**Recommendations for the Development of AI and Technology for Prosthodontics**

By Edward Feinberg DMD; Chair of Prosthodontics, Dental AI Association

**It is very important to ensure that AI in dentistry pursues the right path. Dentists who practice ideal dentistry have to have an active hand in programming AI in dentistry if it is to be a useful tool in diagnosis, treatment planning and execution.**

It is my hope that the Dental AI Association will guide the direction of AI in Dentistry. Left to its own devices, AI has the power to cause great harm. AI has already been known to make errors and even cite sources that don't actually exist! Many companies are racing to create AI solutions without proper safeguards. AI could easily become biased in recommending poor or incomplete treatment options from listening to internet chatter. The majority thinking in prosthodontics has already proven to be incorrect much of the time. It is insanity to think that a few people in the minority could change the world, but that is what must be done. As Steve Jobs once said, "The ones who are crazy enough to think that they can change the world are the ones who do."

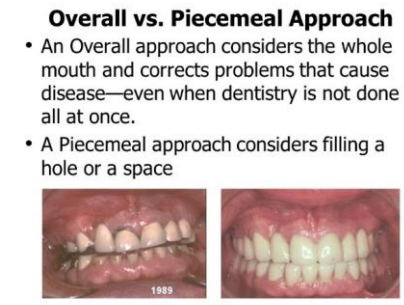
One thing is clear: AI has a promising future only if it can be controlled and guided to make the correct decisions. It is my hope that the Dental AI Association will direct the path that AI will take in Dentistry and ensure that it is safe to use for all practitioners. I am hoping that the Association will work closely with dental AI manufacturers to ensure that no harm is done and that there is true advancement in this developing field.

As Chairman of Prosthodontics, I also want to make sure that all technologies in the prosthetic area of dentistry are properly directed. There are many technologies not based on science that are currently being promoted. Dental AI must not be allowed to lock onto popular myths and misconceptions about these technologies simply because they are promulgated all over the internet. It has to be programmed for correct thinking that is truly based on a high standard of care. I believe strongly that outcomes of any new technologies MUST be compared to the standard of what came before, otherwise there will be no real advancement. This is NOT being done.

My background hails from Dentistry's roots and it is my observation that with much of the new technology, dentists can actually do LESS. Many widely accepted views are based on misconceptions and theories that have been accepted as fact without any proof whatsoever. Everyone marches in lockstep, and nobody thinks critically about what they are doing.

It is important to realize that technology is only a tool; it is not an end in itself. High technology is being used to fool the public into thinking they are getting the best care. Nothing could be further than the truth. As doctors, we are only responsible for the *outcome* of treatment; not the means by which we arrived at that outcome. Not all technology is good technology; and poor technology is not going to result in excellent outcomes.

Seventy years of documentation[1] has clearly identified basic principles that are required for a high percentage of success. From what I can see, a great deal of high technology in prosthodontics actually violates these basic principles. It is my observation that most dentists do not even have any idea what basic principles are required for excellent outcomes.




First, excellent outcomes require an **overall** approach to oral health care—one that looks at the overall mouth with the idea of eradicating and preventing disease. Currently most practitioners have adopted a **piecemeal** approach to dental care—one that only considers filling a hole or a space. This approach does not require critical thinking and is very lucrative. The piecemeal approach is heavily supported by insurance companies, which really do not care about the patient's overall dental health.

The poster child for piecemeal dentistry is the single-tooth implant, which only fills a space and does nothing for the teeth around the space. At lectures and in dental magazine articles, the teeth surrounding the implant site are rarely virginal, but have periodontal bone loss, fillings and crowns or will likely require dentistry in the future. With the piecemeal approach, the patient's problems are never actually solved, and the patients end up with a hodgepodge of treatments.


Sadly, most dentists today only have implant dentistry in their treatment armamentarium. They do not understand the power of full coverage restorations to correct dentitional problems and create health. Worse still is that they have little confidence in their crown and bridge skills. They were taught techniques that veered significantly from the successful techniques that hailed from the origins of full coverage dentistry. The techniques (that just about every dentist is using in mainstream practice) cannot possibly provide consistently successful outcomes. The reasons are discussed in the courses given on [www.theONWARDprogram.com](http://www.theONWARDprogram.com).

**What constitutes an excellent outcome?**

The ideal treatment outcome consists of the following:

1. **Case Longevity**: Ideal dentistry should last for many years in health. It should be resistant to decay, periodontal bone loss, natural tooth and implant fixture loss and breakage.

2. **Contingency:** Ideal dentistry should include a plan for what might go wrong, such as the loss of a weak abutment. If the case is planned properly, the loss of the weak abutment should not jeopardize the overall success of the case.


**3. Replacement is Possible:** Dentistry is not lifetime, and the longevity of cases depends on many factors. Patients should understand that at some point, replacement restorations may be required. The ideal treatment outcome is that when replacement restorations are required, the natural tooth or implant abutments are healthy enough to support a new case.

**4. Patient Comfort and Satisfaction:** Patient satisfaction and comfort during all phases of treatment is a must! The patient must believe in the treatment and have confidence in the practitioner in order for the dentist to achieve an excellent outcome. This means that temporary restorations must fit, function properly and have adequate esthetics. Patients must also be eased into changes carefully. Gradual changes are a lot kinder and more easily accepted than drastic changes. Temporary restorations should be considered as blueprints for the finished case. All the required ideal principles for success should be incorporated in the temporary phase of treatment. If patients are not comfortable during the temporary phase of treatment, it is a sure bet that they won't tolerate the permanent restorations.

**Dental Education and Full Coverage Restorative Dentistry**

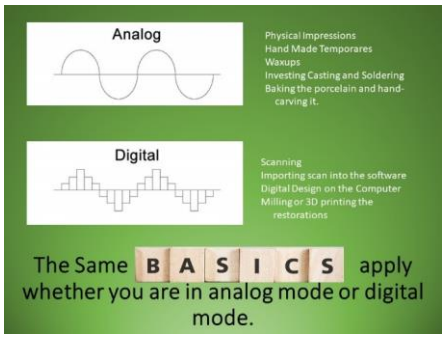
Unfortunately, few dentists embrace the definition of success as just described. It has been my observation that the current generation of dentists does not even respect previous experience, and many young practitioners have the attitude that they know more than older practitioners since they are "modern" and know how to use a computer. They are also poorly prepared in the dental schools since full coverage instruction in these institutions is based on false ideas and unproven myths. No one questions indoctrinated practices, and dentists do not develop critical thinking skills in dental school. They are schooled with high technology that they probably will not have access to in residency programs. As a result, they are poorly equipped to take care of patients when they leave the dental school environment.

Younger practitioners do not understand that much of the new technology actually violates basic principles of science and engineering that are known to contribute to successful outcomes. Many of the problems dentists are having with full coverage restorative dentistry--such as recurrent decay and loss of retention--were actually solved in the 1930s! I have noticed that—of late--there seems to be a general fear of preparing teeth for simple crowns and bridges. I have even witnessed instructors from well-known institutes recommend complicated treatments to avoid preparing a simple, tried-and-true six-unit anterior bridge that would deliver the best esthetic result with the least amount of invasiveness!

Many dentists today have excellent implant skills, but poor crown and bridge skills, and implant therapy has proven to be quite lucrative. It's no small wonder, therefore, that most dentists are placing implants rather than attempting to save teeth. There is an absolute epidemic of tooth

extraction and implant placement. Implants are being overused and used inappropriately. Many teeth that are being extracted can EASILY be saved.

Patients want *choices*, and they want their doctors to excel at full coverage restorations for both natural teeth *and* implants. In actual practice they are rarely offered choices because few practitioners can actually offer them. If you could save your own teeth without implants, isn't that what *you* would want for *yourself*? Implant therapy should be considered as a last resort (except in certain circumstances), not a first resort.




Today's young practitioners also mistakenly believe that "digital" is always better than "analog." This might be true in the future, but it certainly is not true at the present time. In fact, the best outcomes today probably involve a blend of both analog and digital techniques. I believe that it is important to have "analog" skills first, and that these skills will make it easier to absorb digital concepts. However, the dental students no longer do any laboratory work, so they have poor "analog" skills.

The current generation also has no knowledge of where full coverage restorative dentistry came from, so they have no idea how to evaluate digital technology to determine whether it is good or bad. They only know how to evaluate technology from the perspective of "workflow" and "economics," not from the perspective of longevity and health. Young practitioners today seek out the "fast" and "easy." They want "shortcuts" and "cookbook recipes" that do not involve critical thinking.

Such an approach will never result in quality. Quality demands attention to detail, diligence and a step-by-step protocol that reveals errors rather than compounding them. As a result, the current generation can actually do quite a bit *less* with digital than their forbears did with analog.

When I was a resident, my fellow residents and I were so eager to learn from experienced dentists. We would have done anything to learn, and we were always available in the evenings and on weekends when free CE was being offered. But today's generation values time off more than it values free CE. I once offered to give an all-day course to a residency program on a Saturday at my own expense and I was told that the residents would NEVER come on their day off. I have heard lots of complaints about the attitudes of residents from attending dentists I have met.

I always thought I would be a mentor to a young practitioner, since I had an amazing mentor who made me what I am. I have a lot to give. At the beginning of my career, my colleagues would have given their "eye teeth" to have someone like me in their practices willing to teach them everything. I have yet to find a single young practitioner today who would welcome my mentorship—and this is equally true for both New York and Arizona.

The current generation believes that older practitioners are not needed, since all knowledge can be obtained by watching YouTube videos. This mindset is untrue and unlikely to be remedied by AI any

time soon. It is important to recognize that AI is only a tool and will NOT be the answer to everything.

**In order to maximize its usefulness, AI for Dentistry must be engineered to provide education to dental practitioners that is sadly lacking.**

**Full Coverage Restorative Dentistry is *Corrective***


If most dentists were adequately educated in the area of full coverage restorative dentistry, they would know that crowns and bridges are more than mere tooth coverings! They are *corrective!* Only full coverage restorations have the ability to correct abnormalities; to create ideal dentitional architecture, to minimize destructive forces on the periodontal foundation (bone and roots), to prevent recurrent decay, and to minimize or eliminate periodontal bone loss.

