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Utilization of the vacuum form machine: Custom mouthguards versus esthetic bleaching trays

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Table of Contents

List of Tables

ABSTRACT

UTILIZATION OF THE VACUUM FORM MACHINE: CUSTOM MOUTHGUARDS VERSUS ESTHETIC BLEACHING TRAYS

By Jacqueline M. Carney, D.D.S.

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University

Virginia Commonwealth University, 2003

Thesis Director: Arthur P. Mourino, D.D.S., M.S., M.S.D.
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Purpose: This study analyzed the percentage of Virginia practitioners using vacuum form machines for mouthguards or home bleaching trays and types of patient information provided for these appliances.

Methods: Questionnaires were constructed and mailed to 2500 dentists

Results: 80% of dentists used vacuum form machines, 42.5% recommended mouthguards, 60.2% recommended home bleaching trays, 37.6% provided patient information on mouthguards, 37.1% provided patient information on home bleaching trays, 16.5% inquired on patient health histories about mouthguard protection during contact sports, and 17.3% inquired on patient health histories about tooth color satisfaction.

Conclusions: Dentists use vacuum form machines for home bleaching trays more than mouthguards. General dentists and pediatric dentists provide patient information on mouthguards and home bleaching trays more often than orthodontists. General dentists provide patient information on home bleaching trays more often than pediatric dentists. Dentists in practice 25 or more years are the most likely to have patient health histories that address the use of mouthguards.

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INTRODUCTION

Many articles have been written about mouthguard protection. Studies have focused on comparisons between mouthguard types [1-4] and attitudes of dentists regarding recommendation and fabrication of mouthguard appliances.[5-7] Likewise, numerous articles exist that address issues concerning the fabrication/recommendation of home bleaching trays.[8-11] Since the fabrication of custom mouthguards and home bleaching trays utilizes similar materials and methods in the office setting, it is possible for practitioners that fabricate home bleaching trays to also fabricate custom mouthguards and vice versa. Currently no articles exist comparing recommendation/fabrication rates of dental practitioners for mouthguard protection versus home bleaching trays.

Organized dentistry has been active in its recommendation of mouthguard protection.[12,13] There are currently four types of mouth protectors: the stock mouthguard, the boil and bite mouthguard, the vacuum mouthguard and the laboratory pressure-laminated mouthguard.[14] The stock mouthguard is available at most sporting store retailers and is ready to use. Commonly available in sizes small, medium and large, the stock mouthguard often does not fit well and requires the individual to clench down on the appliance for retention. The boil and bite mouthguard, available commercially, is made of a thermoplastic material that, when immersed in boiling water, can be fit and formed in the mouth with tongue, cheek, lip and biting pressure. It too often does not fit well and requires clenching pressure for retention. The vacuum mouthguard is supplied by the dentist. It is made by adapting a thermoplastic material over a stone cast of the mouth with vacuum pressure (usually the maxilla in individuals with a class I or II occlusion and the mandible of individuals with class III occlusion). The laboratory pressure-laminated mouthguard differs from the vacuum mouthguard due to the layering of several sheets of mouthguard material under higher heat and pressure than the vacuum mouthguard to achieve chemical fusion of the layers. Because the vacuum mouthguard and the pressure-laminated mouthguard provide a custom fit and other desirable qualities, they have been deemed superior to the stock mouthguard and the boil and bite mouthguard.[3,4,15,16]

The pressure-laminated mouthguard has the additional advantage of increased thickness, which affords increased protection from impact forces.[17]

Tooth whitening has been available to patients for over fifty years. Original techniques proved to be painful, time-consuming and dangerous.[18] Currently, there are five types of bleaching systems available for patients: over-the-counter stock trays, over-the-counter strips, over-the-counter brush on gel, custom trays and in-office systems.[19] The over-the-counter (OTC) stock trays are available at drug stores and come with a one-size-fits all tray that may or may not be adapted to the patient with a boil and bite method. OTC strips, also available at most retail drug stores, are arch-shaped plastic pieces embedded with eighteen percent carbamide peroxide which delivers approximately six percent hydrogen peroxide as part of its whitening system. OTC whitening gel and brush systems are the newest product available on the retail scene and contain the same active ingredient as the OTC strips. The gel is applied to the dry facial surfaces of teeth and does not require the use of a tray. Custom tray systems are available through a dentist and are made by adapting thermoplastic material over modified stone casts. (The stone casts have a spacer or reservoir adapted onto the facial surfaces of casts to increase the amount of gel contacting the teeth). Ten to fifteen percent carbamide peroxide is placed in the trays and worn daily until desired effects are achieved. In office systems require isolation of tooth structure and application of thirty to thirty eight percent hydrogen peroxide without the use of trays. This process may be used with or without heat or light.

