Examining the Fracture Strength of Implant-based Fixed Partial Prostheses with Different Dimensions of Connectors in the System CAM/CAD/Zir

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Abstract

This study investigated the fracture strength of fixed partial prostheses based on implants. Restoration of shape, function, comfort, beauty, speech and health in edentulous and semi-edentulous patients is one of the goals of modern dentistry, and today it is possible to achieve these goals through treatment with dental implants. Despite the fact that dental implants are a suitable replacement for lost teeth. Implant-based prosthetic treatments have various biological and biomechanical problems. Prosthetic complications in implant-based restorations are very diverse and include mechanical problems in prefabricated components of the implant, such as loosening or breaking of the abutment screw, and technical complications such as ceramic chipping and frequent loss of cement. Also, the loss of interproximal contact between the implant-based fixed prosthesis and the adjacent tooth has been reported, which causes problems such as food entrapment, periodontal defects, and caries of the adjacent tooth. The survival rate and complications of implant-based fixed

restorations have been investigated, and a high rate of mechanical complications after a five-year period has been reported. It has been shown that despite the high survival rate of fixed prostheses based on implants, biological and technical problems were common. The most common complication in single-unit prostheses based on the implant is loosening of the abutment screw, and its rate is reported between 5% and 48%. This complication may not cause the failure of the treatment, but it is significantly related to the time and cost required for maintenance and has a negative effect on the patient's satisfaction with the implant treatment. Abutment screw loosening is somewhat related to the implant system used and the applied forces. Porcelain failure is the second most common prosthetic complication in implant-based prostheses, and its rate has been reported in different studies between 3.8% in all-ceramic veneers and 3.2% in metal-ceramic veneers. The rate of loss of cement has been reported in different articles in the period of 2.5 years, 1.6%. Different cements are used to bond fixed restorations to implants. This issue, along with different cementing techniques, is effective in the amount of cement loss.
Key words: Fixed Partial Prostheses, Implants, All-Ceramic Veneers, Biological and Technical Problems.

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Introduction

The influence of different dimensions of connectors in all-ceramic systems is discussed. The purpose of this study was to evaluate the effect of different sizes of connectors on the resistance to failure of zirconium oxide posterior bridges [1-3]. In recent years, the trend towards all-ceramic restorations has increased due to their high beauty and excellent biocompatibility characteristics, and in many cases, they are preferred to metal-ceramic restorations [4-6]. However, most dental ceramics are brittle and tensile stresses caused by external forces lead to the expansion of cracks that existed in the original structure. High-strength ceramic blinds have been developed to support weaker overlying ceramics, especially for use in posterior all-ceramic restorations [7-9]. Zirconium oxide all-ceramic systems have been considered due to their better mechanical properties than feldspathic porcelains and lithium disilicate-based glass ceramics. Zirconia has the highest bending strength for the framework of all-ceramic restorations compared to other dental ceramics (Figure 1), however, problems related to the fragility and beauty of the blind material still remain. Fracture resistance is an important mechanical property that can help in predicting the performance of brittle materials [10-13]. Pospiech et al did not find any effect of cementing the specimens on the average bearing force of FPDs. However, other studies have obtained different results. In the present study, the samples were cemented on the abutments [14].

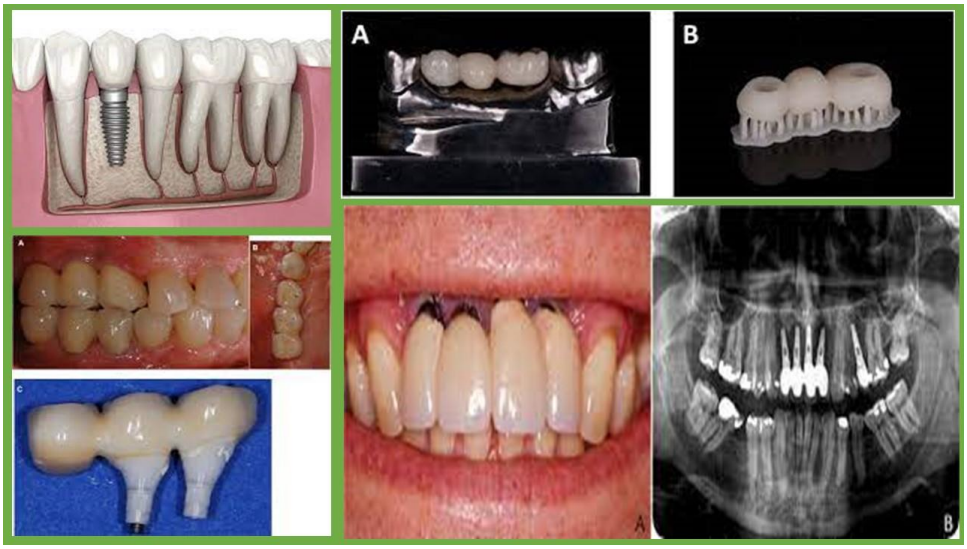


Figure 1. Fracture Strength of Fixed Partial Prostheses based on Implants

The average chewing forces reported are between 110 and 150 newtons, the maximum reported forces were 200 newtons in the anterior region, 350 newtons in the posterior region, and 1000 newtons in parafunctional cases. According to the results of this study, the average fracture strength of zirconia bridges with connector dimensions of 2x3 mm was N1156, which is suggested not to be used in parafunctional cases and if the interocclusal space is limited, zirconia bridges with connector dimensions of 3x3 mm and if beauty is not an issue, use metal bridges with connector dimensions of 2x3 mm [15].

Search strategy and selection of articles

Search in Scopus, Google scholar, PubMed databases and by searching with keywords such as " Analysis of Alveolar Crestal Bone" and " Cantilever Base Implants Using Scientific Sources" and "Fracture Problems" and “Special Care Unit” to obtain articles related to the selected keywords [16]. Case report articles, editorials, and articles that were not published or only an introduction of them were available, as well as summaries of congresses and meetings that were in languages other than English, were ignored. Only the original research articles that evaluated the effectiveness of different drugs in the treatment of COVID-19 using standard methods were studied (figure 2).

