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Awesome! That’s the simplest word that comes to mind describing the 3rd issue of JIPA; in a way which many colleagues even couldn’t believe publishing the first issue, the third has been published successfully. Beyond this achievement, there’s another milestone in the very short history of JIPA, Dr. Charles Goodacre the president of American College of Prosthodontics has accepted our invitation to the membership of our editorial board. This will empower the scientific and international impact of the journal to go for the future steps. On behalf of all Iranian prosthodontists and personally, I welcome him on board.

The 9th annual congress of IAP will be held in Mashhad early this autumn, this is the first experience of IAP congresses out of Tehran. The good reputation and the tireless efforts of our colleagues in Mashhad make a good backbone for the 9th congress.

Despite the best efforts of dental schools and faculties, deans and curriculum committees, there exists many problems with dental educational process yet. It is not simply that the curriculum is out of date; it is that some parts are irrelevant and some of the vectors that drive dental education in general should be redirected. For example, the various board examinations tend to measure what dentistry used to be, not what it should be. Thus, well-intentioned people have created a system that at best tends to preserve the status quo which makes changes slowly and with great difficulty. A full discussion of this issue is beyond the scope of the editorial; however one great and simple problem that I saw was the composition of the curriculum committee.

Kaveh Seyedan DDS, Msc, FICD
Denture Stomatitis in Iranian Dependent Elderly Complete Denture Wearers

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Statement of problem: Denture stomatitis frequently observed in institutionalized elderly patients more than other age groups.

Purpose: The aim of this study was to determine the prevalence of denture stomatitis and their associated causes in dependent elderly complete denture wearers.

Materials and Methods: This study was conducted in dependent elderly complete denture’s wearers living in four randomly selected nursing homes located in Tehran. Associated factors such as gender, age, use of medication, site of nursing home, denture quality, and denture- wearing habit were studied.

Results: Overall, 674 patients were examined; 201 had complete denture. The prevalence of denture stomatitis was 36%. There was significant relationship among the prevalence of denture stomatitis with gender, and denture wearing period (P<0.05).

Conclusions: The present study confirms that in this particular dependent age group, the prevalence of denture stomatitis is high and the associated factors mentioned above should be considered.

Key words: complete denture, denture stomatitis, dependent elderly
Introduction

Throughout the world, a demographic revolution is underway. The proportion of old people is growing faster than of any other age group. Approximately 600 millions are aged 60 and over, and this number will double by 2025. By 2050, it will be 2 billions, 80% living in developing countries. As in developing countries, the proportion of the old population in Iran has dramatically increased the last two decades, with the percentage of individuals over 65 years old rising from 4% in 1985 to 9% in 2005. By 2050, it will be 26 millions.

Not only are chronic systemic diseases prevalent in old age, but also poor oral health and high prevalence rate of oral diseases have been seen. The negative impact of poor oral conditions on daily life is particularly significant among edentulous patients. Edentulism is prevalent among older people, especially the dependent elderly, and it is highly associated with socio-economic status. Removable dentures, especially complete denture are commonly used among the old. Again, the prevalence of removable denture shows a considerable variation on socio-economic status.

Oral mucosal lesions are common in elderly people, especially in institutionalized individuals. The majority of reported oral mucosal conditions in the elderly are benign in nature; however, some may become malignant, especially if local or systemic factors coexist, and there is possibility of widespread of infections to alimentary tract in immunocompromised and dependent elderly patients with denture stomatitis. The prevalence rate of denture stomatitis is reported within the range of 11-67% in complete denture wearers. The prevalence of denture stomatitis correlates strongly with denture hygiene or the amount of denture plaque, nightly use of denture, neglect of denture soaking overnight. Use of defective and unsuitable dentures are also risk factors for denture stomatitis, as is tobacco, alcohol consumption, and medical condition. The lower the level of education the higher the prevalence of stomatitis; and the longer since the last dental visit, the higher the likelihood of denture-related lesions.

Due to negative impact of oral mucosal lesions, especially denture stomatitis, on general health of dependent elderly patients with serious medical and emotional problems and partial loss of social independence; and the scarcity of pertinent data from Iran, the aim of the study was to investigate the prevalence of denture stomatitis, and its associated causes in Iranian dependent individuals at the age of 65 and over, living in nursing home (institutionalized), in the broader region of Tehran, the capital of Iran, in 2008.

Materials and Methods

This cross-sectional study was conducted on dependent elderly complete denture wearers aged 65 years and over attending in four randomly selected nursing home located in two regional area of Tehran. The dependent elderly patients who had natural teeth, fixed and removable partial dentures, and those were completely edentulous with no prosthesis were excluded from the study. Also, individuals who refused to participate, those
who could not take part in decision-making process, and those who were bedridden and seriously ill or unable to communicate were excluded from the study. Permission was obtained from the care homes’ board directors to conduct the survey; and based on ethical background, we took into consideration the dignity and satisfaction of the elderly patients according to ethical principles of dental care, and ethical standards of Islamic Azad University. Complete explanation and recognition of the procedure had been described according to the patients’ understanding and acceptance, and in the informed consent, their competence and decision-making capacity were considered. The information on the overall health and the administration of medication was provided by the resident’s medical notes and nursing staff. Before examination, the author explained to the selected individuals the aim of the study, and the importance of oral diseases associated with complete dentures. Written instruction on denture and oral hygiene were also provided. Medical data were collected through interviews by the participant elderly and the caregivers. Subsequently, a clinician trained in recognizing oral lesions, carried out oral examination by using a wooden spatula, a portable light and a mouth mirror. Denture stomatitis is defined as localized or diffuse erythema involving a part or the entire denture covering mucosa or as granular or papillary inflammatory lesion involving central part of the hard palate and the alveolar ridge. The patient reported discomfort in the absence of inflammation, and there was no sign of inflammatory hyperplasia so-called denture stomatitis. All diagnoses were made clinically, and yeast smears were not collected. Not to mention that the patients who suffered from oral mucosal pathologic lesions, and underwent medical tests were referred to the executives of the nursing home in order to receive treatment.

Factors such as age, gender, nursing home area (poor or rich), denture wearing habits (non-continuous and continuous), quality of denture, and use of medications (anti-hypertensive and anti-depressant versus other medications) that may be associated with denture stomatitis were studied in the literature. Quality of denture was recorded unfavorable when the denture dislodged as the patient opened his/her mouth moderately wide without strain. The research data compromised information from the subject’s interview and intra-oral examination. The prevalence rates of dentures stomatitis were determined and the associated factors were statistically analyzed by Chi-square and Fischer’s exact tests. If there were any statistically significant differences, they were considered significant at level 0.05.

Results
In the four randomly selected nursing homes, 2723 individuals lived in which 674 were dependent elderly aged 65 and over. Among them, 238 had complete dentures, 25 refused to participate in the study, and 12 gravely ill dependent elderly complete denture wearers excluded from study. In general, 201 individuals 18 (11%) aged between 6575-, and 183 (89%) aged 75 and over including 63 (31.5%) men and 138 (68.5%) women were examined. 137 out of 201 individuals were taking anti-depressant and anti-hypertensive drugs. 77 of complete
dentures had favorable quality. 39 individuals were resident in rich nursing home areas, and 162 individuals in poor nursing home areas respectively. Among them, 139 (68%) individuals were wearing complete dentures continuously. 38 (19%) patients had complete denture for five years and less, and 163 (81%) had it for more than five years respectively. The prevalence rate of denture stomatitis was 36% (74 patients out of 201) with confidence interval (CI): 30.143.5%. Out of 74 patients with denture stomatitis, 31 (15.4%) patients had inflammatory papillary hyperplasia (type III), and 43 (20.6%) denture stomatitis type I and II respectively. There was not significant relationships among prevalence of denture stomatitis with age, quality of denture, use of medication, and site of living (P-value<0.5) (Table 1). There was significant relationships among prevalence of denture stomatitis with gender, and denture wearing habits (P-value<0.05) (Table 2).

