“Play Ball”
Hands-On Fabrication of Custom Athletic Mouthguards
Kentucky Dental Association Meeting
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Douglas L. Lambert, DDS, FACP, FASD, FASDA, ABAD

Dr. Doug Lambert, DDS, FACP, FASD, FASDA, ABAD

- Partner: Cosmetic, Family & Sports Dentistry, PA. Edina, Minnesota
- 1980 B.S. in Business from the University of Minnesota Carlson School of Management
- 1984 D.D.S. from the University of Minnesota School of Dentistry
- Involved in organized dentistry
- Lecture nationally and internationally on esthetics, composites, and sports dentistry
- Independent consultant and evaluator for many dental manufacturers
- Team dentist for the WNBA Minnesota Lynx for the past twelve years

Options
Options
Options
Options
Options

Confusion?

Minimally Invasive
Tooth Banking
Less is More
My Treatment Philosophy: The Four Principles

- BE CONSERVATIVE
- PROVIDE FUNCTION
- AESTHETICALLY PLEASING
- GOOD LONGEVITY

The “A Team”

- Athletic Trainer
- Team Physicians
- Oral Surgeon
- Endodontist
- Periodontist
- Orthodontist
- Prosthodontist

By the numbers...

Dental injuries are the most common type of oro-facial injury to occur in sports!
(National Youth Sports Safety Foundation)

Of 11,840 children, ages 5-17, sports accounted for 36% of all injuries!
(Bijur, Trumble, et al. 1995)

Studies show that baseball and softball have one of the highest rates of dental injury!
(Davis and Knott, 1984)

Over 80% of all dental injuries from sports occurred to the maxillary front four teeth!
(Davis and Knott, 1984)
"In football, the oro-facial injury rate (where facemasks and mouthguards are worn) was 0.07%, but in basketball...the rate was 34%.”

(Flanders and Bhat, JADA 1995)

...the overall injury risk was found to be 1.6-1.9 times greater when a mouthguard was not worn, relative to when mouthguards were used during athletic activity.


The best mouthguard is the one that is utilized during sport activities. While custom mouthguards are considered by many to be the most protective option, other mouthguards can be effective if they fit well, are worn properly and stay in place.


...an ideal custom mouthguard

- It should be fabricated to adequately cover and protect both the teeth in the arch, and the surrounding tissues.
- It should be fabricated on a stone model taken from an impression of the athlete.
- Adequate thickness in all areas to provide for the reduction of impact forces. In particular, a minimum of 3mm thickness in the occlusal/labial area.

- It should have a seated equilibrated occlusion that is balanced for even occlusal contact. This helps to provide for the ideal absorption of impact energy.
- A fit that is retentive and not dislodged on impact.
- Speech considerations equal to the demands of the playing status of the athlete.
- A material that meets FDA approval.
- The properly fitted mouthguard should be routinely and professionally examined for fit and function.
Learning Objectives for today’s workshop…

• Increase your experience base with custom fabricated mouthguards and how to apply it to your practice

• Goals:
  – Gain knowledge in the various types of mouthguards available for your patients
  – How to become a team dentist in your community
  – Fabricate a two-layer laminated mouthguard using a positive pressure machine
  – Have some fun!

Disclosure Statement
I have no financial or personal ownership interest in any of the products and companies discussed in this presentation. However, Dentsply Raintree Essix Glenroe has assisted the Kentucky Dental Association in allowing me to be with you today.

Questions I get asked…

• How did I become a team dentist?
• How do you become a team dentist?
• What services do you provide?
• How do you get paid?
• Do I have to be at every game?
• Handling emergencies
• What supplies/equipment do I need?

What’s in the bag!

• Gloves, masks, 2 x 2s
• Local anesthetic, topical, syringe, etc…
• Curing light (plug in)
• RMGI (light activated)
• Self-etch dentin bonding agent
• Flowable and body composites
• Battery operated Dremel with burs
• Splinting materials
• Mirror, explorer, perio probe, cotton pliers
• Save-A-Tooth kit
• Other specific dental items…
...a little history on mouthguards

- 1913: Boxer Ted “Kidd” Lewis-first use of mouth protector
- 1962: Mouthguard use for football mandated by NAIA and National Federation of High Schools
- 1973: NCAA mandated MG for football
- 1975: AHAUS mandates for hockey
- 1990: NCAA-mandated colored MGs

“It is estimated that only 4-6% of athletes in non-mandated sports wear mouthguards.”


