

Iatrogenic Damage to Dental Hard Tissues

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Abstract

Adverse or physical condition induced in patient through any treatment procedures by a clinician is known as iatrogenesis. In the field of dentistry, dentist needs to deal in a small area with lot of obstructions around the tooth structure. So, iatrogenic damage to the oral and para-oral tissue is likely to occur in every aspect of dentistry.

Keywords: Iatrogenic damage, enamel

Introduction

One of the most peculiar features in mankind is the essence of destruction or damage. For this reason, in medical/ dental fields the unforeseen damage that the dentist does to a patient is quite concealed. Dentists are sometimes unaware of what they really do to a tooth, especially when the observation comes to a minute level of dental tissue. The present manuscript/article will try to explore iatrogenic damage that is caused by dentists to the oral and para-oral soft tissues.

Cavity preparation and its considerations

One of the inevitable iatrogenic procedures occurs when the dentist tries to produce class II interproximal cavity preparation. In this particular situation, the two cervical margins of the box undergo trimming by bur (tungsten carbide bur), the embrasure of the entry margin will be cut by the bur blades-which run in a clockwise direction- in a way that these blades are entering the enamel margin, i.e. cutting in inward the tooth surface. The problem comes from the other end of the margin, where the bur exits the margin. In this situation the bur blades are cutting enamel prisms in a direction which is outward the tooth surface; here the enamel prisms are completely unsupported and no dentine left beneath it. Consequently the dentist will end up with pore spaces between the restoration and the rough surface of enamel; in addition to that, there are micro leakages and cracks in the enamel surface due to shrinking property of most filling materials. All of which will result in weak margin and eventually this margin will break and the restoration will fail.^{1-3,7}

Two studies performed by Leidalet *al* and Tronstadet *al* in 1974 and 1975 respectively, described different speed ratio of different rotary instruments (low speed and ultra-speed) with clockwise and counter clockwise rotation and its effect on the class II cavity preparation. In both studies the prepared cavities were assessed by the mean of SEM (scanning electron microscopy), and the authors used cavity margin index (CMI system) to evaluate the quality of the box cavity margin. Overall, the results of both studies indicate that although the authors used a variety of techniques and bur types at low and ultra-speed rotation they end up with imperfect margin of class II box cavity, especially at the exit margin of the cavity.⁴⁻⁵

Another case in which the dentist prepares class I or class II cavity using a diamond bur (which has many sharp particles upon its cutting surface), here the cut surface of the enamel shows deep grooves represent the particles pattern of the diamond bur. As a result of this preparation, enamel chips will develop, because these enamel rods are unsupported by the underlying enamel; and this will lead to the broken appearance of the enamel.

After doing the cavity preparation the dentist tries to use variable methods and techniques to finish the class II cavity preparation. One of which is using

abrasive tools (polishing stone bur) to smoothen the rough surface of the enamel. This will result in cutting the enamel surface with the enamel itself, because the enamel chips intrude into the gaps that found in the bur and filled them up. Consequently there will be a smear layer of melted enamel on the surface of the cut enamel due to the high temperature that arises during this procedure. This layer of smeared enamel will not be well attached to the enamel surface and may lead to further damage and roughness of the enamel surface. This smeared enamel layer depend mainly on the speed of the used device; for example if the rotation speed is high the smeared enamel layer will be minimal and vice versa.^{1, 2, 6, 7}

Placement of the matrix band

Another example where damage could occur to the enamel surface is when the dentist tries to place the matrix band to the prepared class II cavity box. In this case while inserting the matrix, any compression (tightening the matrix band by the dentist) will affect the margin and break the enamel parallel with incremental lines. In such case there are a number of projection from the interproximal margin of the tooth surface, these represent the prominent crest of imbrications lines-perikymata-, therefore any brunt load from the matrix band will be transfer to these projections and fracture the cavity margin.^{1, 7}

Scaling

One of the unavoidable damages to the tooth surface is in case of removing the calculus that accumulates around the tooth surfaces. When a dentist scales the tooth surface in an attempt to remove the calculus the direction adapted will be the cervical up towards the occlusal surface. The sharp edge of the scaler not only removes the calculus layer, but also comes in contact with the enamel surface and cuts bits of enamel parallel to the incremental lines; results in the formation of grooves within the enamel surface. Consequently, this makes the enamel surface rougher and become a good place and a perfect anchor for calculus formation.⁷⁻⁹

Exodontia

While performing a surgical procedure of extracting a tooth, the surgeon grasps the crown of the tooth with the forceps. By this way while squeezing the tooth to generate firm grip, part of the enamel breaks parallel with the incremental lines and could damage the tooth surface. The safest way to extract a tooth and preserve its tissue for further analysis is by using a chisel applied at the bifurcation area between the roots.⁷