Since the 1989 introduction of home bleaching systems with custom, dentist-fabricated trays,[11] the demand for this service has dramatically increased. Surveys indicate that ninety two percent of North American dental schools teach the fabrication and utilization of custom home bleaching trays[8] and as many as ninety seven percent of general dentists offer custom home bleaching tray procedures to their patients.[20] Currently no study exists to assess if the practitioners that are utilizing vacuum form machines for the purpose of fabricating custom bleaching trays are utilizing the vacuum form machine in a similar manner to fabricate custom mouthguards. The purpose of this study is to determine the percentage of practitioners using a vacuum form machine in their practice and the types of appliances fabricated.

METHODS

A thirteen question, one-page survey was sent to 2,500 dentists in Virginia. A survey analyst reviewed the questionnaire. The survey was field tested by distributing it to various faculty members at the Medical College of Virginia School of Dentistry of Virginia Commonwealth University. A final version of the survey was created from comments collected. The dentists were chosen randomly from a list of licensed dentists in the state. If a practitioner did not respond to the survey, a follow-up survey was not mailed to solicit a response. Only general dentists (2,199), orthodontists (213) and pediatric dentists (88) were surveyed. The general dentists were surveyed randomly from the list, thereby allowing general dentists from all regions of the state to be surveyed. The 2,500 surveys sent out represent 65% of all the dentists in the state, or 73% of all general dentists and 100% of all orthodontists and pediatric dentists at the time of the survey. These three groups of dentists were chosen because they usually see the patients on a regular recall basis. Demographic information (sex, age and number of years practicing dentistry) was elicited. Questions were asked about advocating, fabricating and marketing of mouthguards as well as other intraoral appliances. A stamped addressed envelope was enclosed for returned responses.

Participants were asked a yes/no question as to whether or not they routinely recommended mouthguards for their athletically active patients. Respondents that answered "yes" were directed to answer an additional two questions then continue, and

respondents that answered "no" were directed to answer an additional question and continue. All responses were recorded even if more than one response was selected for an item that called for a single response. Comments were summarized and reported where appropriate.

Responses to the questionnaire were tabulated and percent frequency distributions for responses to each item computed. Percents for all items were based on the total number of respondents to the survey or to the three subgroups of general dentists, orthodontists or pediatric dentists. Additionally, the data on

various questions were cross-tabbed and a chi-square analysis or two sample test of proportion was run to determine statistical significance. The value of $p < 0.05$ was regarded as significant.

RESULTS

Of the 2,500 surveys sent out, 1,003 surveys were returned for an overall return rate of 40%. The response rate was 834 (38%) for general dentists, 113 (53%) for orthodontists and 45 (51%) for pediatric dentists. A total of 11 surveys were eliminated. Five surveys were discarded because the dentists indicated that they were retired and no longer practicing dentistry. Four surveys were discarded because the practitioners indicated that they were either dental residents or specialists in an area other than orthodontics or pediatric dentistry. One survey was eliminated because the dentist indicated he performed only administrative work and no clinical dentistry. One survey was eliminated because the practitioner indicated he was both an orthodontist and a pediatric dentist. The number of total usable surveys was 992.

Eight hundred and seventy three practitioners were male (88%), 116 (11%) were female and 3 (<1%) did not specify a gender. Eighteen years was the mean number of years each dentist had been practicing with a range of 0.5 to 50 years. Eleven dentists did not respond to this question.

Practitioners were asked if their office contained a vacuum form machine. Tabulated responses are listed in Table 1. 796 (80.3%) responded yes, 188 (18.9%) responded no and 8 (0.8%) did not respond.

Whether or not a practitioner utilized a vacuum form machine was analyzed by type of practitioner and is listed in Table 2. Vacuum form machines were utilized by 82.1% of general dentists, 73.5% of orthodontists and 62.2% of pediatric dentists. The chi-square analysis of vacuum form machine utilization versus type of practitioner was found to be statistically significant ($p = 0.0003$) for the cross-tabbed data.

Whether or not a practitioner utilized a vacuum form machine was also analyzed by the number of years in practice and the tabulated responses and percentages are listed in Table 3. The analysis of dentists practicing 0-10 years showed 210 answered yes, 35 answered no and 3 did not reply. The analysis of dentists practicing 11-25 years showed 409 answered yes, 94 answered no and 3 did not reply. The analysis of dentists practicing 25 or more years showed 169 answered yes, 56 answered no and 2 did not

reply. The data for utilization of a vacuum form machine was cross-tabbed with the data on number of years practicing and a chi-square analysis determined no statistical significance ($p > 0.05$).