Corrective dentistry is possible because of Wolff's Law, which states that bone is deposited and resorbed in accordance with the forces placed upon it. By minimizing destructive forces and compensating for periodontal bone loss, teeth solidify in their sockets and future bone loss is prevented. Periodontal disease is a multifactorial disease and bacterial infection is only one factor. The most common factor is faulty architecture resulting in subjection to destructive forces. Thomas Forde, in his book The Principles and Practice of Oral Dynamics called this factor "force-induced degeneration" in 1964[2]. He stated emphatically that "Forced-induced degeneration problems must be treated with scientifically proven engineering principles.[2]" Carl Misch later made essentially the same recommendations for the prevention of peri-implant bone loss. Corrective treatment must be centered around the reduction of biomechanical stress.

Corrective measures include the following:

a. Correcting muscle-occlusal imbalances
b. Restoring the integrity of the dental arch
c. Creating an Ideal Plane of Occlusion
d. Correcting faulty dentitional architecture
e. Applying mechanical stress breakers such as splinting and precision attachments.

Unfortunately, very few dentists understand how to incorporate these measures in their restorative treatments—primarily because they have not been taught to do so. Ideal dentistry should be fabricated to minimize force transmission, promote periodontal health with good embrasures, and eliminate the likelihood of recurrent decay. Splinting is recommended wherever possible because it distributes the load among a group of teeth rather than subjecting teeth to bear the full brunt of forces individually. It also prevents the possibility of food impaction, which can rapidly destroy a

periodontium. (There is also the added advantage of control should one of the abutments be lost in the future).

**If AI is going to be used properly and efficiently in the future, it must keep basic principles that have proven to contribute to successful outcomes at the forefront of diagnosis, treatment planning and designing/fabricating restorations.**

**Diagnosis**

Critical thinking is an important part of diagnosis and treatment planning. First it is important that dentists understand that they are treating *individuals*. Literature studies only reflect *averages*, and average treatments do not address the requirements, needs and concerns of individuals. As Dr. Jerome Groopman states in his book How Doctors Think, "statistics cannot substitute for the human being before you; statistics embody averages, not individuals.[3]"

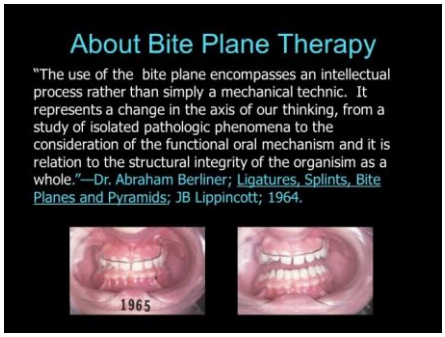
Dentists have differing ideas of how to make an efficient diagnosis. One thing is certain—the first step toward making a diagnosis is fact-finding. The first visit should always concentrate on **fact-finding**. Fact-finding begins with listening closely to the patient's story and questioning them on their medical and dental histories. A good listener will uncover patient needs and preferences and avoid making the same mistakes as the previous dentist. Patient needs and preference play an important role in formulating the correct treatment plan. In fact, patient needs and preferences are specifically stated in the ADA's definition of evidence-based dentistry:

"Evidence-based dentistry is an approach to oral heath care that requires the judicious integration of clinical findings, patient needs and preferences, and the dentist's expertise."


Dentists conduct examinations with differing ideas about how to uncover the facts. At the very minimum dentists should start with a full series of X-Rays, upper and lower models (or scans), probing, clinical intraoral photographs, oral cancer screening and TMJ examination.

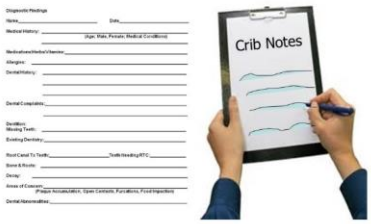
**AI has the power to compile data from thousands of patients, but it must have a streamlined method of inputting data for proper analysis.**

A standardized history and diagnostic form can make it easy for dentists do a proper diagnosis and enter facts into the computer. There should be standardized procedures for collecting images (X-Rays and intra-oral photographs), performing oral cancer screenings, and conducting TMJ examinations. Dental AI has already proven to be of great value in identifying pathology that is easily missed by the human eye.




Model examination can be accomplished by intra-oral scanning or by "analog"-- taking impressions and examining the models. Analog models can also be scanned into the computer via desktop scanning. Model examination uncovers abnormalities with occlusion and with the dentition that may not be obvious on clinical examination. Abnormal wear and midlines that do not line up when the models are in occlusion are tipoffs that the jaw muscles are in disharmony with the occlusion.

The disharmony must be confirmed with additional diagnostic procedures, such as diagnostic appliances. (There are other methods of accomplishing this task as well.) Appliance therapy has been around since the 1960s and Dr. Abraham Berliner's ground-breaking book explains how to use appliance effectively to identify and treat muscular-occlusal disharmony. Unfortunately, many dentists are unaware of the importance of identifying muscular-occlusal disharmonies, which may occur without any clinical symptoms.[4]




Write Down Every Abnormal Finding

In clinical practice, the data from the history, images and models should be compiled into a sheet that will greatly assist the operator in his or her clinical examination. The operator should study the sheet prior to the clinical examination, which is usually conducted during the second visit. If the treatment plan is obvious, the information can be communicated to the patient in the second half of this visit. However, in complex cases, the doctor may need additional appointments and consultation with specialists in order to determine the best treatment option. It is always a mistake to make snap determinations of treatment or to make everyone fit into the same treatment "mold."

**The final diagnosis will consist of all the abnormal findings collected from each area of the examination.**

**Treatment Planning for Full Coverage Restorative Dentistry**

Because sound principles of science and engineering are not taught in the area of full coverage restorative dentistry, dentists do not have enough treatment options in their armamentaria. Most do not even understand what is possible with full coverage restorations. Here is a list of some procedures that are generally not known or recommended:

1. **How to save "hopeless" teeth** flush with the gingiva without posts, buildups, fancy extrusion, or extensive crown lengthening. These teeth are, in reality, no different than teeth with clinical crowns. The approach taught in every dental institution is incorrect because it focuses on tooth structure *above* the gingiva, when the best approach focusses on tooth

structure *below* the gingiva. Dentists also have misconceptions about the amount of gingival attachment (biologic width) that is necessary for health.

2. **How to make copper band (or aluminum shell) temporaries** that fit like permanent restorations and do not fall out. This option works well for patients who are not candidates for sophisticated dentistry or who not ready to have permanent restorations at the present time. Copper band temporary restorations fit like permanent restorations and seal the teeth against recurrent decay. They will ensure that the teeth will be in good condition when the patient is ready to have permanent crowns and bridges. In an emergency where an anterior tooth has fractured flush with the gingiva, copper bands temporaries are a godsend. Copper is extremely anti-bacterial, and studies have shown it harbors zero bacteria, unlike stainless steel and other materials[5].

3. **How to fabricate crowns and bridges that are *corrective;* i.e that resist recurrent decay and loss of retention.** Crowns and bridges for both natural tooth and implant abutments can be fabricated to compensate for periodontal bone loss, prevent periodontal bone loss, promote gingival health, and minimize the forces acting on the periodontal foundation.

4. **When to use Underlay Copings and Telescopic Overlays** to create a contingency plan in a weak mouth for weak abutments, to provide transition to different types of restorations, and to splint sections of bridgework for full arch splinting.[6]

5. **Why the Double-Tilt Precsion Attachment Case has the best track record of any treatment option in dentistry.** This concept was invented in 1906 and works on the weakest natural teeth imaginable. Using this concept with implant abutments avoids involvement with the sinuses and the inferior alveolar nerve. (I wrote a textbook on this subject, and it is available on Amazon.com)[7].

6. **How to achieve full arch splinting in a weak mouth without making roundhouses.**

7. **How to ease patients into major restorative changes with a plan that incorporates gradual changes toward the ultimate outcome.**

8. **How to choose the type of treatment plan that is best for each implant patient**—fixed bridgework, precision attachment case or overlay denture. Dentists have to understand that fixed bridgework is not always the best choice. Many implant cases are being created with large superstructures that clearly overload the implant fixtures and that do not facilitate home care and promote hygiene. Dr. Carl Misch's Stress Treatment Theorem[8] is based on years of studies and research that warns against the very practices that are running rampant. A basic engineering premise is that any engineered structure that is overloaded with forces WILL fail—and this is true for bridges in the mouth just as it is true for bridges across the river. If too much gingiva and bone (pink material) must be added for lip support, removable options should be given priority. If cantilevers might place too much stress on available implant fixtures, perhaps the best approach is an implant fixed bridge

with a double-tilt precision attachment partial denture or an implant-supported overdenture.

One of the worst restorations ever devised is the all-on-four case that seems to be all the rage. To make this case a lot of bone is removed to flatten the ridges. The implants are rarely placed deep enough or are placed at angles that are not ideal for the absorption of vertical forces. A large superstructure that includes the missing gingiva and bone is usually screwed into these implants and home care is just about impossible to accomplish by the patient. Sometimes the implants are immediately loaded--an experimental and unproven procedure. These factors make it likely that all-on-four cases will fail, and when they do the patients will probably not be candidates for implants and they won't even be able to comfortably wear a denture because the ridges have been destroyed.

9. **When to make fixed bridgework cases and when to make cases with removable partial dentures**. Very few dentists know anything about the Double-Tilt Precision Attachment case, which has perhaps the best track record of any treatment option in Dentistry for longevity. The concept was invented in 1906 and has been used successfully for a hundred years (at least 20 years with implant abutments). It is ideal for use with both natural tooth and implant abutments. The Double-Tilt Precision Attachment Case has been very successful in restoring cleft palate patients, who are not candidates for implant therapy.

