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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF IATROGENIC DAMAGE IN CLASS II CAVITIES USING MAGNIFICATION TOOLS DURING TOOTH PREPARATION: AN IN VITRO STUDY

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Abstract

Aims: This is an vitro study compares and evaluates the effect of magnification tools on frequency and extent of iatrogenic damage to approximal tooth surface during conservative Class II cavity preparations.

Methods and Material: 30 Typodont teeth were divided into 3 groups 10 typodont teeth in each group and were mounted on Phantom head. Teeth were prepared for class II (MO) cavity on 36 with conservative design using airotor with naked eye, loupes and microscope and iatrogenic damage was assessed on tooth no 35. Assessment of iatrogenic damage of all the groups was done by profilometer test.

Statistical analysis used: Statistical analysis was done using one-way analysis of variance (ANOVA). Post-hoc pair-wise comparisons were done using Dunnett's test.

Results: Results revealed that tooth preparation was better under microscopes and loupes with statistical significant difference for samples with loupes and microscope on comparison with naked eye. Study also expressed the difficulty faced during tooth preparation with microscope and loupes for the first time.

Conclusions: Magnifying tools helps in better vision and less iatrogenic damage while preparing the tooth for restoration.

Introduction:-

A major clinical concern in restorative procedure is the iatrogenic damage to approximal enamel. Iatrogenic damage is reported with a frequency of 64%-100% for approximal surface to Class II cavity and full crown preparations. Matrix bands can be used to prevent approximal iatrogenic damage but since they are in-effective and not used by most of the practitioners (Medeiros VA, 2000).

Boyde and Knight first examined effects of placement of matrix band on margins of Class II cavity preparation and reported iatrogenic damage to approximal surfaces. An ideal cavity preparation should not damage the adjacent tooth; however, it is difficult to achieve most of the time (Qvist V, 1992). Iatrogenic damage to enamel surface occurs most commonly in the form of vertical grooves upto 1mm wide, and also seen as fine scratches, indentations and extensive damage over a large surface area (Lussi A, 2003).This can cause increased caries susceptibility, temperature sensitivity where the iatrogenic damage reaches the dentin of the involved/adjacent tooth and periodontal disease where the damage is below the contact point.Removal of as minute as 120µm (200

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± 80μm) of the outer layer of enamel leads to increase in permeability to acid like, water soluble molecules. Furrows and indentations also retain dental plaque and increase the likelihood of initiation and progression of caries. In addition, enamel damage on approximal surface will be seen as interproximal radiolucencies which could be misdiagnosed as carious cavitation, leading to unnecessary restorative treatment of non-carious surfaces (Kuhar M, 1997).

Qvist et.al reported that scratches & grooves covering approximately several square millimeters of the approximal surface (0.5-1.0 mm deep) were the common finding (Qvist V, 1992). Medeiros et al. observed lower frequency of iatrogenic damage (49-60%) and attributed this to removal of small defects over time. Lussi et al study reported that deeper layers of enamel are more vulnerable to processes of demineralisation than the superficial ones with increase in plaque accumulation. (Medeiros VA 2000, Lussi A 2003)

Dentists are concentrating more on conservative designs of tooth preparations using magnification and other optical aids for contributing better treatment to their patients. Dentistry has significantly gained from advances in optical technology such as loupes and operating microscope. They help to improve accuracy required beyond unaided vision. Enhanced magnification and better illumination of the operating field has many advantages for operators(Narula,2015). The quality of treatment improves through the usage of these magnifying devices. As per the various data, it has been observed that each dental professional is at potential risk for having occupational musculoskeletal problems that include the vision and posture in which clinicians sits. Little modification in posture and vision using magnifying aids can enhance the work efficiency of clinician (Friedman, 2004).

Achromatic compound magnification loupes generally used for restorative procedures increase the size x2 to x5, through magnification of x2.5 to x4. Therefore, the use of appropriate visual enhancement should be considered to make the practice of dentistry more easy, precise and more comfortable for all dental professionals and thereby decreasing the risk of musculoskeletal problems (Druttman, Farook 2013).

