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Tobacco Usage in Relation to the Anatomical Site of Oral Leukoplakia in Imphal, Manipur - An Observational Study

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Abstract

Objective: Tobacco usage is the most important known aetiological factor in the development of oral leukoplakia. The purpose of this study was to investigate the possible relation of tobacco usage to the anatomical site of the leukoplakia.

Subjects and Methods: Clinical data regarding tobacco usage and localisation of leukoplakia obtained from 166 patients with oral leukoplakia.

Results: Leukoplakia in the floor of mouth appeared to be statistically significantly more often present in smokers than in non-smokers, compared to all other oral sites ($P < 0.001$; OR= 8.47 and 18.13 for men and women, respectively). On the contrary, leukoplakias on the borders of the tongue were statistically significantly more common among non-smokers, than smokers, compared to all other oral sites ($P < 0.001$; OR= 0.22 and 0.12 for men and women, respectively).

Conclusion: The present study suggests that the influence of tobacco on the development of Leukoplakia varies by anatomical site.

Keywords: Oral Leukoplakia; Tobacco

INTRODUCTION

Tobacco usage is the most important known aetiological factor in the development of oral leukoplakia. Patients who smoke have a six-fold increased risk of developing leukoplakia of the oral mucosa than non-smokers.[1] Leukoplakia in non-smokers is often referred to as 'idiopathic leukoplakia'. The site of the leukoplakia depends, among other things, on the type of the smoking habit, the quality, and the quantity of the tobacco.[2] The purpose of the present study is to evaluate possible differences between smokers and non-smokers with regard to the anatomical site of their leukoplakia

PATIENTS & METHODS

Data were obtained from 166 patients with oral leukoplakia, who were referred to the Department of Oral Pathology, JNIMS Imphal. Leukoplakia has been defined as a predominantly white lesion of the oral mucosa that cannot be characterized as any other definable lesion.[3]

Since there were only five patients with leukoplakia of the lips, these patients were excluded. The remaining group of 161 patients consisted of 73 men and 88 women. The mean age was 57 years (range 23–91 years).

Data about the usage of tobacco were obtained from the patients records at the time of diagnosis of the leukoplakia. Fifteen patients were excluded from further evaluation, because of insufficient available data about their smoking habits. In the remaining group of 146 patients, a distinction was made only between smokers (almost exclusively cigarettes) and non-smokers.

The localisation of the leukoplakias was specified according to the anatomical distribution recommended by the ICD-DA (WHO, 1995).[4] For analysis of a possible relation of tobacco usage and the localisation of leukoplakia four oral subsites and a category of 'multiple sites' were studied, separately for men and women. The relation was expressed as an odds ratio (OR) with 95% confidence interval. Statistical significance was assessed using the Chi- square test, with P-values less than 0.05 considered significant.

RESULTS

Table 1 shows the distribution of smokers and non-smokers according to gender for the study population of 146 patients, together with the mean ages. Remarkable is the difference in mean age between female smokers and non- smokers.

Table 1: Mean ages (years) and number (n) of men and women with oral leukoplakia in smokers and non-smokers

	Smoker Mean age (n)	*Non-smoker Mean age (n)*	*Mean age (n)*
Men	57.4 (44)	56.6 (24)	57.1 (68)
Women	48.8 (47)	65.6 (31)	55.7 (78)
Overall	53.1 (91)	61.7 (55)	56.4 (146)

Table 2: Distribution of oral (sub)site of the leukoplakia according to smokers (S) and non-smokers (NS), subdivided according to gender

LOCALISATION	MEN		WOMEN		TOTAL
	S	NS	S	NS	
Cheekmucosa (includingCommissures)	11	1	6	5	23
Gingiva upper/lower, palate	6	6	4	3	19
Borderstongue	10	14	7	19	50
Floorofmouth	12	1	17	1	31
Multiplesites	5	12	13	3	23
TOTAL	**44**	**24**	**47**	**31**	**146**

The distribution of smokers and non-smokers according to oral (sub)site of the leukoplakia is shown in Table 2. Leukoplakias of the cheek mucosa, including the com- missures, were found more often in men who smoke, than in men who did not. Among women, this difference was not noted. Leukoplakias in the floor of the mouth appeared to be statistically significantly more often present in smok- ers than in non-smokers, compared to all other oral subsites (both men and women, $P < 0.001$). Leukoplakias on the borders of the tongue were statistically significantly more common among non-smokers than smokers, compared to all other oral subsites (both men and

women, $P < 0.001$). The odds ratios (ORs) for the oral subsites related to the use of tobacco according to gender are shown in Table 3; the total number of all other oral subsites were used as the reference group for each individual subsite.

Table 3: Odds ratios (ORs) for the use of tobacco of oral leukoplakia of the various oral subsites related to all other localisations according to gender.

ORAL SUBSITE	MEN		WOMEN	
	OR	*95%CI*	*OR*	*95%CI*
Cheekmucosa (includingCommissures)	7.54	1.41–39.93	0.82	0.25–2.67
Gingiva Upper/ Lower, Palate	0.48	0.14–1.62	0.93	0.16–5.50
Borderstongue	0.22	0.08–0.62	0.12	0.04–0.34
Floorofmouth	8.47	1.41–50.97	18.13	3.58–91.95
Multiplesites	1.40	0.28–6.99	3.82	0.23–60.25

The highest ORs for men were seen in the floor of mouth and in the cheek mucosa, being 8.47 and 7.54 respectively. The highest OR for women was seen for the floor of mouth (OR=18.13). The lowest OR for men and women was seen for leukoplakias on the borders of the tongue (0.22 and 0.12, respectively).

DISCUSSION

The results of the present study suggest that the influence of tobacco on the development of oral leukoplakia varies by anatomical subsite. This finding is in accordance with that of a study about the role of tobacco related to the anatomical subsite for the development of oral squamous cell carcinoma.[5] Our study shows that in smokers the floor of mouth is the site of predilection for oral leukoplakia, whereas the borders of the tongue are affected statistically significantly more often in non-smokers. The OR of 8.47 in men for a leukoplakia located in the floor of mouth means that leukoplakia in the floor of mouth is approximately 8.5 times more likely to occur in a smoker than in a non-smoker. The accompanying confidence interval (CI) (1.41–50.97) is with 1.41, on the mini- mum side, rather low. However, the OR of 18.13 in women for a leukoplakia located in the floor of mouth shows a rather high CI (minimum of 3.82), which means that leukoplakia in the floor of mouth in women is at least approximately four times more likely to occur in women who smoke than women who do not smoke. There is no explanation for the gender differences with respect to the differences in the site of predilection for leukoplakia in the cheek mucosa in men who smoke, and leukoplakia located in the floor of mouth in women who smoke. Highly speculative would be that men and women would exhibit a different way of placing the cigarette between their lips; men keep their cigarette perhaps more to the side of their lips, while women might keep the cigarette more centred.

The apparently strong local effect of smoking on the development of leukoplakia in the floor of mouth in smokers may be explained by the fact that saliva in this oral subsite acts as a reservoir for carcinogens in tobacco pro- ducts.[6] Furthermore, the degree of keratinisation and the permeability of the oral mucosa may play a role in the local effect of tobacco products.[7,8]Different tobacco habits may play a role in the distribution of leukoplakia in the various oral subsites as well. In The Netherlands, smoking cigarettes is the most common form of tobacco usage (NIPO, 1991). In the present study 64% of the men were smokers, and 60.3% of the women were smokers, whereas the proportion of the adult population in The Netherlands, smoking tobacco is 36.7% and 30.3% for men and women, respectively.[9]Including the proportion of ex-smokers, these percentages for the adult population for men and women would be 56.0% and 45.5%, respectively;[9] still significantly less than the patients with oral leukoplakia in this study, which

supports the causative relation between smoking and the development of oral leukoplakia.

Various reports have suggested a synergistic effect of tobacco and alcohol usage in oral carcinogenesis.[10,11] Alcohol usage alone probably does not play a major role in the aetiology of oral leucoplakia but may have a similar synergistic effect on the development of leukoplakia as has been reported in oral squamous cell carcinoma.[12] The limited information about alcohol consumption in our group of patients did not allow statistical analysis in this respect.

Various reports showed an inreased risk of malignant transformation of leukoplakia in women without smoking habits.[13] This was also the case in the present material, reported elsewhere.[14] The association of an increased risk of malignant transformation of oral leukoplakia in women who do not smoke remains unclear.

CONCLUSION

Tobacco usage in men results significantly more often in leukoplakia of the cheek mucosa, including the commissures, than in men who do not smoke. This difference is not noted among women. Furthermore, leukoplakia of the floor of mouth almost exclusively occurs in smokers, either men or women. Interestingly, leukoplakia of the borders of the tongue is relatively more common in women who do not smoke. The various limitations of the present retrospective study do not allow further speculation about the significance of the above-mentioned observations.

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Original Research

Periodontal Status of Teeth in Contact with Denture in Removable Partial Denture Wearers in Hazaribag City, Jharkhand

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Abstract The aims of the study were to determine the periodontal status of the teeth in contact with removable partial dentures (RPDs) and to compare them with other teeth in the opposing arch not related to any prothesis. The periodontal status was also assessed in relation to the age of the dentures. Four hundred and twenty-seven patients treated with RPDs from 2019-2021were recalled for examination. Prior to prosthetic treatment they were given periodontal treatment and fillings when required. Initially all were given oral hygiene instructions and motivation. They were reviewed regularly only on a short-term basis. Eighteen patients were suitable for the present study comprising of eight males and 10 females whose mean age was 41 years. The RPDs were in use from l-ñ to 8 years (mean 4-6 years). The following parameters were assessed: Plaque index (PII), Gingival index (GI), loss of attachment (LA) and tooth mobility. The wearing of RPDS resulted in higher PlI, GI and LA compared to the controls and these differences were statistically significant. There was an increased frequency of higher Pll, GI and LA with the increase in denture age. Minor changes in tooth mobility were observed. It was concluded that the wearing of RPDs was detrimental to periodontal health in patients whose oral hygiene was less than adequate.

INTRODUCTION

Various studies have been carried out to determine the effect of RPDs on the oral structures particularly the periodontium and the remaining teeth. The results of these studies are not unanimous. Earlier studies reported an increased occurrence of caries and periodontal disease which were extensive.[1,2,3] Others found moderate

periodontal injuries[4,5,6] or practically no progression of caries and periodontal disease after insertion of RPDs.[7] RPDs promote plaque formation on abutment teeth and teeth in contact with them.[8,9] Plaque is the main aetiological agent in the initiation and progression of chronic inflammatory periodontal disease[10] (Loe, 1983). Some cross-sectional studies found that RPD wearers had significantly more periodontal pockets and a larger number of deeper pockets compared to the control subjects.[11,12] On the other hand it was shown that maintenance of good oral hygiene by the patients together with periodic professional examinations and maintenance therapy resulted in little damage[13] or no damage to the periodontal structures.[14] The purpose of the study was to determine the periodontal status of teeth in contact with RPDs and to compare them with other teeth not related to any prosthesis in the same patient group. The periodontal status of the former was also assessed according to the age of the denture (length of time of denture usage).

MATERIAL AND METHODS

The material for this study comprised patients who received prosthetic treatment for RPDs at the Department of Prosthodontics, crown & bridge, Hazaribag College of Dental Sciences & Hospital, Hazaribag.

The treatment was carried out by undergraduate dental students under the supervision of experienced clinical instructors. Each step in the treatment procedure was checked by the instructors. Prior to prosthetic treatment, all the other necessary dental treatments such as periodontal and restorative (conservative) treatments were carried out. These patients were not put on a long-term recall programme but were advised to see their regular dentists instead. On a short-term basis, the patients were reviewed by the students concerned until the latter graduated. All patients who had RPDs made in the stated time period, a total of 427, were recalled for the examination. Of the patients who responded, only those who were wearing RPDs in one arch were included in this study. The remaining natural teeth in the opposing arch acted as controls. In the arch with prosthesis, only the teeth in direct contact with the prosthesis were utilized for the study. Those not in direct contact with any part of the denture were excluded.

The following parameters were assessed by one examiner sequentially; plaque index (PII),[15] gingival index (GI),[10] probing pocket depth, gingival recession and tooth mobility.[14] The readings for PII, GI, probing pocket depth and gingival recession were taken only on the palatal or lingual of each test and control tooth. Three readings were taken for each tooth, i.e. mesio-lingual, mid-lingual and disto-lingual (or palatal for the maxillary tooth), and the mean was taken as the score for this tooth. The probing pocket depth was measured to the nearest millimetre with a periodontal probe (William's No. 14) from the gingival margin to the base of the pocket and placed parallel to the long axis of the tooth. This procedure was repeated for measurement of gingival recession, except that the measurements were taken from the gingival margin to the cemento-enamel junction. The mean values obtained for pocket depth and gingival recession of a corresponding tooth were summed to obtain the mean value for loss of periodontal attachment (LA) of that tooth. Chi-square test was utilized for the statistical analysis of the collected data. This was done on a computer using a statistical program (Amstat, S.C. Coleman, 1988, Leicestershire, U.K). The level of significance was taken to be P<0-05.

RESULTS

Of a total of 427 call cards sent by mail, only 83 patients responded and returned for examination. This comprised 19 4% of the original group which received removable partial dentures. From this group of 83 patients who responded, only 18 were found to be suitable for this study, i.e. those having a removable partial denture in one arch with an opposing natural dentition in the other arch. This group comprised of eight males and 10 females between the ages of 21 and 65 years. The mean age was 41 years. At the time they were recalled for examination, the age of dentures ranged from 1-5 to 8 years with a mean of 4-6 years. All the RPDs were constructed to replace missing teeth in the maxilla using acrylic resin.

To determine the effect of dentures age on the periodontium, the patients were divided into three groups; <3 years, 3-6 years and >6 years denture usage. There were six patients in each group respectively.

Table 1 shows the frequency distribution of PII groupings according to the teeth in contact with denture, control teeth and abutment teeth. The PU score of 0-1 had the highest frequency distribution for all the three groups of teeth i.e. 65%, 58% and 49% for the control teeth, abutment teeth and teeth in contact with denture respectively. There was a general trend of a decrease in the frequency distribution for all the three groups of teeth with increasing PII score. Statistically significant difference in the PII score was found only between the teeth in contact with denture and the control teeth groups (F<0-05). The frequency distribution of the GI groupings according to the three groups of teeth is shown in Table 2. There was a similar trend in the frequency distribution between the teeth in contact with denture and the abutment teeth. For both these groups, the GI score of M- 2 had the highest frequency of occurrence (50% and 49% respectively). For the control teeth, the GI score of 0-1 had the highest frequency of occurrence (48%). Comparison between groups showed statistically significant differences in GI scores between teeth in contact with denture and control teeth (P< 0-001) and between control teeth and abutment teeth (P<0.05).

Table 3 shows the frequency distribution of the GI groupings according to the dentures' age. No specific trend in common for the three groups was observed. For the dentures' age groups of <3 years and 3-6 years, the highest frequency distribution was for GI score of 1-1-2 which were 64% and 52% respectively. For the dentures' age group of >6 years, the highest frequency (45%) was for GI score 2-1-3. There were no statistically significant differences in the GI frequency distributions between the dentures' age groups except for the between 6 years (P6 years. None of the teeth had a mobility score of 3.

DISCUSSION

Only about 20% of the patients issued with RPDs returned for the examination. It was noted that prosthetic patients did not easily return for recall examinations. Schwalm et al. (1977)[4] in trying to recall 161 patients issued with RPDs for re-examination had a less than 10% response. Thus it was suggested that renumeration should be given to them to participate in the study.[13] We experienced the same problem in the present study. Patients who did not respond to the first call cards mailed were either contacted by telephone (for those with contact telephone numbers in their files) or sent another call card. Some of those contacted through the telephone refused to come for re-examination since they had no complaints concerning their dentures or oral status even though they were informed that they would be given whatever treatment that was necessary, without having to pay any fee.

The results of the present study indicate that the wearing of RPDs had an influence on the status of the periodontal health. The frequencies of higher index values for PII, GI and LA were greater for the teeth in contact with denture than the controls and the differences were all statistically significant. The frequency distributions for PII, GI and LA values were comparable for both the teeth in contact with denture and the abutment teeth and statistically there were no significant differences between the two. As for the tooth mobility, very few teeth were mobile for all the three groups and it was in the abutment tooth group that mobility grade 3 observed. The increased retention of plaque by RPDs observed in this study is in agreement with several previously reported studies.[8,16,9] Mobility changes in the present study were minimal even though some of the RPDs had been in the mouth for quite some time. In a study in elderly patients, it was observed that the tooth mobility increased in RPD wearers.[11] This was also observed in other studies[3] while some reported no increase in mobility.[4,14] The wearing of RPDs caused more gingival inflammation and loss of periodontal attachment when compared to the controls. Cross-sectional studies involving a large number of patients found that the wearing of RPDs were associated with deep periodontal pockets compared to the teeth not associated with RPDs.[12] All these could be attributed to the harmful effects of plaque

on the periodontium. It could be argued that in the present study, the patients' oral hygiene was not optimal since they were not seen at regular intervals by the same examiners and no reinforcement of oral hygiene instruction was done as advocated by Bergman et al.[14] But in the present study, the same patients acted as their own controls and the harmful effects of plaque should be observed on the control teeth as well. The results of this study showed that the teeth in contact with dentures and abutment teeth were more affected than the controls. It can be inferred that the wearing of RPDs had an adverse effect on the periodontium in patients where optimal oral hygiene was not attainable. Complete supragingival plaque control is probably not an achievable goal for most patients.[17] The presence of some degree of plaque is still compatible with health in some individuals. The presence of RPDs not only increase plaque retention (quantity) but the oral environment might also be changed as to encourage plaque growth, i.e. change in flora.[18] This ecological change might cause the overgrowth of flora which is associated with the 'diseased' periodontium, i.e. the spirochetes and motile organisms. It should be emphasized here that not all patients could afford to attend regular dental examinations/check-ups or maintenance visits at a private dental practice. Most would not do so unless there was a specific complaint concerning their oral condition since they would have to pay for the treatment rendered. This is especially so in third world countries where the standard of living is low, there are no health insurance schemes and most cannot afford to pay for dental treatment. The services provided by the government dental clinics are limited. There are no dental hygienists to carry out dental prophylaxis which could lessen the workload of the dentist. It is not feasible to follow-up all the patients at regular intervals of 3—6 months for a long period of time as advocated by others in their longitudinal studies.[9] These longitudinal studies involved small and selected groups of patients who were aware of their research role and they did not pay for the treatment rendered. So it was possible for them to achieve good plaque control and thus it was not surprising to find little or no progression of caries and chronic inflammatory periodontal disease in these patients over the years. But on a large population basis and especially in the third world countries, this treatment regimen is not economically feasible though presently it is the only way to preserve periodontal health of RPD wearers. Chandler & Brudvik (1984)[6] in their clinical evaluation of patients 8—9 years after placement of RPDs fbund that there was increased gingival inflammation in regions covered by the RPDs compared with the regions which were not covered. They attributed this to the poor oral hygiene of their patients, who like the ones in the present study, were not put on a long-term recall program. It could be due to this fact that a greater degree of gingival inflammation and loss of attachment were observed in relation to the teeth in contact with denture and the abutment teeth compared to the controls. It was shown that coverage of marginal gingivae by the denture base had an adverse effect on periodontal health.[19] When the results were analysed according to the age of the denture, for the teeth in contact with the appliance, it was found that the frequency distribution of higher values of PII, GI and LA were significantly greater the longer the dentures were in the mouth. There were no significant differences between the dentures' age groups of <3 years and 3—6 years for all the above parameters. Very few teeth were mobile. Higher mobility score values were seen in the dentures' age group of >6 years and the five mobile teeth observed in this group were from one patient only (Table 4). No tooth mobility was observed in the dentures' age group of <3 years. Carlsson et al. (1965)[3] in their 4-year longitudinal study found an increased incidence of gingival inflammation, deepened gingival sulcus/pockets, mobile abutment teeth, alveolar bone loss and carious lesions compared to the baseline. Oral hygiene techniques were not stressed in their patient group. Lower incidence of caries and periodontal disease compared to Carlsson et al. (1965)[3] were observed by Derry & Bertram (1970)[20] in their 2-year longitudinal study where oral hygiene was emphasized to their patients. A series of longitudinal studies up to 10 years reported by Bergman et al.[13] found no

significant deterioration of the periodontal status of the remaining teeth. Their patients were seen at least yearly or more frequently if necessary and they were remotivated and reinstructed in oral hygiene technique. They were also given scaling, fillings and prosthetic treatment as required. Thus it is obvious that the oral hygiene was the main factor in determining the periodontal health of RPD wearers. Inadequate oral hygiene results in the cumulative increase in the level of periodontal disease over the years as seen in the present investigation.