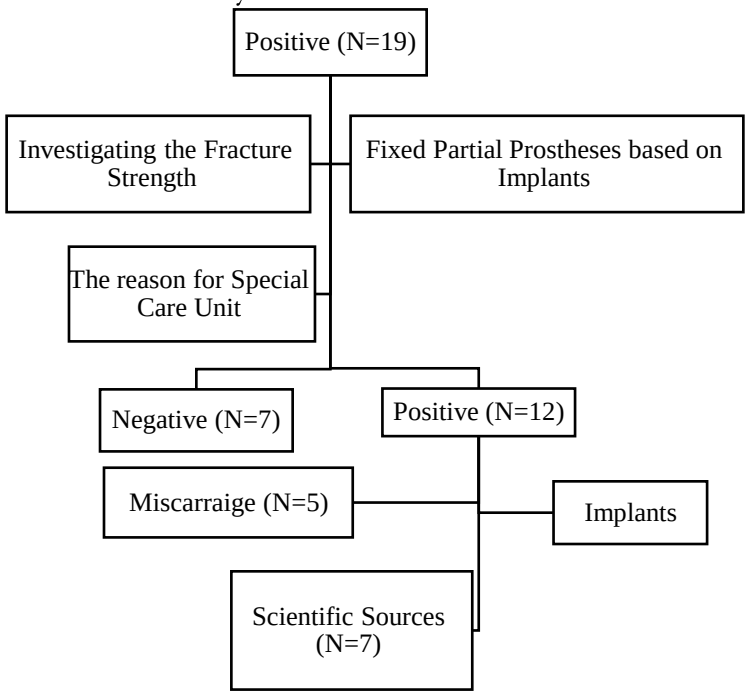


Figure 2. Flow chart of included subjects

Materials and Methods

In this experimental-laboratory study, a dental model of the mandible was used to simulate the jaw.

Table 1. Average and standard deviation of the fracture resistance of zirconium oxide all-ceramic posterior bridges.

Maximum	At least	Standard Deviation	mean (N)	Qty	Type of framework
444	452	1.3	214.32	12	**zirconia**
414	435	3.2	148.67	12	**metal**
858	885	4.5	362.99	24	**Total**

Parsil prosthesis

Parsil dental prosthesis is one of the types of removable dental prostheses. Movable partial dental prostheses are suitable for patients with no or few teeth [17] Parsil dental prosthesis, as its name suggests, can be easily placed in or out of the mouth (Figure 3). Parsil dental prosthesis consists of several teeth attached to a plastic base and the same color as the gums.

Figure 3. Parsil prosthesis

These teeth are connected by a metal frame [18]. Parsil dental prosthesis is attached to your natural teeth with metal clips. These clamps are not visible and have a high quality of construction. In some cases, partial dentures may need to be veneered to better match natural teeth, especially when special and precise attachments are used. Complete prosthesis has 2 types: normal and soft gum [19]. The important point is that the complete dental prosthesis consists of two parts [20]. One is the teeth, which are white, and the other is the pink part of the prosthesis, which is known as prosthetic gums among patients. This part of the prosthetic gum must be strong to be able to have the necessary efficiency [21-23].

Ordenture

Ordenture is also a type of mobile dental prosthesis treatment, which is actually a full set of teeth that are placed on two dental bases or several implant bases [24-26]. It is more comfortable than a complete dental prosthesis, but it is still mobile and less comfortable than a fixed dental prosthesis. What are the benefits of using dentures? If you are one of those people who have lost a few teeth and have difficulty chewing, biting, speaking. Prostheses can be a good solution to improve them. Prostheses are completely customized and made according to the shape and size of your mouth, and they are made to be as natural as possible [27-29]. The use of prostheses prevents the erosion and abrasion or the breakage and damage of the remaining teeth. Not using dentures may cause the natural teeth to

shift or become crooked [30-32]. Artificial teeth can be put in place immediately after they are removed, and it is not at all obvious that the dentures are in your mouth, these types of dentures are called immediate dentures. Dentures can never replace your natural teeth. So, it takes a long time to get used to them. By using removable partial dentures, you can help to restore or improve the 4 functions of beauty, jaw strength, chewing and speaking. Of course, the use of this type of dental prosthesis should not lead to pain and discomfort. Interrupted dental arches, dental arches with free ends and a combination of interrupted arches and free ends can be restored using these prostheses [33-35]. Among the weaknesses of movable partial prostheses, problems related to oral hygiene can be mentioned. Due to the advanced facilities of fixed partial dentures or implants, dentists do not have much desire to use movable partial dentures. However, we expect that there will be a greater demand for the use of removable dental prostheses in the future [36-38].

Types of movable partial prosthesis

There are three types of partial dentures:

- ✓ Acrylic tissue protective prostheses:
- ✓ Prostheses with a metal frame:
- ✓ Prostheses with metal and flexible framework:

Movable partial dental prosthesis with a metal frame

The most common type of partial dentures is a removable partial denture with a metal frame. This type of prosthesis is of high quality and uses precise connections, which leads to an increase in the quality of beauty [39-41].

Removable dental prostheses with acrylic clips

This type of dental prosthesis is made of acrylic flipper and is movable. The cheapest type of movable partial prosthesis is this type. Of course, the fact that this prosthesis is cheaper indicates that this type of prosthesis has some weaknesses. This type of dental prosthesis does not provide the most optimal possible condition for the person. In addition, acrylic clamps are less effective than metal frames [42-44]. For some people, the bulky appearance of these prostheses may not be interesting or comfortable. For this reason, this type of prosthesis is usually considered a temporary solution [45].

Flexible dental prosthesis

If you are allergic to acrylic, flexible dental prosthesis is a suitable alternative to this type of prosthesis. Other advantages of this type of prosthesis (Figure 4) are that they are very comfortable and their gum-colored clips make them draw less attention in the mouth [46]. Of course, it should be noted that the price of this type of prosthesis is higher because of these advantages, and it can even be said that these

prostheses are considered to be the most expensive types of movable partial prostheses. This type of prosthesis can also be used temporarily. One or more missing teeth can be easily replaced with fixed, movable or combined types of dental prostheses [47].

What are the advantages of movable partial prosthesis?

- ✓ The most economical way to replace missing teeth is to use removable prostheses.
- ✓ Usually, removable dentures can be made on the same day of the check-up, and you don't need to go without teeth for months until your tooth is made.
- ✓ Since there is usually no need to perform surgery to place partial dentures, the process of placing it is easier for both the patient and the dentist.
- ✓ Installing partial dentures or removable dentures does not cause any damage to the teeth adjacent to the lost tooth [48].

Figure 4. Flexible dental prosthesis

Disadvantages of movable partial prosthesis:

- ✓ It takes a long time to get used to using partial dentures. In addition, these prostheses are larger than natural teeth and therefore can cause discomfort.
- ✓ Since partial prostheses cover most of the surface of the mouth, they affect the function of the mouth and the quality of the person's speech.

