ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 3, Issue – 3, May - 2020, Page No. : 586 - 594

A comprehensive review and a proposed classification system for complications encountered with All-On-4® dental implant procedure.

[1]Dr. Anandkumar G. Patil, Professor & Head, Department of prosthodontics and crown and bridge, KLE Academy of higher education and research's Vishwanath Katti Institute of dental sciences, Belagavi, Karnataka, India.

[2] Dr. Sayali Dinar Mardolkar, Post Graduate student, Department of prosthodontics and crown and bridge, KLE Academy of higher education and research's Vishwanath Katti Institute of dental sciences, Belagavi, Karnataka, India.

[3]Dr.Swapnil.Shankargouda, Senior Lecturer, Department of prosthodontics and crown and bridge, KLE Academy of higher education and research's Vishwanath Katti Institute of dental sciences, Belagavi, Karnataka, India.

Corresponding author: Dr. Swapnil Shankargouda, Senior Lecturer, Department of prosthodontics and crown and bridge, KLE Academy of higher education and research's Vishwanath Katti Institute of dental sciences, Belagavi, Karnataka, India.

Citation of this Article: Dr. Anand kumar G. Patil, Dr. Sayali Dinar Mardolkar, Dr. Swapnil Shankargouda, "A comprehensive review and a proposed classification system for complications encountered with All-On-4® dental implant procedure", IJDSIR- May - 2020, Vol. – 3, Issue -3, P. No. 586 – 594.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

To overcome the anatomical limitations of conventional dental implant surgeries in the severely atrophied posterior maxilla or mandible, All-on-4® procedure with posterior tilted implants was introduced. Even though this procedure has a proven success rate, it is a very technique sensitive procedure with chances of complication at each stage. So the purpose of this review is to give a detailed description of all the possible complications encountered by any clinician during the treatment procedure and propose a precise and wholesome classification system for the same.

Keywords: All-on-four, complications, dental implants.

Introduction

The most common problem faced by prosthodontists all over the world is the rehabilitation of patients with a severely resorbed maxilla or mandible. Conventional treatment procedures like fabrication of complete dentures may not provide satisfactory results in terms of retention, esthetics or masticatory efficiency.

In recent times, osseointegrated implant-retained prostheses have allowed many patients to improve their quality of life when compared to complete dentures.

An extensive surgical bone augmentation procedure is often necessary to achieve sufficient bone support to place standard implants (10–12 mm length, ~3.5 mm diameter)

in the severely atrophic posterior jaw. Bone augmentation surgery, regardless of reconstructive procedure, carries a higher risk of patient morbidity and complications like infection, loss of graft material etc, as well as higher costs and longer time intervals to complete the treatment. To avoid grafting procedures and to utilize preexisting bone in the most effective way, angled/tilted implants is a well-documented alternative, with no apparent clinically significant difference in success rates compared with axially placed implants.[1]

Since its inception into dental literature in 2003, the All-on-4® treatment concept has proven to be a predictable and cost-effective method used for full-arch implant rehabilitation. The cumulative prosthetic survival rate in maxilla and mandible was 98.8%. Also, the implant cumulative survival and success rates were 93.0% and 91.7%, respectively, from a total of 1,884 implants.[2-6]

While most of the related research, documents the success rate for this treatment concept, fewer studies discuss variations in surgical protocol for specific anatomic situations and complications associated with the procedure other than infections or mechanical fracture of the prosthesis. [7-10]

So the aim of this article is to give a detailed description of the possible complications any clinician/implantologist may encounter during the All-on-4® treatment procedure and propose a classification system for ease of application and reproducibility.

For better understanding, ease of application and elaboration on the possible complications encountered during the All-on-4® surgical and prosthetic procedures, the complications may be broadly classified under BIOLOGICAL and MECHANICAL and further sub classified as complications seen preoperatively,intraoperatively and postoperatively as shown in Figure 1.

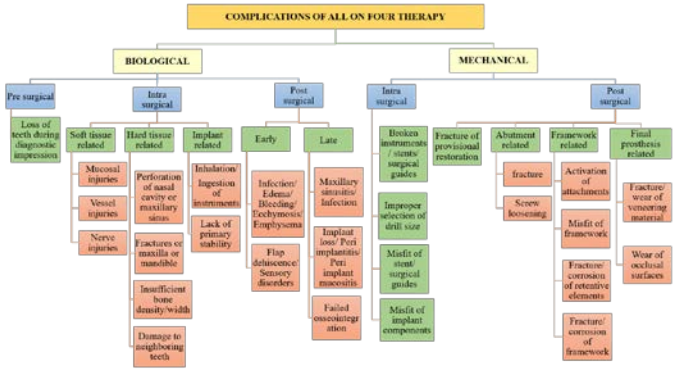

Figure 1: enumerating the biological and mechanical complications associated with All-on-4 implant therapy.

