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Occlusal Trauma and Non-Carious lesions: The role of Eccentric Movements and Guidance

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Declaration
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ABSTRACT

Background: It has been suggested that occlusal trauma during eccentric movements may be an etiological factor in developing non carious lesions(abfractions). **Objective:** The objective of the study was to investigate the association between premature contacts during eccentric movements, guidance type, and development of non-carious lesions (NCCLs), while also assessing the impact of demographic factors (age and gender) on lesion formation. **Methodology:** A total of 100 patients of both gender attending to the clinic for prosthetic treatment were included. Minimum 2 lesions per dentition were selected so 100 participants providing a total sample of 200 teeth. Abfractions per dentition with the depth of at least 1 mm were selected and their and sizes were noted. Size of abfraction was noted using Smith &Knight Tooth Wear Index. 0=tooth contour unchanged, 1=minimum loss of enamel contour, 2= defect less than 2mm in depth, 3= defect between 1-2mm deep, 4=>2mm deep or pulp exposure/secondary dentine. Premature contacts in eccentric guidance were recorded. Number of premature contacts from 0; no contact to 3 i.e., maximum contacts were checked. Number of abfractions from 1 to 6 per dentition were checked. **Results:** Out of 200 abfraction lesions maximum teeth were having no premature contacts 61.5% followed by 19.5% with 1 premature contact. Maximum number of 4 abfractions per dentition was frequently found 50.0% followed by 3 abfractions 19.0%, only 3.0% teeth had 6 abfraction lesions. The association of development of number of abfraction lesions with premature contacts and age was significant; P <0.05. The type of occlusal scheme (the canine guidance and group function) and gender had insignificant association with the number of developed abfraction lesions; p<0.05. **Conclusion:** Premature occlusal contacts and increase of age plays a significant role in the development of abfraction lesions, whereas the type of occlusal scheme and gender, do not appear to have substantial affect.

INTRODUCTION

Non carious lesions also termed as abfractions is a type of dental tissues damage that is independent of bacterial attack.[1] The occurrence of such lesions is often encountered in routine dental practice and they require dental intervention. This dental non cariogenic cervical lesion affects the world's population globally. [1,2] The common site of development is the cervical region of a tooth near cementoenamel junction. The lesions are commonly found on buccal surfaces of incisors and premolars.[3] These lesions located at the tooth cement-enamel junction are characterized as concavities with sharp well-defined angles. They appear markedly on vestibular or buccal surfaces in a V shaped manner and with obtuse angles.[4] Theses pathologies have significantly high incidence in patients with occlusal irregularities and interferences where high masticatory load results in to stress concentration at the specific regions and result in loss of enamel. Occlusal trauma results in to microfractures of enamel hydroxyapatite crystals and results in to deformation and tooth enamel loss.[5]

Natural occlusal scheme is of two types, canine guided occlusion and group function occlusion. Canine guided occlusion has both upper and lower canines in contacts when patients move his mandible in right or left later direction and rest of all teeth are out of occlusion.[6] In group function occlusal scheme, the lateral movements are guided by canine and at least two posterior teeth premolars and molars. There is no contact on balancing side of the arch.[6,7] During eccentric movements of

mandible that is in lateral and protrusive or forward movements horizontally directed forces result in tension at cervical junction of the teeth that result in crystalline fracture of enamel prisms.[8] Vertical forces are well tolerated by teeth but horizontal forces as a result of premature contacts or occlusal interferences will result in development of such lesions.[9] Literature shows that lateral forces of occlusion have strong role in development of such lesions. The development of abfractions is directly related to the direction of laterally applied force and its size is proportional to the duration and strength of applied force.[10]

Flexion, deformation or fatigue interrupts the crystalline structure as the cervical enamel finally the destruction and dentine exposure.[11]

Non carious cervical lesions especially abfractions are of great concerns in dentistry due to their detrimental effects on tooth tissue and bad impact on overall oral health.[11,12] Abfraction results in to poor esthetics, increase plaque, and calculus retention, teeth sensitivity and resultant pulpal infection. These lesions can be located and diagnosed by taking detailed history, tactile and visual examinations.[12]

Occlusal imbalances and premature contacts are potential contributing factors. Premature contacts in eccentric movements, such as lateral and protrusive movements, can put additional stresses on teeth and surrounding tissues.[13] The current study was conducted to identify the role of premature contacts in abfractions and inform the development of targeted prevention and treatment strategies potentially reducing the progression of abfractions. Clarifying the relationship between premature contacts and abfractions can help dentists make informed decisions about occlusal therapy, including need for occlusal adjustments or splint therapy. The objective of the study was to investigate the association between premature contacts during eccentric movements, guidance type, and development of non-carious lesions (NCCLs), while also assessing the impact of demographic factors (age and gender) on lesion formation.

