

Mouthguards During Orthodontic Treatment: Perspectives of Orthodontists and a Survey of
Orthodontic Patients Playing School-Sanctioned Basketball and Football

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Abstract

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Introduction: This study's objectives were to: 1) examine the beliefs and practices of orthodontists about mouthguard use in orthodontic patients, and 2) survey orthodontic patients currently playing school-sanctioned basketball and/or football about mouthguards.

Methods: Fifteen orthodontists were interviewed about mouthguard use in their patients. Patients from 13 of the offices participated in an online survey about mouthguards. Orthodontic patients (11-18 years old) playing organized school basketball (N=53) and/or football (N=22) completed the survey.

Results: Approximately half of the orthodontists surveyed initiated a discussion about mouthguards with their patients. The boil-and-bite type mouthguard was most commonly

recommended by the orthodontists. All football players reported using a mouthguard, as mandated by this sport. Basketball does not mandate mouthguard use and only 38% of basketball players reported wearing one. Mouthguard users most commonly reported having a stock type [football (59%), basketball (50%)]. Players who used mouthguards cited forgetting as the most frequent reason for not always using one. Basketball players who never wore a mouthguard reported that hardly anyone on their team wears one (77%), that it might make it hard to breathe or talk (74%), and that they never thought about wearing one (68%). A greater proportion of football (87%) than basketball (32%) players reported that their coach recommended a mouthguard ($p < 0.0001$).

Conclusions: Orthodontists differ in how they approach mouthguard use by their patients, which likely reflects a lack of evidence-based guidelines. The beliefs, recommendations and practices of orthodontists concerning mouthguard use are discussed. Research directions to improve mouthguard use are suggested.

Introduction

Participation in high school sports in the United States (U.S.) has nearly doubled over the last four decades, with over 7.9 million high school students competing in school-sanctioned athletics during the 2016/2017 academic year.¹ In Washington State, the number of students participating in high school sports now exceeds 172,000.¹ Student participation in high school sports increases risk of injury, including dental trauma. Reportedly, 10-39% of all dental injuries in children occurred during sports-related activities.² Maxillary incisors are most often injured during sports activities and account for as much as 80% of all dental injuries.^{3,4} These dental injuries can have lasting negative effects upon the young player's oral health and quality of life.⁵ Consequently, the American Dental Association (ADA) Council recommends wearing a well-fitting mouthguard to reduce the risk and severity of sports-related dental injuries.⁶

Studies suggests the use of a properly fitted mouthguard can reduce the incidence of orofacial injuries in sports.^{2,7-11} A 2002 prospective cohort study on NCAA Division I men's college basketball teams compared injury rates of athletes wearing custom-fitted mouthguards to athletes not wearing a mouthguard. The study captured 70,936 athlete exposures over an entire season and found that custom-fitted mouthguard users had significantly lower rates of dental injuries as compared to non-users (0.12 vs 0.67; $P < 0.05$; injury rates expressed as number of injuries per 1000 athlete exposures).⁸ Similarly, a 2007 meta-analysis indicated that when a mouthguard is not used, the risk of injury to the orofacial complex increases 1.6-1.9 times compared to when a mouthguard is worn.¹²

The athletic mouthguard is believed to have several protective qualities that may reduce the risk and severity of orofacial injuries. Mouthguards may reduce tooth fracture and dislocation, lip and soft tissue laceration, and jaw fracture.¹² Some conjecture that a mouthguard can reduce the risk of concussion by absorbing forces to the jaw that would normally be transmitted to the brain.^{6,7,13-15} Although this claim has been advertised and promoted by several mouthguard manufacturers, studies have consistently failed to link the use of mouthguards to lowered concussion risk.^{8,12,16-21} Without a large body of evidence, it is generally believed that there are many benefits for all players to wear a well-fitting mouthguard.

The majority of traumatic dental injuries occur during childhood and adolescence and a subset of those injuries result from participating in collision and contact sports.^{22,23} Many

patients receive orthodontic treatment during this same developmental period. Full fixed orthodontic appliances with wires and brackets present unique challenges both in terms of risk of soft-tissue injury to the orthodontic patient and his/her opponent from the braces, and in terms of wearing a protective mouthguard appliance. There are three broad categories of mouthguards that are commonly available: 1) over-the-counter, ready-to-use stock, 2) over-the-counter mouth-formed (e.g., boil-and-bite), and 3) dentist fabricated custom-made.²⁴ A custom-made mouthguard is generally the preferred mouthguard of dental professionals because it is believed to offer the best fit, retention, comfort, durability, and protection.²⁵ However, providing a custom mouthguard to orthodontic patients whose teeth are moving or who are wearing fixed orthodontic appliances can pose difficulties.²⁶ Despite the potential benefit to the orthodontic patient from wearing a mouthguard during sporting activities, difficulty obtaining a comfortable, well-fitting mouthguard that does not interfere with the braces or tooth movement may reduce the likelihood that a mouthguard is recommended and/or actually worn.

The ADA has actively promoted the protective value of wearing properly fitted mouthguards while participating in athletic or recreational activities that carry risk of dental injury and endorsed their use since the mid 1990's.⁶ Yet, in a large survey commissioned by the American Association of Orthodontics (AAO) as part of the 2009 "Play It Safe" campaign, 67% of the 1,014 parent responders with children ages 9-17 playing at least one organized sport reported that their child did not wear a mouthguard during organized sports.²⁷ This low rate of mouthguard use raises numerous questions. If a mouthguard is the best available protective device for reducing the incidence and severity of sports-related dental injuries, why aren't more children wearing them? Further, 31% of these parents responded that their child had played an organized sport while being treated with braces or other orthodontic appliances. Yet, this survey did not address how orthodontic treatment influenced mouthguard use or the type of mouthguard selected.

Several reviews have described mouthguard use, and the barriers to their use.^{5,12} However, there has been little research related to mouthguard use for the orthodontic patient. In 2014, Bussell and Barreto surveyed orthodontists in the United Kingdom about their recommendations and use of mouthguards finding that orthodontists most frequently recommended a boil-and-bite mouthguard, followed by custom-made and stock types for their patients in active orthodontic treatment.²⁸ In 1999, Maestrello, surveyed general dentists, pediatric dentists and orthodontists about their attitudes towards mouthguards. General

dentists and pediatric dentists most frequently recommended a custom mouthguard while the orthodontist most frequently recommended the pre-fabricated stock type mouthguard. Orthodontists were also more likely to recommend mouthguard wear for their patients playing basketball than the general dentists and pediatric dentists.²⁹ Despite these studies, there are little data describing the orthodontists' beliefs and practices about mouthguard use, or their role(s) in the prevention of sports-related dental injury. Similarly, there is a scarcity of data about the beliefs, selection, and use of mouthguards by patients receiving active orthodontic therapy while competing in school-sanctioned sports activities. Little has been reported about what types of mouthguards are selected by orthodontic patients, what type of mouthguard is recommended by the orthodontist and from whom patients are receiving advice and education about mouthguards. This study is an initial investigation to better understand these issues.

The goal of this study was to ascertain the beliefs about mouthguard use in a sample of orthodontists in Washington State, describe their existing practices regarding mouthguard recommendations, and identify orthodontists' perceived role(s) in the prevention of sports-related dental injury. We also surveyed orthodontic patients (11-18 years old) involved in organized school basketball and/or football to examine how often they wear mouthguards, reasons for wearing and not wearing mouthguards, their views of mouthguards, the types of mouthguards the athletes report using, and who is advising and educating these patients about mouthguards. Football, one of the five sports (football, ice hockey, field hockey, lacrosse and wrestlers with orthodontic braces) that mandates (required by rule) mouthguard use by the National Federation of State High School Associations, and basketball, a non-mandated sport, were selected for our study as Maestrello and colleagues found that orthodontists, pediatric dentists and general dentists recommended mouthguard use for these two sports more than any other sport.²⁹ High school basketball players are also at more risk of oral injuries than most other sports.³⁰ Football was included as we anticipated more wear by orthodontic patients as it is mandated by the sport, while we hypothesized that mouthguard wear by basketball playing orthodontic patients may be low.

