

Curriculum Vitae

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Tufts University School of Dental Medicine
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Union College, Schenectady, NY

RESEARCH/PRESENTATIONS

- 2021
Master Thesis Generational Perspectives of Orthodontists in the U.S. and Canada – A
Survey Study
Syed R. Hussain*, Shuying S. Jiang, Dina Sanchez, Mary Anne De Melo,
and Jose A. Bosio
University of Maryland School of Dentistry
- 2019 Shear Bond Strength of RMGI Luting Cements to Indirect Restorations
Syed R. Hussain*, N Epstein, M Finkelman, and G Kugel
Tufts University School of Dental Medicine & SDI Limited
- 2018 Does Disinfecting Extracted Teeth with NaClO Affect Shear Bond Strength?
Syed R. Hussain*, J Daddona, M Finkelman, G Kugel, and S Eisen
Tufts University School of Dental Medicine, Boston, MA
- 2017 Color Stability of Three Restorative Materials – an in vitro study
Syed R. Hussain*, T. Roomian, G Kugel, and S Eisen
Tufts University School of Dental Medicine

INTERNATIONAL EXPERIENCE

- 08/2018 Research travel program to Southern Dental Industries (SDI),
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“Effect of Etching on Shear Bond Strength of GIC with SDF and SDF+KI Pre-
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“Shear Bond Strength of RMGI Luting Cements to Indirect Restorations”
- 07/2018 Dental outreach trip to Zambia
Role: Provide oral health education, prophylaxis, and restorative treatment to
the underserved population of Zambia.
- 01/2012 Dental outreach trip to Cuanacaxtitlan, Mexico
Role: Provided oral health education and assisted a team of licensed dental
providers with hygiene, restorative, and surgical procedures.
- 07/2012 Study abroad in Canada, Denmark, Sweden, and the Netherlands
Role: Student participant in term-abroad program offered by Union College
to study international healthcare systems and do a comparative analysis.

PROFESSIONAL EXPERIENCE

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Dental Dreams, Baltimore, MD
- 04/2018 - 05/2018 UPHAMS Corner Health Center, Dorchester, MA, 02125
Five week Tufts Dental externship
- 04/2018 Student provider at the emergency dental clinic, Tufts University
School of Dental Medicine
- 2013 Dental assistant, Dr. Loffredo DMD Office, Schenectady, NY

TEACHING EXPERIENCE

- 2018-19 Pre-clinic teaching assistant for operative dentistry, TUSDM
2018-19 Pre-doctoral clinic teaching assistant, TUSDM
2018-19 Continuing education (CE) courses teaching assistant, TUSDM
2013-14 AOP/HEOP program tutor for Biology, Union College, Schenectady, NY
2013 STEP program mentor, Kenney Community Center, Schenectady, NY

ACTIVITIES, CLUBS, AND LEADERSHIP

- 2017- 2018 Treasurer, Muslim Student Association, Tufts University School of Dental Medicine.
- 2017 Volunteer, Project Bridge. A student run community service organization at Tufts Dental to provide dental exams, prophylaxis, and restorative procedures to Boston's homeless and runaway youth.
- 2017 Volunteer, Sharewood Project for uninsured population. Conducting oral health cancer screenings, demonstrating proper oral hygiene instructions, applying fluoride varnish, and help in referrals for further dental treatment.

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International Association of Dental Research-IADR
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American Association of Orthodontists-AAO
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2012-13 House Coordinator, Breazzano House, Union College, Schenectady, NY
2012 Volunteer, Schenectady Damien Center, a community center for persons infected with or affected by HIV/AIDS, Schenectady, NY
2012 Volunteer, Habitat for Humanity, Schenectady, NY
2012 Volunteer, Schenectady Inner City Ministry (SICM) food pantry, Schenectady, NY
2009-10 Sales Attendant, Mobil Gas Station, 1351 Central Ave, Albany, NY
2008 Cashier, Citgo Gas Station, 705 Broadway, Albany, NY

ABSTRACT

Generational Perspectives of Orthodontists in the U.S. and Canada– A Survey Study

Syed Rassal Hussain, DMD

Directed by: Dr. Jose A. Bosio, BDS, MS

Objective: To identify differences between generations of orthodontists in the U.S. and Canada and to evaluate the perspective of each generation on widely debated topics in orthodontics.

Materials and Methods: A 22-item IRB approved survey was distributed to orthodontists in the U.S. and Canada. Participants were asked questions about the use of technology, future of clear aligner therapy (CAT), orthodontic education, student debt, marketing, and corporate orthodontics among other topics.

Results: Significant increase in female orthodontists over generations and a decrease in orthodontic educators was found ($P < 0.001$). Among generations, differences were found in regard to their amount of student debt, use of specific diagnostic tools, marketing preferences, and their opinion on the future of CAT.

Conclusions: Clear distinctions exist between different generations of orthodontists. Issues such as increasing student debt load and a decrease in orthodontic educators over generations should be addressed to preserve the future of the orthodontic profession.

Generational Perspectives of Orthodontists in the U.S. and Canada – A Survey Study

by
Syed Rassal Hussain

Thesis submitted to the faculty of the graduate school of the
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LIST OF ABBREVIATIONS

GenX	Generation X
Mi	Millennials
SG	Silent Generation
BB	Baby Boomers
CAT	Clear Aligner Therapy
AAO	American Association of Orthodontists
AAO-PIR.	American Association of Orthodontists Partners in Research
IRB	Institutional Review Board

1. Introduction

It is undeniable that the profession of orthodontics has experienced drastic changes in the last few decades. Therefore, generational perspectives of orthodontists on this transformation may be of interest to orthodontists. This study constructed a web-based questionnaire to highlight and understand the differences in points-of-view of current generations in the orthodontic workforce.

The Pew Research Center defines the age of five current generations in the U.S. based on the individual's birth year: Silent Generation (SG) (1928-1945), Baby Boomers (BB) (1946-1964), Generation X (GenX) (1965-1980), and Millennials (Mi) (1981-1996). Although the post-millennial generation is sometimes referred to as Generation Z, no true agreement exists over the age frame of this generation yet.¹ Despite disagreements over the exact age frame, there is a consensus that each generation is different from the others in many ways. Researchers have characterized the behaviors, values, and mindsets of each generation based on shared history.²⁻⁴ In other words, though individuals in each generation are diverse, they share certain traits due to shared historical events.³⁻⁶ Table 1 shows a summary of key characteristics designated to each generation.²⁻⁴

Table 1. Description of the main traits of different generations. The percentages represent American Association of Orthodontists’ (AAO) practicing orthodontist members of each generation in 2016.

<p>Silent generation (SG) (1928 - 1945) <u>6.4%</u></p>	<p>Children of the Great Depression who have also witnessed wartime. They are known for their patriotism and the greatest majority of this generation describes itself as hardworking. The “silent” label refers to their traditionalist and conformist mindset. They are also known to be disciplined, responsible, loyal, and having respect for authority.</p>
<p>Baby Boomers (BB) (1946 – 1964) <u>37.9%</u></p>	<p>This generation gets its title due to the rise in fertility that occurred after the end of World War II. They have witnessed civil rights movement, Vietnam war, and cold war. Baby boomers are the first ones to be influenced by “The American Dream”, and as a result are often portrayed as more materialistic and ambitious than the previous generation. Some core values attributed to the baby boomers are anti-war, equal rights, optimism, and team oriented.</p>
<p>Generation X (GX) (1965 – 1980) <u>41.9%</u></p>	<p>Experienced the end of cold war and energy crisis in the U.S. Generation X grew up in dual income families and are more highly educated than the previous generations. They are entrepreneurial, independent, and seek life balance. Financially, this generation is thought to be not as well off as their parents.</p>
<p>Millennials (Mi) (1981 – 1996) <u>11.8%</u></p>	<p>Millennials saw a massive expansion of digital and social media, contributing to their tech savviness. They have witnessed terrorist attacks, epidemics, and shootings, as well as the greatest economic expansion. As a result, they are very sheltered but optimistic. They are also confident, competitive, and like personal attention.</p>

A consultation firm dedicated to orthodontics stratified the American Association of Orthodontists’ (AAO) practicing members population by generation, and demonstrated that the majority (80%) of its practicing members consist of Generation X and Baby Boomers (Table 1).⁵ Due to fundamental differences amongst generations of orthodontists, this survey study aimed to evaluate how each generation responds to questions focused on some of the profession’s most pressing issues. These issues include the quality of orthodontic education, rising student debt, the use of technology in orthodontics, and clear aligner therapy (CAT). The orthodontic profession has undergone dramatic transformations in these areas over the years. As an example, many orthodontic appliances including brackets can now be printed with customized prescriptions,

something that was deemed impossible a few decades ago.^{7,8} Similarly, the use of clear aligner therapy has had a phenomenal impact on the orthodontic profession. The largest clear aligner company recently announced its ten millionth patient milestone as of May 2021, which speaks volumes about how orthodontic treatment is being conducted in the world. To further exemplify the changes in this profession, one must attest to the alarming number and quality of orthodontic residency programs in the U.S. In 2010, Eugene Roberts drew attention towards less-than-optimal orthodontic education that residents were receiving, while accumulating an ever-increasing student debt.⁹ Numerous other articles have also highlighted the student debt issue and how it is effecting the present and the future of the orthodontic specialty.¹⁰⁻¹²

Thus, the goal of this study was to highlight the opinions and perspectives of each living generation of orthodontists on the aforementioned topics, as well as some other widely debated issues in the field. Positive and negative trends can be identified to better shape future policies as practitioners, administrators, educators, and students.