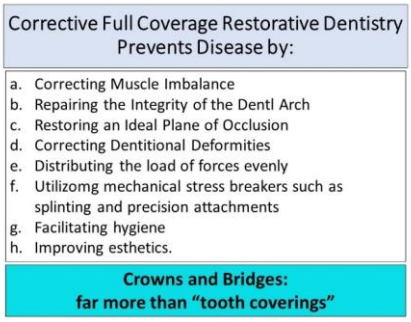
**Dental AI must include treatment options for those who are candidates for sophisticated dentistry and for those who are not in its treatment armamentarium in order to formulate the best treatment plan for each individual patient. It will have to be PROGRAMMED to avoid all of the misconceptions that are running rampant throughout the internet, including recommendations from "experts" who know nothing about alternative treatments that have a documented track record of success.**

**Dental AI will have to be instructed in how to evaluate the periodontal foundation properly and in how to determine the best approach to correcting abnormalities after considering the use of adjunctive treatments such as endodontics, orthodontics, periodontics, orthognathic surgery, and full coverage restorative dentistry. AI will have to know how to combine these treatments to suggest the best outcome with the least amount of invasiveness and with the most reasonable length of treatment.**

I have seen major institutes promote complex treatment that takes many years to accomplish when an acceptable result could have been obtained in much less time with a little esthetic compromise. Sometimes I think these institutes promote complex treatment on purpose so that the class attendees will refer patients rather than attempt the procedures themselves.

**Along with making its treatment recommendations, AI will have to provide appropriate sources of information for dentists who lack the appropriate knowledge to carry out those recommendations.**

**About Veneers**



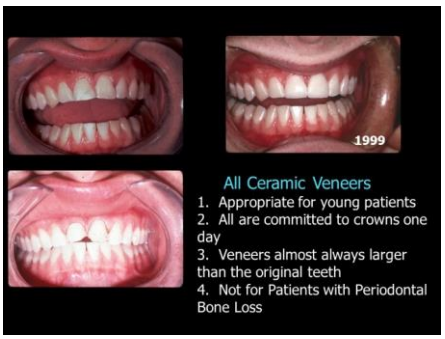

Here's what full coverage restorations can do for patients, aside from creating ideal esthetics:

1. Prevent Recurrent Decay
2. Compensate for Periodontal Bone Loss to prevent future bone loss
3. Minimize forces on the supporting structures (bone and roots)
4. Distribute forces on the supporting structures among a group of teeth through splinting
5. Eliminate Food Impaction Areas
6. Eliminate abnormal vectors of force
7. Change the alignment of the dentition in an arch
8. Create ideal architecture of individual teeth and of the dental arch
9. Promote health and cleansability of the dentition and periodontal structures

Veneers can accomplish none of these feats. Veneers are merely fillings that cover the buccal surfaces of the teeth. They are useful only for esthetic improvement. Unlike full coverage crowns and bridges, veneers and fillings can never be sealed at the micron level, where bacteria live.

Because veneers can only bond well to the enamel layer, it is impossible to fabricate veneers that are not larger than the original teeth. Veneers are thus likely to place *more* stress on periodontal structures.

A young patient with no periodontal bone loss is likely to tolerate the larger veneers. However, older patients—especially those with periodontal bone loss—may not tolerate veneers because the already compromised teeth are now overloaded with forces. By contrast, full coverage restorations can be made *smaller* than the original teeth and fabricated to ideal size, shape, and form. They can also be splinted to distribute the load evenly. This approach minimizes and balances the forces properly on the supporting bone. Some practitioners prepare teeth for veneers like ¾ crowns, where only the lingual surfaces are unprepared. This type of preparation doesn't make sense since




the teeth are almost prepared for full crowns anyway. Wouldn't it be better to make full crowns that have the benefits described above? AI will have to know this.

Now, it may seem like I am totally against veneers, but that is not true. I think veneers are quite suitable for young people with perfect bone and gingiva. Young individuals have teeth with very large pulp chambers, and they are more likely to require root canal therapy with standard crown and bridge preparations than older individuals, because the nerves tend to shrink during the aging process. Also, young individuals have higher tolerance than older patients and they are more likely to have less problems if the teeth are made larger with veneer restorations. There is a place for all types of restorations but is important that AI have a clear understanding of their limitations so they can be used appropriately.

There is one caveat--all patients who opt for veneers are committed to doing crowns one day. I doubt that many are being properly informed when they decide to have veneers. The teeth have been irreversibly cut. There will come a time when the dentistry requires replacement as dentistry is not lifetime. When that day comes, veneers will no longer be the correct treatment; the patient will require crowns.


There also seems to be a growing group of dentists who are afraid to prepare teeth, and some even profess to specializing in "minimally invasive dentistry." I have seen instructors at major institutes place an anterior single tooth implant and prepare the teeth around the implant for veneers. This makes no sense. If the teeth are going to be cut anyway, that patient would be better off with a six-unit bridge from canine to canine. This is one of the most predictable restorations because the canines are the cornerstones of the arch and provide the most support so that teeth do not drift and cause diastemas and food impaction areas. It is possible to make bridgework that lasts for years in health on just two canines and no incisors. Implants are NOT the solution to every restorative problem. It is NOT necessary to restore every edentulous space with an implant. It is NOT always better, like so many dentists believe. It is much easier and more predictable to create ideal esthetics with a six-unit bridge than with a hodgepodge of restorations around an implant(s).

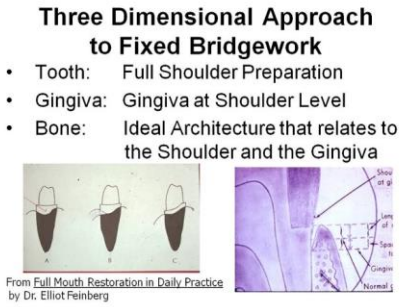
While it is important to have respect for tooth structure and remove only what is necessary to create ideal restorations, the minimally invasive concept is not appropriate for these situations:

1. When changing the architecture of teeth is required to minimize destructive forces on the supporting structures—ie. bone and roots--and to adequately eliminate destructive food impaction areas.
2. Where adequate tooth structure must be removed in order to avoid making oversized restorations.

What good is preserving tooth structure if the teeth remain in jeopardy of being lost?

**Procedures for Full Coverage Restorative Dentistry**


**This was my first full mouth case. Note how the dentistry relates to the bone. This is the best architecture creating health, because the forces are brought as close to the supporting bone as possible.**





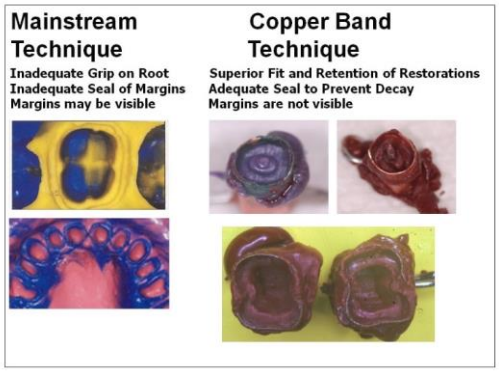
**Rationale for the Three-Dimensional Approach:** Seventy years of documentation demonstrates that the best approach to full coverage restorative dentistry is a three-dimensional approach that prepares the tooth, the gingiva, and the bone at the same time so that they relate ideally to each other. The teeth are prepared with full shoulders because all buildings are built on "shoulders"—they are not built on chamfers, feather-edges or any other type of construct. Placing the shoulder closer to the bone helps tighten the tooth in its socket because some of the forces act on the shoulder, which is close to the supporting bone rather than just on the occlusal surface, which is further away. The shoulder is placed at the gingiva with normal sulcus depth and normal bone without craters or pathology. The shoulder should mirror the gingiva and the bone circumferentially. This arrangement creates a healthy environment to receive dentistry.

The margins of crowns and bridges should be placed on uncut tooth structure. This practice comes from the very roots of dentistry and most of the gold/processed acrylic bridges from that era *were*

made this way. Many of those bridges lasted for *decades*. Each crown is modeled like a Mason Jar Cover, which is the best-known method of food preservation. As a result, recurrent decay is a rarity.

There are a lot of misconceptions about the biologic width, and the truth is that far less room is needed for the gingival attachment than most dentists believe.[9] In a normal, 3mm sulcus, the margin should extend at least halfway. This approach completely avoids visible margins, which is a problem many practitioners worry about when making crowns and bridges. With a step-by-step approach to crown and bridgework there will be three opportunities to avoid impinging on biologic width:

1. **Trimming of Dies.** The margins can be shortened slightly when the dies are ditched.
2. **Fitting the castings/millings.** If there is too much "bounce-back" or discomfort, the margins can be shortened slightly and thinned out slightly.
3. **Trial wear:** Patients should always wear crowns and bridges with Vaseline ointment, Trial (a rubber-like material) or silicone (like Fit-Checker). Anything stronger and it will be impossible to remove the restorations for permanent cementation. Once in a great while a patient may complain of discomfort and a red line might be visible in the crevice. Shortening and thinning the margin slightly usually takes care of the problem. The patient should wear the dentistry until ideal function and comfort is confirmed. Then it is permanently cemented. Once cemented, crowns and bridges with this design RARELY come out.




**Impressions:** In order to achieve an ideal result, registering an accurate impression of the ENTIRE root surface above the bone is a MUST. This practice cannot be accomplished with the widely accepted cord/tray impression technique that is taught in every dental school unless all the gingiva is cut away. It can only be accomplished with the copper band or aluminum shell technique. Many practitioners feel this technique is passe, but they are the ones having trouble with retention and recurrent decay. Why do you think most practitioners would rather place implants than save teeth with crown and bridgework?

**A real game-changer would be the development of an imaging system that can register an accurate digital impression of the entire root surface above the periodontal bone.** At present, CBCT scans and standard imaging procedures cannot provide interproximal accuracy. My fear is that no researcher is even considering interproximal imaging because the technique I just described is not mainstream.