The results of this study demonstrated that the wearing of RPDs was detrimental to the periodontal health in patients whose oral hygiene was less than adequate. It was also found that the periodontal health was affected by the dentures' age. Though the maintenance of low plaque levels compatible with periodontal health is not attainable with all patients either personally or professionally, it should be emphasized that at present, in order to maintain periodontal health in RPD wearers, they should be motivated, instructed in oral hygiene procedures repeatedly and followed-up regularly.

The patients issued with RPDs should be seen at least once a year if not more frequently. During these visits the required dental treatment should be carried out. This seems to be a burden to the dentists in the developing and underdeveloped countries but there is no other alternative at the moment. Further research in this area is needed to find ways in minimizing damage to the periodontium without being too professionally dependent. It was suggested that if patients' cooperation in terms of oral hygiene is questionable, the functional and aesthetic advantages gained by providing a partial denture must be weighed against the potentially adverse pathological changes which may be produced in the supporting tissues of the remaining teeth.[16]

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Table 1: The frequency distribution of PU groupings for teeth in contact with denture, control teeth and abutment teeth

TEETH						
Plaque Index	**Denture**		**Control**		**Abutment**	
	n	**%**	**n**	**%**	**n**	**%**
0-1	64	48.9	132	65.0	25	58.1
1.1-2	48	36.6	51	25.1	15	34.9
2.1-3	19	14.5	20	9.9	3	7
Total	**131**	**100**	**203**	**100**	**43**	**100**

* Teeth in contact with denture, n. Number of teeth. Numbers in parentheses represent percentage. Chi-square tests.

Table 2. The frequency distribution of GI groupings for teeth in contact with denture, control teeth and abutment teeth

TEETH						
Plaque Index	**Denture**		**Control**		**Abutment**	
	n	**%**	**n**	**%**	**n**	**%**
0-1	31	23.7	98	48.3	12	27.9
1.1-2	65	49.6	82	40.4	21	48.8
2.1-3	35	26.7	23	11.3	10	23.3
Total	**131**	**100**	**203**	**100**	**43**	**100**

Chi-square tests

Table3: The frequency distribution of GI groupings of teeth in contact with denture according to the age of dentures

AGE OF DENTURES (YEARS)						
Gingival Index	**<3**		**3-6**		**>6**	
	n	%	n	%	n	%
0-1	9	23.1	13	24.1	9	23.7
1.1-2	25	64.1	28	51.8	12	31.6
2.1-3	5	12.8	13	24.1	17	44.7
Total	**39**	**100**	**54**	**100**	**38**	**100**

Chi-square tests

Tobacco Habits and Risk of Lung, Oropharyngeal and Oral Cavity Cancer: A Population-Based Case - Control Study in Jharkhand, India

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Abstract

Background: Tobacco habits in India are unique and vary in different regions. Few studies, and none from North Eastern part India, have reported on type of tobacco used and risk of the most common cancer types in India. We conducted a population-based case- control study to evaluate the risk of tobacco particularly *bidi* smoking and tobacco *quid* chewing on the most common cancer sites among males in Jharkhand.

Methods: In all, 163 lung, 247 oropharyngeal and 148 oral cavity cancer cases from the Population-Based Cancer Registry records and 260 controls randomly selected from a tobacco survey conducted in the Jharkhand population formed the study population.

Results: A significant risk of *bidi* and cigarette smoking with a dose-response relationship was observed for lung and oropharyngeal cancer. Tobacco *quid* chewing showed no risk for lung, marginally increased risk for oropharyngeal and about a sixfold increased risk for oral cavity cancer. Population-attributable risk per cent (PARP) was observed to be 82.7% and 71.6% for smokers for the development of lung and oropharyngeal cancer, while the same was found to be 66.1% for tobacco chewers for the development of oral cavity cancer.

Conclusions: These data provide strong evidence that smoking *bidi* is even more hazardous than cigarette smoking in the development of lung and oropharyngeal cancer. An intervention study to prevent the use of tobacco will be useful in this population as it also coal mine workers.

Keywords: Bidi smoking, tobacco quid chewing, coal mines.

INTRODUCTION

Lung, oropharyngeal and oral cavity cancer are the most common cancer sites observed by Indian registries.[1] These cancer sites are causally related to the use of tobacco in different forms.[2] In India, the use of tobacco is common in the form of chewing and smoking of bidis and cigarettes.3Two studies are available from India on the role of bidi smoking in the development of lung cancer.[4,5] A few studies, mainly from West Maharashtra and South India, have reported the risk of oropharyngeal and oral cavity cancer and smoking and oral use of tobacco,[6,7,8] but no study has been reported from north eastern India.

In the present study three cancer sites (lung, oropharynx and oral cavity) were investigated using a common protocol and data from the Jharkhand Cancer Registry. The risk of tobacco use, particularly bidi smoking and chewing, was estimated for these three sites. A study on tobacco use in this population is particularly important as it suffered exposure to coal and thus is different from other parts of the world.

MATERIALS AND METHODS

The present study examines data for the three most common cancer sites in males (lung, oropharynx and oral cavity), collected by the Jharkhand Population-Based Cancer Registry during the years 2014-2021.The cancer cases were coded by four-digit International Classification of Diseases for Oncology (ICD-O) code.9 The cancer sites included under oropharynx were posterior third of tongue (141.0 and 141.6), soft palate (145.3), uvula (145.4),oropharynx (146.0–146.9), nasopharynx (147.0–147.9), and hypopharynx (148.0–149.0). The cancer sites included under oral cavity were lip (140.0–140.9), anterior two-thirds of tongue. (141.1–141.5), gingiva (143.0–143.9), floor of mouth (144.0–144.9), cheek mucosa (145.0–145.2), hard-palate and retromolar area (145.5–145.9). A total of 260 controls were randomly sampled from a total of about 2500 males surveyed for tobacco habits in the Jharkhand population. This tobacco survey was based on random samples from the voter list of the all the municipal corporation area. The survey was conducted by the Jharkhand cancer registry during2014-2021. The controls were not matched for age with the cases, however, they were age-stratified and then randomly selected to follow the age distribution of cases. The cases and controls were interviewed according to a pre- coded questionnaire. The subjects were asked about identifi- cation particulars, socioeconomic parameters, tobacco habits, and clinical history. The interview was conducted by three qualified social workers of the Cancer Registry staff. The cases for which detailed information about smoking or chewing history were not available were excluded from the study. Cases registered from death certificates were excluded. Similarly, the tongue not otherwise specified cases (141.9) were not included in the analysis. After exclusion, a total of 163 lung, 247 oropharyngeal and 148 oral cavity cancer cases were available for the analysis.

The data collected were compiled and quality checks were carried out. Age-adjusted odds ratio (OR) and 95% CI for the sites under study according to religion, educational status, smoking and chewing habits were estimated using unconditional multiple logistic regression models. The models were compared using the differences in deviance and in degrees of freedom. The result of variable of interest with and without confounding variable was tabulated. The effect of interaction between variable of interest and confounder were also obtained to understand the validity of adjustment. The dummy variable and linear dose-response model was compared for testing the extent to which the linear trend adequately explains the variation between the dose level.[10] The population attributable risk and attributable risk of individuals exposed to exposure of interest were also estimated. For model fitting, the statistical program SPSS was used.[11]

RESULTS

Table 1 presents the distribution of socio-demographic, smoking and chewing habits for lung, oropharyngeal and oral cavity cancer cases and controls. Most of the cases and controls were Hindu. Of the controls, 51.5% never had formal education, while 53.4% of lung, 64% of oropharyngeal and 70.9% of oral cavity cancer cases had never attended the school. The habit of

smoking and tobacco chewing was more common among cases than the controls.

Religion and educational status did not appear to increase the risk of lung, oropharyngeal and oral cavity cancer after con- trolling for smoking and chewing habits (Table 2). As shown in Table 2, tobacco smokers showed increased risk for lung and oropharyngeal cancer but marginally increased risk for oral cavity cancer. Tobacco chewing showed about a six fold increase in risk for oral cavity, marginally increased risk for cancer of the oropharynx and no increase in risk for lung cancer in com- parison to non-tobacco chewers. There were only 16 subjects who had a history of chewing regularly without using tobacco. The estimates for relative risk, based on small numbers, showed increased risk for oral cavity cancer in comparison to non- chewers even after controlling for smoking habits.

The risk of lung and oropharyngeal cancer according to the number of *bidi* and cigarettes smoked per day. The risk estimates for oral cavity cancer could not be estimated separately for *bidi* and cigarette smoking, as there were only six cigarette smokers among the oral cavity cancer cases. The risk of lung and oropharyngeal cancer increased with number of *bidi* as well as cigarettes smoked. This relationship seemed to be linear as observed departure from linear trend was not statistically significant at the 5% level. The multiplicative interaction between *bidi* and cigarette smoking was significant at the 5% level: the risk of *bidi* and cigarette smoking combined was observed to be 24.1 and 6.2 for lung and oropharyngeal cancer, respectively, in comparison to non-smokers of *bidi* and cigarettes. The risk of developing lung cancer (11.6/7.7 = 1.5) and oropharyngeal cancer (7.9/4.1 = 1.9) was higher for *bidi* smokers in comparison to cigarette smokers.

The risk of lung and oropharyngeal cancer increased approximately more than four and three times, respectively, within three levels of grouping done for duration of smoking of *bidi*/cigarettes. The risk of getting oral cavity cancer was 4.3 for those who had smoked for >30 years compared to non-smokers. The risk of >500 cumulative years of tobacco smoked compared to non-smokers was 67.6 for lung cancer, 23.0 for oropharyngeal cancer and 6.0 for oral cavity cancer. The lung cancer risk according to histological types among smokers compared to non-smokers shows that the risk is higher for squamous cell carcinoma. The OR estimates for small cell and oat cell carcinoma were based on small numbers and no convergence was obtained for this type. The risk among smokers by histological types was not estimated for oropharyngeal and oral cavity cancer as only one case of adenocarcinoma was reported for oropharyngeal cancer while for the oral cavity only squamous cell carcinomas were reported during the study period.

DISCUSSION

The motivation for examining the carcinogenic effects of tobacco smoking and chewing in this population was that smoking habits differ in India and in this region from other parts of the world. The habit of *bidi* smoking and '*zarda*', a form of tobacco chewing, is peculiar to this region. Case ascertainment in the present study is based on Cancer Registry data and thus entailed high-quality diagnostic confirmation. The controls were randomly selected from a tobacco survey conducted in the same population. Although the controls were not selected concurrently with the cases, it seems unlikely that this will alter the risk estimates as the period of survey (2014-2021) was almost same as the recruitment of cases (2014-2021) for the study. Further, no anti-tobacco activities were organized during the study period to alter the prevalence of tobacco habits in this population.

Religion and educational status were not observed to be risk factors in the present study. A study of the association of religion and smoking habits with lung cancer likewise did not observe any excess risk for different religion.[5] Both *bidis* and Cigarettes were found to be independently associated with increased risk of lung and oropharynx cancer. Two previous studies on the risk of lung cancer among *bidi* smokers have shown conflicting results. Notani and Sanghavi,[4] taking hospital controls, found a relative risk of 2.6, while Jussawalla and Jain,[5] taking community controls, found a relative risk of 19.3 in com-

parison to non-smokers. Similar to the present study increased risk for oropharyngeal cancer among *bidi* smokers was observed in a previous study.[6]

The observed OR for *bidi* and cigarette smoking combined (OR = 24.1 for lung and OR = 6.2 for oropharynx) in com- parison to non-smokers of both was much lower than expected, indicating that either mode of action is not multiplicative or those smoking both *bidis* and cigarettes are light smokers of each. The risk estimates further revealed that smoking *bidi* is even more hazardous than cigarette smoking in the development of lung and oropharyngeal cancer (Table 4).The Indian *bidi* contains only a small amount of tobacco dust rolled in a dried leaf of tendu (*Diospyrous malanoxylon*) or Temburni tree (*Diospyrous ebenum*).[12] In comparison to US cigarettes, the mainstream smoke of *bidi* contains a much higher concen- tration of several toxic agents such as hydrogen cyanide, carbon monoxide, ammonia, other volatile phenols, and carcinogenic hydrocarbons such as benz (a) anthracene and benzopyrene. *Bidi* also delivers more nicotine than Indian cigarettes. The nitro-sonornicotine (NNN) and 4 (methyl-nitrosoamino)-1-(3-pyridol) (NNK) level of *bidi* tobacco ranged from 6.2 to 12 µg/g com- pared with 1.3 to 58.0 µg/g in cigarette tobacco.[13] Further, *bidi* smokers were found to take almost five puffs per minute com- pared to the cigarette smokers who smoked two puffs per minute.[12] Thus, higher yields of tobacco-specific nitrosamines (TSNA) and higher puffing frequency among *bidi* smokers suggest that the finding of the present study, that the risk for development of lung and oropharyngeal cancer is higher among *bidi* smokers, is biologically plausible. The effect of smoking differed according to cell type of lung cancer. The risk was highest for squamous cell carcinoma. While the risk of smoking was lowest for developing adenocarcinoma, it was still high (OR = 3.9). These results are consistent with the result of other workers.[14,15]

Chewing tobacco contains a high level of TSNA.13 Of these for NNK and its reduction product 4-(methyal nitrosoamino)- 1-1(3-pyridyl)-1-butanol) (NNAL) the major target organ is the lung, especially the peripheral part of the lung. This is independent of the route of admission, whether these procarcinogens are applied topically to the skin, taken orally or by intraperitoneal injection.[16,17] These experimental studies suggest that tobacco chewing may also enhance the risk of lung cancer. The present study, however, did not observe any increased risk of tobacco chewing for lung cancer. The increased risk for oral cavity cancer among tobacco chewers is in accordance to that observed by other workers.[7,8,18] These risk estimates in the present study could not be adjusted for the use of alcohol as history of alcohol use was not taken in the Cancer Registry proforma. However, this does not seem to alter the risk of tobacco chewing to a great extent. In India the prevalence of alcohol consumption particularly relative to tobacco chewing is low. Studies from India have not observed excess risk for oral cancer among alcohol users.[7,8] The interaction model presented in Table 2 gave an indication that the mode of action of tobacco *quid* chewing and smoking may not be multiplicative. It further indicated a decline in risk of chewing of tobacco with increased amount of tobacco smoked, this may be because heavy smokers chew less than light smokers.

In India cross-sectional surveys have shown that the percentage of people who chew betel *quid* without tobacco is small. In the present study also, based on small numbers, elevated risk was observed for oral cavity cancer among chewers not using tobacco, a finding similar to another study from south India.[8]

Tobacco consumption has decreased in many developed countries while in most developing countries it is still increasing. This may largely be due to the fact that relatively fewer studies have been reported from developing countries, including India, on the risk of cancer at different cancer sites due to the use of various forms of tobacco.[19] In the present study it was estimated that the population attributable risk per cent (PARP) for smoking was quite high for lung (82.7%) and oropharyngeal cancer (71.6%). Similarly, the PARP was found to be 66.1% for tobacco chewers for development of oral cavity cancer. The attributable risk among smokers was observed to be 92% and 85% for lung

and oropharyngeal cancer, respectively. The attributable risk for those who chewed tobacco was 84.4% for development of oral cavity cancer. This suggests that the high percentage of lung, oropharyngeal and oral cavity cancers in Jharkhand could be prevented if tobacco habits were not started. Intervention studies encouraging quitting tobacco use have much relevance in Jharkhand as in this population lungs are already damaged to some extent due to exposure to coal.

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Table 1: Distribution of socio-demographical, smoking and chewing variables studied among lung, oropharyngeal and oral cavity cancer cases and controls

VARIABLE	CANCER SITES							
	Lung		Oropharynx		Oral cavity		Controls	
	No.	%	No.	%	No.	%	No.	%
Religion								
Hindu	104	63.8	174	70.4	107	72.3	201	77.3
Muslim	56	34.4	73	29.6	40	27.0	57	21.9
Others	3	1.8	–	–	1	0.7	2	0.8
Education								
Ever had schooling	76	46.6	89	36.0	43	29.1	126	48.5
Never had schooling	87	53.4	158	64.0	105	70.9	134	51.5
Smoking								
Smokersa	146	89.6	209	84.6	72	48.6	114	43.8
Bidi smokers only	100	68.5	167	79.9	50	69.4	81	71.1
Cigarette smokers only	15	10.3	21	10.0	6	8.3	20	17.5
Bidi and cigarette smokers	31	21.2	21	10.0	16	22.2	13	11.4
Non-smokers	17	10.4	38	15.4	76	51.4	146	56.2
Chewing								
Chewersb	56	34.4	108	43.7	120	81.1	120	46.2
Without tobacco	4	7.1	4	3.7	4	3.3	12	10.0
With tobacco	52	92.9	104	96.3	116	96.7	108	90.0
Non-chewers	107	65.6	139	56.3	28	18.9	140	53.8
Smoking + tobacco chewing	45	27.6	81	33.0	49	33.0	43	16.5
No tobacco habits	10	6.1	15	6.1	9	6.0	81	31.2

a. Smokers with tobacco chewing habits included.

b. Chewers with smoking habits included.

