

Comparing Conventional Impressions & Digital Scans:

A Clinician's Perspective

A presentation for the
Mid-West Spring Technical Meeting
April 16, 2010

PHD Seminars

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Conventional impressions

(old technology)

vs.

Digital intraoral scanning

(new technology)

The one KEY question: What technologies
will your customers be using?

Impression Materials: What You Don't Know Won't Kill *YOU*, but It Can Kill *YOUR BUSINESS*

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For the lab it is not a question of does it work!

- Can you make it profitable for your lab to invest in a laboratory scanner?
- What technology or systems do you invest in that will be compatible with what your clients are going to use?
- Lab scanner payoff calculator:
www.apexmilling.com

What we will cover today:

- Should dental offices embrace in-office CAD/CAM milling?
- What are the advantages and disadvantages of the current intra-oral digital scanning systems?
- How accurate is a digital scan compared to a conventional impression?
- What are some of the common pitfalls of conventional impression materials?
- What can be done to encourage the accuracy of a conventional impression?
- What can you expect in the future?

When a new technology becomes available, I want to know:

- Does it work?
 - Give me better results
 - Improve my efficiency (decrease time)
 - Make the procedure easier
 - For my patient
 - For myself and my staff
- What will it cost?
 - Initial investment
 - On-going maintenance
- How long will it last before it is out-dated?

Being a resource for your clients

- Don't be afraid to offer your advice
- Don't wait until it is too late to do something about it
- Be genuine and sincere
- It is not about you, it is about helping them

**First question to ask
your dentists?
(or they might ask you)**

**Should dental offices
become a manufacturer?**

Emerging technologies: Scanning and Milling

- Digital impressions
 - iTero (Cadent)
 - Lava C.O.S. (3M)
- Digital impressions PLUS In-office CAD/CAM systems:
 - CEREC 3D (Sirona)
 - E4D Dentist (D4D)
- Laboratory based CAD/CAM systems
 - Scan and Mill

Industry trends:

- Subtractive technology
 - movement away from
 - slower
 - more expensive/waste
- Additive technology
 - research/investment into
 - faster
 - more economical/less waste
 - more accurate

Comparison of Most Common Systems

CEREC AC	Optical	AC(Scanner)	\$54,000
	(powder)	MCXL(Milling)	\$45,000
		Sintering oven	\$12,000
E4D Dentist	Laser (no powder)	CAD/CAM	\$135,000
Lava C.O.S.	Optical (powder)	Digital (video) impression	\$26,900 model cost \$16-20
iTero	Laser (no powder)	Digital impression (model only)	\$25,000 plus \$25-35 per case

Considerations

- Cost
- Material limitations (all ceramic)
- Hardware changes & software updates
- Open & standardized architecture (like DICOM)
- Future integration of technologies (iCAT)
- Digital impressions with or without CAD/CAM in-office milling capability
- Survival

Should dental offices
become the
manufacturer?

NO!!!!!!

(with a few exceptions)

Considerations

- Who are making the predictions and why?
- Can this be cost effective? For all? For some?
- Hardware changes & software updates
- Open & standardized architecture (like DICOM)
- Future integration of technologies (iCAT)
- Survival

The Prediction & The Reality:

- In the early 80's, Francois Duret introduced the concept of digital CAD/CAM to dentistry
- Prediction was that within 10 years the concept would be integrated into daily use by dentists
- 30 years later, about 8% of dentists employ CAD/CAM technology in their office

Who is behind the wheel that drives the dental profession... dentists, labs, &/or manufacturers?

Who's interests are being served... dentists, labs, manufacturers, OR PATIENTS?

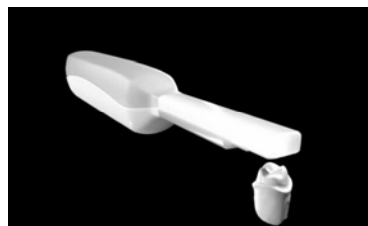
Scanning costs vs. impression costs

	<u>Scan:</u>	<u>Impression:</u>
■ Initial purchase price:	\$22,000+	0
■ Price per impression:	0	\$2-5
■ Cost of temporary:	0	\$20-40
■ Price per model:	\$15-35	0
■ Annual service agreement & software updates	\$1,800+	0
■ Cost of crown seat	?	?