**The Dental Laboratory**

**Fabrication of Crowns and Bridges: The laboratory industry does not have enough skilled technicians and the dental profession does not believe technicians need to be trained, certified, and treated as professionals. This attitude MUST be changed. A team is required to produce ideal dentistry and ALL team members are to be highly educated and valued.**

When I moved to Arizona, I was forced to work with commercial laboratories. I found out quickly that the laboratories only want to work with dentists who will just insert whatever they make. If a dentist complains they are summarily dismissed. I have had the dubious distinction of having been dismissed from several. I always treated laboratory representatives with respect and paid my bill on time. I would never raise a dispute if they wanted to charge me more money. I just want quality work.

I have worked closely with dental technicians during the course of my career, and I personally fabricate my own models to ensure that the technicians could do an ideal job. I always ditch my own dies to make the margin obvious. It is not the technician's job to determine where the margin should be. Only the dentist knows the preparations he or she created.[10]

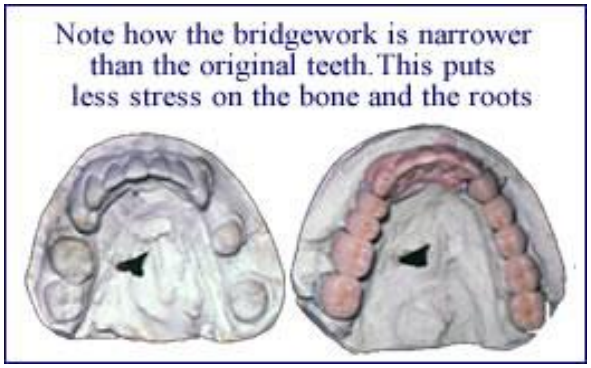
The materials that are best for crown and bridgework are, of course, gold and any of the precious metal alloys including silver-palladium. These metals can be designed for fusion with porcelain or retention of composite (a better choice than acrylic). It is important to design metal properly for the retention of composite—thin sprue extensions are far more retentive than beads. Metal/composite restorations are ideal for implant restorations to facilitate repair should breakage occur. Porcelain on implant restorations is more likely to shatter than porcelain on natural tooth restorations because there is no periodontal ligament to absorb the blow. Porcelain-to-metal frameworks can be cast or milled. The Strategy Milling Company[11] in Pittsburgh is at the forefront of milling precious metals.

**Zirconia:** Zirconia should not be used for full coverage restorations on natural tooth abutments. It saddens me that it was adopted so quickly by the dental profession without any evidence of its efficacy or standards of fabrication. The only reason zirconia is so widely used is because it is cheap and white. This is not a good reason to use this material. Zirconia is too hard a material and it cannot be soldered. It is only suitable for butt-joint restorations and butt-joint restorations can never be sealed. Dentistry is not lifetime, and that zirconia crown will have to be removed to make new dentistry. Zirconia is very hard to cut, and the removal of a zirconia crown can easily damage the underlying tooth structure.

**All-Ceramic Restorations.**

All ceramic restorations are also butt-joint restorations and have a high incidence of recurrent decay because they can never be sealed on the micron level where bacteria live. This has been known since the 1960s when butt-joint all-ceramic restorations were baked in an oven. CEREC crowns are not different from those oven-baked all ceramic crowns—they are both butt-joint restorations. This is the reason why CEREC is bad technology. However, to obtain the best esthetics for a young person such as a model who has good oral hygiene and no periodontal bone loss; all-ceramic crowns can be made for the front 6 teeth and monitored carefully at hygiene visits.

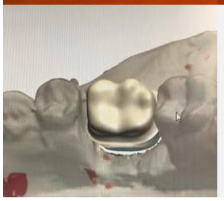
All-ceramic crowns should never be used in the posterior, where adequate esthetics can be obtained with porcelain-to-metal restorations along with protection against recurrent decay and loss of retention.




**Design of Crowns and Bridges:** Crowns and bridges are being improperly designed in the dental laboratory for both analog and digital techniques. The commonly used approach *guarantees* oversized dentistry, which will place too much stress on the periodontium and contribute to force-induced degeneration. In measuring the crowns and bridges with an Iwansen Gauge at most dental laboratories, one would be shocked to discover that the overwhelming majority of full coverage restorative dentistry is too thick.

If only 1.5-2.0mm can be removed from a vital tooth in preparing a crown, it is critically important not to put back more than that. This is true for the buccal, lingual, and incisal thicknesses. I try to put back *less* thickness than the original, and I strive to make the teeth narrower bucco-lingually to put less stress on the periodontium. It is important to design crowns and bridges so that they are *corrective* and prevent disease. Similarly, it is important not to make anterior teeth too long. If one went to a dental laboratory and measured overall incisal length on vital teeth with an Iwansen gauge, one would be shocked to discover that just about every anterior crown or bridge is too long incisally.

Oversized analog Waxup to Full Contour. Cutting back the waxup to create room for the porcelain will create oversized dentistry.



Cutting back the digital waxup on the computer as seen here will lead to the same oversized restoration as cutting back the analog waxup above to create room for the porcelain.

Common Laboratory Errors: Oversized Metal Understructure

The second molar metal understructure is clearly oversized, compared to the first molar, which was hand carved to a thickness of .5mm. Oversized metal will result in a grossly oversized crown when the porcelain is baked on it.

These metal crowns were computer-designed & milled.

The current approach to fabricating crown and bridgework is (1) first waxing the restoration to full contour and then (2) cut back to leave room for the porcelain. The waxed "full contour" is almost

always over-contoured to begin with. This approach <u>always</u> produces over-sized restorations, and it is commonly used by laboratories with both "analog" and digital techniques.

Laboratories generally go on the defensive when confronted about this practice. They try to justify what they are doing by saying that their approach avoids unsupported porcelain and breakage. But the reality is that the dentist will have to deal with the consequences of oversized bridgework long after that laboratory gets paid for the work. Breakage can be repaired; periodontal bone loss cannot be.


Dipped die: .5 mm thick wax.

Inlay wax added for to create lingual collar, interproximal struts and occlusal evenness.

To avoid oversized metal for both analog waxups and computer design:

*Start with minimal thickness and add as needed.

*Don't Wax to full contour and cutback.

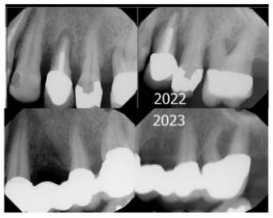
The better approach is the complete opposite and it is a lot simpler. The dies are first dipped with dipping wax at a temperature designed to produce a film that is automatically .5mm thick. All that is necessary to complete the wax up is to add are the interproximal struts, lingual collar and to build up the occlusal if necessary. This approach saves time and avoids wasting precious metal that will have to be ground by hand in order to achieve .5mm thickness. Because this approach has worked so well with analog techniques, it should also be used to fabricate crowns and bridges with digital techniques.

**In the future, Dental AI is likely to be utilized in the digital design and fabrication of crowns and bridges. It is critically important that Dental AI be programmed with the correct approach—digital "wax dipping" technique rather than the full contour/cutback technique.**

**Fabrication of Crowns and Bridges**



The Pontic Space is the width of a large molar, which would be an eyesore. Instead, the pontic space is filled with a normal-sized bicuspid and half of the 1st molar. The restoration is narrow bucco-lingually without excess porcelain beyond the normal confines of the teeth. The design alters the architecture like plastic surgery.




Before: Periodontal Bone Loss Evident

After: No one can tell this patient ever *had* Perio-dontal Bone Loss

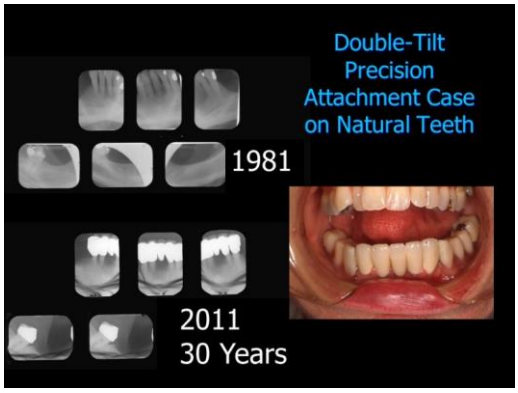
It appears that the hundred-year-old technology of waxing and casting is on the way out. Scanning and milling has proven to be considerably more accurate than casting. Milling avoids the porosities and distortions from high heat that are characteristic of cast restorations. However, there are some problems that have yet to be solved before milling can completely replace cast restorations. The Strategy Milling Company in Pittsburgh is at the cutting edge of research and the company is working on developing a protocol to mill the implant components in one piece with custom abutments. The research hinges on the implant companies leasing their proprietary designs to milling companies. There is also a problem with milling attachments for the double-tilt precision attachment case so that the attachment can be directly milled along with the abutment crown. This problem has yet to be solved. The attachment for the Double-Tilt Precision Attachment Case is a simple male-female without any fancy locking mechanisms. This attachment has been cast since its inception in 1921. At present it is not available through the major companies, but it is possible to design the attachment on the computer and print out plastic components that can then be cast.[12]

While it is possible to mill bridges in one piece, soldering might be required if error is discovered during framework try-in. Many practitioners have no idea what to do if a bridge doesn't seat properly. They have to be trained and prepared to handle this eventuality. Faulty seating will encourage recurrent decay and loss of retention.

It is safe to say that laser welding will replace conventional torch soldering. Laser welding is a direct technique since it is accomplished directly on the original model. By contrast, torch soldering is an indirect technique, since it requires a refractory model before soldering can occur. A direct technique always introduces less error than an indirect technique.

I believe that 3D printing is in its infancy, so the available applications are limited and not widespread. The future may see some novel materials and applications for 3D printing. It will be exciting to watch this technology develop.