- ✓ The taste buds in the roof of the mouth are affected by Parsil prostheses and the ability of a person to taste food is reduced.
- ✓ The use of partial dentures can increase the possibility of oral infections.
- ✓ Unfortunately, partial dentures cannot replace natural teeth and missing teeth bones. For this reason, if you do not use artificial teeth, your gums will shrink and look wrinkled.
- ✓ Whenever the prosthesis becomes loose, it should be replaced [49].

Laboratory steps of movable partial prosthesis:

Prostheses are made exclusively for people in the dental laboratory. The doctor takes the mold of the person's mouth and sends them to the laboratory to make a dental prosthesis for him. It may be necessary to modify the template several times. For this reason, you may have to visit the doctor once a week to complete your prosthesis [50-52]. Complete dental prosthesis is based on acrylic and is placed on the gum. Parsil dental prostheses are based on a metal frame and connected to the natural tooth. In some cases, a crown may be added to the natural teeth to help stabilize the prosthesis. There are two types of removable dentures. If you have lost most of your teeth, it is better to use full dentures. Partial dentures are a better option if you are missing some teeth. Dental implants or bridges can be added to these types of prostheses, but it will cost more, especially if the number of teeth you have lost is high [53].

Choosing the most suitable type of prosthesis

Consult your dentist. Because he knows better than anyone about the condition of your healthy teeth. In most cases, the best option is a partial prosthesis with a metal base [54].

All on 4 implant features

This technique is done in one day. Therefore, there is no need for six-month recovery periods between each stage of treatment in traditional implant methods. For this reason, this method is also referred to as "teeth in a day" or "smile in a day". Implant placement in the jaw can even be done on the same day as teeth extraction. Since only four implants are used in the jaw, their placement is important. Usually, two implants are placed in the front of the jaw and two implants are placed on the side. Unlike front implants, rear implants are placed at an angle of 45 degrees to provide more strength to the prosthesis. Due to the angle of placement of the implant, this method can also be used in people who have jaw bone loss [55]. After the implant is placed in the jaw bone, the artificial tooth prosthesis is installed on it on the same day. Therefore, the patient can resume his normal daily life without the need for recovery and waiting [56].

Discussion

Restoration of shape, function, comfort, beauty, speech and health in edentulous and semi-edentulous patients is one of the goals of modern dentistry, and today it is possible to achieve these goals through treatment with dental implants [57-59]. Despite the fact that dental implants are a suitable replacement for lost teeth, implant-based prosthetic treatments have various biological and biomechanical problems. Prosthetic complications in implant-based restorations are very diverse and include mechanical problems in prefabricated components of the implant, such as loosening or breaking of the abutment screw, and technical complications such as ceramic chipping and frequent loss of cement [60-62]. Also, the loss of interproximal contact between the implant-based fixed prosthesis and the adjacent tooth has been reported, which causes problems such as food entrapment, periodontal defects, and caries of the adjacent tooth.

The survival rate and complications of implant-based fixed restorations have been investigated, and a high rate of mechanical complications after a five-year period has been reported. It has been shown that despite the high survival rate of fixed prostheses based on implants, biological and technical problems were common [63-65]. The most common complication in implant-based single-unit prostheses is abutment screw loosening, and its rate is reported between 5% and 48%. This complication may not cause the failure of the treatment, but it is significantly related to the time and cost required for maintenance and has a negative effect on the patient's satisfaction with the implant treatment. Abutment screw loosening is somewhat related to the implant system used and the applied forces. Porcelain failure is the second most common prosthetic complication in implant-based prostheses, and its rate has been reported in different studies between 3.8% in all-ceramic veneers and 3.2% in metal-ceramic veneers [66-68].

The rate of loss of cement has been reported in different articles in the period of 2.5 years, 1.6%. Different cements are used to bond fixed restorations to implants, each of which provides a different degree of retention. This issue, along with different cementing techniques, is effective in the amount of cement loss. Abutment screw loosening, frequent loss of cement, open proximal contact are problems that cause patient dissatisfaction, lack of successful treatment, and additional costs to the patient. In the present study, frequent loss of cement was the most frequent problem among the problems, which was 15% and 5.5% in single and multiple veneers, respectively. While in a systematic review, this rate was reported as 2% in single veneers and 6% in multiple units [69]. The frequency of repeated loss of cement in the present study was lower than that reported in the study of Woelber and colleagues, which could be due to the longer period of time investigated after placing the prosthesis on the implant compared to the present study. Also, the difference in the amount of cement loss reported in the mentioned studies and the present study can be due to the difference in the type of cement used, the variable length of the abutment, the different distribution of lateral forces on the prosthesis, and errors during molding and manufacturing of the prosthesis in the laboratory [70].

In the present study, all veneers were delivered with temporary cement, while in different studies, the type of cement was not necessarily reported, and this could be the cause of different results with similar studies. Also, in the present study, the person was asked the number of times the prosthesis came off. Because there was a possibility of the person going to a center other than the faculty for cementing again, and there was a possibility of not being registered in the patient's file. This is one of the limitations of the present study and may have caused a difference in the results in the form of overestimation or underestimation. In the present study, in multi-unit prostheses, due to the increase in the surface of the abutments and the area of the cementing area, the frequency of frequent loss of cement was less than that of single prostheses [71].

The next most common problem was porcelain failure. In the current study, the frequency of porcelain failure was 2.6%, which was higher than the results of Mangano et al., Montero et al., Vanilioglu et al., and Hinze et al. In other studies, porcelain failure in single-unit prostheses was reported to be 2%, which was 5.12% in the present study. In the current study, the frequency of porcelain failure in multi-unit prostheses was 3.3%, which has been reported up to 6% in some studies. The reduction of porcelain failure in multi-unit veneers compared to single-unit veneers in the present study can be related to porcelain support in the marginal ridges due to the framework connection. Also, destructive shearing forces are reduced in connected coatings compared to single coatings [72]. Porcelain failure depends on several factors. The skill of the laboratory technician in the various stages of making multilithic veneers, such as designing and preparing the framework and complying with porcelain standards, can be involved in the failure of porcelain [73].

