New clinical innovations and the benefit of magnification to ensure predictable posterior composite restorations – Part 1

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Introduction

For many years gold and amalgam have been the materials of choice for restorations in the posterior dentition due to the clinician's desire for predictable function and a lack of viable aesthetic treatment choices. Today, the benefits of posterior resin restorations extend far beyond appearance alone. Features and benefits include functional stability, conservative cavity preparation, tooth reinforcement, biocompatibility and repairability (Jackson, 1999).

Posterior composite resin restorations are generally performed as fine detail work. The restorative phase requires attention to detail while following a meticulous clinical technique. According to Liebenberg (2001), the direct Class II posterior composite resin restoration is one of the most challenging restorations due to the operative intricacy and proximal precinct. Clinical performance is affected by the degree of fine detail that can be seen by the clinician during any given dental operation. The use of magnification in dentistry is expanding rapidly. It has revolutionized endodontics and will improve many aspects of clinical dentistry. The Dental Operating Microscope (DOM) (Figure 1) improves visual acuity, provides increased precision and is also of important ergonomic benefit to the clinician.

As reported by van As (2008), 10X microscope magnification can provide the clinician with 25 times more visual information compared to that obtained from the use of entry level loupe magnification (2X) and 100 times more information compared to the naked-eye view. In a study by Leknius and Giessberger (1995) they demonstrated that dental students who performed fixed prosthodontics procedures while using magnification were found to make fifty per cent less errors than students who performed the same procedure without the aid of magnification. In 2004,

Figure 1: Global 6-Step Dental Operating Microscope (DOM) fitted with a dual-iris, LED light source, beam splitter and HD video camera.

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Zaugg, Stassinakis and Hotz illustrated the influence of magnification on the recognition of simulated preparation and filling errors. They mounted 37 mistakes or filling errors onto a phantom head model and asked 39 dentists to examine the jaws under clinical conditions using either no visual aid (n=13), magnifying glasses (n=13) or a microscope (n=13). The group using the microscope for examination spent more time on examination and found significantly more defects than the groups using magnifying glasses or no visual aids.

The accuracy of any given procedure is increased when the stereoscopic view of the microscope is combined with the shadowless coaxial light source. Combining magnification with illumination allows the clinician to visualise vital information that can influence the outcome of treatment which is not otherwise perceptible to the naked eye. In general, the benefits of microscope magnification include: magnified images, increased precision (van As, 2008), shadowless illumination, improved ergonomics and posture for the operator, digital documentation of findings by means of integrated photography or video (van As, 2008) that can be used for communication with the patient.

This article will introduce new innovative materials and techniques that the clinician can utilize for posterior composite restorations. The importance and benefits of using the Dental Operating Microscope during the placement of composite restorations will be highlighted.

Figure 2: Occlusal stop contacts that was recorded with articulation paper.

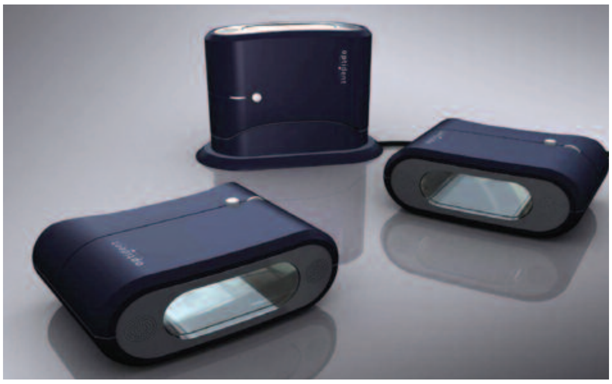


Figure 3: Optilume (Optident) light source.

Preoperative procedures

• Record the preoperative occlusal stop contacts and excursive guiding planes with articulation paper (Figure 2). The occlusal surface anatomy of the tooth or existing restoration, anatomy of the adjacent and opposing tooth must be recorded. This information can be transferred to a hand drawn diagram, recorded by means of an intraoral camera or digital camera. The author prefers to record this data with a digital image and to view this in colour on a computer screen during the procedure (Figure 2). This information is indispensable during cavity preparation design to ensure correct placement of centric stops beyond or within the confines of the restoration. In addition, this information can also help to reduce minimize finishing procedures (Liebenberg, 1996).

• Select a shade. The preoperative photograph will also guide the clinician with a map to identify differences in colour and indicate anatomic morphological details such as developmental grooves, shape of embrasures, prominences, facets, angles, plane areas and any other characteristics that can provide the clinician with valuable information when restoring the tooth (Barattieri et al., 1992). For optimal results, a colour corrected daylight light source of 5500K (Optilume, Optident) (Figure 3) can be utilized to ensure natural colour registration. Do not select the shade after isolation of the working field. It has been shown that rubber dam isolation can cause dehydration of the teeth and render elevated values for shade selection (Fahl, Denehy & Jackson, 1998).

Isolation of the working field

After obtaining adequate anaesthesia the working field should be isolated. Many studies have indicated that the placement of adhesive restorations is sensitive to environmental conditions, such as relative humidity (Plasmanns et al., 1993; Nystrom et al., 1998; Barghi, Knight and Berry, 1991) and the presence of contaminants eg. blood, saliva, gingival crevicular fluid (Liebenberg, 1992; Terry 2005a) or hand piece lubricant (Sugawara et al., 2010).

