Dear Readers,

“We live in a disposable society. It’s easier to throw things out than to fix them. We even give it a name – we call it recycling.” This is a quote attributed to the American film director, screenwriter and playwright Neil LaBute. Indeed, in our society where individuals are trying to upgrade all the time, repair has gone out of style. This trend towards disposal of objects is supported by the fact that often, replacement is even more economically reasonable than repair.

In restorative dentistry, we also tend to opt for replacement instead of repair very often and an economic incentive is present at least for the dental practitioner: The fees chargeable for total replacement procedures are usually much higher than those for fixing. However, especially against the backdrop of demographic changes and due to the enhanced performance of adhesive technologies, repair is becoming a useful option in an increasing number of cases. Taking into account that every restoration is more or less temporary, the factors that count are an extension of a restoration’s lifespan, a minimally invasive approach causing less iatrogenic damage and a cost-reduction for the patient.

Useful information on the topic of repair, on decision criteria of when to select this treatment option and on appropriate repair techniques is provided in this issue of the Expertise™ Magazine.

Enjoy reading!

Gerhard Kultermann, Editor
3M ESPE, Seefeld, Germany

EDITORIAL

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CONTENT
Treatment concepts adapted to the needs of senior patients
Frédéric van Vliet, 3M ESPE, Seefeld, Germany

What kinds of changes and challenges will you as a dental professional have to face due to an increasing number of geriatric patients? And how can we as a solution provider support you in fulfilling your new tasks? On the occasion of the Espertise™ Experts Conference titled “Comfortable Solutions in Times of Demographic Changes” in November 2013, we have spent two days concentrating on these issues together with a group of experts from different European universities.

What became evident in this context and was specifically highlighted by the chairmen, Prof. Dr. Jocelyne Feine and Prof. Dr. Reiner Biffar, is that access to dental care will be a major issue in the future. Therefore, treatments should not only be affordable, but we have to make provision in terms of transport, home care and appropriately trained staff. In addition, minimally invasive, safe and simple therapy concepts are required since elderly patients are often affected by multimorbidity and polypharmacy. They also feel more vulnerable than younger patients and thus will be less willing to accept complex (e.g. surgical) interventions.

Safe local anaesthesia
In general, local anaesthetics are safe, but the risk of local and systemic complications is higher in multi-morbide patients. According to Dr. Dr. Peer Kämmerer, the occurrence of side effects can be decreased by opting for a differentiated approach, meaning that for short dental treatments, solutions with a reduced vasoconstrictor concentration (e.g. 3M™ ESPE™ Ubistesin™ 1:400,000) should be used. In addition, the inferior alveolar nerve block may be replaced more often by other injection techniques.

Minimally invasive restorative concepts
Direct restorative concepts for geriatric patients should be as easy and time-efficient as possible. This is offered by an approach called Style Italiano: only two shades or opacities of 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative are combined to obtain an aesthetic anterior restoration. The concept was explained by its inventor, Prof. Dr. Angelo Putignano: An individual shade guide is produced first and the same shade/opacity combination and layer thickness is applied in the mouth afterwards. The secret of success: The final enamel layer should have a predefined strength (0.5 mm in the mesial part of the tooth) to allow for the desired translucent effect.

According to Prof. Dr. Ivo Krejci, defect-oriented preparations are most important in prosthodontics. In order to preserve natural teeth for a lifetime, it is decisive to be minimally invasive even when indirect restorations are placed, which is possible due to advances in adhesive technologies. He opts for immediate dentin sealing after preparation and places indirect CAD/CAM restorations made of materials with a dentin-like modulus of elasticity (composite, 3M™ ESPE™ Lava™ Ultimate CAD/CAM Restorative). The bonding agent of choice is 3M™ ESPE™ Scotchbond™ Universal Adhesive.

Prof. Dr. Mutlu Özcan asked the participants to use common sense when it comes to the question of repairing or replacing an insufficient restoration. While repair is not always possible, there are many situations in which a restoration can be upgraded with simple methods such as polishing or refurbishing e.g. using direct composite.
also demanded more objective guidelines and an integration of the topic of repair in the undergraduate curriculum.

Comfortable solutions in implantology

Due to an increased life expectancy, you will have to deal with a growing number of partially or completely edentulous patients. Especially in individuals with no remaining teeth, difficult anatomical conditions often cause a low retention of dentures. The concept of placing implant overdentures has proven its worth, however, the invasive surgical intervention and high cost of this treatment causes many patients to opt against it. Thus, less invasive approaches such as the insertion of mini implants (e.g. 3M™ ESPE™ MDI Mini Dental Implants) should be taken into account according to Prof. Dr. Frauke Müller.

Since implant therapy can lead to the occurrence of peri-implant mucositis and peri-implantitis, Prof. Dr. Jürgen Becker focused on prevention and possible treatment of these inflammatory processes. In terms of prevention, he recommends sterilization of abutments prior to their placement and the avoidance of unnecessary probing and associated cross-contamination.

When peri-implant mucositis is diagnosed, early treatment is indicated to avoid a progression of the disease: Once a peri-implantitis is diagnosed, surgical therapy is required.

Important role of digital technologies

In many fields such as restorative dentistry, implantology and orthodontics, digital technologies are taking an important role. Technologies e.g. for optical impression taking, digital data storage, matching of X-ray and CAD data, face scanning and motion capture are continuously improved. They will soon be available at reasonable cost and support you in making workflows easier and more efficient. This will lead to reduced costs for the patient as well. The message of the speaker Dr. Joerd van der Meer: You should start to integrate digital technologies now to make sure that you are well-equipped for the future.

Conclusion

The programme was complemented by a poster session during which young dental professionals presented their research topics and clinical cases.

In the end, all speakers agreed that many adequate therapy concepts for elderly patients are already available, and that we all have to collaborate to reduce the required number of invasive interventions during a lifetime of a patient. This will be possible with the help of preventative measures for adults and minimally invasive approaches.
Digital technologies in dentistry

Intraoral scanners and other technologies on the rise

Manuel Meier-Staude, 3M ESPE, Seefeld, Germany

During the last several years, lots of new digital technologies found their way into dentistry. They enable us to carry out different steps in diagnostics, treatment planning, surgery and restorative treatment with the aid of the computer.

Experience from other industries has already revealed that the use of digital technologies has the potential to help us achieve more predictable results at a lower cost and in a simplified procedure. We had a conversation on the current developments with Dr. Joerd van der Meer, who works at the University Medical Centre in Groningen (the Netherlands) as an expert in 3D technology.

Although digital technologies for the dental practice are still in their infancy, an early investment is beneficial in my opinion. The photography industry has already shown us what is going to happen to those who lag behind: They miss out on important developments and will not be able to tap their full potential at a later date. In order to provide for the future, a dental practitioner should at least be informed about the latest developments. Due to the typical learning curve associated with the use of intraoral scanners, for example, an early investment may pay off in the end.

What are the benefits of optical impression taking for the dental practitioner?

To my mind, one of the most important advantages of optical impressions is that the scan can be taken in increments. This contributes to an increased patient comfort and reduces the pressure on the practitioner. Errors can be eliminated simply by rescanning an area. Moreover, the bite registration process is easy and it is possible to check the preparation by enlarging the image. A tool that allows measuring the occlusal reduction supports the dental practitioner in creating sufficient space for the restoration. Due to this tool, intraoral scanners can also be used successfully to measure tooth wear, a phenomenon with an increasing impact in dentistry. The control options contribute decisively to quality assurance which leads to predictable results.