Materials and methods

Subjects.

Orthodontist Interviews. A sample of Washington State orthodontists (n=15) with varying years of experience in private orthodontic practice, were asked to participate in a qualitative interview using a snowball sampling method. Snowballing is also known as chain

referral sampling, which is a type of purposive sampling method.³¹⁻³³ In this study, we asked each participating orthodontist to recommend two to three orthodontists whom they believed might be interested and willing to participate in a study about mouthguards. In order to obtain willing participants, orthodontists that mentioned mouthguards on their practice website were also invited to participate. The request to identify potential participants continued until 15 orthodontists completed the phone interview. These recruitment methods were used to help identify orthodontists who might have an opinion or practice philosophy about mouthguard use. A sample size of 15 orthodontists was judged by the authors to provide a sufficiently large sample to approach the point of saturation such that little new information would be derived from conducting additional interviews.

Patient Surveys. Subjects were patients undergoing active orthodontic treatment with fixed appliances or clear aligner therapy at participating orthodontic offices. Subjects were between the ages of 11-18 years old and currently playing football or basketball on their school team. Patients that participated in the online survey about mouthguards were recruited from 13 of the offices that participated in the orthodontist interview.

All study procedures and materials were approved by the Institutional Review Board of the University of Washington, Seattle, Washington. Informed consent was obtained from all participants just prior to the interviews and electronic surveys.

Procedures.

Semi-Structured Interviews with Orthodontists. A semi-structured interview guide containing open-ended questions and follow-up questions was created by the study team to allow for a 10-15 minute guided interview of the orthodontists to discuss their beliefs, recommendations and approaches toward mouthguards for their patients undergoing active orthodontic treatment (see online Appendix 1). All interviews were conducted one-on-one by the lead author (NB). Each orthodontist gave permission to have the interviews digitally recorded for transcription (Rev.com, San Francisco, CA) and later analysis. At the end of the interview, each orthodontist was asked whether orthodontic patients (11-18 years old) in their offices could be recruited to participate in an online survey of orthodontic patients playing in school sports (football or basketball).

The Survey Instrument and Patient Survey Procedures. Orthodontists who agreed to allow patient recruitment in their offices were given an 8.5”x11” recruitment poster (see online Appendix 2) and asked to display it at their receptionist desk. The subject recruitment poster was displayed during the appropriate sports season (i.e., football poster from September – December 2016; basketball poster from November 2016 – February 2017). The poster informed patients of the study inclusion criteria and that eligible patient participants would receive a \$10 Amazon gift card for completing a brief online questionnaire. The receptionist was instructed to give interested subjects an instruction card that explained how to participate in the survey (see online Appendix 3). That card directed the subject to an online survey written in REDCap (Research Electronic Data Capture) and hosted by the University of Washington. REDCap is a secure, web-based data collection service designed for freely programmable survey research.³⁴ The survey could be taken using a smart phone or computer. Each instruction card had a unique code that allowed access to the online survey. This unique code prevented individuals from completing more than one survey. In addition, the code also linked the survey to the office location where the subject was a patient.

At the beginning of each survey, participants were informed that involvement in the survey was voluntary and that all information gathered would be anonymous and would not impact their orthodontic care. Additionally, this information was included on the reverse side of the instruction card that was given to the participant by the front desk receptionists. Consent to participate was received when the participant clicked a box agreeing to take the survey. No consent was received from parents as approved by the University of Washington Human Subjects Division. Once consent was obtained, subjects then received a series of questions about their experience with mouthguards. The student athlete survey for basketball and football players is available (see online Appendix 4). At the end of the survey, each participant with a mouthguard was given the opportunity to upload directly to the REDCap survey (or text message to NB) a photo of his/her mouthguard for entry into a lottery for an additional \$40 Amazon gift card. All participants were asked to provide their/or their parent’s email address for the sole purpose of being able to receive the electronic Amazon gift card for participating in the study.

Data Analysis.

The fifteen transcribed interviews were assessed for transcription accuracy by the interviewer. All transcripts were then coded by two study investigators (NB and LH) using a

mixed-method, qualitative approach.³⁵ All responses from the 15 interviews were compiled into a comprehensive data summary. Responses to each interview question were recorded and organized into themes, codes and quotes. Survey data from the student athletes are primarily presented using descriptive statistics. Descriptive data are given for frequency of mouthguard use, frequency of reasons for using and not using a mouthguard, frequency of types of mouthguards worn, and frequency of who is recommending mouthguard use to the athletes. A two-sided chi-square test that compares two proportions for independent groups was used to evaluate whether athletes report receiving different recommendations for mouthguard use from relevant stakeholders (coaches, parents, orthodontists, dentists).

Results

Description of Study Participants. Descriptive data are provided for the orthodontists who were interviewed (Table 1) and for the survey participants who were in active orthodontic treatment while concurrently playing either football or basketball (Table 2). Subjects were recruited from 13 orthodontic offices of the interviewed orthodontists who agreed to allow subject recruitment.

Orthodontist Interviews. Of the 15 orthodontists interviewed, 60% (n = 9) were male with a mean of 11.1 years (range 3-26, SD = 7.9) of experience in practice and 40% (n = 6) were female with a mean of 16.5 years (range 6-23, SD = 7.5) of practice experience.

Table 1: Description of Orthodontists Interviewed (N=15)

	Male	Female
Orthodontists interviewed (N)	9	6
Years in Practice (Mean) (SD, Range)	11.1 (7.9, 3-26)	16.5 (7.5, 6-23)
Orthodontists Providing Subjects (N)	8	5
Patients per Orthodontist (Mean) (SD, Range)	6.4 (3.2, 2-12)	4.8 (4.5, 1-12)

Patient Survey. All but one of the football players who completed the survey were male (n = 22). One female completed the football survey but her data were not included in the analysis because they were not representative of the other data, as she reported not wearing a mouthguard during football despite its use being mandated by the National Federation of State High School Associations. Therefore, the data from this subject are not included in the analyses.

The mean age of football players was 14.3 years (n = 22, range of 11-16, SD = 1.3). Fifty-three basketball players completed the survey; 50.9% were male (n = 27, mean age = 14.2 years, range 11-18, SD = 1.9) and 49.1% were female (n = 26, mean age = 14.0 years, range 11-18, SD = 1.4).

Table 2: Description of Patients Surveyed by Sport and Gender (N=75)

	Football	Basketball	
	Male*	Male	Female
Patients (N)	22	27	26
Patient Age in Years (Mean) (SD, Range)	14.3 (1.3, 11-16)	14.2 (1.9, 11-18)	14.0 (1.4, 11-18)
Orthodontists (N) Providing Patients	10	11	10
Patients per Orthodontist (Mean) (SD, Range)	2.2 (1.2, 1-4)	2.5 (2.3, 1-9)	2.6 (1.8, 1-7)
Patients with Fixed Appliances (N)	20	24	21
Patients with Aligners (N)	2	3	5

* One female participant reported playing football; this participant's data were not included in the final analyses.

Qualitative Analysis of Orthodontist Interviews. Orthodontists were asked about their approach to mouthguards for their sports-playing patients who are in active treatment with braces or aligners. Four general themes with fifteen sub-themes were identified from these interviews.

1. Talking with Orthodontic Patient-Student Athletes about Mouthguards.

- a. *Who Has the Responsibility to Educate Patients About Mouthguards?* When asked who should be responsible for educating the student athlete-patients about mouthguard use, most orthodontists believed the responsibility should be shared between the orthodontist, dentist, coach and parent. Most orthodontists believe that more children will wear mouthguards while playing sports if the coach, dentist, orthodontist and parents each take a role in educating athletes about the risks of injuries and motivate them to wear a mouthguard during sporting events.