Table 2 Risk of lung, oropharyngeal and oral cavity cancer by religion, education, smoking and chewing habits

VARIABLE	CANCER SITES					
	Lung		Oropharynx		Oral Cavity	
	ORa (95% CI)	ORb,c (95% CI)	ORa (95% CI)	ORb,c (95% CI)	ORa (95% CI)	ORb,c (95% CI)
Religion						
Hindu and others	1.0	1.0	1.0	1.0	1.0	1.0
Muslims	1.8 (1.2–2.9)	1.0b (0.6–1.7)	1.5 (0.9–2.2)	1.1b (0.7–1.8)	1.4 (0.9–2.2)	1.2c (0.7–2.0)

Education Status						
Never had schooling	1.0	1.0	1.0	1.0	1.0	1.0
Ever had schooling	1.1 (0.7–1.6)	0.7b (0.4–1.1)	1.7 (1.2–2.4)	1.4b (0.9–2.0)	2.4 (1.5–3.7)	1.5c (0.9–2.5)
Smoking Status						
No	1.0	1.0	1.0	1.0	1.0	1.0
Yes	12.3 (6.9–22.0)	12.1c (6.7–21.6)	7.1 (4.6–10.7)	7.3c (4.7–11.2)	1.3 (0.8–1.9)	1.5c (0.9–2.4)
Tobacco quid chewing						
No	1.0	1.0	1.0	1.0	1.0	1.0
Yes	0.6 (0.4–0.9)	0.7b (0.4–1.2)	1.1 (0.7–1.5)	1.2b (0.8–1.8)	5.5 (3.4–8.9)	5.8b (3.6–9.5)

a. Odds ratios adjusted for age.

b. Odds ratios adjusted for age and smoking.

c. Odds ratios adjusted for age and tobacco *quid* chewing

Comparative Evaluation of the Retentive Bond Strength of Air - Abraded Zirconia Copings to Prepared Extracted Human Teeth Using Different Luting Agents – An In Vitro Study"

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Abstract

Aim: To evaluate the retentive bond strength of single unit air abraded Zirconia copings to prepared extracted human teeth cemented with 3 different luting cements.

Material and Methods: Thirty extracted human mandibular first premolar teeth that were prepared to a depth of 1.5 mm, with a 50 taper angle from a vertical axis to create an angle of convergence of 100. The specimens were randomly distributed into two equal groups (n=15): Group A(control), Group B(sandblasting) andsubgroups for cementation with the 3 resin-based cements: Multilink® Automix[Ivoclarvivadent], RelyX U200[3M ESPE], Panavia F2.0[Kuraray]). To test the retention of specimens, a universal testing machine was used (0.5mm/minute). Statistical analyses of the data were performed by using one-way analysis of variance (ANOVA) (α=0.05).

Result: The mean (SD) coping removal stresses for group A subgroups (N) were control+ Rely X U200 216.40 (90.27), control+ Multilink Automix 336.40 (189.11) and control+ Panavia F2.0 462 (575.69).For group B sandblast+ Rely X U200 412.20 (495.32), sandblast+ Multilink Automix 755.20 (634.19) and sandblast+ Panavia F 2.0 644.60 (495.44), respectively.

Conclusion: Within the limitations of this study, Group BII specimens showed the maximum tensile bond strength scores and proved to be the best option for surface treatment of Zirconia copings.

Keywords: CAD/CAM, Surface Treatment, Zirconia, Sandblasting, Resin Cements

INTRODUCTION

Concerned about the esthetics and biocompatibility of final restorations, dentists have begun demanding metal-free dental restorations. Primarily, because of their reduced physical properties, all-ceramic restorations have been limited to crowns in anterior teeth[1]. To overcome this problem, high-strength ceramics such as alumina were developed. Consequently, Zirconia, a high-strength ceramic was introduced for dental applications. This ceramic has several properties making it the material of choice where esthetic and high functional demands are concerned. Because of its high fracture strength, its biocompatibility and its hard and dense surface, Zirconia was recommended for use in posterior restorations[2-3].

Zirconia is a crystalline dioxide of Zirconium. Its mechanical properties are very similar to those of metals and its color is similar to tooth color. With increasing demand in esthetics and biocompatibility, all-ceramic restorations have gained popularity in recent decade. Among all ceramic systems available, ZIRCONIA OXIDE ceramic has emerged as an excellent esthetic material for fabrication of crowns. The properties of zirconium oxide ceramics such as high strength, excellent mechanical properties and biocompatibility allow it to be used as a core material for all-ceramic crowns and fixed partial dentures (FPDs)[4]. The most utilized Zirconia in dentistry is yttria-containing tetragonal Zirconia polycrystalline[5-9].

Zirconia has mechanical properties similar to those of stainless steel. Its resistance to traction can be as high as 900-1200 MPa and its compression resistance is about 2000 MPa. Surface treatments, mechanically or chemically can modify the physical properties of zirconia. ZrO_2 is essentially an inert and nonpolar material, and, in spite of its superiority in terms of mechanical performance, there are some inherent problems, including the adhesion to a variety of substrates[10]. For example, acid etchants such as hydrofluoric acid or hydrophosphoric acid do not adequately roughen the surface for micromechanical retention[11-12]. Therefore, alternative methods have been explored to bond ZrO_2 such as surface grinding using silicon carbide or aluminium oxide (Al_2O_3) particle air-abrasion or using a diamond bur. This method creates high surface energy, promotes microretention and removes any contaminants from the ceramic surface and also is generally easy to apply[6-9]

Some studies evaluated different resin-based luting cements with different phosphate monomer containing for bonding to Zirconia. However, it still remains unclear as to which resin-based luting cement and Zirconia produced the most durable bond strengths. Higher chemical affinity would be attained with the use of resin cements containing phosphate monomers, such as 10-methacryloyloxydecly dihydrogen phosphate (MDP), promoting higher bond strength[13], or by using additional bond agents, called primers[14-15], which also have these monomers in their composition. The association of resin luting cements with primers promoted a better interaction with ceramic surface due to the increase in cement wetting[15-20]. This wetting favours the adhesion process and improves the chemical interaction between resin cement and the zirconia surface. These ceramic primers usually contain silane and a functional phosphate monomer. Panavia F2.0 (Kuraray) is composed of the functional monomer 10-MDP, 3-metharyloxypropyl6trimetoxisilano (3-MPS) as silane and ethanol. Conventional silane is not effective on zirconia due to the absence of silica in its composition. However, when a silane primer (3-MPS) reacts with 10-MDP, the interaction of the primer with the substrate and resin cement is promoted, forming cross links with the OH groups from ceramic and cement methacrylates. This reaction can be induced and sustained by the acidity of the ceramic treated with the coupling solution.

One of the recently developed phosphate monomers (Rely X U200) has a characteristic of self-etching phosphorylated methacrylates that is designed to bond directly to both enamel and dentine. With two phosphate groups and at least two double bonded carbon atoms, good bond

strength to zirconia plus adequate cross-linking to the resin matrix is achieved.

Another new self-etch phosphate monomer (Multilink Automix) characterized by hydrolytic stability has one phosphate terminal and at least two sites capable of bonding to resin matrix through oxygen bond. This molecule has a terminal hydroxyl group as a subsistent that gives the monomer stability under water and in acidic conditions.

In the light of above facts, this study was planned to investigate the retentive bond strength of untreated and air-abraded Zirconia copings bonded to prepared extracted human teeth using three different resin-based luting agents. The Null hypothesis was that there will be no statistically difference in the bond strength of zirconia bonded to prepared untreated human teeth using three different resin-based luting agents.

MATERIAL AND METHODS

Criteria for Selection of Specimen

Thirty extracted human mandibular first premolar teeth that were sacrificed for orthodontic purpose were used. They were cleaned off surface debris, placed in 1% hydrogen peroxide immediately following extraction for 5 minutes and then stored in tap water that was changed weekly till use.

Mounting of Teeth

To retain the specimens in the acrylic blocks during testing, the root surfaces were notched with an inverted cone bur in a high-speed hand-piece. Also, a 0.7 mm diameter hard steel wire was looped through a transverse hold drilled near the apex of each root. The root was embedded into a cylinder which were filled with self-polymerized resin (DPI - RR Cold Cure, India) upto 2mm below the mid facial cementoenamel junction.

Preparation of Teeth

The tooth with its custom-made jig held firmly in the dental surveyor stand base. For the tooth crown preparation, a straight micromotor hand piece was fixed on a laboratory milling machine to ensure the same preparation angle for each specimen and the cylinder with the tooth was held securely vertically and firmly in a surveyor base. The occlusal surface of each mounted tooth was prepared flat 3 mm above the top of the cylinders, using a diamond wheel shape bur in a high-speed hand-piece. Using a carbide bur mounted to the milling machine, the axial wall of the teeth were prepared to a depth of 1.5 mm, with a 50 taper angle from a vertical axis. A new rotary instrument was used for each tooth. The resultant preparation had an axial length (occluso-gingivally) of 3 mm with a modified chamfer finish line. All the axio-occlusal line angles of each tooth were rounded. Using a caliper, the prepared teeth were measured mesiodistally (MD) and buccolingually (BL) to minimize the effect of variations in the preparation procedure, the same clinician prepared all specimens.

Fabrication OF ZrO2 Copings

A customized special tray was made for each prepared tooth using a visible-light polymerized acrylic resin. A special tray adhesive was applied to each custom tray. An impression of each tooth was made with Addition silicone impression material using the respective custom tray. After the impression had set, the trays were removed and the impressions were then poured with type IV gypsum stone. The master die was recovered from the impression, sectioned and trimmed, and a die hardener material was applied.

Thirty Zirconia copings were manufactured using computer-aided design/computer-assisted manufacturing for all prepared teeth. They were distributed into 2 groups of 15 each as follows:

Group A – Untreated copings

Group B – Internal surfaces treated with 50µm Al2O3 for 15 seconds at a pressure of 1.5 bars.

Each Group was divided into 3 subgroups for cementation with the 3 resin-based cements.

Cementation of the Zirconium Copings

For Rely X U200, prior to cementation, the prepared tooth was cleaned thoroughly with a water spray. The tooth surface was cleaned. The clicker dispenser was depressed to dispense equal volumes of cement pastes on to the mixing pad. The pastes were mixed using a plastic cement spatula for 20 sec until a uniform color was achieved. A thin layer of cement was applied to the inside surface of each coping. The coping was seated firmly. The margins were light polymerized for 2 sec and excess cement

was removed. Light polymerization was then applied for 20 seconds for each surface.

For Panavia F2.0, prior to cementation, the prepared tooth was cleaned with water spray and dried it before cementation. Equal amounts of ED PRIMER II A& B were mixed and applied to the tooth. After a wait of 30 seconds, tooth was gently air dried. Equal amount of paste A & B were dispensed and mixed for 20 sec. The mixture of the paste was applied to internal surfaces of the copings. Excess cement was removed after tack cure of 2-3 sec with conventional halogen light. Margins were then light cured for 20 sec. per surface (conventional halogen light). Self cure material OXYGUARD II, was applied to the margin and left for 3 min during the self curing process.

For Multilink Automix, prior to cementation, the prepared tooth was cleaned with water spray and dried before cementation. Equal amount of Primer A & B were mixed and applied to the tooth and light cured for 20 sec. This was followed by application of zirconia primer, Monobond Plus on the internal surfaces of copings and dried for 3-5 seconds with an air syringe. With the help of automix tip, paste was dispensed in the internal surfaces of copings and placed on the tooth. Excess cement was removed and margins were light cured for 60 sec per surface.

Retention Test of the Zirconium-Oxide Coping

To test the retention of specimens, a universal testing machine was used. A specially customized chain was made to ensure even distribution of pulling tensile forces using a locking mechanism. The cemented crowns were pulled off along the path of insertion with a crosshead speed 0.5mm/minute. The forces required for dislodgement of the crowns were recorded in N.

Statistical analyses of the data were performed by using A one-way analysis of variance (ANOVA) was applied to the mean retentive bond strengths of different cement materials. When a significant cross product interaction was found, a Tukey multiple comparison test was performed to determine which groups were significantly different. All statistical analyses were performed at a 0.05 level of significance (α=0.05).

RESULTS AND OBSERVATIONS

Table 1: Descriptives

Group_2			N	Mean	Std. Deviation	95% Confidence Interval for Mean		P-Value
						Lower Bound	Upper Bound	
Group A	**Surface Area ($mm^{2)}$**	Group AI	5	23.3600	3.54937	18.9529	27.7671	.035
		Group AII	5	20.5800	1.37868	18.8681	22.2919	
		Group AIII	5	18.3400	2.55768	15.1642	21.5158	
		Total	**15**	**20.7600**	**3.24484**	**18.9631**	**22.5569**	
	Test (N)	Group AI	5	216.40	90.268	104.32	328.48	.563
		Group AII	5	336.40	189.111	101.59	571.21	
		Group AIII	5	462.00	575.689	-252.81	1176.81	
		Total	**15**	**338.27**	**343.526**	**148.03**	**528.50**	
Group B	**Surface Area (mm^2)**	Group BI	5	21.6560	2.67875	18.3299	24.9821	.712
		Group BII	5	20.7300	3.19367	16.7645	24.6955	
		Group BIII	5	20.2700	2.01358	17.7698	22.7702	
		Total	**15**	**20.8853**	**2.54533**	**19.4758**	**22.2949**	
	Test (N)	Group BI	5	412.20	495.318	-202.82	1027.22	.571

INFERENCE

The mean (SD) coping removal stresses for group A subgroups (N) were control+ Rely X U200 216.40 (90.27), control+ Multilink Automix 336.40 (189.11) and control+ Panavia F2.0 462 (575.69). Control+ Panavia F2.0 showed the highest mean crown removal stress; however, because one coping fractured during the test. Followed by control+ Multilink Automix than Control+ Rely X U200 found lowest removal stress in this group. For all above-mentioned groups, the mean dislodgement stress was influenced by the cohesive strength of the tooth and the cohesive stress of the zirconia coping. The mean (SD) coping removal stresses (N) for group B sandblast+ Rely X U200 412.20 (495.32), sandblast+ Multilink Automix 755.20 (634.19) and sandblast+ Panavia F 2.0 644.60 (495.44), respectively. Multilink Automix exhibited the highest mean crown removal stress followed by Panavia F 2.0 and Rely X U200.

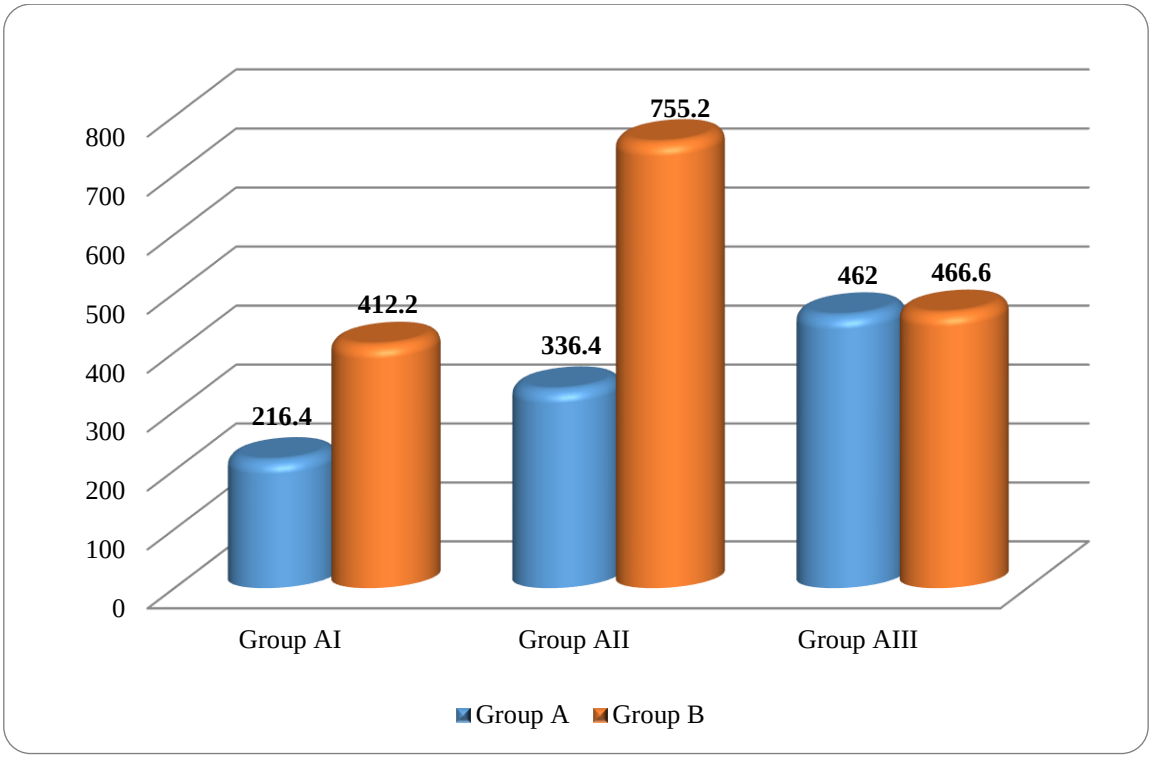
Table 2: Multiple Comparisons (LSD)

Group 2	Dependent Variable	(I) Group 1	(J) Group 1	Mean Difference (I-J)	Std. Error	P-Value	95% Confidence Interval	
							Lower Bound	Upper Bound
Group A	Surface Area (mm^2)	Group AI	Group AII	2.78000	1.67493	.123	-.8694	6.4294
			Group AIII	5.02000*	1.67493	.011	1.3706	8.6694
		Group AII	Group AIII	2.24000	1.67493	.206	-1.4094	5.8894
	Test (N)	Group AI	Group AII	-120.000	223.705	.601	-607.41	367.41
			Group AIII	-245.600	223.705	.294	-733.01	241.81
		Group AII	Group AIII	-125.600	223.705	.585	-613.01	361.81
Group B	Surface Area (mm^2)	Group BI	Group BII	.92600	1.69035	.594	-2.7570	4.6090
			Group BIII	1.38600	1.69035	.428	-2.2970	5.0690
		Group BII	Group BIII	.46000	1.69035	.790	-3.2230	4.1430
	Test (N)	Group BI	Group BII	-343.000	323.004	.309	-1046.76	360.76
			Group BIII	-232.400	323.004	.486	-936.16	471.36
		Group BII	Group BIII	110.600	323.004	.738	-593.16	814.36

*. The mean difference is significant at the 0.05 level.

INFERENCE

From the ANOVA results of the above table, comparison within the groups was not statistically significant with respect to retentive bond strength i.e. higher than 0.05 at 5% level of significance. It means that, the retentive bond strength scores are different in two groups (group AI, AII, AIII, and group BI, BII, BIII).



Graph 1: Mean Values of Test Groups

One-way ANOVA was first applied to these data, because two categorical factors (surface treatment and cement type) are associated with a continuous outcome (coping removal stress), the outcomes are not related to each other, and the shape of the histogram was not statistically significantly different from the normal curve; however, the assumption of equal variance was not violated. In Graph, Rely X U200 was having lowest mean retentive strength values in both the groups whereas, Panavia F2.0 having highest retentive values in Group A and in Group B Multilink Automix having highest mean retentive values.

The results for characterization of failure type are presented. Overall, the predominant mode of failure for Group A I 3 of the specimens had cement in the copings followed by 2 of the specimens with cement principally on the tooth. In contrast, failure modes for Group A II were 4 for cement principally on the coping, 1 with cement principally on the tooth. The group of copings cemented with Group A III 2 of the specimens had cement in the copings followed by 2 of the specimens with cement principally on the tooth, and 1 where tooth or root fracture. The predominant mode of failure for group B I 3 of the specimens had cement on the tooth, 1 on the coping and 1tooth or root fractured. Group B II mode of failure 1 of the specimens had cement on the coping, 3 within the tooth and 1 root or tooth fracture. For Group B III had 3 of the specimens with cement on the coping, 1 with the cement on the tooth and 1 with the root or tooth fracture.

