, TADs (screws), elastics, IPR, vibration	**Clear aligners, elastics, IPR, vibration**	Fixed appliances, Mx extractions, Mn extractions, elastics, IPR, vibration	Too risky
19728H0005	Fixed appliances, TADs (screws)	**Fixed appliances, Mx extractions**	Fixed appliances, headgear	Treatment too long
19230H0002	Clear aligners, TADs (screws), speech therapy, IPR, maxillary expansion, corticotomy	**Fixed appliances, speech therapy, IPR**		Too risky, too costly

Table 3. Patients declining extractions

Patient	Most Recommended	2nd Option	3rd Option	Reason
17281H0009	Fixed appliances, Mx extractions, Mn extractions	**Fixed appliances**		Did not want extractions
19519H0006	Fixed Appliances, Mx extractions, Mn extractions	**Fixed appliances**		- Did not want extractions - "Trial non extraction, start with closing spaces first and then evaluate if extractions are still necessary"
13234H0002	Fixed appliances, Mx extractions, Mn extractions, elastics	Fixed appliances, TADs (plates)	**Fixed appliances, tongue crib, speech therapy, elastics**	- Too risky - Did not want extractions

4. Patients declining fixed appliances

Patient	Most Recommended	2nd Option	3rd Option	Reason
17281H0012	Fixed appliances, elastics	**Clear aligners, elastics**		"Esthetic concerns"
19113H0001	Fixed appliances, Mx extractions, Mn extractions	**Clear aligners, Mx extractions, Mn extractions**		"Did not want fixed appliances"
19532H0002	Fixed appliances, Mx extractions, Mn extractions	**Clear aligners, Mx extractions, Mn extractions**		"Did not want visible braces"
19678H0009	Fixed appliances	**Clear aligners**		"Pt desired clear aligners over conventional appliances due to esthetic reasons entirely"
19836H0001	Fixed appliances, tongue crib, elastics, IPR	**Clear aligners, elastics, IPR**		"Esthetics"
19234H0005	Fixed appliances, elastics	Fixed appliances, Mx extractions, Mn extractions, elastics	**Clear aligners**	"Did not want braces"
19329H0003	Fixed appliances, TADs (screws), elastics, IPR	**Clear aligners, TADs (screws), elastics, IPR, "TADs will only be considered when necessary to intrude posterior teeth"**	Clear aligners, elastics, IPR	"Patient wanted to be treated with Invisalign at the beginning"
19396H0006	Fixed appliances, mandibular surgery, speech therapy, elastics	**Clear aligners, mandibular surgery, speech therapy, elastics**	Clear aligners, speech therapy, elastics	"Chose aligners over fixed appliances, fixed appliances may be needed for the surgical phase"
19719H0001	Fixed appliances, occlusal equilibration, elastics	**Clear aligners**	Clear aligners, maxillary surgery, mandibular surgery	"Wanted clear aligners"
19433H0004	Fixed appliances, TADs (screws), elastics	**Clear aligners, elastics**		"Patient did not want braces again"

5. Patients declining clear aligners

Patient	Most Recommended	2nd Option	3rd Option	Reason
19517H0005	Clear aligners, Mx extractions, Mn extractions	**Fixed appliances, Mx extractions, Mn extractions, TADs (screws), tongue crib, IPR**		Too costly
19715H0001	Clear aligners	**Fixed appliances, elastics**		Too costly

6. Patients declining “other” treatments

Patient	Most Recommended	2nd Option	3rd Option	Reason
19336H0002	Fixed appliances, elastics, IPR, maxillary expansion, corticotomy	**Clear aligners, IPR, maxillary expansion, Propel**		- Too risky - Too costly
19719H0005	Fixed appliances, occlusal equilibration, elastics, glossectomy	**Fixed appliances, occlusal equilibration, elastics**		- Too risky - “Denied glossectomy”
19728H0006	Fixed appliances, elastics, “implant LL6”, “distraction brackets for tongue”	**Fixed appliances, TADs (screws), tongue crib, “distraction brackets for tongue”**		“Did not want implants”

7. Patients accepting initial plan with modification

Patient	Most Recommended	2nd Option	3rd Option	Reason	Patient
19329H0001	Fixed appliances, Mx extractions, Mn extractions, elastics	**Fixed appliances, Mx extractions, Mn extractions, elastics**		Did not want ext, "patient did not want extraction space to be obvious"	Still accepted extractions, just different teeth than in the most recommended plan
19102H0002	Fixed appliances, tongue crib, IPR	**Fixed appliances, tongue crib, IPR, vibration**		Too long, "Added Acceledent for wedding deadline)"	Accepted plan identical to initial plan with addition of vibration due to wedding timeline
19427H0001	Fixed appliances, speech therapy, elastics, IPR, maxillary expansion	**Fixed appliances + clear aligners, speech therapy, elastics, IPR, maxillary expansion**	Fixed appliances, maxillary surgery, mandibular surgery, speech therapy, elastics, IPR, maxillary expansion	Too long, "getting married"	Accepted plan identical to initial plan with addition of aligners due to wedding timeline/ esthetics concerns