Although there have been numerous literature with the similar study design, one such study done by Narula K et al in which they evaluated the effect of magnification loupes on psychomotor skill acquisition during tooth preparation for class II cavities among dental interns and final year BDS students(Narula,2015)but in the present article, we have compared naked eye, loupes and microscopes for evaluating iatrogenic damage in the typodont teeth done by a single operator to eliminate variables in our study. This type of profilometer device was not used in any other study before with the similar study design as per our literature search. It is easily available and cheaper than optical and LASER profilometer; therefore it can be used in further studies for evaluation of surface roughness.

The present article compares and evaluates iatrogenic damage to adjacent tooth surfaces in Class II cavities using magnification tools during tooth preparation. Profilometer device was used to evaluate the surface roughness (Ra) on the adjacent tooth #35.

Subjects and Methods:-

Thirty typodont teeth #36 (Columbia Dentoform, DentalEZ) were mounted on a lower acrylic jaw base of phantom head and Class II cavity was prepared on #36 tooth. Class II mesio-occlusal (MO) conservative design amalgam cavity was prepared using 245 bur and 169 L bur.

Punch cut was made at the central fissure with the 245 bur. (Figure 1) The bur was moved to extend the outline towards mesial proximal box while maintaining the same depth and bur orientation.(Figure 2)

To further isolate and weaken the proximal tooth structure, two cuts were made, one at the buccal and another at the lingual limit of proximal ditch.Remaining weakened enamel wall was then fractured by gentle pressure with a spoon excavator. Proximal contact was then broken with the help of 169L bur providing the clearance on facial and lingual margins of the proximal box i.e. 0.2-0.3mm from adjacent tooth. (Figure 3)

30 tooth samples were divided into 3 groups:

Group A: Class II cavity preparation on 36 (MO) with naked eye.

Group B: Class II cavity preparation on 36 (MO) using Dental Loupes 2.5 X (Ergoptix, India).

Group C: Class II cavity preparation on 36 (MO) using Dental Microscope 12.5 X (Zumax, China).

Following procedure was performed by single operator.After the cavity was prepared, adjacent tooth surface #35 was analyzed for damage with the help of Profilometer test (Mitutoyo, Japan. Model: SJ 210). Stylus Speed was 0.5mm/s with the cut off Length: 1.25mm. Surface roughness was measured in µm on the distal surface of adjacent tooth #35. Surface roughness (R_a) i.e. average value of all absolute distances of the roughness profile from the center line within the measuring length was measured with the help of stylus tip. (Figure 4) Values of surface roughness were noted for each group. (Table 1)

Statistical analysis:
All data was entered into a Microsoft Office Excel (version 2016) in a spreadsheet which was prepared and validated for the data form. Data was entered and checked for errors and discrepancies. Data analysis was done using windows based 'MedCalc Statistical Software' version 18.11.3 (MedCalc Software BVBA, Ostend, Belgium; https://www.medcalc.org; 2019). The mean scores for surface roughness was compared between the three groups using one-way analysis of variance (ANOVA). Post-hoc pair-wise comparisons were done using Dunnett's test. All testing was done using two-sided tests at alpha 0.05 (95% confidence level). Thus, the criteria for rejecting the null hypothesis was a 'p' value of <0.05.

Results:-

When group 1 was compared with group 2, there was a significant difference seen with the p value of 0.0318. Similarly, on comparing group 2 and group 3 no significant difference was observed with the p value of 0.1781 while significant difference was seen with group 1 and group 3 with p value of 0.0052. Hence, we can conclude that surface roughness was seen maximum in group 1 i.e. preparation with naked eye. On comparison within the groups least iatrogenic damage was seen with dental microscope group. (Graph 1) The most frequent type of damage was abrasion, nicks, indentations and vertical grooves. The most commonly damaged surface seen in this study was the middle third of the proximal surface which was found more vertically (occluso-cervically) than horizontally (bucco-lingually).