Two long-term clinical studies showed that there was no substantial difference between rubber dam isolation and compromised isolation with cotton rolls for direct placement of composite resin in posterior teeth (Raskin et al, 2000;

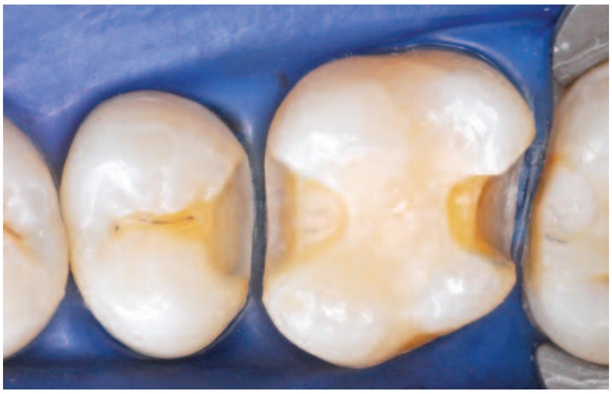


Figure 4: Rubber dam isolation providing adequate access to the working field.

Brunthaler et al., 2003). However, Liebenberg (2001) stated that the complex adhesive protocol for posterior composite restorations is best rendered with the access afforded by rubber dam. Results from both *in vivo* and *in vitro* studies have also indicated that there is an environmental influence on resin-tooth bond strength (Plasmanns et al., 1993; Nystrom et al., 1998; Barghi, Knight and Berry, 1991), volumetric polymerization shrinkage (Tiba et al., 2005; Charlton, 2006) and microleakage of resin based composite restorations (Knight et al., 1993; Besnault and Attal, 2002).

The benefits of rubber dam isolation according to Terry (2005b) includes moisture control, prevention of bacteria and saliva contamination, increased visibility and access to the working field, improves tongue and lip control, reduces airborne debris, prevents gagging, prevents aspiration of restorative materials and instruments, reduces procedural operating time and improves treatment quality and patient comfort.

Figure 4 depicts a clinical case where cavity preparations were done for posterior composite restorations on the upper right first premolar and molar teeth. Note the uncompromised isolation at the rubber dam/tooth junction as well as the adequate access to the working field.

Recently, Kameyama et al., 2010 advocated that it is preferable to avoid performing intra-oral adhesion procedures in the absence of any dry field technique. Investigators have reported that bond strengths to tooth structure is lower under simulated intra-oral conditions that under ambient room temperature. In their study they compared the effects of three dry field techniques (rubber dam, Isolite i2 (Isolite Systems, Santa Barbara, California) and Coolex (APT, Osaka, Japan) on intra-oral temperature and relative humidity compared with the effects of a non-isolated control of intra-oral temperature and relative humidity. The results of their study indicated that all three dry-field techniques effectively reduced both intra-oral temperature and humidity and emphasized the clinical usefulness of dry field techniques to prevent contamination and to manage the environment for bonding to enamel and dentine.

The Isolite Dryfield lluminator (Isolite Systems, Santa Barbara, California) is an innovative device that can provide clinicians with the following advantages: tongue and check retraction of the patient, isolation of the maxillary and mandibular quadrants simultaneously, continuous hands-free saliva evacuation and bright, shadowless illumination of the oral cavity. In addition the device provides the patient with an integrated bite block which allows them to comfortably rest their jaw while keeping their mouth open at all times. The mouthpiece also serves as a barrier which obturates the throat to prevent inadvertent aspiration of objects.

The system consists of a control head with dual vacuum levers to give the operator control of suction strength in the upper and lower quadrants; a vacuum and light pipe with a button to activate the LED light (Figure 5); a single- use mouthpiece, available in different sizes (Figure 6), and a vacuum hose that is attached to a high volume suction port in the operatory.

Figure 5: Control head of the Isolite Dryfield Illuminator.

Figure 6: Single-use mouthpiece of the Isolite Dryfield Illuminator.

Figure 7 illustrates a case where the Isolite device was used to create a dry working field during the placement of two Class I posterior composite restorations on the lower left second and third molars. Note the excellent isolation and control over the patients tongue and cheek that is afforded by the Isolite mouthpiece.

Examination of the isolated tooth

Dental caries is the progressive demineralization of tooth structure by organic acids produced from plaque bacteria. Early detection of demineralised or carious tooth structure can either prevent or lead to more conservative cavity preparations. According to Pitts (1997), traditional methods of caries detection based on visual, tactile or radiographic evidence are unreliable due to more recent changes in caries disease and epidemiology. Additional examination of the tooth in question after isolation with either laser fluorescence, AC impedance spectroscopy or magnification can provide the clinician with valuable information. The information of these findings in conjunction with radiographic findings can aid in detection and identification of possible infected carious tissue (Pretty et al., 2003; Terry, 2005a).

The occlusal and interproximal surfaces of the tooth to be restored can be examined with quantitative light-induced fluorescence (Diagnodent, KaVo) (Figure 8). The Occlusal tip (Figure 9) is used to examine occlusal and buccal surfaces and the Approx tip (Figure 10) is used to examine interproximal surfaces.

The principle of the device is that when a red light with a wavelength of 655nm is applied to tooth enamel, caries induced changes in the structure of the enamel lead to increased fluorescence (Hibst et al., 2001). The fluorescence changes according to the optical characteristics of the tooth structure and depth of the lesion. The intensity of the fluorescence is displayed as a number ranging from 0 to 99, with 0 indicating minimum and 99 maximum light fluorescence. However, according to Bader et al., 2004 the Diagnodent measurements appear to vary considerably and can lead to false positive or false negative results in the identification of carious tooth structure.

Figure 7: Isolation afforded by the Isolite Dryfield Illuminator during a clinical case.

Figure 8: Diagnodent (KaVo).