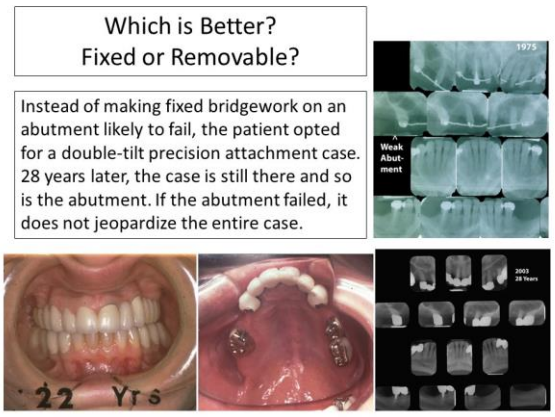
**The Double-Tilt Precision Attachment Case[13]**




**Dentists don't know that it IS possible to save teeth that are very weak. The teeth have short roots, conical shape and half the periodontal bone is missing. Not only are they weak, but they are also supporting the missing teeth with a partial denture. This case has lasted in health for at least 30 years with very few changes in the periodontal bone.**

Most dentists consciously or unconsciously assume that fixed bridgework is always the best treatment option. This assumption is based on the fact that removable partial dentures rest on tissue and as a result, they move. The removable partial denture must overcome gravity and the pull of the musculature in order to stay in place. Sometimes denture paste or powder is required for retention of the removable.

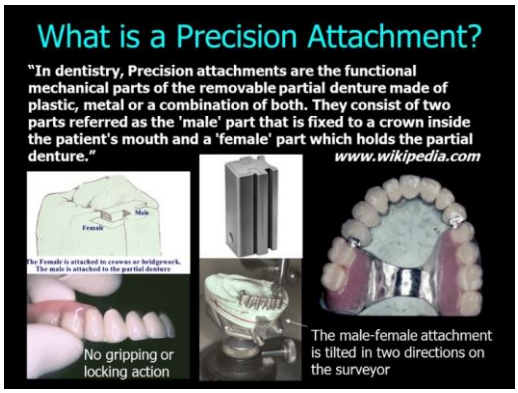
Because most dentists are biased against removable prostheses, they often stretch fixed bridgework beyond its limitations. Consider this common scenario of consequences for patients who are provided with fixed bridgework on weak posterior abutments. Often these patients are struggling financially to afford this dentistry. The weak abutments fail after a short time and the patient ends up with a second-rate clasp partial denture as a solution to this failure. That patient would have been better off with a first-rate precision attachment case from the outset. "Precision attachment partial dentures should be the *primary* treatment plan rather than long spans of fixed restorations,[14]" concludes Dr. Elliot Feinberg. This includes fixed bridgework on implants that are not likely to succeed.



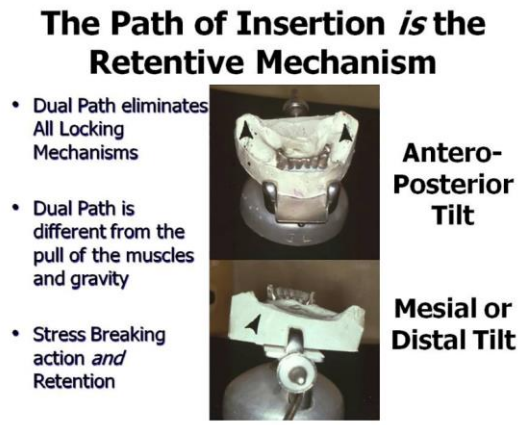

The double-tilt precision attachment case is an ideal option for the patient who cannot have successful fixed bridgework. This option has been around a long time--it was conceived in 1906 by Herman Chayes, patented by Isadore Stern in 1924 and refined by Dr. I. Franklin Miller more than 70 years ago. However, the technique never achieved mainstream popularity because few practitioners are familiar with double-tilt precision attachment partial dentures and precision techniques are required for their fabrication.

There is also a perception that the prosthesis is too complex for patients with limited manual dexterity. This perception is false. "Original concern over the difficulty of insertion appears to be unsupported by clinical experience," says Dr. Elliot Feinberg. "In teaching patients how to insert more than 1000 double-tilt cases…just one patient…could not master the path of insertion with 15 minutes of practice[15]." There is a skill that patients must master, but it is no more difficult than learning to wear contact lenses. Double-tilt precision attachment partial dentures have proven successful on patients with arthritis, Parkinson's disease and other diseases that affect manual dexterity.

The double-tilt precision attachment case fabricated as described in this book offer unique advantages:




1. Superior esthetics.
2. Maintainable periodontal health.
3. Optimal support of the musculature through replacement of missing structures.
4. Superior comfort and confidence for the patient.
5. Superior longevity of the abutment teeth and preservation of the edentulous ridges.
6. The ability to retain questionable teeth so that they do not affect case longevity.
7. The ability to compensate for changes that occur in the mouth.
8. No necessity for frequent replacement of the precision attachment apparatus even after *decades* of continuous function
9. No need for the use of denture powder or paste.
10. Natural tooth and/or implant abutments can be used.




Unlike almost every attachment, the attachment used for the Double-Tilt Precision Attachment Case is a simple male-female. It functions in a manner that does not apply pressure to the abutment teeth or implant fixtures, but instead dissipates forces. Instead of locking or gripping, the double-tilt precision attachment is passively retained by the *path of insertion.* The path of insertion retentive mechanism functions as a true stress-breaker, reduces wear of the attachment components, and eliminates the need for retention adjustment and replacement of the attachment apparatus. Many patients wear these precision attachment partials for *decades* without replacing the male or female components of the attachment. When the partial denture becomes loose, relining the tissue surface is generally all that is needed.

At present no manufacturers are making a simple male-female attachment. However, Creodent Laboratory in New York City has designed male-female patterns on the computer that can be 3D printed in burnout acrylic and then cast in the Ceramicor metal. All of the previous attachments were cast this way, but with special molds. At present there are some difficulties that need to be overcome to have these attachments milled instead of cast.

**Dental AI will require the Double-Tilt treatment option in its armamentarium and know when to recommend its use for both natural tooth and implant abutments.**

**Implants**

No one can say that I don't appreciate one of the greatest innovations in the dental profession—the osseointegrated dental implant. Where appropriate dental implants can be a godsend and restore form and function to patients who have lost dentition. However, the use of dental implants has mushroomed far beyond what they were designed for. They are often overused and used inappropriately, and this has resulted in a rising failure rate for dental implants. "The long-term prognosis for implants has been shown to be far less promising than that for natural teeth, even when they are compromised by periodontal disease or endodontic problems," conclude WV Giannobile and NP Lang.[16]

When osseointegrated implants first came to this country in the 1980s, they were used only for fully edentulous arches. Dr. Brånemark was a true scientist and he invested 20 years of scientific research before bringing his invention to this country. Following his recommendations was a guarantee of achieving a success rate of at least 85-90% success. In the 1990s, practitioners started using implants for single tooth and small bridge restorations. The dam seemed to have burst in the 2000s. Today, implants are being placed without regard to basic principles and common sense.

These are the contributing factors to the rising failure rate:

1. **Dental implants are often NOT the best treatment option if teeth can be saved.** Teeth are being extracted that CAN be saved easily. Implant therapy should be a *last* resort except in certain circumstances like congenitally missing lateral incisors in an otherwise perfect dentition. WV Giannoble and NP Lang have observed that "often practitioners recommend implants even when teeth are only modestly compromised by caries, the need for endodontic therapy, or periodontal disease to provide the patient with a quick solution to the problem. Less trained individuals often recommend tooth extraction rather than retention. This condemns many teeth that could be treated and returned to good function. Even those teeth that are compromised have a much greater life span than the average implant[17]."

   Dentists today do not understand that crown and bridgework is *corrective* and not merely "tooth coverings." These restorations can be made that change the architecture to minimize the forces on the supporting structures, compensate for periodontal bone loss to prevent bone loss and completely eliminate recurrent decay. Many teeth that can be saved are currently being extracted.


There is a disturbing trend of late. Fewer dentists are acquiring acceptable crown and bridge skills, but more are becoming quite adept at placing and restoring implants. As a result, every edentulous space is now a candidate for an implant. As I mentioned previously, the placement of single tooth implants among compromised teeth has become the poster child of a piecemeal approach to dentistry.

If one observes the placement of single tooth implants in dental publications and implant courses, most of the time the teeth surrounding the implant are compromised with crowns, fillings, periodontal bone loss or will require crown and bridgework in the future. **Bridgework is often the better treatment option, as it can solve problems in an entire quadrant.** A single tooth implant only fills a hole or a space and does nothing for the teeth around the space. With the single tooth implant, the patient's problems are NEVER solved.



Dentists today are not aware that teeth flush with the gingiva can be easily restored without posts, build-ups, fancy orthodontic extrusion, or extensive crown lengthening procedures. It is clear that many teeth—such as those pictured above—are being extracted even though they that can easily be saved with a different philosophical approach.

**Dental AI will have to understand when it is appropriate to make fixed bridgework on natural tooth abutments and when it is appropriate to place implants.**

2. **Implants are being placed that cannot possibly support the restorations that are made for them.** Implants are feats of engineering and should be seen as such. They can osseointegrate perfectly, but if they are overloaded with forces with large superstructures, they are certain to fail. The structural engineering world is full of famous failures where overloaded bridges collapsed. The engineering principles from that world apply equally to intraoral bridgework.


The bottom line: **If implants cannot be placed properly, they should not be done.** (AI will have to know this). Carl Misch, an expert researcher in the field of implant biomechanics, agrees. He states emphatically that **"treatment related to the science of implant dentistry should be centered around the biomechanical management of stress[18]."**

Unfortunately, Implants are often placed in areas where there is not enough bone for adequately long implant fixtures or in areas where the bone is of very poor quality.


In presentations and published articles, it is common to see inadequate implants overloaded with large, impossible-to-clean superstructures. Carl Misch points out that natural teeth have the ability to recover from trauma because of the periodontal ligament. Implants, however, have no such ligament. Trauma from occlusion is likely to cause bone loss from which there will be no recovery even when the trauma is removed.