DISCUSSION

The present study revealed that retention of copings/crowns depends on the following factors: preparation design of the prepared tooth surface, any surface treatments given on the intaglio surface of the copings/ crowns, type of resin cements used. In this study, Zirconia oxide blanks (ZrO_2 stabilized by Y_2O_3) from Ziecon, were used to prepare the copings by CAD/CAM on the prepared extracted human mandibular premolar teeth with 3mm axial length and 5 degrees of taper as per previous in-vitro studies by Khalil Aleisaet al[10]. The samples were divided into 2 groups, one as the control and the other with copings being sandblasted before cementation. Each group was further divided into 3 sub-groups for luting the copings with the 3 selected resin cements with

different phosphate monomer chemistry, viz. Rely X- U200, Multilink Automix and Panavia F2.0

Several studies by Markus B. Blatz et al, Gokhan Akgungor et al, Jeong-yeon Yun et al[14,19,20] have established airborne particle abrasion is considered to be the most effective method for treating zirconia ceramics by improving surface roughness and creating micro-mechanical interlock with the luting agent. Airborne particle abrasion also cleans and increases the surface area, resulting in higher bond strength due to mechanical retention. In our study, in the experimental group, the Zirconia copings were sandblasted using 50um Al_2O_3 at 15 bars pressure for 15 seconds.

However, there have been some concerns raised by Mona W et al[22] regarding possibility of micro-cracks formation at the inter-grain level which could affect the longevity of the ceramic restoration. On the other hand, there are studies indicating that air abrasion might even strengthen zirconia ceramics when done cautiously as regards the time to which the specimens are subjected to sandblasting and particle size of the Al_2O_3.[21]

In our study, we have used 3 resin based luting cements based on different chemistry related to the phosphate monomers used. Rely X U200 dispenser is a dual-cure, two-paste, hand mix resin material containing methacrylate monomers with phosphoric acid groups. This cement is able to make a hydrogen bond with the zirconia surface because the phosphoric acid groups in its composition promote this surface bonding.

Multilink Automix is a dual-cure, two-paste, automix resin material containing phosphate monomer characterized by hydrolytic stability, has one phosphate terminal and at least two sites capable of bonding to resin matrix through oxygen bond. This molecule has a terminal hydroxyl group as a substituent that gives the monomer stability under water and in acidic conditions.

Panavia F 2.0 is a dual-cure, two-paste, hand mix resin material containing functional monomer 10-MDP (10-methacryloyloxydecly dihydrogen phosphate), 3-metharyloxypropyltrimetoxisilano (3-MPS) as silane and ethanol. Conventional silane is not effective on zirconia due to the absence of silica in its composition. However, when a silane primer (3-MPS) reacts with 10-MDP, the interaction of the primer with the substrate and resin cement is promoted, forming cross links with the OH groups from ceramic and cement methacrylates. This reaction can be induced and sustained by the acidity of the ceramic treated with the coupling solution.

Taking the probability Type I Error (α) = 0.05 & Power ($1-\beta$) = 0.8, no. of groups in this study being 3 and the effect size (largest difference between any 2 mean divided by SD) was derived as 2.73. Accordingly, as per calculation, the sample size (n) was arrived as 3 per group. For sake of convenience and not to lose any precision in the study, we took the sample size (n) as 5. The results of this study showed no statistically significant difference in the bond strength values among the three groups tested and hence, the Null Hypothesis was accepted.

The results showed that in Group A (untreated samples), the mean surface area of the prepared teeth were not significantly different across the 3 sub-groups. The mean retentive bond strength values also showed no statistically significant difference across the subgroups. Specimens cemented with Rely-X U200 showed the least values (216.40N) and Panavia F2.0 showed the highest (462N). It was interesting to note that the specimens cemented with Panavia F2.0 showed the highest values in spite of them having the least surface area of the prepared teeth. In Group B (sand blasted samples), the mean surface area of the prepared teeth were not significantly different across the 3 sub-groups. The mean retentive bond strength values also showed no statistically significant difference across the subgroups. Specimens cemented with Rely-X U200 showed the least values (412.20N) and Multilink Automix showed the highest (755.20N). It is evident that sandblasting the copings has a positive effect on the retentive values among all 3 sub-groups. It is interesting to note that sandblasting had the most positive effect on the retentive bond strength values of the samples cemented with Multilink Automix. In Group B, all the sub groups showed fracture of

the tooth/root and dislodgement of the tooth itself from the resin block, in 1 sample each before debonding of the coping. This was due to the high bond strength values observed in Group B across all the 3 sub-groups.

Studies done by Clayton GH et al[23] and Sheets JLet al[24]have shown that, dislodging loads in natural tooth intra-orally range between 207-509N. From our study, it may be inferred that all the three cements may be capable of retaining the ZrO_2 copings successfully, with and without treatment air-braded of the internal surface of each coping.

The findings of this study were in accordance with the study by Palacios et al[18], in which no statistically significant difference between three different resin types was found; however, in their study, the retention values for Panvia F 2.0 and RXU were higher than the retention values recorded in this study. The possible explanation could be that the zirconia copings tested in that study were different in manufacturing system; therefore, conclusion drawn for one zirconia system may not be valid for others.

In another study, Kern and Wegner[25] airborne-particle abraded the zirconia ceramic surface with 110-µm aluminum oxide, applied different luting agents, and found that Panavia F 2.0 provided the highest bond strength values. This is in partial agreement with the results of our study as in group A, the retention value of Panavia F2.0 cement was the highest. In a previous study by Hesam Mirmohammadi et al, they had reported that Multilink Automix showed the highest bond strength after sand blasting where the samples had shown cohesive failure reflecting the capacity of its monomer for bonding to zirconia and tooth surface. The superior performance of Multilink Automix could be due to its chemistry characterized by hydrolytic stability, having one phosphate terminal and at least two sites capable of bonding to resin matrix through oxygen bond.

Overall, we may say that all the 3 cements tested may show satisfactory clinical performance, both with untreated and treated Zirconia crowns. However, considering the significant increase in retentive values after sandblasting, surface treatment of the intaglio surface of Zirconia crowns by sandblasting can be an easy, practical and useful procedure prior to cementation. This assumes more importance in cases where the retention and resistance forms of the prepared tooth has already been compromised due to any reason. Multilink Automix may be the luting agent of choice in such situations for luting air abraded Zirconia crowns.

The results of this study however, have to be seen in light of some limitations: The samples were stored in water for only 24 hours and were not subjected to thermocycling or fatigue cycle testing and hence could not simulate the complex intra-oral environment before testing.

Within the limitation of this study, the following conclusions can be drawn: there is no statistically significant difference in the bond strength in both the groups under investigation. Panavia F2.0 shows the best bond strength with untreated Zirconia copings while Multilink Automix shows the best bond strength after the copings are sandblasted. Sandblasting the Zirconia based crowns may be made a mandatory procedure prior to cementing them with resin based luting agents to ensure adequate long term clinical performance.

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Comparative Evaluation of Apical Extrusion of Debris Using K-Files, Protaper Next, Oneshape, Waveone and Revos: An In Vitro Study

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Abstract

Aim: To compare and evaluate the apical extrusion of debris using 2 rotary multiple file system (RevoS, ProTaper Next), one rotary single file system (OneShape) and one reciprocating single file system with hand K-file.

Material and Methods: seventy-five single rooted teeth with single root canal were selected and divided into five experimental groups (n =15) according to the rotary system used: Groupo 1- K-fill, Group 2 - Protaper Next, Group 3 - Revo S, group 4 - OneShape and group 5 - WaveOne. After instrumentation debris adhered to root surface was collected by washing root with 1ml distilled water in the glass vial and stored in MICROWAVE at 900 watts for 2 minutes and 3 consecutive cycles. The dry weight of extruded debris was weighed in an electronic balance.

Result: Protraper Next significantly show less debris extrusion compared with K-fill, Revo S, OneShape and WaveOne.

Keywords: Apical extrusion, debris, K-fill, ProTaper Next, Revo S, OneShape, WaveOne

INTRODUCTION

Complete preparation of root canal space is important stage in root canal preparation. The preparation of the root canal system is crucially important not only for the removal of the organic and inorganic irritants but also for allowing the correct placement of the obturating material. Even though instrumentation technique force intracanal content through periapical tissues[1], the amount of debris extrusion may differ according to the preparation techniques and the design of the file systems[2-7]. During root canal preparation, these materials and the irrigant may be extruded into the periapical tissues despite strict control of working

length. This extrusion may cause an inflammatory reaction and postoperative pain, the so called flare-up (Seltzer & Naidor 1985)[8]. The main purpose of root canal treatment is to enlarge the root canal system in order to remove all residual pulp tissue, bacteria, necrotic tissue and dentine chips from the root canal system[8].

Forcing microorganisms and their products into the periradicular tissues can generate an acute inflammatory response, whose intensity will depend on the number and or virulence of the extruded microorganisms. At present, all preparation techniques and instruments are associated with extrusion of debris, even when the preparation is maintained short of the apical terminus and manual instrumentation happens to produce greater extrusion when compared to engine driven rotary preparation[9-12]. The studies so far have proven that none of the various techniques and instruments can clean and shape the root canal system without producing some apically extruded debris (AED)[13]. However, it has been proved that various instrumentation techniques have been associated with different amounts of AED[14]. As AED generates an acute inflammatory reaction in the periapical tissues, it is considered as an important parameter to assess the efficacy of an instrumentation technique or instrument design during root canal preparation.

The clinical endodontic breakthrough was progressing from utilizing a long series of stainless steel hand files and several rotary Gates Glidden drills to integrating Ni-Ti files for shaping canals. When properly performed; these mechanical objectives promote the biological objectives for shaping canals, 3-dimensional (3-D) disinfection, and filling root canal systems. [5]

WaveOne are characterized by a triangular or modified triangular cross-section resulting in a lower cutting efficiency and smaller chip space[15]. This design may enhance debris transportation toward the apex when used in combination with a reciprocal motion. Contrarily, incontinuous rotation may improve coronal transportation of dentine chips and debris by acting like a screw conveyor[9,16]. ProTaper Next instruments have an off-centered, rectangular design, generating traveling waves of motio along the active part of the file. The superior performance of the ProTaper Next system might be caused by the new swaggering motion, which serves to minimize the engagement between dentine and the file and enhances augering debris out of the canal[17].

RevoS (Micro-Mega, France) - Contains three basic file, SC1, SC2 and SU. The corresponding size is 25/. 06, 25/. 04 and 25/. 06 respectively. The asymmetrical cross section provides less stress on the instrument. The canal axis has 3 cutting edges located on 3 different radiuses: R1, R2 and R3. The 3 cutting edges are located to the canal axis on 3 different radiuses: R1, R2 and R3.

OneShape (Micro-Mega, France) - It contain single instrument for canal shaping and size 25/. 06. 3 different cross-section zones: The first zone presents a variable 3-cutting edge design. The second (transition zone) has a cross-section that progressively changes from 3 to 2 cutting edges. The last (coronal) is provided with 2 cutting edges.

The aim of this study is to compare and evaluate the apical extrusion of debris using 2 rotary multiple file system (Revo S, Protaper Next), one rotary single file system (One shape) and one reciprocating single file system with hand K-file.

MATERIALS AND METHOD

Methodology

In this study 75 freshly extracted human mandibular premolar teeth that were sacrificed for orthodontic and periodontal purpose were used. Teeth with Single rooted premolar, root curvature between 0-10 degree, working length approximating 21mm. Teeth with Sign of crack, Internal resoption, External resorption, Root caries, Canal calcifications, Open apices were extruded from study. Radiograph taken both mesiodistally and buccolingually to assess internal resorption, calcification and curvature of canals. Degree of root curvature was calculated from buccolingual radiograph using Schneider method.

External root surface of experimental teeth were cleaned of tissue tags and debris with periodontal scalars. Teeth were stored in 2. 5% Sodium hypochlorite for 2 hours before experimentation. To create an ease of refence point for the working

length of teeth cuspal reduction was done using taper fissure bur and air rotor handpiece.

Following this procedure endodontic asses cavity was prepared using endoasses bur (DENTSPLY Maillefer, Switzerland). No. 10 K-file was introduced uptil visible at apical foramen and working length was established by subtracting 1mm from this measurement. The size of minor foramen was controlled moving No. 15 K-file to working length. If it extruded beyond apical foramen, the tooth was extruded from study.

75 glass vials with rubber stopper were selected for the study. Holes were created in center of rubber stopper by heated instruments. After this individual teeth were inserted with pressure into rubber stopper. Now teeth with rubber stopper were placed onto the glass vials and vented with 27 gauge needle alongside rubber stopper. Following this procedure, empty vials without stopper were weighed on electronic balance and values were recorded in terms of grams. Rubber stopper with attached teeth were reposition on the preweight vials.

75 glass vials were randomly assigned to 5 groups, 15 teeth in each.

Group A: K-file

Group B: ProTaper Next

Group C: RevoS

Group D: OneShape

Group E: WaveOne

Each instrument was used in 3 canals.

Group A: K-File

K-file was used in step back manner. Apical preparation was continued till size 40. After this stage, step back technique was applied uptil size 55 file reducing 1mm length for every next file used.

Group B: ProTaper Next

In sequence of X_1 followed by X_2 (both uptil working length) with speed of 300 rpm and torque of 2 Ncm. File was used in brushing motion.

Group C: RevoS

Used according to manufacturer's instructions. Speed with 300rpm.

Instrument Sequence

SC1 – uptil 2/3 rd of working length, with slow and unique downward movement in a free progression and without pressure.

SC2 – uptil working length, with a progressive 3 wave movement(up and down movement).

SU – uptil working length, with a slow and unique downward movement in a free progression and without pressure.

Group D: OneShape

Size 25 at tip and taper. 006 was used at a speed of rotation of 350-450rpm and maxi torque of 2. 5 Ncm. Used with in and out movement without pressure.

Group E: WaveOne

According to manufacturer's instructions. Primary file with tip size ISO 25 and apical taperwith 8% was used in progressive up and down movement no more than three to four times.

For IRRIGATION PROTOCOL 4ml distilled water was used between files group 1-3 and between pecking sequences- group 4 &5. Irrigation needle was placed slightly coronal to the point where resistance was offered. For single file systems, irrigation was done at every 3 pecks of instrumentation.

After instrumentation was complete, stopper was partially removed and debris adhered to root surface was collected by washing root with 1ml distilled water in the glass vial. Vials were then stored in INCUBATOR at 70^0C for 7 days to evaporate distilled water before weight extruded debris. Weight of extruded debris was calculated by subtracting the weight of empty vials from weight of vials containing debris using electronic balance.

RESULT

The weight of the extruded debris was determined by subtracting the weight of the preweighed empty vials from the weight of the vials plus the dried debris. The mean weight of extruded debris was calculated for each group and statistical analysis performed using SPSS programme.

In group-I, instrumentation was done with K-file showed the mean extrusion value of 0. 0009920.

In group-II, instrumentation was done with ProTaper Next showed the mean extrusion value of 0. 0004133.

In group-III, instrumentation was done with RevoS showed the mean extrusion value of 0. 0007713.

In group-IV, OneShape showed the mean extrusion value of 0. 0007140.

In group- V, WaveOne showed the mean extrusion value of 0. 0008407.

These data were then, analyzed using **ONE WAY ANOVA** test and difference between the groups were found using **TUKEY HSD** test.

The mean extrusion, median values, and range of extrusion (minimum and maximum values) were calculated. The P values obtained after the comparison of groups.

Table 1: One Way ANOVA Demonstrating Statistical Difference for Weight of Empty Vials of Different Groups
ANOVA

		Sum of Squares	Df	Mean Square	F	P-Value
Preweighed	Between Groups	0. 00439	4	0. 00110	1. 75903	0. 14691
	Within Groups	0. 04366	70	0. 00062		
	Total	0. 04805	74			

Table 2: One Way ANOVA Demonstrating Statistical Difference for Weight of Vials Containing Debris of Different Groups
ANOVA

		Sum of Squares	Df	Mean Square	F	P-Value
Preweighed	Between Groups	0. 00450	4	0. 00113	1. 80199	0. 13818
	Within Groups	0. 04371	70	0. 00062		
	Total	0. 04822	74			

Table 3: One Way ANOVA Demonstrating Statistical Difference for Weight of Extruded Debris Different Groups
ANOVA

		Sum of Squares	Df	Mean Square	F	P-Value
Preweighed	Between Groups	0. 00000	4	0. 00000	28. 34712	0. 00000
	Within Groups	0. 00000	70	0. 00000		
	Total	0. 00000	74			

Table 4 - Tukey HSD Test
Post Hoc Test
Multiple Comparisons: Dependent Variable: Diff (Preweighed)
Multiple Comparisons - Tukey HSD

Dependent Variable	(I) Group Name	(J) Group Name	Mean Difference (I-J)	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Preweighed	**K- File**	Protaper next	0. 01729	0. 00912	-0. 00824	0. 04283
		Revo S	0. 01974	0. 00912	-0. 00579	0. 04528
		One shape	0. 01168	0. 00912	-0. 01385	0. 03722
		Wave One	0. 02088	0. 00912	-0. 00465	0. 04642
	Protaper next	K- File	-0. 01729	0. 00912	-0. 04283	0. 00824
		Revo S	0. 00245	0. 00912	-0. 02309	0. 02799

		One shape	-0. 00561	0. 00912	-0. 03115	0. 01992
		Wave One	0. 00359	0. 00912	-0. 02194	0. 02913
	Revo S	K- File	-0. 01974	0. 00912	-0. 04528	0. 00579
		Protaper next	-0. 00245	0. 00912	-0. 02799	0. 02309
		One shape	-0. 00806	0. 00912	-0. 03360	0. 01747
		Wave One	0. 00114	0. 00912	-0. 02439	0. 02668
	One shape	K- File	-0. 01168	0. 00912	-0. 03722	0. 01385
		Protaper next	0. 00561	0. 00912	-0. 01992	0. 03115
		Revo S	0. 00806	0. 00912	-0. 01747	0. 03360
		Wave One	0. 00920	0. 00912	-0. 01633	0. 03474
	Wave One	K- File	-0. 02088	0. 00912	-0. 04642	0. 00465
		Protaper next	-0. 00359	0. 00912	-0. 02913	0. 02194
		Revo S	-0. 00114	0. 00912	-0. 02668	0. 02439
		One shape	-0. 00920	0. 00912	-0. 03474	0. 01633
* The mean difference is significant at the 0. 05 level.						