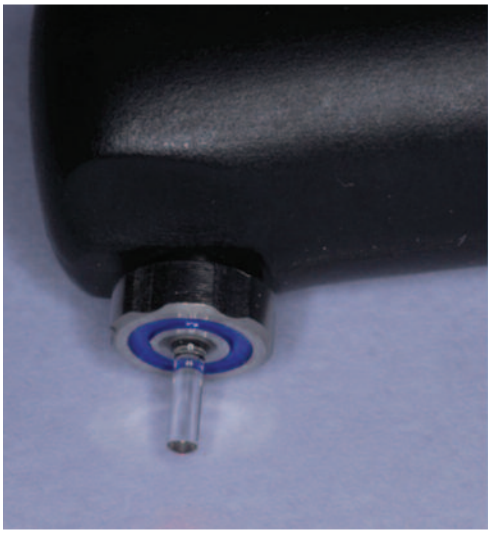


Figure 9: Diagnodent Occlusal Tip.

Figure 10: Diagnodent Approx Tip.

Figure 11: CariesScan Pro (CariesScan).

Figure 12: The CariesScan Pro is used to measure the probability of decay on the occlusal surface of an upper first molar.

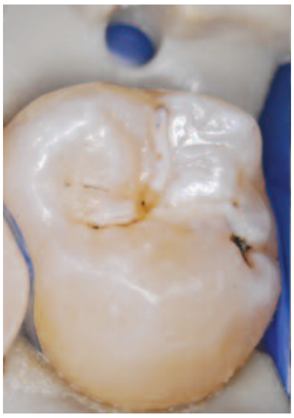


Figure 13: Magnified view (10X magnification) of the occlusal surface of upper second molar with a previously placed fissure sealant. Note the partial sealant loss on the occlusal surface and stained enamel adjacent to the distal fissure.

Figure 14: Magnified view of the final cavity preparation after removal of defective tooth structure, confirming the CarieScan Pro findings recorded pre-operatively.

Recently, a new device, CarieScan Pro (CarieScan), was introduced for caries detection on the occlusal and buccal surfaces of teeth. Impedance methods have been demonstrated to be able to distinguish between sound tooth structure from those that possesses early caries lesions or established decay (Bruce et al., 1996). Demineralization of enamel caused by the carious process can increase enamel permeability. The electrical resistance of a tooth is related to its permeability, thus any physical change caused by the carious process can be identified, and even quantified by measurement of electrical behaviour. The CarieScan Pro system implements a custom algorithm to extract a diagnostic score on bio-impedance values that is then mapped against a clinical reference (Guimera, et al., 2008).

The unit consists of a hand piece and a disposable sensor (Figure 11) which is held against the tooth structure (Figure 12) being examined in a process that takes approximately 4 seconds with the result displayed on the digital display of the unit.

It provides the clinician with information whether the examined tooth structure is healthy or at different stages in the decay cycle. According to the manufacturer this device measures the amount of demineralization of the enamel and not the effect or result of demineralization, compared to Diagnodent. In other words, the CarieScan Pro measures the presence of tooth decay earlier and more accurately than any other device. According to Pitts et.al., 2008, the device is 92.5% accurate in detecting both sound and carious tooth structure, minimising false positive or false negative results.

Figure 13 shows a magnified view of the occlusal surface of upper second molar with a previously placed fissure sealant. Under microscope magnification (12X) it was evident that there was partial sealant loss on the occlusal surface and stained enamel adjacent to the distal fissure. Examination of the suspected fissure with CarieScan Pro revealed a digital reading of 90, indicating the possibility of established decay equating to carious change extending through the enamel into superficial dentine. Figure 14 demonstrates the magnified view (magnification 12X) of the final cavity preparation after removal of defective tooth structure, confirming the CarieScan Pro findings pre-operatively.

Magnification (14 – 16X) under the Dental Operating Microscope (Figure 1) can provide the clinician with very valuable information. Enamel cracks can indicate underlying caries, dentine cracks or microleakage. This evaluation should be done according to the Classification system outlined by Clark, Sheets and Paquette (2003). Figure 15a (magnification 5X) demonstrates a case where a 30 year old male patient presented with a history of sensitivity on his upper left first molar. Radiographic examination revealed no evidence of decay. Examination under the DOM (magnification 19X) revealed two enamel cracks on the mesial marginal ridge (Figure 15b). After removal of the amalgam restoration and unsupported enamel on the mesial marginal ridge, a carious lesion was evident, extending into the dentine (Figure 15c).

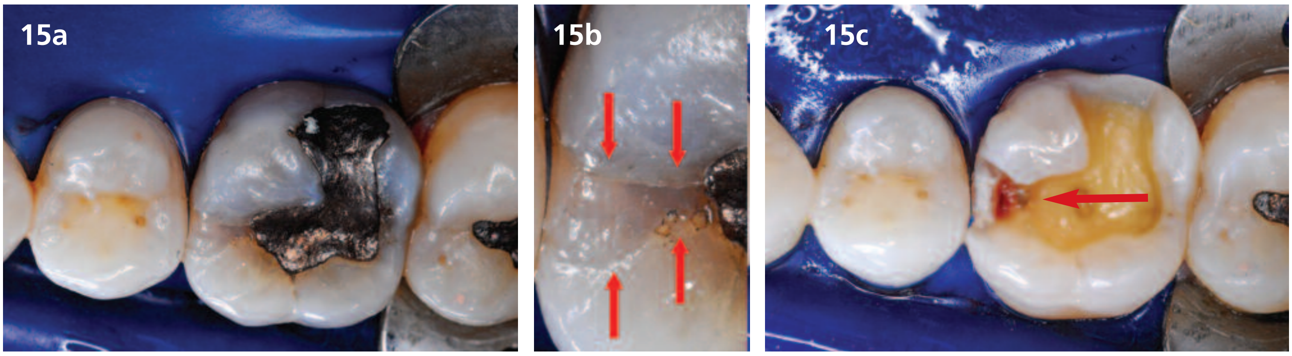


Figure 15a: A 30 year old male patient presented with a history of sensitivity on his upper left first molar.
Figure 15b: Examination under the DOM (10X) revealed two enamel cracks on the mesial marginal ridge (arrows).
Figure 15c: After removal of the amalgam restoration and unsupported enamel on the mesial marginal ridge, a carious lesion was evident, extending into the dentine (arrow).