- *"I feel like when they are in my care with ortho treatment then I would take that upon myself."*
- *"Awareness is our responsibility. I think that, and I think the AAO has pretty much made that a standard. April is that month, National Patient Protection Month."*
- *"Orthodontist, dentist, but to be honest primarily the people that know whether the kids are doing sports or not would be the leagues and the coaches. If they mandate them and they can't play without their mouthguard in football, then they all worry about it. If the coaches were laissez faire, then even no matter whatever us dentists and orthodontists do, you're going to get partial use."*
- *"Ideally I would like to see the coaches of the sports teams require mouthguards. We can talk about it and educate the patient, the dentist can as well. That's where they're going to be putting them in, and if everybody on the team's wearing them, then it'll be easier to get patients to wear them."*

b. *Which Sports Should Have a Mouthguard?* More than half of the orthodontists interviewed stated that they recommended mouthguards for all sports. Other sports specifically named included: football, basketball, soccer, hockey, wrestling, boxing, softball, lacrosse and martial arts. A common response by the orthodontists on recommendations for mouthguard use included the sport's potential for incurring trauma to the participant's face.

- *"We recommend them to anybody playing an active sport, where they could have potential trauma to the face."*

c. *Initiating Conversation about Mouthguards.* Over half of the orthodontists indicated that they themselves, or their assistant/treatment coordinator initiated conversations about mouthguards with their patients. Mouthguards were discussed at the time of consent, at the initial exam, at the time of consultation or at the bonding appointment. Two orthodontists responded that they only discussed mouthguards if they learned that the patient was playing a sport, while the five other orthodontists did not initiate a conversation about mouthguards and only discuss that topic if the patient initiated the conversation.

- *"I start discussing mouthguards with families at the first appointment no matter what the age is."*
- *"Typically, at our bonding appointment, the staff will ask if the kids play sports. Sometimes it comes up in their initial exam or consultation and we make a note that they do, but when we're putting braces on, typically is when we say, "Are you playing any sports?", and then, "Do any of those sports require a mouthguard?" That's how we get the answer."*
- *"We don't typically ask them if they're playing a sport. It's if they volunteer. Any kind of conversation if they volunteer that they're playing a sport then we bring it up."*

2. What is Considered when Recommending a Mouthguard?

a. *Consideration of Patient Characteristics.* Three orthodontists reported that activity level and degree of competitiveness of the sport in which the patient participated was considered when making a recommendation about mouthguards, based on the belief that athletes who are more competitive or play at higher activity levels are more likely to have a dental injury.

- *"If they are playing soccer and they're 6 years old, I'm not very worried about them, but the kids that are elite soccer players and are 12 and 14, I absolutely am a hard sale for that. I ask if they're on a team and then what type of team and then I talk about the skill level because in my opinion, as the skills of the kids improve, the risk increases because the kids are stronger, the balls fly faster, the elbows are sharper and things get traumatized."*

Three orthodontists reported that they are more likely to recommend a mouthguard for someone with increased overjet.

b. *Type of Mouthguard Recommended.* Four orthodontists recommended a custom mouthguard that is made in-office, while three more orthodontists recommended custom mouthguards only occasionally. Nine orthodontists recommended a boil-and-bite mouthguard and only two orthodontists recommended a stock mouthguard.

- *"We encourage them to get custom mouthguards. We offer to make them in our office. "*
- *"Most of the ones in the sports stores are heatable. If they're heatable, we prefer those. We usually tell them, go ahead and try them in, make them fit loose around your teeth, not too tight, because we don't want them to get too tight and knock brackets off. That's somewhat self-serving. For the most part, we just want it protective."*
- *"We recommend the stock type right out of the box, there's just a kind of trough where they bite into it."*

c. *Recommending a Specific Brand Name Mouthguard.* Six orthodontists recommended a specific brand name of mouthguard. Two recommended the Shock Doctor® brand, while two others recommended Under Armour® mouthguards. One recommended Totalgard® and one orthodontist recommended both the Shock Doctor® and Under Armour® mouthguards.

- *"We do encourage moldable mouthguards and there's two brands that we usually recommend. There's the Under Armor Sports Guard® and Shock Doctor®."*

d. *Influence of Mouthguard Cost.* Four orthodontists related that the cost of mouthguards influences their recommendation about what type of mouthguard should be worn. These four orthodontists recommend a boil-and-bite mouthguard as an inexpensive option believing that parents and patients would not spend the extra cost for a custom mouthguard that may need to be remade several times throughout treatment as teeth are moving. The boil-and-bite type is relatively inexpensive and can be re-shaped more than once as treatment progresses.

- *"Because the teeth tend to change as braces align the dentition, mouthguards don't fit. So, parents tend to be a little bit reluctant to invest in a mouth guard, because it's not going to fit. And also, patients won't wear it if it doesn't fit. So, the boil-and-bite was sort of an economical way to get around that."*
- *"They really requested something that fits really, really snugly that was of more low-profile. The problem in orthodontics is, if you get something that fits that well, it limits your tooth movement. We're*

just not that interested in taking a lot of time in making these over and over, because a lot of parents can't afford to pay for multiple mouthguards."

e. Fees Versus No Fees for Mouthguards. Two orthodontists, one who provides a boil-and-bite mouthguard and one who provides a custom mouthguard, said they charge a nominal fee when providing a mouthguard. One orthodontist only charges when providing a custom mouthguard, but usually provides a boil-and-bite mouthguard at no charge to the patient. Eleven others said they do not charge a fee when providing a mouthguard.

- *"We just feel it's part of our good will. They're not that expensive to buy."*

f. Perceptions of Liability for Recommending Mouthguards. Three orthodontists discussed concern about personal liability when making a recommendation for mouthguards that are intended to prevent dental trauma. One orthodontist required a waiver be signed before a mouthguard is provided. One other orthodontist recommended a Shock Doctor® mouthguard because of the dental warranty up to \$10,000 that the mouthguard company provides.

- *"If we give them a mouthguard, they sign a waiver. The purpose of the waiver is to educate them that there are risks that they're playing sports, letting them know that we'll give them a mouthguard, but it's not saying it's going to protect you against injury, maybe lessen the severity of it, but it won't protect you."*
- *"It goes back, again, to liability. If somebody has a mouthguard, there's some liability associated with it, one that comes with an insurance policy is beneficial, because then you can shift that liability across to the manufacturer versus us. I don't love carrying any more liability than I have to."*

3. Influences on the Orthodontist's Approach to Mouthguard Use.

a. Influence of Previous Doctor on Mouthguards. Four orthodontists said that they formed their approach and recommendation for mouthguards based on the approach used by the doctor from whom they purchased their orthodontic practice. Three of these

orthodontists continued to provide the same mouthguard that the previous doctor stocked.

- *"Honestly, this is what we had in the office when I purchased it, and we still have quite a few of them, so I've just continued to give this kind."*

b. *Experience with Traumatic Injuries.* Twelve of the 15 orthodontists expressed that experiences of patients presenting with trauma had a major influence on their approach and practices concerning mouthguards.

- *"I think it's just, if you practice long enough you just get trauma with athletics. That shapes your view of trying to get people more to wear them. I think that seeing trauma makes you want to try to have more people wear them."*

c. *Belief that Orthodontic Appliances Can Be Protective.* Four orthodontists viewed braces as having protective qualities, that braces can protect the teeth and reduce the severity of trauma. At the same time, these orthodontists indicated that there may be an increased risk of soft tissue trauma with braces.

- *"A lot of the dental trauma I've seen has been with braces on and I think the braces have actually protected teeth. Obviously, they don't protect lips so there's some cut-up lips and lips that need to be pulled off brackets, but the braces have probably also saved more serious dental trauma. I tell that to patients that even though the braces are protective to your teeth, they're not protective to your lips."*

Five orthodontists viewed wearing aligners during sports as being "safer than not wearing anything."