Discussion:-

The current study was conducted with the notion to evaluate significant and often overlooked aspect of restorative dentistry, and evaluate the basic ethical issue defining a practitioner's primary duty to do no harm. Currently, there are very limited studies on this imperative subject. With this intention in mind, this study was carried out on a phantom head in order to simulate clinical circumstances and it can be assumed that results can have the same clinical relevance. Clinician was well acquainted in using magnification devices such as loupes and dental microscope.

Magnification has stepped as a boon in the dental market as every minute detail in preparations of Class II cavity can be observed at a glance without straining the normal eyesight. To standardize the difference in cavity preparations #36 typodont tooth was selected and mesio-occlusal (MO) conservative cavity design was prepared. The armamentarium consists of hand instruments and two pear shaped carbide burs were used for testing the iatrogenic damage on adjacent tooth using different magnifying aids. Efforts were taken to minimize the iatrogenic damage by using a hand instrument for breaking the contact initially. The results support the previous authors' hypothesis that damage to the adjacent teeth is almost always inevitable while working on proximal areas(Lussi,2003).The results also revealed that iatrogenic damage was less when magnifying aid such as dental microscope and dental loupes were used for cavity preparation. This could be due to magnifying devices indirectly helping to enhance the visibility of the operating sites to improve the quality of work. One of the advantages seen with higher magnification is reduced field of vision and the smaller depth of field(Shanelec,1992).During intense visual work, ciliary muscles of the eye produces accommodation and the extra ocular muscles converge the visual axis of each eye on to the object of interest becomes fatigued. It may also help to allow better ergonomics so that the posture is improved by subconscious attempts. Good ergonomics allow longer working time without repetitive muscle strain (Christensen, 2003). Similar studies were done by Farook et al., Burley et al. and Maggio et al. which showed that working with the magnifying loupes is always better(Buhrley2002, Farook2013, Maggio2011) .Eichenberger et al. in their study evaluated

the near visual acuity of forty dentists and they observed improvement by using different magnification devices. They concluded that near visual acuity decreases during life time. Visual acuity can be improved significantly independent of age or natural vision by using magnification devices. Thus, all dental professionals should use appropriate visual enhancement to make the practice of dentistry easier and more comfortable as well as to reduce the risk of musculoskeletal injury.[15]Some authors have listed drawbacks of magnification such as hindrance in learning curve, high cost of dental microscope and cross contamination while using dental loupes (Apotheker1981, Rubinstein1997, and Sitbon2014).

In this study, it has been observed that the most common type of iatrogenic damage seen was in the form of vertical grooves (0.5-1.0 mm wide) often extending vertically from the marginal ridge towards the contact area. This pattern of damage is commonly seen with damage from a vertically held bur at proximal surface that had unintentionally touched the adjacent tooth enamel on a number of occasions. The basic method of preparation however is the use of high speed burs which over the past half century remained largely unchanged. More modest damage was seen haphazardly in the form of indentations and scratches (Long TD, 1988). Profilometer device was used to assess the surface roughness caused due to the iatrogenic damage on tooth #35. Profilometer used in this study is a contact type profilometer (mechanical) with a stylus tip which makes direct contact with the surface of the sample. It can measure small variations ranging in height from 10 nanometres to 1 millimetre. The electrical signals from the stylus tip go through an amplification and digital conversion process is recorded in the form of graphs. The value of surface roughness (R_a) is displayed on the screen of the device. These values were noted for all the three groups in the study.

Measures to prevent iatrogenic damage are nowadays not practiced or in effective mostly by the practitioners. Iatrogenic damage may also contribute to injuries to surface enamel which can expose the deeper layers of enamel and lead to demineralisation (Elderton RJ 1992,1983).In a longitudinal study of seven years, iatrogenically damaged surfaces were found to be three times more prone to be restored than non-damaged surface(Qvist V 1992,Lussi,2003).In addition to that, iatrogenic damage might be misdiagnosed on a bitewing radiograph as a radiolucency caused by caries. Operative treatment of such iatrogenic defects is difficult; the only measure is to seal the defect.