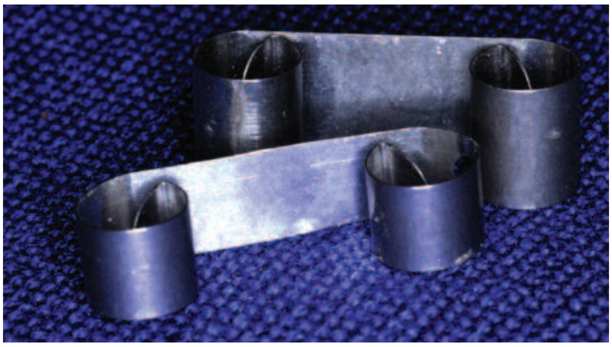


Figure 16: InterGuard (Ultradent Products).

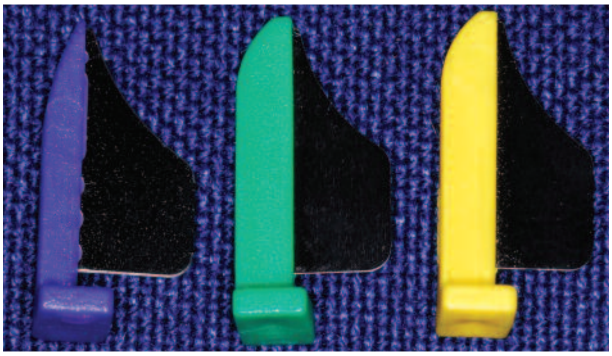


Figure 17: FenderWedge (Directa).

Protection of the Adjacent Tooth

Protection of the adjacent tooth surfaces against iatrogenic damage by rotary instruments begins prior to cavity preparation. Three protection devices can be utilized prior to cavity preparation:

• Any metal matrix band that can be placed between the involved and uninvolved adjacent tooth surface.

• InterGuard (Ultradent Products) (Figure 16) is a stainless steel preventative aid for operative dentistry that enables fast and safe protection of the adjacent tooth during cavity preparation. The device curls at each end in order to stabilize it during cavity preparation and it also facilitates clear access to the interproximal area of the involved tooth.

• FenderWedge (Directa) (Figure 17) is an innovative tool that combines a thin metal shield with a plastic wedge, available in four different sizes: x-small (purple), small (orange), medium (green), large (yellow). After placement of this apparatus the adjacent tooth is protected against iatrogenic damage from the rotary instruments while the plastic wedge cause separation between the involved and uninvolved tooth surfaces. In addition, the plastic wedge also protects the

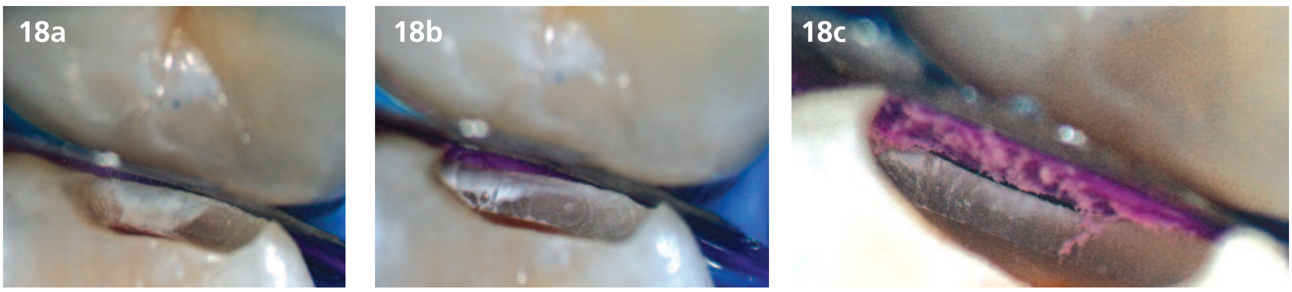


Figure 18a: Cavity preparation where the gingival extent of the preparation on the mesial aspect of an upper left premolar was taken right up to the matrix (Magnification 10X).
Figure 18b: The preparation was extended into the plastic material of the wedge (Magnification 10X) to allow removal of more decalcified enamel on the gingival margin.
Figure 18c: Higher magnification (15X) under the DOM ensured complete and accurate removal of the defective enamel. Note the protection of the adjacent tooth surface and gingival tissues that is provided by the FenderWedge.

Figure 19a: Three different sizes of WedgeGuard (Triodent): small (white), medium (pink) and large (purple).

Figure 19b: Metal guard detached form the wedge.

gingival tissues against damage from the rotary instruments in deep interproximal cavity preparations. Figure 18 illustrates a case where the gingival extent of cavity preparation on the mesial aspect of an upper left premolar was taken right up to the matrix (Figure 18a, magnification 12X) and into the plastic material of the wedge (Figure 18b, magnification 12X) to ensure complete removal of decalcified enamel on the gingival margin. Magnification under the DOM ensured complete and accurate removal of the defective enamel (Figure 18c, magnification 19X).

• WedgeGuard (Triodent) is a new tool that can be used to remove any risk of damaging the adjacent tooth or the papilla during cavity preparation. It is available in three different sizes: small (white), medium (pink) and large (purple) (Figure 19a). WedgeGuard looks very similar to FenderWedge (Directa) with the main difference being that

Figure 20a: Clinical case with evidence of distal decay on the lower right second premolar. Prior to cavity preparation a large WedgeGaurd was inserted to protect the adjacent tooth during cavity preparation.