Is the accuracy of the available intraoral scanners also sufficient to provide for high-quality scanning results?

Today, all available optical impression systems produce high-accuracy datasets which enable the computer-aided manufacturing of precisely fitting single tooth restorations. When it comes to full-arch scans, there are differences between the systems. In a study comparing the performance of three devices, it was revealed that the 3M™ ESPE™ Lava™ Chairside Oral Scanner C.O.S. produced the most accurate data over the complete arch[1]. One of the reasons for this
result might be the strict scanning protocol that is recommended by the manufacturer and was used in the study. The accuracy of the obtained data was sufficient for the production of complex restorations. What is still challenging is taking optical implant impressions: The scanners have problems capturing e.g. a narrow edentulous ridge properly. But I am sure that these limitations will soon be overcome.

Another important factor for clinical success is the ease of use of digital impression systems. Does an intraoral scanner help us to simplify the process of impression taking?

Since the procedure is very different from the conventional workflow, training is required in the beginning. The most difficult part of taking optical impressions is eye-hand coordination: While the hands are guiding the scanner over the teeth, the eyes are on the monitor. However, these movements can be trained within a very short time. In a scanning experiment, the participants were able to acquire all relevant skills within one day – the scanning times were adequate and the results satisfactory by then. The younger generation usually fulfills the task effortlessly since they are used to similar movements from video games etc. After training, the workflow is more efficient compared to the traditional one not only because the procedure is quick, but also since the control options eliminate the need for remakes.

Does the integration of an intraoral scanner lead to a cost reduction in the dental practice?

Typically, digital technologies are advancing exponentially and the cost for these technologies drops at the same rate. This indicates that optical impression taking will become cheaper in the near future. In addition, further developments will lead to additional fields of application: Intraoral scanners are already being used in orthodontics to generate digital models which serve as a basis for the creation of virtual set-ups. Thus, physical models are no longer needed and all problems associated with their storage are solved. In implant planning and treatment, the combination of virtual models generated from optical impressions, CAD data, CBCT scans and facial scans will enable more precise implant placement which is optimized for the prosthetics. With this increasing number of applications, the devices become even more cost-efficient.

In addition, other treatment steps which are still carried out in the conventional way are likely to be affected by digital technologies: One example is tooth preparation. Today, this procedure is the source of many errors and surely, milling machines would produce more consistent results.

Dr. van der Meer, thank you for sharing your visions with us.

References


Contact

Dr. Joerd van der Meer
joerdent@yahoo.com
Aesthetic layering principle for beautiful anterior restorations

Nils van Calcar, Amsterdam, the Netherlands

It is not always easy to obtain aesthetic, natural-looking restorations in a direct restorative procedure using composite: The result is strongly dependent on many different factors such as the material of choice, correct shade selection and the layering technique. The following case report illustrates a simple approach to lifelike composite restorations using a putty index and the aesthetic layering principle.

Patient case

The 22-year-old female patient came to our practice with the wish to have whiter front teeth. Years ago, the maxillary central incisors of this woman had been endodontically treated and restored following a trauma.

There were two different problematic aspects: On the one hand, tooth 11 (FDI) had a brownish and tooth 21 a greyish shade. On the other, the not completely restored left central incisor had a slightly palatal position, while tooth 22 showed a distal rotation, resulting in a diastema between those teeth (Fig. 1).

Treatment plan

The treatment plan was to clean the pulp chambers of both central incisors in the first step, remove the gutta-percha and bleach internally with sodium perborate for one week. Afterwards, the correct shade and translucency should be determined. It was planned to create direct composite restorations on the central incisors: A class IV restoration on tooth 11 and an extension of the incisal edge of tooth 21, mainly in order to optically change its position. Furthermore, we decided to create a direct restoration on the left lateral incisor for diastema closure and optical rotation of this tooth. Taking into account the desires of the patient, we opted for an approach with only minimal characterization, without microcracks, and planned to work with a slight translucency in the incisal line.

Treatment approach

After endodontic treatment and internal bleaching, but before starting with the preparation of the teeth (Figs. 2 and 3), the occlusion and articulation were checked. In addition, a silicone index was produced using putty impression material. In this context, an adjustment to the central embrasure and the incisal edge was made right away using an instrument with cylindrical nibs and rounded ends (Ash 49).

Subsequently, the existing restorations were removed, the teeth prepared (Fig. 4) and rubber dam was placed for conditioning of the tooth surfaces. In order to create a micropore surface ensuring high bond strength, the areas of the old composite restorations were sandblasted, followed by etching, priming and bonding (Fig. 5). Mylar strips were used to separate the teeth from each other during the restoration procedure (Fig. 6).

In the first step, the palatal area of the central incisors was built up (Fig. 7). For this purpose, a small amount of enamel mass (3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative, shade A2E) was applied on the silicone index. The index was then placed in the mouth and the restorative
material adapted to the tooth with instruments to create a foundation for the restorations.

For the build-up of the dentin core, a layer of Filtek Supreme XTE in the shade A3D was applied (Fig. 8), followed by a layer of material in the slightly more translucent shade A2B. At this stage, it is already decisive to take into account the space required for the labial enamel layer which is also responsible for a natural incisal translucency.

The remaining space was filled with a translucent composite. Prior to the application of the buccal enamel layer consisting of highly translucent composite, some pigments were added for characterization. The desired effect was discussed with the patient, who opted for a precise copying of the adjacent tooth. The characterization was visible through the final layer of composite. Its high translucency also ensured a glass-like enamel effect.

In order to ensure highly aesthetic results, special attention should be paid to the finishing and polishing process. In the present case, a diamond veneer burr was used for the buccal contour. For shaping of the incisal edges, 3M™ ESPE™ Sof-Lex™ Finishing and Polishing Discs were employed and for the approximal areas, abrasive strips turned out to be well-suited. The restorations were subsequently polished with polishing cups and finally a buff disc with aluminium oxide polishing paste (Enamelize™ Polishing Paste, Cosmedent) was used to obtain a natural gloss. For the creation of a smooth transition of the composite material to untreated and non-covered enamel, a scalpel can be a useful tool. Figure 9 shows the result immediately after finishing and polishing.

Well-integrated, harmonic restorations with a symmetric appearance and a uniform gingival margin are obtained (Fig. 10). Figure 11 shows the result nine months after the treatment: The incisal edge of the anterior restorations follows the lip line, so that a natural look is achieved.

Conclusion

Direct composite restorations created according to the aesthetic layering principle by use of the putty index technique can be highly aesthetic. In my view, Filtek Supreme XTE Universal Restorative is extremely well-suited for the production of life-like anterior restorations using this technique. The material is easily applied into the index and sculpting of the distinct layers is possible without difficulties. Due to the hardness of the material, it is possible to polish the surface structure to a high-gloss.

Contact

Dr. Nils van Calcar
vancalcar@gmail.com
Despite the continuous improvement of restorative materials and workflows, “every restoration is temporary, except for the last one”. This is what Prof. Dr. Ivo Krejci (University of Geneva) stated during the Expertise™ Experts Conference in November 2013 in Munich. Some of the reasons for failure are marginal leakage and staining, the occurrence of secondary caries and chipping or fractures of a restoration. While in some cases, a complete replacement is required, many defective restorations can be upgraded successfully by repair. For these procedures, a high-performance dental adhesive is needed to establish a strong bond between the restored tooth surface and the repair material.