Discussion
Oral health is an important part of the quality of life of any individual especially in elderly. Ageing, edentulism, and complete denture wearing cause changes in oral mucosal epithelium, reducing the ability of epithelial regeneration, and subsequently decreasing tissue resistance to microbial and traumatic factors. Therefore, it is not surprising to observe denture stomatitis in such dependent elderly patients in this study. Denture stomatitis is the most frequent lesion (36%), an expected finding as suggested by other investigators within the range 22-67% among institutionalized older adults. Nevertheless, any comparison between epidemiological surveys is difficult, as they vary in the methodology, sample size and diagnostic criteria, while the inter-examiner variability causes further confusion. Although current thinking suggests the interplay of various factors in the pathogenesis of the disease, Candida albicans has been implicated as the causative organism. In the present study beside denture wearing habits, gender had a significant relationship with denture stomatitis. The reason for high rate of this disease in women may be attributed to denture wearing habits of women, because women wear complete denture more continuously than men due to aesthetic reason. Numerous studies present high rate of prevalence of denture stomatitis in women than in men and the prevalence increased with age. Some study present the high rate of prevalence of denture stomatitis in men rather than women. It may be associated with the population selected for the study, e.g. tobacco or alcohol abuse in the selected men population. Our finding indicated that individuals wearing non-acceptable complete denture had higher prevalence of denture stomatitis than those with acceptable complete denture, however, it was not statistically significant. This conflict with findings of others who found patients with stable complete denture had higher denture stomatitis. One of the interesting findings of this study was the presence of vacuum-suction in all maxillary complete dentures of individuals who had inflammatory papillary hyperplasia (31 out of 201 complete denture wearers). In Iran, denturists usually make maxillary complete denture with vacuum-suction because they believe that it can improve retention and stability of the maxillary
complete denture, however, soft tissue inflammation and hyperplasia are usually associated with presence of vacuum-suction. Moreover, its association with inflammatory papillary hyperplasia should be determined, and other studies with large samples should be conducted. Poor oral hygiene and continuous use of dentures are considered to be major predisposing factors in manifestation of denture stomatitis. Although denture stomatitis usually does not reflect a serious disease or abnormality, with denture wearing as direct cause of the lesion, it should be realized that severe infections by Candida species may occur in immunocompromised hosts. Thus, it is important to give instructions related to denture hygiene measures to the elderly, and those living in protected environments. The institutional staff must be instructed and trained in necessary procedures. As recently shown, oral health care education programs can improve caregivers’ knowledge, attitudes and oral health care performances for dependent elderly. In conclusion, the present study demonstrated that among dependent elderly people wearing complete dentures, the prevalence of denture stomatitis is high. Denture wearing habits, poor quality denture, and poor oral hygiene have negative impact on oral mucosa. Although denture stomatitis usually does not reflect a serious disease, there is possibility of widespread oral mucosa and alimentary tract infection in immunocompromised and dependent elderly patients. This particular group of population, due to poor general health condition, less demand for dental and prosthetic care, in addition lack of support services and general poor socioeconomic status require special clinical attention and follow up. Regular oral examinations by a dentist should be part of continuous multidisciplinary medical care provided for this increasingly growing group of patients.

Table 1- Distribution of understudied complete dentures wearers based on denture stomatitis in terms of age, quality of denture, site of living, and use of medication

<table>
<thead>
<tr>
<th>Associated Factors</th>
<th>Denture Stomatitis</th>
<th>Not-Present (N =127)</th>
<th>Present (N =74)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a – 65-75 years</td>
<td></td>
<td>12(9.5%)</td>
<td>6(8%)</td>
<td></td>
</tr>
<tr>
<td>b – 75 years and over</td>
<td></td>
<td>115(90.5%)</td>
<td>68(92%)</td>
<td>p &lt;0.5 N.S*</td>
</tr>
<tr>
<td>Quality of denture:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a - Favorable</td>
<td></td>
<td>51 (39.5%)</td>
<td>26(35%)</td>
<td></td>
</tr>
<tr>
<td>b – Unfavorable</td>
<td></td>
<td>76 (60.5%)</td>
<td>48(65%)</td>
<td></td>
</tr>
<tr>
<td>Site of living:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a – Rich area</td>
<td></td>
<td>27(21%)</td>
<td>12(16.5%)</td>
<td></td>
</tr>
<tr>
<td>b – Poor area</td>
<td></td>
<td>100(79%)</td>
<td>62(83.5%)</td>
<td></td>
</tr>
<tr>
<td>Use of medication:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a – Anti-depressants &amp; anti-hypertensive</td>
<td></td>
<td>88(70%)</td>
<td>49 (67.5%)</td>
<td></td>
</tr>
<tr>
<td>b – Other drugs</td>
<td></td>
<td>39(30%)</td>
<td>25(32.5%)</td>
<td></td>
</tr>
</tbody>
</table>

N.S* = Not Significant

Table 2- Distribution of understudied complete dentures wearers based on denture stomatitis in terms of the gender, years of denture using, and denture wearing period

<table>
<thead>
<tr>
<th>Associated Factors</th>
<th>Denture Stomatitis</th>
<th>Not-Present (N =127)</th>
<th>Present (N =74)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a - men</td>
<td></td>
<td>52 (41%)</td>
<td>11(15%)</td>
<td>p &lt;0.05 S*</td>
</tr>
<tr>
<td>b - women</td>
<td></td>
<td>75 (59%)</td>
<td>63(85%)</td>
<td></td>
</tr>
<tr>
<td>Denture wearing period:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a - Noncontinuous</td>
<td></td>
<td>58(33%)</td>
<td>4(5.4%)</td>
<td></td>
</tr>
<tr>
<td>b – Continuous</td>
<td></td>
<td>69 (66%)</td>
<td>70 (96.4%)</td>
<td></td>
</tr>
</tbody>
</table>

S* = Significant
References
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Evaluation of Wear and Bond of Four Types of Acrylic Teeth

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Purpose: Acrylic teeth are widely used by dentists and dental technicians because of their physical and chemical characteristics such as the bond between artificial teeth resins and base denture resins by means of chemical polymerization reaction as well as their economical aspects. Recognition of the factors affecting wear and bond of acrylic teeth is a matter of importance. The aim of this laboratory study was to assess wear rate in acrylic teeth: Yaghoot, Super Berilian, Ivoclar (Cuspid & Flat), and Myerson (Cuspid & Flat) and also, to evaluate the bonding manner of these teeth according to standard ISO. No.3336.

Materials & Methods: This research consisted of two parts: In the first part, the wear rate of artificial acrylic teeth: Flat Myerson (Flat & Cuspid), Ivoclar (Flat & Cuspid), super Berilian and Yaghoot ( Ideal Macoo) has been studied and compared with Pin & Plate Method and abrasive surface of Aluminade disks(Al2o3). In the second part, the manner of bonding in the above teeth has been evaluated according to Standard ISO. No. 3336.