1. Materials and Methods:

This survey study was evaluated and approved as exempt under the number HM-HP-00088764-4 from the Institutional Review Board (IRB) at the University of Maryland School of Dentistry.

2.1 Survey Development

A systematic three stage approach was taken to develop this survey. The first step was to conduct a thorough literature review related to this research topic. An independent literature review, as well as AAO librarian services were utilized during this process. Based on the literature review, a few topics of interest were selected. A first draft of the survey was then developed and shared with several relevant staff members at the AAO, who provided feedback on the usefulness

and quality of the survey. In the second stage, a statistician, as well as several orthodontic faculty members at the University of Maryland School of Dentistry orthodontic program were invited to critique the survey. Some of these faculty members have been practicing orthodontics for over 40 years with experience in private practice, teaching, research, leading professional organizations, and directing orthodontic residency program. In the third stage, the survey was submitted to the AAO Partners in Research (PIR) program for review. The AAO-PIR conducts an independent review of surveys before approving them for distribution. After AAO-PIR's approval, the survey was distributed to collect responses.

A 22-question survey was designed and administered through the Survey Monkey® software (Table 2). The AAO-PIR program was utilized to distribute the survey to orthodontists mainly in the U.S., as well as some in Canada. The PIR program invited 2188 active, service, and retired members to participate in this study. Program directors and chairs from several orthodontic programs in the U.S. and Canada were also requested to distribute the survey to their alumni and faculty. It is difficult to predict precisely how many program directors/chairs acted upon our request. Finally, approximately 700 orthodontists were personally emailed by the authors requesting them to complete the survey. Figure 1 illustrates the process of survey distribution and data analysis. Participants were required to read and agree to a consent statement prior to beginning the survey. This survey was targeted towards orthodontists only, thus any respondent who identified themselves as an orthodontic student/resident was eliminated from the statistical analysis.

Table 2: Survey Monkey questionnaire in the order it was administered.

Questions:	Choices
DEMOGRAPHICS	
1. What gender do you identify with?	<ul style="list-style-type: none"> a. Male b. Female c. Undisclosed
2. Please select your ethnicity?	<ul style="list-style-type: none"> a. White/Non-Hispanic b. Black/African American c. Hispanic d. Native American e. Asian f. Middle Eastern g. Undisclosed h. Other
3. Please select year you were born?	<ul style="list-style-type: none"> a. (enter four-digit year).
4. Which current career status best describes you? Select all that apply.	<ul style="list-style-type: none"> a. Orthodontic Educator b. Orthodontic Practitioner (Private practice) c. Orthodontic Practitioner (Hospital setting) d. Orthodontic Practitioner DSO/OSO e. Orthodontic military service f. Retired Orthodontist g. Other (please describe) : _____
5. Please indicate your AAO constituent society	<ul style="list-style-type: none"> a. Great Lakes Association of Orthodontists b. Mid-Atlantic Orthodontic Society of Orthodontists c. Midwestern Society of Orthodontists d. Northeastern Society of Orthodontists e. Pacific Cost Society of Orthodontists f. Rocky Mountain Society of Orthodontists g. Southern Association of Orthodontists h. Southwestern Society of Orthodontists i. Do not wish to disclose.
6. Please select one reason that contributed the most in your decision to become an orthodontist.	<ul style="list-style-type: none"> a. I loved my orthodontic experience as a kid. b. To own my own business c. Great work/personal life balance d. Lucrative profession e. Ability to make a significant different in people's lives f. Other: _____
TECHNOLOGY AND INNOVATIONS	
7. Select two of these innovations that have contributed the most towards making orthodontic treatment easier to provide today?	<ul style="list-style-type: none"> a. Cephalometrics b. Bondable brackets c. Nickel-Titanium (NiTi) Wires d. Clear aligners e. Temporary Anchorage Devices (TADs)

Table 2 continued

	<ul style="list-style-type: none"> f. Intraoral scanning g. It is not easier to perform orthodontic treatment today. h. CBCT i. In-house 3D Printing j. Other: _____
<p>8. Besides clinical examination, which of these diagnostic tools do you/did you routinely use/used in your practice? (Select all that apply).</p>	<ul style="list-style-type: none"> a. None b. Panoramic radiograph X-ray c. Lateral cephalometric X-ray d. Postero-Anterior (P-A) cephalogram X-ray e. Hand-Wrist film X-ray f. Intraoral scanning g. Alginate impressions h. Intraoral/extraoral photographs i. Articulator j. CBCT k. Video Recording l. Other: _____
<p>9. How do you see the future of clear aligners use in orthodontics in comparison to conventional orthodontics with brackets/wires?</p>	<ul style="list-style-type: none"> a. Clear aligner market will fade away completely overtime. b. Clear aligners will occupy majority of the orthodontic consumer market in the future. c. Clear aligners and conventional braces will have an equal share of the orthodontic consumer market. d. Conventional orthodontic treatment will always have the greater share of orthodontic consumer market. e. Other: _____
<p>10. Do you have any prediction for the future of orthodontics that you would like to share?</p>	<ul style="list-style-type: none"> a. Open ended answer _____.
ORTHODONTIC EDUCATION	
<p>11. Do you think the quality of orthodontic education has declined over time?</p>	<ul style="list-style-type: none"> a. Yes (Proceed to #12 and #13 only if responded yes) b. No
<p>12. In your opinion, what is the main reason why the quality of orthodontic education has declined over time?</p>	<ul style="list-style-type: none"> a. Lack of passionate educators b. Inadequate length of orthodontic programs c. Lack of research component in orthodontic programs d. Lack of patients to treat from start to finish e. Inability of educators/institutions to keep up with technological advancements f. Programs not teaching modern treatments such as clear aligner

Table 2 continued

	<p>g. Lack of control over department finances Other: _____</p>
<p>13. Please select two most important actions in improving orthodontic education in the United States and/or Canada.</p>	<p>a. Give orthodontic departments more autonomy and control over the funds generated through the department. b. Change length of the Orthodontic programs c. Increased salaries for educators. d. Recruit residents with potential to become educators. e. Invite more international educators to join academics in United States and/or Canada f. Mandate programs to teach clear aligners and other newer treatments/techniques. g. Others: _____</p>
<p>14. How much student loan debt did you have at the end of your orthodontic residency?</p>	<p>a. None b. Under 50K c. >50K – 150K d. >150K – 250K e. >250K – 500K f. >500K – 750M g. >750K</p>
<p>15. How long did it/will it take/ to pay your student loans?</p>	<p>a. I did not have any student loans b. 1-3 years c. 3-5 years d. 5-7 years e. 7-10 years f. Longer than 10 years</p>
<p>16. How did student loan burden influenced your career choices or patient care philosophy? (select all that apply)</p>	<p>a. Student loan debt did not influence my career choice or patient care philosophy. b. Due to student loan burden, I had to work for a corporate practice after the residency. c. There was a heavy focus on production rather than quality of result. d. Although I wanted, I was unable to enter academia. e. I had to work as an Associate f. I had to move out of the area I wanted to work g. Other: _____</p>
<p>ORTHODONTIC PRACTICE</p>	
<p>17. Please select two greatest challenges orthodontic profession faces currently.</p>	<p>a. Competition from DIY aligners b. Corporate orthodontics c. Non-specialists treating orthodontic patients d. Orthodontic residents graduating with huge student loan debts e. Declining quality of orthodontic education</p>