Implants must be placed in the correct tooth positions and treated as if they were natural tooth abutments so that forces can be minimized, and hygiene facilitated. The use of surgical stents to place implants is therefore a MUST! The stents can be made by hand or from computer-generated CBCT scans. The best strategy for implant restorations is to have screw-hole access for retrievability. Implants and their restorations may not be "forever" even under the best circumstances, and screw-hole access gives the operator control in the event of complications. The abutment-overlay strategy can result in disaster because it may be impossible to remove

the overlay without destroying it. The costs of remaking a new overlay will make for a very unhappy patient.

**Dental AI will have to incorporate the stress treatment recommendations in designing implant treatment plans, implant placement and implant restorations.**

In order to create the best architecture, dental implants must be placed in the ideal position of the teeth. Screw hole access should be on the lingual or the occlusal. When the angle of the screw hole is less than ideal, the use of angulated abutments that allow for proper screw-hole access is an ideal corrective strategy. Perhaps AI can be engineered to recommend the best implant systems for each case.

This case was done at the level of the implant in stages and is "half" Brånemark Case, since the patient did have sinus lift surgery on one side.


Notice the narrow bucco-lingual width and the sleek metal lingual surfaces anteriorly. The screw holes generally correspond to individual teeth, making hygiene easy for the patient.

As with fixed bridgework on natural tooth abutments, it is equally important to minimize forces on implants by creating restorations with a narrow bucco-lingual dimension. In order to accomplish this ideal, the lingual aspect of anterior restorations should be made as thin and sleek as possible. In order to achieve this ideal, the lingual surfaces can be fabricated solely with polished metal.

Adding pink material to the buccal aspect of the restoration in order to compensate for the loss of gingiva and bone overloads the bridgework and is not recommended. Yes, the teeth will appear longer without the pink material, but the extra length is usually hidden by the lips when the patient smiles. In this case, structure and function must take precedence over esthetics. If esthetics is a concern, or if too much bone and gingiva has been lost so that the restoration cannot adequately support the lip without the pink material, an overdenture would be a better treatment option to restore the implants than fixed bridgework.

Once the implants are uncovered, an ideal temporary restoration with the correct emergence profile should be created in order to correctly shape the gingiva. Metal temporary cylinders are the most accurate and stable copings. They should be the option of choice to create the temporary restoration. The temporary restoration should be observed closely for esthetics, function, and comfort; and any changes deemed necessary should be instituted in the temporary restoration. Once satisfied, the operator can use this provisional restoration to fabricate the final impression while the patient sits in the chair. All the required information for a permanent restoration is encoded in the temporary restoration, and this information is easily transferable to master models in this manner. This approach ensures that the final restoration will be properly constructed so it will not stretch or pinch the tissue when it is inserted fully.

3. **The Dentist's Implant Case Armamentarium should include more than fixed bridgework on implants.**

**But "if all you have is a hammer, everything looks like a nail**," American statesman and financier Bernard Baruch once remarked. There is a disturbing trend to give all patients the same option of full arch fixed bridgework on implants because that is all most dentists know how to do. Patients are therefore rarely offered choices of treatment options and they are often subjected to invasive surgeries and needless extractions because they think that is their only choice. When the fixtures are overloaded, failure is the likely result. That patient may be in big trouble. Implant loss may also result in additional bone loss that may make it impossible to place additional implants and fabricate a new case. Here are three ideal treatment options for implant restorations when adequate posterior implants cannot be placed for full arch bridgework:


a. **Brånemark Case:** The Brånemark Case has a great track record of success and was the only implant treatment option when Dr. Brånemark brought his invention to this country. The Brånemark case consists of the anterior placement of 4-5 implants in the anterior region with cantilevered bicuspids posteriorly. It is not necessary to have a "high-water" design. Instead, the abutments should be shaped like teeth with proper emergence profile with pontics and cantilevers lightly resting on the gingiva that facilitate hygiene.


**b. The Double-Tilt Precision Attachment Case:** Usually, the anterior section of the mouth has better bone quality than the posterior section. Often good, long implants can be placed anteriorly, but not posteriorly. It is possible to place three implants (one in each canine location and one in the central incisor location and make a fixed bridge with a double-tilt precision attachment posterior partial denture. In treatment planning this case, the operator stays away from sinus lift surgery, interference with the inferior alveolar nerve, and placing implants in inferior quality bone.

The double tilt precision attachment case has a long track record of success on natural tooth abutments that dates back to 1906. This type of case also has a track record with implant abutments for over 20 years. Unfortunately, very few dentists know anything about this treatment option, as it is not taught—and fewer still know how well this option works with implant abutments.

c. **The Overdenture.** Overdenture attachments, such as the locator attachment, grip and lock the implant abutments. This locking action applies deleterious forces to the implant abutments that can eventually result in their loss. A better strategy is to create an overdenture that rests on implant abutments or milled structures that connect the implants above the gingiva. More than adequate retention can be achieved with this strategy without having the overdenture grip or lock in place. Relining the areas around abutments with quick cure acrylic or composite periodically will tighten the overdenture.


Arian Deutsch, of Surprise, AZ, is fabricating precisely milled bars and polished abutments. He then fabricates precisely fitted copings custom made for the abutments and bars are from electrochemically deposited 24-carat gold. Unlike castings made with 24 carat gold, these copings are extremely strong and fit like gloves. These copings become part of the overdenture to make the most precise fitting overdentures that I have ever seen. Unlike other treatment options, the overdenture has a built-in contingency plan: If something happens to the implants, nothing has to be remade.

**Dental AI will have to have to know when to recommend fixed bridgework, the Double-Tilt Precision Attachment Case or Overdentures when treatment planning for implants. It will have to evaluate the strength of the implants by length and bone quality and understand which implant systems are the best candidates for each situation. Dental AI will have to identify weak abutments and suggest a contingency plan in the event that they are lost so the entire case will not be affected.**

**Dentures**

The outcome of conventional dentures made with flasked acrylic that is subjected to heat and pressure is very unpredictable. With crown and bridgework, if a step-by-step approach (where each step has a perfect outcome before going onto the next step) is followed, an ideal result is assured. Not so with dentures. When every step is done perfectly, a heat-processed denture almost always results in discrepancies—either in fit, occlusion, or tooth position.

A milled baseplate was made from a digital scan of the master model. It was tried in before the teeth were set up to verify fit.

Next the teeth were set in wax within a demarcated area carved with an inverted cone bur.

After try-in to verify esthetics, the teeth were processed to the baseplate in the dental laboratory.

Milled dentures avoid the distortion problems that characterize the heat processed dentures. For many years I made milled digital baseplates from the master model *first*. From the outset fit is assured. I would not set up the teeth unless the baseplate fit perfectly. Once fit was verified, I outlined the area on the outside of the baseplate for tooth setup. I created sharp lines of demarcation and thinned out the area of the baseplate inside the lines of demarcation. I then set up the teeth in wax so that the wax was flush with the lines of demarcation. After successful try-in the case was sent to the laboratory to process the teeth to the milled base plate.

There are methods of computerizing and milling the entire denture, but these methods require a mockup to verify at try-in. Computerized dentures have the advantage of being duplicated at any time.

However, a mockup does not have the same esthetics as the final denture. Making changes to mockups is also no easy task. Dentists do not work this way when it comes to making dentures. More importantly, patients want to see what they are getting, especially with the use of porcelain anterior teeth. **Methods have to be developed for denture fabrication to allow dentists to show patients the actual teeth in their setups before milling. The dentist must be able to retain control over the fit, the occlusion and the esthetic outcome and still have the advantage of computerized instructions that can duplicate the final denture at any time.** It is always advisable for denture patients to have an emergency spare denture in case the original is broken or lost.

Impression taking for dentures has not really changed much from the early days of making denture. **Methods of scanning and registering muscle attachments and movements need to be developed that can create accurate, functional digital models of the edentulous arches.**

**Disturbing Trends in Dental Manufacturing**

I remember a time when the major dental manufacturing companies were actually interested in furthering the practice of Dentistry. We--dentists who want to deliver the highest quality care to patients--need the right tools to do so. We depend on dental manufacturing companies to help us in this endeavor. Dental manufacturing companies do not see patients and they have no idea how their products actually work and hold up in the mouth. They do know what tools the average practitioner is willing to settle for. At one time most dental manufacturing companies tried to accommodate all types of practitioners.

Most dental manufacturers at the beginning of my career were eager to collaborate with dentists in order to offer products for the practice of high-quality dentistry. Often these products were innovative advancements for the profession. No more. Ideas of planned obsolescence and bottom-line thinking now rule the marketplace.

I have seen sweeping changes in attitude by dental manufacturers since I started in practice over 45 years ago. I was trained by a master and pioneer in full mouth reconstruction and crown and bridge dentistry—my father. He was renowned during his life and well respected by his peers. I remember the great relationship we had with representatives from the dental manufacturing world. They often sent their top technical representatives to collaborate with us. We had actual proof of efficacy of their products essential to creating ideal dentistry and this proof was of great interest to them.

But today, many of these products have been discontinued. Never mind proof of efficacy. All that matters today is how they sell. Never during the course of my career did I ever think that basic products necessary for ideal dentistry would go by the wayside and that I would have to scramble for alternatives that could accomplish the same tasks.

The common denominator is that no matter how hard one pleads with manufacturing companies not to discontinue important products; no matter what proof of efficacy is sent to them, they adamantly refuse to reinstate those products or figure out a way that they can be made more profitably. It matters not a whit to them how these products benefit patient care. In interacting with these companies, I found out that it is not uncommon to be treated with indifference or downright rudeness.

Since moving to Arizona, I have had to spend a great deal of my time finding replacements for many standard or excellent products, something I never thought I would *ever* have to do. Fortunately, I have been able to come up with substitutes for some of them. While these substitutes are generally adequate—they are usually not better.

Here are several examples of bygone products that were important advancements for the practice of high-quality dentistry. I don't want to mention the names of the companies for obvious reasons—I simply want to expose the patterns and trends that I am seeing.