4. Characteristics of a Mouthguard.

a. *Obstacles for Mouthguard Use.* More than half of the orthodontists described barriers for mouthguard compliance. One orthodontist recommends to his patients that they find a mouthguard that fits and is most comfortable, or it will not be worn. Another responded that most mouthguards are not worn "because they are bulky and the patient has difficulty breathing." One orthodontist reported previously dispensing a stock

mouthguard that covered upper and lower arches because the office's previous doctor used to provide these to patients. This orthodontist stopped recommending/giving them to patients because, they didn't fit well. Another orthodontist reported that they had received "pushback from patients" about mouthguards because they interfered with speech. Two other orthodontists stated that mouthguards are usually not worn because they are uncomfortable. One said they usually don't fit well so they are not worn. Two other orthodontists stated that mouthguards are only worn when they are required by the sport.

- *"If it is uncomfortable then it won't be worn."*
- *"They were too cumbersome, patients said they couldn't breathe so they wouldn't wear them. They were too bulky and didn't fit."*
- *"It's just whether or not you're going to get kids to wear them or not. Sports where they're required, everybody wears them. Sports where they're not required, pretty much hardly anybody wears them. Doesn't matter whether they have braces or no braces or anything else."*

b. *Inhibit or Hinder Tooth Movement.* Six orthodontists reported that they do not recommend a custom mouthguard because they believe that it will inhibit tooth movement or that the mouthguard will no longer fit well once the teeth are moving.

- *"The custom-made ones are not going to fit if you're trying to move teeth and put appliances on."*

One other orthodontist who regularly recommends a custom mouthguard will instead recommend a boil-and-bite mouthguard if there is a *"lot of tooth movement expected."*

c. *Techniques for Custom-Made Mouthguards.* Those who recommended and made in-house custom fabricated mouthguards reported very similar techniques with one exception. Several different materials were used to block-out, or create space around the braces to allow insertion and removal of the appliance from the mouth as well as to provide relief to accommodate expected tooth movement. Base-plate wax, Triad® Gel, blue block-out resin, and Play-Doh were all reported to work well as materials used to create space around the braces and teeth in the mouthguard. Laminating two layers of

ethylene vinyl acetate (EVA) was used most commonly in the construction of mouthguards.

- *"We do the model with the wires off. And then we take a strip of base-plate wax and block-out where we think the wire and brackets will be. There's a kind of a limit to how much you can do before it won't be retentive."*

Survey Results from Orthodontic Patients Who Are Currently Playing School-Sanctioned Sports. Orthodontic patients were asked via survey about how often they wear a mouthguard, reasons for wearing and not wearing mouthguards, their views of mouthguards, the types of mouthguards the athletes report using, and who is advising and educating these patients about mouthguards.

Frequency of Mouthguard Use. All participants who played football (n=22) reported wearing a mouthguard at least “most of the time” during their current football season (see Table 3). Twenty (20/22; 91%) football players reported wearing a mouthguard “always” during the season while two (2/22; 9%) reported wearing their mouthguard “most of the time.” No football players reported using mouthguards “half of the time,” “only sometimes,” or “never.” Conversely, basketball players were less likely to report frequent mouthguard use compared to football players. Fewer basketball players (both male and female) reported using a mouthguard “most of the time” or “always” (see Table 3) as compared to football players. Most basketball players reported using a mouthguard “only sometimes” or “never” during their sport season (18/27; 67% of males, 21/26; 81% of females).

Table 3: Frequency of Mouthguard Use by Orthodontic Patients (N=75)

	Football Male (n=22)	Basketball Male (n=27)	Basketball Female (n=26)
Always	20(91%)	4(15%)	1(2%)
Most of the time	2(9%)	3(11%)	3(12%)
Half of the time	0(0%)	2(7%)	1(4%)
Only sometimes	0(0%)	3(11%)	3(12%)
Never	0(0%)	15(56%)	18(69%)

Reasons Orthodontic Patients Gave for Using a Mouthguard. The top reasons football players reported wearing mouthguards are that their sport required it (20/22; 91%), it made their mouth and teeth feel protected (20/22; 91%), and they were used to wearing it (17/22; 77%). Seventy-three percent reported their reason for wearing a mouthguard was the recommendation of their dentist/orthodontist (16/22; 73%). Seventy-three percent reported they wore their mouthguard because it stayed in place well (16/22; 73%). Basketball players reported the top reason for wearing mouthguards was because it made their mouth and teeth feel protected (17/20; 85%). The next most commonly reported reasons for wearing a mouthguard by basketball players were: the mouthguard stays in place well (14/20; 70%); and they were given a mouthguard (13/20; 65%); and their orthodontist/dentist told them to wear one (13/20; 65%).

Reasons Orthodontic Patients Gave for Sporadically Using a Mouthguard. The most common response given by both football and basketball (male and female) players for not always wearing a mouthguard was forgetting to wear it (Football: 2/2; 100%, Basketball: 11/15; 73%). Basketball players also reported that wearing their mouthguard made it hard to breathe or talk (9/15; 60%) and that their mouthguard was uncomfortable (9/15; 60%). The two football players who reported wearing a mouthguard “most of the time” reported failing to remember to wear their mouthguard. Additional reasons selected by these two players for not always wearing their mouthguard included: it is uncomfortable, it does not fit well, and it makes it hard to breathe.

Reasons Orthodontic Patients Gave for Never Using a Mouthguard. Of the 31 basketball players who reported they had never worn a mouthguard, 77% (24/31) reported that hardly anyone on their team wears one, 74% (23/31) believed that it might make it hard to breathe or talk, and 68% (21/31) said they never thought about wearing one. In contrast, all football players reported wearing a mouthguard at least most of the time.

Types of Mouthguards that Patients Report Wearing. Survey participants were asked to report the category of mouthguard type that they wear (see Table 4). Overall, stock mouthguards were most commonly worn (23/42; 54.8%) followed by the boil-and-bite type (13/42; 31%). Custom mouthguards were not commonly worn by orthodontic patients (2/42; 4.7%). Nearly 10% (4/42; 9.5%) of respondents could not identify the type of mouthguard they

wore. Only two participants submitted a photo of the mouthguard they wore, which were both the boil-and-bite type.

Table 4: The Category of Mouthguard Type that Patients Reported Wearing. (N=42)

Mouthguard Type	Football	Basketball		
	Male (n=22)	Male (n=12)	Female (n=8)	Both Genders (n=20)
Stock	13 (59%)	7 (58%)	3 (38%)	10 (50%)
Boil-and-bite	6 (27%)	3 (25%)	4 (50%)	7 (35%)
Custom	1 (5%)	1 (8%)	0 (0%)	1 (5%)
Not shown	2 (9%)	1 (8%)	1 (12%)	2 (10%)

Footnote. Patients who reported not wearing a mouthguard are excluded from this table.

Who Recommends Mouthguard Use? Most football players (20/23; 87%) reported that their coach instructed them to wear a mouthguard. Eighteen (18/23; 78%) reported that a parent told them to wear a mouthguard, followed by the recommendation of their orthodontist (15/23; 65%) and their dentist (11/23; 48%). The results for basketball, were different than football in that basketball players, for whom mouthguard use is not required, reported fewer recommendations to wear a mouthguard (Figure 1). Specifically, parents were most often the ones to tell basketball players to wear a mouthguard (18/31; 58%), followed by the orthodontist (16/31; 52%). Thirty-two percent of basketball players reported that their coach had told them to wear a mouthguard (10/21; 32%). Lastly, 23% of basketball players reported that their dentist recommended mouthguard use (7/31; 23%). Patients reporting that 87% of football coaches recommended mouthguard use was statistically greater than the 32% that basketball players reported ($p < 0.0001$; 95% CI, 33.2, 76.2).