Table 2 continued

	<ul style="list-style-type: none"> f. Increased demands of orthodontic patients g. Lack of Educators h. Lack of Regulation i. Other: _____
<p>18. Please select the two most important factors in defining success of orthodontic treatment?</p>	<ul style="list-style-type: none"> a. Functional occlusion with good periodontal health. b. Class I molar and canine relationship c. Patient satisfaction d. Esthetics e. Good profile f. Length of treatment g. Other: _____
<p>19. What should be the main criteria for determining if orthodontic treatment should be covered by medical/dental insurance?</p>	<ul style="list-style-type: none"> a. Malocclusions caused by trauma b. Craniofacial disharmonies due to developmental abnormalities/syndromic patients c. When it impairs patient’s physical or emotional health d. No orthodontic treatment should be covered by medical/dental insurance e. All orthodontic treatments should be covered f. Other: _____
<p>20. Which resources do you or did you use to market your orthodontic practice? (select all that apply)</p>	<ul style="list-style-type: none"> a. I do/did not market or advertise. b. Social media/email c. Local newspaper/bulletins d. Regular mail advertisements e. Television or radio advertisements f. Outdoor advertisements g. Other: _____
<p>21. How can independent orthodontic practice owners compete with corporate? (select 2 options)</p>	<ul style="list-style-type: none"> a. By clearly defining the mission and culture of their practice and marketing it extensively. b. By providing unique patient experience. c. By incorporating more technology into their practices d. By doing more cases with clear aligner therapy e. By reducing prices of treatments offered. f. Through increased support from the AAO g. Others: _____
<p>22. What do you wish you had learned during your residency that would have greatly benefitted your career?</p>	<p>Open ended answer _____.</p>

Participants were asked to share some demographical information. Based on the age provided, participants were classified into a generation using the Pew Research Center's 'modified' definition of generations.¹The modification was made to SG's birth date frame to make it 1922-1945. This modification was made to classify 3 out of 535 participants as SG, who reported being born before 1925. Responses were collected over a time period of approximately two months (July-August 2020). Survey Monkey® allowed only one response per participant if the participant accessed the survey through the same IP address. Personal email invitations to orthodontists explicitly requested the invitees to ignore the email if they had already completed the survey previously through any different invitation. Participation was completely voluntary, and there were no financial incentives for the participants.

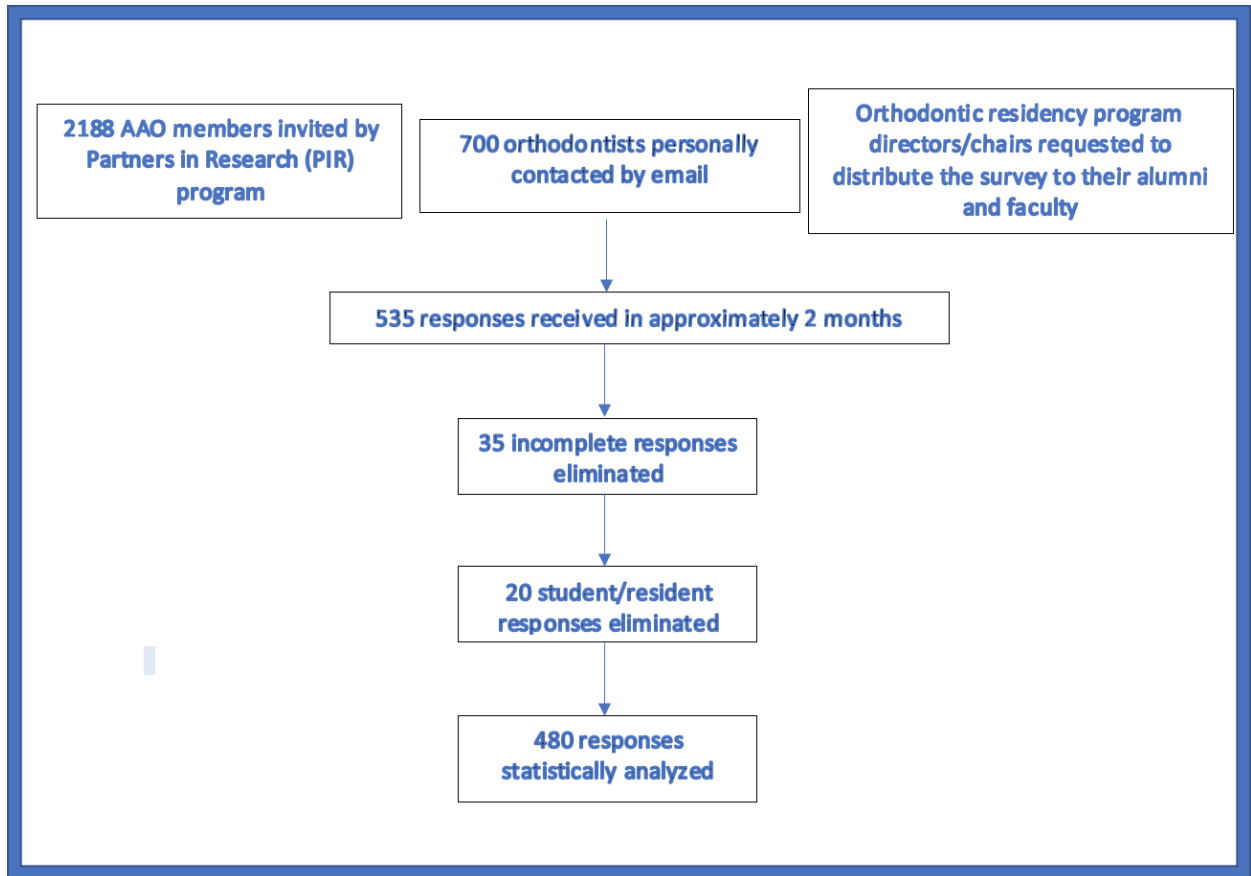


Figure 1: Flow chart illustrating the methodology of survey distribution and filtration of responses for statistical analysis.

2.2 Statistical Analysis

Descriptive statistics were calculated for demographics (Q1-Q5), and for Q6-Q22 by generation. Chi-square or Fisher's Exact tests were used to determine any associations between the generation variable and each of the questions. Chi-square or Fisher's Exact tests were not used for question #2 and #5, as well as the questions that required open-ended responses such as questions #10 and #22. The Cochran-Armitage trend test was used to detect a linear trend in binomial proportions of response across the generations. For questions with binary responses and those that allowed the participants to pick more than one answer choice, a significant Cochran-Armitage trend test meant that more than 50% of the items for that question and that particular

answer choice were significant. SAS 9.4 statistical software was used for data analysis. The significance level (2-sided) was set to 0.05 for all tests.

2. Results:

A total of 535 responses were received. Response rate was calculated to be approximately 17% from the total number of emails distributed by the AAO-PIR program and personal email requests by the authors. Thirty-five respondents did not respond to any question after accessing the survey, so they were completely eliminated from the data analysis. Additionally, 20 respondents who identified themselves as orthodontic students/residents were also eliminated from the statistical analysis. The remaining 480 responses were statistically analyzed. Finally, if a respondent did not answer any specific question, s/he was eliminated from the statistical analysis for that particular question. Figure 2 displays a demographical summary of the 480 orthodontists who completed the survey partially or fully. Tables 3 - 6 show the descriptive statistics and the test results of the association between the generation variable and each of the survey questions, except the ones with open-ended responses. Open-ended answers are subjectively analyzed in the discussion section.

