Pulp protection in today clinical practice: what about the role of materials?

By Dimitrios Triadas, DDS, PhD

Vital Pulp Protection and Therapy (VPPT) is the method used for the treatment of exposed pulpal tissue in a healthy and functional state, whenever the dentin-pulp complex is compromised by caries, trauma or restorative procedures. Pulp vitality is considered as the only potential for continuation of root development and strengthening of the rule of the tooth. Together with living pulp the capacity of the dentin-pulp complex of mature permanent teeth to repair dentin defects and to retain the damaged complex as a functional and structural unit is maintained (Bergenholtz 2005). The objective of VPPT is to minimize reversible and irreversible stimuli, to allow pulp tissue healing and to protect it from exogenous stimuli. It is well recognized that the damaged dentin-pulp complex requires protection from thermal conduction, chemical injury from the overlying restorative materials and further bacterial invasion from dentinal canals or oral bacteria leakage. It must be clarified here that protection from thermal conduction depends mainly on the conductivity of the main restoration and is beyond the scope of the present article. In order to assess the therapeutic validity of the current restorative materials in vital pulp protection, the biology of dentin-pulp complex is briefly reviewed.

Biology of dentin-pulp complex

The pulp and the dentin have been widely considered as a functional and structural unit; they form an embryological and functional entity. The dental pulp is a connective tissue entirely encased by dentin in the pulp chamber of the tooth. Dentin is a collagenous mineralized tissue characterized by the presence of parallel dentinal tubules, forming a semipermeable substrate which is regulated by the defensive function of the pulp and is effective in protecting the pulp from leaking bacterial threats and chemical injury. Pulp structure is not only a functional and structural entity, but also a sensory receptor of pain.

The reader of the present article is encouraged to study a number of papers reviewing experimental and clinical observations as well as the level of evidence in relative clinical research, which have been presented in the symposium held on 2007 in Chicago, Illinois, on “Emerging science in pulp therapy: new insights into dilemmas and controversial issues” jointly sponsored by American Association of Endodontists and American Academy of Pediatric Dentistry (see Pulp Symposium, Journal of Endodontics, July 2008, Volume 34, Number 7). It has been well recognized that the following critical factors are playing a role: a. Treatment indications: As has been well demonstrated the VPPT is indicated for teeth with healthy pulp or reversible pulpitis. More particularly:

1. Pulp protection, where a material is placed on the pulpal surface of a dentinal cavity in order to act as a barrier between the pulp and the overlying restorative material. A network of inflammatory reactions of pulpal cells, microcirculation and nerves, directly affect the outcome of the fundamental defensive mechanisms in the dental pulp. Whenever the basic scheme of pulp periphery is affected due to exogenous stimuli, regardless of the existence of pulpal exposure, a typical wound healing process of the pulp tissue takes place. Complete reconstitution of the pulp peripheral region, by reconstituting the biosynthetic activity of surviving odontoblasts and or replacement of lost odontoblast with odontoblast-like cells might be considered as the optimal end result of the healing process in the dental pulp complex. Under pathological conditions in the pulp-dentin complex a wide spectrum of atypical forms of matrices could be present at the pulp periphery. These atypical matrices are characterized from purpleness due to their osteogenic appearance and they are not effective in protecting the pulp from leaking bacterial threats and non-destructive external irritants. Clinical and experimental data clearly show that the presence and quality of the tissue reconstituting pulp periphery is a crucial diagnostic factor for the long-term success of the restorative outcome of VPPT. The clinical exploitation of dentinogenic potential of pulp tissue to reconstitute the structural and functional specificity of pulp periphery represents the basis of modern VPPT (Triadas 2010).

Clinical variables in VPPT

Numerous variables in VPPT and clinical studies carried out over than 6 last decades clearly showed that the successful outcome for vital pulp therapy is primarily dependent on the type of injury, while other variables related to the status of the dentin-pulp complex and the treatment modality have also been investigated. In general and beyond the role of treatment modality (techniques and materials), as the most important mechanism in effective long-term protection of the damaged pulp which will be analysed below, other critical factors have attracted attention.
of immature permanent teeth must satisfy different goals than treatment for mature permanent teeth, due to the central role of the pulp in the physiological continuation of root development and in further deposition of primary dentin which strengthens the root dentinal walls. Thus, preservation of pulp vitality is particularly important in the immature permanent teeth, even with very different treatment indications.

e. Remaining dentin
Effective protection from the chemical and bacterial irritants depends on the following two parameters (Smith 2002):

i. The remaining dentin thickness has been widely recognized as the main factor which determines the long-term success of the treatment, in absence of bacteria. In general remaining dentin thickness more than 1 mm is considering to be a safe limit for adequate pulp protection.

ii. Situation and dimensions of the exposed dentinal surface in the cavity seem to influence the overall dentin permeability through the number of exposed and open dentinal tubules.

d. Operative trauma
The operative trauma has been also implicated with pulpal injury and subsequent pulp healing. Frictional heat due to uncontrolled mechanical cavity prepa- ration, over-drying of the exposed dentin, direct damage to odontoblastic processes in deep cavities, and the chemical treat- ment of the dentinal surface due to acid-etching, may be associ- ated with transient pulp damage and/or increased pulpal sensitivity, which can delay pulp healing, while also development irreversible pulpitis cannot be excluded.