Figure 20b: Cavity preparation after most of the carious tooth structure was removed.

Figure 20c: Occlusal view after removal of the metal guard. Note the excellent ginigival tissue protection that is still afforded by the wedge.

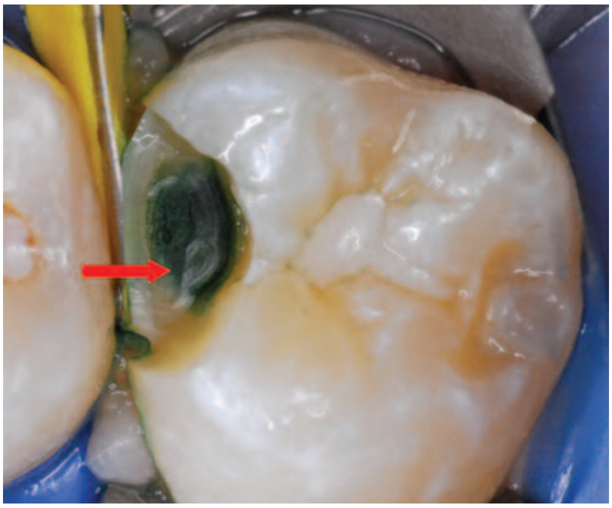


Figure 21: Caries detecting dye was used to identify remaining caries infected dentine in the cavity preparation.

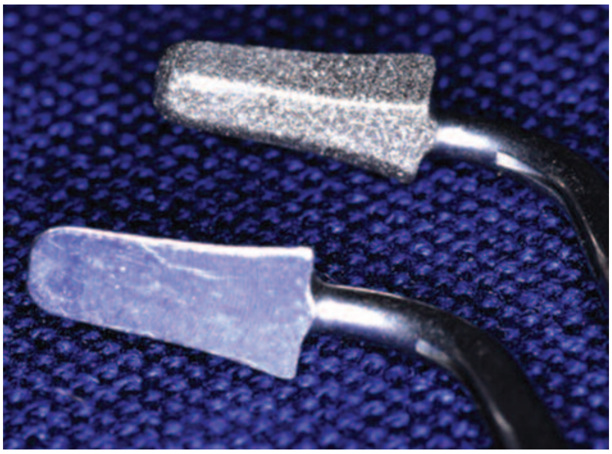


Figure 22a: Diamond coated SonicSys Prep Ceram tips (KaVo).

Figure 23: The smooth, safe-side of the instrument provide excellent protection to the adjacent tooth surface.

Figure 22b: NSK AS200 Air Scaler (NSK).

the metal guard can be detached (Figure 19b) while the wedge stays in place after cavity preparation. The same wedge can then be used with the matrix system.

Figure 20 depicts a clinical case where distal decay was diagnosed radiographically on a lower right second premolar. Prior to cavity preparation a large WedgeGuard was inserted to protect the adjacent tooth against iatrogenic damage during cavity preparation (Figure 20a). Figure 20b shows the result after the carious tooth structure was removed while Figure 20c demonstrates the occlusal view after the removal of the metal guard. Note the excellent protection of the gingival tissues that is still afforded by the wedge that remained after the removal of the metal guard. Gingival margin preparation can now be completed with the wedge in place.

InterGuard, FenderWedge or WedgeGuard are thicker than conventional matrix systems and can be difficult to place initially. Pre-separation of the teeth by means of a BiTine (Palodent, Dentsply), G-Ring (ComposiTight Gold, Garrison Dental) or V3 Universal Ring (Triodent) can allow sufficient separation to permit easier placement of these protection devices.

Cavity Preparation

Information obtained from the initial examination (radiographs, Diagnodent, CarieScan Pro and magnification) can guide the clinician during the operative phase to ensure optimal cavity preparation design. In addition the following guidelines can be used:

• The occlusal outline (if necessary) of the cavity preparation and proximal extension should only be extended to include carious enamel and suspect cracks to provide access to underlying dentine. Sound tooth structure should only be removed when the occlusal outline requires extension beyond or within the previously indicated functional stops.

• Carious dentine is removed by utilizing a caries indicating

Figure 24: Proxoshape Files (Intensiv).

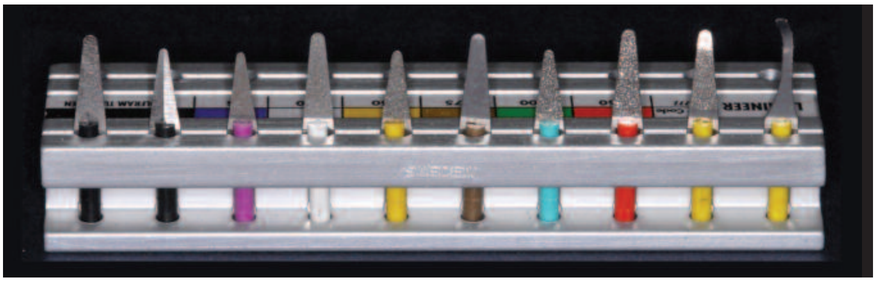


Figure 25: Lamineer Tips (Dentatus).

Figure 26: Intra-compact 2061 CHC contra-angle hand piece (KaVo).

Figure 27: NSK Ti-Max X55L hand piece (NSK).

dye (Sable Seek, Ultradent). The location and extent of stained caries infected dentine in a cavity preparation can be easier visualised by using magnification. Figure 21 shows the exact location and outline of the caries infected dentine after caries indicating dye was used in a cavity preparation.

• Keep the width of the preparation as narrow as possible because the resistance of the restoration is a direct function of dimension (Leinfelder, 1991).