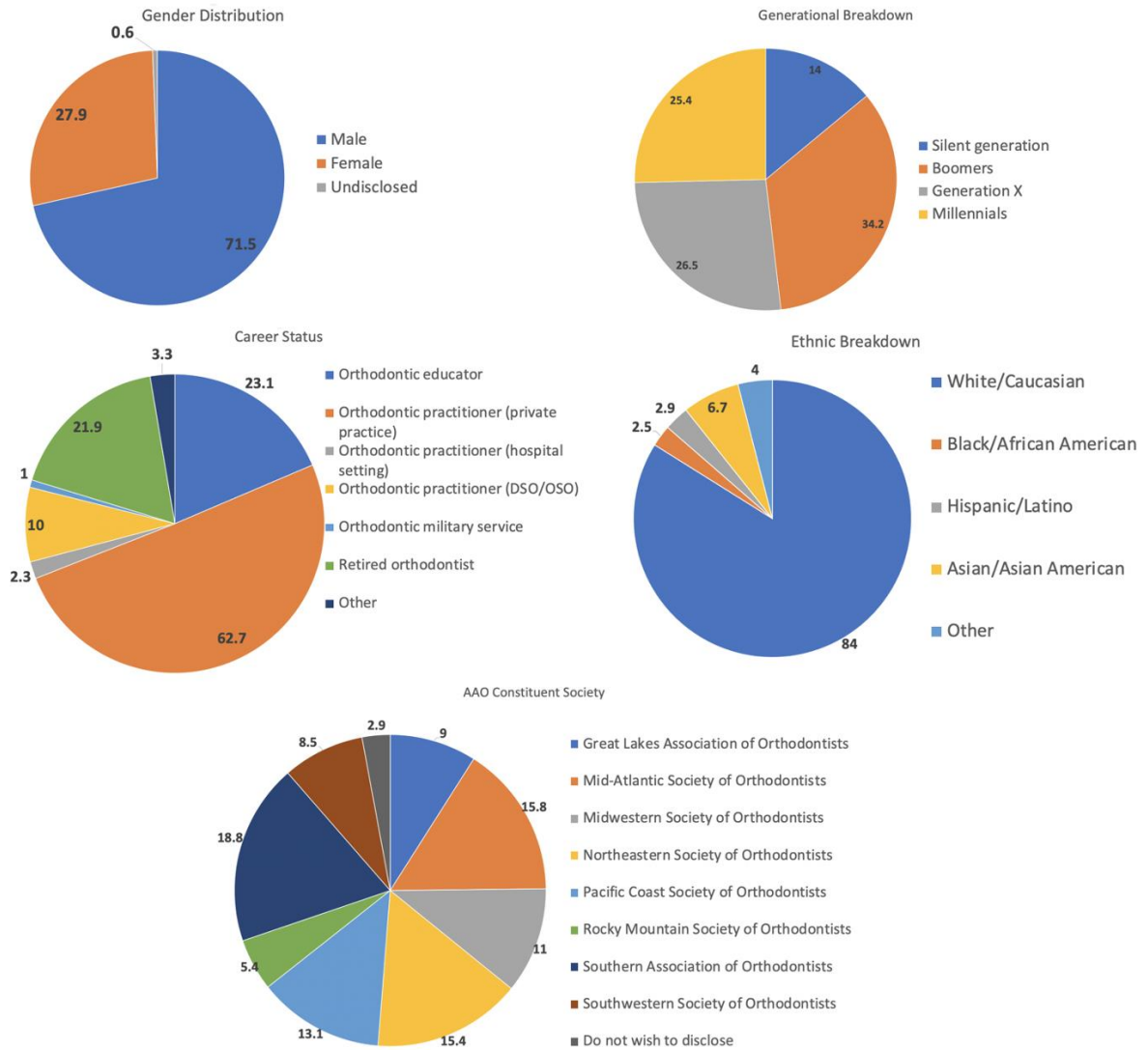


Figure 2. Demographics represented as percentages for a total of 480 respondents (N=480). Total percentage may be over 100% for career status due to the ability to pick more than one answer choice.

From the total survey respondent sample, 71.5% were male and 27.9% were female (figure 2). The Cochran-Armitage trend test showed a significant increase in the percentage of female orthodontists as we moved from older to younger generations ($P < 0.001$) (Table 3). Ethnicity wise, Caucasians were the greatest in number, followed by Asian Americans. As anticipated from the generational breakdown of the AAO membership presented in table 1, the greatest number of respondents of our survey were BB and GenX, followed by Mi and SG. Finally, this survey study

had participation from all AAO constituent societies, with Southern Association of Orthodontists having the highest participation and Rocky Mountain Society of Orthodontists having the lowest participation.

When asked about the main reason for choosing the orthodontic profession, the most popular choice among older generations (SG and GenX) was “the ability to make a significant difference in peoples’ lives”. In contrast, a greater percentage of the younger generation of orthodontists chose the “great work/personal life balance” as the main influencer in their decision (Table 3).

Table 3. Descriptive statistics and the test results of association between the generations variable and each of the questions from Q6-Q9, along with gender and career status.

		Silent generation	Boomers	Generation X	Millennials	P-value
Question	Total N (%)	n (%)	n (%)	n (%)	n (%)	
Gender						
Male	343 (71.5)	64 (95.5)	142 (87.1)	80 (63.5)	57 (47.1)	<0.001*
Female	134 (27.9)	3 (4.5)	21 (12.9)	46 (36.5)	64 (52.9)	
Career status*						
Orthodontic educator	111 (23.3)	20 (29.9)	52 (31.9)	22 (17.5)	17 (14.1)	<0.001*
Orthodontic practitioner (private practice)	298 (62.5)	11 (16.4)	93 (57.1)	99 (78.6)	95 (78.5)	<0.001*
Orthodontic practitioner (hospital setting)	11 (2.3)	0 (0.0)	4 (2.5)	4 (3.2)	3 (2.5)	0.36
Orthodontic practitioner (DSO/OSO)	48 (10.1)	1 (1.5)	6 (3.7)	13 (10.3)	28 (23.1)	<0.001*
Orthodontic military service	5 (1.1)	2 (3.0)	0 (0.0)	3 (2.4)	0 (0.0)	0.335
Retired orthodontist	105 (22.0)	56 (83.6)	48 (29.5)	0 (0.0)	1 (0.8)	<0.001*
Q6. Please select one reason that contributed the most in your decision to become an orthodontist						
I loved my orthodontic experience as a kid	56 (11.7)	4 (6.0)	12 (7.3)	16 (12.6)	24 (19.7)	<0.001*
To own my own business	18 (3.8)	2 (3.0)	5 (3.1)	8 (6.3)	3 (2.5)	
Great work/personal life balance	159 (33.1)	24 (35.8)	43 (26.2)	46 (36.2)	46 (37.7)	
Lucrative profession	15 (3.1)	1 (1.5)	5 (3.1)	2 (1.6)	7 (5.7)	
Ability to make a significant difference in peoples’ lives	153 (31.9)	24 (35.9)	60 (36.6)	37 (29.1)	32 (26.2)	
Other	79 (16.5)	12 (17.9)	39 (23.8)	18 (14.2)	10 (8.2)	
Q7. Please select one of these innovations that has contributed the most towards making orthodontic treatment easier to provide today?						
Cephalometrics	7 (1.5)	2 (3.0)	1 (0.6)	2 (1.6)	2 (1.6)	<0.001*
Bondable brackets	191 (39.8)	37 (55.2)	72 (43.9)	44 (34.7)	38 (31.2)	
Nickel-Titanium (NiTi) Wires	106 (22.1)	8 (11.9)	38 (23.2)	29 (22.8)	31 (25.4)	
Clear aligners	63 (13.1)	4 (6.0)	23 (14.0)	15 (11.8)	21 (17.2)	
Temporary Anchorage Devices (TADs)	18 (3.8)	6 (9.0)	6 (3.7)	3 (2.4)	3 (2.5)	