The role of materials - In general similar materials are widely used in today clinical practice for both sites, pulp protection in deep sound dentinal cavities, and in active carious dentinal le- sions, despite the facts that the objectives of the two techniques are clearly different. For many years the hard setting zinc oxide eugenol cements have been used under amalgam restora- tions, and the materials were used in deep sound dentinal cavities, especial- ly in cases of indirect pulp treatments, as well as resin-modified glass ionomers, as well as resin-modified glass ionomers have been evalu- ated from deep carious lesions over the last two decades, while direct application of adhe- sive materials in the base of the cavities has also been proposed. Recently calcium silicate-based materials, acting as dentin re- placement materials, are under preclinical and clinical evalua- tion.

Four criteria seem to be con- cerned to the characterization of an effective pulp protective ma- terial (see table):

- Physical properties
  Adherence to dentin, resistance to dissolution, setting time, flow, and dimensional stability repre- sent the most important physi- cal properties of an ideal pulp protective material. The physical limitations of Ca(OH)₂-based materials, such as the non-adhe- rence to dentin, dissolution in tissue fluids and degradation upon tooth fixture ranked them in the last position of the materi- als for using in pulp protection. Lack of any adherence to dentin has also been found for the zinc oxide-eugenol based materials. On the opposite excellent physi- cal and mechanical properties have been reported for the res- inous materials. The glass inom- nors present several important properties, such as an elasticity similar to dentin, and bonding to dentin and enamel. However glass ionomers are not resistant to water and have a slow setting rate. Improved physical proper- ties have been obtained with the resin modified glass ionomers. Newly released calcium silicate- based dentin substitutes have also showed interesting physio- chemical properties.

- Antibacterial activity
It is widely accepted that the ability of the pulp protective ma- terial to reduce bacterial leakage and to prevent post-operative growth of leaking bacteria and their invasion into dentinal tu- bules is the most critical require- ment to avoid deleterious pulp inflammations and necrosis (Ber- gunz Holtz 2005, Smith, 2002, Tri- alias 2010). Furthermore several micro-organisms could be iso- lated from deep carious lesions and hence, the use of a material with antimicrobial activity un- der dental restorations has been highly recommended. Since bacteria can differentially affect the ability of odontoblasts to re- pair the dentine barrier function, and the role of capping material in reduction of bacterial growth is important. Histological inves- tigations have demonstrated prevention for bacterial growth in almost 100% of the restora- tions with glass ionomer-based materials, in caries free teeth of young adults for post-operative period up to one year. In a few recent studies the MTA and hydroxyapatite-based materials showed significantly better anti- bacterial activity than Ca(OH)₂.

- Biocompatibility
Absence of cytotoxic effects and biocompatibility of the restora- tive materials are reasonably of critical importance to reduce the possibility of pulp tissue irrit- ation or degeneration. Various cell culture systems, implanta- tion testing models in animals or usage tests in animal or hu- man teeth have been repeatedly evaluated the biocompatibility of materials used as pulp pro- tective bases. Calcium hydrox- ide-based materials have been much studied and represent the gold standard in the research of dental material biocompatibility. Conventional glass ionomers are highly biocompatible materials, while the resin modified glass ionomers, the resin composites and the adhesive systems have been shown to be considerably more cytotoxic, due to the re- lease of non-polymerized monomers (BISGMA, UDMA, TEG- DMA, HEMA). These monomers can cause directly pulp inflamm- ation in toxic concentrations, or dramatic reduction of the de- fensive ability of the pulp in sub- toxic concentrations. However histological studies in deep cavities of human teeth are expected to confirm these issues.

- Biospecificity
It is associated with the capabil- ity of material to stimulate re- pair of dentin permeability (barrier function). Systematic in- vestigations on the ability of the use pulp protective materials, in- cluding the gold standard group of calcium hydroxide-based ma- terials, to mediate inflammation in the underlying pulp and to
Editorial report on the Dental Hygiene Day
at the 9th CAD/CAM & Digital Dentistry International Conference
09-10 May 2014 Dubai

By Victoria Wilson,
Dental Hygiene Therapist, UK

Dubai, UAE: A truly remarkable day for Hygienists in the MENA, over 100 Hygiene delegates attended the first Dental Hygiene Day on Saturday May 10th, 2014 which was a continuation of the 9th CAD/CAM & Digital Dentistry Intl Conference, May 09-10, 2014 at the Jumeirah Beach Hotel, Dubai, UAE. Hygienists practicing in the UAE and from other countries in the MENA attended the first of its kind in the Middle East.

The timetable included a variety of relevant topics tailored specifically to the Hygiene profession.

The exceptional speakers made it worthwhile for any hygienist to attend.

Prof. Crawford Bain delivered an interesting informative lecture on the maintenance of the dental implant patients, an extremely relevant topic for all Hygienist in light of the growing number of implants being placed and the crucial role of the Hygienist in the necessary maintenance.

Dr. Matthieu Gabriele gave a lecture on Oral Hygiene protocols and complications with various fields of dental treatment, a must know-how for every Hygienist.

Dr. Rasha Ahmed presented the important topic on dentine hypersensitivity management. Hygienists face patients common complaints of hypersensitivity on a daily basis, and the well presented topic by Dr. Rasha was much appreciated by the audience.

Victoria Wilson’s Lecture, the Editor of Hygiene Tribune, focused on communication within Dentistry, a topic essential for the delivery of oral health education and achieving long term compliance and maintenance of oral health.