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Top Ten reasons for not wearing a mouthguard...

#10: I can’t breathe when I wear one
#9: I can’t talk when I wear one
#8: No body else wears one
#7: My dental insurance doesn’t cover it
#6: It’s not required
#5: I play baseball
#4: I have braces
#3: They just don’t work for me
#2: I can still get a concussion
#1: I’ve never been hit in the mouth before!

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FOUR BASIC TYPES OF MOUTHGUARDS

TYPE I: STOCK MOUTHGUARDS
TYPE II: MOUTH-FORMED or “BOIL AND BITE”
TYPE III: CUSTOM-FITTED
- Vacuum formed
- Heat Pressure Laminate

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STOCK MOUTHGUARDS
“Off the shelf and into the mouth”

• Not fitted to the teeth or alveous
• Teeth must be clenched
• Hampers speech and breathing
• Generally not easily or comfortably worn
• Truly offers little, if any, protection
• False sense of security

“BOIL AND BITE” TYPES

• 90-95% of the mouthguard market
• Difficult to achieve a good fit
• 70-99% loss of thickness while fitting
• Cost-effective
• Difficult to breathe and speak
• Difficult to adapt to orthodontic appliances

High-End B & B MGs

Shock Doctor Gel Max

Shock Doctor Braces

Bite-Tech’s “Edge”
TapouT Mouth Guard
www.tapoutmouthguard.com

- Uses Ever-Mold composite technology to allow you to boil and reboil the MG as needed
- Two guards and two straps in every case
- Allows you to bite into the mouth guard when fitting to “lock the jaw” into place
- Touts enhanced performance because it “properly aligns the jaw”

Gladiator from Sports Guard International

- Comes in three different versions: Junior ($45), Pro ($50), and Elite ($75) base prices
- Each model increases thickness layers of the EVA for protection (5mm, 6mm and 8mm)
- Junior or Pro for braces
- Numerous options can push any model over $100
- “Custom” fit from an impression you take on yourself and mail into the company
- Also touts enhanced performance due to oxygen flow from its Free-flow System

360 Mouthguards
www.360mouthguards.com

- A unique customization module where an athlete can see a simulated version of a mouthguard online that has 360 degree rotation allowing for different views. The athlete can choose their desired colors, logo and text that displays on the guard.
- They act as an intermediary, between the athlete and the dentist making it easier for an athlete to find a dentist to take impressions of the athletes teeth, with their online dentist directory.
- Dentist signs up to be a 360 Dentist ($10 first year, and $99 after), but fee of the MG is determined by each office.

Flavored Mouthguards
www.mogosport.com

- The flavors made from all-natural ingredients
- All flavors and materials are FDA compliant & BPA free
- Quick-release tether included
- Not designed for braces
- $10,000 “Dental Warranty”

CUSTOM-FITTED MOUTHGUARDS

- Standard for the profession
- Excellent protection
- High level of patient acceptance
- Can be adapted to mixed dentition or ortho
- Costs will be higher than boil and bite
Vacuum Formed

- Sheet of EVA (Ethyl Vinyl Acetate) is pulled over a cast
- Heat-pressure laminate
  - Multiple layers of EVA
  - Pushes EVA onto the cast with positive pressure
  - Biostar (Great Lakes) or Drufomat (Dentsply Raintree)

Both have 6 times the pressure of any vacuform machine!

Heat-pressure laminate

My options:
1. Two layers of 2 mm or 3 mm EVA
2. One layer of 2 mm or 3 mm EVA with a layer of .040” polypropylene

A custom mouth guard begins with a good impression that has all the anatomical components — including good vestibular extensions.

The cast should be poured so it has a uniform thickness so the EVA material will also have a uniform thickness and not thin out.

Trace a line with a pencil to mark the border limits of the mouth guard and outline the palate extensions as well. Coat the model with a separating agent.

The laminated mouth guard will be made of two layers of 2mm (or 3mm) of EVA. This will create a more uniform thickness in the final product.

The Biostar heats to 427°F and applies 4.8 bars positive pressure.

Remove the first EVA layer from the model and trim the border with a curve crown and bridge scissors following the outline you made with the pencil.

www.greatlakesortho.com
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• Replace the trimmed EVA first layer back onto the model.
• Add name, logo, etc. to the surface prior to adding the second layer.