• Prepare round internal line angles to allow for better resin adaptation (Small, 1998).

• To complete interproximal cavity preparation it is advisable to utilize safe-sided reciprocating instruments to allow optimal protection of the adjacent tooth or restorative material surface. The diamond coated Sonicsys Approx tips (KaVo) or SonicSys Prep Ceram tips (KaVo) (Figure 22a), operating at a frequency of approximately 6kHz in a Sonicflex Air Scaler (KaVo) or a NSK AS200 Air Scaler (NSK) (Figure 22b) that can ensure optimal bevelling and finishing of both the gingival and axial surfaces.

These instruments transfer the geometry of the tips directly onto the tooth structure involved in the preparation. The smooth, safe-side of these instruments will provide excellent protection to the adjacent surface of the uninvolved tooth surface (Figure 23).

Bevelling of the margins increases the fracture resistance by increasing the volume of the restoration and the bonding

Figure 28: Proxoshape File is used to remove unsupported enamel and to bevel the buccal proximal margin of a Classs II cavity preparation on an upper right second premolar. Note how the adjacent tooth is protected by the polished, uncoated side of the instrument during cavity margin preparation.

Figure 29a: The head of the NSK Ti-Max X55L hand piece (NSK) will allow the Lamineer Tips (Dentatus) to rotate freely and follow tooth contours naturally.
Figure 29b: The Lamineer Tips (Dentatus) can also be locked radially for direct and specific modifications.
Figure 30: The Intra-compact 2061 CHC contra-angle hand piece (KaVo) do not allow the tips to rotate freely but have a prepcontrol head with 36 preset positions that can be positioned manually.

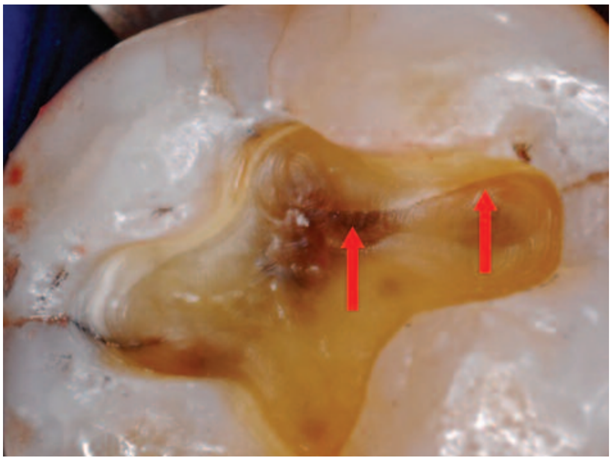


Figure 31: Clinical case where a Class I amalgam restoration was removed from a lower left first molar (Magnification 10X). Note the internal dentine crack (arrows) underneath the mesio-buccal cusp.

Figure 32: Class II preparation on the mesial aspect of an upper, second premolar. Note the extensive decalcification (arrow) on the gingival enamel margin (Magnification 8X).

Figure 33: Unsupported enamel on the buccal aspect of the proximal box after preparation (Magnification 15X).

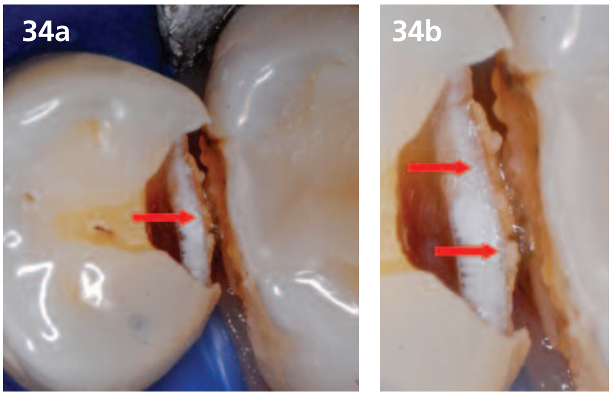


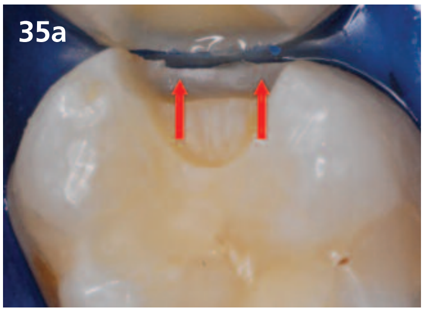
Figure 34a: Initial cavity preparation on the distal aspect of an upper right second premolar. Note the plaque accumulation (arrow) on the gingival margin as well as on the proximal margin of the mesial aspect of the upper first molar (Magnification 8X).
Figure 34b: Higher magnification (15X) of the plaque accumulation (arrows) on the gingival margin as well as on the mesial proximal margin of the upper first molar.

surface area (Terry, 2005a). It also decreases microleakage because it exposes the enamel rods for etching (Strassler, 1992).

• If cavity preparation was completed by rotary instruments the gingival and axial margins of the interproximal box preparation can be bevelled with Proxoshape Files (Intensiv)(Figure 24) or Lamineer Tips (Dentatus)(Figure 25) driven by the Intra-compact 2061 CHC contra-angle hand piece (KaVo)(Figure 26) or a NSK Ti-Max X55L hand piece (NSK)(Figure 27).

The Proxoshape Files (Intensiv) and Lamineer Tips (Dentatus) are flat, thin diamond coated tips. The diamond coating is only on the one side of the instrument that gives the clinician maximum safety and control. They come in a variety of shapes, sizes and grits (Figures 24 and 25). Figure 28 illustrates the use of a Proxoshape File to remove unsupported enamel and to bevel the buccal proximal margin of a Classs II cavity preparation on an upper right second premolar. Note how the adjacent tooth is protected by the polished, uncoated side of the instrument during cavity margin preparation.