Last year impression material expense in my office was \$1220.00

Almost \$600. less than the annual service and software contract for the 3M COS

Current hardware is bulky and more difficult to use than it appears to be



If you are considering a scanning solution, make sure you have a second...

Accuracy of the intraoral scan

- There is a surprising absence of well-documented, peer-reviewed literature comparing the accuracy of impressions and scans
- Despite this, it seems logical, given the problems with current impression materials and techniques, that intraoral scans are more accurate than impressions

So the **REAL** question to answer:

Is not Will digital impressions become the “standard of care”???

But When will digital impressions become the “standard of care”???

Impact of intraoral scanning on:

- Adequate tooth reduction
- Preparation design
 - Undercuts
 - Degree of taper
- Sub-gingival margins
- Impression techniques

Will the digital technology make a dentist better?
Or will the same problems you now see be the same...or worse?

Has this, in fact, been the reason why some CEREC users put it aside?

If you now have “a” dentist who takes poor impressions, what will you do if they take a poor scan?

Understanding & improving impressions

- To help your dentists
- To help your own lab
 - Less frustration
 - Reduction of remakes, more profitability
- Ultimately, to make it better for the patient

The end-user of EVERYTHING we do!

When labs were asked to identify the 2 most common problems seen in their clients' work:

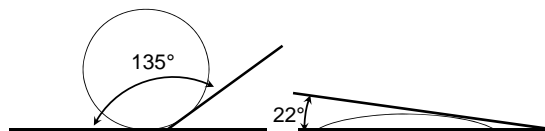
■ Inadequate impressions	59%
■ Inadequate tooth preparations	42%
■ Inadequate bite registrations	26%
■ Incomplete prescriptions	19%
■ Poor margins	19%
■ Poor form/undercuts	10%
■ Non-parallelism	3%

-2006 Survey results
LMT, January, 2006

Areas that you can help your dentist understand about impressions:

- Hydrophilicity of impression materials
- Teeth must be kept dry
- How polymerization shrinkage effects the impression
- Triple trays and how to use them correctly
- Tissue management
- Temperature, chemical & timing of materials

Hydrophilic/Hydrophobic



Accomplished by the addition of surfactants

Wettability vs. Moisture Displacement

- ***There is no relation between contact angle and ability to displace moisture contamination.***

-B.K. Norling, et. al., U of Texas San Antonio
IADR/AADR/CADR 82nd General Session, March, 2004

What does the addition of surfactants do to PVS's?

- In 1st and 2nd generation PVS materials, surfactants increases the amount of material that does not catalyze. The more added the more material that does not catalyze.
- The more material that is not catalyzed, the greater the dimensional instability of the material

Conclusion:

No clinical benefit to the dentist to use a "hydrophilic" impression material.

Hydrophilicity relates to ease of model pouring, has no relationship to moisture displacement, and in fact, may be an undesirable characteristic because of the increase in dimensional instability.

Is there a benefit to Hydrophilicity?

- Study compared surface reproduction of hydrophilized PVS impression materials in dry and wet (saliva) conditions
- Concluded that *hydrophilized PVS impression material reproduced surface detail significantly better under dry conditions.*

-R. PRADELLI, & W.J. DUNN, Wilford Hall Medical Center, TX
IADR/AADR/CADR 82nd General Session, March, 2004

Is there a benefit to Hydrophilicity?

- Study compared surface reproduction of polyethers and hydrophilized PVS impression materials in dry and wet (distilled water) conditions
- Concluded that *with all the materials tested dry conditions produced significantly better detail than wet conditions.*

-Johnson, G.H., Lee, X, Aw, TC
JPD, April, 2003

Conclusion:

The drier the tooth and sulcus the more accurate the impression!