• Apply a second layer of EVA to the first under the same temperature and pressure.
• Remove from the model and trim with the curved scissors as before.

There are many ways to smooth and polish the edges of the mouthguard. One option is to use the Brasseler H79- EF acrylic bur with fine staggered toothing.
• Fine smooth the edge by heating a #7 wax spatula over a bunsen burner and rolling it over the border to create a very smooth finish.
• Note the finished mouthguard with the proper protective thickness of EVA on the incisal.

Single Sheet vs Laminated

"Double layer or laminate mouth guards have advantages over single-layer ones in terms of longitudinal dimensional stability because of smaller residual stress accumulation during the forming process."


www.cassic.com
www.greatlakesortho.com

Athletic Performance Appliances

• A controversial topic for decades...
• Many case histories and anecdotal reports of enhanced athletic performance with the use of an oral appliance (Bill Heintz, Jack Stenger, Harold Gelb, and others)
• Research in the area has been sparse until recently


Background on Mouthguards and Athletic Performance

• Literature has suggested that mouthpieces (MP) increase strength (Smith, 1978; Smith, 1981; Fuchs, 1981 & Alexander, 1999).
• Garabee (1981) reported that MP use increased a runner’s performance by decreasing injury and increasing training capacity.
• Francis and Brasher (1991) cited that ventilation was improved during heavy exercise with MP use, which suggests a lessened metabolic cost of breathing during exercise.
• Rat models have suggested biting and teeth clenching provide an outlet for tension and stress (Hori, Yuyama, & Tamura, 2004 and Hori, Lee, Sasaguri, Ishii, Kamei, Kimoto, Toyoda, & Sato, 2005).

Can I become Tiger Woods?

STUDY PARAMETERS:
• Evaluated eight professional golfers (5 male and 3 female). Avg age = 20.5
• Performed three trials of 10 driver swings and 10 putts with a stabilization splint (2mm), with a mouthguard (2mm), and with no appliance.
• On the 4th trial, they altered the occlusion from bilateral balanced posterior occlusion to unilateral.

理论如何工作...

- 人在进行体力活动时咬合牙齿是正常的，会压缩颞下颌关节。
- 压缩会触发释放过量的压力激素，如皮质醇（由肾上腺皮质释放）和乳酸，导致疲劳和分心。
- 引起各种效果，如血压和血糖上升，以及免疫反应和蛋白合成下降。
- 舌骨护齿器以一种方式定位下颌，减少对颞下颌关节的压力，减缓负激素的产生。

运动员的反馈...

“我试过，不仅在场上，也在场外的训练。我感觉到了耐力的提升。我更强壮，感觉更好。”
- 艾德里安·彼得森，明尼苏达维京队的跑锋

“(它)帮助我更努力地训练，恢复得更快，滑雪也更有力。”
- 林赛·沃恩，美国奥运金牌得主

“当比赛的关键时刻，我希望我的身体和大脑同步，这种技术让我做到了。”
- 莫瑞安·加博里克，纽约游骑兵队的NHL全明星

“重量感觉没那么重了。”
- 大卫·奥特，波士顿红袜队

更需要研究...

- 额外的研究将评估氧气和二氧化碳的差异，有和没有托架。
- 未来的研究将涉及面部、颈部和下颌肌群放松时下颌的定位变化。

“没有证据表明这是什么导致的（改进的表现）。有证据表明唾液和下颌之间的关系，但我们不知道原因。”
- 安德鲁·梅赫塔，牙科学院院长，塔夫茨大学牙医学院

无功能力护齿器（PPM）

- 基于神经肌肉牙科原理
- 自然定位运动员的下颌，面、颈和下颌肌肉放松。
- 表现结果来自各种因素的组合，包括更高效地功能的神经肌肉结构，以及增加的空气流量。
- 4个级别：关键（$695），1.0（$1495），精英（$2495），签名（$2995）
Studies and Research

At this point, no specific studies or independent research by a major university has been done, or if completed has not been released...and the company has ceased activity.

Latest info at www.ppm-help.com

Comfort and Wearability

- #1 reason athletes give for not wearing a MG
- Study compared a single-layer EVA MG to a double-layer heat and pressure laminated mouthguard
- 22 dental students at University of Pacific who played basketball regularly in a rec league wore both MGs for two weeks

“...the increased thickness of a double-layered heat- and pressure-laminated mouthguard does not reduce comfort and wearability.”