In order to obtain detailed information on the required properties of the material and the recommended repair workflows, we had a conversation with Dr. Christoph Thalacker. He is the Head of Adhesives Research and Development at 3M ESPE in Seefeld, Germany.

Dr. Christoph Thalacker

**“An adhesive is needed that bonds to every surface”**

Frédéric van Vliet, 3M ESPE, Seefeld, Germany

The greatest challenge is that in the context of repair, an adhesive is needed that bonds to every surface. There may be parts of tooth structure (enamel and dentin) as well as old restorative materials such as composite, metal or ceramics to which a strong bond has to be established. And, of course, there is the new restorative serving as a repair material. Thus, we have a more complex situation than in standard bonding procedures, meaning that the bonding agent in question has to be highly versatile and universally applicable. The material recommended by 3M ESPE for this purpose is 3M™ ESPE™ Scotchbond™ Universal Adhesive.

The bonding agent is based on a unique chemical composition. Due to its formulation, the material bonds to enamel, dentin, indirect and direct substrates alike. Apart from standard components such as dimethacrylate resins, HEMA, fillers, ethanol, water and initiators, Scotchbond Universal Adhesive contains the proprietary 3M™ ESPE™ Vitrebond™ Copolymer. This methacrylate-modified polyalkenoic acid copolymer was invented by 3M ESPE in the early 1990s and provides a moisture-tolerant performance to dentin. The result: distinct hybrid layers are formed for moist and dry dentin and consistent high bond strengths are obtained. Other distinctive components are the MDP (methacryloxydecyl phosphate) monomer and silane.

It has been revealed that the MDP monomer ensures higher enamel bond strength than other phosphate monomers that were used in the past. In addition, its use leads to an increased bond strength to oxide ceramic materials and non-precious metal alloys, while the hydrolytic stability of the complete formulation is increased. Due to silane, a chemical bond is established to glass ceramic restorations without application of a separate liquid. This eliminates an additional work step. 

**Please explain the role of these substances in the bonding procedure.**

**What are the specific properties of this material that make it particularly suitable for repair procedures?**

![Hybrid layer formed after application of 3M™ ESPE™ Scotchbond™ Universal Adhesive on etched moist dentin. Image courtesy of Dr. Jorge Perdigao, University of Minnesota.](image)

![Hybrid layer formed after application of 3M™ ESPE™ Scotchbond™ Universal Adhesive on etched dry dentin. Image courtesy of Dr. Jorge Perdigao, University of Minnesota.](image)
and leads to simplification of bonding and repair procedures. By carefully balancing the silane with the other components, 3M ESPE research came up with a formulation that contains a sufficient amount of reactive silanes not only for fresh material, but also after two years storage on the shelf\(^1\).

Would you please describe the repair workflow with Scotchbond Universal Adhesive?

In the beginning, the workflow may differ depending on the material the existing restoration is made of. Glass ceramics should be etched with hydrofluoric acid. Separate silanization is not required when Scotchbond Universal Adhesive is used. For oxide ceramics such as zirconia and alumina as well as non-precious metal alloys, roughening of the surface by sandblasting is recommended. In this way, it is ensured that the phosphate group forms a stable bond with the surface. Cleaning with phosphoric acid is contraindicated.

What about precious metal and composite restorations?

Sandblasting with alumina is also the preferable pretreatment for gold alloys: In this case, the bonding mechanism involves mechanical inter-

How should a dental practitioner proceed after pre-treatment of the existing restoration?

The subsequent work steps in the repair procedure are always identical: Scotchbond Universal Adhesive is applied and rubbed in for 20 seconds, air-dried for 5 seconds and light-cured for 10 seconds. Afterwards, a light-curable composite is applied for repair. This standard application procedure avoids errors and thus supports dental practitioners in obtaining very high bond strengths, day after day.

Yes, there are different study results that confirm very high bond strengths to different restorative materials, enamel and dentin. For example, Dr. Markus Blatz et. al. from the University of Pennsylvania tested the shear bond strength to zirconia, alumina and glass ceramic material after thermocycling, with very good results. In an internal investigation comparing Scotchbond Universal Adhesive with a competitor’s multi-bottle system, the latter was outperformed by the single-bottle adhesive. The results are summarized in the table below. For those who are interested in additional information about the in-vivo and in-vitro performance of our bonding agent, a Scientific Facts Booklet is available online.

Dr. Thalacker, thank you very much for informing us about Scotchbond Universal Adhesive and its use within the framework of repair procedures.

References

\(^1\) Thalacker C, Eckert AS, Loll H, Krueger DD, Guggenberger R: Bonding Mechanism of a Universal Adhesive to Glass Ceramic, IADR 2013, #631.
The replacement of defective restorations is a dental treatment that is carried out quite frequently. However, it is associated with a major drawback: In many cases, total replacement requires a complex procedure involving an extension of the preparation. This may lead to a further weakening of the tooth structure leading to increased instability instead of a more durable restoration.

Benefits of repair

A minimally invasive alternative is the repair of the existing restoration. In this procedure, the intact part is maintained and only the defective part replaced or the restoration locally extended. As a consequence, much less tooth structure is destroyed so that a negative effect on the pulp and the stability of the tooth is avoided. However, for successful repair, a long-lasting bond has to be established between the old restorative, the tooth structure and the repair material. What is needed for this purpose is not only a high-performance adhesive that bonds to the most diverse substrates and materials like enamel, dentin, porcelain, oxide ceramics, composite and metal. The use of appropriate repair techniques is decisive as well.

Pre-treatment of the old restoration

In order to provide sufficient attachment to the old restoration, surface conditioning is required. Different approaches are available to establish macro-mechanical and micro-mechanical retention or a chemical bond.

Macro-mechanical retention can be obtained by retention holes, undercuts or by simply roughening the surface with a coarse diamond bur. Micro-mechanical retention is created by etching with phosphoric acid or hydrofluoric acid and sandblasting or air-abrasion with aluminum oxide powder. A chemical bond may be established between resin and silica glass filler particles by application of special primers, such as silane.

In general, the effectiveness of a surface conditioning method strongly depends on the substrate to be treated. But even for resin-based composite restorations, there is no standardized procedure available. Etching with phosphoric acid, for example, has no direct effect on the surface roughness of a restoration except for glass ionomer cement. Instead, it is used for cleaning of the surface and leads to an improved wettability.

Etching with hydrofluoric acid has a direct effect on materials containing glass particles. However, the impact strongly depends on the composition of the fillers: e.g. the effect on barium glass is much stronger than on zirconia clusters[1].

Scientific evidence

In order to get an idea of the effect of surface treatments on the success of repair procedures, studies have to be conducted. Unfortunately, clinical studies are scarce and most of the repair studies are conducted in-vitro. As there are no guidelines on how to perform in-vitro repair testing, a large diversity of methods and techniques are used by investigators, leading to inconsistent results and conclusions.

Several aspects are of importance: simulation of aging of the substrate to obtain a clinically relevant substrate surface, surface pre-treatment and the type of substrate. In addition, the use of primers, adhesive systems and the selected testing proce-
dure may have an impact on the study results. For correct interpretation of the data, the use of a negative and a positive control group is essential.

Two in-vitro studies

Since 2007, only two studies are available with a negative and a positive control group: one testing the repair of five composite resins after artificial aging[4] and one focusing on repair of a silorane-based substrate[5].