Additionally, whether or not a practitioner utilized a vacuum form machine was analyzed by gender and is listed in Table 4. Vacuum form machines were utilized by 79.6% of male practitioners and 84.5% of female practitioners. A chi-square analysis on the utilization of vacuum form machine usage versus gender was found to be statistically significant ($p = 0.0184$) for the cross-tabbed data.

Practitioners were asked to indicate if they recommend TMJ splints, mouthguards for sports or bruxism or home bleaching trays for patient use. This data was analyzed by practitioner type and is listed in Table 5. Mouthguards were recommended by 58.9% of general dentists, 17.7% of orthodontists and 51.1% of pediatric dentists. Home bleaching trays were recommended by 86.9% of general dentists, 24.8% of orthodontists and 68.9% of pediatric dentists. A two sample test of proportion analysis of the data for practitioner type versus mouthguard recommendation was found to be statistically significant for general dentists versus orthodontists ($p < 0.0001$) and pediatric dentists versus orthodontists ($p < 0.0001$). No statistical significance was found between general dentists versus pediatric dentists ($p = 0.31$). A two sample test of proportion analysis of the data for practitioner type versus home bleaching trays was found to be statistically significant for general dentists versus orthodontists ($p < 0 .0001$), general dentists versus pediatric dentists ($p = 0.01$) and pediatric dentists versus orthodontists ($p < 0.0001$).

Whether or not a practitioner recommended intraoral appliances was also analyzed by the number of years in practice. The tabulated responses and percentages are listed in Table 6. The analysis of dentists practicing 0-10 years showed 54.8% recommended mouthguards and 81.0% recommended home bleaching trays. The analysis of dentists practicing 11-25 years showed 53.8% recommended mouthguards and 80.2% recommended home bleaching trays. The analysis of dentists practicing 25 or more years showed 52.9% recommended mouthguards and 73.6% recommended home bleaching trays. A two sample test of proportion analysis of the data for types of appliances recommended versus years in practice found no statistical significance for mouthguards or home bleaching trays. For mouthguards, 0-10 years in practice versus 11-25 years in practice, $p = 0.779$, 0-10 years in practice versus 25 or more years in practice, $p = 0.666$ and 11-25 years in practice versus 25 or more years in practice, $p = 0.823$. For home bleaching

trays, 0-10 years in practice versus 11-25 years in practice, $p = 0.791$, 0-10 years in practice versus 25 or more years in practice, $p = 0.052$, and 11-25 years in practice versus 25 or more years in practice, $p = 0.051$.

Additionally, the appliances recommended by a practitioner was analyzed by gender and is listed in Table 7. Mouthguards were recommended by 53.7% of male practitioners and 54.3% of female practitioners. Home bleaching trays were recommended by 79.8% of male practitioners and 73.3% of female practitioners. A two sample test of proportion analysis on recommended appliances versus gender was not statistically significant for mouthguards ($p = 0.905$) or home bleaching trays ($p = 0.129$).

Practitioners were asked whether or not they had patient information available on mouthguards or home bleaching trays. This data is listed in Table 8 and shows 44.5% of general dentists had patient information available on mouthguards and 69.7% had information available on home bleaching trays. 23.9% of orthodontists had patient information available on mouthguards and 10.6% had patient information available on home bleaching trays. 44.4% of pediatric dentists had patient information available on mouthguards and 31.1% of pediatric dentists had patient information available on home bleaching trays. A two sample test of proportion analysis on availability of patient information versus practitioner type was found to be statistically significant for mouthguard information for general dentists versus orthodontists ($p < 0.0001$) and pediatric dentists versus orthodontists ($p = 0.015$). Statistical significance was not found for mouthguards for general dentists versus pediatric dentists ($p = 0.996$). A two sample test of proportion analysis on availability of patient information versus practitioner type was found to be statistically significant for home bleaching tray information for general dentists versus orthodontists ($p < 0.0001$), general dentists versus pediatric dentists ($p < 0.0001$) and pediatric dentists versus orthodontists ($p = 0.006$).