Mouthguards as a Petri Dish!

- Mouthguards harbor a wide range of opportunistic and pathogenic bacteria, as well as fungi, including molds and yeast, creating a complex biofilm
- Football players: soil microorganisms, yeasts and molds
- Hockey players: Gram-negative bacteria and yeasts (Candida)
- Two reports: Both 13 yr old football players
  - Leg injury complicated by bacteria traced to MG
  - Exercise-induced asthma (EIA) complicated by yeasts and molds in MG
- Authors suggested discarding the mouthguards on a weekly basis!


A Properly Fitted Mouthguard will have...

- Adequate thickness in all areas to provide for the reduction of impact forces
- A fit that is retentive and not dislodged upon impact
- Speech considerations equal to the demand of the playing status of the athlete
- A material that meets FDA approval
- Preferably a wearing time of one season of play

Let’s get started!

Hope to see you in Chicago June 19-21!

www.academyforsportsdentistry.org
Inventory Checklist

- Maxillary full arch stone model
- Drufosoft Sports Mouthguard material (3mm ethyl vinyl acetate - EVA)
- Drufomat Scan Pressure machine stations
- Trimming and polishing stations
  - Electric heat knife
  - Various scissors/lab knives
  - Micromotors
  - Trimming burs
  - Polishing brushes (fine, medium, and coarse)
  - Blazer torch
  - Finishing liquid

Pressure Thermoformed Athletic Mouthguards

Comparison of Conventional Vacuum MG’s vs. Pressure Laminated MG’s

- Conventional Vacuum Machines have a forming power of up to 1 atmosphere (14.2 lbs/sq in) which cannot be varied.
- Pressure machines have forming power between 1-6 atmospheres which can be varied.

Heat/Pressure Laminated Custom Made Mouthguards

Drufomat
- Drueve
- Raintree Essix

Erkopress™
- Erködentr®
- Glidewell Laboratories

Biostar®
- Great Lakes Orthodontics.

“State of the Art” Pressure Thermoforming

Pressure Thermoforming with the Drufomat Scan:
- Highest quality dual layered custom athletic mouthguards
- Nightguards/bruxism
- Minor Tooth Movement (MTM) System
- Essix retainers/implant provisionals
- Surgical implant stents
- Bleaching/Fluoride trays

Essix® Plastics Guide
Essix® Plastics Guide

MG Fabrication Costs
- The true $64 question!
- Lab costs range from $60-80 per MG
- What will you charge?
- Purchase of your own machine (Druomat) will pay for itself with the versatility of the unit: (bruxism appliances, Minor Tooth Movement, provisional stents, bleaching trays, etc...)

Keys to the Fabrication of a Custom Made Mouthguard
- Impression
- Fabrication
- Trimming and Polishing
- Placement and Occlusal Equilibration

Impr Essix
- Improved formula alginate
- Excellent elasticity and tear strength
- Two accurate pours per impression
- Two formulas: Color Change and Extra Fast Set
- Extra Fast Set goes two days without shrinking in a closed plastic bag
- Can be mixed by hand or with the Turbo Max

TurboMax
Drufomat Scan System

Set up for the Drufomat

Drufosoft Plastics Guide

Ethyl Vinyl Acetate “Drufosoft Data”

- Softens at 43°C.
- Tensile Strength = 33mPa
- Tear Strength > 18 N/mm²
- When layering plastics, approximately 40% shrinkage occurs.
- Therefore, 2-3mm layers = 3.5 to 4.0mm thick MG

Bar codes make scanning the correct settings a snap!
1. Place the Drufosoft Sports Mouthguard material 3mm blank onto the holding arm.

2. Place the tension ring over the two pins and on top of the plastic.

3. Be sure it is a secure fit.

4. Place the stone cast in the middle of the metal base.

5. Rotate the plate reception with the 3mm plastic blank over the stone cast.

6. Rotate the heating element over the cast and the plastic.

7. Locate the correct bar code for the type, thickness, and layer (1st or 2nd) then scan it into the Drufomat Scan. This presets the heating time and cooling time to exact parameters to ensure an excellent result.

Press the OK button… the heat indicator light will shine red at the base of the Drufomat indicating that the heating process has started.