Results: The results of the wear tests displayed a meaningful statistical difference in Myerson teeth comparing to the other teeth specimens. In this research, based on the results of bonding tests and adhesive breakage of Yaghoot samples, this very artificial tooth was rejected. Myerson (Flat & Cuspid), Ivoclar (Flat & Cuspid) and Super Berilian with 6 positive results from six series of anterior teeth were substantiated according to Standard.

Conclusion: The highest wear resistance belonged to Super Berilian, Yagoot, Cuspid Ivoclar and Flat Ivoclar respectively.

Key Words: wear, bonding, acrylic tooth, myerson, ivoclar
Nowadays the materials used in denture teeth are acryl or modified acryl. The reasons why acryl is widely used by dentists and dental technicians are its physical and chemical features such as the bond between artificial teeth resins and base denture resins by means of chemical polymerization reaction as well as its economical aspects. Durability and the health of oral tissue and prevention of TMJ disorders are the main goals in dentistry which some disadvantages such as wear in short time endangers it. Two main points in evaluating acrylic dentures are:

- The rate and speed of wear
- Separation from acrylic denture base

Recognizing the factors which affect these features is of main importance.1,2 Wear of denture teeth in removable partial dentures may cause not only a decrease in chewing performance but also a change in occlusion and parafunctional activities. To maintain proper function and occlusion, more attention should be given to the selection of the denture teeth associated with the opposing materials.3,5 In case of antagonistic enamel, the denture teeth as a tooth substitute should have a wear resistance similar to that of enamel and low abrasiveness against enamel.6 Cunningham and Benington evaluated some of the variables that affect the bond between acrylic teeth and denture base resin, including the effects of resin dough time, tooth surface condition, processing variables, monomer cementation, and acrylic resin cement. They found that the most important steps to obtain a high bond strength were thorough dewaxing of the tooth surface and the application of a resin cement.7 Thean et al demonstrated the debonding of 3 resin denture teeth (Bioform, Dentacryl, and TNR) from a single base material and found that 93% of specimens exhibited cohesive failure within the body of the tooth rather than adhesive failure at the tooth/denture base junction.8 In one study, the tensile bond strength of specimens from standardized and anonymously fabricated partial dentures was evaluated. Four, randomly selected commercial dental laboratories and a university dental laboratory produced the dentures. A wide range of tooth debonding forces was recorded. The results highlighted the need for further investigation to determine a more standardized technique to provide satisfactory denture tooth bond testing.

The aim of this laboratory study was to assess wear rate in acrylic teeth; Yaghoost, Super Berilian, Ivoclar (Cuspid & Flat), and Myerson (Cuspid & Flat) and to asses the bonding manner of these teeth according to standard ISO No.3336.

Materials & Methods
This research was an experimental study and the denture teeth under examination were Yaghoost, Super Berilian, Ivoclar (Cuspid & Flat), and Myerson (Cuspid & Flat). From each specimen 6 molar of upper and lower jaw were chosen. Totally, 36 specimens of all teeth were tested for wear test. Longitudinal sections of the teeth were made by a metal disk. After cutting the specimens and by knowing that the glaze layer of occlusal surface should stay intact, the surrounding area of the specimens was repaired, thus, the specimens were made in the shape of cube with a squared section of 3×3 mm. After that, the occlusal surface of the specimens became flat, subsequently the enough glaze layer for wear was remained. To obtain a parallel wear condition for all specimens and consequently to have more reliable results, the surface of all disks was refined by 200, 400, 600, 800, 1200 sand papers, respectively.

To remove the microscopic peaks on the surface of the pin specimens (tooth specimens), and also to equalize the roughness of the specimens’ surface, each tooth was rotated on the disk while dry for a short time (40 seconds) before being washed in ultrasound machine. They were washed in ultrasound machine containing distilled water for 6 minutes. Then the specimens were dried by a heater and rolled in aluminum foils to prevent the contamination.

The holder made of a non-rusty steel was a cylinder by the diameter 7 mm with a ditch or a small pit at one of its ends and two furrows in the two sides to put the tooth specimen at the place. It was fixed by self-cure acryl so that it wouldn’t move or rotate during the examining stages. This holder was put into the actual brass holder, and the actual holder was joined to the vertical bar by a screw.

It was necessary to have a holder to hold the pin specimen in the wear test machine and also essential to keep the disk in order to remain the artificial saliva in the area to conduct the test humidity. To demonstrate the nature of the alminidy disk, the XRD test was conducted according to its specimens. The weighted disk and pin specimens put in the proper holder and joined to the pin wear machine on the disk.

Then, a specific amount of artificial
saliva should be shed into the disk holder. The pressure of the newmatic pump in these tests was set on the 20 N. There were four stages of wear for each specimen while the changes in coefficient in each stage were being recorded by a computer simultaneously in every 250 meters of wear. The test lasted after 1660 seconds.

\[
wear\ rate = \frac{\Delta w}{L} = \frac{(W_2 - W_1)}{L + L_2}
\]

It should be mentioned that specimens rate of wear in the steady stage should be compared to each other. Steady stage was a stage where the rate of the wear was fixed during the process. In other words, the graph would be linear. The data was conveyed to a chart. The distance of the wear (in meter) was plotted in the vertical axis against the decrease of weight (rate of wear) (in milligram) in the horizontal axis.

The chart of rate of wear according to distance of the wear was described. During the examination, the specimens were placed by 11 mm distance from the center of the disk. After each stage of wear, the specimen and disk were cleaned by deionizer water in ultrasound machine. Then, they were weighted after drying by heater. The saliva was replaced for each stage. The weight discrepancy of each specimen was calculated before and after the four stages of the wear test and the rate of wear was determined in each stage. All data was analyzed.

**Bonding test:** The process was according to ISO No.3336 standard. Six anterior teeth of the upper jaw were joined to the acrylic block (self cure) by means of wax. 1/3 of the ridge area of teeth and 1/3 of the incisal area were out of the acryl surface. Then, the wax was replaced by acryl with a procedure like making denture at the laboratory. After preparing specimens, they were debonded by universal testing machine (1190 series, Instrument, INSTRON).

**Results**

The results of wear experiments have shown in Table1 and Graphs 1 and 2. The Myerson teeth (flat and cuspid) were completely worn after a short distance in the first stage and reached to the protective steady surface. In this stage, the test was stopped so it wasn’t possible to go on with the test. The Myerson teeth had the most rate of wear. There was statistical significant difference between Myerson and other samples. But this difference wasn’t significant in Yaghoot, Super Berilian, Ivoclar teeth.

In this research, based on the results of bonding tests by considering adhesive breakage of Yaghoot samples, this very artificial tooth was rejected according to standard ISO No. 3336. Other samples with 6 positive results from six series of anterior teeth were substantiated according to standard.

**Discussion**

The important effect of the wear is the reduction of interception of teeth to a great extent. Therefore, it affects the relations of jaw, efficiency of chewing and vertical height of the face. Removing these defects requires replacement of the denture which charges time and money. It is necessary to use teeth with less rate of wear, in other words with higher wear resistance. The time for wearing denture and having para functional movements are different in various people. The abrading disk in this study was made of aluminum oxide. After the test, it was proven to contain the same minerals, and aluminum oxide in its actual phase. Comparing the previous studies done by grit 1200, aluminidy disks rate of roughness was less which caused the wear to be sticky rather than scratchy. It leaded to a more accurate test, more similar to the wear in the mouth.