METHODOLOGY

A cross-sectional observational study, was carried out in the outpatient dept. of Prosthodontics of Lahore Medical & Dental College Lahore, from 3rd May 2025 till 3rd August 2025. A total of 100 patients of both gender attending to the clinic for prosthetic treatment were included. Minimum 2 lesions per dentition were selected so 100 participants providing a total sample of 200 teeth. Age ranged from 20-70 years. Non probability purposive sampling was used for sample selection. The sample size was taken from the study carried out on abfractions and attachment loss in teeth with premature contacts in centric relation.[14] Inclusion criteria was set and patients who had teeth with cervical non carious lesions were selected. All patients who had teeth with antagonist pairs, free from mobility and coronal restoration were included. Abfractions per dentition with the depth of at least 1 mm were selected. Exclusion criteria were set and all patients who has undergone occlusal equilibration, periodontal therapy, history of orthodontic treatment, abrasive and erosive lesion were excluded. Informed consent was taken. The ethical clearance of the study was obtained from the Dental College Ethical Review Board.

All selected patients were comfortably seated in the dental chair. History was taken and demographic data likes age and gender was noted. All patients were clinically checked for the presence of non-carious lesions. Occlusal examination was carried out using examination set (mouth mirror and dental probe). Abfractions or non-carious lesions were detected; the shape (sharp wedge-shaped or V shaped lesions) and type of teeth with abfractions were noted. Bimanual technique was used for guiding mandible. Dynamic occlusal analysis was conducted by gliding the mandibular movement in both protrusive and right, left lateral directions starting from maximum intercuspation position. Guidance of occlusal scheme was recorded (canine guidance; if lateral movements were guided by canines and dis occludes posterior teeth, Group function; if lateral movements were guided by canine and premolars.) Premature contacts in lateral and protrusive guidance were recorded. Double sided colored articulating paper blue and red was used for detecting premature contact and interference in teeth with abfraction during mandibular eccentric movements. Number of premature contacts from 0; no contact to 3 i.e., maximum contacts were checked. Number of abfractions from 1 to 6 per dentition were checked. Size of abfraction or non-carious lesions was noted using Smith &Knight Tooth Wear Index. 0=tooth contour unchanged, 1=minimum loss of enamel contour, 2= defect less than 2mm in depth, 3= defect between 1-2mm deep, 4=>2mm deep or pulp exposure/secondary dentine. [15]

Data was entered and analyzed using SPSS version 26. Descriptive analysis was done. Frequency distribution of gender, number of abfraction lesions, number of premature contacts, and type of occlusal scheme was found. Mean and SD for age was obtained. Chi Square was used to find out the association of number of abfraction lesions with age, gender, occlusal premature contacts and type of occlusal guidance (lateral or protrusive). P values significance was $p<0.05$.

RESULTS

Out of total 100 patients 54(54.0%) were males and 46(46.0%) patients were females. The age ranged from 20 to 70 years with mean age 51.06± SD 12.50. The occlusal scheme i.e., canine guided occlusion was found 44(44.0%) whereas group function occlusion was present in 56(56.0%). Out of 200 abfraction lesions the size of the lesions according to size index was 1=85(42.5%), 2=92(46.0%), 3=23(11.5%). Frequency distribution of number of abfractions and premature occlusal contacts was shown in Table 1. Maximum teeth were having no premature contacts 123(61.5%) followed by 39(19.5%) with 1 premature contact. Maximum number of 4 abfractions per dentition was frequently found 50(50.0%) followed by 3 abfractions 38(19.0%) only 6(3.0%) teeth had 6 abfraction lesions. Table 1.

