International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 9; Issue 01 (B); January 2020; Page No.20940-20944
DOI: http://dx.doi.org/10.24327/ijcar.2020.20944.4103

Research Article

EMPHASIS ON TITANIUM VERSUS ZIRCONIA AS A DENTAL IMPLANT MATERIAL – A CRITICAL REVIEW

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A R T I C L E I N F O

Article History:
Received 13th October, 2019
Received in revised form 11th November, 2019
Accepted 8th December, 2019
Published online 28th January, 2020

Key words:

Aesthetics; Osseo-integration; Titanium; Peri-Implantitis; Zirconia implants;

A B S T R A C T

Purpose: Dental implants also known as oral or endosseous implants have been used to substitute missing teeth for more than a decade. The success is largely influenced by the ability of the implant material to assimilate with the surrounding tissue. Titanium (Ti) was the most commonly used biocompatibility material with mechanical and physical properties, such as resistance to corrosion, high strength and low weight. **Study selection:** The literature search for articles written in the English language in PubMed, MEDLINE, Embase and Google Scholar database from 1990 till date was retrieved by using MeSHterms "zirconia", "implant material""zirconia implants", "titanium implants" "Zirconia Vs titanium". The present evaluation is to provide a broad literature review on the conventional titanium implants as well as increasingly prevalent zirconia dental implants. **Observations:** It was observed that the major disadvantage of Ti causing hypersensitivity reactions and predominantly poor esthetics. With improvement in technology, ceramic materials are attempted as implant substrate especially "Zircon" type of dental implants can offer better aesthetic results as color of the implant components is completely of "tooth colored". **Conclusion:** It is not arbitrary to conclude that the implant material should be selected carefully and a restorative driven approach should be implemented to avoid an unwanted result.

INTRODUCTION

Dental implants are widely considered to be one of several treatment options to replace missing teeth. A number of implant-supported treatment options have been used successfully to replace a single tooth and multiple teeth, as well as a completely edentulous jaw [1]. Dentists are often expected to see patients with implant-supported restorations or prostheses as the demand and extent of dental implants patients are increasing. The success of these implants depends on the ability of the material to make it compatible with the surrounding tissue. However, this integration is influenced by several factors, such as implant material, bone quality and quantity, and the implant loading condition.

Biocompatibility is the most essential property required for a dental implant material. The materials used for implantation must also have some specific characteristics such as immunity to corrosion, high ultimate strength, yield value at low density, low modulus of elasticity, damage tolerance, capacity to integrate with human bone and other surrounding tissues [2].Metallic biomaterials can be conveniently grouped as Stainless steel, Cobalt base alloys,

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Titanium base alloy and specifically modified metallic alloys.In 1940's "Vanadium" an alloy in combination with steel developed for human use is not any longer in practice due to its poor corrosion resistance in-vivo. 18-8 SMo with very low carbon content (known as 316L) stainless steel was introduced in early 1950's showed reduced sensitization and a very good resistance to chloride solution has been used widely for implant fabrication.

Cobalt-Chromium-Mo alloy, wrought Cobalt-Nickel-Cr-Mo alloy used as a cast able alloy for manufacturing prostheses of joints such as the knee and hip joints where loading capacity was highly recommended. Both alloys showed excellent corrosion resistance. Pure titanium (cpTi) was introduced commercially as an alternative choice in the field of prosthesis rehabilitation since noble alloys were expensive; base metal alloys demonstrated potential biological hazards and also offered poor compatible properties [3].

Commercially pure Titanium (Ti CP) is the first bio-compatible material found to be the only metal biomaterial to Osseo-integrate [4] with immune to corrosion by body fluids, acids and oxygen, hard enough to withstand the forces of chewing due to the slow growth of hydrated titanium oxide on the surface of the titanium implant that leads to the incorporation of calcium and phosphorous [5]. Recently there is increased use of this titanium alloy containing 90%

Titanium, 6% Aluminum and 4% Vanadium (Grade 5- Ti-6Al-4V). It is believed to offer better strength and fracture resistance with similar Osseo-integration performance as commercially pure titanium [6].

Pure Titanium and its alloys have been clinically accepted and frequently considered the materials of choice. Surface activation or tuning of titanium surfaces certainly will improve biological integrity in compromised situations and increasing clinical service of implant therapies even further [7, 8].Zircon Dioxide of zirconium (ZrO2) is a new type of metal with similar biocompatibility properties with titanium. Zircon implants are to be used when there are more aesthetic requirements such as for restoring front teeth but they are much more expensive than titanium ones [9]. The present evaluation is to provide a broad literature review on zirconia and titanium as a choice of implant material for dental treatment. These review emphases on the conventional titanium implants and increasingly prevalent zirconia dental implants.

Titanium as a choice of Implant Material

For the construction of dental and orthopedic implants titanium and its alloys are extremely popular materials with low specific weight, high strength and low modulus of elasticity, very high resistance to corrosion with excellent biocompatibility. Bran mark in 1908 first discovered the concept of Osseo-integration. Since then, numerous investigations and clinical studies have established titanium as a reliable biomaterial for oral rehabilitation and reconstruction. Various modifications in the structure, composition and design of titanium implants have been made since then to enhance its physical, mechanical and optical properties in addition to its biocompatibility [10].