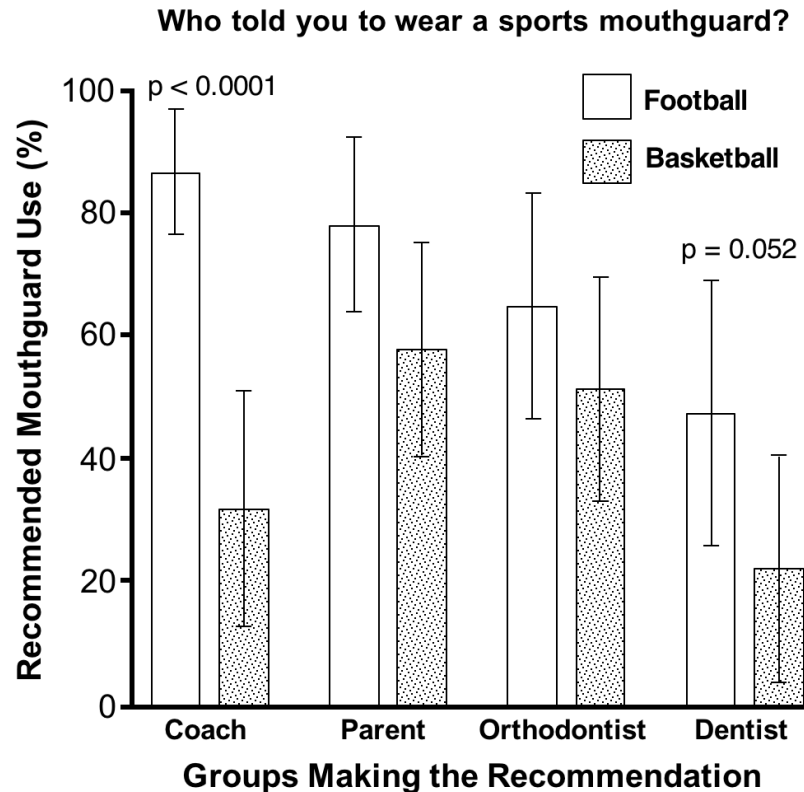


Figure 1. Mean percent (95% confidence interval) of orthodontic patient athletes who indicated whether a coach, parent, orthodontist, and / or dentist recommended that a mouthguard be used while playing football or basketball.

Discussion

Orthodontic treatment can present challenges for obtaining a well-fitting and comfortable mouthguard that accommodates braces. With no clear guidelines or evidence-based recommendations that the orthodontist can present to their student-athlete patients,^{26,28} we wondered how orthodontists viewed this concern and wanted to know what they are recommending to their patients. We also desired to know how often the orthodontic patient wears a mouthguard, what type of mouthguard they wear, and what influences their decision to wear or not to wear a mouthguard while playing football and basketball. To the best of our knowledge, this is the first study of mouthguard use in orthodontic patients playing school sports that directly surveys the student athlete.

We found that most orthodontists felt that they had a responsibility to their patients to inform them about mouthguard use, which is similar to a previous study that found a high percent (97%) of orthodontists who self-reported that they recommend mouthguards to their

athlete patients.²⁹ Most of the orthodontists intend to discuss mouthguards with their patients playing sports and usually have a conversation with the patient at the consult or time of bonding appliances. Boil-and-bite mouthguards were the most often recommended type of mouthguard and stock mouthguards were recommended the least. Yet, from our survey of patients, we found that the stock type mouthguard was used most often. Custom mouthguards were rarely recommended and rarely worn. Football being a mandated sport (i.e., a sport that requires participants to wear a mouthguard) had a high rate of mouthguard use. Conversely, basketball, a non-mandated sport, had a lower use of mouthguards.

The published literature on mouthguard use suggests that only 4.2 - 17% of athletes playing basketball, baseball, softball, and soccer wear mouthguards during competition.³⁶⁻⁴⁰ However, these studies did not report mouthguard use data for the subset of athletes who may have been in active orthodontic treatment. We hypothesized that orthodontic patients having more challenges in finding an acceptable mouthguard, might have an even lower frequency of mouthguard use. To our surprise, 100% of football players surveyed wore a mouthguard at least most of the time, while 44% of male basketball players and 31% of female basketball players had worn a mouthguard during the season. Based on the higher use of mouthguards than anticipated, it is possible that patients actively undergoing correction of their malocclusion are more aware or invested in preventing dental trauma or are being advised on a regular basis to protect their dentition. Another possible reason is that reported mouthguard use frequencies may be outdated. In the last several years, awareness of player safety has increased as advertisements and campaigns to educate athletes have increased. It is possible that the general population today wears a mouthguard more frequently than previously reported. However, our sample of orthodontic patients is not a random sample of orthodontic patients and thus it is not possible to draw a firm conclusion.

Some of the orthodontists who were interviewed for this study considered patient characteristics when recommending mouthguards. A few orthodontists recommended mouthguard use for patients with increased overjet. A recent meta-analysis supports this recommendation as increased overjet more than 3mm in children has been suggested to double one's risk of injury to the anterior teeth and the risk increases as the overjet increases.⁴¹ Indeed, increased overjet is an oral predisposing risk factor associated with traumatic dental injuries, but the anterior incisors are not the only teeth at risk of trauma and those with increased overjet are not the only ones that may have an accident. Consider the seatbelt law while driving. Every

person in a moving automobile is required by law to wear a seatbelt, as every person in the car is at risk of being in an accident. Similar to driving a car, every athlete runs the risk of having an accident. For this reason, shouldn't everyone be recommended a mouthguard while playing a sport activity?

Some of the orthodontists in this study also stated that they consider the athlete's level of activity in making mouthguard recommendations, such that as the elite status of level of play increased so does the importance of mouthguard use. These orthodontists were more likely to recommend a mouthguard fearing that patients that are stronger and more skilled would also play more aggressively and increase one's risk for injury. In contrast, some theorize that athletes at lower skill levels who may be less coordinated or clumsier may in fact be at higher risk than the stronger, more skilled and aggressive athlete. While some of the orthodontists interviewed consider certain patient characteristics before making a recommendation on mouthguard use, the overwhelming majority recommend that everyone playing a sport or activity where there is a potential for injury to the mouth or face should be wearing a mouthguard. Given the nominal cost and availability of mouthguards and the potential for any dentition to sustain an injurious blow regardless of oral predisposing risk factors or level of competitive play, it stands to reason that all players participating in contact sports should wear a mouthguard.

A common theme among these orthodontists was the belief that most athletes, regardless of what recommendation was made by the orthodontist, will not wear a mouthguard unless required. Accordingly, the current survey data from football players indicate that stock was most commonly worn and 91% of players wore their mouthguard all the time and the other two players reported wearing it most of the time. In basketball, a non-mandated sport, only 38% wore a mouthguard at least some of the time and described their mouthguard as being uncomfortable and that it made it hard to breathe and talk. Player acceptability of mouthguards may vary by sport. The orthodontists described many other reasons why they believe mouthguards are not worn. They believe that most athletes will not wear a mouthguard when they are bulky, uncomfortable, expensive, inhibit breathing or speech, and that mouthguards are only worn when a sport requires one to be worn.

A stock mouthguard does not have any retentive features, as it relies on the athlete to hold it in the mouth by biting into it. It is more challenging to hold a stock mouthguard in the

mouth during basketball as the time of continuous play is longer than football and communication during the active play is more common in basketball. Football players generally communicate in-between plays and the plays generally lasts less than 30 seconds. In-between plays, football players often take their mouthguard out, or if it has a strap to the helmet, they take out their mouthguard and replace it before beginning the next play. For these reasons, it is possible that a stock mouthguard would be more acceptable to the football player. One might also assume that basketball players would be more inclined to choose a boil-and-bite mouthguard over a stock because of its more retentive features, however, our sample showed that more male basketball players wore a stock mouthguard and slightly more female basketball players wore boil-and-bite. Perhaps mouthguard usage by basketball players would increase if more players owned a better fitting mouthguard like a boil-and-bite or custom mouthguard as opposed to the stock mouthguard that many of the basketball players reported using.