The vertical force in this research regarding the weight of holder and specimen was 20N, and the contacting area of the specimen to the disk was 9 mm². Therefore, the pressure was equivalent to 2.2 MPa. In previous studies, the force was 10 (Whithman, 1989), 0/5-2/5 (Koczorowski, 1999) and 0/8-1/75 MPa (Hu, 1999). The main features of this study were as follows:
- Using the non-rusty steely holders
- Choosing the type of wear (pin on the disk)
- Using the artificial saliva (similar to the natural saliva’s formula)
- Replacement of saliva in each stage of the test
(four times for each specimen)
- Using 7 CC of saliva in each stage, the specimen was tested in a complete humid area
- Cleaning the disk by the specimen on the pin in each stage of the test by using the deionizer water in an ultrasound machine
- The amount of pressure on the tooth was 2.22 MPa.
- The distance of the wear was 1000 meters.
- Using the Gril 1200 disk by the least roughness
- The contact area of the specimen with the disk
- Conducting the test in the glaze layer area
- The more accurate measurement by means of a scale with the accurate of 0/0001

According to Krejci, there is less amount of wear when contacting point's area increases, as the force to the surface by a parallel vertical force decreases.16 The result of the wear test in this research demonstrated that Myerson teeth had a remarkable discrepancy compared with other specimens. This specimen had a great rate of wear from the first stages and they were ruined. Since it was unknown when the surface of the holder reached the surface of the disk, the result which had been reported for the first stage was not accounted for the total results. The reason is that the rate of wear of the holder might also be accounted in the wear tooth. Regarding Myerson teeth, the following reasons might be related to the result of the test:
1. The glaze layer for the Myerson tooth has been less than other kinds of specimen measured by means of a gage.
2. There had been more microscopic peaks in the glaze layer.
3. The components of this tooth were not resistant.

A pin-and-disk wear apparatus which has been developed, overcomes many of limitations, and stimulates some of the physiologic and mechanical factors in the functioning human masticatory system.13 Tooth wear is a complex process that depends on extrinsic factors such as masticatory function, tooth form, and positions of teeth relative to the arch as a whole (Carlsson et al., 1985). Ogle and Davis (1998) reported that there was a significant difference in individual tooth wear (1st molar > 2nd premolar > 1st premolar > 2nd molar > canine) and by arch (maxillary arch > mandibular arch). However, in vitro methods used in many areas of engineering are important to study the mechanisms of wear and to screen materials prior to clinical use. Because it is difficult to simulate an oral environment completely, it may be necessary to consider various clinical factors contributing to wear. Furthermore, denture tooth materials should have a characteristic to resist wear in the same and the opposing enamel surfaces.5 This series of experiments has attempted to determine the quality of the denture tooth bond formed under commonly employed dental laboratory conditions. A specimen preparation and testing technique was employed throughout which ensured a high degree of physical conformity among the specimen batches.

The amount of free monomer in acrylic resin at the packing stage might appear to be a critical factor in denture tooth bonding. If this was the case, then early dough packing should produce better tooth bonding. The low packing consistency of early dough resin may not only produce less dense denture bases but also appear to achieve an intimate and pressurized contact with the tooth surface considered desirable for successful bonding.7 In this research, based on the results of bonding tests by considering adhesive breakage of Yaghoot samples, this artificial tooth was rejected according to standard ISO No. 3336. Other samples with 6 positive results from six series of anterior teeth were substantiated according to standard.

Acknowledgment
The authors thank Dental Research Center, Research Center of Science and Technology in Medicine, Tehran University of Medical Sciences, for their support and cooperation.
**Table 1** - Wear rate of teeth in 4 stages of wear

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<tr>
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<tr>
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<tr>
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**Graph 1** - Comparison of wear rate of teeth
References
In Vitro Evaluation of Fracture Resistance in Endodontically Treated Teeth with Four Restorative Methods

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Statement of problem: Treatment of teeth with extensive destructive crowns and endodontically treated teeth is difficult. Such teeth are usually restored by prefabricated or casting posts, and these treatments have their specific problems and complications.

Purpose: The purpose of this study is to compare the fracture strength of extensively damaged anterior teeth, being reconstructed by four different methods.

Materials and methods: In this experimental study 24 central maxillary teeth were used. Their crowns were cut. They were divided into four groups. In the first group, after preparing a post space, a FRC post with resin-composite core and a celluloid crown were used respectively. The second group was prepared like the first one, with this difference that the crown was metal. In the third group, the dentatus pin with resin-composite core was used and the crown was formed by celluloid. The fourth group was prepared in the same way as the third one but a metal crown was fabricated. The samples were mounted in an acrylic block, and pressed in Instron machine with the cross head speed of 2mm/min under the angle of 45; the press power was calculated as well. The results were analyzed with One-way variance, and the Duncan examination way was used to compare the average break point among the four groups.

Results: With regard to limitations of this study in the error percentage of 5, there was no significant relationship between the break points of the four groups (P-value=0.44). The highest required amount of fracture load was for the first group and the lowest amount was found in the second group.

Conclusion: There was no significant relationship among the rates of fracture resistance in four groups. Crown does not provide more strength for tooth in this condition.

Key words: fracture resistance, endodontically treated teeth, reconstruction
Introduction

Most endodontically treated teeth require a post and core build-up to have the optimum health and function. Selection of an appropriate post and core system from the wide range of available systems may be a clinical dilemma. Selection of a post and core system should satisfy many interrelated biological, mechanical, and esthetic factors to optimally restore the endodontically treated tooth to provide form and function.

Using the Dentatus posts is a method to restore tooth before crown placement. These posts do not have enough strength, therefore, when a higher force is applied, they break in the root canal. Besides, due to their less retention and short length, they may come out of the root easily.

Recently carbon fiber posts are purported to have mechanical properties similar to the tooth. They have the same modulus of elasticity as dentin, so stresses are better distributed in the root, and the fracture in endodontically restored teeth occurs less than other posts.

In vitro studies, however, have demonstrated that carbon fiber posts have lower strength compared with metal posts when subjected to forces simulating in the oral cavity. Metal posts are rigid and they can break roots.

Hock demonstrated that the strength of teeth with post and crown is related to the remaining coronal tooth structure and the dowel designs do not have any effect on tooth strength.

Dean evaluated the influence of endodontic and restorative procedures on fracture resistance of teeth. He compared the incidence of root fracture in teeth which the clinical crowns were removed and restored with three different types of posts and resin-composite core build-ups. The groups with post and resin-composite build-ups failed at significantly lower force than a normal tooth force of which the crown had not been removed. The group restored with the carbon post had no root fractures, whereas there were fractures in each of the parallel and tapered post groups.

Carbon fiber posts (CFP) are widely used to restore endodontically treated teeth to enhance the mechanical characteristics in spite of metallic posts, and to prevent vertical fractures of the tooth under chewing loads.

Raygot’s study was undertaken to characterize the fracture resistance and mode of fracture in endodontically treated incisors restored with cast post and core, prefabricated stainless steel post, or carbon fiber-reinforced composite post systems. The use of carbon fiber-reinforced composite posts did not show any changes in the fracture resistance or the failure mode of endodontically treated central incisors when compared with metallic posts.