Table 1:- Values of surface roughness (R_a) noted using profilometer device in all three groups.

Sr. No.	Sample No.	Surface Roughness, Ra (in µm)		
		Group I	Group II	Group III
1	No.1	2.080	0.293	0.450
2	No.2	1.795	0.270	0.195
3	No.3	0.931	0.354	0.860
4	No.4	1.061	0.995	0.511
5	No.5	0.791	0.691	0.611
6	No.6	0.891	0.456	0.359
7	No.7	0.632	0.677	0.310
8	No.8	0.454	0.712	0.602
9	No.9	0.792	0.668	0.352
10	No.10	0.699	0.802	0.300

Figure 1:-Punch cut was made with 245 bur.

Figure 2:- Bur was moved to extend the outline towards mesial proximal box.

Figure 3:- Proximal contact was broken with the help of 169L bur.

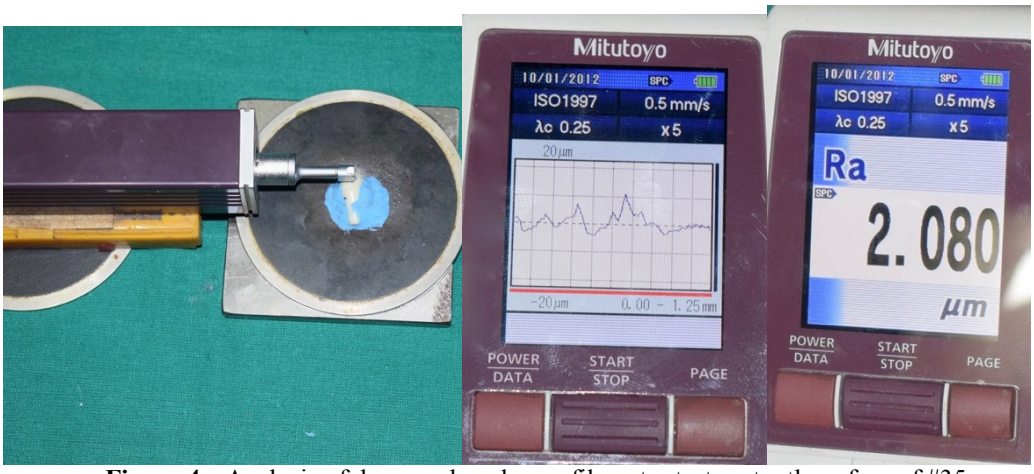
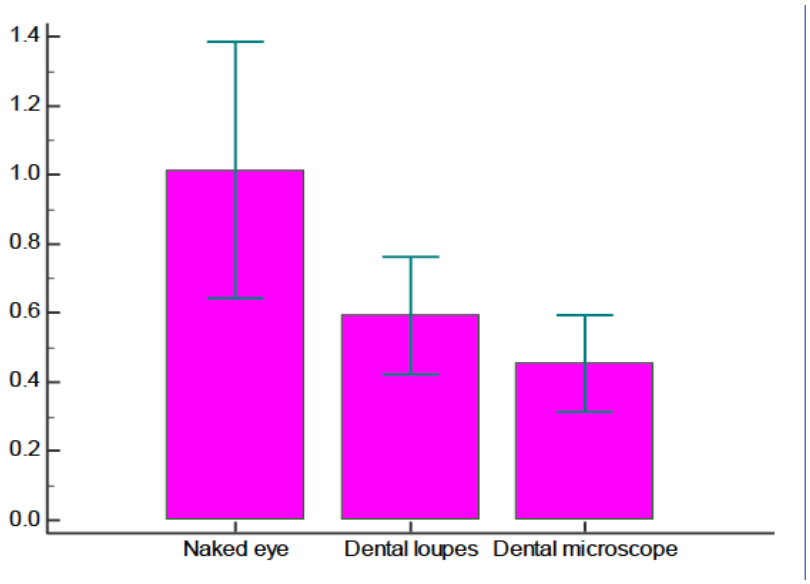


Figure 4:- Analysis of damage done by profilometer test on tooth surface of #35.