Table 5 - Tukey HSD Test

Post Hoc Test

Multiple Comparisons: Dependent Variable: Diff (Postweighed)

Multiple Comparisons - Tukey HSD

Dependent Variable	(I) Group Name	(J) Group Name	Mean Difference (I-J)	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Postweighed	**K- File**	Protaper next	0. 01787	0. 00912	-0. 00768	0. 04342
		Revo S	0. 01996	0. 00912	-0. 00559	0. 04552
		One shape	0. 01196	0. 00912	-0. 01359	0. 03751
		Wave One	0. 02104	0. 00912	-0. 00452	0. 04659
	Protaper next	K- File	-0. 01787	0. 00912	-0. 04342	0. 00768
		Revo S	0. 00209	0. 00912	-0. 02346	0. 02764
		One shape	-0. 00591	0. 00912	-0. 03146	0. 01964
		Wave One	0. 00316	0. 00912	-0. 02239	0. 02872
	Revo S	K- File	-0. 01996	0. 00912	-0. 04552	0. 00559
		Protaper next	-0. 00209	0. 00912	-0. 02764	0. 02346
		One shape	-0. 00800	0. 00912	-0. 03355	0. 01755
		Wave One	0. 00107	0. 00912	-0. 02448	0. 02662
	One shape	K- File	-0. 01196	0. 00912	-0. 03751	0. 01359
		Protaper next	0. 00591	0. 00912	-0. 01964	0. 03146
		Revo S	0. 00800	0. 00912	-0. 01755	0. 03355
		Wave One	0. 00908	0. 00912	-0. 01648	0. 03463
	Wave One	K- File	-0. 02104	0. 00912	-0. 04659	0. 00452
		Protaper next	-0. 00316	0. 00912	-0. 02872	0. 02239
		Revo S	-0. 00107	0. 00912	-0. 02662	0. 02448
		One shape	-0. 00908	0. 00912	-0. 03463	0. 01648
* The mean difference is significant at the 0. 05 level.						

Table 6 - Tukey HSD Test

Post Hoc Test

Multiple Comparisons: Dependent Variable: Diff (Postweighed – Preweighted)

Multiple Comparisons - Tukey HSD

Dependent Variable	(I) Group Name	(J) Group Name	Mean Difference (I-J)	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Difference	K- File	Protaper next	. 00057867*	0. 00006	0. 00042	0. 00074
		Revo S	. 00022067*	0. 00006	0. 00006	0. 00038
		One shape	. 00027800*	0. 00006	0. 00012	0. 00044
		Wave One	0. 00015	0. 00006	-0. 00001	0. 00031
	Protaper next	K- File	-. 00057867*	0. 00006	-0. 00074	-0. 00042
		Revo S	-. 00035800*	0. 00006	-0. 00052	-0. 00020
		One shape	-. 00030067*	0. 00006	-0. 00046	-0. 00014
		Wave One	-. 00042733*	0. 00006	-0. 00059	-0. 00027
	Revo S	K- File	-. 00022067*	0. 00006	-0. 00038	-0. 00006
		Protaper next	. 00035800*	0. 00006	0. 00020	0. 00052
		One shape	0. 00006	0. 00006	-0. 00010	0. 00022
		Wave One	-0. 00007	0. 00006	-0. 00023	0. 00009
	One shape	K- File	-. 00027800*	0. 00006	-0. 00044	-0. 00012
		Protaper next	. 00030067*	0. 00006	0. 00014	0. 00046
		Revo S	-0. 00006	0. 00006	-0. 00022	0. 00010
		Wave One	-0. 00013	0. 00006	-0. 00029	0. 00003
	Wave One	K- File	-0. 00015	0. 00006	-0. 00031	0. 00001
		Protaper next	. 00042733*	0. 00006	0. 00027	0. 00059
		Revo S	0. 00007	0. 00006	-0. 00009	0. 00023
		One shape	0. 00013	0. 00006	-0. 00003	0. 00029
* The mean difference is significant at the 0. 05 level.						

DISCUSSION

The endodontic procedures would be much simpler if all the root canals possess a smooth funnel shape from the orifice to the foramen, without curvatures or ramifications and the foramen is also located exactly at the radiographic apex. But in reality, the root canal anatomy is complex and manifest in different configurations. To clean and shape these canals requires appropriately designed instruments and thorough irrigation. Endodontic treatment is a triad of debridement, sterilization and obturation. The primary objectives in cleaning and shaping the root canal system are:

i) To remove infected soft and hard tissues,

ii) Give disinfecting irrigants access to apical canal space and

iii) To create space for the delivery of medicaments and subsequent obturation.

To obtain these objectives during root canal preparation, debris such as dentinal shavings, necrotic pulp tissue, bacteria and their products or irrigants may be extruded into the periradicular tissue, from the apical foramen. This may leads to periapical inflammation or post instrumentation pain or “flare-ups”[16]

Main objective of the present study was to evaluate the quantity of the debris extruded from the . apical foramen during canal preparation using three rotary system (ProTaper Next, RevoS, OneShape), one reciprocating system (WaveOne), and manual technique (K-file).

In the present study 75 single rooted teeth were selected with mature apex. Experimental teeth were divided into five groups:

Group A: K-file

Group B: ProTaper Next

Group C: RevoS

Group D: OneShape

Group E: WaveOne

In this study al root canals were irrigated with distilled water using 27 gauge blunt needles. Distilled water was used as an irrigant solution to avoid any crystallization of Sodium hypochloride and also distilled water was used as a last irrigant to avoid any possible weight increase caused by NaOCl crystal formation[15,20,2122].

The results of present study showed that all the groups cause apical extrusion of debris. The study reveals that engine –driven nickel titanium instruments that were used for the crown down technique extruded less debris and irrigant than K-flex files for the step-back technique. The result of present study agree broadly with the previous findings – filing motion, that is step back technique with circumferential filing motion create a greater mass of debris than those involving some sort of rotational action.

The results of present study are correlating with the results of the study done by **Ruiz Hubard et al[17]** (1987) who determined the amount of debris forced through apical constriction during root canal instrumentation, comparing conventional step-back instrumentation technique with crowndown pressure less technique and reported that greater amount of debris was forced periapically in both straight and curved canals when stepback technique was performed.

This brief review of the literature suggests that apical extrusion is common to all preparation techniques, but that the amount of extruded material varies. As far as hand preparation techniques are concerned, stepback technique with circumferential filing motion extruded greater mass of debris as compared to engine driven groups. In the stepback technique, the reason for more apical extrusion of debris is that the file acting in the apical one third acts as a piston that tends to push the debris through the foramen and less space is available to flush it coronally. While crowndown technique by engine driven nickel titanium instruments produce early flaring of the coronal part of the preparation which improves the instrument control during preparation of the apical third of the canal, and allows deeper penetration of irrigating solution and easier removal of debris from the apical area. The rotatory motion of nickel titanium instruments direct debris towards the orifice, avoiding its compaction in the root canal[17,19]. So the results presented herein are consistent with other investigations and reinforce the fact that the conventional stepback technique extrudes more debris apically. (add reciproc system n one file system reason)

In this study, the rotary NiTi system extruded less debris than the K-files, although the difference was not significant. When the rotary system was used, early flaring of the coronal part of the canal with a crown-down technique may increase the guidance of debris towards the orifice of the canal through the rotational motion (Goerig et al. 1982, Beeson ET AL. 1999). When a step-back technique is used, increased apically extruded debris could be a result of the cation of the file acting as a piston in the apical one-third of the tooth. The difference between hand instrumentation and rotary files in the present study was comparable with the difference between theiruse in other studies (Zarrabi et al. 2006, De-Deus et al. 2010)[8].

The reciprocating single-file system showed significantly more debris extrusion compared with both the full-sequence rotary NiTi instruments. The obtained differences may be caused by the preparation technique and/or the cross-sectional designs of the instruments[23]. A study by Burklein et al. found that there was more debris in the apical part of the canals after canal preparation with WaveOne and PeoTaper instruments as they are characterized by three cutting edges with radial lands to support the blades and a relatively small chip space[26]. ProTaper and WaveOne are characterized by a triangular or modified triangular cross-section resulting in a lower cutting efficiency and smaller chip space. This design may enhance debris transportation toward the apex when used in combination with a reciprocal motion. Contrarily,

incontinuous rotation may improve coronal transportation of dentine chips and debris by acting like a screw conveyor[9,16].

ProTaper Next instruments have an off-centered, rectangular design, generating traveling waves of motio along the active part of the file. The superior performance of the ProTaper Next system might be caused by the new swaggering motion, which serves to minimize the engagement between dentine and the file and enhances augering debris out of the canal[17].

Previous studies which demonstrated that no method completely avoids debris extrusion (Reddy & Hicks 1998, Mangalam et al. 2002, Tanalp et al. 2006, Kustarci et al. 2008, Logani & Shah 2008, Elmsallati et al. 2009, De-Deus et al. 2010). The reciprocating file extruded significantly more debris compared to the multiple-file rotary instrument and the single-file rotary system. This observation is in agreement with previous findings in as far as multiple-file rotary instrumentation was associated with less debris extrusion compared with the use of reciprocating single-file syatem[24](Burklein & Schafer 2012). OneShape extruded significant less debris than Reciproc. w/h file give Highest extrusion n min extrusion.

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Respiratory Effects in Children from Exposure to Second-Hand Smoke

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Abstract

Background: The effect of exposure to air pollution during childhood on the development of lung disease in adulthood remains to be defined. A common component of air pollution from fossil fuels, environmental tobacco smoke, and burning of solid fuels such as biomass is particulate matter. The detrimental effects of tobacco on children's health are well known. Nonetheless, the prevalence of secondhand cigarette smoke exposure in the pediatric population has not significantly decreased over time. As early as1974, two articles published in the journal Lancet alerted readers to a possible link between parental smoking & the risk of a lower respiratory illness among infants[1]. Although adverse effects on children from exposure to secondhand tobacco smoke had already been suggested, the association with early episodes of acute chest illness was of immediate and continuing interest because of the suspected long- term consequences for lung growth, chronic respiratory morbidity in childhood, and adult chronic obstructive lung disease [2].

Keywords: Chronic obstructive pulmonary disease (COPD), passive smoking, respiratory disease, asthma, pneumonia.

INTRODUCTION

It is now established beyond doubt that inhaling secondhand smoke as a result of smoking is harmful. There is no safe level of exposure. According to World Bank exposure to secondhand smoke causes an estimated 5% of the global burden of disease, slightly higher than the burden from direct use of tobacco (4%) [3]. Also called passive smoking, environmental tobacco smoking or second-hand smoke (SHS), worldwide exposure to it caused nearly [6], 03,000 premature deaths of non-smokers estimated in 2004. The associated effects include heart disease, lung cancer, severe asthma attacks, sudden infant death syndrome and many others[4]. Early childhood (usually defined as a new born baby until the age of 8 years) is the phase of incredible growth in several aspects: physical, cognitive, social-emotional, and language skills. During the early years, the brain develops quickly and has a high capacity for change, with the foundation set for health and wellbeing throughout life. Therefore, this period is critical. Protecting children from threat, including secondhand smoke exposure, is part of nurturing care that is sensitive to children's health and nutrition needs[5].

Mechanisms of Health Effects from Secondhand Tobacco Smoke

This reviews the biologic impact of secondhand smoke on the respiratory system of the child.

Developmental Vulnerabilities

Pregnant women who smoke expose the fetus to tobacco smoke components during a critical window of lung development, with consequences may be persistent. In infancy and early childhood, the contributions of prenatal vs. postnatal exposure to secondhand smoke are difficult to separate. For children, exposure to secondhand smoke may lead to respiratory illness as a result of adverse effects on immune system and on lung growth and development.

Postnatal lung growth is divided into the first 3 years of life where new alveoli are developed, and later childhood where lung growth occurs by expansion. The effect of very early environmental exposures may therefore be more damaging, or at least qualitatively different, to exposures in later childhood6. The higher breathing rate in children also increases risk of particulate matter-induced lung damage. Young children may also be more vulnerable to oxidative stress–mediated injury to the airway. Oxidative stress is a putative mechanism for both PM-induced lung injury [7], and the development of COPD [8]. Exposure to Secondhand smoke is associated with increased oxidative damage to DNA and lipids. As noted above, MDA can be used as a measure of lipid peroxidation, and children exposed to SHS have been found to have significantly higher circulating levels of MDA and also significantly lower levels of glutathione peroxidase. Concerning antioxidant micronutrients, the evidence for SHS exposure mirrors the evidence for smoking. Compared to non-smokers not exposed to SHS, non-smokers exposed to SHS have significantly reduced circulating concentrations of vitamin C and provitamin A carotenoids, indicating that even low-dose cigarette smoke exposures lower circulating antioxidant micronutrient concentrations. Evidence of lowered circulating antioxidant micronutrient concentrations has also been observed in children of smokers [9, 10, 11]. Data on developmental changes in antioxidant defenses in human airway cells are limited. One of the very few studies that compared mRNA and activity levels of superoxide dismutases (SOD), catalase (CAT), and glutathione peroxidase (GPx) in human adult, neonatal, and fetal lung tissue found conflicting results. Whether a functionally relevant immaturity in pulmonary oxidant defenses is present in young children therefore remains unclear.

Lung Gowth and PM

Entering adulthood with impaired lung function is a nonspecific risk factor for respiratory disease in adulthood. Lower lung function per se is also a risk factor for diseases in childhood that may cause further structural damage to the developing lung. Studies show that older children whose parents smoke get sick more often. Their lungs grow less than children who do not breathe secondhand smoke, and they get more bronchitis and pneumonia. For example, infants with lower lung function in the first weeks of life (i.e., before their first respiratory infection) are at increased risk of developing respiratory syncytial virus (RSV)-bronchiolitis [12]. This primary infection of the bronchioles triggers persistent wheezing, and presumably structural changes in the lung, in a subgroup of infants. Secondhand smoke can trigger an asthma attack in a child. Children with asthma who are around secondhand smoke have more severe and frequent asthma attacks [13]. There is convincing evidence that exposure to PM increases the prevalence of respiratory symptoms in young children.

The tracking of lung function from infancy to early adulthood suggests that damaging exposures in the first years of life may have a disproportionate influence on attainment of maximal lung function in early adulthood [14]. But measuring lung function in infants is difficult, and the association between environmental PM and infant's lung function remains unknown. The most convincing evidence that PM impairs lung growth comes from studies of school-age children, in whom spirometry is easier to perform. The mechanism for PM-mediated effects remains unknown.

Bacterial infection

Increased vulnerability to bacterial infection of the lower respiratory tract is a hallmark of COPD[15]. Recent data from human bronchial epithelial cells exposed to cigarette smoke suggest that this may, in part, be due to suppression of antibacterial host defense [16]. Similarly, in children, there is good

evidence that exposure to PM increases vulnerability to bacterial infection. This association between PM and bacterial infection in children is important because (1) exposure to PM is ubiquitous and (2) infection is common, with 156 million new episodes of pneumonia per year in young children worldwide (151 million of these in the developing world) [17]. Ten percent of these episodes are life-threatening. Also, there is increase in hospital admission in doctor-diagnosed "pneumonia or bronchitis" in children less than 5 years of age. A putative mechanism whereby environmental factors increase vulnerability to pneumococcal pneumonia is via increased nasopharyngeal carriage [18].

Chronic obstructive pulmonary disease (COPD):

Long-term exposure to secondhand smoke (SHS) during childhood increases the risk of chronic obstructive pulmonary disease (COPD) in adulthood, according to a new study. Offspring exposed to parental smoking in childhood had approximately twice the risk of having a carotid atherosclerotic plaque in adulthood than did those with non-smoking parents. However, among offspring of parents who smoked and had a detectable serum cotinine level, which was indicative of poor parental smoking hygiene (e.g., smoking in the presence of the child), the risk of plaque was more than doubled compared with those with no detectable cotinine. These data add to the growing body of evidence proposing that exposure to parental smoking early in life has an irreversible effect on arterial health in adulthood [19, 20]. A putative sequence is that chronic exposure to PM (1) reduces attainment of maximal lung function in childhood, (2) accelerates lung function decline in adulthood, (3) stimulates airway mucus production, and (4) impairs pulmonary innate immunity. If exposure to PM during childhood is high, then symptoms suggestive of COPD will develop early.

Immunologic effects and Inflammation

The development of lung immunophenotype (i.e., the pattern of immunologic response in the lung) is considered to have a key role in determining the risk for asthma, particularly in regard to the T-helper 1 (Th1) pathway (which mediates cellular immunity) and the Th2 pathway (which mediates allergic responses). Secondhand smoke exposure may promote immunologic development along Th2 pathways, thus contributing to the intermediate phenotypes associated with asthma and with a predilection to chronic respiratory disease.

Secondhand smoke effects on T cells may influence gene regulation, inflammatory cell function, cytokine production, and immunoglobulin E (IgE) synthesis. These effects are particularly important to consider in regard to immune system ontogeny and for the subsequent development of allergies in childhood. Researchers have demonstrated that mainstream and side stream smoke condensates selectively suppress the interferon gamma induction of several macrophage functions, including phagocytosis of Ig-opsonized sheep red blood cells, class II major histocompatibility complex expression, and nitric oxide synthesis, which are all representative of effects on immunity [21]. Alterations in antigen presentation may occur not only in the respiratory tract but also in the rest of the body where absorbed toxicants are distributed. Macrophages are potent effector cells for immune responsiveness; suppression of their ability to respond to environmental challenges could have lifelong consequences on immune function.

There are many specific components of secondhand smoke that may adversely affect a child's lung. For example, a bacterial endotoxin known as lipopolysaccharide (LPS) can be detected in both mainstream and side stream tobacco smoke. Some suggested that chronic LPS exposure from cigarette smoke may contribute to the inflammatory effects of secondhand smoke. Other studies show that LPS exposure may alter responses to allergen challenge[22].

DISCUSSION

Children whose parents are smokers are at increased risk of SHS exposure in the home. There was also some evidence that children whose parents held more negative attitudes towards SHS were less likely to be exposed. Associations were strongest for parental cigarette smoking status; compared to children of non-smokers, those whose mothers or both parents smoked were between two and 13 times more likely to be exposed to SHS at home. The best way to prevent child SHS exposure in the home is by encouraging smoking parents to quit.

To improve child health, we therefore need interventions targeted at adults: preventing them

from taking up smoking, or helping them quit. One approach is that of individual prevention, which attempts to change parents' attitudes and educate them through individual counselling, education or smoking cessation programs. A second approach is structural, which depends on changing the environment and organizational structures by methods such as economic incentives, reducing the availability of cigarettes, tobacco-free advertising, or smoke-free public spaces 23.

Individual prevention remains important in clinical practice. Combining medication and counselling by a physician doubles the chance that individual smokers will quit, and is more cost-effective than other clinical interventions [19]. However, absolute rates of quitting remain low and smoking cessation programs, including nicotine replacement therapy; electronic cigarettes and nicotine vaccines have small effects 24, 25.

In line with the findings of this review, sociodemographic characteristics are often linked to health inequalities. Low SES is frequently reported to be associated with poorer health outcomes, health morbidity and mortality. There was also some evidence that children whose parents were single, separated or divorced were at increased risk of SHS exposure in the home. The greatest observed risks in this review were for children whose mothers 26 or both parents were smokers, which strongly suggests that the best way to reduce child SHS exposure in the home is for parents who smoke to quit. This finding has implications for younger children of pre-school age, who spends an increased proportion of their time at home with parents compared to older, school-aged children. In a recent review 27, the effectiveness of any one interventional approach to reduce children's SHS exposure was not conclusively demonstrated and as such there remains a need for novel, evidence-based interventions which are sensitive to both the context in which smokers live and smokers' environments. The Theory of Reasoned Action argues that interventions designed to change beliefs and attitudes can influence intentions and subsequent behavior across a range of health behaviors 28. Interventions targeting attitudes towards SHS by supporting parents to recognize the benefits of protecting their children from SHS may therefore be useful to promote smoke-free homes.