In the first study, the effect of nine repair procedures was tested: no treatment (negative control), roughening of the surface with a diamond bur, sandblasting with alumina particles, treatment with the 3M™ ESPE™ CoJet™ System, etching with phosphoric acid, etching with 3% hydrofluoric acid for 20 or 120 seconds and etching with 9.6% hydrofluoric acid for 20 or 120 seconds. In addition, the cohesive strength of the tested composites was measured as a positive control. The results are summarized in the tables below. Here, only a small difference was found between the negative and positive control group. There was a large variation between the different repair techniques as well as composites and the effect of the aging procedures is questionable.

In the study of Palasuk, three different surface conditioning methods — acid etching, aluminum oxide sandblasting and diamond bur abrasion — were tested on one aged substrate (3M™ ESPE™ Filtek™ Silorane Low-Shrink Posterior Restorative). Silane was not applied. Two different repair materials, one methacrylate-based resin composite and a silorane-based material, were used. In this study, the microtensile bond strength achieved after aluminum oxide sandblasting was not different from the cohesive strength of the silorane resin composite. The other tested techniques led to significantly lower values. Here, the effect of the substrate and the potential impact of not using silane have to be discussed.

Conclusion

Due to the varying methodology used in these and other in-vitro repair studies, inconsistent results are obtained and it is impossible to derive a universal repair technique from them. There are too many variables, which prevent specific conclusions. From a comparison of the literature, it may be inferred that air abrasion in combination with the application of a silane primer seems to provide the best surface repair technique independent of the substrate and the repair material. However, more research is needed to confirm this in the nearby future.

References


Contact
Bas Loomans, DDS, PhD
b.loomans@dent.umcn.nl

Results achieved for a micro-hybrid composite (containing barium glass fillers) using different repair procedures.

Results achieved for a nano-composite (containing zirconia clusters) using different repair procedures.
During the past several years, repair of restorations has become increasingly popular. This option is regarded by most universities as a minimally invasive alternative to replacement which allows stopping or slowing down the restorative downward spiral that ultimately would lead to tooth loss. For practicability of repair techniques in the dental practice, however, detailed criteria are needed to distinguish between failed restorations which have to be replaced and those that can be repaired. Only in this way, it is possible to change the current policy of choosing repair as a treatment merely on a case-by-case basis.

Literature review

A systematic review of the literature focusing on in-vitro and clinical aspects of repair showed that there are very few clinical studies available and their validity is often limited\(^1\). Due to different settings and procedures of in-vitro testing, a comparison of the results of those studies is also difficult in many cases. Nevertheless, some useful recommendations are possible on the basis of the literature review.

Marginal defects

Repair of marginal defects is usually possible when accessible, independent of the type of restoration and kind of restorative material used. The restoration margin should be opened carefully at the defect and cleaned to check if caries adjacent to the restoration has occurred. Then, the margins are smoothened, followed by etching of the surface with phosphoric acid and application of an adhesive, which should contain silane if the sub-strate consists of composite or ceramics. Finally, resin-based (flowable) composite is applied to seal the gap.

Other failures

Restorations with chipping defects, bulk fracture, partial loss or severe wear can also be repaired depending on the location and dimension of the defect and the condition of the remaining part of the restoration. After smoothening and cleaning of the surface, the recommended conditioning procedure is different depending on the restorative material.

Composites (especially microhybrid) resin surfaces should be treated with silane before the adhesive and the repair material (composite) are applied. In the critical area, occlusal contact points should be eliminated or avoided. Glass ceramics may be etched with buffered hydrofluoric acid if the risk of contamination of human tissue can be excluded. Here, silane is used as well and occlusal contact points are to be avoided. Metal surfaces are best conditioned by silica-coating (3M™ ESPE™ CoJet™ System). Prior to application of the composite material, silane and an opaquer are used. Etching with phosphoric acid is recommended for exposed dentin and enamel surfaces before starting the adhesive repair procedure with composite.

Recommendations based on scientific and clinical evidence

Reinhard Hickel, University of Munich, Germany

Repair or replacement?

During the past several years, repair of restorations has become increasingly popular. This option is regarded by most universities as a minimally invasive alternative to replacement which allows stopping or slowing down the restorative downward spiral that ultimately would lead to tooth loss. For practicability of repair techniques in the dental practice, however, detailed criteria are needed to distinguish between failed restorations which have to be replaced and those that can be repaired. Only in this way, it is possible to change the current policy of choosing repair as a treatment merely on a case-by-case basis.
Repair or replacement?

These recommendations support dental practitioners in choosing an adequate repair technique. However, advice regarding the question of when a restoration is unacceptable and how to decide whether repair or replacement is indicated cannot be derived from the studies. For this purpose, clinical criteria for evaluation have been developed (2, 3). The first step in the decision-making process is the assessment whether or not a restoration is still acceptable. If a need for action is identified, the dental practitioner has to determine which kind of treatment is appropriate. The following criteria may be used as a guideline for the assessment and decision-taking (1).

Apart from choosing the appropriate treatment procedure, it is essential that the dental practitioner analyzes the reason for a failure to prevent its repeated occurrence.

Conclusion

The presented criteria and recommendations may serve as a guideline for dentists in the process of treating patients with insufficient restorations. They help identify an adequate procedure (either repair or replacement) and provide orientation regarding the selection of the appropriate surface conditioning technique and workflow in case of repair.

For the development of further guidelines, more randomized clinical trials are needed. They should study repair of all existing restorative materials and differentiate between the different types of failure.

Clinical problems

<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair</th>
<th>Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Marginal problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marginal staining</td>
<td>Pronounced localized marginal staining</td>
<td>Deep marginal staining, not accessible</td>
</tr>
<tr>
<td>Marginal adaptation</td>
<td>- Gap &gt; 250 μm or dentin/base exposed</td>
<td>- Restoration (complete or partial) is loose but in situ</td>
</tr>
<tr>
<td></td>
<td>- Severe ditching or marginal fractures (tooth or restorative material)</td>
<td>- Generalized major gaps or irregularities</td>
</tr>
<tr>
<td></td>
<td>- Larger irregularities (negative) steps</td>
<td></td>
</tr>
<tr>
<td>Caries adjacent to restoration (secondary caries)</td>
<td>Severe marginal demineralization or caries with cavitation and suspected undermining caries but localized and accessible</td>
<td>Deep caries or exposed dentin that is not accessible for repair</td>
</tr>
<tr>
<td>2. Surface problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface luster</td>
<td>Voids or rough surface, cannot be masked by saliva film, simple polishing is not sufficient</td>
<td>Generalized very rough and unacceptable plaque retentive surface</td>
</tr>
<tr>
<td>Aesthetic anatomical form</td>
<td>Form is affected and unacceptable aesthetically. Intervention/ correction is necessary</td>
<td>Form is unsatisfactory and/or lost. Repair not feasible or reasonable</td>
</tr>
<tr>
<td>Approximal anatomical form</td>
<td>Contact point too weak and possible damage due to food impaction or inadequate contour</td>
<td>Contact point too weak and/or clear damage due to food impaction and repair not feasible/possible</td>
</tr>
<tr>
<td>Occlusal contour and wear</td>
<td>Wear considerably exceeds normal enamel wear; occlusal contact points are lost</td>
<td>Generalized excessive wear, repair not feasible</td>
</tr>
<tr>
<td>3. Fractures and bulk loss</td>
<td>Remaining restoration (larger filling or crown) is sufficient</td>
<td>Remaining restoration is insufficient, repair not feasible</td>
</tr>
<tr>
<td>Closure of access cavity after endodontic treatment</td>
<td>- Chip fractures which damage marginal quality or proximal contact or contour</td>
<td>(Partial or) complete loss of restoration and/or multiple fractures</td>
</tr>
<tr>
<td></td>
<td>- Bulk fractures with partial loss (less than half) of the restoration</td>
<td></td>
</tr>
<tr>
<td>Fracture of restorative material</td>
<td>- Larger cracks &gt; 250 μm, probe penetrates.</td>
<td>Large cusp or tooth fracture</td>
</tr>
<tr>
<td></td>
<td>- Large enamel chipping or wall fracture</td>
<td></td>
</tr>
<tr>
<td>Tooth integrity (enamel cracks, tooth fractures)</td>
<td>- Cusp fractures (which are easily accessible for repair)</td>
<td></td>
</tr>
<tr>
<td>4. Patient’s view</td>
<td>Desire for improvement in aesthetics or function, e.g. tongue irritation and reshaping of anatomic form or refurbishing impossible/insufficient</td>
<td>Completely dissatisfied and/or adverse effects, incl. pain</td>
</tr>
</tbody>
</table>