**Precision Attachment Removable Partial Dentures contain no hooks or clasps. They are worn 24 hours a day and no one can tell that a patient is wearing removable bridgework.**

Precision Attachment Partial Dentures

**They require very little maintenance and do not need denture paste or powder. These cases last *longer* than fixed bridgework cases—even on teeth with inadequate roots and bone!**

**The Passive Precision Attachment**

The passive precision attachment comes from the very roots of full coverage restorative dentistry. Only one design offers truly passive function for the removable partial denture, and it consists of a simple male-female. *All* of the other designs currently on the market are locking or gripping mechanisms that inflict deleterious forces on the abutment teeth. In this regard they function no better than clasps, which grip the abutment teeth and torque them until they are

eventually lost. Clasp partials are really transitory restorations to a denture.

However, the simple male-female attachment is the only design that does not grip or lock the abutment teeth for retention. The means of retention is the path of insertion, which is tilted in two directions that are different than the directions of muscle contractions and gravity. This arrangement allows stress to be dissipated because the partial denture can move slightly to release the stress, but it cannot be dislodged by those forces.

The idea for the passive precision attachment and double-tilt path of insertion was first introduced in 1906 by Dr. Herman Chayes. In 1921, a well-known dental manufacturing company patented its own design in 1921. My father compiled about a dozen cases (pictures and X-Rays) into a report for this company to demonstrate the attachment's efficacy and longevity for FDA approval. I have all the pictures. I also have supporting documentation for this attachment that spans 70 years, and I compiled all of this information into a textbook that I wrote: **The Double Tilt Precision Attachment Case for Natural Teeth and Implants.** (This book is available at www.theONWARDprogram.com).

The company that made the original attachment is under different management today than at the beginning of my career. The new management does not care about the company's amazing history of its own passive precision attachment! Perhaps company leaders concluded that the attachments were too difficult for the vast majority of dentists to learn how to use. The use of these attachments is, after all, only for ideal full coverage restorative dentistry.

There is another reason that makes much more sense. The company hired a chief technician that invented his own attachment that grips the abutment teeth with vinyl sleeves. This attachment does not have the track record for longevity that their original attachment has. The components of their original attachment rarely require replacement, even after *decades* of continuous 24-hours-a-day wear. By contrast, the vinyl sleeves on the attachment this company is heavily promoting do not last long and require continual replacement. Perhaps the company is only interested in selling that particular attachment because dentists will require an endless supply of vinyl sleeves.

The company's chief technician is not interested in having his company promote any other attachment but his own. I know this to be true because I interacted with him in the past. After extensive discussions with him, I sent him all of the information and documentation for the passive male-female attachment that came from his company's roots. I never heard from him again.

Other companies *have* manufactured male-female attachments that have proven successful with precision attachment cases. However, no company exists at the present time that offers a simple male-female attachment for precision attachment partial denture cases! The only solution at present is to have the attachments custom cast. The Creodent lab in Manhattan has developed computer-generated patterns that can be 3D printed in burnout acrylic that is then cast with a Ceramicor-like alloy. There are other manufacturers that may also be able to provide attachments in this manner.

All attachments to this point in history have been cast, usually with the same special molds for interchangeable parts. Eventually the molds wear out and apparently creating new molds requires substantial investment. In the future, it may be possible to have the attachments milled, instead of cast. Milling circumvents many of the problems inherent in casting, and milled restorations may

actually be more accurate than castings. The Strategy Milling© Company of Pittsburgh, which is at the forefront of milling precious metals, has been investigating a solution. Apparently, there are some technical problems that have yet to be solved before the attachments can be milled.

**The Copper Band**

Copper Band Set

Aluminum Band Set

Use of Copper Bands And Aluminum Shells

Copper Band Impressions

Copper Band Temporaries

Copper Bands have been around since the beginning of full coverage restorative dentistry. This year, manufacturers stopped making the copper bands. There are still some suppliers who have copper bands and no doubt there are "old timers" who would be happy to donate their copper bands to a younger practitioner.

Copper bands are used for two purposes. The first purpose is for registering an impression of the entire root surface below the gingiva. There is no other way to accomplish this task without cutting away the gingiva and no practitioner is going to do that. The standard retraction cord technique cannot register an impression of the entire root surface below the gingiva.

The copper band impression is the standard by which all other techniques should be compared. It has by far the best track record. I have 70 years of documented cases for proof. But practitioners don't even know about the standard that came from Dentistry's roots. In fact, there is a general misconception that this type of impression can do harm by impinging on the gingival attachment. This idea is false.

Copper bands are also used to create retentive temporaries on teeth with little or no clinical crowns. Buildups, posts, orthodontic extrusion, or extensive crown lengthening procedures are not necessary for retention when the entire root surface under the gingiva is used for retention. Copper bands can be used to establish a firm grip on the root surface for temporary restorations. Copper band temporaries have superior fit and retention and fit like permanent restorations. Their use markedly reduces patient visits for re-cementation of provisional restorations. Like permanent restorations, copper band temporaries are modeled on the Mason Jar cover, which is the best-known means of food preservation, so recurrent decay is a rarity. Copper itself is extremely antibacterial and studies have shown that copper has zero bacteria on its surface, unlike stainless steel and other metals. I have had patients actually wear copper band provisional restorations for *years* and the preparations remained pristine underneath.

Although several dental manufacturers actually have the machines that can make copper bands, they are reluctant to make them—even for a custom order. They only want to make 10,000 of each size at a time, because the machine has to be calibrated to fabricate each size. One manufacturer told me that he would have to charge me $10 per band to make it cost-effective for him to make them. Of course, this cost is not reasonable.

Fortunately, aluminum shells are widely available from several dental supply companies. Aluminum shells are manufactured in the exact same sizes as copper bands and will fit perfectly on holders designed for copper bands. Aluminum is not quite as easy to work with as copper, but it does work. Unlike copper bands, aluminum shells are closed off on one end. This end can be easily cut off with a disk, and the cut edges smoothed with a rubber wheel. Like copper bands, aluminum shells may require annealing to soften the metal. However, unlike copper bands, too much heat in the annealing process can cause aluminum shells to burn up.

It is my hope that the dental profession can push the manufacturers to resume making copper bands and make an intensive effort to educate dentists on how to use them effectively.

**Renaissance™ Crowns**


The Renaissance™ Crowns appeared in the 1980s and were perfectly designed for single crowns. The crowns came in "umbrellas" of gold and palladium foil. Renaissance™ crowns combined the best of two worlds: the beauty of the ceramic material and the superior fit, retention and protection against decay afforded by porcelain-to-metal restorations.

Renaissance™ crowns were much thinner than /cast alloys. Renaissance™ crowns utilized a *direct* technique, meaning they were made directly on the original dies. A direct technique is less likely to incorporate error than an *indirect* technique such as cast restorations, which require the creation of a wax-up, investment, burnout, and casting.

Renaissance™ crowns could be fabricated in twenty minutes, ready to bake porcelain. They were so easy to make that the dentist could easily make them in the office. The technique consisted of closing the umbrella pleats and swaging the umbrella against the die. Excess material beyond the margin was cut away with a scissors. Once the Renaissance™ Crown was adapted tightly to the die, it was briefly heated in an open Bunsen Burner flame so that the gold could flow and solder the umbrella pleats together. My father and I made hundreds of these crowns in the 1980s and 1990s, and they typically lasted for decades with minimal breakage. Apparently, most dentists did not understand how amazing Renaissance™ restorations were and how easy it was to make them. The crowns were also most likely not marketed well.

The replacement for the Renaissance™ crown was the CAPTEK™ crown, which utilizes similar chemistry, but in a different way. Like Renaissance™, CAPTEK™ works well for single crowns and combines the best of the two worlds previously mentioned. The CAPTEK™ crowns are much stronger than the Renaissance™ Crowns, as they cannot be easily bent. However, unlike a Renaissance™ Crown, CAPTEK™ is an *indirect* technique in that a duplicate refractory die has to be made from the original die in order to create the CAPTEK™ crowns. Wax-impregnated palladium sheets are adapted to the refractory die and heated in an oven for a half hour; then wax-impregnated gold sheets are

applied and heated again in the oven for a half hour. The entire process requires the use of substantially more materials than the Renaissance process, and fabrication takes up a whole afternoon. My technician loved to make Renaissance™ crowns but hated to make the CAPTEK™ crowns. Unlike Renaissance™ crowns, which were discontinued long ago, CAPTEK™ crowns are still available.

One of the problems with products and materials in general is that they are often stretched beyond their limitations and both the manufacturers of Renaissance™ and CAPTEK™ were guilty of this practice. Both manufacturers provided tricky protocols to connect crowns and pontics in order to fabricate bridgework. It was clear from the get-go that these products were best suited for single crowns.

I believe digital dentistry, along with milling and 3D printing, may come up with better solutions in the future. The main advantage of Renaissance was that the crowns were easy to make and within 20 minutes they could be baked with the porcelain. In addition, Renaissance crowns had a long track record of longevity with very little breakage. It was a very good alternative to all-ceramic crowns because it allowed for maximum esthetics and still provided protection against recurrent decay.

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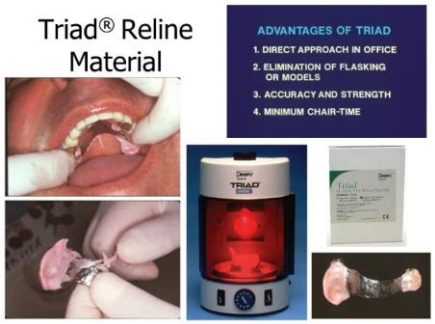


**Triad™ Composite Materials**

Triad™ is the latest fantastic product on the casualty list. It was perhaps the best reline material ever invented, as it was easy to use, not messy and gave the operator maximum control over the outcome. The composite material is innocuous and came in sheets that had to be protected from ambient light.

Relining partials and dentures can be tricky, and it is not uncommon to make a mistake requiring the tedious removal and replacement of the reline material. After removing some of the inside of a denture, triad material could be added a little at a time and allowed to flow to conform to the patient's tissues. Excess material was easily removed with a Bard-Parker knife and there was no gloppy mess, as with most chairside reline materials. The Triad™ material was ideal for border molding and could be pre-solidified in the mouth with the curing light. When the operator was satisfied with fit and flow of the reline material, the denture was placed in the Triad™ light curing oven for final cure. Once hardened, the Triad™ material proved to be quite durable and stain resistant.