A better fitting mouthguard for basketball players still does not solve one other problem. As mentioned, football players have a place to store their mouthguard in-between plays; either let it hang from a strap, or some even wedge their mouthguard into a space on the helmet. Basketball players do not have such options. They can either hold it in their hand or chew on it like Steph Curry and other professional basketball players. Basketball uniforms usually do not allow pockets, but a structural solution such as a small convenient pocket in the shorts or jersey would offer a place for players to store their mouthguard in-between plays or while sitting on the bench.

Orthodontists in this study expressed different views about the type of mouthguard to recommend. Most recommended boil-and-bite, followed by custom-made, and then stock. This seemed to reflect the orthodontists' general belief that boil-and-bite styles are adaptable and will more likely be worn by student athletes. However, this does not seem to be the case for football players. Most football players wore a stock mouthguard which is believed to be the poorest fitting type, yet 100% of football players wore a mouthguard and 73% found their mouthguard to fit well despite being the least retentive type of mouthguard. Some orthodontists continued to provide the same mouthguards that the previous owner of the practice provided and some recommended specific brand names.

To the best of our knowledge, there are no studies that looked at the effect a mouthguard has on orthodontic tooth movement. Yet, some of the orthodontists were concerned that custom mouthguards might hinder tooth movement believing they could be too adaptive and would

prevent desired tooth movement during treatment unless a custom mouthguard was re-made several times as orthodontic treatment progresses. Even though boil-and-bite mouthguards were recommended most often and having only one orthodontist recommended a stock type, stock was the most commonly used type, followed by boil-and-bite, while only two of the total number (N= 75) of patients surveyed reported owning a custom mouthguard.

In this sample of student athletes, the infrequent use of custom mouthguards might be attributed to few of the orthodontists recommending a custom mouthguard, but also, in our sample, only one office that regularly recommends a custom mouthguard provided survey subjects and only two offices that occasionally recommend a custom mouthguard provided subjects that completed the survey. Price was not a commonly-reported factor for the student athlete in choosing a mouthguard. Price was also not a common concern of parents in a previous survey conducted by the AAO.²⁷ Some orthodontists did not recommend a custom mouthguard because they thought that patients would not accept the higher costs of a custom mouthguard.

Another concern raised by the orthodontists was that well adapted boil-and-bite mouthguards can lock-on to the braces during the initial molding to the patient's teeth, requiring an orthodontist to cut off the mouthguard, with some reporting that they had seen this. A relatively new type of mouthguard called SISU® is made of a thin rigid thermoadaptable plastic that the patient can fit at home. However, to avoid the material from locking on to braces, the company recommends that for individuals wearing fixed orthodontic appliances, the mouthguard should be fit by an orthodontist.⁴²

A few orthodontists in our study mentioned concerns of liability. Some required a waiver be signed before delivering a mouthguard to the patient. A waiver can explain that a mouthguard may reduce the severity of injury, but that injuries can still happen even with excellent mouthguard use. Two orthodontists recommended a mouthguard to patients that carries its own insurance policy to relieve the burden of possible liability. Some mouthguard brands come with a policy that will cover up to \$10,000 dollars of dental care if the athlete has a dental injury while wearing the mouthguard.⁴³ The issue of mouthguards and liability was discussed in a 2017 AAO podcast.⁴⁴ The AAO's legal counsel indicated that orthodontists can unexpectedly assume liability when providing mouthguards to individuals who are not their patients. In some states, delivering and fitting a mouthguard may begin a doctor-patient

relationship where the orthodontist would be responsible to diagnose gum disease, malocclusions, and oral cancer for example. The podcast suggested that orthodontists who wish to offer mouthguards to non-patients and avoid assuming liability should consider making a monetary donation to the team or club so the team can purchase and provide an over-the-counter mouthguard.⁴⁴

Many techniques were described by the orthodontists about how to fabricate a custom mouthguard for the orthodontic patient. The effort to create a custom mouthguard is likely attributed to the overwhelming opinion from the dental community that custom mouthguards are more protective and more comfortable for the patient.^{45,46} The ADA and other professional dental associations are making recommendations based on research of custom mouthguards on non-orthodontic patients. A 2002 study college men's basketball players indicated the reduced risk of traumatic dental injuries for those wearing a custom made mouthguard compared to those not wearing a mouthguard.⁸ However, there is little evidence that distinguishes one style of MG over another in terms of evidence of clinical protection.¹² The conclusions from these studies may not apply to the orthodontic patient. AAO posters and advertisements that promote mouthguard use suggest patients ask their orthodontist which type is most appropriate for their sport.²⁴ However, there is no standard recommendation for orthodontists to relay to their patients, which leaves many unsure what is the best mouthguard for patients in active orthodontic treatment and whether the recommendation may vary by sport.

After considering all comments of the orthodontists interviewed, the ideal mouthguard would be adaptable and modifiable more than once; it would be comfortable, not bulky, have little inference with speech and breathing, it would be relatively inexpensive, would have its own insurance policy and be widely available for purchase in stores. The standard recommendation for patients not in orthodontic appliances is a custom mouthguard, but a custom mouthguard does not fit all the criteria sought for individuals in active orthodontic treatment. It can be very challenging for the orthodontist to offer and make custom mouthguards for all their patients playing sports considering the time, resources needed, and the possibility of needing to re-make it several times during the course of orthodontic treatment, for these reasons some orthodontists might choose to recommend a stock type mouthguard as a more convenient option.²⁹ As awareness of player safety has increased, more and more products are available. There are many new mouthguards on the market today designed to fit many of the criteria desired by orthodontists that may be more acceptable to the athlete. Although different styles of

mouthguards have been evaluated for comfort in non-orthodontic patients,^{45,46} similar investigations have not been done with orthodontic patients.

How do we increase mouthguard usage in student athletes? In football, despite encountering similar challenges to mouthguard use as other athletes in active orthodontic treatment, 100% of the players wore a mouthguard regularly. Basketball players who sporadically wore their mouthguard and basketball players that never wore a mouthguard reported forgetfulness or having never thought about wearing a mouthguard (n= 11/15 and n=21/31 respectively). A reminder to players before and during practice and games may be a simple intervention to improve mouthguard wear. Also, in a mandated sport, the coach and the parents were very involved making sure nearly every athlete wore their mouthguard. Whereas in basketball, a non-mandated sport, coaches rarely recommended to their players to wear a mouthguard. A previous published survey of coaches' knowledge and views about mouthguard use reported 73% of coaches understood that their athletes were at risk for orofacial injury, yet nearly one third would still not support mouthguard use when not mandated by the sport, even if the mouthguards were provided for free.⁴⁷ If the National Federation of State High School Association mandated mouthguard use for basketball and other sports, coaches, parents, orthodontists and dentists would encourage mouthguard wear more often and perhaps these sports would also have a dramatic increase in mouthguard use. One orthodontist attributed mouthguard awareness to Steph Curry of the Golden State Warriors basketball team as he is often seen playing with his mouthguard. Marketing campaigns with sports stars might be useful as well to increase mouthguard awareness and use.

Most of the orthodontists interviewed felt at least partially responsible for educating their patients on the benefits of mouthguard use and made attempts, usually at the beginning of treatment, to inform their patients of the risks and benefits. Of the patients surveyed, 65% of football players and 52% of basketball players reported being told by their orthodontist to wear a mouthguard. It seems that some of the patients are not remembering these educational moments, or the orthodontists are missing opportunities to educate their patients or they are over-reporting. Perhaps repeated reminders to the patient by their orthodontist is warranted. Orthodontists have a unique opportunity to influence and educate their patients; when patients are in active orthodontic treatment, they are being seen routinely every several weeks over many months during a time in a child's life where they are very active in school sports and are at risk of injury. The orthodontist has more opportunities to provide mouthguards and to encourage

safety by regular mouthguard use than any other healthcare professional for these children. We believe orthodontists should routinely remind their patients and their parents of the benefits of mouthguards to increase their use.