Whether or not a practitioner had patient information available on mouthguards or home bleaching trays was also analyzed by years in practice and is listed in Table 9. The analysis of dentists practicing 0-10 years showed 47.6% had patient information available on mouthguards and 66.9% had patient information available on home bleaching trays. The analysis of dentists practicing 11-25 years showed 41.7% had patient information available of mouthguards and 61.7% had patient information available on

home bleaching trays. The analysis of dentists practicing 25 or more years showed 39.2% had patient information available on mouthguards and 55.1% had patient information available on home bleaching trays. No statistical significance was found for mouthguards when comparing 0-10 years in practice versus 11-25 years in practice ($p = 0.127$), 0-10 years in practice versus 25 or more years in practice ($p = 0.065$) or 11-25 years in practice versus 25 or more years in practice ($p = 0.095$). A two sample test of proportion analysis of availability of patient information versus years in practice showed statistical significance for home bleaching trays with practitioners practicing 0-10 years versus 25 or more years ($p = 0.008$). No statistical significance was found for home bleaching trays when comparing 0-10 years in practice versus 11-25 years in practice ($p = 0.153$) or 11-25 years in practice versus 25 or more years in practice ($p = 0.095$).

Whether or not a practitioner had patient information available on mouthguards or home bleaching trays was additionally analyzed by gender and is listed in Table 10. Patient information on mouthguards was available from 41.4% of male dentists and 49.1% of female dentists. Patient information on home bleaching trays was available from 61.2% of male dentists and 62.1% of female dentists. A two sample test of proportion analysis was performed on this data and was not found to be statistically significant ($p = 0.114$ for mouthguards and $p = 0.851$ for home bleaching trays).

Practitioners were asked whether or not patient health histories contained questions about patient satisfaction with tooth color or mouthguard use. This data is listed in Table 11. 35.0% of general dentists had patient questions regarding satisfaction with tooth color and 15.9% of general dentists had patient questions regarding mouthguard use. 8.0% of orthodontists had patient questions regarding satisfaction with tooth color and 20.4% of orthodontists had questions regarding mouthguard use. 8.9% of pediatric dentists had questions regarding satisfaction with tooth color and 13.3% had questions about mouthguard use. A two sample test of proportion analysis of patient questions versus practitioner type was found to be statisically significant for the question regarding the color of teeth for general dentists versus orthodontists ($p < 0.0001$) and general dentists versus pediatric dentists ($p < 0.0001$). Orthodontists versus pediatric dentists did not have statistical significance ($p = 0.852$). A two sample test of proportion analysis of patient questions regarding mouthguard use was not statistically significant for general dentists versus

orthodontists (p = 0.270), general dentists versus pediatric dentists (p = 0.617) or orthodontists versus pediatric dentists (p = 0.267).

Whether or not patient health histories inquired about tooth color satisfaction or mouthguard use was also analyzed by years in practice and is listed in Table 12. The analysis of dentists practicing 0-10 years showed 35.9% asked questions about tooth color satisfaction and 18.1% asked questions about mouthguard use. The analysis of dentists practicing 11-25 years showed 31.4% asked questions about tooth color satisfaction and 12.5% asked questions about mouthguard use. The analysis of dentists practicing 25 or more years showed 23.3% asked questions about tooth color satisfaction and 23.3% asked questions about mouthguard use. A two sample test of proportion with the question regarding color of teeth was found to be statistically significant for 0-10 years in practice versus 25 or more years in practice (p = 0.002) and 11-25 years in practice versus 25 or more years in practice (p = 0.020). No statistical significance with the question regarding tooth color was found when comparing 0-10 years in practice versus 11-25 years in practice (p = 0.225). A two sample test of proportion analysis with the question regarding mouthguard use was found to be statistically significant for 0-10 years in practice versus 11-25 years in practice (p = 0.046) and 25 or more years in practice versus 11-25 years in practice (p = 0.001). No statistical significance was found for the question regarding mouthguard use for 0-10 years in practice versus 25 or more years in practice (p = 0.162).

Whether or not a practitioner inquired about tooth color satisfaction or mouthguard use was additionally analyzed by practitioner gender and is listed in Table 13. Patient health histories addressed tooth color satisfaction with 31.4% of male dentists and 25.9% of female dentists. Patient health histories addressed mouthguard use with 16.5% of male dentists and 15.5% of female dentists. A two sample test of proportion analysis was performed on this data and no statistical significance was found. The p value for male versus female practitioner regarding the question about tooth color satisfaction was calculated to be 0.205 and the p value for male versus female practitioner regarding the question about mouthguard use was calculated to be 0.785.