Changing attitudes alone may not be sufficient to change behavior. A combined approach that targets attitudinal change and provides practical context specific advice to parents, for example balancing child safeguarding with smoking outside of the home or negotiation with other household smokers, may be helpful.

CONCLUSION

Childhood respiratory disease covers a spectrum of diseases and underlying pathogenic mechanisms that include infection, prenatal alterations in lung structure, inflammation, and allergic responses. There is a potential for secondhand smoke to contribute over the long term to the development of respiratory disease through altered organ maturation and immune function. Mechanisms underlying the adverse health effects of secondhand smoke vary across the phases of lung growth and development, extending from the in utero period to the completion of lung growth in late adolescence. The long-term effects of secondhand smoke are a field of ongoing research. These effects may vary among individuals because of individual genetic susceptibilities and gene-environment interactions.

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A Juxtaposition of Bi-Cortical Screws and Erich's Arch Bar for Maxillomandibular Fixture

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Abstract

Background and Objectives:

Inter-maxillary fixation (IMF) plays a vital role in management of fractures involving maxilla and mandible. Various methods to achieve IMF were practiced in history. Most popular methods of IMF are by using Erich arch bar and IMF screws. Every method used for IMF have their own merits and demerits.

The objective of the study is to evaluate and compare the various parameters of the conventional arch bars and IMF screws in achieving inter-maxillary fixation.

Method:

Thirty dentulous patients who reported to Department of Oral and Maxillofacial Surgery, Daswani dental college & research Centre, Ranpur, Kota with maxillo-mandibular fractures and required inter-maxillary fixation as a part of treatment plan followed by open reduction and internal fixation were selected and randomly divided into 2 groups of 15 patients each that is Group A and Group B. Group A included patients who received inter-maxillary fixation with Erich arch bars. Group B includes patients who received inter-maxillary fixation with IMF Screws. The parameters compared in both the groups included, surgical time taken, post-operative mobility, IMF stability, oral hygiene and weight loss at the time of end of the 1st, 3rd and 6th week post-operatively.

Results:

The average surgical time taken and patient's weight loss were more in Group A, and oral hygiene was better in Group B but immobilization and stability of the jaws were comparatively better in Group-A, there was not much statistically significant difference in postoperative immobilization and IMF stability in both groups.

Conclusion:

Both the techniques offer good temporary inter-maxillary fixation. The benefits and risks of both the techniques should be weighed depending on the type of fracture we are dealing with.

Keywords:

Erich's arch bar, IMF screws, Inter-maxillary fixation.

INTRODUCTION

Mandibular fractures were first described in 1650 BC, when Papyrus, an Egyptian described the examination, diagnosis, and treatment of mandible fractures. Mandibular fractures during that period had high morbidity due to lack of proper treatment. Occlusion is the way in which one's maxillary and mandibular teeth relate to each other when the jaw is closed. When treating fractures of the mandible, the first and primary objective is to re-establish the patient's premorbid occlusion.

Inter-maxillary fixation (IMF) plays a vital role in management of fractures involving maxilla and mandible & helps in stabilizing the patient's occlusion and thus reduction in fracture segments. The purpose of this randomised prospective controlled clinical study is to compare the efficacy of IMF screws with Erich arch bars in achieving intermaxillary fixation for treatment of mandibular fractures. Various parameters for comparison include: occlusal stability during fixation, Mobility of the fracture segments, time taken for each procedure during placement, weight loss and Oral hygiene intra & post operatively.

AIMS & OBJECTIVES

Aims:

- To assess the ideal technique of immobilization for inter-maxillary fixation in maxillo-mandibular trauma.

Objectives:

- To assess and determine the time period for inter-maxillary fixation (IMF).
- To assess intra and post-operative occlusion stability and mobility.
- To compare the amount of weight loss.
- Assess the oral hygiene during the treatment period.

MATERIAL & METHODOLOGY

Materials:

A prospective randomized Comparison clinical study was conducted between 2018 to 2020. The study was conducted in the Department of Oral and Maxillofacial surgery, Daswani dental college and research Centre, Ranpur, Kota. 30 patients were randomly selected for the study to evaluate the efficacy of Erich's arch bar and IMF screws as a mean of intermaxillary fixation in the treatment of mandibular fractures. The selected cases will be treated by closed reduction and internal fixation under GA. In these, 15 cases with Erich's arch bar with 26 gauge stainless steel wire and 15 cases with IMF screws will be used as a method of inter-maxillary fixation intra-operatively. Here, All the procedures for IMF were performed in the same institution. After that, Pre-operative, intra operative and post-operative on end of the 1st, 3rd and 6th week assessment was done. Inter-maxillary fixation will be achieved with Erich's arch bar and 26 gauge stainless steel wire. (Figure-1)

IMF screws of 2/2.5mm diameter, 8/10 mm length. The screw has a pointed tip and its head having a slot where the 26 gauge wire can be passed for inter-maxillary fixation. (Figure-2)

SELECTION CRITERIA

Inclusion Criteria:

- patients undergoing close reduction
- all types of mandibular fractures
- unilateral maxillary fractures
- dento-alveolar fractures.

Exclusion Criteria:

- Le-fort I, II, III
- Zygomatic and naso-ethomoidal fractures
- Orbital fractures
- Pediatric patients.
- Patients with mobile teeth.
- Edentulous patients.
- Panfacial trauma

METHODOLOGY

The patients between the age group of 16–60 years with single or multiple maxillary / mandibular fracture were included in this study. Edentulous patients, patients with underlying systemic disease (American Society of Anaesthesiologists III and IV), pathologic fractures, comminuted fracture of mandible, patients with multiple fractures (para-symphysis with angle, associated condylar fractures, and maxillary fractures), and patients having primary and mixed dentition were also included from the study. The selection of the patients was done by simple randomized enveloped method and designated as Group A and Group B. Group A patients received IMF with Erich arch bars and Group B patients received IMF with IMF screws.

Group-A patients would be treated with Erich arch bar for either of the jaws which is stabilized by 26 gauge stainless steel wires and further inter-maxillary fixation is done with the box wires. Irrespective of open or closed method, this group had 15 patients. The method used for the placement of Erich arch bar is as follows. (Figure-1)

After appropriate anaesthesia, a prefabricated arch bar with hooks incorporated on the outer surface with flat malleable stainless steel metal strip was cut accurately to the length of both upper and lower dental arches. On the upper jaw, the hooks were arranged in an upward direction and to the lower jaw in a downward direction. The arch bar was adapted to the buccal surface of each arch and given shape of the arch by bending it, starting from the mesial part of last tooth progressing past the midline and finishing at the other end. It was fixed to each tooth, using prestretched 26-gauge stainless steel wire, which is passed from mesial surface of tooth to the lingual side and back on the buccal side from the distal surface of the tooth, making sure that one end of the wire is passing above the arch bar and the other below it. (Figure-4 A,B,C)

After this, both ends of the wire were twisted together in a clockwise manner and the arch bar was attached securely and firmly to the necks of each tooth on the buccal surface of the arch. Open reduction and internal fixation were then carried out using conventional miniplate/screw system with a single design and configuration, i.e., 2 mm thickness, 4-hole plate with gap in all cases based on Champy's lines of osteosynthesis. Arch bar was left in place for 4–6 weeks to enable the postoperative traction to correct the small discrepancies in occlusion.

Group-B patients inter-maxillary fixation is done by IMF was achieved by the use of six stainless steel IMF screws of 2 mm diameter and 8 mm or 10 mm length. (Figure-2)

After appropriate anesthesia, holes are drilled through mucosa with 1.5 mm or 1.7 mm drill bits, without any gingival incision preferably between the canine and first premolar teeth in each quadrant, and the third pair of IMF screws was inserted in the same way in the upper and lower dental midlines. After this, IMF screws were inserted through the predrilled holes, taking care not to penetrate the lingual or palatal mucosa. IMF was achieved using wires or elastic bands. (Figure-7 A,B) (CUT) Open reduction and internal fixation were then carried out using conventional miniplate/screw system with a single design and configuration, i.e., 2 mm thickness, 4-hole plate with gap in all cases based on Champy's lines of osteosynthesis. Screws were left in place for 4–6 weeks.

The follow-up periods were 1 week post-operative, 3 week post-operative and 6th week post-operatively. During the whole study, only one operating surgeon was involved although the assistants varied. The following parameters were recorded, tabulated, and subjected to statistical analysis. In our present study intra-operative occlusion is taken as a key for further follow-up of stability of occlusion, mobility of the jaw, time required for fixation, maintenance of oral hygiene (Figure-10,11) (CUT) and amount of weight loss.

Criteria Used:

a) **Time**: It is noted from the start of the first wire passed till inter-maxillary fixation.
b) **Occlusion Stability**: This is measured by the occlusion achieved at the time of reduction which is adequate or present and inadequate or absent. The molar relations are key for occlusion, which is assessed in the follow-up after the release of inter-maxillary fixation.
c) **Weight:** The weight of the patient is taken pre-operatively and it re-measured every follow-up visit.

d) **Oral Hygiene**: This is measured by OHIS index in every follow-up as oral hygiene maintenance by patient.

e) **Occlusion Mobility:** This is measured by observation and palpation of the fracture segments of the jaw and evaluated as mild, moderate, severe and absent according to the mobility of the segments.

RESULTS

The results showed that erich's arch bar needed more time for fixation when compared with IMF screws. (Fig.a) Erich's arch bar had superior stability and poor oral hygiene (Fig. b & e) than IMF screws. Weight was reduced with both arch bar and IMF screws but arch bar showed more reduction comparatively (Fig. c).

Timing

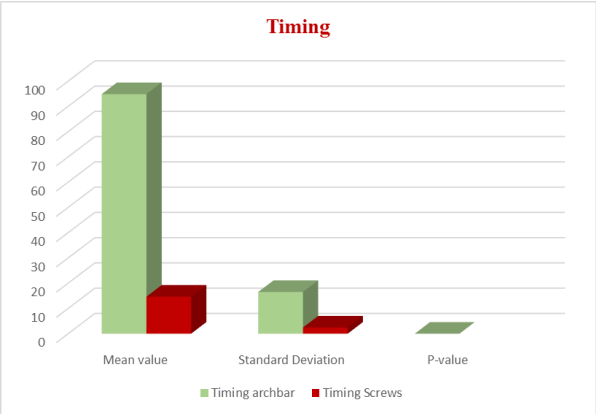

Figure a.

Oral Hygiene

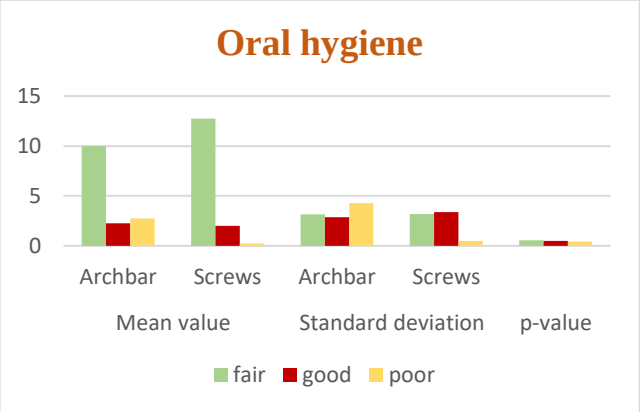

Figure b.

Weight

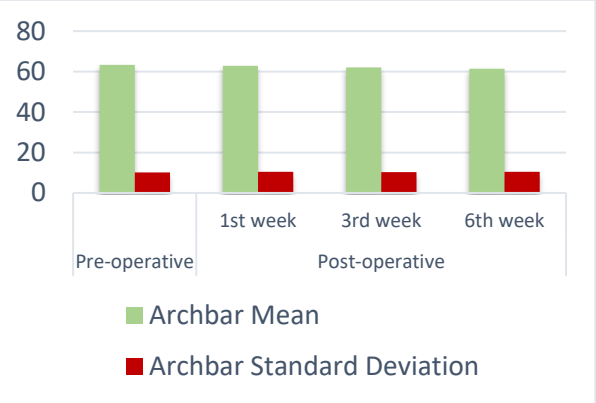

Figure c.

Mobility

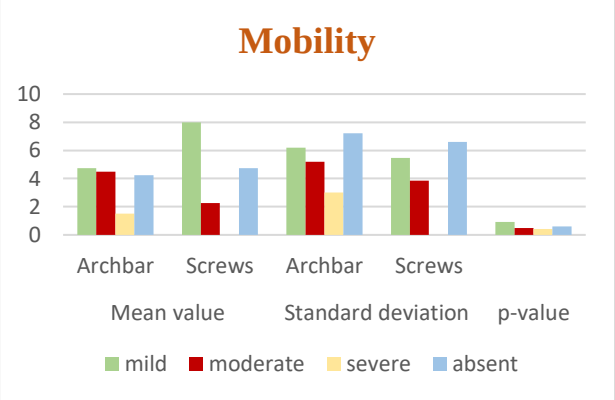

Figure d.

Stability

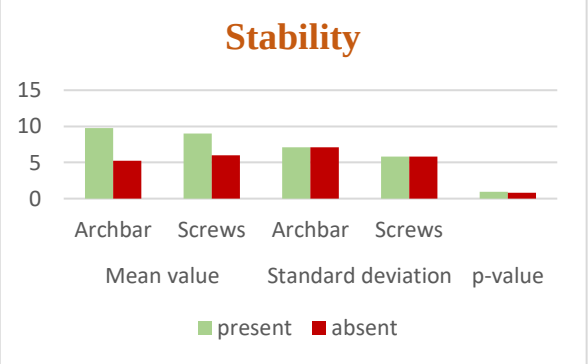

Figure e.

DISCUSSION

As said by **Arthur** and **Berardo, Jones, Fabbroni *et al*., Roccia *et al*.,** and **Coletti *et al*** [5,6.7], the maximum time taken for arch bar fixation was 120 min and in case of IMF screws only 20 min in this study. IMF screws fixation is four to six points fixation where Erich's arch bar fixation includes whole dentition which have multiple point fixation, so the Erich's arch bar technique is more time consuming for fixation when compare with IMF screws technique.

As said by **Roccia *et al*.** and **Qureshi AA *et al*** [4,7]**,** stability was found more adequate in relation to Erich's arch bars compared to IMF screws. In Erich's arch bar fixation it includes complete dentition for fixation and there are multiple points for fixation where as in IMF screws fixation there are only four to six point of fixation that's the reason that the stability is comparatively better in Erich's arch bar technique compare to IMF screw technique.

As said by **Nandini *et al*** and **Bergh *et al*** [1,2] **,** Oral hygiene of all the patients was found to be good, and in fact, it had improved postoperatively after meticulous oral hygiene instructions with IMF screws, but it was found to be very poor in patients with Erich arch bars.

As said by **Nandini *et al*** and **Anshul *et al*** [1,8], it was found that due to inadequate nutrition intake in cases of Erich's arch bar and IMF screws. The patients were advised to adhere to strictly liquid diet to immobilize the maxilla-mandibular relation for competent healing. Liquid diet is nutritionally insufficient as many macro nutrition cannot be given to the patient by the oral route. As the Erich's arch bar involves too much of the wire components, patients were unable to keep a proper oral hygiene. Lack of oral hygiene, psychologically deprived the patients from accepting food and hence more weight reduction was found in this patients. In IMF screws, limited wire component did not caused the patients the lack of oral hygiene hence the psychologically the acceptability of the food was maintained. So, the weight reduction was less in relation to the Erich's arch bar. But weight loss was a consistent feature in both, due to liquid diet.

As said by **Bergh *et al* and YK Sandhu *et al*** [2,3]**,** IMF screw have only four to six point fixation hence less stable and of limited use, on the contrary Erich' had multiple point of fixation and generally involves the entire dentition hence more stable and rigid. Because of four to six stable points are there in IMF screws it has limited application for simple fractures (symphysis & para-symphysis) on the contrary in the Erich's ach bar as it has multiple stable points it can be used for right from the simple fracture to all types of comminuted fractures.

SUMMARY AND CONCLUSION

Inter-maxillary fixation (IMF) plays a vital role in management of fractures involving maxilla and mandible & helps in stabilizing the patient's occlusion and thus reduction in fracture segments. Erich arch bar provides good stable immobilization of fracture fragments during fixation. We conclude that the use of both the techniques in achieving inter-maxillary fixation is efficacious with both the techniques having merits and demerits over each other. Use of arch bars as seen in our results has a few disadvantages over IMF screws like time consumed in application and removal is more, increased number of needle stick injuries, difficulty in maintaining oral hygiene and weight loss due to lack of nutrition, however it has its own advantages like it can be used in the treatment of dento-alveolar fractures, multiple teeth bearing fractured fragments can be reduced into an arch form and comparatively good stability and rigidity of the jaws.

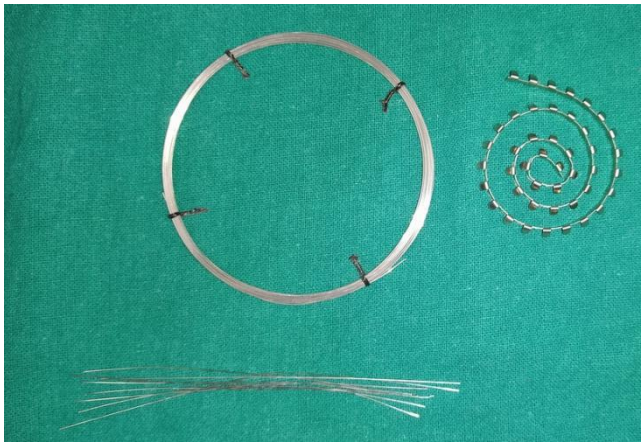

Figure-1: Erich's Arch Bar, 26 Gauge Stainless Steel Wires

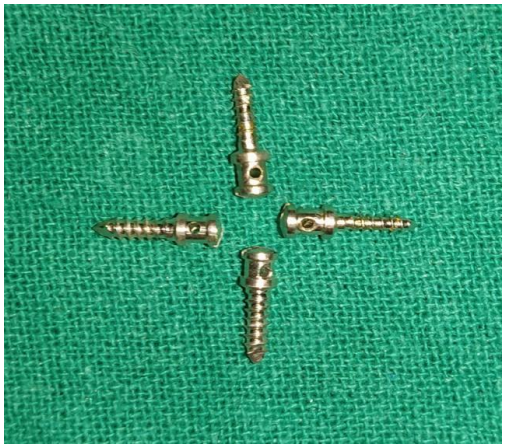

Figure-2: 2.5 mm * 8mm/10mm length IMF Screws

Figure-3: Instruments & Materials

Figure-4 (A)

Figure-4 (B)

Figure-4 (C)

Figure-4: (A, B, C): IMF Wiring with Erich's Arch Bar Technique

Figure -5 (a)

Figure-5 (b)

Figure-6: Occlusal after Erich's Arch Bar Removal

Figure-7: Occlusal after Erich's IMF Screws Removal

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Comparative Evaluation of the Efficacy & Pain Perception using Four Types of Orthodontic Separators

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Abstract To evaluate the amount of separation produced by four types of orthodontic separators viz. the elastomeric separator, Kesling separator, Kansal separator and Dumbbell separator and determine the patient's perception of pain and discomfort caused by these four types of separators. Evaluate the time taken to achieve adequate separation and record the number of different separators lost.Time taken for adequate separation was significant in all the 4 separators; dumbbell being the fastest followed by elastomeric separator.