This study has limitations. We did not interview a randomly selected group of orthodontists, but rather selected them based on obtaining a variety of perspectives and feelings toward mouthguard use. Thus, the views expressed by orthodontists are better used to understand issues surrounding recommendations for mouthguard use rather than represent how common these perspectives are among practicing orthodontists. Similarly, the patients surveyed were not selected randomly from orthodontic patients in the state of Washington and thus the survey may not be representative of the state. In addition, our survey neglected to ask football and basketball players who wore a mouthguard to evaluate their mouthguard on numerous factors (e.g. comfort, breathing, speaking). Further studies should also evaluate comfort, fit, and overall player satisfaction with different types of mouthguards as has been done in non-orthodontic patients.^{45,46} Such information would help distinguish which types are best recommended for each sport. The purpose of this preliminary study was to investigate the perspectives of orthodontists and orthodontic patients playing sports to orient future research on this topic.

Future research: There is a need for high quality evidence about which mouthguard styles are most easily worn and are most protective for the orthodontic patient. A prospective randomized trial of different styles to determine player use, comfort, and satisfaction is important. Finding which styles are most protective is needed, yet we recognize that this is challenging for both ethical reasons and because the low occurrence of dental injury which would require using a very large sample size making it difficult to conduct.⁴⁸ In 2006, the ADA Council on Access, Prevention and Interprofessional Relations and the ADA Council on Scientific Affairs co-authored an article on the use of mouthguards to reduce sport-related injury.⁶ That article stated, *“The key educational message is that the best mouthguard is one that is worn. While custom mouthguards are considered by many to be the most protective option, other mouthguards can be effective if worn properly.”* By learning which mouthguard has the greatest comfort and player satisfaction, usage may then increase and in turn reduce traumatic dental injuries.

Conclusions:

- Many orthodontists recommend that everyone playing a sport or activity where there is a potential for injury to the mouth or face should wear a mouthguard.
- Boil-and-bite mouthguards are most commonly recommended by orthodontists for patients in active orthodontic treatment.
- Custom mouthguards are rarely recommended to and rarely worn by athletes in active orthodontic treatment.
- Stock is the least recommended and yet most commonly worn mouthguard type.
- Those playing football (a sport requiring mouthguard use) are significantly more likely to report that a coach recommended mouthguard use compared to those playing basketball (a sport that does not recommend mouthguard use).
- Forgetfulness is a major factor in mouthguard use, while comfort, fit, and the ability to breathe and talk while wearing a mouthguard are very important to athletes.
- Orthodontists differ in how they approach mouthguard use by their patients, which emphasizes the need for evidence-based guidelines.

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Appendix 1

- 1) What is your approach, if any, regarding athletic mouthguard use in your teenage orthodontic population?

Possible follow-ups:

- How is that implemented in your office?
 - How often do you ask your patients whether they play contact sports?
 - Are there specific patient characteristics that make you more likely to ask?
 - Who initiates the conversation about mouthguards?
 - *“I don’t really make a recommendation unless someone asks me…”* How did you arrive at this approach?
 - *“I don’t usually make any recommendation…”* Can you tell me about the last experience you had with a patient regarding MG’s?
 - Who should be primarily responsible for educating patients on mouthguard use? Can you tell me how you arrived at this conclusion?
 - Do you ever collaborate with other professionals to reinforce mouthguard use, like other dentists, coaches, or teachers? Can you tell me about that?
- 2) What is your recommendation?
 - Do you recommend different types of mouthguards, depending on the type of orthodontic treatment that is being done? (e.g., fixed appliances vs aligners)? What do you recommend? What about after debonding – do your recommendations change?
 - You say you recommend a custom mouthguard, do you fabricate this yourself? Can you walk me through the process of how you make one, and how often it should be replaced?
 - You say you recommend a boil-and-bite MG/ stock, do you provide these in your office? If not, where do you send patients to get one? Do you help fit or adjust it? How much do you charge for this type of mouthguard in your office? Do you make a profit on this service?
 - Why do you provide this type of MG?

- 3) What has shaped your viewpoint and approach on athletic mouthguard use among your teenage orthodontic population?

Are there particular activities or patients that you are more likely to recommend MG use for? Why are you more likely to recommend use for this activity/patient?

- Have you had a patient that presented with dental and or orofacial injury? How has this experience altered your recommendation regarding mouthguards?

“I’ve asked you a lot of questions, is there anything else that you would like to add?”

As part of our research, we are also planning to ask orthodontic patients who play middle-school or high-school basketball or football about their experience using mouthguards while wearing braces. Would you be willing to display a small notice at the reception area so that patients know they can participate in this internet research survey and earn \$10?”

What is your age?

What is your gender?

Where did you receive your DDS and MSD education and what year did you graduate?

Appendix 2



**FROM SEPTEMBER 19TH- NOVEMBER 12TH,
COMPLETE OUR QUESTIONNAIRE AND RECEIVE A
\$10 AMAZON GIFT CARD.
SOME PARTICIPANTS WILL QUALIFY FOR A CHANCE
TO WIN AN ADDITIONAL \$40.**

**ARE YOU
11-18 YEARS
OLD?**

**DO YOU
CURRENTLY
PLAY ON A
SCHOOL
FOOTBALL
TEAM?**

**ARE YOU
CURRENTLY
WEARING
BRACES OR
CLEAR
ALIGNERS?**

**IF YES,
EARN \$10
IN 5
MINUTES!**

**TAKE THIS QUESTIONNAIRE ON YOUR
COMPUTER OR SMART PHONE. ASK THE FRONT
DESK FOR THE WEBSITE AND ENTRY CODE.**

W This study is being conducted by the University of Washington Department of Orthodontics



**FROM NOVEMBER 15TH- FEBRUARY 28TH,
COMPLETE OUR QUESTIONNAIRE AND RECEIVE A
\$10 AMAZON GIFT CARD.
SOME PARTICIPANTS WILL QUALIFY FOR A CHANCE
TO WIN AN ADDITIONAL \$40.**

**ARE YOU
11-18 YEARS
OLD?**

**DO YOU
CURRENTLY
PLAY ON A
SCHOOL
BASKETBALL
TEAM?**


**ARE YOU
CURRENTLY
WEARING
BRACES OR
CLEAR
ALIGNERS?**

**IF YES,
EARN \$10
IN 5
MINUTES!**

**TAKE THIS QUESTIONNAIRE ON YOUR
COMPUTER OR SMART PHONE. ASK THE FRONT
DESK FOR THE WEBSITE AND ENTRY CODE.**

W This study is being conducted by the University of Washington Department of Orthodontics

FROM SEPTEMBER 19 - NOVEMBER 12



 COMPLETE OUR QUESTIONNAIRE AND
RECEIVE A \$10 AMAZON GIFT CARD.
 SOME PARTICIPANTS WILL QUALIFY FOR
A CHANCE TO WIN AN ADDITIONAL \$40.

ARE YOU 11-18 YEARS OLD?	DO YOU CURRENTLY PLAY ON A SCHOOL FOOTBALL TEAM?	ARE YOU CURRENTLY WEARING BRACES OR CLEAR ALIGNERS?	IF YES, EARN \$10 IN 5 MINUTES!
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Go to www.redcap.com/athletesurvey and enter
CODE: **UNIQUE ACCESS CODE** to see if you are eligible.
At the end of the questionnaire, enter your email address
to receive your Amazon gift card.

W This study is being conducted by the University of Washington Department of Orthodontics

FROM NOVEMBER 15 - FEBRUARY 28

 COMPLETE OUR QUESTIONNAIRE AND
RECEIVE A \$10 AMAZON GIFT CARD.
 SOME PARTICIPANTS WILL QUALIFY FOR
A CHANCE TO WIN AN ADDITIONAL \$40.