The afternoon consisted of a hands on course on periodontal instrumentation, with the renowned Prof. Mary Rose Pincelli Boglione from Italy and the International Federation of Dental Hygienists IFDH. Due to the popularity and demand the course was extended to 2 days. We were honored to have such an expert in the profession join us on a revision of the essential skills of scaling and instrumentation. Hygienists are trained extensively on scaling and instrumentation in their education, however it is easy to fall into bad habits. This was an invaluable refresher course for Hygienists and we hope that Mary will join us in the future for more courses. Dr. Rasha Ahmed also delivered a very informative hands on continuing course in the afternoon on the practical application of the management of dentine hypersensitivity.

In the 7 years I have been living and working in the UAE I have never known for there to be such an extensive program for the profession on one day and for so many Hygienists to be in one room at one time.

The year 2014 is an exceptionally exciting time for the profession of Dental Hygiene in the MENA. Four months ago the Dental Tribune Middle East opened the Dental Hygiene Tribune section dedicated entirely to the Dental Hygiene profession. More and more dental and medical professionals are requesting to have a Hygienist on board. Following on from the Dental Hygiene Day we look forward to more Hygienists days by CAD/CAM with more hands on courses, and lectures tailored to the needs of hygienists professionals.

What we all have to keep in our mind is that a healthy periodontium is the backbone to all good restorative dentistry and medical treatment – not in the whole process an essential part in over all health and wellbeing.
Reveal your patients’ most healthy, radiant smile with Philips Zoom WhiteSpeed

Give your patients the immediate white smile they want and the healthy white teeth they need, with the new Philips Zoom WhiteSpeed. The number one patient-requested professional teeth whitening brand* is clinically proven to deliver superior whitening results in just one office visit. WhiteSpeed is shown to whiten teeth up to 8 shades in 45 minutes; that's 40% better than a comparable non-light activated system.†

The new Whitening LED Accelerator’s variable intensity settings allow you to customize the output to ensure each patient receives a more comfortable treatment. 91% of patients experienced little to no sensitivity with Zoom WhiteSpeed.‡

New Philips Zoom WhiteSpeed Whitening LED Accelerator
The advanced Philips blue LED technology provides approximately 50,000 hours of use—reducing operating costs, downtime and is 40% more energy efficient. The light also emits 100% greater light intensity* with no compromise to safety. Redesigned to be easier to position and more ergonomic, your patients and your treatment will be better than ever.

New support for your practice
Philips Zoom is funding a worldwide public relations campaign to drive patients to dental professionals, and new programs to help you quickly and easily integrate Zoom into your practice.

“With this new light the patient’s sensitivity is minimal, making the procedure much more pleasurable.”
– Juban Dental Care - Baton Rouge, LA

* In the U.S.
† Compared to Philips Dash
‡ Results based on 500-person study Data on file.

New Philips Zoom WhiteSpeed Light-Activated Whitening System.
A better experience for your patients and your practice.

Philips Zoom In-Office Whitening kit makes treatments easier
Packed in procedural order, you get everything you need for each treatment, including Philips Zoom at-home whitening gel for follow up and maintenance complete in a single package. The Philips Zoom Kit also includes simplified visual instructions.

Unique products for your sensitive patients
Each treatment comes with a Patient Post Care and Maintenance kit that includes the Relief ACP Oral Care Gel. This unique formula combines potassium nitrate for sensitivity relief along with Amorphous Calcium Phosphate (ACP) that helps create healthier smiles through advanced enamel protection. To ensure a more comfortable experience all around, instruct patients to use it for 10-30 minutes after treatment.

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“With this new light the patient’s sensitivity is minimal, making the procedure much more pleasurable.”
– Juban Dental Care - Baton Rouge, LA
Philips introduces its best brush yet, Sonicare DiamondClean, helping users achieve brushing brilliance every time

By Philips

Dubai, U.A.E. - Philips is proud to present the new Sonicare DiamondClean - a brush that updates your sonic tooth brushing to its most sophisticated level and which delivers Sonicare’s best clean yet removing up to 100% more plaque in hard to reach places than a manual toothbrush.

Sonicare DiamondClean harnesses Philips’ patented sonic technology to produce a powerful dynamic cleaning action for a difference users can see and feel. It is gentler on teeth and gums than a manual toothbrush, helping to keep teeth stronger and healthier on teeth and gums than a manual toothbrush, helping to keep teeth stronger and healthier.

Sonicare DiamondClean is clinically proven to remove up to 100% of plaque from hard to reach places and to improve gum health in just 2 weeks. It is also clinically proven to whiten teeth in 1 week; and its gentle technology actually helps protect against gum irritation and recession to help reduce sensitivity. Now is the perfect time to give your teeth the celebrity treatment and switch to Sonicare to really experience the difference.

The brush is able to deliver a unique whole mouth cleaning feeling thanks to its five brush modes that allow you to tailor your brushing according to your needs as well as your dental professional’s advice. The brush modes range from: • Clean – the standard mode for a whole mouth clean • White – removes surface stains to whiten teeth • Polish – brightens and polishes teeth to bring out their natural beauty • Gum Care – gently stimulates and massages gums • Sensitive – an extra-gentle mode for sensitive teeth Highly charged

DiamondClean’s chrome base also features a unique charging glass that can be used for mouth rinsing, but also incorporates the latest in inductive charging technology to charge the toothbrush as it rests in the glass – making it stylish enough to display in the most fashion-forward bathroom. Not only is Sonicare DiamondClean Philips’ most advanced brush yet, it’s also our most easy to use and stylish. DiamondClean’s power handle has a ceramic finish and a chrome accent ring highlights the elegant neck of the brush. The technology in the handle is hidden so that the sleek matte white finish of the brush is uncluttered by electronic visual displays. Only when the on button is pressed do the toothbrush modes illuminated to reveal the array of options. These are then simply selected by scrolling down using a one button action.