The purpose of this study is to compare the fracture strength of extensively damaged anterior teeth which were restored by four different methods.

Materials and Methods

In this experimental study, 24 central maxillary recently extracted teeth with periodontal problems were selected and kept in physiologic serum. The crowns were cut perpendicular to their long axes, 1mm above the cementoenamel junction by using a diamond disk. The root heights were 12 mm. Then, endodontic preparation for all teeth was carried out in the same process. The sealer was eugenol free calcium hydroxide (AH 26 De Tray Zurich, Switzerland) due to using the resin cement. Twenty –four hours after completing canal instrumentation, the post space was prepared, removing the necessary part of the gutta percha with pizorimer No III (Mani, Germany), and conforming the canal with Prapost system drills (Coltene/ Whaledent) to a diameter of 1.2 and a depth of 8 mm from the sectional coronal surface. The sectional coronal surface was prepared the same as the carries were removed. Finally, the outer coronal surface had 1mm width and 3 mm depth. A guideline was also cut for crown restoration using chamfer margin in cervical portions, 0.5 to 1mm from the coronal surface. The specimens studied were divided into four groups of six teeth, each according to the type of posts and cores used for restoration:

1. After preparing the post space, the first group was etched with phosphoric acid 37% for 15 second, subsequently washed with water for 30 seconds and dried by paper points. Then the FRC post (RTD, France) was cemented with Panavia F2 (Kurary, Japan) in canals in standardized proportions according to manufacturers’ directions. Cores were formed by composite resins (Tetric Ceram HB), and crowns were restored by celluloid crowns and composite resins (Vivadent, Tetric ceram Ivoclar) around 8 mm.

2. In the second group, as the first one, canals were etched with phosphoric acid 37% for 15 second, then washed for 30 seconds and dried by paper points. After that the FRC post was cemented with Panavia F2 (Kurary, Japan) in canals. Following forming the core by Tetric ceram HB, metal crown was used.

3. In the third group, the dentatus pin (Dentatus, Switzerland) with resin-composite core Tetric ceram HB (Vivadent, Ivoclar) were used and the crown was restored by composite resin and celluloid crown.

4. The fourth group was carried out similar to the third one with this difference that a metal crown was used.

For load testing, the examples were fixed along their long axes into copper cylinders filled with self-polymerizing acrylic resin (Formatray, Ker), ensuring that approximately 2mm of dental margin emerged from the resin...
surface. The restorations were then subjected to progressive compression force in the Instron device (Zwick, Japan), and were pressed by the cross head speed of 2mm/min under the angle of 45, additionally the press power was calculated. The results were analyzed with One-way variance and, the Duncan examination way was used to compare the average break point among the four groups.

**Results**

The mean and standard deviation of the groups are presented in Table 1.

The mean forces applied in all groups were 18.18± 5.27 Kgf. The minimum force was 10.75 Kgf for group B and the maximum was 31.32 Kgf for group C.

The mean fracture loads in groups in descending order were:
1. Group A (Fiber post with resin-composite core and celluloid crown)
2. Group C (Dentatus post with resin-composite core and celluloid crown)
3. Group D (Dentatus post with resin-composite core and metal crown)
4. Group B (Fiber post with resin-composite core and metal crown)

The highest mean amount of fracture load was 20.515 Kgf for the first group (A), and the least one was 15.428 Kgf for the group B.

To compare fracture strength among the groups, One-way ANOVA was used (Table 2).

There was no significant relationship between the break points in four groups (P-value=0.44). The most required amount of fracture load was found in the first group and the least one belonged to the second group.

**Discussion**

In this research the fracture strength of extensively damaged anterior teeth restored by four different methods, were investigated. The results are discussed in two sections:

The first section concludes reconstruction of teeth of group A (FRC post with resin-composite core and celluloid crown), and group C (dentatus post with resin-composite core and celluloid crown). In these two groups, the method was the same except the type of post used. There was no significant relationship between the rates of fracture resistance in the two groups. Mean while in group A the fracture resistance was 20.515 Kgf, and it was 18.466 Kgf in group C.

This result accords with Newmans’ study (2003) in which the fracture strength of Stainless steel post was 18.33 Kgf. This statement was demonstrated in Deans’ study. Raygot et al (2001) discovered that the use of carbon fiber-reinforced composite posts did not change the fracture resistance or the failure mode of endodontically treated central incisors compared with metallic posts. This statement is in accordance with our findings.

Hock demonstrated that the strength of post crowned teeth was related to the remaining coronal tooth structure, and dowel designs had no effect on the strength of teeth. The subject mentioned was demonstrated in this study, too. Dowels had different designs, but the amount of remaining coronal tooth structure was the same in all groups, so there was no significant relationship among the break point of four groups. The second section of our discussion is related to the teeth with post core and metal crown:

In group B (FRC post with resin-composite core and metal crown), the fracture resistance was 15.428 Kgf, and in group D (post with resin-composite core and metal crown), it was 18.311 Kgf. There was no significant relationship between the rates of fracture resistance in these two groups. This was exactly demonstrated in Hu Yu study (2003). He evaluated the fracture resistance and the mode of failure of endodontically treated teeth restored with four post and core systems (serrated, parallel-sided, cast post and core, serrated, parallel sided, prefabricated post and resin-composite core and metal crown).
core, carbon-fiber-reinforced (CFC) post and resin-composite core, and ceramic post and resin-composite core). Full-coverage metal crown was fabricated and cemented onto each tooth. Each specimen was subjected to a compressive load at a 45-degree angle to its axis until failure. In this study, there was no significant difference in the failure loads among the groups.\textsuperscript{12}

Linde described that endodontically central incisors restored with composite resins did not need metal crowns. Resin-composite cores had been reinforced and retained in their roots, almost in every case by screw-posts.\textsuperscript{13}

In this study, it was demonstrated that the teeth restored with dentatus and FRC post did not need metal crowns. It was showed that more than 1mm ferrule structure could increase the fracture strength of the teeth.\textsuperscript{14,15} In this study the amount of remaining tooth structure was the same, and it was 1mm over the CEJ. It was obvious that this structure could not sufficiently play the ferrule effect roll in teeth with metal crowns. Groups B and D (metal crown groups) showed less fracture resistance than Groups A and C (Celluloid crown groups). In this situation, metal crown did not enhance the fracture strength.

**Conclusion**

Within the limitation of this research, the following conclusions were drawn:
1. There was no significant relationship among the rates of fracture resistance of groups.
2. The highest fracture load level was achieved with the first group. (FRC post, resin-composite core and celluloid crown)
3. In this situation, metal crown did not enhance the fracture strength.

**Acknowledgement**

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**References**

Prosthodontic Management of Soft Tissue Deficiencies in Mal-positioned Maxillary Anterior Single Implant-Supported Restoration (A case report)

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Abstract

This article presents a case that eliminates soft and hard tissue deficiencies by using customized castable abutment and gingiva-colored porcelain. It also indicates a method to overcome difficulties associated with impression procedures for implant in proximity to natural tooth, which make the placement of impression copings difficult.