Keywords: Visual analogue scale (VAS), Reproximation, Hyalinised, Qestionnaire, ANOVA

INTRODUCTION

Separators are used in dental practice to create a space usually between molars prior to placement of orthodontic bands and crown restoration. A separator is considered ideal if it is easy to place, radiolucent, provides sufficient separation with minimum pain and discomfort, with minimum or no loss after placement.[1]

Pain and discomfort[2] due to separator placement is the most common chief complaint of the patients and one of the reasons for avoiding orthodontic treatment[3, 4]. Since, there is limited research data[5] available on orthodontic separators; our study was designed to compare efficacy of different separators.

AIMS AND OBJECTIVES

The aims and objectives of our study were

1) To evaluate the amount of separation produced by four types of orthodontic separators viz. the elastomeric separator, Kesling separator, Kansal separator and Dumbbell separator.
2) To evaluate the time taken to achieve adequate separation
3) To determine the patient's perception of pain and discomfort caused by these four types of separators.
4) To record the number of different separators lost

MATERIALS AND METHODS

The study population consisted of 40 subjects (20 girls and 20 boys) in the age range of 12-16 years. The subjects were randomly selected from patients visiting the Department of Orthodontics and Dentofacial Orthopedics Mahatma Gandhi Dental College & Hospital, Jaipur, Rajasthan. The ethical clearance for the study was obtained from Institutional Ethical Committee of Mahatma Gandhi Dental College and Hospital, Jaipur.

INCLUSION CRITERIA

1) Healthy patients requiring fixed orthodontic treatment in maxillary and mandibular arches with no systemic disease.
2) Patients with bilaterally tight contact between 2nd premolar, 1st molar and 2nd molar.
3) Healthy periodontium
4) Fully erupted mandibular second molar

EXCLUSION CRITERIA

1) Patients with gingival and periodontal problems
2) Root Canal Treated teeth in the arch
3) Patients undergoing orthodontic treatment
4) Presence of inter-proximal caries or restorations
5) Presence of inter-dental spaces

Apparatus used in this study (Fig-1 and Fig-2)

1. Elastomeric separator
2. Kesling separator
3. Kansal separator
4. Dumbbell separator
5. Separator placing plier
6. Straight howe plier
7. Light wire plier
8. Leaf gauge

Fig. 1: Different Separators and Separator Placing Plier

Fig. 2: Leaf Gauge

Method of Collection of Data

The above mentioned four separators were placed alternately in four different quadrants in each patient to avoid right and left and maxillary and mandibular bias. Kansal and Kesling separators were placed using a light wire plier, Elastomeric and Dumbbell separator were placed using a separator placing plier and straight howe plier (Fig-3and fig-4). The patient was evaluated for 5 days for amount of separation, pain perception and loss of separator in each quadrant. After air-spray drying of the maxillary molars, the amount of separation of each maxillary first molar, was measured mesially and distally with a leaf gauge (sensitivity 5/100mm). Pain and discomfort was assessed with the help of visual analogue scale (VAS).

Fig. 3: Separators Placement: A. Kansal separator in maxillary right side **B.** Dumbbell separator in maxillary left side **C**. Elastomeric separator in mandibular right side **D**. Kesling separator in mandibular left side.

Fig. 4: After Separators Placed In: A. Maxillary arch (Right and Left side) **B.** Mandibular arch (Right and Left side)

Measuring the Separating Effect

The separators were kept for 5 days and the number of times separators were lost, was recorded. The Kansal and Kesling were removed with light wire plier, elastomerics were removed with a curved probe, and dumbbell separator were removed with straight howe plier. After removal of separators, air-spray drying was done and the amount of separation of each maxillary and mandibular first molar was measured mesially and distally with a leaf gauge (Fig-5). The duration to achieve required separation (0.2 mm) was also noted.

Fig. 5: Amount of separation measurement with leaf gauge

Measurement of Patient Perception of Pain or Discomfort

A questionnaire consisting of 13 questions was given to the patient before and after placement on 1st day, 2nd day, 3rd day, 4th day and before and after removal on 5th day (Table 1). The patients were given written and oral instructions, with an explanation on how to fill the questions.First, an initial survey assessing the baseline perception of pain and discomfort at was done. Then questions regarding pain perception were asked before and immediately after placement of the separators, as well as once a day at home for the following 3 days. Finally, the two remaining questionnaires were completed on day 5 at the clinic during removing of separators. The questionnaires consisted of 13 questions describing pain and discomfort. 8 questions used a visual analogue scale (VAS), with scores ranging from 0 (no pain) through 5 (Moderate pain) to 10 (Worst possible pain) (Fig 6.) Rest 5 questions had Yes/No as choices and patients were supposed to choose either.

Table 1- Questionnaire

1.	Do your upper molars (back teeth) hurt when you chew on the right side ?	☐
2.	Do your upper molars (back teeth) hurt when you chew on the left side?	☐
3.	Do your lower molars (back teeth) hurt when you chew on the right side ?	☐
4.	Do your lower molars (back teeth) hurt when you chew on the left side?	☐
5.	Do your upper molars (back teeth) hurt at rest on the right side ?	☐
6.	Do your upper molars (back teeth) hurt at rest on the left side ?	☐
7.	Do your lower molars (back teeth) hurt at rest on the right side ?	☐
8.	Do your lower molars (back teeth) hurt at rest on the left side ?	☐

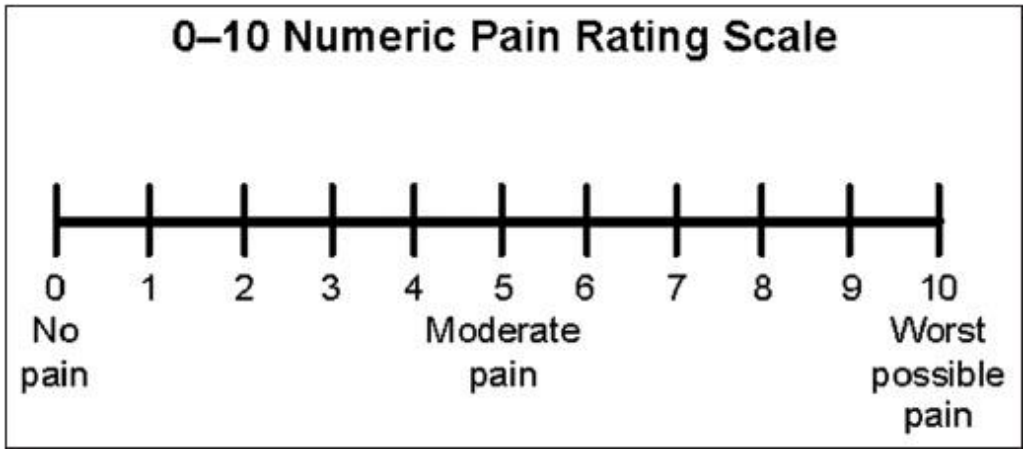


Fig 6: VAS Scale for pain measurement

Five questions had to be answered with fixed answers by choosing Yes or No

1.	Has it hurt so much that you have changed your diet to soft food? (Ex.: Yogurt, Banana)	Yes / No
2.	Has it hurt so much that your leisure activities were influenced? (Ex.: Music, sports, time with friends)	Yes / No
3.	Has it hurt so much that your schoolwork was influenced?	Yes / No
4.	Has it hurt so much that you have been awake in the night?	Yes / No
5.	Has it hurt so much that you had to take pain killers?	Yes / No

STATISTICAL ANALYSIS

All statistical analyses were performed using IBM SPSS 23.0. The following calculations were used in the present investigation:

ANOVA ONE-WAY TEST

The One-way ANOVA compares the means of the samples or groups in order to make inferences about the population means.

Post Hoc Test

Post hoc tests are run to confirm where the differences occurred between groups, they should only be run when you have a shown an overall statistically significant difference in group means (i.e., a statistically significant one-way ANOVA result).

Student T Test

A "T" test most commonly applied when the test statistic would follow a normal distribution if the value of a scaling term in the test statistic were know.

RESULTS

Table 2 and 3 shows amount of separation in different types of separators.

S.No.	Name of separator	N	Mean±SD	P
1.	**Dumbbell**	40	.3663±.07106	.000
2.	**Kesling**	40	.2188±.05739	
3.	**Kansal**	40	.1525±.03387	
4.	**Elastomeric**	40	.2250±.05189	

*. The mean difference is significant at the 0.05 level.

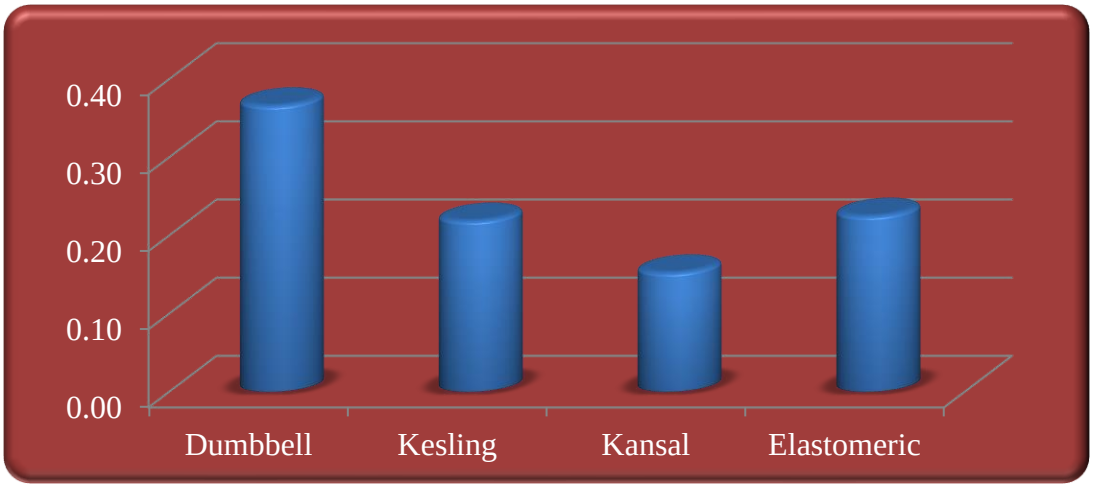
Table 2: Shows amount of separation in different types of separators

		Mean	P
Dumbbell	Kesling	.14750*	.000
	Kansal	.21375*	.000
	Elastomeric	.14125*	.000
Kesling	Dumbbell	-.14750*	.000
	Kansal	.06625*	.000
	Elastomeric	-.00625	.957
Kansal	Dumbbell	-.21375*	.000
	Kesling	-.06625*	.000
	Elastomeric	-.07250*	.000
Elastomeric	Dumbbell	-.14125*	.000
	Kesling	.00625	.957
	Kansal	.07250*	.000

*. The mean difference is significant at the 0.05 level.

Table 3: Multiple Comparisons in amount of separation in different types of separators

The results show that the amount of separation was significantly different between four type of separators – dumbbell, kesling, kansal and elastomeric. The mean separation was 0.36 mm for dumbbell, 0.21 for kesling, 0.15 mm for kansal and 0.22 for elastomeric (Table-2). There was no statistically significant difference between elastomeric and kesling (Table-3) (Graph-1).



Graph 1: Shows amount of separation in different types of separators

Table 4 and 5: Show time taken for adequate separation in different types of separation.

S.No.	Name of Separator	n	Mean±SD	P
1.	Dumbbell	40	2.425±.5006	.000
2.	Kesling	40	4.475±.5057	
3.	Kansal	40	4.575±.5006	
4.	Elastomeric	40	3.425±.5006	

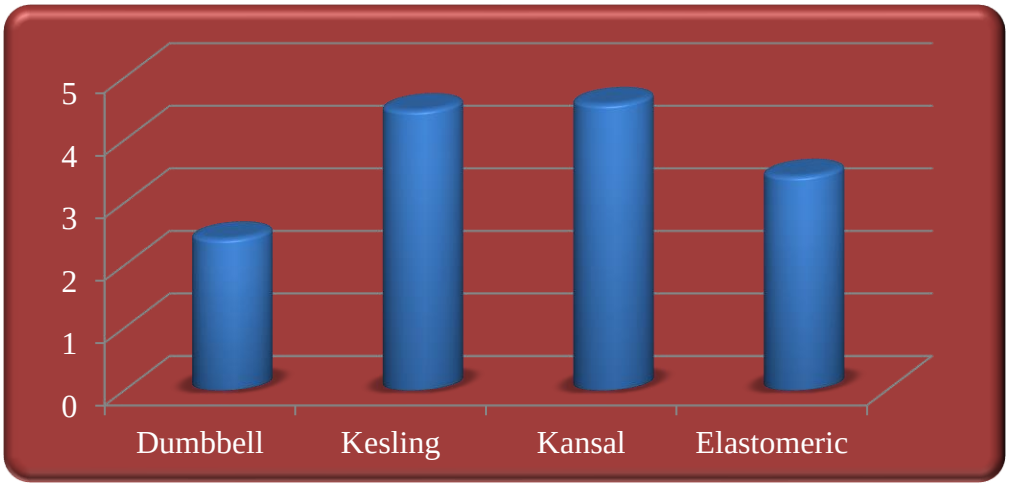
Table 4: Show time taken for adequate separation in different types of separators

		Mean	P
Dumbbell	Kesling	-2.0500*	.000
	Kansal	-2.1500*	.000
	Elastomeric	-1.0000*	.000
Kesling	Dumbbell	2.0500*	.000
	Kansal	-.1000	.810
	Elastomeric	1.0500*	.000
Kansal	Dumbbell	2.1500*	.000
	Kesling	.1000	.810
	Elastomeric	1.1500*	.000
Elastomeric	Dumbbell	1.0000*	.000
	Kesling	-1.0500*	.000
	Kansal	-1.1500*	.000

***. The mean difference is significant at the 0.05 level.**

Table 5: Show Multiple Comparisons in time taken for adequate separation in different types of separators

Adequate separation was considered 0.2 mm because molar band material thickness is .005 inch /0.127 mm. It was found that the time taken for adequate separation was significant in all the 4 separators; dumbbell being the fastest followed by elastomeric separator. There was no significant difference between kesling and kansal separator. The mean of time take for adequate separation was 2.4 days for dumbbell, 4.4 days for kesling, 4.5 days for kansal and 3.4 days for elastomeric separator (Table-4, 5) (Graph-2).



Graph 2: Shows time taken for adequate separation (days) in different types of separators

Table 6: Show pain and discomfort at rest in different types of separators**.**

		N	Mean	SD	P-Value
Day1_Before placement	Dumbbell	40	0.000	0.0000	
	Kesling	40	0.000	0.0000	
	Kansal	40	0.000	0.0000	
	Elastomeric	40	0.000	0.0000	
	Total	**160**	**0.000**	**0.0000**	
Day1_After placement	Dumbbell	40	.500	.5064	
	Kesling	40	0.000	0.0000	
	Kansal	40	0.000	0.0000	0.0000
	Elastomeric	40	0.000	0.0000	
	Total	**160**	**.125**	**.3318**	
Day 2	Dumbbell	40	2.075	.5256	
	Kesling	40	.475	.5541	
	Kansal	40	.375	.4903	0.0000
	Elastomeric	40	1.250	.5430	
	Total	**160**	**1.044**	**.8640**	
Day 3	Dumbbell	40	3.775	.7334	
	Kesling	40	1.300	.4641	
	Kansal	40	1.025	.3572	0.0000
	Elastomeric	40	2.325	.4743	
	Total	**160**	**2.106**	**1.2006**	
Day 4	Dumbbell	40	1.900	.5905	
	Kesling	40	.450	.5038	
	Kansal	40	.325	.4743	0.0000
	Elastomeric	40	1.250	.5883	
	Total	**160**	**.981**	**.8353**	
Day5_Before remove	Dumbbell	40	.775	.5768	
	Kesling	40	0.000	0.0000	
	Kansal	40	0.000	0.0000	0.0000
	Elastomeric	40	0.000	0.0000	
	Total	**160**	**.194**	**.4415**	
Day5_After remove	Dumbbell	40	.250	.4385	
	Kesling	40	0.000	0.0000	
	Kansal	40	0.000	0.0000	0.0000
	Elastomeric	40	0.000	0.0000	
	Total	**160**	**.063**	**.2428**	

Table 7: Show Multiple Comparisons pain and discomfort at rest in different types of separators.

Tukey HSD				
Dependent Variable			**Mean Difference (I-J)**	**Sig.**
Day1_After placement	Dumbbell	Kesling	.5000*	.000

		Kansal	.5000*	.000
		Elastomeric	.5000*	.000
	Kesling	Dumbbell	-.5000*	.000
		Kansal	0.0000	1.000
		Elastomeric	0.0000	1.000
	Kansal	Dumbbell	-.5000*	.000
		Kesling	0.0000	1.000
		Elastomeric	0.0000	1.000
	Elastomeric	Dumbbell	-.5000*	.000
		Kesling	0.0000	1.000
		Kansal	0.0000	1.000
Day 2	Dumbbell	Kesling	1.6000*	.000
		Kansal	1.7000*	.000
		Elastomeric	.8250*	.000
	Kesling	Dumbbell	-1.6000*	.000
		Kansal	.1000	.833
		Elastomeric	-.7750*	.000
	Kansal	Dumbbell	-1.7000*	.000
		Kesling	-.1000	.833
		Elastomeric	-.8750*	.000
	Elastomeric	Dumbbell	-.8250*	.000
		Kesling	.7750*	.000
		Kansal	.8750*	.000

Day3	Dumbbell	Kesling	2.4750*	.000
		Kansal	2.7500*	.000
		Elastomeric	1.4500*	.000
	Kesling	Dumbbell	-2.4750*	.000
		Kansal	.2750	.094
		Elastomeric	-1.0250*	.000
	Kansal	Dumbbell	-2.7500*	.000
		Kesling	-.2750	.094
		Elastomeric	-1.3000*	.000
	Elastomeric	Dumbbell	-1.4500*	.000
		Kesling	1.0250*	.000
		Kansal	1.3000*	.000
Day 4	Dumbbell	Kesling	1.4500*	.000
		Kansal	1.5750*	.000
		Elastomeric	.6500*	.000
	Kesling	Dumbbell	-1.4500*	.000
		Kansal	.1250	.731
		Elastomeric	-.8000*	.000
	Kansal	Dumbbell	-1.5750*	.000
		Kesling	-.1250	.731
		Elastomeric	-.9250*	.000
	Elastomeric	Dumbbell	-.6500*	.000

		Kesling	.8000*	.000
		Kansal	.9250*	.000
Day5_Before remove	Dumbbell	Kesling	.7750*	.000
		Kansal	.7750*	.000
		Elastomeric	.7750*	.000
	Kesling	Dumbbell	-.7750*	.000
		Kansal	0.0000	1.000
		Elastomeric	0.0000	1.000
	Kansal	Dumbbell	-.7750*	.000
		Kesling	0.0000	1.000
		Elastomeric	0.0000	1.000
	Elastomeric	Dumbbell	-.7750*	.000
		Kesling	0.0000	1.000
		Kansal	0.0000	1.000
Day5_After remove	Dumbbell	Kesling	.2500*	.000
		Kansal	.2500*	.000
		Elastomeric	.2500*	.000
	Kesling	Dumbbell	-.2500*	.000
		Kansal	0.0000	1.000
		Elastomeric	0.0000	1.000
	Kansal	Dumbbell	-.2500*	.000
		Kesling	0.0000	1.000
		Elastomeric	0.0000	1.000
	Elastomeric	Dumbbell	-.2500*	.000

*. The mean difference is significant at the 0.05 level.