The association of development of number of abfraction lesions with premature contacts was significant; P 0.00. With 3 premature contacts the number of 5 abfraction lesions were maximum found 61(61.0%) followed by 3 lesions; 23(60.0%). With 2 premature contact per

dentition maximum 4 lesions were found 22(22.0%) followed by 3 lesions 11(28.9%). With one premature contact per dentition 4 lesions were found 16(16.0) whereas with no premature contact in occlusion only 1(1.0) and 2(6.3%) 4 and 5 lesions found. Table 2.

The age groups had significant association with the number of developed abfraction lesions p 0.01. Maximum of 4 lesions were found 14(35.9%) in younger age group i.e., <50 years, whereas 36(59.0%) were found in older age group i.e., >50 years. Table 2.

The type of occlusal scheme (the canine guidance and group function) had insignificant association with the number of developing abfraction lesions; p= 0.18. Maximum number of 4 abfraction lesions were found in canine guided occlusion 16(32.0%) followed by 3 and 5 lesions i.e., 10(52.6%) and 10(62.5%). In group function occlusion maximum number of 4 abfractions were found 34(68.0%) followed by 3 lesions 9(47.4%). Table 2.

The association of number of developed abfractions with respect to gender showed insignificant results p 0.47. Maximum of 4 lesions were developed in both genders i.e., 25(50.0%) however 6 lesions were found in male 3(100%) as compared to female. Table 2.

Table 1

Frequency Distribution of Number of Abfraction Lesion and the Number of Premature Contacts. N=200

Variables						
Number of abfractions	**1 n(%)**	**2 n(%)**	**3 n(%)**	**4 n(%)**	**5 n(%)**	**6 n%**
	2 (1.0%)	22 (11.0%)	38 (19.0%)	100 (50.0%)	32 (16.0%)	6 (3.0%)
Number of premature contacts	**0 n(%)**	**1 n(%)**	**2 n(%)**	**3 n(%)**		
	123 (61.5%)	39 (19.5%)	35 (17.5%)	3 (1.5%)		

Table 2

Association of Number of Abfraction Lesions with Premature Contacts, Age Groups, Type of Occlusal Scheme and Gender; N=200

Variable	Number of Abfraction lesions						
	1	**2**	**3**	**4**	**5**	**6**	
Number of Premature contacts							**P value**
3	2 (100.0)	19 (86.4)	23 (60.0)	61 (61.0)	17 (53.1)	1 (16.7)	0.00
2	0 (0.00)	3 (13.6)	11 (28.9)	22 (22.0)	3 (9.4)	0 (0.0)	
1	0 (0.00)	0 (0.0)	4 (10.4)	16 (16.0)	10 (31.3))	5 (83.3)	
0	0 (0.00)	0 (0.0)	0 (0.0)	1 (1.0)	2 (6.3)	0 (0.0)	
Age groups							
<50 years	1 (2.6)	9 (23.1)	9 (23.1)	14 (35.9)	4 (10.3)	2 (5.1)	0.01
>50years	0 (0.00)	2 (3.3)	10 (16.4)	36 (59.0)	12 (19.7)	1 (1.6)	
Types of occlusal scheme							
Canine guided	1 (100.0)	5 (45.5)	10 (52.6)	16 (32.0)	10 (62.5)	2 (66.7)	0.18
Group function	0 (0.00)	6 (54.5)	9 (47.4)	34 (68.0)	6 (37.5)	1 (33.3)	
Gender							
Male	1 (100.0)	5 (45.5)	10 (52.6)	25 (50.0)	10 (62.5)	3 (100.0)	0.47
Female	0 (0.00)	6 (54.5)	9 (47.4)	25 (50.0)	6 (37.5)	0 (0.00)	

Significance level p <0.05.

DISCUSSION

Non carious lesions(abfractions) are frequently found in dental routine examination worldwide. present study was aimed to evaluate the association of premature contacts during eccentric movements and development of non-carious lesions (NCCLs). In the current study significant association of development of abfractions with presence of premature contacts was seen. Maximum of 4 abfractions per dentition was found ;50.0% followed by 3 abfractions 19.0%. In accordance with the results of current study another study reported number of lesions per subject to be 5. Reyes1 and coworkers studied the development of abfraction due to presence of premature contact and clinically observe the presence and extent of the development lesion. These non-carious lesions develop due to flexure at the cervical end of the tooth being over loaded by harmful occlusal forces. Presence of occlusal irregularities and premature occlusal contacts can result in the development of abfractions.

