Minimal Intervention in Cariology - new devices for MI restorations

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Because of the absence of any restorative material which can fully replace the enamel and dentin, preservation of tooth structure should be of paramount importance in any treatment plan. Almost all twentieth century dentistry used the classification of cavities Black, for the treatment of dental caries, so the injuries were treated by removing the diseased tissue of healthy tooth extensions. New minimal intervention approaches display more respect for the dental structures, aiming to preserve tooth tissue and minimize treatment side-effects as much as possible. Appropriate technology and tools continue to be developed. This article covers some currently available for cavity preparation: manual removal, micro-preparation tools, micro-abrasion, sono-abrasion, laser and magnification.

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Dental decay continues to be one of the most prevalent diseases experienced by man. However, the pattern of the disease is changing: the incidence and morphology of the decay is currently evolving /diminishing as a result of improved hygiene and harder enamel due to the adoption of preventative measures (e.g. fluoride, improved tooth cleaning, etc.), which has led to a focus on other areas.

Preparing the cavity is the first stage in restorative dentistry. Traditional dentistry is based on using rotary instruments and diamond or tungsten drills when preparing cavities. This is extremely rapid but generally requires excavation affecting a wider area than that of the actual decay and, owing to the heat involved, can damage the pulp despite irrigation with water.

The aim of the new minimally invasive techniques is to preserve dental tissue and minimise any side effects to the greatest possible extent. Minimally invasive dentistry represents a veritable revolution in the field. It has developed a new approach for addressing dental decay and has proved effective in addressing cosmetic requirements and current societal issues. This type of dentistry has met the challenge through using new materials and adhesive systems for direct restorations.

Changes have resulted in a reassessment of the tools previously used in dental work. An emphasis on new values has meant that removal techniques used in the past, which were previously considered to be impractical and slow, now allow us to minimise trauma levels and tissue loss, thereby increasing the life expectancy of teeth. This approach has resulted in the development of “cleaner techniques” that offer greater quality and predictability in terms of the outcome of the treatment, at a lower ‘biological cost’. Pulpar trauma is minimised, the discomfort of patients reduced and the need to use many tools, such as drills and anaesthesia, is considerably decreased.

The advantage of the new procedures is that they not only to eliminate the tissue damaged by the decay (irreversible). They also avoid weakening the tooth by cutting into it, which is a normal procedure when the treatment involves using materials such as amalgam in a filling. It should also be noted that at present, no single method for removing damaged tissue is ideal, either from the viewpoint of patients or from that of professionals. Therefore, a combination should be considered in attempting to attain the objectives of preserving dental tissue and minimising any side-effects.

The main resources at our disposal are examined below and include: manual removal, micro-preparation instruments, micro-abrasion, lasers and magnification. All of the techniques allow an approach that is more respectful towards the dental structure, which once lost, cannot be retrieved: restoration of the tooth and all its functions. Cosmetic issues are included.

Manual systems of removal

Manual removal is a traditional procedure, which plays a key role in current dentistry. It is based on removing decayed dental tissue by using manual instruments, incisions and using materials in the subsequent restoration. This technique is indicated when the active dental decay can be accessed through use of hand-instruments, which offer a higher level of control when removing the decay, and greater sensitivity that enables the dentist to be more selective and achieve a superior restoration.

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Mechanical and chemical removal

Bomsteine and Ericson, two Swedish dentists, created a gel which combines sodium hypochlorite and three amino acids capable of dissolving decayed tissue (Carisolv). This gel helps removal of necrotic material from the tooth and softens the dentine, as the naturally-bound chlorine is active and can attack the denatured collagen in the carious lesion. The technique involves application of the gel to the area of decay. The gel then acts on the damaged area, allowing the subsequent removal of the tissue with manual instruments instead of having to cut into the tooth and causing abrasion to the carious dentine. This product was designed to avoid causing damage to the gums or the healthy structure.

Micro-preparation rotary instruments

Significant advances in the area of early detection have been fundamental to the treatment of lesions at an incipient phase, and have resulted in new demands regarding the design of rotary instruments to allow a 'micro' approach to the tooth. The rotary method continues to be the most widely used technique and is currently being adapted to the new demands, through the use of more accurate drills with smaller active components with longer and thinner necks, to ensure that interventions will respect the dental structures to a far greater extent, as once lost they can never be recovered. A result of the instrument's length and delicacy, the area involved is now much more visible, which, combined with size of the drill's active component, means that the work can be carried out far more accurately in order to preserve as much of the healthy structure of the tooth as possible. Contra-angle instruments are also available. These work at slower speeds than those of the high velocity tools and are easier to control. When high velocity rotary methods are used it is much easier to over-extend/excavate the area and cause irreversible damage and loss.