The high frequency of porcelain failure in the present study compared to similar studies can be due to the insufficient skills of laboratory technicians working in Yazd College and the need for more training and experience in them. Also, the difference in functional forces in different people and variable cycles of causing fatigue in porcelain and the bonding surface to the framework can be another factor in the difference in the results of the studies. In this study, out of 130 prosthetic units examined, the frequency of abutment screw loosening was 3.07% in total, which is similar to the frequency reported in different studies. The frequency of screw loosening in single-unit prostheses in the present study was 5.7%, which was almost similar to the results of Sadid-zadeh et al. and Hinze et al. The frequency of screw loosening has been reported in single-unit prostheses more than in multi-unit prostheses [74-76].

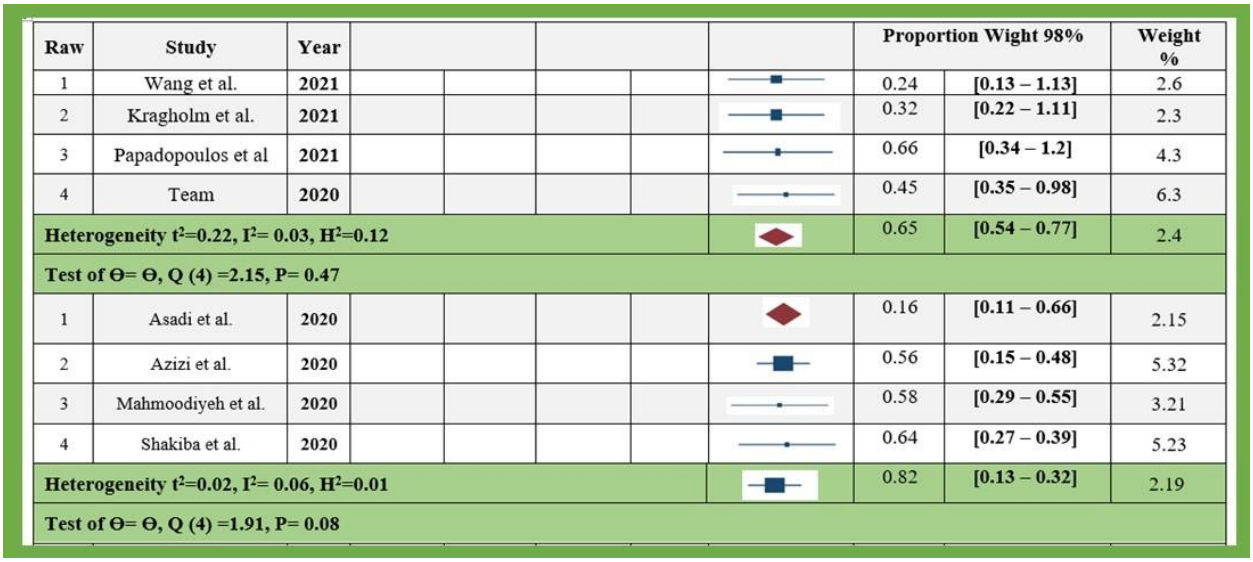
The rate of abutment screw loosening was reported to be 25% in the early years of single implant placement, but it has decreased to 8% in recent studies. Newer designs and materials in the manufacture of screws, improved designs in the abutment-implant connection area, and standardization of devices and protocols for applying torque to the screw are among the reasons for this decrease. In the study of Woelber et al., 96 implant units were examined and the rate of abutment screw loosening was reported as 89.13%. In the study of Montero and his colleagues, the rate of

loosening of the abutment screw was 10.8% of the 93 implant units investigated, which due to the similarity of the number of samples of these two studies with the present study, this percentage can be higher due to the longer period of time investigated after placing the prosthesis. on the implant (10 to 23 years) compared to the present study. With the passage of prosthetic loading time, the preload force applied to the abutment screw during function is gradually lost and the frequency of screw loosening increases. In two systematic review studies, the annual rate of screw loosening in single veneers has been reported as 29.2% and 93.1%. The reason for this difference can be the results of using different implants with a unique design as well as different force factors in patients such as bruxism and clenching [75].

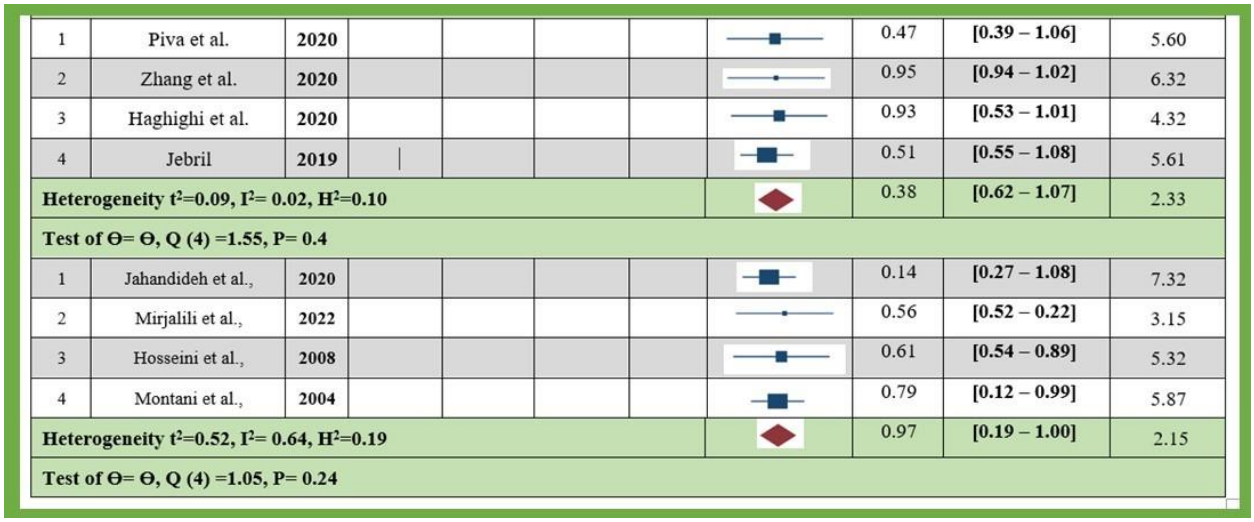
In the study by Wang et al., it was shown that experienced operators experienced a lower rate of abutment screw loosening after prosthetic treatments. While in the present study, all prosthetic treatments were performed by specialized assistants with little experience, which can be one of the reasons for the frequent loosening of the abutment screw. In the present study, there was no significant difference in the frequency of porcelain fracture and screw loosening in anterior and posterior maxilla. Although the number of functional forces is higher in the posterior region, the direction and type of forces are more destructive in the front, and therefore the frequency of force-related prosthetic problems can be similar in the front and back. Also, prosthetic problems were not related to age, sex, and duration of loading.