The head of the NSK Ti-Max X55L hand piece (NSK) will allow the Proxoshape Files (Intensiv) or Lamineer Tips (Dentatus) to move in a reciprocating axial direction (1.4mm stroke length) and it can be set to allow the tips to rotate freely (Figure 29a) and follow tooth contours naturally, or it can be locked radially (Figure 29b) for direct and specific modifications. The Intra-compact 2061 CHC contra-angle hand piece (KaVo)



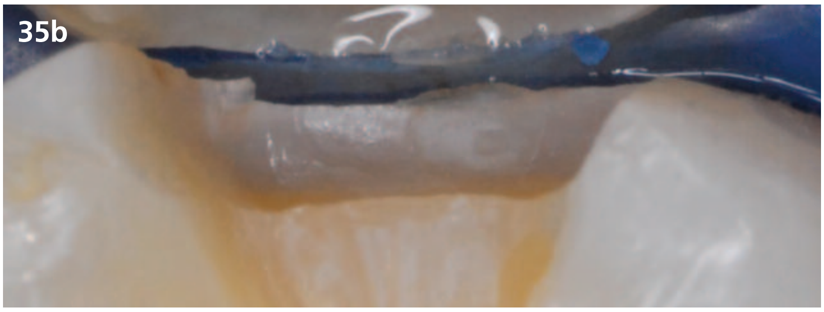


Figure 35a: Occlusal view of a cavity preparation on the mesial aspect of an upper first molar. Small irregularities on the enamel margin of the proximal cavity preparation is visible at 5X magnification.
Figure 35b: On higher magnification (15X) the extend of these irregularities is more visible. These small enamel spurs will prevent excellent matrix band adaptation against the cavity preparation margins.

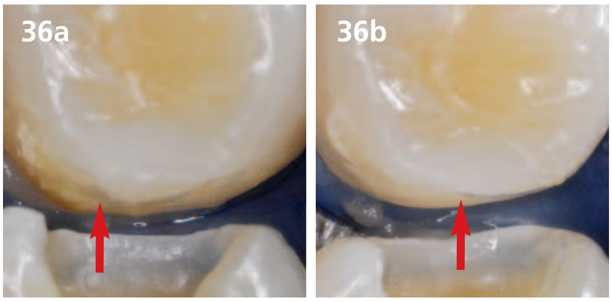


Figure 36a: Class II cavity preparation on the lower left first molar. Examination with the DOM (10X) revealed a very irregular distal surface of the distal aspect of the second premolar (arrow).
Figure 36b: Polished surface of the distal aspect of the second premolar (arrow) after polishing with a fine grit Proxoshape File (Intensiv).

with a stroke length of 0.8mm do not allow the tips to rotate freely but have a prepcontrol head (Figure 30) with 36 preset positions that can be positioned manually.

Magnification through the DOM during cavity preparation can be used for detection and removal of:

• Internal cracks in the dentine. Figure 31 depicts a case where a Class I amalgam restoration was removed from a lower left first molar (magnification 12X). Note the internal dentine crack (arrows) underneath the mesio-buccal cusp.

• Decalcification on the preparation margins. Figure 32 shows a case where a Class II preparation was done on the mesial aspect of an upper, second premolar. Note the extensive decalcification (arrow) of the gingival enamel margin that was left that still have to be removed before completion of cavity preparation (magnification 12X).

• Unsupported enamel. Figure 33 demonstrates the previous cavity preparation (Figure 32) after removal of the decalcified enamel on the gingival margin. Note the unsupported enamel on the buccal aspect of the proximal box preparation (magnification 12X).

• Calculus and plaque on the preparation margins. Figure 34a (magnification 8X) and 34b (magnification 15X) illustrates an

Figure 37a: An upper right first molar with deep, sticky and stained fissures on the occlusal surface.

Figure 37b: After intitial investigation with fissurotomy burs and identification of carious dentine, a Class I cavity was prepared to ensure complete removal of all the defective tooth structure.

Figure 37c: Postoperative occlusal view after placement of a composite resin restoration.