Table 3 continued

Intraoral scanning	45 (9.4)	3 (4.5)	6 (3.7)	18 (14.2)	18 (14.8)	
CBCT	15 (3.1)	2 (3.0)	3 (1.8)	6 (4.7)	4 (3.3)	
In-house 3D printing	3 (0.6)	0 (0.0)	1 (0.6)	2 (1.6)	0 (0.0)	
Provision of orthodontic care has not changed from the past	3 (0.6)	1 (1.5)	0 (0.0)	1 (0.8)	1 (0.8)	
Other	29 (6.0)	4 (6.0)	14 (8.5)	7 (5.5)	4 (3.3)	
Q8. Besides clinical examination, which of these diagnostic tools do you/did you routinely use/used in your practice? (Select all that apply)						
None	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	N/A
Panoramic radiograph	442 (92.1)	64 (95.5)	156 (95.1)	113 (89.0)	109 (89.3)	<0.001*
Lateral cephalogram	432 (90.0)	66 (98.5)	149 (90.9)	110 (86.6)	107 (87.7)	0.012*
P-A cephalogram	57 (11.9)	24 (35.8)	21 (12.8)	10 (7.9)	2 (1.6)	<0.001*
Hand-Wrist film	38 (7.9)	14 (20.9)	17 (10.4)	5 (3.9)	2 (1.6)	<0.001*
Intraoral scanning	275 (57.3)	18 (26.9)	75 (45.7)	93 (73.2)	89 (73.0)	<0.001*
Alginate impressions	240 (50.0)	54 (80.6)	107 (65.2)	41 (32.3)	38 (31.2)	<0.001*
Intraoral/extraoral photographs	442 (92.1)	61 (91.0)	151 (92.1)	115 (90.6)	115 (94.3)	0.496
Articulator	46 (9.6)	19 (28.4)	23 (14.0)	4 (3.2)	0 (0.0)	<0.001*
CBCT	137 (28.5)	17 (25.4)	35 (21.3)	46 (36.2)	39 (32.0)	0.043*
Video Recording	10 (2.1)	3 (4.5)	2 (1.2)	1 (0.8)	4 (3.3)	0.916
Other	21 (4.4)	6 (9.0)	10 (6.1)	4 (3.2)	1 (0.8)	<0.001*
Q9. How do you see the future of clear aligners use in orthodontics in comparison to conventional orthodontics with brackets/wires?						
Clear aligner market will fade away completely overtime	2 (0.42)	1 (1.5)	1 (0.6)	0 (0.0)	0 (0.0)	
Clear aligners will occupy majority of the orthodontic consumer market in the future	97 (20.2)	6 (9.0)	34 (20.7)	32 (25.2)	25 (20.5)	
Clear aligners and conventional braces will have an equal share of the orthodontic consumer market	241 (50.2)	37 (55.2)	67 (40.9)	62 (48.8)	75 (61.5)	<0.001*
Conventional orthodontic treatment will always have the greater share of orthodontic consumer market	120 (25.0)	18 (26.9)	53 (32.3)	29 (22.8)	20 (16.4)	
Other	20 (4.2)	5 (7.5)	9 (5.5)	4 (3.2)	2 (1.6)	

*Statistically significantly different at 0.05 significance level.

Note: Chi-square or Fisher's Exact tests were used for Q6, Q7 and Q9. Cochran-Armitage trend tests were used for the gender, career status and Q8.

Although a majority of each generation chose bondable brackets as the foremost innovation that made the provision of orthodontic treatment easy, SG gave this category more value than any other generation. Nickel-Titanium (NiTi) wires were regarded as the second most important innovation in orthodontics across all generations. Moreover, clear aligners were chosen by a higher

percentage of millennials (17.2%) compared to any other generation as the third most popular contributor towards making the provision of orthodontic treatment easier (Table 3).

Approximately 90% of each generation routinely uses panoramic radiograph, lateral cephalometric radiograph, and intra/extraoral photographs for diagnostic purposes. Statistical analysis showed that older generations were/are more likely to use P-A cephalogram, hand wrist radiograph, alginate impression, and an articulator as diagnostic tools ($P < 0.001$). In contrast, the younger generations (GenX and Mi) are more likely to use intraoral scanning ($P < 0.001$) and CBCTs ($P = 0.043$) as diagnostic tools. All of these differences were confirmed by a significant Cochran-Armitage trend test (Table 3).

The most popular opinion among each generation was that clear aligners and conventional braces will have an equal share of the orthodontic consumer market in the future. However, a greater number of orthodontists in the younger two generations believe that clear aligners will take over as the main technique to treat malocclusions. In comparison, a greater number of orthodontists in the older two generations expressed that conventional braces will always have a larger share of the consumer market (Table 3).

Only a third (30.8%) of the study participants expressed that the quality of orthodontic education has declined over time (Table 4). Across all generations, this decline was attributed mainly to lack of passionate educators. More millennial orthodontists (40%) blamed “lack of passionate educators” than any other generation. Across all generations, the second most popular factor contributing to a decline in education quality was the inability of educators/institutions to keep up with technological advancements. Considerable number of participants (44.1%) chose “other” as the answer for question 12, which asked the participants for their suspected reason(s) for a decline in orthodontic education. The following were listed as reasons with the highest to

lowest recurrence: 1) income discrepancies between private practice and academia, 2) increase in program size leading to a worsening faculty to student ratio, 3) increased emphasis on digitization and aligner therapy, and a reduced focus on the basics, 4) treatment regimen choices without scientific support, and 5) shifting focus from orthodontics as healthcare to a business profession.

Table 4. Descriptive statistics and the test results of association between the generations variable and each of questions from Q11- Q13. These three questions were focused on the orthodontic education.

	Total N (%)	Silent generation n (%)	Boomers n (%)	Generation X n (%)	Millennials n (%)	P-value
Q11. Do you think the quality of orthodontic education has declined over time?						
Yes	148 (30.8)	20 (29.9)	56 (34.2)	45 (35.4)	27 (22.1)	0.149
No	332 (69.2)	47 (70.2)	108 (65.9)	82 (64.6)	95 (77.9)	
Q12. In your opinion, what is the main reason why the quality of orthodontic education has declined over time?						
Lack of passionate educators	34 (25.0)	3 (18.8)	9 (17.3)	12 (27.9)	10 (40.0)	<0.001*
Inadequate length of orthodontic programs	6 (4.4)	1 (6.3)	1 (1.9)	3 (7.0)	1 (4.0)	
Lack of research component in orthodontic programs	3 (2.2)	0 (0.0)	2 (3.9)	1 (2.3)	0 (0.0)	
Lack of patients to treat from start to finish	5 (3.7)	0 (0.0)	1 (1.9)	3 (7.0)	1 (4.0)	
Inability of educators/ institutions to keep up with technological advancements	13 (9.6)	2 (12.5)	4 (7.7)	4 (9.3)	3 (12.0)	
Programs not teaching modern treatments such as clear aligner	8 (5.9)	0 (0.0)	3 (5.8)	3 (7.0)	2 (8.0)	
Lack of control over department finances	7 (5.2)	2 (12.5)	2 (3.9)	2 (4.7)	1 (4.0)	
Other	60 (44.1)	8 (50.0)	30 (57.7)	15 (34.9)	7 (28.0)	
Q13. Please select two most important actions in improving orthodontic education in the United States and/or Canada						
Give orthodontic departments more autonomy and control over the funds generated through the department.	68 (14.2)	10 (14.9)	24 (14.6)	23 (18.1)	11 (9.0)	0.296
Change length of the Orthodontic programs	12 (2.5)	2 (3.0)	3 (1.8)	6 (4.7)	1 (0.8)	0.643
Increased salaries for educators	67 (14.0)	5 (7.5)	27 (16.5)	20 (15.8)	15 (12.3)	0.738
Recruit residents with potential to become educators	29 (6.0)	5 (7.5)	11 (6.7)	8 (6.3)	5 (4.1)	0.309

Table 4 continued

Invite more international educators to join academics in United States and/or Canada	7 (1.5)	1 (1.5)	2 (1.2)	2 (1.6)	2 (1.6)	0.831
Mandate programs to teach clear aligners and other newer treatments/techniques	27 (5.6)	0 (0.0)	8 (4.9)	9 (7.1)	10 (8.2)	0.02*
Other	23 (4.8)	4 (6.0)	9 (5.5)	8 (6.3)	2 (1.6)	0.165

*Statistically significantly different at 0.05 significance level.

Note: Chi-square or Fisher's Exact tests were used for Q11 and Q12. Cochran-Armitage trend tests were used for Q13.

The two most popular strategies suggested to improve the quality of orthodontic education were increasing salaries for educators, as well as giving orthodontic departments greater autonomy over internally generated funds (Table 4). Interestingly, there was a statistically significant upward trend across generations (from older to younger) saying that programs should be mandated to teach clear aligners and other newer treatments/techniques to improve the quality of orthodontic education (P=0.02).

As expected, student loan debt increased from older to younger generations. About 55.2% of the silent generation had zero student debt at the end of their residency, whereas 60% of millennial orthodontists graduated with a student debt ranging from 150k to over 750k (Table 5). As a result, it took/will take 84.4% of millennials anywhere from one to more than 20 years to pay back their student debt. Although majority of the respondents (72.7%) stated that student debt burden did not influence their career choice, the Cochran Armitage trend test revealed that over generations this became decreasingly true (P<0.001). The trend test also demonstrated that different ways in which student debt affects orthodontists increased from older to younger generations. In other words, millennials are affected the most and they more frequently report being forced to work as an associate or for a corporation due to their student debt burden.

Table 5. Descriptive statistics and the test results of association between the generations variable and each of questions from Q14-16. These three questions were focused on student debt and its impact.