The plastic will sag as it heats and a long “beep” signals the heating is complete. Rotate the heating element out of the way with your right hand, and press the white button on the left side simultaneously. The pressure chamber closes and the pressure rises.

Once it reaches Level 2, release both the button and the lever.

After the cooling phase ends, you hear a short beep. Release the air pressure valves to improve adaptation of the plastic to the model. Press the white button on the left and the chamber lifts away from the first layer of the MG.
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Remove the tension ring from the plastic and pull off the model and first layer.

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Trim the borders with the electric heat knife – being sure to follow the vestibular borders and the frenum.

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Athletic Mouthguards

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Athletic Mouthguards
Option to end at distal of 1st molar.

Interior detail is exceptional...

Adding Logos and Names

- Very easy to customize your mouthguards with a team logo or player’s name
- Logo can be a premade sticker or simply a paper replica printed off your home computer
- Paste it into place prior to adding the 2nd layer of the clear 3mm Drufosoft

Adding a name is just as easy... especially with a label maker (P-Touch Home and Hobby by Brother). The label tape has a peel off backing which makes it a snap to attach to the 1st layer.

Repeat swinging the plastic and the heating element over the cast.

• Add a clear Drufosoft 3mm blank to the plate receptor and secure the tension ring over it.
• Place the cast with the blue 1st layer onto the metal base plate with the distal end close to the rear. This allows for more coverage of the 2nd layer of the plastic to cover the anterior teeth.
Scan the barcode in for the Drufosoft 3mm 2nd layer as it differs in the heating and cooling times from the 1st layer… if you don’t scan in the proper barcode, the two layers will not laminate!

Press the OK button to begin the heating phase. The clear layer will begin to slump. When the beep sounds, repeat the same steps as before by rotating the heating element away and pushing the white button on the left.

Once the cooling cycle ends, release the air valves again and press and hold the white button, allowing the chamber to lift from the cast. The dual layered laminated mouthguard is completed.

Remove the cast and mouthguard from the Drufomat.

Use the heat knife to trim off the excess clear EVA.

Lots of options available! Try the Sports Mouthguard Trimming Bur (MGTB-1) to smooth the borders and thin out the palate.
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**Thinning out the palate…**

**ScotchBrite polishing wheel**

ScotchBrite is not a trademark of DENTSPLY.

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**Final Laminated MG Using the Drufomat**

Let’s make one!

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**Other uses for the Drufomat**

- Nightguards/bruxism appliances
- Whitening/Fluoride trays
- Minor Tooth Movement (MTM)
- Essix retainers
- Provisional splints
- Implant surgical guides
- Many more…

**Bruxism Splint**

- Hard Splint (Acrylic)
- Soft Splint (Drufosoft® Pro)
- Combination Hard/Soft Splint (Kombiplast)
Bruxism Splint
Combination Hard/Soft with Kombiplast

Pre-laminated Dual Laminate

Hard Acrylic Outer Layer
Soft Inner EVA Layer

Aligning of Teeth

- Full orthodontics
- Invisalign
- Minor Tooth Movement (MTM)

Minor Tooth Movement (MTM)

www.essix.com

- Moving a limited number of teeth – usually 1 to 4 teeth – a distance of 2-3mm within the arch
- Requires space within the arch for the teeth to move into
- Done using clear aligners
- Should be performed on patients with permanent teeth only*

* Exception is pediatric crossbite
Applications for MTM

- Minor esthetic orthodontics
- Positioning for veneer, crown or implants
- Arch alignment for periodontics
- Intrusion to gain implant/bridge space
- Others…

Types of movement possible

- Bodily/Lateral movement
- Rotation
- Tipping
- Torquing
- Space closure (diastemas/extraction space)
- Crossbite correction
- Intrusion (without moving adjacent teeth)
- Extrusion (without moving adjacent teeth)

Good Candidates for MTM

- Patient’s primary concern is esthetics
- No TMD/TMJ symptoms
- No periodontal concerns
- Adequate space for movement
- Second molars present*
- Motivated patient!

MTM Concept:

Space + Force + Time = Tooth Movement
(Sheridan’s First Law of Biomechanics)

Options for Creating Space in the Arch:

- Burs
- Abrasive Strips
- Abrasive Discs

Options for Creating Space in the Aligner:

- Window
- Blockout
- Thermoplier™ Pliers
Questions and clean up…Thanks!

Feel free to contact me at DDSSmile@aol.com

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