Introduction

The placement of dental implants in the anterior maxilla is challenging for clinicians due to patients’ esthetic demands and difficult pre-existing anatomy. The practice of implant dentistry requires an interdisciplinary approach that integrates knowledge, skills, and experience of all dental guildlines into a comprehensive treatment plan. The team must examine the anticipated restorative sites to determine the suitability of existing hard and soft tissues for implant placement. Deficiencies in hard and soft tissues, which prevent ideal implant placement, must be recognized and addressed to ensure a more predictable esthetic outcome. Various prosthodontic techniques reported to improve the soft tissue deficiency include the use of a gingiva-colored porcelain or acrylic resin, a flexible silicone-based tissue-colored material, or removable prostheses such as the Andrews Bridge System (Institute of Cosmetic Dentistry, Amite, La). The loss of peri-implant tissue can also be corrected by applying gingiva-colored porcelain on the cervical portion of implant-supported metal-ceramic restorations. However, when the implant is incorrectly angled or improperly positioned with soft tissue defects, the challenge of creating harmonious mucogingival contours may be facilitated by the application of gingiva-colored porcelain onto the cervical collars of metal or ceramic implant customized abutments. The lack of space or the angulation between the implant and adjacent tooth may preclude the incorrect fastening of the impression copings to the osseointegrated implants resulting in an incorrect registration of the implants’ positions.

This clinical report illustrates how using gingiva-colored porcelain manages soft tissue deficiencies for anterior single implant-supported restorations, a method which overcomes difficulties associated with impression procedure and composite materials to correct the dental midline.

Case report

A 21-year-old white man referred with an interim removable acrylic resin partial denture for the missing maxillary left central incisor. Clinical and radiographic examinations showed that there was an osseointegrated titanium dental implant in the left central incisor in proximity to left lateral incisor (Replace System; Nobel Biocare) (Figs. 1,2). The patient’s chief complaint was the uneven level of maxillary anterior marginal gingiva, uneven level of incisal edge of left central incisor and disharmony between midline of upper and lower teeth. The patient’s dental history
indicated orthodontic treatment and previous malposed implant placement with a mucogingival tissue defect. Therefore, prosthetic management of soft tissue around the implant which included the use of a customized castable abutment and porcelain build-up modified with gingiva-colored porcelain was suggested to the patient. Due to proximity of implant to left lateral incisor, it was difficult to connect direct or indirect transfer coping to implant, so an indirect implant-level impression was made using Gold Adapt abutment (Nobel Biocare) (Fig. 3). Since this abutment was symmetric, some autopolymerizing acrylic resin material (Duralay; Reliance Dental Manufacturing, Worth, Ill.) was applied in buccal and palatal sides near the gingiva (Fig. 4). The screw access hole was closed with one layer of wax and an implant-level final impression was made using a stock tray and poly vinyl siloxan impression material. After complete setting, the impression was removed, and the Gold Adapt abutment remained in the patient’s mouth. Then, it was unscrewed, removed and an implant analog was attached to Gold Adapt abutment, and this assembly was placed into the impression before pouring the master cast (Fig. 5). Working cast was poured which included a soft tissue replica made from an elastomeric material. The casts were mounted, and artificial tooth was set to represent the planned implant-supported crown. A clear plastic, vacuum-formed template was made for guide during wax up and porcelain build-up. Wax up, investing and casting were made, the abutment was prepared for porcelain application by steam cleaning, followed by firing with tooth-colored porcelain and gingiva-colored porcelain for the cervical portion. The restoration was evaluated intraorally, and the abutment screw was torqued to 35 N.cm with a torque wrench (Nobel Biocare). The screw-access channel was obturated using a light-cured polymerizing provisional resin (Fermit; Ivoclar Vivadent) (Fig. 6).

Discussion
Tooth loss due to trauma or periodontal disease is often associated with extensive deficiencies of the supporting hard and soft tissues, and atrophy of the alveolar ridges. The functional and aesthetic predictability of an implant-supported prosthetic restoration in patients with extensive tissue augmentation is evaluated, even when damaged tissues are restored at an early stage by local ridge augmentation. The prosthetic

Figure 1. Intraoral view of soft and hard tissue deficiencies in maxillary left central incisor

Figure 2. Radiographic view of titanium dental implant in the left central incisor in proximity to left lateral incisor
reconstruction of major tissue defects is especially difficult, as loss of the alveolar ridge structure must be replaced by the restoration which is expected to provide optimal function and aesthetics, yet allow for optimal oral hygiene. Customized abutments permit the fabrication of aesthetic restorations that correct deficiencies in implant angulation, alignment, and position. These abutments also enhance soft tissue emergence profile of the restoration and allow the prosthetic margins to be properly positioned in all dimensions. Additional benefits include: ease of treatment delivery and comparative expense. Making an implant-level impression with conventional metal impression coping can be cumbersome when problematic implant position or angulation is present or when there is limited space. Customized castable abutment can be used as an alternative, compared to conventional impression coping which is shorter and easier to use. Moreover, improved precision of the impression is achieved when the gold adapt abutment is used as an impression coping.

**Summary**

A Gold Adapt abutment was used to make final impression and to manage soft tissue deficiencies for single implant-supported restorations. By the use of gingiva-colored porcelain on the cervical portion of screw retain metal ceramic restoration, predictable aesthetic results can be achieved.

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**Figure 3.** Intraoral view of Gold Adapt abutment after connecting to implant

**Figure 4.** Intraoral view of Gold Adapt abutment after applying some autopolymerizing acrylic resin material on abutment in buccal and palatal sides near the gingiva

**Figure 5.** Implant analog and modified Gold Adapt abutment assembly into the impression

**Figure 6.** Intraoral view of final implant-supported restoration
References

Introduction

The restoration of the abutment tooth of an existing removable partial denture (RPD) can be challenging and time-consuming for the clinician. Numerous techniques have been described in the literature. Some techniques require the patient to leave the prosthesis for subsequent laboratory work, some involve fabrication of a full cast metal restoration, and still some use more esthetic but less wear resistant materials such as glass polymers for this purpose. Other procedures require considerable time for chairside adjustments. In all these techniques, the existing RPD has to be used to determine the exact morphology of the fixed crown, and it is done by a direct intraoral procedure. However, the fabrication of the fixed abutment crown can be done without the availability of the RPD in the laboratory stage, which can add an indirect component. Therefore, in this article the authors use the term direct-indirect technique to describe their methodology.

In this article we will describe a simple and accurate technique for fabrication of a crown to fit an existing removable partial denture without keeping the patient’s appliance during the procedure.

Case presentation

A fifty-five-year-old male patient with a fractured palatal cusp on his maxillary left second bicuspid (tooth #13) referred to the office. His first bicuspid (#12) was missing and it was replaced by a removable partial denture and the second bicuspid was used as an abutment for its clasp assembly (Figs. 1-4).
Materials and Methods
1- Tooth preparation was performed, and an impression was made for a ceramometal crown (Figs. 5,6).
2- To create an index of the clasp assembly, according to the crown preparation, a small amount of *addition reaction polyvinyl siloxane* (Panasil Kettenbach, Germany) was mixed and placed on the preparation, the clasp assembly was pressed onto it, and the patient was guided to centric occlusion relation (Fig. 7).
3- An acrylic resin temporary crown was fabricated for the patient which could receive the clasp assembly passively, and the patient was dismissed with his removable partial denture in function.
4- After the fabrication of the master cast, the die was ditched, mounted, and the silicon index was seated on the die (Fig. 8), lubrication and block-out of the related areas was performed on the master cast, and a simulation of the clasp assembly was made on the silicon index with an *acrylic pattern resin* (Duralay, Reliance, USA). The adjacent teeth were used as stabilizing platforms, and the *acrylic pattern resin* was casted in the chromium-cobalt alloy (Figs. 9-11).
5- At this level, the ceramometal crown was fabricated to fit this framework, using the conventional laboratory techniques, and it was finally delivered to the patient (Figs.12-14).