Due to the conditions of the covid disease, few patients came to the faculty to participate in the study, which was one of the limitations of the present study, and the average duration of treatment was approximately 2.5 years, and therefore, due to the short scope of the study and the small number of patients, the results cannot be obtained. He extended what came to the bed. The loss of proximal contact and eventually food entrapment in place can be the result of the mesial drift of the teeth and the absence of such movement in the implant. In the present study, the frequency of open proximal contact was 3.2%. In the study of Varthis and his colleagues, 128 patients (174 implant units) were evaluated. Interproximal contacts were checked with a dental floss with a diameter of 0.07 mm. The rate of open interdental contact was reported as 8.52%. Koori et al investigated proximal contact using a 50 μm thick gauge (Figure 5 & 6).

Figure 5. Forest plot showed Investigating the Fracture Strength of Fixed Partial Prostheses



Raw	Study	Year					Proportion	Wight 98%	Weight %
1	Wang et al.	2021					0.24	[0.13 – 1.13]	2.6
2	Kragholm et al.	2021					0.32	[0.22 – 1.11]	2.3
3	Papadopoulos et al	2021					0.66	[0.34 – 1.2]	4.3
4	Team	2020					0.45	[0.35 – 0.98]	6.3
Heterogeneity t^2=0.22, I^2= 0.03, H^2=0.12							0.65	[0.54 – 0.77]	2.4
Test of Θ= Θ, Q (4) =2.15, P= 0.47									
1	Asadi et al.	2020					0.16	[0.11 – 0.66]	2.15
2	Azizi et al.	2020					0.56	[0.15 – 0.48]	5.32
3	Mahmoodiyeh et al.	2020					0.58	[0.29 – 0.55]	3.21
4	Shakiba et al.	2020					0.64	[0.27 – 0.39]	5.23
Heterogeneity t^2=0.02, I^2= 0.06, H^2=0.01							0.82	[0.13 – 0.32]	2.19
Test of Θ= Θ, Q (4) =1.91, P= 0.08									



1	Piva et al.	2020					0.47	[0.39 – 1.06]	5.60
2	Zhang et al.	2020					0.95	[0.94 – 1.02]	6.32
3	Haghighi et al.	2020					0.93	[0.53 – 1.01]	4.32
4	Jebril	2019					0.51	[0.55 – 1.08]	5.61
Heterogeneity t^2=0.09, I^2= 0.02, H^2=0.10							0.38	[0.62 – 1.07]	2.33
Test of Θ= Θ, Q (4) =1.55, P= 0.4									
1	Jahandideh et al.,	2020					0.14	[0.27 – 1.08]	7.32
2	Mirjalili et al.,	2022					0.56	[0.52 – 0.22]	3.15
3	Hosseini et al.,	2008					0.61	[0.54 – 0.89]	5.32
4	Montani et al.,	2004					0.79	[0.12 – 0.99]	5.87
Heterogeneity t^2=0.52, I^2= 0.64, H^2=0.19							0.97	[0.19 – 1.00]	2.15
Test of Θ= Θ, Q (4) =1.05, P= 0.24									

Figure 6. Forest plot showed Implants studies

Interdental contact loss was reported to be 43% over 5 years. The amount of open proximal contact reported in the aforementioned studies was different from the present study. This difference can be due to the use of different indicators to investigate open interdental contact in different studies. Also, with the passage of time, the mesial migration of the teeth has increased, and this difference can be due to the longer period of time investigated after placing the prosthesis on the implant in other studies compared to the present study.

Types of failure

1- Mechanical failure: In the case of mechanical failure, the screws that secure the restoration may be bent, loosened, or broken. The most damaging type of mechanical failure is implant failure.

2- Biological failure: In biological failure, the resorption-remodeling response of the bone surrounding the implants will be stimulated and will lead to the progressive breakdown of the bone. In some cases, the bone breakdown around the implant progresses to such an extent that the implant is no longer supported by the bone and Osseointegration is lost. Among the important factors that can be mentioned as one of the influencing factors on this issue is the ratio of the crown to the implant, which is based on the variables that can be created, such as the location of the support and its distance from the top of the worker's arm. This distance has two anatomical and clinical definitions, which according to biomechanics rules, in this research, its clinical definition is used, which is the highest point of the crown to the top of the bone crest, it has a very effective role on the results of implant treatment. If the crown-to-implant ratio is inappropriate, it increases the effects of non-axial forces and increases failure in prosthetic treatments and decreases bone support in the cervical region. This ratio is obtained from the comparison of two separate components including crown height and implant length.

Prevent dental implant failure

Today, in modern implantology, it has been completely proven that the result of surgical treatment without the cooperation of prosthodontist, prosthetics technician and radiologist is mostly disappointing and, in some cases, the only way is to even remove the implants. In addition, it has been proven that improper placement of implants can lead to abnormal increase in side pressures, bone loss, and in some cases even dental implant breakage. Failure to place the implant in the right direction and the insertion of chewing pressure in the wrong direction is the main cause of many daily failures in impentology. Problems like this have caused that before any type of surgery and implant placement, he pays attention to the issues of diagnostic assistance and by preparing study casts, diagnostic preparation, taking different types of wax-up stereotypes, types of radiographs and the exact position of the patient's final prosthesis. evaluate and determine the best position of the implants in advance. Therefore, to prevent the failure of the dental implant, he used various factors that are available today.

Conclusion

Increasing the dimensions of the connector significantly increased the fracture resistance of all-ceramic frameworks. The average fracture resistance of all-ceramic frameworks was significantly lower than that of metal frameworks with connector dimensions of 2x3 mm. Among the ceramic frames, the highest fracture resistance was related to frameworks with 4x4 mm connector dimensions and the

lowest fracture resistance was related to frameworks with 2x3 mm connector dimensions. In recent years, the use of implant-related treatments has increased due to the effect of these factors:

- ✓ The life expectancy of the elderly population has increased.
- ✓ Consequences of failure of fixed prostheses and partial movable prostheses.
- ✓ Anatomical consequences of toothlessness.
- ✓ Poor performance of movable prostheses.
- ✓ Psychological consequences after tooth loss.
- ✓ The results of implant-based prostheses are more predictable.

Treatment planning for a successful implant requires a good knowledge of biomechanics, a proper assessment of load bearing capacity and a good engineering plan to maintain osseointegration along with resistance to anticipated occlusal load.