Etching

Etching the tooth surface is the usual step in applying composite filling to a prepared tooth cavity; i.e., the etching agent (phosphoric acid) will spread over the prepared tooth surface and dissolve bits of the surface to create micro-porosity within the surface allowing the bonding to occur in these porous areas. However, applying a layer of acid to the enamel is far more destructive procedure than the actual intension of this procedure. During etching the enamel surface, a bulk of enamel tissue is removed and a macro-porosity layer develops and deeper within another layer of micro-porosity is created, beneath all these layers is the sound enamel. Further analysis in various studies of the etched enamel surface by SEM showed that the uncontinuous enamel prism boundary spaces expanded to become a bigger space. These spaces become bigger in size because of the insoluble calcium phosphate that accumulates in these areas which is then called 'prism sheaths'; which project from etched enamel surfaces. After the placement of the composite filling, any damage to this filling would result in a fracture. Whereas in the case of fractured filling, the crack developed will not be at the level of macro or micro layer of the etched enamel; on the contrary, it will be within the sound enamel.

On comparing reconstruction of a tooth with a composite filling, a great amount of intact enamel tissue will be lost than in case of fractured filling.^{7, 11}

Debonding in orthodontic treatment

In orthodontic treatment the bracket is bonded to the tooth surface, and is removed after finishing the treatment. The consequence of removing the bracket from the tooth surface (debonding) leads to a considerable amount of enamel chipping parallel to the incremental line. Thus, SEM was used by various researchers to give better idea of these areas. By taking a closer look to the enamel surface after debonding, rough tooth surface profile was seen, due to the fact that the enamel breaks parallel to enamel prism and parallel to the incremental lines which is the natural tendency. In addition, there will be chunks of adhesive material left over the enamel surface. As a result, the tooth surface will become rougher after debonding. To restore the original smooth enamel surface the orthodontist polishes the tooth in order to even all incremental lines, but actually enamel is removed about 100-500 µm, which is almost half the thickness of the enamel that covers the tooth. To conclude, a simple fact is that the enamel is not designed to withstand pulling forces, if done so it simply break parallel with the incremental lines.^{7, 11-13}

Bleaching

Teeth bleaching or teeth whitening is one of the commonest procedures used in cosmetic dentistry to recover the white /original colour of the teeth. Many types of bleaching materials have been used so far with multiple techniques. It can be applied by the dentist or the patient (self-applied). However, whatthey are not aware of is that, this procedure is far most destructive method which has been applied to the tooth surface up to the present day. The reason behind that is the fact enamel is made of crystals adhering to each other by enamel protein matrix, this organic matrix holds the enamel crystals altogether in one solid structure. Enamel bleaching dissolves the glue (enamel protein matrix) in between these crystals. Moreover, it will directly affect the enamel lamellae that go all the way through the enamel to the enamel-dentine junction EDJ. These lamellae represent crack zones filled with enamel matrix, and by enamel bleaching these lamellae will dissolve and subsequently expose the dentine. Furthermore, bleaching materials will dissolve every minute components of the structure such as enamel prism boundary discontinuity, enamel tufts and extracellular spaces between the incremental lines. The resultant of which is the white porous weaker structure of enamel Later as an outcome of this the possibility of staining will be higher and more rapid.^{7, 14, 15}

Another important fact or side effect of teeth bleaching is dental sensitivity; in which the bleaching agent will eventually expose dentine and its dentinal tubules (which contain afferent nerve ending and dentinal fluid). Consequently these exposed tubules will be prone to any type of irritants such as hot or cold water; as a result, considerable amount of pain (mild to severe) will occur.

Adjacent teeth damage in class II interproximal cavity preparation/ crown preparation

A very classical harm thatmany dentists do to the adjacent teeth in case of preparing aproximal surface of class II cavity. In this situation, many dentists accidentally hit by the bur, the adjacent tooth surface that is in contact with the interproximal box. Therefore, this damaged are of the tooth surface will require a filling to compensate the loss in enamel or even in dentine.

In a crown or bridge preparation the dentist introduce an unintentionally damage to the adjacent teeth surfaces. Plenty of research has been carried out to determine the percentage of these faults and the results were considerably high.^{16- 18}

Conclusion

Dental hard tissue is a very sensitive structure, which is prone to any kind of damage whether it is intentionally or unintentionally induced. Despite the

fact that this type of tissue as a one unit is one of the hardest tissue in human, it is very likely to be in a position where dentists become the real threat of damaging it. Enamel, is the structure which has the property of being hardest among all other tissues within the body; this special characteristic enables it to cover human teeth which are in turn the most force- resistant organ in the body. However, any slight damage carried out by nature (caries or any other diseases) or by dentist (iatrogenic damage) will affect it on many levels.

Needless to say, they should distinctly realize the fact that any damage to the enamel will break it in a way which is parallel to the incremental lines; this fact is fixed in stone and has a great impact on all dental procedures. In regard to dentine and cementum, both contribute to the internal tooth composition and have a leading role in determining the identity of the tooth as an extraordinary biological structure of the body. Thus, any inevitable harm will directly affect these structures and lead to further complication. As a concluding remark, a permanent tooth is a one lifetime structure, dentists should be extremely careful not to damage it while applying various dental treatments.

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