References


Contact

Prof. Dr. Reinhard Hickel
hickel@dent.med.uni-muenchen.de

Clinical issues and suggestions of how to solve them.
When to repair and when to replace

Objective intervention criteria are needed

Mutlu Özcan, University of Zurich, Switzerland

In case of failures of dental restorations, the decision of when to repair and when to replace is often taken based on subjective criteria. Dentists in general opt for replacement of defective restorations, even though this procedure is usually accompanied by the associated loss of tooth structure and intact restorative materials. Repair procedures employing adhesive technologies, on the other hand, are more cost and time efficient and lead to a reduced iatrogenic damage\[^{[1-4]}\]. Therefore, such actions should be undertaken wherever appropriate.

The use of repair and maintenance methods in the dental practice, however, seems to depend on different factors: Firstly, repair is carried out more often in some countries than in others, which might be connected to the way the subject is taught at the respective universities (in many dental schools, repair is not a part of the undergraduate curriculum). Secondly, factors such as the size of the restoration and its position in the patient’s mouth have an impact on the decision. Also, the original dentist is more likely to choose for repair than a practitioner that did not place the restoration. For many dental practitioners, the lack of objective guidelines for quality evaluation and the fact that the repair procedure is different depending on the substrate, is rather confusing. Since dentists are usually paid by the number of restorations they deliver, every replacement delivers financial income. Attempts in prolonging the lifetime of partially failed restorations with repair actions, however, does not bring much financial benefit to the dentists depending on the healthcare system. As a consequence, replacement constitutes the majority of chairside time of a general dentist.

Direct restorations

For the evaluation of direct restorations, the following Ryge/CDA criteria have been suggested\[^{[5]}\]:

<table>
<thead>
<tr>
<th>Category</th>
<th>Rating</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal Integrity</td>
<td>Alpha</td>
<td>No visible evidence of a crevice along which an explorer will catch</td>
</tr>
<tr>
<td></td>
<td>Bravo</td>
<td>The explorer catches a crevice along the margin, but there is no exposure of dentin or base</td>
</tr>
<tr>
<td></td>
<td>Charlie</td>
<td>Visible evidence of a crevice with exposure of dentin or base</td>
</tr>
<tr>
<td></td>
<td>Delta</td>
<td>The restoration is fractured or missing in part or in tota</td>
</tr>
<tr>
<td>Anatomic Form</td>
<td>Alpha</td>
<td>The restoration is not undercontoured</td>
</tr>
<tr>
<td></td>
<td>Bravo</td>
<td>The restoration is undercontoured, but there is no dentin or base exposed</td>
</tr>
<tr>
<td></td>
<td>Charlie</td>
<td>Sufficient restorative material is missing so that dentin or base is exposed</td>
</tr>
<tr>
<td>Secondary Caries</td>
<td>Alpha</td>
<td>No evidence of secondary caries along the margin of the restoration</td>
</tr>
<tr>
<td></td>
<td>Bravo</td>
<td>Presence of softness, opacity at the margins as evidence of undermining or demineralization, or etching or white spots as evidence of demineralization in areas where an explorer catches or resists removal after insertion</td>
</tr>
<tr>
<td></td>
<td>Charlie</td>
<td>The discoloration penetrated along the margins of the restoration in a pulpal direction</td>
</tr>
<tr>
<td>Marginal Discolouration</td>
<td>Alpha</td>
<td>No existing marginal discoloration at all</td>
</tr>
<tr>
<td></td>
<td>Bravo</td>
<td>Presence of discoloration at the margins between the restoration and the tooth structure; discoloration does not penetrate along the margins of the restoration toward the pulp</td>
</tr>
<tr>
<td></td>
<td>Charlie</td>
<td>The discoloration penetrated along the margins of the restoration in a pulpal direction</td>
</tr>
<tr>
<td>Colour Match</td>
<td>Oscar</td>
<td>The restoration cannot be detected with a mirror</td>
</tr>
<tr>
<td></td>
<td>Alpha</td>
<td>The restoration is visible, but there is no mismatch in colour, shade and/or translucency between the restoration and the adjacent tooth structure</td>
</tr>
<tr>
<td></td>
<td>Bravo</td>
<td>There is a mismatch in colour, shade or translucency, but not outside the normal range of tooth colour, shade and/or translucency</td>
</tr>
<tr>
<td></td>
<td>Charlie</td>
<td>The mismatch is outside the normal range of tooth colour, shade and/or translucency</td>
</tr>
<tr>
<td>Surface</td>
<td>Romeo</td>
<td>Surface is smooth, and the adjacent tissues showed no irritation</td>
</tr>
<tr>
<td></td>
<td>Sierra</td>
<td>Surface of the restoration is slightly rough or pitted but can be refinished</td>
</tr>
<tr>
<td></td>
<td>Tango</td>
<td>Surface is deeply pitted or shows irregular grooves, which were not related to the natural anatomy and could not be refinished</td>
</tr>
<tr>
<td></td>
<td>Victor</td>
<td>Surface is fractured or flaking</td>
</tr>
</tbody>
</table>

Ryge/CDA criteria used for clinical evaluation.

The criteria may be used for an assessment that serves as a basis for decision making. In general, repair of amalgam restorations is often possible with simple methods. An upgrade from “delta” to “bravo” score can be achieved in some cases simply by refurbishing and repolishing procedures. Repair of composite restorations is usually also unproblematic after surface conditioning and relayering.

In any case, the repair process should be carried out using high-performance adhesive technologies in combination with a suitable physio-chemical surface conditioning technique. The repair...
material of choice remains to be a resin-based composite for chairside applications.

Indirect restorations

Metal and glass ceramic restorations can be repaired with composite as well. When the sub-
strate is glass ceramics, I use the following repair protocol: Firstly, premature contacts are
controlled and removed where needed. Then, surface contamination is eliminated and hydro-
fluoric acid is applied for conditioning of the surface. Subsequently, a silane coupling agent and
an adhesive resin are applied.