Dimensional Accuracy:

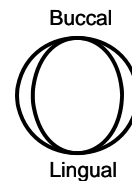
- ANSI/ADA does NOT test for three-dimensional accuracy
- Study evaluating polyether & PVS impression materials found that *all* materials produced *elliptical* shaped dies from round machined steel dies placed in a dentiform model

-Chandur, P.K., et al., University of Washington
JPD, June, 2005

- Numerous other studies in literature confirm this finding

Three-dimensional distortion:

- Distortion causes the BL dimension of dies to be larger & MD dimension to be smaller
- Observed with all brands of all materials– but to differing degrees
- Caused by polymerization shrinkage
 - Towards the center of mass when unrestricted
 - Towards the tray when there is adhesive/mechanical retention



Choice of:

- Dual-arch tray
 - Varieties in design
 - Plastic vs. metal
- Stock tray
 - Quadrant
 - Full
- Custom tray

Dual-Arch Impression Study

- Study evaluated:
 - Effect of metal vs. plastic dual arch trays
 - Viscosity of material on accuracy of dies
 - Which side of the dual-arch tray should be poured first

-Drs. Ceyhan, Johnson, and Lepe
University of Washington
JPD, August 2003

Dual Arch Impressions and Quadrant Disposable Articulators

- Study evaluated 6 most popular systems
- Found virtually impossible to maintain and repeat centric position stops with any system
- Viable for single unit restorations only and not when terminal unit is being prepped

-Thornton, L.J., A Survey on the Utilization of Disposable Quadrant Articulators, 2002: Jan/Feb, Journal of AGD

Conclusion: "There was a statistically significant difference"

- Viscosity selection most significant in BL & OG dimensions
 - Rigid materials produced dies 1 μ m shorter
 - Monophase produced dies 4 μ m taller
- Metal trays were more accurate in the MD dimension
- Monophase materials in plastic trays produced dies 30 μ m smaller in MD dimension
- No difference noted in which side of tray was poured first

Conclusion:

The sturdier the tray the more likely
that distortion will be minimized! Use a
metal tray!

Dual arch impression “Rules”:

- Best for single units only – maximum two!
- Best not used for terminal tooth in arch
- Make sure cuspid is recorded in impression
- Best if patient has cuspid rise occlusion
- Must use HEAVY body material
- Consider metal tray (Quad Tray, Clinician’s Choice)

Stock impression trays

- ~~Quadrant~~
- Full arch
 - Use adhesive compatible with impression material
 - Must take opposing arch impression
 - Must take bite registration
 - Most accurate for multiple or terminal teeth

Custom impression trays

- Study evaluated custom vs. stock trays
- Concluded custom trays save cost of material
- Using laser optical scanners to evaluate stone casts made with custom trays and stock trays, found no difference in accuracy

Source: Mary Broskey, et. al.
JPD, 87:2:202-207
Feb, 2002

Material techniques

- Putty/Wash
 - One step
 - Two step:
 1. Putty impression before prep
 2. Remove 2-3 mm of putty prior to wash, reseal tray
- Heavy body/Light body or Tray/Wash
- Monophase

Effect of Hydrostatic Pressure

- Increased hydrostatic pressure during setting leads to a cast reduction because of the elastic recoil

-Sadat-Khonsari, M.R., University of Hamburg, Germany
ZWR, 108: 288-291, 1999

Conclusion:

The impression should be held in place without operator transfer using only passive pressure with as little movement as possible!

Know your Working and Set Times

Material	Set	WorkingTime (Extra-Oral)	Set Time (Intra-Oral)
Extra Light Body	Regular	3:00	4:30
	Fast	1:45	2:30
Light Body	Regular	2:35	4:30
	Fast	1:35	2:30
Monophase	Regular	2:35	4:30
	Fast	1:35	2:30
Heavy Body	Regular	2:05	4:30
	Fast	1:15	2:30
Putty	Regular	1:25	4:30
	Fast	1:15	2:30

Effect of Preparation Taper

- Study investigated influence of preparation angle on accuracy of one- and two-step impression techniques
- Results: In 2-step impressions, there is a direct relationship between angle of prep taper & margin accuracy. Increasing the angle increases dimensional accuracy.
-C. Fenske University of Hamburg, Germany
Braz Dent J (2000) 11(1): 19-27

Number One Mistake:

Beginning with poor
tissue health!
This will not change with
scanning!!