Discussion
Various methods of fabricating a new abutment crown to fit an existing RPD have been reported. Mc Arthur, in 1984, described a technique in which an impression was taken from the prepared abutment tooth and the existing RPD in the mouth, which allowed the direct fabrication of the crown to fit the RPD in the laboratory. This technique may introduce some inaccuracies in the impression in the form of distortion or displacement, and the patient is deprived of his/her prosthesis during the procedure.2
In 1993, Silberman used a polyvinyl siloxane material to create an index of the prepared abutment tooth and its relation with the clasp assembly, in the procedure similar to the present article with two exceptions: Firstly, his technique was presented on the cast models and no intraoral verification was demonstrated, and secondly, he further used a stabilizing hole which was drilled in the edentulous space on the ridge, whereas the present technique uses the adjacent teeth as stabilizing platforms.7
Hansen, in 1994, applied small acrylic pattern resin projection attached to the rest and on to the occlusal surface of the prepared tooth prior to the pick-up impression of the existing RPD, which was sent to the laboratory for direct fabrication of the crown. The acrylic pattern resin maintained the relationship between the abutment tooth and the clasp assembly while the pick-up impression procedure was being performed, ensuring that the removable prosthesis was not displaced in the process. In this technique, the patient should
leave his/her prosthesis in the office for laboratory procedure.Livaditis, in 1998, used the polyether occlusal registration material to make an index of the relationship between the clasp assembly and the prepared abutment tooth to fabricate an acrylic pattern resin clasp analogue for retrofitting procedure. Despite the technique’s simplicity and accuracy, the handling of the acrylic pattern resin in the laboratory could cause distortion or fracture of the analogue, significantly altering the results.

In 2002, Helvey described a technique in which a vacuum form plastic shell was adapted to the cast of an intraorally repaired RPD abutment which needed a fixed restoration, then superimposed the shell on the die of the prepared tooth, and constructed a new crown with a polymer ceramic material. Although the long-term prognosis of such material in stress-bearing situations is controversial, the technique provides a simple, accurate, and time-saving solution for selected cases.

Conclusion
This article indicates an accurate and practical method which can be used by a restorative dentist to retrofit a new crown to an existing RPD with a high degree of confidence. It is imperative that the laboratory technician be thoroughly informed about the sequence of the procedure in advance.

Acknowledgements
This work was not possible without the expertise of master technicians, Mr. Mahmoud Moghaddam, and Mr. Mohsen Minaii. I also give my sincere thanks to Dr. Naghmeh Aminzadeh for her outstanding editing work. Finally, I thank my office staff for their excellent assistance and patient management.

References
Pre-prosthetic adjunctive orthodontic treatment to facilitate implant restoration

(A case report)

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Introduction

The most complex treatment plan for a single missing tooth is in the anterior maxillary region. Placement of dental implants in the anterior maxilla may be a challenge for clinicians because of patients’ perfect esthetic demands and difficult pre-existing situations. Usually the patient’s primary demand is to replace a tooth esthetically, providing a nice smile. Successful restorations must restore normal contour, function, aesthetics, phonetics and health for the patient.

In treatment planning, the first question is either the occlusion can be restored by the existing tooth or some tooth movements are needed to achieve a satisfactory, stable, healthy and esthetic result? Mal-aligned or spaced anterior teeth adjacent or opposite to the missing site may trouble implant insertion or prosthetic restoration of the missing anterior teeth, not to mention that malocclusions or mal-alignments may interfere with normal and harmonious occlusion.

Adjunctive orthodontic treatment for adults is, by definition, tooth movements carried out to facilitate other dental procedures necessary for controlling the disease, restoring function and/or improving patient’s appearance. As it almost always involves just a part of dentition, the primary goal is to replace the missing or damaged teeth in an easy and effective method.

Articulator-mounted casts are likely to be needed since they facilitate treatment planning of associated restorative procedures, and are integral parts of each diagnostic phase. The treatment may last a few months,
rarely more than a year, and long-term retention usually is supplied by restorations. As stretched gingival fibers are potent forces to relapse after the incisor rotation has been corrected, there is always a tendency for the space to reopen after any degree of space closure. In other words, retention is necessary even after the completion of the restoration of the opposite arch. Bonding a flexible wire on the lingual of the incisors as a semi-permanent retainer is recommended.4
The pre-prosthetic adjunctive orthodontic treatment presented in this article can be done by a general dentist.

Case Presentation
A 30-year old white male referred to the office, with a chief complaint of missed right upper central incisor due to trauma (Fig.1). The patient hoped to keep the adjacent teeth intact, and as the patient’s desire was contradicted to a traditional fixed prosthesis, a single-tooth implant was considered.1 The quantity and quality of bone was ideal for implant placement, besides, the space available in the missing site was exactly the same as the mesio-distal width of sound left central incisor. Therefore, a root-formed implant fixture with 4.1mm diameter (Regular Neck, Standard, Strauman dental implant system) was placed in the site (Fig. 2).

Due to loss of contact, the lower central incisor was tilted buccally and distally and a 2mm diastema was evident between adjacent lower central incisors (Fig. 3). Prosthetic replacement in this situation would have led to a protruded and buccally tilted upper incisor which would negatively affect the esthetics and function of the patient. Also, malaligned incisors may interfere with lateral movements of the mandible.

Materials and Methods
A standard lower incisor orthodontic brace on the lingual surface of the lower central incisor effects as a retentive point where the corrective force will be applied to (Fig. 4). The tooth was etched with 37% phosphoric acid, the brace was bonded to the enamel applying a bonding agent, and was cemented by a specific orthodontic self-cure resin cement (NoMix, 3M ESPE). A finger-spring was formed from 0.05 inch stainless steel wrought-wire, and added to the anterior region of a simple Hawley’s appliance, which was consisted of two Adams clasps on lower first molars providing retention (Fig. 5). Body of this appliance was made from clear cold cure acrylic resin with sprinkle-on method. A 0.08 inch wrought wire labial bow was also formed in the labial side to aid inserting the appliance, enhancing the retention and providing a lingually directed force in order to upright the buccally tilted incisor, as well.

The spring was activated 2mm each month to move the incisor 1mm mesially, therefore the patient was visited at a month interval. After the correction of the mesio-distal inclination, the labial bow was activated at the buccal surface of the incisor, and again the situation was controlled monthly until the buccolingual inclination was repositioned. A flexible wire was bonded to the lingual surface of the lower incisors, as a fixed retainer, to keep the aligned tooth in proper position.

At this time, the restorative phase began. A fixture level impression was made using open tray technique. SynOcta ITI abutment (15 degree A angulated, Strauman, Switzerland) was screwed to the fixture according
to the prescribed torque, and a ceramo-
metal crown was made, and cemenetd by the conventional method. To gain
the best fitness, marginal integrity and biocompatibility, precious dental
alloy was used for casting the metal
coping (Degubond 4, Degudent,
Germany) (Figs. 6,7).