In bilayered all-ceramic restorations with a core and
a veneering material, the most frequent reason for
failure is chipping. The reason for chipping is multi-
factoral but usually the cause is insufficient thick-
ness of the porcelain layer or inadequate frame-
work support. Repair is possible depending on the
extent of the defect. A classification including deci-
sion criteria is provided by Crisp et al.¹⁰:

A. A minor chip < 1 mm in diameter within
the veneering porcelain – may be left
alone or polished.

B. A larger chip > 1 mm but still within the
veneering porcelain.

C. A repairable after diameter chip involving
the framework interface.

D. A catastrophic loss of veneering porcelain
requiring restoration replacement.

In the case of oxide ceramics, air-abrasion and
subsequent silanization of the framework ceramic
is recommended instead of etching with hydro-
fluoric acid.

Conclusion

In order to implement repair and maintenance
procedures for failed restorations, that are a clini-
cal reality in virtually every dental practice for
intervention, more objective guidelines for deci-
sion-making have to be developed. Furthermore,
maintenance and repair options have to be inte-
grated in the undergraduate curriculum.

What is also needed is a simplification of sur-
face conditioning methods for repair proce-
dures. Chemicals can be developed that work
equally effective on every substrate in order to
substitute physical surface conditioning meth-
ods and to avoid cross-contamination of sur-
faces with different chemicals. With the intro-
duction of new multipurpose adhesives (e.g.
3M™ ESPE™ Scotchbond™ Universal Adhesive),
manufacturers aim at simplifying the adhesive
procedures without compromising the perfor-
mance.

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Contact

Prof. Dr. Mutlu Özcan
mutluozcan@hotmail.com
Two years ago, a new class of restorative materials was introduced into dentistry: One that is referred to as resin nano ceramics or hybrid ceramics. These CAD/CAM machinable materials are believed to combine the most beneficial properties of composite resins and glass ceramics in themselves and thus offer several clinical advantages.

The first material of this class is 3M™ ESPE™ Lava™ Ultimate CAD/CAM Restorative. It has been available since January 2012 and can be processed chairside e.g. with the CEREC® system (Sirona Dental, Salzburg) as well as with different laboratory CAD/CAM systems (like 3M™ ESPE™ Lava™ Precision Solutions). The blanks are made of individually bonded zirconia and silica nano particles as well as zirconia and silica nano particles agglomerated into clusters. These nano-ceramic fillers are embedded in a highly cured polymeric matrix.

In order to learn more about the material-specific properties, the clinical advantages and the future potential of the class of innovative materials, we had a conversation with Univ.-Prof. Dr. Gerwin Arnetzl, President of the Austrian Society of Computerized Dentistry (ÖGCZ). He is the head of the working group for restorative dentistry and adhesive prosthetics of the Clinical Department for Dental Restorative Sciences at the University of Graz and has gained clinical experience with different resin nano ceramic and hybrid ceramic materials including Lava Ultimate restorative.

Prof. Arnetzl, you have already tested different restorative materials that combine the properties of ceramics and polymers in the clinical environment. When did you start using Lava Ultimate restorative?

During the CEREC Winter Opening we (the ÖGCZ) held in Kitzbühel in December 2011 we were provided with detailed information about a new CAD/CAM restorative material, Lava Ultimate. There, the participants were given the opportunity to learn and exercise how to individualize restorations made of this material within the framework of a workshop. Since then, I have been using the restorative at the university and in my own dental practice in Graz. I am convinced that the development of this new class of materials has been the most innovative step in dental material development of the past several years. The user benefits from various advantages related to processing and ease of use and these advantages are not restricted to chairside users but available to all dental practitioners.

In the chairside CAD/CAM workflow, the easy milling and consequently the short processing times of hybrid materials are particularly advantageous. In addition, the restorative does neither require nor allow a firing process. This fact does not only lead to a more time-efficient finishing procedure, but also opens up new options of intraoral individualization, adaptation and repair: Adjustments with light-curable composite material are possible at any time even after permanent cementation of the restorations. In my opinion, this is one of the main benefits of these innovative materials, since repair procedures are becoming increasingly important in restorative dentistry.

What are the clinical advantages of resin nano ceramics or hybrid ceramics?

Compared to traditional, brittle all-ceramic materials, Lava Ultimate and similar materials have a much lower elastic modulus that is similar to that of dentin. This higher elasticity makes hybrid ceramics more antagonist-friendly, causing low wear to the opposing dentition. Moreover, the less brittle nature of the materials results in easy milling and an excellent edge stability that is better
than that obtained e.g. with glass ceramics. This fact even enables the dental practitioner to opt for alternative preparation geometries.

Last but not least, the elastic restoratives have a shock-absorbing function. This means that the stress to the restorative system is reduced and the restoration’s lifespan may be increased.

Indeed, the shock absorbing function makes Lava Ultimate specifically suited for the treatment of patients with dysfunctions, non-vital teeth or implants. While bruxism is a contraindication for most glass-ceramic restorations, the resin nano ceramic material is able to withstand high chewing forces and reduce the resulting stress. This is also advantageous after endodontic treatment when the stability of the remaining tooth structure is limited or for implant-based restorations. Implants are lacking the periodontal ligament which is able to absorb chewing forces acting on natural teeth and the restorative assumes this function. This is why we use the resin nano ceramic predominantly for these indications.

What is really important for every single step in the production process in the same manner as to the bonding protocol. When processed, finished and placed in the recommended way, very good results can be obtained with materials of the new class. Even the aesthetic appearance is very good, with a very nice chameleon effect obtained with Lava Ultimate restorative when used as an adhesive partial restoration.

To my mind, the introduction of Lava Ultimate and other materials that combine the beneficial properties of ceramics and polymers has been an important step in the evolution of dental materials. In the future, this material class will become prevalent in restorative dentistry. However, I am sure that interesting enhancements and further developments are going to follow. I am already curious where this development will take us.

Prof. Arnetzl, thank you for the interesting conversation.

References

In Denmark, there are two publicly funded universities – in Copenhagen and Aarhus – where a degree in dentistry can be obtained. A Master’s degree is usually granted after five years, with two years of preclinical and three years of clinical training. A person who wants to study dentistry has to apply to the university. A limited number of students are admitted every year. In 2013, 101 students (77 females, 24 men) started to study dentistry in Copenhagen and 65 students (60 females, 5 men) were admitted in Aarhus. Around 80% of them qualified due to their grade point average, others were accepted thanks to their work experience.

After graduation, an individual can work immediately as an employed dentist. However, a permission is required for owning a practice: this permission can be obtained after 1,440 hours of work treating adults as well as children. Since 2007, this experience has to be gained partly in the public system and partly in a private practice. Training for the two recognized specialties orthodontics and oral and maxillofacial surgery is offered at the university hospitals. A specialist degree in orthodontics is obtained after three years of training and a final examination. Oral and maxillofacial surgeons have to train five years and have no final exam. Supplementary training courses are mandatory for all dentists in Denmark.

Insurance system

The Danish national health service is funded by general taxation. The cost of dental care is subsidized by the health care system, but the major amount of the fees is generally paid by the patients. Only dental care for children (up to the age of 18) is covered completely by the national insurance and usually provided by the municipal paediatric dental care service. The amount of subsidy granted for adults depends on the kind of treatment and the age of the patient as well as his socio-economic status.

Private health insurance usually does not cover general dental treatment in Denmark. Some individuals are members of a private health insurance called Denmark, which covers a small part of the costs for dental services. Most people make use of this option when a complex prosthodontic treatment is necessary.