When traveling or on the go, Sonicare DiamondClean is designed for convenience with users being able to keep their brush fully charged using a revolutionary USB travel case that can be plugged into almost any laptop computer and saves the hassle of having to pack plugs and adaptors. But only the most intrepid travellers need worry about this advanced feature as Sonicare DiamondClean holds an impressive three weeks charge.

Brilliant cut

Sonicare DiamondClean brush heads also sport a new diamond-cut tuft formation to provide you with an even more efficient brushing experience. The uniquely designed diamond bristle heads have 44% more bristles than Philips Sonicare’s standard sized ProResults brush heads, providing you with both superior plaque removal and whiter teeth. The heads come in two sizes – Standard and Compact – for focused cleaning in areas of special need, for orthodontic patients and those with smaller mouths.

How much do you care for your hands?

By Beverley Watson RDH,
Kings College, London

LONDON, UK: It is understood that out of many professions Dental Hygienists are in the high risk category of suffering from Repetitive Strain Injury RSI or Carpal Tunnel Syndrome CTS. This article aims to evaluate ways to reduce this risk. Two widely used brands of Hand instruments are to be evaluated as a comparison, LM DuraGradeMax and American Eagle XP Technology.

Method: Online research publications.

Conclusion: After reviewing the information from both LM and American Eagle instruments, it was found that some parts of the LM information in Figure 5 was not able to clearly state what it was trying to prove. Yet with electron microscope photographs and the Rockwell hardness test proves the hardness of the cutting edge of American Eagle instruments.

Objectives: To determine the best ways a Dental Hygienist can avoid RSI or CTS through out their career. This will include exercises’ and what to do when travelling.

XP Technology American Eagle
*Specially filtered titanium nitride/stainless steel alloy not a coating but infused.
*Rockwell hardness test most steel instruments 58-60, XP 89, Diamond 100
Strokes 1500 XP = 1,500 other

DuraGradeMax LM steel
Hardened steel alloy by thermo-mechanical heat treatment, controlled gas atmosphere and cryogenic processing.

Figure 7 shows its durability outlasts any other instrument including XP Technology.

5. Poor posture or activities that require work in an awkward position.
4. Holding the instrument USS or hand scalers with the wrist is bent. It is best to keep the wrist in line with the arm not at an angle compressing the median nerve (Figure 1).

Signs and symptoms can vary but the most common are pain, aching or tenderness, stiffness, throbbing, tingling or numbness, weakness and cramp.

> Page 20
Are your patients’ dentures truly clean?

Dentures contain surface pores in which microorganisms can colonise.1

Corega® cleanser is proven to penetrate the biofilm* and kill microorganisms within hard-to-reach surface pores.2

SEM images of denture surface.

*In vitro single species biofilm after 5 minutes soak


Date of preparation: June 2014.
Ref: CHSAU/CHPLD/0008/14c

Help your patients eat, speak and smile with confidence with the Corega® denture care regime.
In ‘bleeding on probing’ trials over 4 weeks, parodontax® demonstrated significant effects in reducing bleeding gums by 22% (p<0.01)

Bleeding on probing increased after 4 weeks of brushing with the fluoride control toothpaste

Adapted from Saxer et al 1994. All interdental spaces from 6+ to +6 were tested at baseline and 4 weeks for bleeding on probing on the right side (buccal) and left side (lingual). Findings were recorded as 0=no bleeding; 1=slight/isolated bleeding; 2=marked bleeding. Mean scores were determined. N=22.

Baseline values [Mean SD]: Control (fluoride-containing toothpaste) group 24.75 (6.34); parodontax® group 25.40 (6.80). After 4 weeks: Control (fluoride-containing toothpaste) group 26.00 (9.14); parodontax® group 19.80 (7.38). *parodontax® vs control p<0.05.
Prevention: Take regular hand breaks to stretch and exercises the muscles, tendons and ligaments. See Figure 2 for some possible exercises.

Breaks don’t only include time away from scaling, but also time away from the computer and writing notes. Typing can also compress the nerves in the Carpal Tunnel.

Treatment: If it is not possible to take long term time out from the activity causing the repetitive strain on the small muscle groups, then it is necessary to take regular short breaks and stretch (Figure 2, 5).

A hand splint, the hand is held in a relaxed position to take pressure of the Median nerve run-ins through the Carpal Tunnel and as a final resort surgery.

A brief history of Hygiene

The earliest recorded text associated with teeth cleaning dated 5000 BCE where tooth picks were used in Mesopotamia (early Iraq) according to the M dentistry Time line of Dental Hygiene, but it was not until 1915 in USA, Connecticut that Alfred C. Fones trained 97 Dental Hygienists and the Dental Act set regulations stating their duties. Then in UK 1945 saw the 1st Dental Hygienists trained in the Women’s Auxiliary Army WAAF. Instruments: The 1st Dental hand instruments were very thin and heavy with smooth metal handles requiring a very tight grip. Later a cross hatch was scored into the metal handles for easier grip but were still very thin, wider lighter steel gripped handles were introduced and in the last 10 years a wider ergonomnic soft silicone was used around a metal inner part then came into production, a very light completely resin handle with a grip for less wear on the muscles and tendons.