		Silent generation	Boomers	Generation X	Millennials	P-value
Question	Total N (%)	n (%)	n (%)	n (%)	n (%)	
Q14. How much student loan debt did you have at the end of your orthodontic residency						
None	121 (27.0)	32 (55.2)	46 (30.1)	25 (20.3)	18 (15.7)	<0.001*
<50K	104 (23.2)	24 (41.4)	59 (38.6)	15 (12.2)	6 (5.2)	
50K – 150K	78 (17.4)	1 (1.7)	42 (27.5)	22 (17.9)	13 (11.3)	
150K – 250K	47 (10.5)	1 (1.7)	6 (3.9)	31 (25.2)	9 (7.8)	
250K – 500K	68 (15.1)	0 (0.0)	0 (0.0)	26 (21.1)	42 (36.5)	
500K – 750M	22 (4.9)	0 (0.0)	0 (0.0)	3 (2.4)	19 (16.5)	
>750K	9 (2.0)	0 (0.0)	0 (0.0)	1 (0.8)	8 (7.0)	
Q15. How long did it/will it take/ to pay your student loans?						
I did not have any student loans	121 (27.0)	33 (56.9)	45 (29.4)	25 (20.3)	18 (15.7)	<0.001*
1-4 years	101 (22.5)	14 (24.1)	49 (32.0)	16 (13.0)	22 (19.1)	
>4-8 years	74 (16.5)	6 (10.3)	27 (17.7)	25 (20.3)	16 (13.9)	
>8-12 years	71 (15.8)	5 (8.6)	22 (14.4)	16 (13.0)	28 (24.4)	
>12-16 years	24 (5.4)	0 (0.0)	4 (2.6)	9 (7.3)	11 (9.6)	
>16-20 years	31 (6.9)	0 (0.0)	4 (2.6)	18 (14.6)	9 (7.8)	
> 20 years	27 (6.0)	0 (0.0)	2 (1.3)	14 (11.4)	11 (9.6)	
Q16. How did student loan burden influence your career choices or patient care philosophy? (select all that apply)						
Student loan debt did not influence my career choice or patient care philosophy.	349 (72.7)	53 (79.1)	143 (87.2)	93 (73.2)	60 (49.2)	<0.001*
Due to student loan burden, I had to work for a corporate practice after the residency	44 (9.2)	1 (1.5)	3 (1.8)	12 (9.5)	28 (23.0)	<0.001*
There was a heavy focus on production rather than quality of result	15 (3.1)	1 (1.5)	1 (0.6)	3 (2.4)	10 (8.2)	0.001*
Although I wanted, I was unable to enter academia.	16 (3.3)	0 (0.0)	1 (0.6)	2 (1.6)	13 (10.7)	<0.001*
I had to work as an Associate	64 (13.3)	7 (10.5)	11 (6.7)	13 (10.2)	33 (27.1)	<0.001*
I had to move out of the area I wanted to work	27 (5.6)	0 (0.0)	0 (0.0)	8 (6.3)	19 (15.6)	<0.001*
Other	36 (7.5)	4 (6.0)	11 (6.7)	11 (8.7)	10 (8.2)	0.471

*Statistically significantly different at 0.05 significance level.

Note: Chi-square or Fisher’s Exact tests were used for Q14 and Q15. Cochran-Armitage trend tests were used for Q16.

More than 50% of orthodontists in each generation expressed that the greatest current challenge to the orthodontic profession is non-specialists treating orthodontic patients (Table 6). The second and third biggest challenges chosen by each generation were rising student debt and corporate orthodontics respectively. A follow up question asked how private practices could

compete with corporations. Each generation recommended providing a unique patient experience. The second most popular advice was to create and define a clear mission of the practice and marketing it extensively.

Table 6. Descriptive statistics and the test results of association between the generation's variable and each of questions of #17, 18, 19, 20 and 21.

		Silent generation	Boomers	Generation X	Millennials	P-value
Question	Total N (%)	n (%)	n (%)	n (%)	n (%)	
Q17. Please select two greatest challenges orthodontic profession faces currently.						
Corporate orthodontics	183 (38.1)	26 (38.8)	58 (35.4)	56 (44.1)	43 (35.3)	0.993
Non-specialists treating orthodontic patients	257 (53.5)	40 (59.7)	89 (54.3)	64 (50.4)	64 (52.5)	0.329
Orthodontic residents graduating with huge student loan debts	214 (44.6)	24 (35.8)	79 (48.2)	54 (42.5)	57 (46.7)	0.441
Declining quality of orthodontic education	34 (7.1)	3 (4.5)	17 (10.4)	7 (5.5)	7 (5.7)	0.534
Increased demands of orthodontic patients	15 (3.1)	2 (3.0)	4 (2.4)	5 (3.9)	4 (3.3)	0.697
Lack of Educators	69 (14.4)	8 (11.9)	32 (19.5)	18 (14.2)	11 (9.0)	0.132
Lack of Regulation	65 (13.5)	7 (10.5)	10 (6.1)	22 (17.3)	26 (21.3)	<0.001*
Other	61 (12.7)	6 (9.0)	17 (10.4)	20 (15.8)	18 (14.8)	0.123
Q18. Please select two most important factors in defining success of orthodontic treatment?						
Functional occlusion with good periodontal health	366 (76.3)	47 (70.2)	125 (76.2)	94 (74.0)	100 (82.0)	0.106
Class I molar and canine relationship	26 (5.4)	8 (11.9)	6 (3.7)	7 (5.5)	5 (4.1)	0.136
Patient satisfaction	278 (57.9)	30 (44.8)	96 (58.5)	77 (60.6)	75 (61.5)	0.055
Esthetics	173 (36.0)	16 (23.9)	61 (37.2)	55 (43.3)	41 (33.6)	0.282
Good profile	23 (4.8)	6 (9.0)	8 (4.9)	3 (2.4)	6 (4.9)	0.239
Length of treatment	13 (2.7)	3 (4.5)	3 (1.8)	5 (3.9)	2 (1.6)	0.534
Other	19 (4.0)	6 (9.0)	7 (4.3)	5 (3.9)	1 (0.8)	0.011*
Q19. What should be the main criteria for determining if orthodontic treatment should be covered by medical/dental insurance?						
Malocclusions caused by trauma	8 (1.8)	1 (1.7)	1 (0.7)	3 (2.4)	3 (2.6)	<0.001*
Craniofacial disharmonies due to developmental abnormalities/syndromic patients	93 (20.3)	11 (19.0)	32 (20.9)	17 (13.8)	33 (28.7)	
When it impairs patient's physical or emotional health	133 (29.6)	22 (37.9)	38 (24.8)	40 (32.5)	33 (28.7)	
No orthodontic treatment should be covered by medical/dental insurance	12 (2.7)	0 (0.0)	6 (3.9)	4 (3.3)	2 (1.7)	
All orthodontic treatments should be covered	161 (35.9)	18 (31.0)	60 (39.2)	49 (39.8)	34 (29.6)	
Other	42 (9.4)	6 (10.3)	16 (10.5)	10 (8.1)	10 (8.7)	
Q20. Which resources do you or did you use to market your orthodontic practice? (select all that apply)						
I do/did not market or advertise	146 (30.4)	39 (58.2)	49 (29.9)	25 (19.7)	33 (27.1)	<0.001*

Table 6 continued

Social media/email	263 (54.8)	10 (14.9)	84 (51.2)	91 (71.7)	78 (63.9)	<0.001*
Local newspaper/bulletins	99 (20.6)	4 (6.0)	42 (25.6)	31 (24.4)	22 (18.0)	0.354
Regular mail advertisements	49 (10.2)	4 (6.0)	16 (9.8)	18 (14.2)	11 (9.0)	0.458
Television or radio advertisements	56 (11.7)	1 (1.5)	17 (10.4)	24 (18.9)	14 (11.5)	0.029*
Outdoor advertisements	65 (13.5)	0 (0.0)	15 (9.2)	28 (22.1)	22 (18.0)	<0.001*
Other	101 (21.0)	14 (20.9)	39 (23.8)	26 (20.5)	22 (18.0)	0.377
Q21. How can independent orthodontic practice owners compete with corporate? (please select 2 options)						
By clearly defining the mission and culture of their practice and marketing it extensively	289 (60.2)	46 (68.7)	89 (54.3)	80 (63.0)	74 (60.7)	0.924
By providing unique patient experience	374 (77.9)	44 (65.7)	129 (78.7)	102 (80.3)	99 (81.2)	0.037*
By incorporating more technology into their practices	64 (13.3)	5 (7.5)	15 (9.2)	24 (18.9)	20 (16.4)	0.014*
By doing more cases with clear aligner therapy	12 (2.5)	1 (1.5)	9 (5.5)	1 (0.8)	1 (0.8)	0.105
By reducing prices of treatments offered	20 (4.2)	2 (3.0)	5 (3.1)	5 (3.9)	8 (6.6)	0.152
Through increased support from the AAO	74 (15.4)	11 (16.4)	28 (17.1)	16 (12.6)	19 (15.6)	0.628
Other	65 (13.5)	7 (10.5)	31 (18.9)	18 (14.2)	9 (7.4)	0.108

*Statistically significantly different at 0.05 significance level.