Number Two Mistake:

Attempting to prepare margins
that are too far subgingivally!
And this won't change with
scanning either!!

Margin placement directly affects:

- Difficulty of preparation
- Difficulty of impression taking
- Which restorative materials can be used
- Which cementation procedures can be used
- More critical than ever with
 - all-ceramic restorations
 - Bonding

Tissue *Retraction*
vs.
Sulcular Expansion

Dual cord technique:
 It's NOT about STOPPING bleeding, It's about
 CONTROLLING hemorrhage BEFORE it starts

- Break contact
- Gross reduction completed
- Measure sulcus depth
- Place 1st cord, then finish/refine preparation
- Second cord placed after completion of all preparation

Dual cord technique

- Second cord placed after completion of all preparation
 - Left in place 3-5 minutes
 - Preparation cleansed with Detail 10 sec.
 - Rinsed
 - Remove top cord immediately prior to syringing material in sulcus and THEN thoroughly dried

**Silicones exhibit poor
 thermal conductivity**

- When cold...stays cold
 - When hot...stays hot
 - Will take 6-8 hours to reach ambient room temperature
 - Rule of thumb: For each 10°F temperature difference, time recommendations will be halved to doubled
- | | | |
|-----------|-----------|----------|
| 60°F | 70°F | 80°F |
| 4 minutes | 2 minutes | 1 minute |

Vinyls are very sensitive to temperature during

- Transportation
 - Manufacturer to Supplier
 - Supplier to Office
- Storage
 - Warehouse
 - Office
- Mixing

"Chilling the material, however, should be approached with caution when using automix tips or dynamic mixing units. Furthermore, reducing the temperature below 18.3° C will affect the flow of the pastes and result in altered base/catalyst ratios."

-Douglas A. Terry DDS
 Practical Procedures & Aesthetic Dentistry
 October 2006
 "The Impression Process: Part 1 Material Selection"

Conclusion:

Care should be given to storing material after received in the office

Allow 8 hours for material to reach room temperature before use

Material affected by:

- Oral temperature (not just storage and transportation temperature)
- Hemostatic agents
- Latex gloves
- Eugenol
- Powders

Conclusion:

Limit handling retraction cords
with gloves

Wash preparation with EDTA-type
cleanser just prior to taking impression to
remove possible contaminants and lower
surface tension

Shelf life dependent on:

- Delivery time, conditions, and storage

- Manufacturer to Company

- Company to Local dealer

- Local dealer to Dentist

Up to 18 months

- Dental office shelf life

- Time

- Temperature

DEGRADES GRADUALLY OVER TIME!!!

Shelf Life

- 1 year
- 1.5 years
- 1.66 years (20 months)
- 2 years
- 3 years

Batch-to-batch Discrepancies

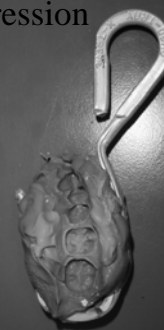
- 6 yrs ago, a gypsum manufacturer wanted to market brands of gypsum with expansion % paired to VPS brands with corresponding shrinkage %
- Project abandoned because:
 - Each brand of PVS tested different (some even expanded vs. the usually observed shrinkage)
 - **EVERY BRAND SHOWED BATCH-TO-BATCH VARIATIONS, SOME AS MUCH AS 30%**

Moisture control

- Anti-sialagogues
- Hemostatic agents and Astringents
 - Epinephrine
 - Non-epinephrine
 - Aluminum sulfate
 - Expa-syl (Kerr)
 - Tissue Goo (Clinician's Choice)
- Cleaning agents
 - Detail (Clinician's Choice)

Before sending your impression to the lab, check for:

- Complete margin 360° around preparation
- Entire preparation is captured in wash material
- No voids, pulls and streaks around preparation
- No tooth or tissue contact with tray
- No separation of material from tray
- Tray and wash material are adequately bonded



Disinfection

- ADA recommends disinfection of ***all*** impressions in the office and marked accordingly, so as to not duplicate the disinfection process
- NADL recommends ***all*** incoming impressions and casts be disinfected, even when received in a heat-sealed bag that has been marked as already having been disinfected