Ultra Sonic Scalers have dramatically improved the Dental Hygienists ability to remove hard deposits from the tooth surface by either working in a Magnetoconductive or Piezo electric capacity. This reduces the need for excessive forces applied by the hand over an extended period of time increasing the risk of strain and inflammation of the wrist muscles and tendons resulting in RSI or CTS (Figure 4).

Sharpening: Numerous articles state the different methods of sharpening instruments. Arkonstone different shapes round, flat, long, short, different sizes, angles, grades course, medium, fine.

- Machines: The Hu-Friedy instrument sharpener, the LM Rondo-plus electrical disc sharpener
- The Neivert Whittler to name a few.

The consistency of the angle of application is unpredictable and operator error possible. It is possible to affect the cutting edge, causing more strain on the fingers hand and wrist. It is human nature to not sharpen immediately when required. Figure 5 shows the different types of next generation hardened steel.

Results: LM handles present to be ergonomically superior with a wider silicone grip to help keep the Carpal Tunnel open, however they do still contain an inner part of steel. This runs the entire length of the handle increasing the overall weight compared to the completely resin handle of the American Eagle.

The XP technology instruments requires no sharpening at all, and will allow more repetitive strokes with minimal pressure on the tendons and wrist. The LM DuragradeMax uses a hardened steel alloy more durable than the XP Technology. It is advised to send the instruments back to the LM company for factory sharpening, requiring downtime in the practice in order to continue a full working schedule, resulting in LM being less cost effective. Once the XP technology tips becomes dulled it is feasible to use their Quick tips to replace the tip as less cost than the full instrument.

The statistics in Figure 7 do not clearly state how the results were determined for LM instruments, it is not clear what numbers 8, 7, 5 and 3 represent, minutes, hours, Days. Strokes? It is possible however to see in the photographic evidence 15000 strokes to 1,500 from American Eagle instruments.

Regarding the hardness of the Steel alloy of the LM instruments there is no evidence to support this but the American Eagle XP instruments have the Rockwell hardness test to prove their claim.

Conclusion: In conclusion the Ultra Sonic Scaler should be used as much as possible to avoid excessive strain on the transverse carpal ligament and median nerve. It is clear that some calculus deposits remain interdentally after Ultra Sonic Scaling alone. Ultra Sonic Scaling alone is not sufficient and hand instrumentation is necessary in conjunction with Ultra Sonic Scaling.

The correct choice of hand instrument is essential for a Dental Hygienist to help avoid RSI. It seems the American Eagle lightweight resin handle with the XP Technology blade will be of most benefit long term. Due to its superior strokes carried out 15000 to 1,500 before starting to dull.

For this reason it seems the American Eagle XP technology would be in the instrument of choice compared to the LM DuragradeMax. The American Eagle XP will ensure less pressure is exerted on the median nerve, the transverse ligaments and the carpal tendons reducing the risk of RSI or CTS.

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In conclusion the XP Technology is beam of the future for Ultrasound Scaler. It seems the American Eagle XP technology is the best available on the market at this time.
PRECISION CLEAN BRUSH HEAD PROVIDES

UP TO 5x
GREAT REDUCTION
IN PLAQUE BIOFILM ALONG THE GUMLINE

5x

Oral-B®, most Dentist Recommended
Toothbrush Brand worldwide

* vs. a regular manual toothbrush

continuing the care that starts in your chair
KaVo CAD/CAM workflow with the new products ARCTICA AutoScan, KaVo multiCAD Virtual Articulator and VITA ENAMIC

By KaVo

With the production of two monolithic posterior crowns, the KaVo CAD/CAM application technology demonstrates a practical case in which the new CAD/CAM products ARCTICA AutoScan, KaVo multiCAD Virtual Articulator and VITA ENAMIC for KaVo ARCTICA play a major role.

Described below are the following individual steps, which consist of:
1. Order preparation
2. Scanning
3. CAD construction
4. Preparation for manufacture
5. Manufacturing
6. Completion

Order preparation: 50 seconds

First, the practitioner, the patient and the respective technician are defined in the order entry form. The second step consists of the definition of the indication including all parameters. In the present case, this concerns the creation of two full crowns to be made of Vita ENAMIC Regio 46 and 47. The parameters for the respective practitioner can be referenced in the KaVo multiCAD software. This function guarantees consistent quality regardless of the originator of the order (Figure 1, 2).

Scanning: 180 seconds

This case is scanned with the new fully-automatic ARCTICA AutoScan. The scan process is very simple as the software guides the user step by step through the scan process. The individual scans are performed completely automatically. First, the upper jaw is scanned, followed by the lower jaw. If necessary, single stumps may then be scanned separately. This is followed by a vestibular scan allowing the correct positioning of the jaws by the software (Figure 3).

The next step consists of matching the individual jaw scans and the vestibular scan by marking three identical points on the respective jaw and vestibular scan. Afterwards, the software calculates the exact position of the upper and lower jaw scans (Figure 4, 5, 6).

Construction of the restoration in the KaVo multiCAD software: 180 seconds

In the KaVo multiCAD software, the contact relief of the corresponding jaw is displayed in the scan software. For analytical purposes, it may be displayed in color. The respective color and intensity indicate the distance to the antagonist.

Afterwards, the articulator KaVo PROTAR evo 5B is started in the KaVo multiCAD software. The respective patient-specific settings of the physical PROTAR articulator such as, for example, the condyle track inclination and the Bennett angle, are entered into an entry mask. The correct positioning of the models in the virtual articulator (KaVo PROTAR 5B) is done automatically. Based on the scan of the articulated models in the ARCTICA AutoScan and the positioning of the models by the KaVo Splitcast system, the correct positioning is automatically transferred to the CAD-software. This positioning also applies to models that were inserted into the articulator by means of a facebow.