DISCUSSION

The mouthguard is an important appliance for the prevention of oral injuries. It is important that dental professionals not only recommend these appliances, but also distribute them to ensure patients possess appliances. Custom mouthguards are better than the stock or mouth-formed trays because of their superior protection, retention, fit, ease of speech, resistance to tear and ease of breathing. For these same reasons, the custom mouthguard has the greatest compliance.[3,4,15,16] These mouthguards are relatively simple to make and the results of this survey indicate that a large majority of dentists (80%) have the necessary vacuum form machine to fabricate them.

Practitioner type was found to be statistically significant in this survey when vacuum form machine utilization was considered. General dentists (82.1%) had a larger majority of vacuum form machine utilization than orthodontists (73.5%) or pediatric dentists (62.2%). These differences can perhaps be explained when considering the uses of vacuum form machines in the particular office types. General dentists serve a population with higher prosthodontic and esthetic demands. The vacuum form machine can be utilized for temporary crown and bridge matrices, model duplication, bleaching tray fabrication, custom trays and implant stents, in addition to mouthguards. Orthodontists may be utilizing the vacuum form machine for retainers, bleaching trays or mouthguards. Pediatric dentists may utilize the vacuum form machine primarily for mouthguards, but perhaps also for bleaching trays. Practitioners who provide orthodontic services to their patients may recognize that the custom mouthguard is superior to other protective appliances, but choose not to recommend it because of the ever changing tooth position and appliance changes during treatment, thus reducing the need for a vacuum form machine. The fewer uses a practitioner may have for a vacuum form machine, the less likely he or she may be to utilize one.

In this study, the recommendation rates of mouthguards for general dentists (58.9%), orthodontists (17.7%) and pediatric dentists (51.1%) were much lower than the reported use of vacuum form machines for general dentists (82.1%), orthodontists (73.5%) and pediatric dentists (62.2%). Home bleaching tray

recommendation percentages more favorably correlated to vacuum form machine usage for general dentists (86.9%), orthodontists (24.8%) and pediatric dentists (68.9%). This data suggests that practitioners are utilizing vacuum form machines more often for home bleaching trays than for mouthguards. Profitability may, to some degree, play a part in the different utilization rates of the vacuum form machine for mouthguards versus home bleaching trays. These appliances are essentially fabricated in the same manner, yet there may be a five to ten fold difference in profitability between the two appliance types. Mouthguard fabrication may be seen by many practitioners as more of a community service than a profitable endeavor.

It is also of interest to note that the reported recommendation rates in this study for mouthguards are lower than previous studies addressing mouthguards. Other studies have reported recommendation rates from 71-90%.[5,21] This study had recommendation rates from 17.7-58.9%. The differences noted might be explained by variations in the types of questions asked. If a practitioner is asked if he or she recommends mouthguards or if he or she recommends mouthguards to his or her patients, the responses could be different. Practitioners may, in theory, agree with the first question that mouthguards are an important preventive measure and should be promoted. These same practitioners may not think it is their responsibility to specifically ask their own patients about mouthguard ownership or use and may not actually discuss the appliances in the patient consult. Multiple practitioners made note of this in the comments section of the survey.

Whether or not a practitioner had patient information available on mouthguards or home bleaching trays when compared to type of practice was statistically significant in several categories. General dentists provided patient information on mouthguards and home bleaching trays more often than orthodontists and provided information on home bleaching trays more often than pediatric dentists. General dentists are the likeliest practitioners to treat patients interested in home bleaching trays when compared to orthodontists and pediatric dentists so high percentages of providing this information is to be expected. Additionally, orthodontists might be referring patients back to general dentists for information on home bleaching trays and many pediatric dentists are treating primarily younger children, which would not need home bleaching trays. Since orthodontists and pediatric dentists would likely have the greatest number of patients

participating in contact sports, this survey suggests that these specialists could increase efforts to provide mouthguard information to patients.

Whether or not patient health histories addressed tooth color satisfaction was found to be statistically significant for type of practitioner and years in practice. General dentists and dentists in practice 0-10 years had the highest rates of inquiry and this data supports the theory that the highly esthetic-oriented practices are asking about, recommending and fabricating home bleaching trays.

The number of years a practitioner had been in practice had statistical significance when considering the issue of patient health history information. Practitioners in practice 25 or more years were the most likely to have patient questions that inquired about mouthguards. This could be explained by increased awareness of prevention and the importance of mouthguard use at the time these practitioners were starting practices. Mandatory mouthguard requirements were implemented in 1962 for the National Alliance Football rules committee and in 1973 with the National Collegiate Athletic Association. The Academy of Sports Dentistry was formed in 1983,[22] and practitioners at that time were at the forefront of the push to obtain mouthguard protection for all athletes involved in contact sports.