Micro-abrasion

Micro-abrasion is a pseudo-mechanical non-rotary method of incision that sprays aluminium oxide micro-particles (Al_2O_3) mixed with air and water (the new systems include water) to remove resins and the infected areas of the tooth.

It transfers the kinetic energy of a jet (particles) and bombards the tooth at high velocity, using a pressurised stream of air, which, on impact with the surface of the tooth, rapidly removes the affected tissue or material. This method avoids the vibration and noise of the high-velocity instruments. After removal of the infected tissue, the tooth is filled, using the latest-generation adhesive materials.

This technique offers excellent cosmetic results, and is easy to apply. It has also been proven to be well tolerated by patients. However, when losing the sensation of touch it is easy to over-treat the tooth; furthermore, such systems also have limitations related to the removal of soft dentine.

Ultrasound-abrasion equipment

This equipment has been developed from the traditional ultra-sound materials used to prepare the tooth, and is the same as that used for periodontal treatments. It has been specifically developed with different partially-shaped diamond points, in order to prevent damage to the neighbouring teeth in the critical interproximal area. However, it can be applied to any surface (occlusal, cervical and proximal). It can also be used for minor enamel preparations and for finishing the areas around preparations. It allows controlled vibration of the instruments, with an abrasive action that guarantees the shaping, cleaning and removal of hard tissue.

Laser

A laser is a high-intensity concentrated light that is capable of selectively removing the affected dental tissue without touching the healthy tissue. The absorption of radiation from the laser is determined by an equation called SPA (Selective Photon Absorption), based on the histological composition of the tissue to radiate (chromospheres) and the wavelength of the laser selected. The preferred laser for removing hard dental tissue is one that emits erbium as its active medium. This type of laser can be combined with a YAG crystal (Erbium: YAG-2940 nm) or with chromium, enhanced with an yttrium, scandium or gallium garnet crystal (Er Cr: YSGG-2780 nm). Both are capable of being absorbed by the dental tissue and are therefore well suited to the selective removal of such tissue.

Erbium lasers are classified as surgical, infrared and non-ionising lasers, whose active medium is solid and categorised as Class IV, in accordance with the risk level involved. The fundamental question raised by such lasers is whether they are able to remove enamel, dentine and the tooth decay, since their action is selective and conservative. The answer is simple. These lasers emit energy on a constant basis. However, histological differences mean that carious dentine is tissue with the highest percentage of water and the lowest percentage of minerals, as a result of demineralisation. This type of tissue, therefore, will be the first to absorb the radiation and the first to be vaporised: the healthy dental structure will remain intact, as its removal requires a force of a higher density. Its removal will also depend on other factors, such as the duration of the radiation and the pulse frequency. Laser energy is therefore used to prevent, diagnose and treat tooth decay.

At present, this method of removing dentine is not widely used, as the amount of heat it produces can damage the pulp tissue and reduce the strength of the adhesive systems.

Magnification

It is preferable to use magnification with minimally-invasive methods. The issue of visibility is one of the most common challenges facing all fields of dentistry, including restorative dentistry. As the working areas are extremely small, it is necessary to obtain as much assistance as possible in terms of visibility. For this purpose, magnifying glasses and, more recently, microscopes are used. Although such sophisticated equipment is not required in all cases, it can help dentists to see items otherwise invisible to the human eye.

The advantages offered by improved lighting and greater magnification greatly facilitate provision of good dental care. Improved visibility, greater ergonomics and the higher quality of the results are some of the main areas that dentists can immediately appreciate.

Conclusions

The decreasing volumes of work and the provision of added value (through greater respect for the nature of the teeth and quality treatments) represent a growing trend in present-day dentistry. We consequently need to reassess the focus of our work, placing an emphasis on minimally-invasive models and reviewing the methods for removing diseased tissue. The speed of dental tissue removal is not an important issue. However, the emphasis is now on the selective and respectful nature of the removal, since the modern adhesive materials help us to preserve the healthy structure.

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