The cause of dental implant breakage: It is clear that in case of using restorations based on implants, knowledge of implant biomechanics is necessary. The load bearing capacity of restoration supporting implants must be greater than the amount of load during function, otherwise it will cause the failure of the dental implant. If the load is greater than the load bearing capacity of implants, prosthesis or supporting bone, excessive load can lead to mechanical or biological failure.

References

[1]. A Yarahmadi, K Kamrava, A Shafee, M Milanifard, M Aghajanpour, et al., Investigation of Olfactory Function Following Septorhinoplasty in Iranian Population by Rapid Smell Test (RST), J Pharm Res Int, 2017, 1-6

[2]. Abadi TSH, Askari M, Miri K, Nia MN. Depression, stress and anxiety of nurses in COVID-19 pandemic in Nohe-Dey Hospital in Torbat-e-Heydariyeh city, Iran. J of Military Med 2020; 22 (6): 526-33.

[3]. Abbasi, M. Nakhostin, A. Namdar F. Chiniforush, N. Hasani Tabatabaei, M. The Rate of Demineralization in the Teeth Prepared by Bur and Er:YAG Laser, J Lasers Med Sci, 2018, 9(2):82-86.

[4]. Alipour A, Ghadami A, Alipour Z, Abdollah Zadeh H. Preliminary Validation of the Corona Disease Anxiety Scale (CDAS) in the Iranian Sample. J of health psychology 2020; 8 (4): 163-75.

[5]. Alrabadi N, Shawagfeh S, Haddad R, Muktesh T, Abu Hammad S, Al-rabadi D, et al. Medication errors: a focus on nursing practice. J of Pharmaceutical Health Services Research 2021; 12 (1): 78-86.

[6]. Aminzadeh M, Mohebi far R, Azamines Y, Faraji M. The Frequency of Medication Errors and Factors Influencing the Lack of Reporting Medication Errors in Nursing at Teaching Hospital of Qazvin University of Medical Sciences, 2012. J of Health 2015; 6 (2): 169-79.

[7]. Asadi N, Salmani F, poorkhajuie s, mahdavifar m, royani z. Investigating the Relationship Between Corona Anxiety and Nursing Care Behaviors Working in Coronary Referral Hospitals. IJPCP 2020; 26 (3): 306-19.
[8]. Azizi Aram S, Bashar poor S. The role of rumination, emotion regulation and responsiveness to stress in predicting of Corona anxiety (COVID-19) among nurses. Quarterly J of Nursing Management 2020; 9 (3): 8-18.
[9]. B Mahmoodiyeh, S Etemadi, A Kamali, S Rajabi, M Milanifard, Evaluating the Effect of Different Types of Anesthesia on Intraoperative Blood Glucose Levels in Diabetics and Non-Diabetics Patients: A Systematic Review and Meta-Analysis, Annals of the Romanian Society for Cell Biology, 2021, 2559–2572
[10]. B Shakiba, N Torabi, R Alimoradzadeh, R Maghsoudi, Medical Workplace Civility Watch: An Attempt to Improve the Medical Training Culture, Journal of Iranian Medical Council, 2022, 5 (1), 227-228
[11]. B Shakiba, N Torabi, R Alimoradzadeh, R Maghsoudi, Medical Workplace Civility Watch: An Attempt to Improve the Medical Training Culture, Journal of Iranian Medical Council, 2022, 5 (1), 227-228
[12]. Barzideh M, Choobineh A, Tabatabaei S. Job stress dimensions and their relationship to general health status in nurses. Occupational Medicine 2012; 4 (3): 17-27.
[13]. Beachboard, D.C., J.M. Anderson-Daniels, and M.R. Denison, Mutations across murine hepatitis virus nsp4 alter virus fitness and membrane modifications. J Virol, 2015. 89(4): p. 9-2080.
[14]. Borba MGS, Val FFA, Sampaio VS, Alexandre MAA, Melo GC, Brito M, et al. Effect of high vs low doses of chloroquine diphosphate as adjunctive therapy for patients hospitalized with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection: a randomized clinical trial. JAMA network open. 2020;3(4): e208857-e.
[15]. F Afkar, S Golalipour, M Akanchi, SM Sajedi, A Zandi Qashghaie, Systematic Reviews of Different Types of Drug Delivery in the Treatment and Prevention of Oral and Dental and Cardiorespiratory Diseases in Patients and Animals Involved, NeuroQuantology, 2022, 20 (8), 632-642
[16]. F Zabihi, MA Abbasi, R Alimoradzadeh, The Association of Serum Albumin Level with Cognition and Daily Function in Patients Undergoing Hemodialysis, Annals of the Romanian Society for Cell Biology, 2021, 2573–2579
[17]. Fazel Karimzadeh, Seyed Masoud Sajedi, MSc,b Saman Taram, Stu,c and Fathemeh Karimzadeh, Comparative evaluation of bacterial colonization on removable dental prostheses in patients with COVID-19: A clinical study, The Journal of Prosthetic Dentistry, 2021, 1-3
[18]. Furuta Y, Gowen BB, Takahashi K, Shiraki K, Smee DF, Barnard DL. Favipiravir (T-705), a novel viral RNA polymerase inhibitor. Antiviral research. 2013;100(2):446-54.