Organized dentistry has been actively recommending mouthguard protection. It is important that all practitioners with patients involved in contact sports actively recommend mouthguard use. The techniques required to fabricate a comfortable, protective appliance are already being utilized by many practitioners for other appliances and it is possible to provide patients with a valuable service by adapting those techniques to protect the dentition during sporting activities.

CONCLUSIONS

1. General dentists, orthodontists and pediatric dentists use vacuum form machines for home bleaching trays more often than for mouthguards.
2. The recommendation of home bleaching trays or mouthguards for general dentists, orthodontists and pediatric dentists did not increase or decrease significantly when evaluated by years in practice.
3. General dentists and pediatric dentists provide patient information on mouthguards and home bleaching trays more often than orthodontists.
4. General dentists provide patient information on home bleaching trays more often than pediatric dentists.
5. General dentists, orthodontists and pediatric dentists in practice 25 or more years are the most likely to have patient health histories that address the use of mouthguards.

Table 1 – Dentists With Vacuum Form Machines

Response	Number of Dentists
Yes	796
No	188
No Reply	8
Total	992

Table 2 – Vacuum Form Machines by Type of Practitioner

Response	General Dentists		Orthodontists		Pediatric Dentists		All Dentists	
	N	(%)	N	(%)	N	(%)	N	(%)
Yes	685	(82.1)	83	(73.5)	28	(62.2)	796	(80.2)
No	143	(17.1)	30	(26.5)	15	(33.3)	188	(19.0)
No Reply	6	(0.7)	0	(0.0)	2	(4.4)	8	(0.1)
Total	834	(100.0)	113	(100.0)	45	(100.0)	992	(100.0)

Table 3 – Vacuum Form Machines by Number of Years in Practice

Response	0 – 10 Years		11 – 25 Years		25 or more Years	
	N	(%)	N	(%)	N	(%)
Yes	210	(84.7)	409	(80.8)	169	(74.4)
No	35	(14.1)	94	(18.6)	56	(24.7)
No Reply	3	(1.2)	3	(0.6)	2	(0.9)
Total	248	(100.0)	506	(100.0)	227	(100.0)

* Eleven practitioners did not indicate number of years in practice.

Table 4 – Vacuum Form Machines by Gender of Dentist

Response	Male		Female	
	N	(%)	N	(%)
Yes	695	(79.6)	98	(84.5)
No	173	(19.8)	15	(12.9)
No Reply	5	(0.6)	3	(0.3)
Total	873	(100.0)	116	(100.0)

* Three practitioners did not specify gender

Table 5 – Recommended Intraoral Appliances by Type of Practitioner

Appliance	General Dentists		Orthodontists		Pediatric Dentists		All Dentists	
	N	(%)	N	(%)	N	(%)	N	(%)
TMJ Splints	647	(77.6)	90	(79.6)	13	(28.9)	750	(75.6)
Mouthguards	491	(58.9)	20	(17.7)	23	(51.1)	534	(53.8)
Bruxism Appliances	767	(92.0)	89	(78.8)	32	(71.1)	888	(89.5)
Home Bleaching Trays	725	(86.9)	28	(24.8)	31	(68.9)	784	(79.0)
None of These	11	(1.3)	6	(5.3)	1	(2.2)	18	(1.8)
Total	2641		233		100		2974	

* Multiple responses were made by the participants, therefore the total number of selections is greater than the number of participants and percentages are greater than 100. Percentages are based on total number of practitioners in each category.

Table 6 – Recommended Intraoral Appliances by Years in Practice

Appliance	0 – 10 Years		11 – 25 Years		25 or more Years	
	N	(%)	N	(%)	N	(%)
TMJ Splints	187	(75.4)	398	(78.7)	155	(68.3)
Mouthguards	136	(54.8)	272	(53.8)	120	(52.9)
Bruxism Appliances	218	(87.9)	463	(91.5)	198	(87.2)
Home Bleaching Trays	201	(81.0)	406	(80.2)	167	(73.6)
None of These	6	(2.4)	6	(1.2)	6	(2.6)
Total	748		1545		646	

* Multiple responses were made by the participants, therefore the total number of selections is greater than the number of participants and percentages are greater than 100. Percentages are based on total number of practitioners in each category.

Table 7 – Recommended Intraoral Appliances by Gender

Appliance	Male		Female	
	N	(%)	N	(%)
TMJ Splints	673	(77.1)	74	(63.8)
Mouthguards	469	(53.7)	63	(54.3)
Bruxism Appliances	783	(89.7)	102	(87.9)
Home Bleaching Trays	697	(79.8)	85	(73.3)
None of These	14	(1.6)	4	(3.4)
Total	2636		328	

*Multiple responses were made by the participants, therefore the total number of selections is greater than the number of participants and percentages are greater than 100. Percentages are based on total number of practitioners in each category.