In my private dental practice located in the small town Aabenraa in the southern part of the country, most patients pay for their treatment privately.

Practicing dentistry in Denmark

According to the Danish Dental Association, there are currently 3,225 dentists in Denmark working in a private practice. The ratio of female to male dentists is almost equal, with a clear tendency towards an increase of the female proportion.

In rural areas and smaller cities, there are many single and joint practices with only one or two dentists, while there are often four to ten dentists working in one practice in the larger cities.

My own private practice which was established in 2012 is a joint practice with two practitioners and three dental nurses. We treat all kinds of patients and offer all treatments apart from orthodontics and complicated surgical interventions.
The Espertise™ Talent Award has a long-standing tradition at 3M ESPE. It was organized for the first time in 1998 to give young dental researchers the opportunity to present their own scientific project and their skills as a lecturer. While there was a separate German event in the beginning, the contest is open for European universities today, with English as the main language.

Since 2011, talented clinicians are also given the chance to prove their abilities by presenting a clinical case. In both the scientific and the clinical categories, the participants have the prospect of winning a sponsorship for further development of their skills: The person with the best scientific presentation receives a scholarship for a three-month research visit at a foreign university. The price for the winner of the clinical category is a grant for the participation in a selected high quality practical workshop.

The award in 2013

In 2013, a total of 36 dentists who are at the early stages of their career took up the challenge and presented their current project to be awarded the title of best lecturer.

The topic and content of the presentations as well as the didactic skills, professional nature and potential of the speakers were judged by the jury that consisted of four experts from the scientific and practical field.

Scientific studies

The jury decided that Dr. Katharina Kuhn from the University of Ulm in Germany delivered the best scientific presentation. She explained the operating principles of new testing procedures for shear and tensile bond strength testing developed in Ulm. In addition, she presented the results of an evaluation of this procedure. The testing devices were used to determine the shear and micro tensile bond strengths obtained with dual-cure cements on different restorative materials. What followed was a statistical analysis and a comparison with the results found in the literature. The speaker’s conclusion: due to low standard deviations, the testing procedure can be regarded as reliable.

The second winner, Tobias Waller of the University Hospital Bonn, held a lecture titled “Immunomodulatory features of porphyromonas gingivalis outer membrane vesicles”. The third place is shared by Dr. José Ignacio Zorzin of the University Hospital Erlangen in Germany, who investigated polymerization properties of bulk-fill composites, and Dr. Dr. Peer Kämmerer. This young researcher from the University Medical Center of Mainz in Germany focused on monitoring of biochemical bone remodelling after augmentation.

Clinical cases

The winner of the clinical category was Erik-Jan Muts: At the University of Groningen, the Netherlands, he has executed a Digital Rehabilitation Concept in a very complex and challenging clinical situation. In his lecture, he presented a corresponding patient case that is published in this issue of the Espertise™ Magazine. The second-place winner in this category is Dr. Miguel Angel Luengo Capilla of the University of Madrid, who presented a technique for closing diastemas.

Conclusion

While the members of the jury agreed that the quality of the lectures was exceptionally high, the participants were particularly enthusiastic about networking opportunities with dentists at the same point of their career. In addition, they gained lecturing experience and new impulses which may be useful for their future career.
Digital Rehabilitation Concept

Cost-effective treatment of a patient with severe dental abrasion

Erik-Jan Muts, Apeldoorn, the Netherlands

In order to treat a patient with severe dental abrasion and limited financial means effectively, the use of digital technologies can be valuable. What I need in this case is a productive workflow and the option of processing a high-performance material that is antagonist-friendly and may be used despite of parafunctional habits. Intra-oral repair of the restorations should be possible without restrictions.

These aspects are combined in the digital rehabilitation concept that was developed by me at the University of Groningen in collaboration with Prof. Dr. M. S. Cune, Dr. A. W. J. van Pelt and Dr. U. Schepke. It is specifically suited for the treatment of patients with severe tooth wear and includes technologies for optical impression taking as well as computer-aided design and manufacturing of indirect restorations. In this way, a time-efficient production process is ensured.

The material used in this approach is 3M™ ESPE™ Lava™ Ultimate CAD/CAM Restorative, a high-strength material that is elastic at the same time. In this way, chewing forces are absorbed by the material and fractures are unlikely to occur. Due to a monolithic design, the risk of chipping is eliminated. However, repair is always possible with light-curing direct composite material. In the following, the Digital Rehabilitation Concept is explained using a patient case.

Figure 1: The male patient had problems during chewing and in conversations because of his hypersensitive teeth and an instable occlusion. Especially the posterior teeth had multiple restorations. He also showed rhagades and frequently bit his tongue and lips.

Figure 2: Due to the severe loss of tooth structure, his teeth were virtually invisible even when he smiled. This edentulous appearance was a problem for him as well.

Figure 3: Before starting with the treatment, the shape of the restorations was planned using digital photographs and aid lines. More than half of the natural tooth structure was lost in the anterior region. This was one of the reasons to opt for an indirect approach.

Figure 4: A minimally invasive tooth preparation was necessary in this case due to the high increase in the vertical dimension of occlusion, the parafunctional habit of the patient and the high number of existing restorations.

Figure 5: Situation after immediate dentin sealing and soft tissue management using retraction cords. The patient is ready for digital impression taking with the 3M™ ESPE™ Lava™ Chairside Oral Scanner C.O.S.

Figure 6: For the digital bite registration, a mock-up of the anterior teeth was placed after having established the planned bite in centric relation using 3M™ ESPE™ Imprint™ Bite Registration Material in the posterior region. This enabled us to scan the anterior teeth in centric relation.
Figure 7: The digital models of maxilla and mandible are already assigned to each other in the new vertical dimension of occlusion. This is possible due to the described procedure of the digital bite registration.

Figure 8: In the dental laboratory, a digital mock-up was designed. Due to financial limitations, this mock-up was tried in virtually using the digital photographs of the patient that were taken for planning.

Figure 9: Resin nano ceramic restorations after the milling process at Elysee Dental, University of Leuven, Belgium. The outer surfaces of the onlays and veneers were polished extraorally.

Figure 10: After ultrasonic cleaning of the restorations and prior to their placement, their inner surfaces should be sandblasted using the 3M™ ESPE® CoJet™ System. Subsequently, the corundum should be removed with alcohol and the surface dried with air.

Figure 11: It is also possible to characterize the restoration. For this purpose, the surface was roughened with a burr in the area of the fissures. Then, it was cleaned with alcohol, conditioned with 3M™ ESPE® Scotchbond™ Universal Adhesive and light cured before the stains were applied and polymerized.

Figure 12: A dry working field is important to ensure a strong and long-lasting bond of the cement to the tooth surface and the restoration. As recommended by the manufacturer, 3M™ ESPE® Scotchbond™ Universal Adhesive was used in combination with 3M™ ESPE® RelyX™ Ultimate Adhesive Resin Cement.

Figure 13: Situation after placement of the restorations in the maxilla. Due to immediate dentin sealing, intra-oral sandblasting was required before etching of the tooth surfaces, application of the adhesive, and air-drying. The cement was applied directly into the restorations. Excess cement was removed after short polymerization.