[19]. Gadlage, M.J., et al., Murine hepatitis virus nonstructural protein 4 regulates virus-induced membrane modifications and replication complex function. J Virol, 2010. 84(1): p. 280-90.
[20]. Ghaibi E; Soltani Manesh MR; Bushra M; Gilani Z; Salimi Nabi K; Zarif F., Comparison of Organizational Citizenship Behavior and Job Creativity between Male and Men's Education Personnel 1 Ahwaz, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 1(2), 2022, 49-57
[21]. Ghaibi E; Soltani Manesh MR; Jafari Dezfouli H; Zarif F; Jafari Z; Gilani Z., Comparison of Marital Satisfaction, Emotional Divorce and Religious Commitment among Nurses and Staff of Ahvaz Government Hospitals, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 1(1), 2022, 33-39
[22]. Goyal K, Chauhan P, Chikara K, Gupta P, Singh MP. Fear of COVID 2019: First suicidal case in India! Asian J of psychiatry 2020; 49: 101989.
[23]. Graham, R.L., et al., The nsp2 replicas' proteins of murine hepatitis virus and severe acute respiratory syndrome coronavirus are dispensable for viral replication. J Virol, 2005. 79(21): p. 13399-411.
[24]. H Alizadeh Otaghvar, K Afsordeh, M Hosseini, N Mazhari, M Dousti, Causes of wound dehiscence in trauma patients with penetrating and non-penetrating abdominal wound in Rasool Akram Hospital within 2017-2020, Journal of Surgery and Trauma, 2020, 8 (4), 156-160
[25]. H Alizadeh Otaghvar, S Moghaddam, A Molaei, et al., Pharmacological and Medical Effect of Modified Skin Grafting Method in Patients with Chronic and Severe Neck Burns, Journal of Medicinal and Chemical Sciences, 2021, 369-375
[26]. H Jahandideh, A Yarahmadi, S Rajaieh, AO Shirazi, M Milanifard, et al., Cone-beam computed tomography guidance in functional endoscopic sinus surgery: a retrospective cohort study, J Pharm Ree Int, 2020, 31 (6), 1-7
[27]. H Mirfakhraee, S Golalipour, F Ensafi, A Ensafi, S Hajisadeghi, Survival rate of Maxillary and Mandibular Implants used to Support Complete-arch Fixed Prostheses & Investigation of internal and Neurological manifestations, NeuroQuantology, 2022, 20 (6), 5118-5126
[28]. H Mirjalili, H Amani, A Ismaili, MM Fard, A Abdolrazaghnejad, Evaluation of Drug Therapy in Non-Communicable Diseases; a Review Study, Journal of Medicinal and Chemical Sciences, 2022, 5 (2), 204-214
[29]. HA Otaghvar, R Rezapour-Nasrabad, MA Ebrahimzadeh, M Yaghoubi, et al., The effects of Feijoa sellowiana fruit extract on wound healing in rats: a stereological and molecular study, Journal of Wound Care, 2022, 31 (Sup8), S36-S44
[30]. Hao Xu. High expression of ACE2 receptor of 2019-nCoV on the epithelial cells of oral mucosa. International Journal of Oral Science (2020) 12:8; https://doi.org/10.1038/s41368-020-0074-x.
[31]. Helmy YA, Fawzy M, Elaswad A, Sobieh A, Kenney SP, Shehata AA. The COVID-19 pandemic: a comprehensive review of taxonomy, genetics, epidemiology, diagnosis, treatment, and control. Journal of Clinical Medicine. 2020;9(4):1225.

[32]. Holmes EA, O'Connor RC, Perry VH, Tracey I, Wessely S, Arseneault L, et al. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. The Lancet Psychiatry 2020; 7 (6): 547-60.
[33]. Hosseini Khalili AR, Thompson J, Kehoe A, Hopkinson NS, et al. Angiotensin-converting enzyme genotype and late respiratory complications of mustard gas exposure. BMC Pulm Med. 2008;8(1):15.
[34]. Johnson A., Investigation of Network Models Finite difference Method, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 2(1), 2023, 1-9
[35]. MR Khami, A Gholamhossein Zadeh, D Rahi; A cross-sectional study on COVID-19-related changes in self-medication with antibiotics; PloS one 17 (6), 2022, e0269782
[36]. Kalantari H, Tabrizi AHH, Foroohi F. Determination of COVID-19 prevalence with regards to age range of patients referring to the hospitals located in western Tehran, Iran. Gene reports. 2020;21: 100910.
[37]. Karampela I, Dalamaga M. Could Respiratory Fluoroquinolones, Levofloxacin and Moxifloxacin, prove to be Beneficial as an Adjunct Treatment in COVID-19? Archives of medical research. 2020;51(7):741-2.
[38]. Zbuzant M., Different Weight Percentages Doubled in the Catalyst, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 1(2), 2022, 40-48
[39]. Lo Han K., Investigation of Heavy Polyethylene Catalytic Pyrolysis, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 1(2), 2022, 64-70
[40]. Lo Han K., Investigation of Network Models as a Numerical Method for Solving Groundwater Equations, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 1(1), 2022, 1-9
[41]. M Abbasi, Afrooz Nakhostin, Fatemeh Namdar, Nasim Chiniforush, Masomeh Hasani Tabatabaei, The Rate of Demineralization in the Teeth Prepared by Bur and Er: YAG Laser, J Lasers Med Sci, Spring 2018;9(2):82-86.
[42]. M Milanifard, G Hassanzadeha, Anthropometric study of nasal index in Hausa ethnic population of northwestern Nigeria, J Contemp Med Sci|, 2018, 4 (1), 26-29
[43]. M Yavari, SE Hassanpour, HA Otaghvar, HA Abdolrazaghi, AR Farhoud, The incidence of ossified superior transverse scapular ligament during nerve transfer through posterior shoulder approach, Archives of Bone and Joint Surgery, 2019, 7 (3), 258
[44]. Mahmoodi S, Hesabi M, Emami sigaroudi A, Kazemnejad leili E, Monfared A. General health and related factors in employed nurses in Medical-Educational Centers in Rasht. JHNM 2015; 25 (1): 63-72.
[45]. MB Abhari, PF Afshar, R Alimoradzadeh, H Mirmiranpour, Comparing the effect of including omega-3 to treatment regimen in elderly patients with ulcerative colitis with placebo: A randomized clinical tria, Immuno pathologia Persa, 2019, 6(1), e10-e10