Table 8 – Availability of Information on Intraoral Appliances by Type of Practitioner

Appliance	General Dentists		Orthodontists		Pediatric Dentists		All Dentists	
	N	(%)	N	(%)	N	(%)	N	(%)
TMJ Splints	336	(40.3)	43	(38.1)	4	(8.9)	382	(38.5)
Bruxism Appliances	372	(44.6)	21	(18.6)	8	(17.8)	400	(40.3)
Mouthguards	371	(44.5)	27	(23.9)	20	(44.4)	418	(42.1)
Home Bleaching Trays	581	(69.7)	12	(10.6)	14	(31.1)	607	(61.2)
None of These	165	(19.8)	46	(40.7)	20	(44.4)	230	(23.2)
Total	1825		149		66		2037	

* Multiple responses were made by the participants, therefore the total number of selections is greater than the number of participants and percentages are greater than 100. Percentages are based on total number of practitioners in each category.

Table 9 – Availability of Information on Intraoral Appliances by Years in Practice

Appliance	0 – 10 Years		11 – 25 Years		25 or more Years	
	N	(%)	N	(%)	N	(%)
TMJ Splints	92	(37.1)	205	(40.5)	83	(36.6)
Bruxism Appliances	102	(41.1)	207	(40.9)	89	(39.2)
Mouthguards	118	(47.6)	211	(41.7)	89	(39.2)
Home Bleaching Trays	166	(66.9)	312	(61.7)	125	(55.1)
None of These	45	(18.1)	118	(23.3)	62	(27.3)
Total	523		1053		448	

* Multiple responses were made by the participants, therefore the total number of selections is greater than the number of participants and percentages are greater than 100. Percentages are based on total number of practitioners in each category.

Table 10 – Availability of Information on Intraoral Appliances by Gender

Appliance	Male		Female	
	N	(%)	N	(%)
TMJ Splints	340	(38.9)	41	(35.3)
Bruxism Appliances	348	(39.9)	52	(44.8)
Mouthguards	361	(41.4)	57	(49.1)
Home Bleaching Trays	534	(61.2)	72	(62.1)
None of These	204	(23.4)	26	(22.4)
Total	1787		248	

* Multiple responses were made by the participants, therefore the total number of selections is greater than the number of participants and percentages are greater than 100. Percentages are based on total number of practitioners in each category.

Table 11 – Questions on Patient Information Form by Type of Practitioner

Questions on Patient Information Form:

A. Are you pleased with the appearance of your smile?
B. Are you pleased with the color of your teeth?
C. Do you ever clench or grind your teeth?
D. Have you ever had any jaw pain?
E. Do you participate in any contact sports?
F. Do you wear mouthguard protection when participating in contact sport activity?

Question	General Dentists		Orthodontists		Pediatric Dentists		All Dentists	
	N	(%)	N	(%)	N	(%)	N	(%)
A	391	(46.9)	40	(35.4)	6	(13.3)	436	(44.0)
B	292	(35.0)	9	(8.0)	4	(8.9)	304	(30.6)
C	529	(63.4)	88	(77.9)	16	(35.6)	632	(63.7)
D	540	(64.7)	91	(80.5)	15	(33.3)	645	(65.0)
E	136	(16.3)	28	(24.8)	9	(20.0)	172	(17.3)
F	133	(15.9)	23	(20.4)	6	(13.3)	161	(16.2)
None of These	164	(19.7)	11	(9.7)	15	(33.3)	190	(19.2)
Total	2185		290		71		2540	

* Multiple responses were made by the participants, therefore the total number of selections is greater than the number of participants and percentages are greater than 100. Percentages are based on total number of practitioners in each category.

Table 12 – Questions on Patient Information Form by Years in Practice

Questions on Patient Information Form:

A. Are you pleased with the appearance of your smile?
B. Are you pleased with the color of your teeth?
C. Do you ever clench or grind your teeth?
D. Have you ever had any jaw pain?
E. Do you participate in any contact sports?
F. Do you wear mouthguard protection when participating in contact sport activity?