After the adjustment of the patient-specific parameters, the motion tracks are simulated and any interferences are corrected by the software (Figure 7, 8, 9).

The illustration shows a laterotrusion to the left (Figure 10).

In the subsequent construction process, the movements of the jaws may be visualized at any time (Figure 11).

The manufacture of the two VITA ENAMIC crowns on 46 and 47 is performed quickly and easily by means of library teeth that are automatically positioned onto the preparations and may be loaded into the situation via a simple mouse click. Furthermore, the library teeth may subsequently be matched to the individual occlusal relief of the chewing surface. The user is able to adjust the suggestions of the software via a wizard (step-by-step assistant) at any time during the construction process. Various tools
Giomers are a remarkable class of bioesthetic restorative materials that exhibit the aesthetics, strength and durability of nano-hybrid resin composites, further enhanced with the benefit of fluoride and anti-plaque effect pertaining to S-PRG fillers.

These unique fillers are manufactured through Shofu’s patented PRG filler technology that imparts Beautifil II, Beautifil Flow, Beautifil Injectable and FL-Bond II with protective fluoride benefits and greater tissue tolerance.
Now is the time to consider investing in your own CBCT System

By Ernesto Jaconelli

This Century has seen the introduction of 3D imaging as a readily available dental diagnostic tool. This trend has been inspired by the development of both Cone Beam Computed Technology (CBCT) and PC storage capability making 3D imaging more convenient, easier to use, and affordable.

To be able to view the area of interest in all three dimensions significantly improves the accuracy of diagnosis and this in turn makes for better patient treatment. Each year new systems are becoming available such as the new CS 8100 3D System from Carestream Dental. These new systems are now significantly smaller, more versatile and user friendly than their predecessors. The CS 8100 3D has a “resting” width of 35cm (110cm when in use) and weighs only 92Kgm so will fit easily into most compact dental clinics.

A very important feature of all modern CBCT systems is that they provide the Dentist with a choice of volumes that will be right for the area of interest. These volumes are known as the Field of View (FOV). The CS 8100 3D for example gives choices from taking a 2D Panoramic to capturing a selection of 3D FOV's of 4 x 4 / 5 x 5 / 8 x 8 and 8 x 9 mm. As with all x-rays it is essential to minimise the dose to the patient - the larger the FOV the more dose to the patient. Each area of dental surgery will require a different FOV depending on the treatment being considered so it is essential to have a choice of FOVs to select from.

For a single implant a FOV of 5 x 5 mm will be sufficient and the dose to the patient in this case will be similar to that from a 2D panoramic scan. However for the preparation of multiple implants or surgical guides then a single arch FOV of 8 x 8 / 8 x 9mm FOV would be selected. Dentist who specialising in Implants were the first to fully appreciate the benefits of 3D imaging such that it is now unusual to find one who does not have their own CBCT system.

For Endodontists, the key diagnostic tool is always their surgical loupes. But they are also adopting 3D image to reveal more clearly any additional canals that are present and possibly missed from a 2D image as well as their exact position and apical areas. A sectorial FOV of 5 x 5 mm will provide a very high definition image for an Endodontist to be able to examine the area in precise detail.

Until now Orthodontists have mainly been satisfied with a 2D panoramic view. However having a CBCT system that switches easily from a 2D panoramic to 3D image allows the Orthodontist to select a 3D view when required. Retention and angulation for example are more precisely diagnosed from an 8 x 5 / 8 x 9 mm FOV.

3D imaging will soon be the norm for dental diagnostics requiring all dentists to be familiar with the technology and capable of analysing 3D images. There has never been a more appropriate time to consider having your own CBCT System. Manufacturers are supplying in depth training such as at the Carestream Dental Training Centre at Ajman University of Science and Technology, and now that CBCT systems are available from 40,000€, a return on the investment can be achieved within two years.
Simple, planned aesthetic orthodontics for the General Practitioner

By Dr. Tif Qureshi

Dr. Tif Qureshi shows how digital technology has moved progressive smile design on and the enormous benefits this will have for planning and consent. Digital Smile Design is making a come back in a very smart and intelligent form through the use of live video, cameras, and keynote presentations.

I commend the users of this technique as it is clearly a far better form of smile design planning than just using plain static before and after pictures with someone else’s smile stitched into place.

However in cases where there are alignment issues, I would still argue that any patient who does not at least go down the pathway of alignment and bleaching, cannot really see their teeth change in a dynamic way.

I have found that patient’s feelings about their smiles change, not only do they want one thing but after they see their smile change a little they start to appreciate it in a different way. How can someone really be consented unless they are given the opportunity to bleach their teeth, perhaps with slight alignment and bonding.

This case is the perfect example and will show how progressive smile design also using digital technology can produce beautiful predictable results that often require far less invasive treatment.

We use digital technology in a different way of course and this is all to do with planning and consent. Previously with Inman Aligners, we had to use esthetic models. These are effectively fairly crude stone models which take a cut and once repositioned in wax the aligner is then built on that model. As soon as the aligner is fitted into an uncorrected mouth the forces are there to push the teeth to the final position. The real downside of it at the wax creates quite large inaccuracies. Also it is very difficult to see how much adjustments have been made to the teeth to get them to fit within the curve. This is even more so of a problem for flared teeth which have been out of the arch for many more years. These teeth tend to be highly triangular and often need more targeted adjustment to get them to fit within the arch form. You can visualize the width of these teeth, it is almost impossible to accurately know how much production is required to each.