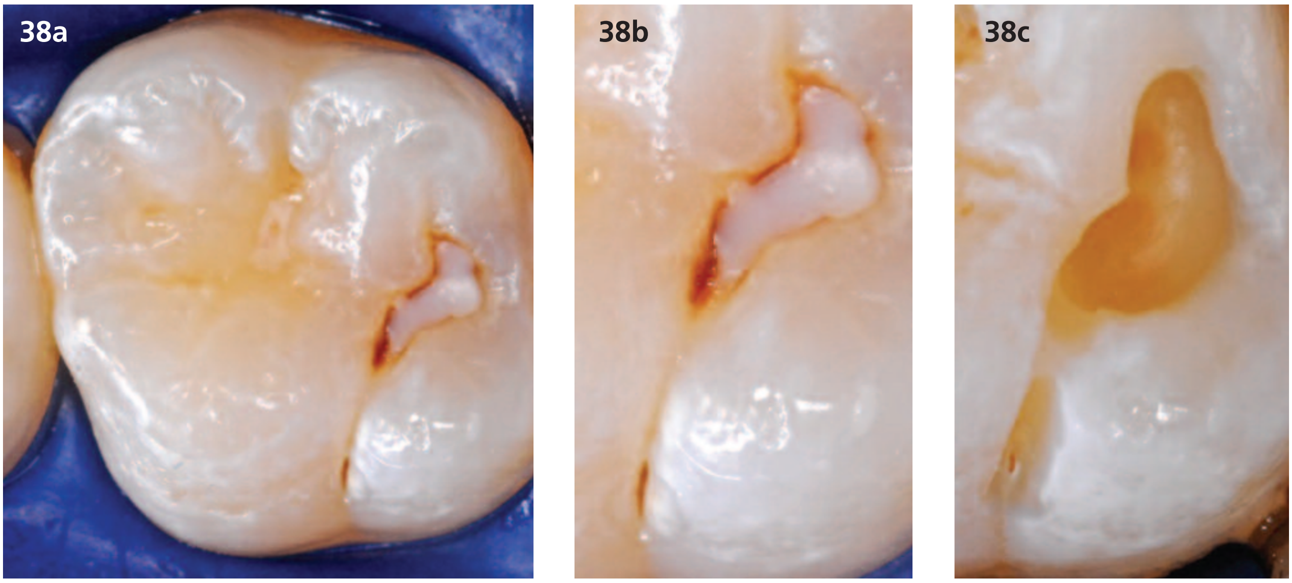


Figure 38a: Occlusal view of an upper right first molar (Magnification 5X) showing a leaking fissure sealant.
Figure 38b: High magnification(12X) of the distal aspect demonstrating the poor adaptation of the fissure sealant and evidence of decay.
Figure 38c: Final cavity preparation after using air-abrasion (Magnification 12X).

initial cavity preparation on the distal aspect of an upper right second premolar. Note the plaque accumulation (arrows) on the gingival margin as well as on the contact point of the mesial aspect of the upper first molar.

• Irregularities in the cavity preparation and on the cavity margins. Figures 35a (magnification 8X) and Figure 35b (magnification 12X) shows small irregularities on the enamel margin of the proximal cavity preparation. These small enamel spurs will prevent excellent matrix band adaptation against the cavity preparation margins.

• Examination of the proximal and contact area of the adjacent tooth to identify any irregularities on the enamel or previously placed restorative material prior to placement of the restoration. Figure 36a shows a clinical case were a Class II cavity preparation was done on the lower left first molar. Examination with the DOM (10X) revealed a very irregular distal surface of the adjacent tooth. Figure 36b illustrates the same surface after polishing with a fine grit Proxoshape File (Intensiv).

• Deep occlusal and /or stained fissures that should be cleaned by means of fissurotomy burs (SS White) or air–abrasion (Aqua-Abrasion, Velopex). Figures 37a illustrates an upper right first molar with deep, sticky and stained fissures on the occlusal surface. After intitial investigation with fissurotomy burs and identification of carious dentine, a Class I cavity was prepared to ensure complete removal of all the defective tooth structure (Figure 37b). Figure 37c shows the final result after placement of a composite resin.

• Existing, leaking fissure sealants. Figure 38a and 38b depicts a case where a leaking fissure sealant was identified on an upper right first molar (magnification 5X and 12X respectively). Figure 38c illustrates the final cavity preparation using air-abrasion.

• Iatrogenic damage to the adjacent tooth/teeth. Figures 39a (magnification 5X) and 39b (magnification 12X) depicts a case where a previously placed amalgam was removed from a lower left first molar. Note the extensive iatrogenic damage that was caused on the distal aspect of the lower second premolar by the operator during initial cavity preparation.

Magnification through the DOM during cavity preparation can also be used to ensure:

• Smooth cavity walls (Figure 40)
• Round internal line angles (Figure 40)
• Adequate bevelling of axial walls (Figure 40)
• Smooth contact surface of the adjacent tooth/teeth.
• Minimal damage to the gingival tissue during cavity preparation with rotary or oscillating instruments.

Conclusion

This paper has described new innovative materials and techniques that can be used clinically to improve the long-term success of posterior composite restorations. Magnification can help to eliminate some of the procedural errors that can occur during the restorative phase and thereby improving the overall quality of the bonded restoration. Part 2 will discuss the benefit of magnification during matrix assemblage, bonding techniques and composite insertion techniques.

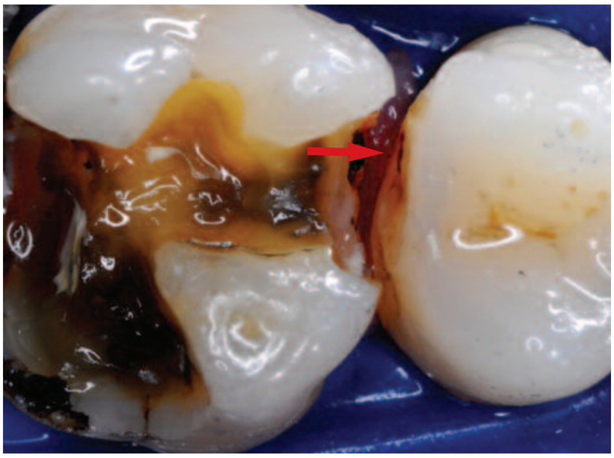


Figure 39a: Clinical case where a previously placed amalgam was removed from a lower left first molar. Note the evidence of iatrogenic damage that was caused on the distal aspect of the lower second premolar (arrow) by the operator during initial cavity preparation (Magnification 5X).

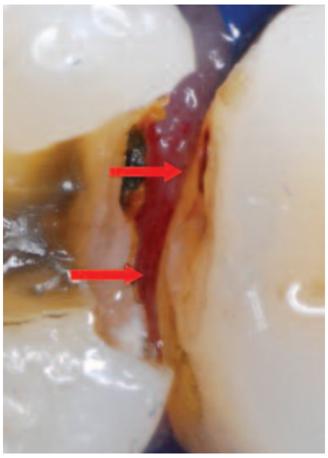


Figure 39b: Higher magnification (12X) demonstrates extensive iatrogenic damage (arrows) on the distal aspect of the lower second premolar.

Figure 40: Final inspection of cavity preparations under the DOM (Magnification 5X) can reveal and ensure smooth cavity walls, round internal line angles and adequate bevelling of axial walls.

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