Note: Chi-square or Fisher's Exact tests were used for Q19. Cochran-Armitage trend tests were used for Q17, Q18, Q20 and Q21.

No remarkable differences were found between generations regarding factors defining successful orthodontic treatment. Functional occlusion with good periodontal health was selected as the most important factor. Patient satisfaction, aesthetics, molar and canine relationship, profile, and the length of treatment were chosen next in order of decreasing frequency (Table 6).

Almost 60% of the silent generation stated that they did not market their orthodontic practice (Table 6). However, marketing and advertising became increasingly popular over generations. Trend test revealed that marketing through social media, emails, and outdoor advertisements has significantly increased over generations ($P < 0.001$).

There were 2 open-ended questions in this survey study. The first question asked the participants to make a prediction regarding the future of orthodontics, and 208 participants chose to respond. Responses are listed as follows in order of most to least recurring: 1) private practices will decrease in number while Dental Support Organizations (DSOs) will continue to increase, 2)

clear aligner therapy will become increasingly popular, 3) greater use of technology in all aspects of orthodontics, 4) non-specialists will continue to treat more orthodontic patients. However, the demand and value for treatment from an orthodontic specialist will remain if specialists maintain and uphold high standards of care, and 5) there will be an increased need for public awareness regarding the benefits of seeking specialized care.

The second open-ended question asked orthodontists what they wish they had learned during residency that would have benefitted their careers. A large group of participants (303) chose to answer this question. Over 50% of the respondents expressed their desire for more education in orthodontic business management including staff training, marketing, billing, and insurance handling.

3. Discussion

The purpose of this study was to involve orthodontists from all generations, constituencies, ethnicities, and diverse work-settings to stimulate a discussion regarding the evolution of the orthodontic profession. Each topic that was a part of this survey study can be a research subject on its own. However, the trends observed in this study can potentially serve as a guide towards future research. Additionally, different/more questions and answer choices could have been added to the survey, but the authors wanted to respect the consensus among the consultants and the statistician who contributed towards the survey design. Furthermore, the authors wanted to limit the number of answer choices to increase power of the statistical analysis.

4.1 Demographics

The gender distribution observed in our respondent sample matches closely with AAO's 2017 Orthodontic Workforce report, which estimated 72% of all professionally active orthodontists in the U.S. to be male. However, the increase in female orthodontists over

generations is an excellent example of how the profession of orthodontics has transformed demographically. Furthermore, racial and ethnic breakdown (Figure 2) observed in this research is not only true for orthodontics, but is also a general reflection of the extent of diversity among dentists in the United States. Based on the observed racial and ethnic trends, we believe that continued diversification within the orthodontic profession is necessary. This diversity should be instituted in all aspects of the profession from residents to teachers and administrators.

Statistical analysis also revealed that across generations, there is a decrease in orthodontic educators, which should be alarming, considering that the number of programs and residents continue to grow. It will be elaborated further in this section that this decrease could possibly be due to income discrepancies between academia and private practice, increasing student debt, and lack of incentives to become academicians.

4.2 Choosing orthodontics as a profession

While it may be unreasonable to expect that professionals in late stages of their careers remember or know what their original motivation may have been for choosing orthodontics, the authors tried to determine if motivations among older and younger generations were different. It was observed that older generations were motivated by a desire to help others. This was indicated by “the ability to make a significant difference in peoples’ lives” being the deciding factor in their pursuit of orthodontics. The younger generations, however, chose “great work/personal life balance” as their key motivation. Although these differences were statistically insignificant, they do exemplify the fundamental differences in the mindset of each generation as outlined in Table 1.

4.3 Innovations and diagnostic tools in orthodontics

The reason that SG chose bondable brackets as a valuable innovative tool more than other generations may be because SG treated patients by placing bands on every tooth – something that was probably cumbersome and unaesthetic. It was interesting to see a higher percentage of millennial orthodontists (17.2%) than any other generation choosing clear aligners as the third best contributor towards easing the provision of orthodontics. Whether this has to do with the quality of treatment outcome with clear aligners, or clear aligner treatment simply being convenient, is difficult to speculate. Nonetheless, we believe that since millennials represent the future of the profession, they are likely to incorporate the latest innovations and advancements in CAT into their practices.

This study provides evidence of how traditional diagnostic tools—some of which may still be helpful and relevant—are losing value in the eyes of younger orthodontists. This use of latest technology by young orthodontists versus traditional methods used by older generations reaffirms the tech savvy nature of millennials and the fact that 3D imaging, CAD/CAM appliances, and digital treatment planning are increasingly being viewed as the future standards of care.¹⁴ Overall, the authors consider it a positive trend for the profession. By incorporating technology such as CBCTs, intraoral scanning, 3D-printing, etc., into 21st century orthodontic offices, providers can improve their diagnostic abilities while making the treatment more comfortable for the patient. As an example, some newer CBCT machines expose patients to less radiation than panoramic and cephalometric radiation combined. Along with less radiation, these CBCTs can provide far greater diagnostic information on anatomy, pathology, impactions etc., thereby enhancing diagnostic capabilities, treatment planning, and ultimately quality of care.

4.4 Future of clear aligner use in orthodontics

Recent studies have shown that a significant number of patients find traditional orthodontic metal appliances unattractive and unacceptable, and are willing to pay more for aesthetically pleasing options.¹⁵ An increasing acceptability and preference for clear aligners has been seen in youth especially, suggesting that clear aligners will continue to expand their share in the orthodontic consumer market.¹⁶ Therefore, an underlying thought behind asking question #9 was that if CAT continues to penetrate orthodontic consumer market at its current rate, conventional orthodontic metal appliances may become obsolete. From the opinions of each generation on the future of CAT, it seems obvious that this modality of care is here to stay. Between May 2020 – May 2021, the stock market shares of Align Technology rose more than 136%. Furthermore, numerous new aligner companies are entering the market, demonstrating a surge in demand and use of clear aligner therapy. Additionally, CAT can be friendlier to periodontium and sometimes cheaper in cost. Considering all of these factors, CAT and in-house 3D-printed aligners should receive substantial importance in not only orthodontic education, but also orthodontic research.

4.5 Orthodontic education, student debt, and other challenges to the profession

Intriguingly, across generations, the respondents who expressed that the quality of orthodontic education has declined, attributed it mainly to lack of passionate educators. The authors are inclined to consider it a recent phenomenon since more millennials (40%) blamed “lack of passionate educators” than any other generation. As mentioned earlier, the reason for lack of passionate educators could be income discrepancies between academia and non-academia careers combined with increasing student debt. This was confirmed when participants suggested “increased salaries for educators” and “more autonomy for orthodontic departments over internally generated funds” as the main actions to improve the quality of orthodontic education. Current data

also coincides with the findings of Bogle et al., who suggested that increasing salaries increases satisfaction level for existing educators and attracts new ones.¹⁷ The authors believe that autonomy of orthodontic departments would enable them to provide educators with better incentives. Furthermore, many orthodontic residency programs have to rely on numerous part-time volunteer faculty. While these volunteer faculty can be an invaluable asset to any program, the lack of proper professional contracts and incentives (like for any other job) could compromise the effort that is placed in teaching.

The student debt discrepancy among generations observed in this study is enormous, and many current challenges to the profession of orthodontics are likely linked with it. The authors believe that the rising student debt would continue to negatively affect the profession unless drastic measures are taken to tackle this phenomenon. The following suggestions could be considered as a starting point and can be easily implemented in short-term. First, adding a stipend for residents, even if small, could help the residents fulfill their personal needs and responsibilities. Second, allowing orthodontic residents to moonlight (in general dentistry) at least one day a week could assist in paying off loan interests accruing during residency. Preventing moonlighting, in certain situations, may force residents to work in non-dentistry related jobs during residency. Finally, residency programs should consider organizing continued seminar series that teach orthodontic students effective debt management strategies.