Biological complications are related to the hard and soft tissues whereas mechanical complications are related mainly with the prosthetic failures.

Biologic Complications

Preoperative Complications

Loss of teeth with diagnostic impressions: Patients having extremely compromised teeth due to caries or periodontitis may be accidentally removed during the diagnostic impression procedures. Such situations must be identified and these patients must be advised of the potential tooth loss before the impression procedure. The exfoliated teeth can be temporarily bonded back to neighboring teeth using composite resins with no opposing tooth contact or can be incorporated to their existing removable partial dentures until surgery.[5]

Intraoperative Complications

Soft tissue related injury: During mucogingival flap reflection, arterial disruptions may occur due to anatomic variability or vasculature of the area. It can be managed by administration of local anesthetic agent with at least 1:100,000 epinephrine, an electrosurgical generator or soft tissue laser with a coagulation setting, applied to the source of hemorrhage or use of resorbable suture to tie off the ruptured vessel posterior to the site of hemorrhage. However, in case of a hemorrhaging nutrient canal, use of the blunt end of a handheld instrument can be used to put

heavy pressure on bone directly adjacent to the bleeding nutrient canal.[5]

In cases of severe mandibular atrophy, supracrestal exposure of the mental foramen or inferior alveolar nerve may be possible. When encountered, these situations require special consideration for incision design, mucogingival flap reflection, bone reduction, dental implant placement, soft-tissue reduction, and suturing.[5] When faced with an exposed inferior alveolar nerve, placing dehydrated human amnion-chorion membrane directly onto the nerve fiber can be administered.[11]

All-on-4 procedure in the mandible requires dental implant placement anterior to the mental foramina, so special consideration should be given to the vasculature or sublingual artery insertion in the anterior mandible in this region.[5]

Hard tissue related injury: In severely resorbed maxilla, it is very common to find pneumatized maxillary sinus extending below the bone reduction plane. In such cases, careful evaluation of the amount of bone left, followed by careful bone reduction and elevation of the sinus membrane with curettes will reduce the chances of perforation of the membrane and further complications. [12]

Dental implants that partially extend into the cavity of the nose are often asymptomatic and might reside within the nose for several years. However, when complications do occur, unilateral mucopurulent and fetid nasal discharge are the foremost prevalent symptoms, which may be along with pain, discomfort, headache, or congestion of the affected side. Therefore, patients complaining of nasal discharge after dental implant placement should be thoroughly checked for foreign bodies in their nasal cavities. [13]

Attempts to place implants in patients with severely atrophic mandible increases the risk of fracture, especially when monocortical grafts and ridge-splitting surgeries are completed. In patients who present with osteomalacia or osteoporosis, implant placement may subject the brittle bone to splintering due to the loading or frictional forces. A fracture of the mandible should be restored to maintain form and function. Management should include stabilization with an attempt to also simultaneously eliminate atrophy if indicated.[14]

Implant related complication: Inhalation or ingestion of surgical instruments are not an uncommon situation especially in the implant related procedures as the size of the components are very minute. For these reasons, preventive measures such as gauze throat screens and floss ligatures on implant components should be advocated. If a patient swallows or aspirates an implant component, they should be referred to a hospital, as an acute obstruction can be life threatening and prolonging the removal of foreign objects may make a bronchoscopy technically more difficult.[15]

A high degree of primary implant stability will be a prerequisite for the successful immediate loading of dental implants. In cases of inadequate bone density or “soft bone”, clinicians recommend underpreparing dental implant osteotomies and place a larger-diameter implant or a longer implant of a larger diameter.[16,17] In the maxilla, primary implant stability may be achieved by engaging a longer implant in the vomer or lateral piriform rims and to the cortical bone at the inferior border, in the mandible.[7]

Post Operative Complications

Early complications: Infections arising during immediate postoperative days, present with edema, exudate and pain. It may be caused by bacterial contamination during the surgery either directly via accidental contact with the implants or indirectly from gloves or instruments. The risk of such a complication may be reduced by following strict principles of surgical asepsis. [18-20]