The Triad™ material was ideal for relining precision attachment cases, which can be difficult to reline. The attachments and palatal/lingual bars must be completely inserted to the "home" position when relining these cases—without the patient occluding on the removable partial denture. Otherwise, the reline could result in excess thickness, food-trapping space under the bar, or poor fit that will contribute to tissue inflammation and discomfort.

The Triad™ material allowed the operator an unlimited amount of working time to ensure a perfect result. Curing takes place outside of the mouth so there is no chance of reline material setting

within the attachment system. By contrast, most reline materials are messy to work with and have limited working time. They are usually allowed to self-cure in the mouth. Disaster can result if excess reline material sets within the attachment system.

**Will dental manufacturers allow dentists to offer patients the best products for ideal full coverage restorations in the future?**

I believe that the loss of these items is a huge step backward for precision restorative dentistry. The best techniques and materials are NOT always the most popular and may not be the best money-makers for dental manufacturers. Does today's bottom-line thinking by dental manufacturers mean that dentists will not be able to offer our patients the best treatment in the future that they know how to perform today?

The Dental Profession should be greatly concerned about this disturbing trend. I believe strongly that dental manufacturers should care as much about patient care as we do. It seems to me that they certainly cared a lot more at the beginning of my career than they do now.

**What about new and innovative products?**


I'm very concerned about new innovative products that could vastly improve the practice of ideal dentistry in the future coming to the marketplace. Will dental manufacturers be willing to take risks inherent in investing in new products? Perhaps not. In fact, in some cases they have already shown that they are *unwilling*.

There was a brilliant practitioner—Dr. Walter Manzi—who practiced dentistry in Westchester, NY for many years. He invented and patented an ingenious diamond bur—the Manzi™ Diamond--that could precisely limit the amount of tooth structure that was required to be removed for adequate tooth preparation.

The removal of tooth structure with the Manzi™ Diamond was much faster than the conventional method of wearing away the tooth structure. The diamond consisted of rings of diamonds on a central shaft. When the tooth was prepared with these diamonds, horizontal use of the diamonds created grooves that could only be as deep as the rings, as they were stopped by the central shaft. There were different sizes of Manzi™ diamonds, depending on the desired depth of penetration. When used vertically, grooves were quickly stripped, and the tooth was almost completely prepared. A quick truing-up with a conventional diamond was all that was needed to complete the gross preparation. Such a diamond was not only a great advancement for full coverage preparations but a great advancement for the preparation of veneers, as it would guarantee the removal of just the right amount of tooth structure, and no more.

Dr. Manzi made the diamonds himself and sold them to dentists in kits. My father wrote scholarly articles on the use of these diamonds and snapped a lot of pictures of their use on patients for his courses.

After making the kits for many years, Dr. Manzi decided to meet with several manufacturers who could mass produce and nationally market the diamonds, but he was unsuccessful in procuring an agreement. He continued to manufacture the diamonds himself until he came down with cancer and had to stop. He felt that the chemicals used to make the diamonds contributed to his cancer. "Teach me and let me make them," I begged him. I would have gladly made them for him for nothing. But he refused. "You don't know what you're asking," he replied.

After Dr. Manzi passed away and his patent ran out, I took some of the diamonds and along with my father's articles to several manufacturers. I, too, was unsuccessful in finding a company that was willing to manufacture the diamonds. Perhaps the manufacturing process was too complex—I had the feeling that the manufacturers may not have understood how those diamonds were actually made. Perhaps they did not think the diamonds would sell. So, here's the bottom line: no dental professionals have the option to use Manzi™ Diamonds today.

I bet there are many other products with potential value that have failed to inspire manufacturers. Dental manufacturers today only seem interested when products guarantee huge profits. They are not as concerned whether those products actually promote health and stand up to rigorous function in patients. Dental manufacturers do not understand that many of the commonly used techniques used to create full coverage restorations actually violate basic principles that have a proven track record. Products used for those techniques often fall short and cannot be used for ideal full coverage restorations.

**Products with proven efficacy that are required for ideal restorative dentistry cannot be allowed to fall by the wayside because manufacturers favor short-term profits with inferior products. Dental AI must be "basic principle" driven and not "product" driven.**

These are the disturbing trends are clear to me:

1. Fewer dental manufacturers appreciate having superior products that support ideal full coverage restorative dentistry--products with a real track record for longevity. They seem unwilling to devote resources to educate dentists on how to use them and would rather discontinue selling them.

2. The vast majority of dental manufacturers seem to be perfectly fine with catering to the lowest common denominator. Selling products to meet the bottom line is the ruling consideration. Those products do not have to meet any previously established standard. **Dental AI must not be allowed to fall into the trap of "bottom-line" thinking.**

3. It seems like fewer dental manufacturers are willing to take risks on innovative products that can dramatically improve the practice of ideal dentistry.

**Dental Manufacturers must be made to change their thinking. They exist primarily to help dentists with patient care. Increasing short-term profits should NOT be their primary mission. Dental Manufacturers must be willing to reinstate discontinued products that enhance the practice of dentistry, support dental education, and promote the innovation of new products that conform to basic principles of health and longevity.**

**Conclusion**

When I started my career dental leaders swore that they would not let corporatism rule over dentistry. When I gave a presentation at ADA Annual Session many years ago, the Programs Committee looked at every one of my slides to make sure that I wasn't selling any products. But the lure of money enticed subsequent leaders into capitulating to corporate entities. I heard one presenter publicly comment on how lucky he was to work for so many esteemed companies. Today, many CE venues want presenters to come with sponsors and still have no conflicts of interest! How does *that* work?

It is my hope that the dental profession can turn some of these disturbing trends around. The rule of corporatism must be stopped and replaced with collaboration.

**Dentists must have a close relationship with the dental laboratories and with the dental manufacturers. Bottom-line thinking is inappropriate for creating an ideal dental care system and dental profession.**

**Summary of Recommendations for the future of Dental AI and technology:**

1. It is very important to ensure that AI in dentistry pursues the right path. Dentists who practice ideal dentistry have to have an active hand in programming AI in dentistry if it is to be a useful tool in diagnosis, treatment planning and execution.

2. In order to maximize its usefulness, Dental AI must be engineered to provide the education to dental practitioners that is sadly lacking.

3. If Dental AI is going to be used properly and efficiently in the future, it must keep basic principles that have proven to contribute to successful outcomes at the forefront of diagnosis, treatment planning and designing/fabricating restorations.

4. AI has the power to compile data from thousands of patients, but it must have a streamlined method of inputting data for proper analysis.

5. Dental AI must include treatment options for those who are candidates for sophisticated dentistry and for those who are not in its treatment armamentarium in order to formulate the best treatment plan for each individual patient. It will have to be programmed to avoid all of the misconceptions that are running rampant throughout the internet, including recommendations from "experts" who know nothing about alternative treatments that have a documented track record of success.

6. Dental AI will have to be instructed in how to evaluate the periodontal foundation properly and in how to determine the best approach to correcting abnormalities after considering the use of endodontics, orthodontics, periodontics, orthognathic surgery, and full coverage restorative dentistry. AI will have to know how to combine these treatments to suggest the best outcome with the least amount of invasiveness and with the most reasonable length of treatment.

7. A real game-changer would be the development of an imaging system that can register an accurate digital impression of the entire root surface below the gingiva and above the periodontal bone.

8. The laboratory industry does not have enough skilled technicians and the dental profession does not believe that technicians need to be trained, certified, and treated as professionals. This attitude MUST be changed. A team is required to produce ideal dentistry and ALL team members are to be highly educated and valued.

9. In the future, Dental AI is likely to be utilized in the digital design and fabrication of crowns and bridges. It is critically important that Dental AI be programmed with the correct approach—digital "wax dipping" technique rather than the full contour/cutback technique.

10. Dental AI will have to have to know when to recommend fixed bridgework, the Double-Tilt Precision Attachment Case or Overdentures when treatment planning for implants. It will have to evaluate the strength of the implants by length and bone quality and understand which implant systems are the best candidates for each situation. Dental AI will have to identify weak abutments and suggest a contingency plan in the event that they are lost so the entire case will not be affected.

11. Dental AI will require the Double-Tilt Precision Attachment Case treatment option in its armamentarium and know when to recommend its use for both natural tooth and for implant abutments.

12. Dental AI will have to understand when it is appropriate to make fixed bridgework and when it is appropriate to place implants. Dental AI will have to incorporate the stress treatment recommendations of Carl Misch in designing implant treatment plans, implant placement and implant restorations.

13. Methods have to be developed for denture fabrication to allow dentists to show patients the actual teeth in their setups before milling. The dentist must be able to retain control over the fit, the occlusion and the esthetic outcome and still have the advantage of computerized instructions that can duplicate the final denture at any time.

14. Methods of scanning and registering muscle attachments and movements need to be developed that can create accurate digital models of the edentulous arches for dentures.

15. Products with proven efficacy that are required for ideal restorative dentistry cannot be allowed to fall by the wayside because manufacturers favor short-term profits with inferior products. Dental AI must be "basic principle" driven and not "product" driven.

16. The practice of ideal restorative dentistry cannot be allowed to fall by the wayside in favor of short-term profits with inferior products that violate basic principles of health and longevity. Dental AI must be "basic principle" driven and not "product" driven.

17. Dental Manufacturers must be made to change their thinking. They exist primarily to help dentists with patient care. Increasing short-term profits should NOT be their primary mission. Dental Manufacturers must be willing to reinstate discontinued products that enhance the practice of dentistry, support dental education, and promote the innovation of new products that conform to basic principles of health and longevity.

18. Products with proven efficacy that are required for ideal restorative dentistry cannot be allowed to fall by the wayside because manufacturers favor short-term profits with inferior products. Dental AI must be "basic principle" driven and not "product" driven.

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