The data presented in this study regarding student debt load also aligns well with another survey study implemented at the Graduate Orthodontic Resident Program (GORP) meeting in 2018. It showed that debts influenced decisions on where to work for 62%, and were a source of anxiety for 72% of all respondents.¹² These findings are somewhat true all across dentistry as well. Dentists with higher debts are less likely to specialize and more likely to enter general practice,

accept lower paying jobs upon graduation, and work longer hours.¹⁸ Further evidence in the current study indicating how student debt may be preventing younger generations the most from entering academia can be extracted from the following three findings: 1) in response to question 16, as analyzed across generations for choice d, the number of orthodontists who wanted to enter academia but could not do so due to student debt, increased as we move from older to younger generations ($P < 0.001$), 2) the trend test performed on the career status of the survey respondents showed a significant decrease in the percentage of orthodontic educators over generations ($P < 0.001$) and 3) student debt was rated as the second biggest challenge to the profession of orthodontics, which coincides with the findings of the 2016/17 Orthodontic Resident Graduate Tracking Survey administered by the AAO.¹⁹

Each generation agreed that the greatest challenge facing the orthodontic profession is non-specialists treating orthodontic patients. Previous studies have reported that 18% to 20% of general dentists provide routine comprehensive orthodontic treatment, while 32% to 57% offer some limited form of orthodontic treatment.^{20,21} The authors believe that rising student debt for dentists in general combined with ease of providing orthodontic care through CAT, will likely increase competition from non-specialists further. This become an even greater challenge for millennial orthodontists and subsequent generations.

4.6 Insurance coverage of orthodontic treatment

A question about what kind of orthodontic treatments should be covered by insurance agencies is often debated in orthodontic circles. The most popular opinion among the SG was that insurance should cover orthodontic needs of patients when it impairs their physical and mental health. In the younger three generations, the most popular opinion was that insurance should cover all orthodontic treatments. While these differences were statistically insignificant, the latter view

can be supported with studies which have shown that even mildly deviated occlusal traits affecting aesthetics can reduce oral health related quality of life, therefore impairing physical or mental health to varying degrees.¹³

4.7 Marketing orthodontic practice

Effective marketing of orthodontic practices is increasingly becoming a necessity. A study by Nelson et al., indicated the importance of social media. It was reported that 89% of orthodontic parents/patients used social media, with Facebook being the most preferred platform.²² With the amount of competition in the orthodontic world today, it probably leaves practice owners no choice but to aggressively market their practices through widely utilized social media platforms. For question #20 which inquired about marketing, it is worth mentioning that marketing to GPs and pediatric dentists is just as important as marketing to the public. However, before the 1980's it was considered unethical to advertise directly to the public for most healthcare services. This could be a potential explanation for why majority of the SG indicated that they did not market their orthodontic practices. Nonetheless, the importance of marketing in the current times is reaffirmed with the finding that 60.2% of SG recommended marketing orthodontic practice extensively to be able to compete with large corporations.

4.8 Wishful knowledge from orthodontic residency

Previous studies have listed faculty to student ratio, diversity of cases, and alumni contributions as some of the distinctive features of an excellent residency program.²³ While that remains true, in the current study, most respondents expressed their desire for more education in orthodontics business management. This includes staff training, marketing, billing, and insurance handling. This may perhaps be the first study reporting business management training as a characteristic of a good orthodontic residency program.

4. Conclusions:

This study provides an outlook of the orthodontic profession by highlighting and comparing perspectives of four living generations of orthodontists in the United States and Canada on various issues. Orthodontic residents must be cautious of their student debt prior to and during their residency, since it influenced post-residency career choices of approximately 50% of millennial orthodontists. Furthermore, educators should consider training their residents in business management aspects of orthodontics. CAT training and research should receive just as much importance as conventional orthodontic techniques in residency programs. Greater incentives are necessary to attract orthodontists towards teaching careers for the sake of preserving the future of the profession. Better incentives could boost the effort placed in teaching. Finally, representatives of the orthodontic profession at the association level should continue to dedicate more resources for marketing, in order to create consumer awareness regarding the quality of care provided by the orthodontists.

References:

1. Dimock M Defining Generations: Where Millennials end and Generation Z begins. Pew Research Center: 2019. "<https://www.pewresearch.org/fact-tank/2019/01/17/where-millennials-end-and-generation-z-begins/>". Accessed 09/24 2020.
2. Paulin G Expenditure patterns of young single adults: two recent generations compared. 2008. "<https://www.bls.gov/opub/mlr/2008/12/art2full.pdf>".
3. Tolbize A. Generational differences in the workplace: University of Minnesota; 2008. p. 1-25.
4. Twenge J, Campbell S, Hoffman B, Lance C. Generational differences in work values: leisure and extrinsic values increasing, social and intrinsic values decreasing. *Journal of Management* 2010;36(5):1117-42.
5. Patterson S. Embracing The Next Generation of Orthodontists: Benston Clark 2016. p. 1-3.
6. Zemke R, Raines C, Filipczak B. Generations at work: Managing the clash of veterans, boomers, Xers, and nexters in your workplace. New York: AMACOM; 1999.
7. Kravitz ND, Groth C, Jones PE, Graham JW, Redmond WR. Intraoral digital scanners. *J Clin Orthod* 2014;48(6):337-47.
8. Bosio JA. Will I ever be a good teacher? *Angle Orthod* 2015;85(6):1080-1.
9. Roberts WE. Is the education worth the debt? *Am J Orthod Dentofacial Orthop* 2010;138(2):125-6.
10. Haskell B, Keefe T. Surviving orthodontic graduate debt: Making correct career choices to manage debt re-payment, reduction or forgiveness. *Angle Orthod* 2019;89(4):529-34.
11. Ackerman MB. Six keys for making orthodontics a sustainable dental specialty. *Angle Orthod* 2013;83(6):1102-3.
12. Behrents RG. Me, the applicant, and the 500,000-pound gorilla: A challenge in orthodontic education. *Am J Orthod Dentofacial Orthop* 2016;149(1):1-3.
13. Nguee AAM, Ongkosuwito EM, Jaddoe VWV, Wolvius EB, Kragt L. Impact of orthodontic treatment need and deviant occlusal traits on oral health-related quality of life in children: A cross-sectional study in the Generation R cohort. *Am J Orthod Dentofacial Orthop* 2020;157(6):764-72 e4.
14. Jacox LA, Mihas P, Cho C, Lin FC, Ko CC. Understanding technology adoption by orthodontists: A qualitative study. *Am J Orthod Dentofacial Orthop* 2019;155(3):432-42.

15. Rosvall MD, Fields HW, Ziuchkovski J, Rosenstiel SF, Johnston WM. Attractiveness, acceptability, and value of orthodontic appliances. *Am J Orthod Dentofacial Orthop* 2009;135(3):276 e1-12; discussion 76-7.
16. Alansari RA. Youth Perception of Different Orthodontic Appliances. *Patient Prefer Adherence* 2020;14:1011-19.
17. Bogle S, Bosio JA, Cangialosi TJ, Jiang SS. U.S. and Canadian Orthodontic Faculty Professional Satisfaction: A Survey Study. *J Dent Educ* 2018;82(11):1146-54.
18. Nicholson S, Vujicic M, Wanchek T, Ziebert A, Menezes A. The effect of education debt on dentists' career decisions. *J Am Dent Assoc* 2015;146(11):800-7.
19. AAO R. 2017 Orthodontic Workforce Report. St. Louis, MO: American Association of Orthodontists; 2017. p. 33.
20. Wolsky SL, McNamara JA, Jr. Orthodontic services provided by general dentists. *Am J Orthod Dentofacial Orthop* 1996;110(2):211-7.
21. Galbreath RN, Hilgers KK, Silveira AM, Scheetz JP. Orthodontic treatment provided by general dentists who have achieved master's level in the Academy of General Dentistry. *Am J Orthod Dentofacial Orthop* 2006;129(5):678-86.
22. Nelson KL, Shroff B, Best AM, Lindauer SJ. Orthodontic marketing through social media networks: the patient and practitioner's perspective. *Angle Orthod* 2015;85(6):1035-41.
23. Allareddy V, Shin K, Marshall SD, Southard TE. Characteristics of an excellent orthodontic residency program. *Am J Orthod Dentofacial Orthop* 2019;156(4):522-30.