Figure 14: Treatment result after intra-oral polishing using 3M™ ESPE® Sof-Lex™ Spiral Finishing and Polishing Wheels. The occlusion and articulation were checked overnight with BRUX CHECKER® (Scheu-Dental) and the patient received a night guard to protect his teeth.

Figure 15: The patient is very satisfied with the function and appearance of his restorations. His formerly toothless appearance has changed significantly.

Contact

Erik-Jan Muts
info@erikjanmuts.nl
With the availability of an ever-growing range of indirect restoratives, the number of products offered for their cementation has increased steadily. Apart from traditional zinc phosphate and glass ionomer cements and their modified variants, numerous modern resin-based materials for adhesive cementation arrived on the scene during recent decades.

The number of available products leads to confusion in many dental practices. In order to provide information regarding which type of cement is suited for which situation, 3M ESPE organized a Lunch and Learn event in Florence in September 2013. The two lecturers – Prof. Dr. F. J. Trevor Burke from the University of Birmingham and Dr. Sigrid Hader, Scientific Affairs Manager at 3M ESPE – provided an overview of relevant materials and their clinical performance. In a conversation, they summarized the most important facts for us.

Dr. Hader, “If we don’t have it, you don’t need it ...” was the title of the event in Florence. What does it imply?

The message is that the 3M ESPE portfolio of cementation solutions includes every product a dentist might want to use for cementation. The current range of materials is based on decades of experience with diverse cements, all of which have been developed and optimized in close collaboration with practitioners. The main portfolio consists of three recently optimized materials which have been developed primarily to bring reliability and simplicity into cementation workflows: the resin-modified glass-ionomer cement 3M™ ESPE™ Ketac™ Cem Plus Automix, 3M™ ESPE™ RelyX™ Unicem 2 Self-Adhesive Resin Cement and 3M™ ESPE™ RelyX™ Ultimate Adhesive Resin Cement. Additional products, such as a veneer cement, are also available for dentists with particular requirements.

Ketac Cem Plus Automix can be described as the typical PFM cement suited for traditional indications. The specific features of this economical, fluoride-releasing material are easy application due to the automix delivery system and the new tack-cure function that facilitates clean-up and leads to a very good marginal seal.

I am sure that there is a need for different cements today. Years ago, it has been sufficient to use traditional luting cements which simply provide retention by interlocking the minor irregularities on the prepared tooth surface and the restoration surface. The availability of new restorative materials, however, has changed the situation. Adhesive technologies are needed to obtain the desired aesthetics, support ceramic restorations and allow for alternative forms of preparation. When it comes to traditional restorative materials and indications, the conventional cements may still be used due to financial reasons, although they are becoming redundant from a clinical perspective.

The dual-cure resin cement RelyX Unicem is an all-rounder that eliminates numerous work steps for simplification of the adhesive procedure. For example, there is no conditioning of the tooth surface. The product is recommended for various indications like the cementation of restorations to natural tooth structure or implant abutments and the luting of posts (preferably 3M™ ESPE™ RelyX™ Fiber Post) and screws. The secret of RelyX Unicem’s clinical success is its unique chemical composition: it is...
initially hydrophilic, leading to moisture tolerance and a direct bond to the tooth. After cure, it is hydrophobic and completely neutralized so that a long-lasting, high bond strength is ensured.

RelyX Ultimate is an important addition to the portfolio because it offers ultimate bond strength and top aesthetic properties. This is exactly what is needed for the cementation of CAD/CAM and glass ceramic restorations. Especially in demanding cases where a strong enamel bond on a small surface area is needed – for example when inlays, onlays or Maryland bridges are placed – RelyX Ultimate should be the first choice. It is optimized for use with 3M™ ESPE™ Scotchbond™ Universal Adhesive: the two components are all that is needed for the complete cementation process.

Yes, within the PREP Panel (Product Research and Evaluation by Practitioners), a UK-based group of practice-based researchers, we have tested the three different cements Dr. Hader has just described. Co-founded by me more than 20 years ago, the PREP Panel is a group of currently 33 experienced dental practitioners who test and evaluate new materials and devices in their own dental office. Test reports are made available to colleagues and serve as a useful source of information, since our tests often have a higher significance to them than investigations carried out under ideal conditions.

**Please give a summary of the PREP Panel’s evaluations regarding the three cements.**

Let us begin with RelyX Unicem: In 2006, the overall clinical handling of the product was rated as being as good as that of conventional luting materials. This was surprising since the drawback of all previous resin cements had been their complicated handling and high technique sensitivity. The latter was also very low for RelyX Unicem. The fact that all evaluators were still using RelyX Unicem several years later speaks for itself. Thanks to the availability in an automix syringe, RelyX Unicem 2 received even better ratings than its predecessor regarding the ease of application.

**Ketac Cem Plus Automix**
- Main indication: The “PFM Cement”
- Primary benefits: Fluoride release, tack cure, economic

**RelyX Unicem**
- Main indication: The “all-rounder”
- Primary benefits: Strength, ease-of-use, universal

**RelyX Ultimate**
- Main indication: The “CAD/CAM, Glass Ceramic Cement”
- Primary benefits: Highest bond strength, fewer components than competitors, good aesthetics

Overview of cements, their strengths and indications.

RelyX Ultimate was assessed on the basis of 143 restorations luted with the material. The overall score for handling and dispensing was 4.9 out of 5! Furthermore, 83% of evaluators stated that they would buy this system if available at average cost. Last but not least, 70% of the PREP Panel evaluators assessing the clinical handling of Ketac Cem Plus considered the tack-cure function as excellent and the seating of the restorations was regarded as uncomplicated.

**Dr. Hader, is there anything you would like to add?**

Dental practitioners should always keep in mind that independent of its quality and ease of use, a product will only perform well if it is processed properly. For light-curing cements for example, polymerization is a very decisive step, since a sufficient cure is responsible for the long-term success of a restoration.

**Thank you very much for the interesting conversation.**
### Calendar of Events 2014

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Location</th>
<th>Website</th>
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<tr>
<td>20.02.2014</td>
<td>149th Chicago Midwinter Meeting</td>
<td>Chicago, USA</td>
<td><a href="http://www.cds.org/Midwinter_Meeting/Midwinter_Meeting.aspx">www.cds.org/Midwinter_Meeting/Midwinter_Meeting.aspx</a></td>
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<td>22.02.2014</td>
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<td>Chicago Dental Society</td>
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<td>28.02.2014</td>
<td>Dentistry Show 2014</td>
<td>Birmingham, UK</td>
<td><a href="http://www.thedentistshow.co.uk">www.thedentistshow.co.uk</a></td>
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<td>01.03.2014</td>
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<td>CloserStill Media Healthcare Ltd</td>
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<td>06.03.2014</td>
<td>Dental South China</td>
<td>Guangzhou, China</td>
<td><a href="http://www.dentalsouthchina.com/En">www.dentalsouthchina.com/En</a> Department of Science &amp; Technology of Guan</td>
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<tr>
<td>09.03.2014</td>
<td></td>
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<td>dong Province</td>
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<td>13.03.2014</td>
<td>Expodental 2014 13th International Dental Equipment,</td>
<td>Madrid, Spain</td>
<td><a href="http://www.ifema.es/expodental_01">www.ifema.es/expodental_01</a> IFEMA</td>
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<td>15.03.2014</td>
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<td>Scandefa</td>
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<td>16.05.2014</td>
<td>WID – Wiener Internationale Dentalausstellung</td>
<td>Vienna, Austria</td>
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