The association of premature contacts with the development of abfraction was significantly observed in the current study. However, contrasting results i.e., no association of premature contacts with the development of abfraction lesions was found in a study carried out by Reyes16 and coworkers. They stated that the premature contacts were frequently seen in premolars 45.6% out of which 29.6% were in first premolar followed by canine 16.8% but the developing lesions had no association with them. They further reported that the attachment loss was also evident in patients with abfractions but difference of loss was also insignificant in patients who had abfractions and who did not. In accordance with the results of current study Zavala17 reported occlusal forces to be the main cause of cervical abfractions lesions. Out of total 145 injuries they reported 23% premature contacts 29% occlusal interferences and 48 % patients with parafunctional habits. Similarly, few other studies have reported that the time and intensity of the applied force is directly related to the extent of hard tissue damage.18- 20 Bartlelt21 and coworkers found development of lesions due to occlusal stresses at a prevalence rate of 18%. Similar finding was stated by Popescu22 and coworkers and reported that the cervical region whenever undergoes stress concentration the development of abfractions occur. In the present study no significant gender association was seen with the lesions and the size of the abfraction lesions reported according to the tooth wear index was 1= 42.5%, 2=46.0% and 3=11.5%. Badavannavar23 and coworkers 5 reported anterior teeth and premolar teeth to be commonly involved teeth because of small size and observed maximum lesions to be developed on vestibular teeth surface due to direction of force applied because of angle of occlusal and incisal table. Zavala17 suggested that with early diagnosis and prevention we can prevent the enlargement of abfraction. Likewise, Reves and coworkers found majority of the lesions on the vestibular premolars. They commented that the cuspid inclination directs the occlusal force that will acts as tensile force on the cervical third of the buccal surface of teeth. Oudkerk24 and coworkers further concluded that laterally directed forces

produce maximum amount of stress than axial loading.

Age could have an effect on the development of non-carious lesions. In this study we observed that the number of abfraction lesions increases with the increasing age. 35.9% abfraction was found in younger population i.e., less than 50 years and 59.0% abfractions were reported in older individuals of more than 50 years age. The association of development of lesion with age was found to be significant. Similarly, Reves16 and coworkers reported older patients with increased number of abfractions but in contrast found insignificant association of development of abfractions with the age; p 0.15. In their respective study they found more premature contact in centric relation in younger patients, but reported it to be an insignificant trend. They observed less bony support in teeth trauma from occlusion. Another study concluded that the older people due to loss of teeth, attrition or tooth movement due to periodontal disease may have eliminated premature contacts.25 Saikarian26 and coworkers analyzed the prevalence of development of abfractions in students and found occlusal pathology i.e., premature contact and increase of age as factors directly related to the progression of the disease.

The occlusal; scheme of dentate individuals can be canine guided or it can be a group function occlusion. The type of occlusal scheme can result in development of non-carious lesion if impact of occlusal force is more than normal.18 In the current study, the type of occlusal scheme was assessed in relation with the development of lesion and the results showed lesion developed 32.0% in canine guided occlusion whereas 52.6% in group function occlusion however there existed an insignificant association. Similarly, Ispas27 and coworkers checked the non-carious lesion on a sample of 100 teeth and stated that the lesions developed in group function occlusion were more i.e., 50% abfractions as compare to the lesion found in canine guidance occlusal scheme 31.0%; due to loss of hard tooth structure. They further reported tooth structure damage along with periodontal attachment loss and recommend the importance of occlusal adjustments to prevent the tooth damage. Abfractions develop due to heavy occlusal load impact and must be diagnosed and premature contacts and occlusal irregularity must be treated to prevent tooth tissue damage, alleviate sensitivity and restore aesthetics. The limitation of the study was its cross-sectional study design. Collecting information from a single point in time does not allow evaluation of disease programmed.