Question	0 – 10 Years		11 – 25 Years		25 or more Years	
	N	(%)	N	(%)	N	(%)
A	134	(54.0)	223	(44.1)	75	(33.0)
B	89	(35.9)	159	(31.4)	53	(23.3)
C	173	(69.8)	330	(65.2)	124	(54.6)
D	185	(74.6)	334	(66.0)	121	(53.3)
E	48	(19.4)	74	(14.6)	49	(21.6)
F	45	(18.1)	63	(12.5)	53	(23.3)
None of These	31	(12.5)	96	(19.0)	63	(28.3)
Total	705		1279		538	

* Multiple responses were made by the participants, therefore the total number of selections is greater than the number of participants and percentages are greater than 100. Percentages are based on total number of practitioners in each category.

Table 13 – Questions on Patient Information Form by Gender

Questions on Patient Information Form:

A. Are you pleased with the appearance of your smile?
B. Are you pleased with the color of your teeth?
C. Do you ever clench or grind your teeth?
D. Have you ever had any jaw pain?
E. Do you participate in any contact sports?
F. Do you wear mouthguard protection when participating in contact sport activity?

Question	Male		Female	
	N	(%)	N	(%)
A	390	(44.7)	45	(38.8)
B	274	(31.4)	30	(25.9)
C	551	(63.1)	79	(68.1)
D	563	(64.5)	80	(69.0)
E	151	(17.3)	22	(19.0
F	144	(16.5)	18	(15.5
None of These	170	(19.5)	20	(17.2)
Total	1993		294	

* Multiple responses were made by the participants, therefore the total number of selections is greater than the number of participants and percentages are greater than 100. Percentages are based on total number of practitioners in each category.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Guevara PH, Hondrum SO, Reichl, RB. A comparison of commercially available mouthguards and a custom mouthguard. General Dentistry July-August, 402-406, 2001.
2. American Dental Association: News of dentistry: fitted mouthguards afford key protection. J Amer Dent Assoc 84:531, 1972.
3. Bass HB, Williams FA. A comparison of custom vs. standard mouthguards. NY State Dent 55:74-76, 1989.
4. Holland GJ. Custom vs. commercial mouthguard use: effect on exercise metabolic-ventilatory response of trained distance runners. J Applied Sports Science Research 10:100-101, 1989.
5. Maestrello CL, Mourino AP, Farrington FH. Dentists' attitudes towards mouthguard protection. Ped Dent 21(6):340-344, 1999.
6. Project Mouthguard: a survey of Illinois dentists' attitudes on mouthguards. CDS Rev Jan-Feb 91(1):28-33, 1998.
7. Padilla R. Overcoming objections: Providing professionally made custom mouthguards. Dent Today Sept, 84-90, 2000.
8. Frazier KB, Haywood, VB. Teaching nightguard bleaching and other tooth-whitening procedures in North American dental schools. J Dent Educ 64(5):357-364, 2000.
9. Boyd MA. Curricular trends in North America. Int Dent J Dec: 38(4):247-51, 1988.
10. Croll TP, Segura A. Tooth color improvement for children and teens: Enamel microabrasion and dental bleaching. J Dent Children Jan-Feb(17):17-22, 1996.
11. Haywood VB, Heymann HO. Nightguard vital bleaching. Quintessence Intl 20(3):176-177, 1989.
12. Johnsen DC, Winters JE. Prevention of intraoral trauma in sports. Dent Clin North Am 35:657-67, 1991.
13. Stenger JM, Lawson EA, Wright JM, Ricketts J. Mouthguards: protection against shock to head, neck, and teeth. J Amer Dent Assoc 68:273-81, 1964.
14. Padilla R. Overcoming objections: providing professionally made custom mouthguards. Dent Today Sept, 84-90, 2000.
15. American Society for Testing and Materials: Standard practice for care and use of mouthguards. Designation F 697-80:323, 1986.
16. Dennis CG, Parker DA. Mouthguards in Australian sport. Aust Dent J 17:228-35, 1972.
17. Hunter K. Modern Mouthguards. Dent Outlook 15:63-67, 1989.
18. Christensen GJ. The tooth whitening revolution. J Amer Dent Assoc September 133: 1277-79, 2002.
19. Sarrett DC. Tooth whitening today. J Amer Dent Assoc November 133: 1535-38, 2002.
20. Christensen GJ. Tooth bleaching: state-of-art '97. CRA Newsletter 21(4):1-3, 1997.
21. Kumamato DP, Meleedy-Rey P, Thayer-Doyle C. Project Mouthguard: a survey of Illinois dentists. CDS Review January/February 28-33, 1998.
22. Going RE, Loeman RE, Chan MS. Mouthguard materials; their physical and mechanical properties. J Amer Dent Assoc 89:84-87, 1974.

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