[46]. Mileski M, Pannu U, Payne B, Sterling E, McClay R. The impact of nurse practitioners on hospitalizations and discharges from long-term nursing facilities: a systematic review. Healthcare 2020; 8 (2): 114-34.
[47]. MM Fard, Effects of Micronutrients in Improving Fatigue, Weakness and Irritability, GMJ Med. 2021, 5 (1): 391 395
[48]. N Shahkarami, M Nazari, M Milanifard, R Tavakolimoghadam, A Bahmani, The assessment of iron deficiency biomarkers in both anemic and non-anemic dialysis patients: A systematic review and meta-analysis, Eurasian Chemical Communications, 2022, 4 (6), 463-472
[49]. N Zaimzadeh, S Ziaie, N Mohammadzadeh, H Alizadeh Otaghvar, et al., The study of dietary intake of micronutrients in four phenotypes of polycystic ovary syndrome separately based on Rotterdam criteria, Razi Journal of Medical Sciences, 2018, 25 (3), 59-68
[50]. N Zaimzadeh, S Ziaie, N Mohammadzadeh, H Alizadeh Otaghvar, et al., Comparison of vitamin D dietary intake among four phenotypes of polycystic ovary syndrome and its association with serum androgenic components, Razi Journal of Medical Sciences, 2018, 25 (2), 87-96
[51]. Najafi F, Kerjasama F, Gangoozehi E. The Relationship between General Health and Quality of Work Life of Nurses Working in Zahedan Teaching Hospitals. Iranian J of Rehabilitation Research in Nursing 2018; 4 (2): 53-9.
[52]. Nazardani SZ; Nourizadeh Dehkordi SH; Ghorbani A., A comprehensive evaluation of the Sports Physiotherapy curriculum. Eurasian Journal of Chemical, Medicinal and Petroleum Research, 2(1), 2023, 10-16
[53]. Nurmeksela A, Mikkonen S, Kinnunen J, Kvist T. Relationships between nursing management, nurses' job satisfaction, patient satisfaction, and medication errors at the unit Level: A correlational study. Research Square 2020; 1 (1): 1-22.
[54]. P Dini, B Shakiba, R Alimoradzadeh, N Torabi, MWC Watch, Impaired mental health status and uncivil workplace behavior's: An egg and chicken problem, Journal of affective disorders, 2021, 281, 502
[55]. R Alimoradzadeh, H Mirmiranpour, P Hashemi, S Pezeshki, SS Salehi, Effect of Memantine on Oxidative and Antioxidant Indexes Among Elderly Patients with Prediabetes and Mild Cognitive Impairment, Journal of Neurology & Neurophysiology, 2019, 10 (1), 1-5
[56]. R Alimoradzadeh, M Mokhtare, S Agah, Comparing the prevalence of constipation risk factors in the elderly with and without constipation in Hazrat-e Rasoul (PBUH) Hospital, Iranian Journal of Ageing, 2017, 12(1), 78-89
[57]. R Alimoradzadeh, MA Abbasi, F Zabihi, H Mirmiranpour, Effect of Anesthetics on Oxidant and Antioxidant Parameters After Inguinal Hernia Surgery in Older Patients, Iranian Journal of Ageing, 2021, 15(4), 524-533

[58]. Rebout F., Effect of Polymers on Transient Reynolds Number Change in Pipe Flow and Reduction of their Coefficient of Friction, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 1(1), 2022, 20-32
[59]. Rebout F., Friction Coefficient Pressure Gradient in Fully Developed Flow, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 1(2), 2022, 58-63
[60]. Rothan HA, Byrareddy SN. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. Journal of autoimmunity. 2020:102433.
[61]. S Golalipour, Z Soleimanydarinsoo, N Qaderi, H Ghazipoor, M Salahi, Examination of Dental Problems and Radiological and Cardiac Evaluations in Patients Affected by Covid-19, NeuroQuantology, 2022, 20 (8), 1519- 1527
[62]. S.H Salehi, K As'adi, S.J Mousavi, S Shoar, Evaluation of Amniotic Membrane Effectiveness in Skin Graft Donor Site Dressing in Burn Patients, Indian J Surg, 2015 Dec;77(Suppl 2):427-31.
[63]. S.H Salehi, M.J Fatemih, K Aśadi, S Shoar, A Der Ghazarian, R Samimi, Electrical injury in construction workers: a special focus on injury with electrical power, Burns, 2014 Mar;40(2):300-4.
[64]. Samiei, N. Ghane, HK. Khaled, Y. COVID-19 and Periodontal Disease: The Potential Role of Interluekin-6, SVOA Dentistry, 2021, 2(6), 254-257.
[65]. Serrano, P., et al., Nuclear magnetic resonance structure of the nucleic acid-binding domain of severe acute respiratory syndrome coronavirus nonstructural protein 3. J Virol, 2009. 83(24): p. 12998-3008.
[66]. SP. Smieszek, Przychodzen BP, Polymeropoulos MH. Amantadine disrupts lysosomal gene expression; a hypothesis for COVID19 treatment. International Journal of Antimicrobial Agents. 2020:106004.
[67]. Spinner CD, Gottlieb RL, Criner GJ, López JRA, Cattelan AM, Viladomiu AS, et al. Effect of remdesivir vs standard care on clinical status at 11 days in patients with moderate COVID-19: a randomized clinical trial. Jama. 2020;324(11):1048-57.
[68]. Stoessl AJ, Bhatia KP, Merello M. Movement Disorders in the World of COVID-19. Movement Disorders Clinical Practice. 2020;7(4):355-6.
[69]. Zbuzant M., An Overview of the Use of Photo Catalysts for Desulfurization, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 1(1), 2022, 10-19
[70]. V. Monteil, Dyczynski M, Lauschke VM, Kwon H, Wirnsberger G, Youhanna S, et al. Human soluble ACE2 improves the effect of remdesivir in SARS-CoV-2 infection. EMBO molecular medicine. 2020: e13426.
[71]. Karimzadeh F., Sajedi SM., Taram S., Karimzadeh F., Comparative evaluation of bacterial colonization on removable dental prostheses in patients with COVID-19: A clinical study, The Journal of Prosthetic Density, 2021, 1-3

[72]. M Noori Ibrahim; E Mohammed Mostafa; F Nasir Toama, Histological Effects of Monosodium Glutamate on Brain of Infant Albino Swiss Mice Mus Musculus, Journal of Medicinal and Chemical Sciences, 4(6), 2021, 564-570

[73]. S Aghili; T Alirezaei; S Nikmanzar; S Salehgargari, Comparing the Inflammatory Markers between Women with Eclampsia- Preeclampsia and Normotensive Pregnant Women in Gynecology, Journal of Medicinal and Chemical Sciences, 4(6), 2021, 571-578

[74]. M Karimzadeh Jouzdani; M Karimzadeh Jouzdani; B Mohebbi, The Role of Inflammatory Biomarkers in Predicting in-Stent Restenosis, Journal of Medicinal and Chemical Sciences, 4(6), 2021, 635-645

[75]. M Dousti; H Alizadeh Otaghvar; A Jafarian; I Rokhzadi; N Mazhari; S Moghaddam, Evaluation of the Effect of Gummy Candy on Postoperative Ileus and Its Complications, Journal of Medicinal and Chemical Sciences, 4(6), 2021, 579-585

[76]. S Manifar, A Tonkaboni, S Rahi, B Jafarnejad, A Gholamhosseinzade, et al., The Prevalence of intubation induced dental complications among hospitalized patients, Journal of Dentomaxillofacial Radiology, Pathology and Surgery 10 (1), 2021, 20-26