CONCLUSION

Premature occlusal contacts and increase of age plays a significant role in the development of abfraction lesions, whereas the type of occlusal scheme and gender, do not appear to have substantial affect.

REFERENCES

1. Nascimento MM, Dilbone DA, Pereira PN, Duarte WR, Geraldeli S, Delgado AJ. Abfraction lesions: etiology, diagnosis, and treatment options. Clin Cosmet Investig Dent. 2016; 8:79-87. https://doi.org/10.2147/CCIDE.S63465.
2. Medeiros TLM, Mutran SCAN, Espinosa DG, Do Carmo Freitas Faial K, Pinheiro HHC, D'Almeida Couto RS. Prevalence and risk indicators of non-carious cervical lesions in male footballers. BMC Oral Health. 2020 ;20(1):215. https://doi.org/10.1186/s12903-020-01200-9
3. Worawongvasu R. Scanning electron microscope characterization of non-carious cervical lesions in human teeth. J Oral Maxillofac Pathol. 2021;25(1):202. https://doi.org/10.4103/jomfp.jomfp_232_20
4. Warreth A, Abuhijleh E, Almaghribi MA, Mahwal G, Ashawish A. Tooth surface loss: A review of literature. Saudi Dent J. 2020;32(2):53-60. https://doi.org/10.1016/j.sdentj.2019.09.004
5. Teixeira DNR, Thomas RZ, Soares PV, Cune MS, Gresnigt MMM, Slot DE. Prevalence of noncarious cervical lesions among adults: A systematic review. J Dent. 2020; 95:103285. https://doi.org/10.1016/j.jdent.2020.103285
6. Philip N, Suneja B. The revolutionary evolution in carious lesion management. Journal of Conservative Dentistry and Endodontics. 2023;26(3):249-57. https://doi.org/10.4103/jcd.jcd_54_23
7. Goodacre CJ, Eugene Roberts W, Munoz CA. No carious cervical lesions: Morphology and progression, prevalence, etiology, pathophysiology, and clinical guidelines for restoration. Journal of prosthodontics. 2023;32(2): e1-8. https://doi.org/10.1111/jopr.13585
8. Mazur M, Jedlinski M, Ndokaj A, Cipollone A, Nardi GM, Ottolenghi L, Guerra F. Challenges in diagnosing and managing non-cavitated occlusal caries lesions. A Literature overview and a report of a case. La Clinica Terapeutica. 2021;172(1):80-6. https://doi.org/10.5114/jos.2018.85565
9. AlShaya MS, Sabbagh HJ, El-Housseiny AA. Diagnosis and Management Approaches for Non-cavitated Carious Dental Lesions-A Narrative Review. The open dentistry journal. 2021;15(1). https://doi.org/10.2174/1874210602115010337
10. Schwendicke F, Walsh T, Lamont T, Al-Yaseen W, Bjørndal L, Clarkson JE, Fontana M, Rossi JG, Göstemeyer G, Levey C, Müller A. Interventions for treating cavitated or dentine carious lesions. Cochrane Database of Systematic Reviews. 2021(7):204-210. https://doi.org/10.1002/14651858.cd013039.pub2
11. Hayashi M, Kubo S, Pereira PN, Ikeda M, Takagaki T, Nikaido T, Tagami J. Progression of non-carious cervical lesions: 3D morphological analysis. Clinical Oral Investigations. 2022;26(1):575-83. https://doi.org/10.1007/s00784-021-04036-x
12. Gonçalves DF, Shinohara MS, Carvalho PR, Ramos FD, Oliveira LD, Omoto ÉM, Fagundes TC. Three-year evaluation of different adhesion strategies in non-carious cervical lesion restorations: a randomized clinical trial. Journal of Applied Oral Science. 2021;29: e20210192. https://doi.org/10.1590/1678-7757-2021-0192
13. Tróia PM, Spuldaro TR, da Fonseca PA, de Oliveira Fernandes GV. Presence of gingival recession or noncarious cervical lesions on teeth under occlusal trauma: a systematic review. European Journal of General Dentistry. 2021;10(01):050-9. https://doi.org/10.1055/s-0041-1732781
14. Rusu Olaru A, Popescu MR, Dragomir LP, Rauten AM. Clinical Study on Abfraction Lesions in Occlusal Dysfunction. Curr Health Sci J. 2019;45(4):390-397. https://doi.org/10.12865/CHSJ.45.04.07.