ARE YOU 11-18 YEARS OLD?	DO YOU CURRENTLY PLAY ON A SCHOOL BASKETBALL TEAM?	ARE YOU CURRENTLY WEARING BRACES OR CLEAR ALIGNERS?	IF YES, EARN \$10 IN 5 MINUTES!
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Go to www.redcap.com/athletesurvey and enter
CODE: **UNIQUE ACCESS CODE** to see if you are eligible.
At the end of the questionnaire, enter your email address
to receive your Amazon gift card.

See reverse side for more details.

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Appendix 4

You are being asked to take part in a research study that is being conducted at the University of Washington, Department of Orthodontics. The purpose of the study is to better understand mouthguard use in student athletes. We are asking you to take a survey that will take you about 5 - 10 minutes to complete. This survey can only be taken once by entering the single-use access code printed in RED on the front of the card given to you. You will not be asked to provide your name and the answers that you provide will not be shared with your orthodontist.

We will ask you to enter an email address at the end of the questionnaire so that we can send you an electronic \$10 Amazon.com gift card. You may either enter your email address or your parent/guardian's email address to receive the electronic gift card. This survey will ask you questions about being an orthodontic patient and playing sports. There are no right or wrong answers. We hope that participating in this study and the information you provide may help orthodontists better care for the patients who play sports.

Your email address will only be used to send the electronic gift card. The email address will not be stored and will not be used for any further contact.

If you have any questions about this survey, please contact Dr. Neal Bastian at nbastian@uw.edu.

By checking this box, I confirm that I have read and understand the information statement above, and that I am between the ages of 11-18.

Enter the Unique Code Number located on the card given to you here: _____

Please answer the next questions to see if you are eligible to participate.

1. What is your age in years? _____ (11-18 accepted numerical values) Drop down of 10 or younger, 11 – 18, 19 or older → exit survey if outside acceptable range

2. Are you playing (football/basketball) on a school team **this** season?

- Yes
 No → exit survey

3. **Right now**, do you have braces on your teeth or have removable clear plastic trays to wear to straighten your teeth?

- Yes
 No → exit survey

If one of the above questions disqualifies the participant, then **exit survey, re-entry not allowed**.

To those that are exited: Thank you for your interest in our study, unfortunately you are not eligible to take this survey. If you have any questions, please contact Dr. Neal Bastian at nbastian@uw.edu.

4. Gender: _____

5. Select the kind of treatment below that looks most like what you are wearing now.

BRACES

(brackets glued to your teeth and metal wires)

REMOVABLE CLEAR PLASTIC TRAYS

(i.e. Invisalign, Clear Correct)



6. During **this** (football/basketball) season, how often did you wear a sports mouthguard **while** wearing braces or clear aligners?



- Always → Go to 6a+b
- Most of the time → Go to 6a+b+c+d
- Half of the time → Go to 6a+b+c+d
- Only sometimes → Go to 6a+b+c+d
- Never → Go to 7 then 8, skip question 9 and receive question 10

6a) What are the reasons that you wear a sports mouthguard?

My sport requires I wear one (Omitted for basketball survey)

All of my friends wear one

I was given one

Makes me feel that my teeth are protected

My parents make me

My dentist/orthodontist told me what to use

I'm used to wearing it

Mouthguards are cool

I like the colors and customization of my mouthguard

It stays in place well

6b) What is the number one reason why you wear your sports mouthguard?
Only options selected from above are shown.

6c) What are the reasons why you don't always wear a sports mouthguard?
YES or NO response required for each

It is uncomfortable
I don't think I'll get hurt
It won't protect my teeth or mouth
It doesn't fit well
It makes it hard to breathe or talk
Hardly anyone or no one on my team wears a mouthguard
I forget to wear it

d) What is **your number one reason** for not wearing your sports mouthguard?

Selected only among the reasons identified as YES by in Question 10a.

7. Did you wear a sports mouthguard for (football/basketball) **BEFORE** having braces or clear trays?

- Yes
- No

8. Did anyone tell you that you should wear a sports mouthguard when playing (football/basketball)?

- Yes → Question 8a
- No → Question 9

8a) Who told you to wear a sports mouthguard? Check all that apply.

- Parent
- Coach
- Athletic Trainer
- Dentist
- Orthodontist
- Friend
- Teammate
- Other _____

9. Question skipped if participant reports never wearing a mouthguard in question 6)

9a) Which teeth are covered by your sports mouthguard? (Select One)

- My upper teeth only
- My lower teeth only
- Both my upper and lower teeth are covered by my mouthguard

9b) Which of the following statements are true about your sports mouthguard? Yes or No response required for each.

The color or design is important to me
My dentist/orthodontist gave me one or told me what to use
I chose the same one that my friend or teammate has

My parent picked it out for me
I chose it because of the price
I chose the one I thought was safest for my teeth or mouth
I chose the one that looked most comfortable
I chose the one the store clerk said I should get
I chose the same type of mouthguard that I had before
My school gave me my mouthguard

10. **If Answer to Question 6=Never AND Answer to Question 7=No → Question 10a**

10a) Why don't you wear a sports mouthguard?

YES or NO response required for each

It looks uncomfortable
I don't think I'll get hurt
It won't protect my teeth or mouth
It costs too much
It doesn't fit well
It might make it hard to breathe or talk
Hardly anyone or no one on my team wears a sports mouthguard
I never thought about wearing one

10b) What is **your number one reason** for not wearing a sports mouthguard?

Selected only among the reasons identified as YES by in Question 10a.

If Answer to Question 6=Never AND Answer to Question 7= Yes → Question 11

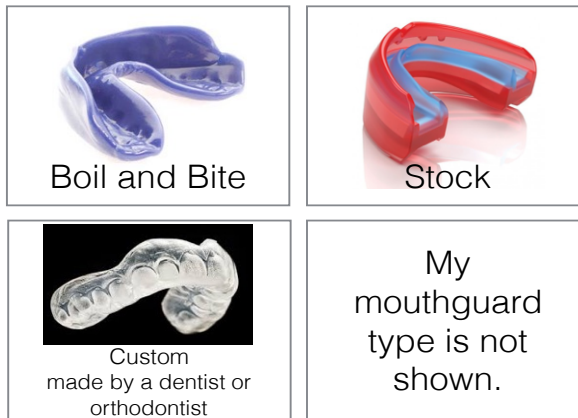
11a) Why did you stop wearing a sports mouthguard while you were wearing braces or clear trays? YES or NO required for each

Too uncomfortable
It doesn't fit
It makes it hard to breathe
It makes it hard to talk
I can't play as well when wearing it
I just don't like them
Forgot to use it
Comes out too easily
It breaks or wears out too fast
It is not cool
No one on my team wears one
I can't wear it now that I have braces

11b) What is the number one reason why you haven't worn a sports mouthguard?

Selected only among the reasons identified YES by responded in Question 11a.

12) Please look at the pictures below. Click on the photo that looks most like the type of mouthguard that you wear while playing football.



Digital Photo

If you use a sports mouthguard while wearing braces or being treated with clear trays/Invisalign[®], you can also enter to win an additional \$40 Amazon gift card. After you complete the survey, you can upload a photo of your mouthguard. If you do not have your mouthguard with you, you can send a text message with a photo of the mouthguard to ###-###-####. If you decide to send a text message with a photo of the mouthguard, you must include in your message the unique number that is printed in RED on the front of the card given to you at your orthodontist's office.

Photo instructions

Be sure to take the photo so that it shows the inside surface of your mouthguard, the side that touches your teeth.

After we finish this study, we will randomly select two photos, and will provide a \$40 Amazon.com gift cards to those two selected participants. If your mouthguard photo is selected, we will contact you to provide the \$40 Amazon.com gift card by email.

Thank you for participating in this survey. Please enter your email address below so that we can send you the \$10 electronic Amazon Gift Card electronically. _____

If you have any questions about this survey, please contact Dr. Neal Bastian at nbastian@uw.edu