Of course with digital 5-D printing this has all changed. The difference if you like it is night and day. We can also use print models to show the patients the proposed outcome. This is excellent for the consenting process. Untreated patients will now see any compromises areas and the final outcome. If they are not happy they could reject the treatment before it starts.

A case

A 22 year old gentleman did not like the appearance of his teeth especially because the two centrals was so prominent. He had considered having porcelain veneers done just to improve his smile in one treatment. He did not like the appearance of his enamel and also the discrepancy in the shape of his front teeth. We showed him the occlusal view of his teeth and he could see that the upper anterior is one mildly misaligned. Indirect veneers would have been fairly aggressive towards the preparation of the upper central incisors. By showing examples of other cases where small alignment had dramatically improved the aesthetic value the patient agreed to try to align his teeth first before having veneers done.

Consent part one

A full orthodontic examination was carried out. All orthodontic options were discussed and the patient understood the benefits of fully comprehensive orthodontics, and was also given a range of short-term techniques that he could have chosen. He declined comprehensive orthodontics on the basis that he only wanted to deal with his anterior teeth.

He chose to have an Inman Aligner because of the shorter wear time and the minimal cost impact on his overall treatment desires. Our first goal was to evaluate the aesthetics and function to decide on landmark or reference teeth. As part of the digital planning process these teeth are not moved and ensure the setup accommodates these teeth to ensure the proposed curve is not flared or over constructed.

In this case the patient had also had a retained upper left deciduous tooth (no canine had developed). Fortunately this tooth was in the right position so it became the reference tooth and hence no orthodontic force would need to be applied. Both upper centrals needed to be retracted and both laterals advanced. It was important to visualize a chin up view to ensure this is viable for the patient from an occlusal and guidance point of view. All the movements were possible.

(Figure 1) Occlusal showing landmark and desired movements.

(Figure 2) Showing spacewize trace

In the chair the occlusal photo was taken and uploaded into the spacewize digital calculator.

The curve is set according to the landmark teeth and required movements. This showed a crowding result of 5mm which was within the easy limits for Inman treatment.

Impressions were taken and were sent to the lab with the spacewize trace.

Consent part two

The 3D model was returned and we could view the proposed setup made according to the spacewize instructions.

An appointment was made with the patient to sit down and examine the models. At this point the patient clearly sees any compromises in the posterior region of his mouth. These were again highlighted but the patient insisted he did not want these treated. The over jet was also discussed with the patient he could see a reduction but not complete closure, he was happy with this.

You can see the width differences in the anterior teeth that would require adjustment and the laterals advanced by about 1.75mm exactly.

These setups can be viewed as digital files in 3D if needed beforehand by the dentist and adjustments can be made if needed. Once we are happy, the 3D model was printed.

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tooth shaping with PPR (predictive proximal reduction). This made it far easier for him to understand the processes required to create the space. Finally he could also see the differential wear in his tooth outline that would be evident after alignment. He clearly understood that edge bonding and tooth contouring might be required after alignment and bleaching were complete. That is assuming he did not want to continue with porcelain veneers.

It was noted that the patient had reviewed and understood the 3-D model and what it was proposing. The Inman Aligner was then built and fitted.

Treatment

Inter-proximal and Predictive proximal reduction were carried out in a progressive and measured manner over 5 visits. This was done to ensure good anatomy and to reduce the risk of gouging, over stripping and poor contacts. With Inman Aligner treatment stripping is never carried out in one go.

Composite anchors were also placed in a timed and sequenced manner to ensure the forces could be directed at the right time. This allows for rapidly increased treatment times.

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We used some mockup flammable material to show the patient what was possible and he was thrilled with the results. So an appointment was booked for 2 weeks to have this done.

Figure 6: Before Close-front view
Figure 7: After alignment and bleaching at 10 weeks
Figure 8: Immediately after bonding

Composite bonding was carried out on the 7, 9 and 10. A composite veneer was placed on the 11. All these were carried out with only roughening and no prep or bevel. Venus Diamond composite from Heraeus Kulzer was used. I find that the Opaque shade allows superb blocking out of light meaning that if layered as dentine, it means a long bevel is not required to block out the join. Enamel shade can then be placed thicker towards the incisal edge.

A wire retainer was fitted and the guidance adjusted to ensure there were still balanced excursive contacts on the left side so the load was not focused on the deciduous tooth.

Roughening, total etch Opti-bond solo and Venus flow were used to bond the wire in place. A clear essix retainer was also given to the patient to wear at night initially then to use occasionally and to have as a back up if the wire de-bonded.

Discussion

Figure 9: Before front smile view
Figure 10: After Alignment and bleaching at 10 weeks
Figure 11: After Edge bonding and retainer
Figure 12: Side profile before
Figure 13: Side Profile after
Figure 14: Side Smile before
Figure 15: Side Smile After alignment and bleaching
Figure 16: Side Smile at 6 months
Figure 17: Before occlusal
Figure 18: After occlusal at 10 weeks
Figure 19: After 6 months with retainer

On viewing the sequenced shots it is clear to see the changes. The patient was delighted that he had emerged from the treatment with his own teeth looking more attractive than having ceramic porcelain veneers. As good as ceramic restorations are, they will always require further treatment/maintenance and replacement.