15. Karan K, Yao X, Xu C, Wang Y. Chemical profile of the dentin substrate in non-carious cervical lesions. Dent Mater. 2009;25(10):1205-12. https://doi.org/10.1016/j.dental.2009.04.006.
16. Reyes E, Hildebolt C, Langenwalter E, Miley D. Abfractions and attachment loss in teeth with premature contacts in centric relation: clinical observations. J Periodontal. 2009 ;80(12):1955-62. https://doi.org/10.1902/jop.2009.090149.
17. Zavala MCE, Mendiburu CJ, Lugo-Ancona P. Relationship between traumatic occlusion and abfractions; their role in pulp disease. Revista odontológica Mexicana. 2017;21(2):81-6. https://doi.org/10.1016/j.rodmex.2017.05.011
18. Lee, S.K.Y.; Salinas, T.J.; Wiens, J.P. The Effect of Patient Specific Factors on Occlusal Forces Generated: Best Evidence Consensus Statement. J. Prosthodont. 2021, 30, 52–60. https://doi.org/10.1111/jopr.13334
19. Levartovsky, S.; Peleg, G.; Matalon, S.; Tsesis, I.; Rosen, E. Maximal Bite Force Measured via Digital Bite Force Transducer in Subjects with or without Dental Implants—A Pilot Study. Appl. Sci. 2022, 12, 1544. https://doi.org/10.3390/app12031544
20. Su JN, Pan YH, Dorj O, Lin JCY, Salamanca E, Chen IW, Wu YF, Chang WJ. Association between oral health status and occlusal bite force in young adults. J. Dent. Sci. 2024, 19, 1182–1189. https://doi.org/10.1016/j.jds.2023.11.005
21. Bartlett DW, Shah P. A critical review of non-carious cervical (wear) lesions and the role of abfraction, erosion, andabrasion. JDentRes.2006;85(4): 30612. https://doi.org/10.1177/154405910608500405.
22. Popescu AM, Ionescu M, Popescu SM, Ionescu AG, Vlăduțu DE, Iacov-Crăițoiu MM, Ştefârţă A, Lascu LC, Mercuț V. Oral Clinical and Radiological Signs of Excessive Occlusal Forces in Bruxism. Diagnostics. 2025 Mar 12;15(6):702. https://doi.org/10.3390/diagnostics15060702
23. Badavannavar AN, Ajari S, Nayak KUS, Khijmatgar S. Abfraction: Etiopathogenesis, clinical aspect, and diagnostic-treatment modalities: A review. Indian J Dent Res. 2020;31(2):305-311. https://doi.org/10.4103/ijdr.IJDR_863_18.
24. Oudkerk, J.; Grenade, C.; Davarpanah, A.; Vanheusden, A.; Vandenput, S.; Mainjot, A.K. Risk factors of tooth wear in permanent dentition: A scoping review. J Oral Rehabil. 2023, 50, 1110–1165. https://doi.org/10.1111/joor.13489
25. Vlăduțu, D, Popescu SM, Mercuț R, Ionescu M, Scrieciu M, Glodeanu AD, Stănuşi A, Rîcă AM, Mercuț V. Associations between Bruxism, Stress, and Manifestations of Temporomandibular Disorder in Young Students. Int. J. Environ. Res. Public Health 2022, 19, 5415. https://doi.org/10.3390/ijerph19095415
26. Saikiran KV, Gurunathan D, Nuvvula S, Jadadoddi RK, Kumar RH, Birapu UC. Prevalence of Dental Trauma and Their Relationship to Risk Factors among 8-15-Year-Old School Children. Int J Dent. 2022; 22:3343827. https://doi.org/10.1155/2022/3343827.
27. Ispas A, Iosif L, Ţâncu AMC, Manziuc M, Gheorghe GF, Bodnarthe DC. Effect of the occlusal discrepancies from the eccentric movements of the mandible on the periodontal and hard tooth structure. Romanian J Oral Rehabili 2025;17(1):624-636. https://doi.org/10.62610/rjor.2025.1.17.61