Edema is the accumulation of excess plasma fluid (transudate) in the interstitial spaces (at least a 10% increase) which may be caused due to surgical trauma or long duration of surgery.Atraumatic surgical techniques, application of ice packs and administration of corticosteroids will prevent or limit edema after implant surgery. [18]

Blood effusion infiltrating surface tissues (ecchymoses) and circumscribed blood collection (hematomas) are not common after implant surgery. Particularly long and complex procedures, lack of patient compliance during immediate postoperative period, vessel fragility, elderly patients and failure to discontinue antiplatelet therapy before surgery may favor the appearance of ecchymoses and hematomas. [18,21]

Emphysema is a very rare complication resulting from a sudden rise of the intraoral pressure. This may occur when a patient sneezes and air is forced through the mucoperiosteal tissue of a not perfectly approximated flap and into the muscular interstices at the interface between the muscular fascia and soft tissues. Measures for preventing this complication include avoiding the use of high-velocity instruments to prepare the bone bed or irrigation of the wound with hydrogen peroxide and ensuring a perfect approximation of incised edges when suturing. [18]

Failure to stabilize the mucoperiosteal flap, tearing of soft tissues caused by tight or sharp suture material, masticatory trauma and trauma resulting from early temporization or an inappropriately modified temporary prosthesis are all causes of postoperative bleeding. Treatment will consist of eliminating the cause of bleeding and implementing the normal procedures to promote hemostasis by compression and tamponade with surgical gauzes soaked in tranexamic acid. If the bleeding does not stop, the flap will be re-elevated, the blood clot removed and new sutures applied to fully immobilize the soft tissues and promote clot formation and stabilization.[18]

Flap dehiscence is the opening of the surgical wound edges, exposing part or all of the implant head and/or surrounding bony tissues. Etiologically, flap dehiscence may result from a very thin mucosa; failure to ensure passive reapproximation and closure of the flap margins or tension on suture line.[18] If it is small, no surgical correction is required because the granulation tissue that forms will promote healing by secondary intention. A large dehiscence should be treated by removing the sutures and resuturing.[22, 23]

Maxillary sinusitis is a complication resulting from bacterial contamination of the maxillary sinus during surgery performed under non-aseptic conditions. Bacterial contamination may also occur during healing of wound dehiscence or because of implant displacement into the sinus causing a foreign body reaction and chronic infection.[18] Treatment includes systemic therapy with antibiotics, mouthwashes, irrigation of nasal orifices and use of nasal decongestants.[24-26]

Periapical implant lesion may be seen involving pathological areas of osteolysis at the apex of an osseointegrated implant and may be prevented through a careful preoperative examination of the periodontal and endodontic conditions of the remaining teeth and eradication of any microbial foci.[18,27-29]

Late complications: Implant loss may occur as “early implant loss” up to at least one year after implant insertion and “delayed implant loss” after a time period of one year, after implant insertion whereas inflammation and destruction of soft and hard tissues surrounding dental implants is termed as peri-implantitis.[30]

Peri implant mucositis describes a bacteria-induced, reversible inflammatory process of the peri-implant soft tissue with reddening, swelling and bleeding on

periodontal probing. Patients with a history of severe periodontitis, smoking, soft tissue defects in area of implantation or history of previously failed implants are at a higher risk of implant loss or failure.[30]

Failed osseointegration or lack of osseointegration is diagnosed at phase II surgery or when implant is loaded. Clinically, it is diagnosed when the implant has loosened and a muffled sound is heard upon percussion. Radiographs show small radiolucent margin around the implant indicating that there is no direct bone implant contact. Treatment will require removal of the loose implant and thorough debridement of the area involved so that a new implant may be inserted after healing.[18]

Mechanical Complications

Intra operative complications: For a successful implant supported prosthesis the prosthodontists should use a properly fitting surgical guide (stent) with radiopaque marker in conjunction with dental CT scan imaging to plan and insert dental implants in accordance with accurate mesiodistal and buccolingual location, angulation with residual bone and correct implant orientation. Failure for exact placement of this surgical stent may cause change in the angulation or placement of the implant which may further cause complications during prosthesis fabrication.[31]