Table 8: Show multiple comparisons in pain and discomfort at rest in different types of separators

		N	Mean	Std. Deviation	P-Value
Day1_Before placement	Dumbbell	40	0.000	0.0000	
	Kesling	40	0.000	0.0000	
	Kansal	40	0.000	0.0000	
	Elastomeric	40	0.000	0.0000	
	Total	**160**	**0.000**	**0.0000**	
Day1_After placement	Dumbbell	40	.600	.4961	
	Kesling	40	0.000	0.0000	
	Kansal	40	0.000	0.0000	.000
	Elastomeric	40	0.000	0.0000	
	Total	**160**	**.150**	**.3582**	
Day 2	Dumbbell	40	2.425	.5943	
	Kesling	40	.900	.4961	
	Kansal	40	.700	.4641	.000
	Elastomeric	40	1.725	.4522	
	Total	**160**	**1.438**	**.8518**	
Day 3	Dumbbell	40	4.750	.8697	.000

	Kesling	40	1.775	.5768	
	Kansal	40	1.475	.5057	
	Elastomeric	40	2.725	.4522	
	Total	**160**	**2.681**	**1.4247**	
Day 4	Dumbbell	40	2.475	.5986	.000
	Kesling	40	.600	.5905	
	Kansal	40	.525	.5057	
	Elastomeric	40	1.500	.5547	
	Total	**160**	**1.275**	**.9710**	
Day5_Before remove	Dumbbell	40	.950	.6385	.000
	Kesling	40	0.000	0.0000	
	Kansal	40	0.000	0.0000	
	Elastomeric	40	0.000	0.0000	
	Total	**160**	**.238**	**.5199**	
Day5_After remove	Dumbbell	40	.250	.4385	.000
	Kesling	40	0.000	0.0000	
	Kansal	40	0.000	0.0000	
	Elastomeric	40	0.000	0.0000	
	Total	**160**	**.063**	**.2428**	

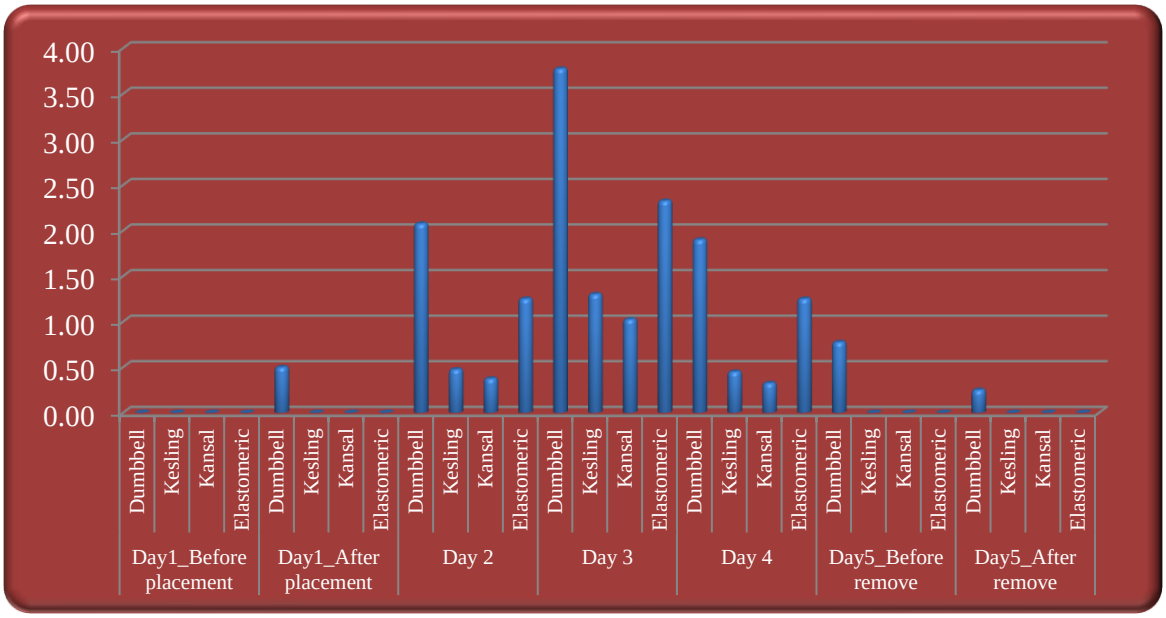
Table 8: Show pain and discomfort at chewing in different types of separators

Table 9: Show multiple comparisons in pain and discomfort at chewing in different types of separators.

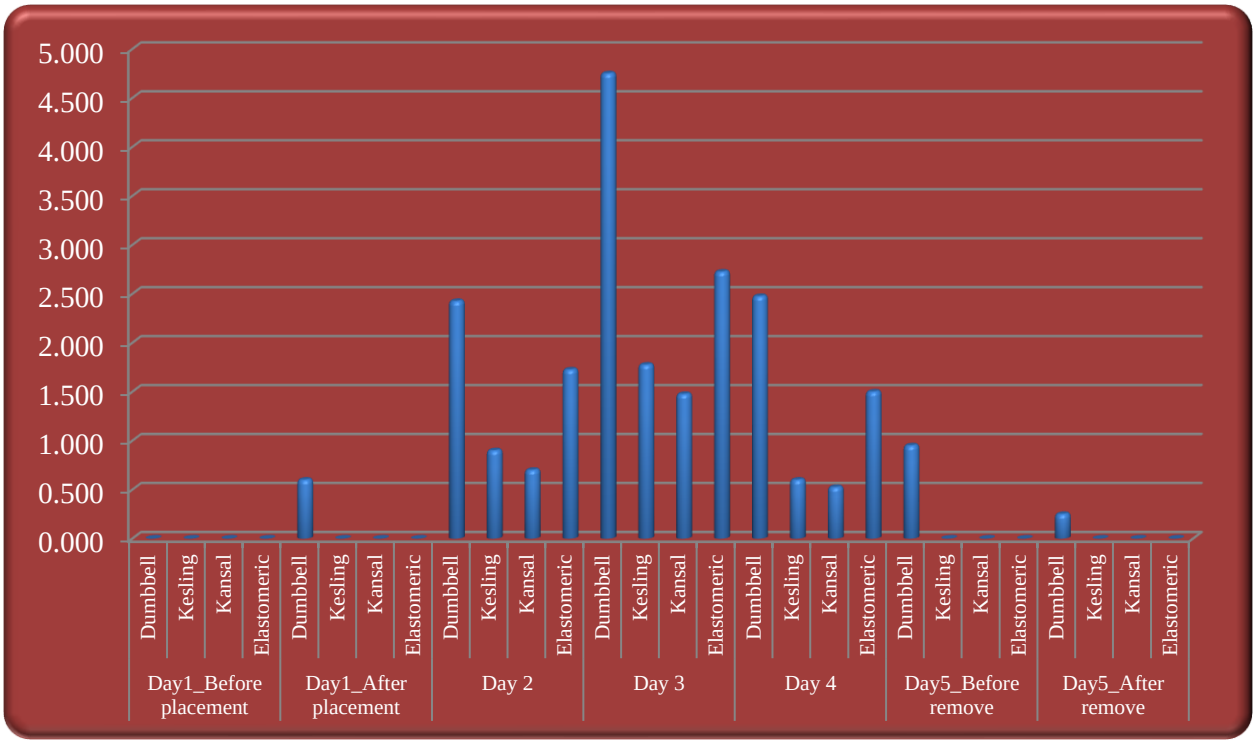
Dependent Variable			**Mean Difference (I-J)**	**Sig.**
Day1_After placement	Dumbbell	Kesling	.6000*	.000
		Kansal	.6000*	.000
		Elastomeric	.6000*	.000
	Kesling	Dumbbell	-.6000*	.000
		Kansal	0.0000	1.000
		Elastomeric	0.0000	1.000
	Kansal	Dumbbell	-.6000*	.000
		Kesling	0.0000	1.000
		Elastomeric	0.0000	1.000
	Elastomeric	Dumbbell	-.6000*	.000
		Kesling	0.0000	1.000
		Kansal	0.0000	1.000
Day 2	Dumbbell	Kesling	1.5250*	.000
		Kansal	1.7250*	.000
		Elastomeric	.7000*	.000
	Kesling	Dumbbell	-1.5250*	.000

		Kansal	.2000	.291
		Elastomeric	-.8250*	.000
	Kansal	Dumbbell	-1.7250*	.000
		Kesling	-.2000	.291
		Elastomeric	-1.0250*	.000
	Elastomeric	Dumbbell	-.7000*	.000
		Kesling	.8250*	.000
		Kansal	1.0250*	.000
Day 3	Dumbbell	Kesling	2.9750*	.000
		Kansal	3.2750*	.000
		Elastomeric	2.0250*	.000
	Kesling	Dumbbell	-2.9750*	.000
		Kansal	.3000	.140
		Elastomeric	-.9500*	.000
	Kansal	Dumbbell	-3.2750*	.000
		Kesling	-.3000	.140
		Elastomeric	-1.2500*	.000
	Elastomeric	Dumbbell	-2.0250*	.000
		Kesling	.9500*	.000
		Kansal	1.2500*	.000

Patients had no pain before placement of separators at rest and at chewing in both maxillary and mandibular arch in all types of separators. Only dumbbell separator was painful throughout, at rest and at chewing at day 1 after placement and day 5 before and after removal. Other three separators were painful at day 2, 3, 4 both at rest and at chewing. Pain was more in all the separators on chewing than rest position from day 1 to day 5. Statistically significant difference between all four type of separators at rest and chewing is shown in table 6, 7, 8, 9 and graph 3, 4.



Graph 3: Show pain and discomfort at rest in different types of separators



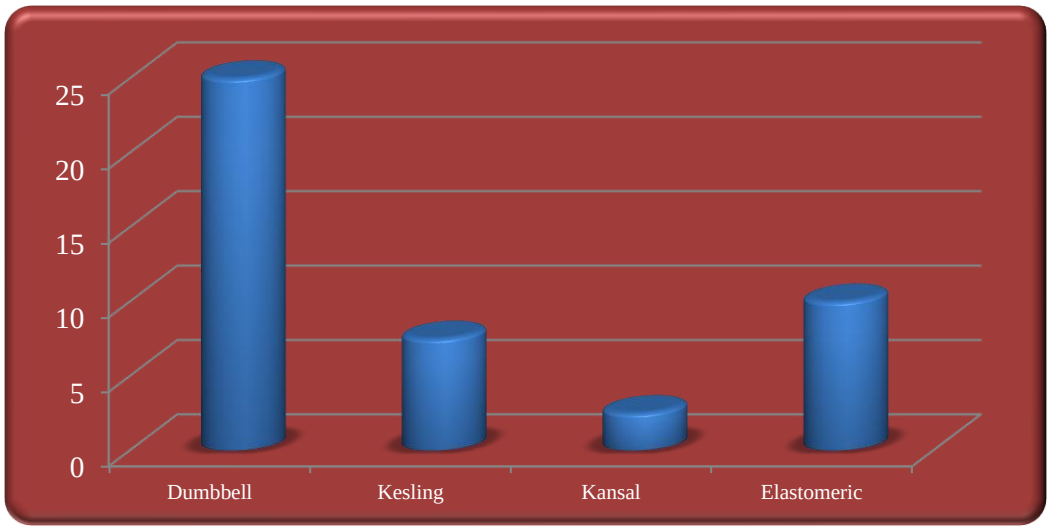
Graph 4: Show pain and discomfort at chewing in different types of separators

Table 10: Shows the percentage of patients in whom the separator lost and percentage of separator lost.

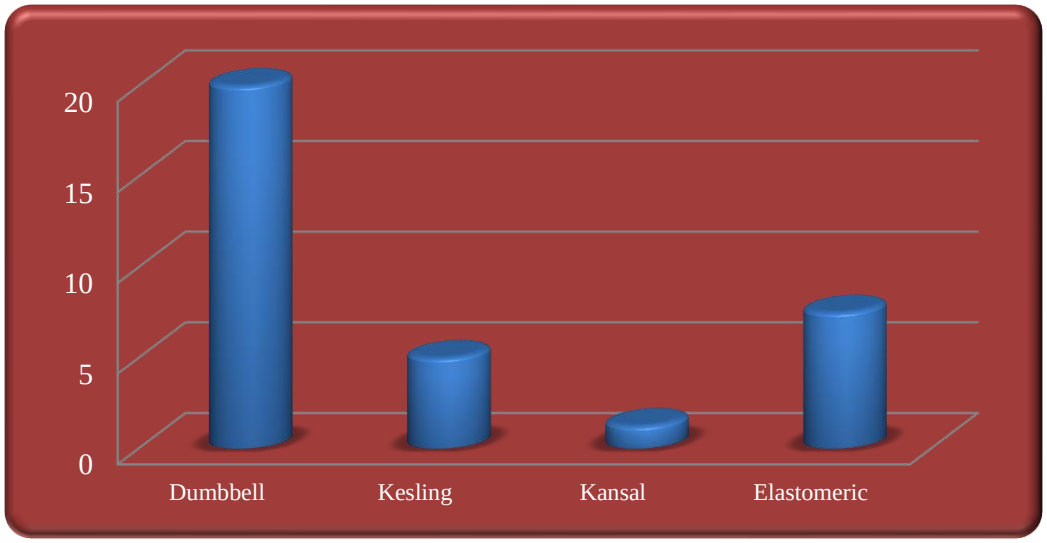
Name of separator	No. of patients in whom the separator lost		Total No. of separator lost	
	No.	%	No.	%
Dumbbell	10	25	16	20
Kesling	3	7.5	4	5
Kansal	1	2.5	1	1.25

Elastomeric	4	10	6	7.5

The study shows that total 27 separators were lost; 16 dumbbell, 4 kesling, 1 kansal and 6 elastomeric separator. Dumbbell separator showed (20%) highest frequency of loss and kansal separator the least (1.25%) (Table-10) (Graph-5, 6).



Graph 5: Shows the percentage of patients in whom the separator lost



Graph 6: Shows the percentage of separator lost

DISCUSSION

Pain and discomfort are most common chief complaint of patient during separation period. It was found that the amount of separation by dumbbell separator was significant at day 1 to day 5 compared to three other separators. This was in agreement with the study done by **Malagan et al**[1] where a significant difference was observed between four type of separators; elastomeric, kesling, dumbbell and NEET spring on day 1,2 and 3. In our study the amount of separation of elastomeric separator was 0.2 mm. This separation value is more

than the earlier study done by **Hoffmann[6]**. Our result also showed statistically significant difference between the separation effect of elastomeric, Dumbbell, kesling and kansal separator.

Elastomeric separators also showed statistically significant amount of separation in comparison with kesling and kansal on all five days which was similar to previous study done by **Cureton and Ronald[7]**. In our study reliability of elastomeric separators, 7.5% were lost which was in contrast to above study.

In the present study, Dumbbell separators provided fastest and greater amount of separation than the elastomeric, kesling and kansal separator. However, 20% of dumbbell separators were lost which was very high compared to other separators. This was in agreement with the study done by **Malagan M et al[1].** In this study the dumbbell separator provided fastest and more amount of separation than the other 4 types of separators and frequency of loss of separator was 16%, which was highest among other separators.

In this study, the VAS was used to measure the pain /discomfort leval. VAS is a useful tool for pain perception of patient. The pain and discomfort of patient at 1st to 5th day by dumbbell separator was more than other three separators. This was, again, in agreement with the study done by **Malagan M et al[1].**

Kesling separator was easy to place in tight contact point and frequency of loss of separator is less than the dumbbell and elastomeric due to engagement of the opposite embrasure area. Pain perception was more at chewing than at rest position in all four types of separators at 1st to 5th days. This result is in agreement with **Bondemark et al[2]** study. In our study the pain was worst at 2 and 3 day and gradually decreased at 4th and 5th day. This result agrees with **Bondemark et al[2]** study. In the present study the elastomeric separator was more painful than the kesling and kansal separator; similar to earlier study done by **Nalbantgil et al[3]** in which the elastomeric separators was more painful than the brass wire separators. Also loss of elastomeric separator in the above study was more than the brass wire separator but in our study the frequency of loss of elastomeric separator was more than the kesling and kansal separator but less than the dumbbell separator.

In our study, adequate separation of elastomeric separation was 3.4 days but in a previous study done by **Juneja et al[8]**, the adequate separation of elastomeric separation was 2 days after placement of separator.

In the present study the separation and discomfort caused by elastomeric was more than the kesling separator and similar result are shown in a previous study done by **Sandhu G P[9].**

A study conducted by **Bothra et al[10]** shows that the loss of "elastomeric" separator is significantly higher than the "kansal" separators. Similary, in the present study, the Elastomeric separators were lost significantly more than kansal separators. **Kapoor K et al[11]** conducted a study showed pain of mild to moderate intensity with elastomeric and Kesling separators but less painful than the brass wire separator. But the difference was not statistically significant. But in our study statically significant difference in pain was noted in kesling and elastomeric, but, less than the dumbbell separator.

In our study the pain associated with separators started after placement and peaked at 2 and 3 day and subsided on fifth day. This result is similar to previous study done by **Asiry, M A et al[12]** where the pain associated with orthodontic separation started and peaked within 4-48 hours from separator placement, then started to decline to reach the lowest level on fifth day. According to our study, adequate separation was achieved in 2.4 days for dumbbell, 4.4 days for kesling, 4.5 days for kansal and 3.4 days for elastomeric separator. Thus, according to this study, molar band fits easily at least 4 days after placement of separator. Eating was most affected during the separation period, thus, patients had to change to the soft food, like yogurt, banana etc. These finding are same as **Scheurer et al[13]** study.

Thus, elastomeric separator is less painful than the dumbbell separator and short duration to achieve adequate separation than kesling and kansal separator.

CONCLUSIONS

The following conclusions can be drawn from the present study:

1. All four separators showed significant amount of separation on days 1st, 2nd, 3rd, 4th and 5th day respectively.
2. The time taken for adequate separation was 2.4 days for dumbbell, 4.4 days for kesling, 4.5 days for kansal and 3.4 days for elastomeric separator.
3. Only dumbbell separator was painful throughout at rest and at chewing. Other three separators were painful at day 2, 3, 4 both at rest and at chewing. Pain was more in all the separators on chewing than rest position from day 1 to day 5.
4. Dumbbell separator showed (20%) highest frequency of loss and kansal separator the least (1.25%).

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