On a 22 year old if alignment, bleaching and bonding can satisfy the patient that it has to be better than placing ceramic veneers. The problem with digital smile design is that the patient is not really given the opportunity to see the teeth change slowly and in situ.

It is fine if whitening, bonding and alignment are part of those protocols but arguably patients should not be shown images of multiple veneers until they can visualize their own teeth looking better.

You can see how very subtle changes can dramatically improve the appearance. Even though the colour is not truly homogenous and the teeth have a mottled appearance the most important thing here is that the patient was completely delighted with the treatment.

Ultimately a patient being happy with their own smile has to far outweigh the parameters that are set up traditional smile design.

Final images at the 6 month review are also shown.

Contact Information

Dr Tif Qureshi teaches Inman Aligner Training
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may be used for this purpose, for example free forming, virtual wax knife, scaling, turning and shifting of teeth.

Interferences remaining after the construction will be displayed by the software and automatically removed in consideration of both static as well as dynamic factors (by means of the virtual KaVo PROTAR Evo 5B) including the previously identified motion tracks. This allows for a drastic reduction or even the complete omission of subsequent follow-up work in the mouth of the patient for the practitioner. Not only does this facilitate time and cost savings, the danger of chipping may be reduced as well (Figure 12, 15).

The following color illustration shows the occlusal pattern after dynamic adjustment (Figure 14).

In the image, one can clearly recognize the deviations (color markings) between the static and dynamic structure and the adjustment of interferences in the chewing relief.

The dynamic adjustment may be displayed over the static one as wire netting. Any interferences to be expected are clearly recognizable (Figure 15).

After the dynamic adjustment, the finalized VITA ENAMIC crowns may be displayed in the KaVo multiCAD module TruSmile in a photo-realistic manner (Figure 16, 17).

Preparation for manufacture in the KaVo CSS: 60 seconds

The next steps for the completion of the dentures are performed in the KaVo CSS software, which is a job, material, tool and machinery management software by KaVo.

First, the manufacturing method is defined. This means that the user has the opportunity to send the produced,
open STL data of the restoration to his ARCTICA engine, his Everest engine or to other KaVo milling partners via the free KaVo Everest portal. The work to be manufactured and the predefined material to be used may be reviewed in a 3D view. If necessary, additional modifications such as, for example, a change of the material may be made.

After the selection of the KaVo ARCTICA engine as the production machine and a VITA ENAMIC for KaVo ARCTICA block, which was previously booked into the KaVo CSS via RFID technology, the nesting, i.e. the positioning of the restoration in the virtual material block, may be performed (Figure 18).

Production on the KaVo ARCTICA engine: 25 minutes per crown

Now, the blanks are inserted in the block bracket of the ARCTICA engine and affixed with a torque wrench with a defined tightening torque (Figure 19, 20, 21).

Afterwards, the tool stack with the tools required for the Vita ENAMIC - in this case, 4 different grinding tools with diameters between 0.6 – 3.6 mm - is inserted.

These tools were also previously booked in the KaVo CSS software via RFID chip and assigned to the glass ceramic tool stack. The advantage is that the tool service times are precisely logged and that the ARCTICA engine uses a traffic light pattern (green, yellow, red) to show the user when a tool should be exchanged. This also helps to minimize application errors.

In case of an automatic tool change in the KaVo ARCTICA engine, the tools are once again inspected with a laser for breakage or faulty positioning once they have been removed from the stack. The processing is started at the touch of a button on the touch-screen of the ARCTICA engine or, alternatively, directly at the PC (Figure 22).

Completion of the VITA ENAMIC crowns: 180 seconds each

After the successful production of the two restorations on the KaVo ARCTICA engine, the VITA ENAMIC crowns may be separated from the material block. The ARCTICA engine may be connected to a KaVo lab handpiece (ERGOgrip and POWERgrip) and used to further process the works. Prior to the start of the grinding procedure, there is also an opportunity to reduce the diameter of the connectors to a minimum at the end of the production process, so that the time expended for the separation of the restoration becomes negligible.

After the grinding procedure, the VITA ENAMIC crowns are polished in a time-saving manner with the tools from the VITA ENAMIC polishing set. An additional subsequent individualization of the work is possible with the colours of the VITA ENAMIC stains kits. In this case, an additional individualization was omitted upon the request of the patient (Figure 23, 24, 25).

Thanks to the use of the virtual articulator during the construction in the KaVo multiCAD software and the precise 5-axis technology of the ARCTICA engine, the work could be inserted directly into the mouth of the patient and corrections of the occlusal relief could be waived. As can be seen, precisely integrated process chains pay off.
stabilize directly tertiary dentin formation and intratubular mineralization, are entirely lacking from the literature. A few recent investigations at the preclinical level have shown that application of newly commercialized calcium-silicate based materials in deep dentinal cavities resulted in rapid stabilization of the bioinorganic activity of odontoblasts and dramatic reduction of dentin permeability. Again, all these data have to be confirmed clinically.

In conclusion, despite the fact that numerous scientific articles studied experimentally or clinically the pulp protective materials in experimental or clinical investigations (Bjornell et al. 2010), and a number of critical and systematic reviews discussed their results, it must be emphasized that they have not been evaluated for the complete range of their effect. Given that application of a calcium hydroxide-based material in combination with a glass ionomer, seem to be the best choice according to the guidelines of American Academy of Pediatric Dentistry and the American Association of Endodontists, further randomized multi-centered controlled clinical research is needed to assess firstly the overall role of capping material in the VPPT, and then the ability of today used and/or newly developed materials to provide long-term pulp protection.

References