Failure to diagnose and select proper drill depth recommended by appropriate radiographic measurement tools can result in permanent injuries to nerves and other vital bone structures, by drilling beyond recommended depth. A wider osteotomy may hamper with the primary stability where as a smaller osteotomy may lead to bone necrosis due to increased friction.[32]

Breakage of instruments or implant components is rare during implant surgery. However this may occur due to flaws in the material or repeated cycles of sterilization or excessive pressure used while handling them. If this happens the broken instrument may be visualized using an intra-oral radiograph and should be carefully removed with a pair of tweezers or hemostat or sometimes trephination of the bone may be needed.[33]

In case of misfit between implant and abutment or implants and any other component, compressive and traction loads could be directed to the bone resulting in bone micro fractures surrounding the implants and even fracture of the implant body.Also breakage of screws may take place inside the implant body and retrieval of same might be difficult. Misfits between the components of a screwed connection have been considered as a possible cause of mechanical complications, such as screw loosening and/or fractures.[33]

Post-operative complications : The most common post operative mechanical complication noted in the dental literature is fracture of the provisional restoration, ranging from 4.17% to 41% of the cases. Fracture of provisional All-on-four restorations during healing are alarming, because they eliminate cross-arch stabilization and disturb patterns of stress distribution Furthermore, fractures of those prostheses are unsettling to patients because they impair esthetics and mastication. The most common causes of broken All-on-four provisional restorations are frameworks of reduced thickness owing to under-reduced bone, fabrication errors, or improper occlusal corrections.[5]

Screw loosening, screw fracture and gold cylinder fracture are the most common prosthetic complications seen after loading the implant. Among these, screw loosening is the most common problem. This is seen more in single implant supported prosthesis with external connection and molars.[34]Reasons for screw loosening include inadequate preload, inappropriate implant position and occlusal scheme, variations in hex dimension and abutment counterparts, differences in fit and accuracy, tension on

abutment, improper screw design and excessive occlusal forces. The anti-bending ability of screw joint is important in resisting the screw loosening. [34]

Abutment screw fractures are related to inadequate screw tightening, screw loosening, improper occlusion concept, premature occlusal contacts, parafunctional habits, cervical misfit of the prosthesis and consequent fatigue of the screw material and fabrication failures. [35]Fractured abutment screws may be replaced by new abutment screws. However, sometimes, the screw can't be removed and therefore the entire implant must be surgically removed and replaced.

Framework related complications are often due to misfit, which necessitates maintenanace of the passive fit during the laboratory procedures.Using non-engaging multiple unit screw-retained abutments for a one-piece structure or dividing a full arch framework into three segments, particularly when the implant axes hinder a single path of placement, could be considered as the alternative solutions.[36]

Fracture of the framework is rare and could be a result of the constant shear and tensile forces and also excessive compressive forces. Defects in the manufacturing design or the poor material quality of the framework may also lead to its fracture.[36]

Other rare mechanical complications seen can be due to fracture of the retentive attachment & loss of retention of the retentive elements. In some cases only altering the retentive elements may resolve the problem but in more severe cases the framework may have to be replaced.[36]

Acrylic fracture of the final prosthesis has been reported to be the most common complication in All-on-four prosthesis but the lack of proprioception capacity of the normal dentition plays a role in the higher incidence of porcelain fracture in implant-supported restorations. This complication could be prevented by regular occlusal adjustments and by using a night guard.[36]

Discussion

Although the All-on-4® procedure for placing dental implants is known to have a very high success rate, it is a technique sensitive procedure necessitating the need for a keen eye on careful diagnosis, treatment planning and maintenance of the prosthesis. However, the following advantages, limitations and clinical implications of the present proposed classification can be drawn.

Advantages of the proposed classification

- Easy to understand and communicate
- Enumerates a broad spectrum of complications in a single classification
- Can also be an aid in diagnosing the possible risks and outcomes before starting the treatment

Limitations of the proposed classification

- Validation of the classification is needed
- Testing of accuracy and reproducibility amongst various clinicians is needed
- Does not reflect the severity of complication

Clinical implications of the proposed classification:

- There is no classification till date that enumerates all the possible complications ranging from pre-surgical period to post-surgical period.
- There is a need for a newer classification system to assess the quality of treatment and patient care before, during and after any procedure.
- Variations in clinical procedures and treatment approaches necessitates a need for identification of most problems so as to prevent any major negative outcomes and to portray the same to the patient and other personnel included.