Discussion
Although implant placement may be
favorable in one arch, irregularities in the opposite arch may encounter some problems in the prosthetic phase.
The main indication for adjunctive orthodontic treatment to correct mal-aligned anterior teeth is preparation
for buildups, veneers or implants to improve the appearance of the maxillary incisor teeth.
Simple pre-prosthetic tooth movement may be effectively done using removable orthodontic appliances, which is a cost-effective and viable method to fulfill the patient’s esthetic and functional needs.

Conclusion
Correction of mal-aligned teeth with simple adjunctive orthodontic treatments will restore the patient’s function and esthetics to its normal position.

References
Purpose: This article represents a modified indirect technique in repairing fractured porcelain of pontics. In this technique a new “overlay” restoration is luted to the (existing) bridge. It can be specially used in situations where a large bulk of porcelain is fractured and the metal is widely exposed. Simplicity, cost-effectiveness and fewer invasions are the characteristics of this method. In addition, the result is more predictable and less chair-side time is required.

Keywords: porcelain repair, repair technique, porcelain fracture, metal-ceramic restoration, pontic
Introduction

Metal-ceramic crowns and fixed partial dentures (FPDs) are the most widely used full coverage restorations.\(^1,2\) Intraoral porcelains are susceptible to fracture due to different factors such as impact and fatigue load, inappropriate porcelain metal bonding, incompatible thermal expansion coefficients between the porcelain and metal substructure, vast difference in elastic modulus between porcelain and metal, use of metal with low elastic modulus, excessive seating force during trial, insertion or cementation, improper coping design, microdefects within the material, and trauma from occlusion.\(^3-6\)

The range of failure resulting from porcelain fracture has been reported from 2.3% to 8%.\(^7,9\)

Sometimes it is possible to remove the restoration intact and have the porcelain refired, but more often, it seems impossible to remove the crown or fixed partial denture without any damage and thus need to fabricate a new restoration.

There are various techniques to repair the fractured porcelain. All the methods fall into 2 categories: the direct methods and the indirect methods. In direct methods, a composite resin is used to repair the fractured porcelain intraorally.\(^10-17\)

The use of etch (with HF) and silan is the basis of fractured porcelain repair in the mouth.\(^18\) Ease of application, lower cost and less chair-side time are the advantages of direct repair. On the other hand, disadvantages include: low strength, poor wear qualities, and poor esthetic appearance due to lack of color stability and shade-matching to the remaining porcelain.\(^19-23\)

Besides, repair of fractured porcelain with composite doesn’t show predictable clinical results, and long-term success is questionable.\(^5,9,16,24-26\)

More problems may appear when the fracture occurs in metal exposure. Attempts to bond resin to metal depends on roughening the exposed metal surface in order to provide mechanical retention for the resin\(^27\) which is not a successful technique in many cases.

Indirect repairing methods consists of extra oral repair techniques for fractured metal-porcelain restorations. Indirect techniques include fabrication of a pin-retained casting with a fused porcelain veneer\(^28\) or fabrication of an “overlay” restoration.\(^29-33\)

When the problem occurs on anterior teeth, it is especially difficult because the repair must not only be durable but also esthetically pleasing. This article demonstrates an indirect technique to repair fractured porcelain of metal-ceramic pontics.

Case report

A 45 year-old man, referred to Dental School of Mashhad University, was evaluated for repairing or remaking his fractured FPD. Clinical examination revealed an anterior 6-unit fixed partial denture with fractured porcelain on the two adjacent pontics (Fig. 1). The restoration had been fabricated 8 month earlier. The patient was asked to choose one of the following treatments: Either to remove the fractured fixed partial denture and replace the bridge, intraoral repair of the fractured surface with porcelain repair materials (direct method), or prepare fractured pontics for overlay crowns, similar to principles of a telescopic crown (indirect method).

The patient refused to remove and remake the fractured restoration as it was costly and required a lot of chair-side time. The other choice was to repair the damaged bridge with composite resins which was considered to be a less optimal approach because of porcelain bulk fraction and excessive metal exposure. Therefore, the indirect repair technique was selected to repair the fractured metal-ceramic restoration. Not to mention that the

Figure 1. Fractured porcelain on two adjacent pontics

Figure 2. Preparation of original pontics (occlusal view)
patient’s hygiene was poor, so he was instructed to improve his oral hygiene.

All the remaining facial and lingual porcelain were removed by using a high speed handpiece with air-water coolant and a fine diamond bur. It’s important not to chip away the adjacent porcelain and the connecters from the interproximal areas. Undercuts on buccal and lingual sides of original pontics were removed. It is important not to compromise the strength of the original substructure, especially in the region of the connectors between the pontic and the retainers. A chamfer finish line was created on the lingual side of the original pontics (Fig. 2). Adequate bulk for metal framework and porcelain is necessary. An impression was taken with a low-viscosity vinyl polysiloxane impression material (Panasil, Kettenbach, Eschenburg, Germany) which its favorable rigidity prevents entrapment of the impression material around pontics and large embrasures. Before taking the impression, the space between pontics and ridge was filled with orthodontic wax (GUM Orthodontic Wax, Sunstar Butler, Chicago, USA). The casting pattern was fabricated with duraly acrylic resin (Duraly, Reliance Dental Mfg Co, USA) in order to facilitate removal of the working cast. The acrylic pattern was invested and cast (Fig. 3). After the application of porcelain (Omega 900, VITA Zahnfabrik, Bad Sackingen, Germany) on the framework, the restoration was tried in intraorally, and the occlusion was adjusted. The completed overlay restoration was cemented with resin cement (Panavia 21, Kuraray Co Ltd, Osaka, Japan) (Figs. 4, 5).

Discussion

Intraoral repairing of the fractured porcelain of pontics typically involves the application of a resin-based composite to the fractured porcelain. Resin–metal bonding depends on mechanical retention which is not a successful method in many cases. Therefore, when the porcelain fracture occurs in metal exposure there will be more problems.

In the indirect repair technique described here, a new “overlay” restoration was used. In comparison with composite resins used in direct method, this technique is more reliable especially when a large portion of porcelain is missing and the metal is widely exposed. Shade matching of a composite resin to the remaining porcelain is another problem. However, even the best composite resin repairs are not predictable in longevity and so color-stable as the porcelain repairs, as well. Since in this method a metal-ceramic restoration is fabricated, the problem of shade matching and color stability will be solved. Additionally, several in vitro studies revealed that thermal cycling and long-term water absorbing decreases resin–metal bond strength. Moreover, replacing the bridge is costly and time-consuming and the risk of abutment fracture or pulpal damage will increase.

The success of this method depends on careful case selection. Patients with deep overbite, heavy protrusive guidance, occlusal interferences, bruxism or other parafunctional habits are not ideal candidates. If the original substructure doesn’t have adequate occlusogingival height and sufficient surface on buccal and lingual sides, this technique is not recommended. Simplicity, cost-effectiveness and fewer invasions are the characteristics of this method. In addition, the result is more predictable and less chair-side time is required. Therefore, it is an easy and useful technique in repairing fractured porcelain of metal-ceramic pontics suggested to all dentists especially prosthodontists.

Figure 3. The acrylic pattern is ready for investing procedure.  
Figure 4. Completed overlay restoration (lateral view)  
Figure 5. Cemented overlay restoration
References
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