Disinfection

- ***All*** polyether and PVS impression materials exhibit better reproduction of detail when disinfected with a **2% acid gluteraldehyde** solution than alkaline gluteraldehyde or phenylphenol solutions

-Drs. Drennon and Johnson
JPD, 1990

Hand-mixing materials vs. Machine-mixing or Extrusion-mixing

- Because hand-mixing is believed to have the potential to incorporate more microscopic air bubbles that would in turn absorb disinfectant, imbibition, and consequently distortion, would be greater.
-Drs. Lepe, Johnson, and Berg
JPD, August, 1995
- Recommendation: no hand-mixed materials should be used.

1998 OSAP Position Paper

- Hydrocolloid & Polyether Recommendations
 - Gently scrubbed with camel hair brush (1/2 inch bristle) and liquid detergent removing bioburden (sprinkle with dental stone for stubborn materials)
 - Spray with disinfectant (iodophor or NaOCl 1:10) for 10 minute contact time and rinse
- Polyvinyl Siloxine Recommendations
 - Same scrubbing techniques
 - 10 minute immersion in acid glutaraldehyde

Conclusion:

Impressions should be
disinfected in the office, marked
accordingly, and instruct the lab
NOT to repeat the process!

Earliest Model can be poured after taking Impression

- Immediately
- One minute
- 5 minutes
- 15 minutes
- 20 minutes
- 30 minutes
- 60 minutes

Latest Model can be poured after taking Impression

- 7 days
- 14 days
- 21 days
- 30 days
- 49 days
- 60 days
- 90 days
- 109 days
- 360 days
- 365 days

Compatibility with Gypsum

- Study compared surface detail reproduction of various PVS materials with various brands of die stone
- Only 25% of casts completely reproduced a 20 μ m line - wide degree of variation of compatibility of PVS and gypsum
- Concluded that that clinicians & technicians should carefully select compatible brands

-Butta, R. et al., Eastman Dental Institute, London
JPD, June, 2005

Conclusion:

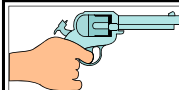
The lab should be given the
brand name of the impression
material and time parameters on
pouring of models!

Vinyls are very sensitive to temperature during

- Transportation
- Storage
- Mixing
- After mixing, transportation to lab is equally critical unless models are poured in the office

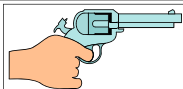
Conclusion:

For maximum control and optimal results, impressions should probably be poured in the office!



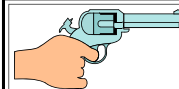
Trouble Shooting Guide: Dentists

1. Material
 1. Type/brand/manufacture
 2. Batch-to-batch variation
 3. Shelf life
2. Transportation
 1. To the distributor/dentist/laboratory
3. Storage
 1. At the distributor/dental office
 2. Ambient room temperature 8 hours prior to taking impression
4. Technique
 1. Tray/adhesive
 2. Syringe/tray material timing – working & setting



Trouble Shooting Guide: Dentists

4. Technique
 3. Dryness of field
 4. Cleanliness of field – free of contaminants
 5. Placement of tray within the arch space – material bulk
 6. Stabilization of tray while setting without hydrostatic pressure
 7. Removal of impression
 8. Entire preparation captured in wash material
 9. Degree of preparation taper
5. Disinfection
6. Model pouring - timing



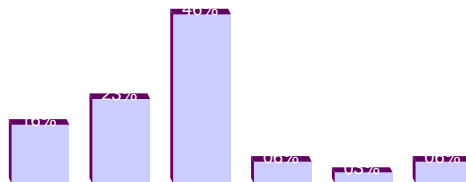
Trouble Shooting Guide: Lab

1. Transportation
2. Disinfection
 1. Type
 2. Timing
 3. Drying
3. Model pouring
 1. Gypsum compatibility
 2. Timing

My prediction:

- Not as soon as you may be led to believe
- Bell Curve of technology adoption
- Based on history with:
 - Air driven handpieces
 - Intraoral cameras
 - Digital radiography
 - CEREC

Which category of equipment do you think will experience the greatest growth in the next three years?



DentalTown On-line Survey; 2007

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