- There is a need for standardization and reproducibility of information and comparison of the same amongst difference clinicians.
- Important in defining results in case of retrospective analysis.

Conclusion

Careful evaluation of the case and systematic approach to the final insertion of prosthesis will reduce the number of complications and risk factors. However,within the limitation of the proposed classification,it will aid as a useful tool in assessing the possible complications a clinician/implantologist might encounter prior to performing the All-on-4® procedure of implant placement.

References

1. Del Fabbro M, Testori T, Francetti L, Weinstein R ,Systematic review of survival rates for implants placed in the grafted maxillary sinus,Int J Periodontics Restorative Dent, vol 24, 2004,p.565–577.
2. Malo P, Rangert B, Nobre M, “All-On-Four” immediate-function concept with Branemark System implants for completely edentulous mandibles: a retrospective clinical study, Clin Implant Dent Relat Res, vol 5, suppl 1,2003,p.2-9.
3. Malo P, Nobre M, Lopes A, The rehabilitation of completely edentulous maxillae with different degrees of resorption with four or more immediately loaded implants: a 5-year retrospective study and a new classification, Eur J Oral Implantol,vol 4, 2011,227-243.
4. Malo P, de Araujo Nobre M, Lopes A, “All-on-4” immediate function concept for completely edentulous maxillae: a clinical report on the medium (3 years) and long-term (5 years) outcomes, Clin Impl Dent Rel Res,vol 14, suppl 1, 2012,p.e139-e150.
5. Holtzclaw D,All-on-4 Implant Treatment: Common Pitfalls and Methods to Overcome Them,Compend Contin Educ Dent,vol 37,2016,p.458-465.
6. Malo P, de Araujo Nobre M, Lopes A, Ferro A, Botto J, The All on 4 treatment concept for the rehabilitation of the completely edentulous mandible: A longitudinal study with 10 to 18 years of follow up,Clin Implant Dent Relat Res,vol 21, 2019,565-577
7. Jensen OT, Adams MW, Butura C, Galindo DF. Maxillary V-4, Four implant treatment for maxillary atrophy with dental implants fixed apically at the vomer-nasal crest, lateral pyriformrim, and zygoma for immediate function. Report on 44 patients followed from 1 to 3 years, J Prosthet Dent,vol 114, 2015,p.810-817.
8. Jensen OT, Adams MW, All-on-4 treatment of highly atrophic mandible with mandibular V-4: report of 2 cases, J Oral Maxillofac Surg,vol 67, 2009,p.1503-1509.
9. Jensen OT, Adams MW,Secondary stabilization of maxillary m-4 treatment with unstable implants for immediate function: biomechanical considerations and report of 10 cases after 1 year in function, Int J Oral Maxillofac Implants,vol 29, 2014,p.e232-e240.
10. Jensen OT, Adams MW,The maxillary M-4: a technical and biomechanical note for all-on-4 management of severe maxillary atrophy-report of 3 cases,J Oral Maxillofac Surg,vol 67, 2009,p.1739-1744.
11. Patel VR, Samavedi S, Bates AS, Kumar A, Coelho R, Rocco B, Palmer K,Dehydrated human amnion/ chorion membrane allograft nerve wrap around the prostatic neurovascular bundle accelerates early return to continence and potency following robot-assisted radical prostatectomy: propensity score matched analysis,Eur Urol,vol 67,2015,p.977-980.