Graph 1:- Graph showing comparison of all three groups.

Conclusion:-

Within the limitation of the study, a high frequency of iatrogenic damage to the adjacent teeth had been found during Class II cavity preparation without using magnification aids. This study also showed that the use of loupes and dental microscope decreases the iatrogenic damage significantly to adjacent tooth surface. Protection of the adjacent tooth surface be it with matrix bands or any other devices is of paramount importance during Class II cavity preparation. Magnification devices should be recommended to be included in the undergraduate armamentarium also.

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References:-

1. Apotheker H, Jako GJ. A microscope for use in dentistry. J Microsurg 1981; 3:7‑10.
2. Buhrley LJ, Barrows MJ, BeGole EA, Wenckus CS. Effect of magnification on locating the MB2 canal in maxillary molars. J Endod 2002; 28:324-7.
3. Christensen GJ. Magnification in dentistry: Useful tool or another gimmick? J Am Dent Assoc 2003; 134:1647-50.
4. Eichenberger M, Perrin P, Neuhaus KW, Bringolf U, Lussi A. Influence of loupes and age on the near visual acuity of practicing dentists. J Biomed Opt 2011; 16:035003.
5. Elderton RJ. Iatrogenesis in the treatment of dental caries. Proceedings of the Finnish Dental Society 1992; 88:25–32.
6. Elderton RJ, Nuttall NM. Variation among dentists in planning treatment. British Dental Journal 1983; 154:201–6.
7. Farook SA, Stokes RJ, Davis AK, Sneddon K, Collyer J. Use of dental loupes among dental trainers and trainees in the UK. J InvestigClin Dent 2013; 4:120-3.
8. Friedman MJ. Magnification in a restorative dental practice: From loupes to microscopes. CompendContinEduc Dent 2004; 25:48, 50, 53-5.
9. Kuhar M, Cevc P, Schara M, Funduk N. Enhanced permeability of acid etched or ground dental enamel. J Prosthet Dent 1997; 77:578–582.
10. Lussi A, Kronenberg O, Megert B. The effect of magnification on the iatrogenic damage to adjacent tooth surfaces during class II preparation. J Dent 2003; 31:291–296.
11. Long TD, Smith BGN. The effect of contact area morphology on operative dental procedures. Journal of Oral Rehabilitation 1988; 15:593–8.

12. Maggio MP, Villegas H, Blatz MB. The effect of magnification loupes on the performance of preclinical dental students. Quintessence Int 2011; 42:45-55.
13. Medeiros VA, Seddon RP. Iatrogenic damage to approximal surfaces in contact with Class II restorations. J Dent 2000; 28:103–110Boyde A, Knight PJ. Scanning electron microscope studies of Class II cavity margins. British Dental Journal 1972;133:331
14. Narula K, Kundabala M, Shetty N, Shenoy R. Evaluation of tooth preparations for Class II cavities using magnification loupes among dental interns and final year BDS students in preclinical laboratory. Journal of conservative dentistry: JCD. 2015 Jul; 18(4):284.
15. Qvist V, Johannessen L, Bruun M. Progression of approximal caries in relation to iatrogenic preparation damage. J Dent Res 1992;71:1370–1373.
16. Rubinstein R. The anatomy of the surgical operating microscope and operating positions. Dent Clin North Am 1997; 41:391‑413.
17. Shanelec DA. Optical principles of loupes. J Calif Dent Assoc 1992; 20:25‑32.
18. Sitbon Y, Attathom T, St. Georges AJ. Minimal intervention dentistry II: Part 1. Contribution of the operating microscope to dentistry. Br Dent J 2014; 216:125‑30.
19. Tony Druttman Top 10 Tips: Magnification and Illumination. Available from http://www.londonendo.co.uk.