12. Tolstunov L, Thai D, Arellano L, Implant-guided volumetric analysis of edentulous maxillary bone with cone-beam computerized tomography scan. Maxillary sinus pneumatization classification, J Oral Implantol vol 38, 2012,p.377-390.
13. Wolff J,Karagozoglu KH,Bretschneider JH, Forouzanfar T, Schulten EA, Altered nasal airflow: an unusual complication following implant surgery in the anterior maxilla. Int J implant Dent,vol 2, 2016,p.1-3.
14. Agliardi E, Panigatti S, Clerico M, Villa C, Malo P, Immediate rehabilitation of the edentulous jaws with full fixed prostheses supported by four implants: interim results of a single cohort prospective study, Clin Oral Implants Res,vol 21, 2010,p.459-465.
15. Babbush CA, Kutsko GT, Brokloff J, The all-on-four immediate function concept with NobelActive implants: a retrospective study, J Oral Implantol,vol 37, 2011,p.431-445.
16. Misch K, Wang HL, Implant surgery complications: etiology and treatment, Implant Dent,vol 17, 2008,p.159-68
17. Martín LP, Soto MJ, Burgos RS, García MB, Bronchial impaction of an implant screwdriver after accidental aspiration: report of a case and revision of the literature, Oral Maxillofac Surg,,vol 14,no.1, 2010,p.43-47.
18. Annibali S, Ripari M, La Monaca G, Tonoli F, Cristalli MP, Local complications in dental implant surgery: prevention and treatment, Oral Implantol,vol 1,no.1, 2008,p. 21–33.
19. Friberg B, Sterile operating conditions for the placement of intraoral implants, J Oral Maxillofac Surg,vol 54, 1996,p.1334–1336.
20. Kraut RA, Clean operating conditions for the placement of intraoral implants, J Oral Maxillofac Surg,vol 54, 1996,p.1337–1338.
21. Worthington P, Bolender CL, Taylor TD, The swedish system of osseointegrated implants: problems and complications encountered during a 4- year trial period, Int J Oral Maxillof Implants ,vol 2, 1987,p.77–84.
22. Esposito M, Hirsch JM, Lekholm U, Thomsen P, Biological factors contributing to failures of osseointegrated oral implants: (II) Etiophatogenesis, Eur J Oral Sci ,vol 106, 1998,p.721–764.
23. Haas R, Haimbock W, Mailath G, Watzek G, The relationship of smoking on peri-implant tissue: a retrospective study,J Prosthet Dent,vol 76, 1996,p.592–596.
24. Ueda M, Kaneda T, Maxillary sinusitis caused by dental implants: report of two cases, J Oral Maxillof Surg,vol 50, 1992,p.285–287.
25. Quiney RE, Brimble E, Hodge M,Maxillary sinusitis from dental osseointegrated implants, J Laryng Otol,vol 104, 1990,p.333–334.
26. Regev E, Smith RA, Perrott DH, Pogrel MA, Maxillary sinus complications related to endosseous implants, J Oral Maxillofac Surg vol,10, 1995,p.451–461.
27. Piattelli A, Scarano A, Balleri P, Favero G,Clinical and histologic evaluation of an active implant periapical lesion: a case report, Int J Oral Maxillofac Impl ,vol 13, 1998,p.713–716.
28. Piattelli A, Scarano A, Piattelli M, Podda G, Implant periapical lesions: clinical, histologic and histochemical aspects. A case report, Int J Periodont Rest Dent ,vol 18, 1998,p.181–187.
29. Piattelli A, Scarano A, Piattelli M, Abscess formation around the apex of a maxillary root form implant: clinical and microscopical aspects, A case report.J Periodontol ,vol 66, 1995,p.899–903.

30. Smeets R, Henningsen A, Jung O, Heiland M, Hammächer C, Stein JM, Definition, etiology, prevention and treatment of peri-implantitis–a review, Head Face Med,vol 10, 2014,p.34.
31. Talwar N, Singh BP, Chand P, Pal US, Use of diagnostic and surgical stent: a simplified approach for implant placement, J Indian Prosthodont Soc vol 10, 2010,p.234–239.
32. Leave limits behind.User manual:Dental implant system, https://adin-iberica.com/wp-content/uploads/2016/11/User-manual_Dental-implant system.
33. Barbosa Gustavo Augusto Seabra, Bernardes Sergio Rocha, Neves Flavio Domingues das, Fernandes Neto Alfredo Julio, Mattos Maria da Gloria Chiarello de, Ribeiro Ricardo Faria. Relation between implant/abutment vertical misfit and torque loss of abutment screws, Braz Dent J,vol 19, 2008,p.358-363.
34. Krishnan V, Thomas CT, Sabu I, Management of abutment screw loosening: Review of literature and report of a case, J Indian Prosthodont Soc,vol 14, 2014,p.208-14.
35. Neumann Eduardo Aloisio Fleck, Villar Cristina Cunha, Franca Fabiana Mantovani Gomes, Fracture resistance of abutment screws made of titanium, polyetheretherketone, and carbon fiber-reinforced polyetheretherketone, Braz oral res,vol 28, 2014,p.1-5.
36. Siadat H, Rokn A, Beyabanaki E, Full Arch All-on-4 Fixed Implant-Supported Prostheses with 8.5 Years of Follow-Up: A Case Report, J dent,vol 15, 2018,p.259.