Puretitanium (Ti CP) and extra low Ti-6Al-4V (ELI) are the most common commercially available titanium base implant biomaterials. These metals do not induce allergic reactions and are often tolerated well by the human tissues. Unalloyed pure (CP) Ti are available at various grades ranging from 1 to 4 for dental applications. These grades are defined by their oxygen and iron content, as these elements have a substantial effect on the mechanical and physical properties of the metal, even in very small concentrations [7, 11]. The titanium implant surface influences the initial sequences of protein adsorption, platelet adhesion, haemostasis, inflammation and osteogenic cell response [12]. Complications are often encountered with aggregation and growth of fibrous connective tissue on the surface of the implant materials. These tissues interfere with healing of the tissue damaged during surgical placement of the implant material. Recently Grade 5 (Ti-6Al-4V) demonstrated good bone growth capacity by producing a very little fibrous tissue interface [12, 13].

Formation of a biofilm at the surface with compromised immune status at the implant-tissue interface is the major factor associated with infection at the implant surface. The biocompatibility of titanium as an implant material is attributed to its ability to form protein layer formed under functional environments. This protein layer actually makes the surface suitable for bacterial colonization and biofilm formation [14]. Oral tissues with persistent aqueous environment combined with the surface biofilm, weak fatigue forces and interaction with other metals within the mouth may harm the surface oxide film passively. These environmental conditions cause corrosion, affecting the mechanical reliability of the implant and the favorable health of the surrounding soft and hard tissue [15]. The mechanical stability and clinical outcome of the implant materials largely depends on the low pHor acidic environment conditions during inflammation between implant with bone and galvanization current or corrosion between Titanium with other metallic alloys [16]. The body tries to encapsulate the Ti-based implant due to its passive nature but in rare case scenarios failure to bond on to bone creating favorable micro-movements for loosening of the implant. Undesirable movements at the implant-tissue interface pointers to failure cracks of the implant. In such cases for improving implant lifetime can be achieved by coating the metal surface with a bioactive material like hydroxyapatite (Ca10 (PO4)6(OH)2), the inorganic component of natural bone which will stimulate the formation and adhesion [17].Degradation products of metallic biomaterials including titanium may mediate metal hypersensitivity or allergic reactions [12]. The greatest disadvantage of extra low interstitial Ti-6Al-4V (ELI) being the component “V” causing potential cytotoxicity or adverse tissue reactions [3] and “Al” ions from the alloy might cause long-term Alzheimer diseases [18].

The recent trend in research and development of titanium for biomedical applications is aimed to develop excellent mechanical stable alloys composed of non-toxic and non-allergenic elements [19]. The first generation of design orthopaedic alloys attempts to replace the V and Al alloys with other non-toxic components like Nb, Fe and Mo (for the V) and Ta, Hf and Zr (for the Al) [2].

Zirconia as a choice of implant material:

Ceramic Implant provides a unique esthetics for patients with thin or slender gingival biotype and for those patients who precisely demand for a metal-free alternative as in cases of missing anterior. Zirconium, a silver-gray transition metal that is malleable, ductile, easily forms stable compounds, highly resistant to corrosion became widespread in dentistry often used in the form of zirconium oxide zro2. Zirconia does not suffer corrosion like titanium, does not show piezoelectric current at dissimilar metal joints in mouth. The material is thermally non-conductive [20].

It presents not as pure oxide form but with traces of another element hafnium (Hf) and its oxide is combined with yttrium to enhance its properties that yields a white opaque [21] similar to the color of the natural tooth identified in 1789 by German Chemist Martin Heinrich Klaproth [22] . JonsJakobBerzeliusin1824wasthefirsttoisolatezirconiuminanimpureform.In 1990 Muller, Piesold and Glien worked on Bionit implant system. In 1993–1999 Akagawa, Dubruille were the first practitioners to try zirconia implants experimentally and in 2004 Kohal and Klaus successfully performed first case of zirconia implant [10, 22].

Yttrium based tetragonal zirconia poly-crystals; alumina-toughened zirconia and zirconia sintered alumina are the three basic types of zirconia-containing ceramic systems available in dentistry at present. Zirconia has mechanical properties similar to those of stainless steel and is characterized by high flexural strength and fracture toughness as a result of a physical property known as transformation toughening. An increase in moisture or stress can cause transformation of zirconia crystals to a monoclinic phase with micro-crack formation that

increases the water penetration, crack propagation, surface deterioration, phase destabilization and decreased resistance to load [23]. Zirconia based ceramics are chemically inert bio-materials with minimal local or systemic adverse reactions; good cell adhesion; excellent tissue response and a high degree of bio-compatibility with the surrounding bone and soft tissues [10]. Experimental results on fibroblasts, lymphocytes, monocytes, macrophages, connective tissue, immunologic and bone tissues revealed that the various forms of zirconia tested on in vitro tissues do not induce any adverse reaction or global toxic effects [24].

Ceramic blocks called as TZP-A was manufactured recently by adding minimal quantity of alumina to 3Y-TZP. Improved stability and toughness under humid environments and withstand high temperatures are the added advantage of these ceramic blocks. Reduction in translucency of ceramic blocks was the only considerable aesthetic disadvantage. Minimizing LTD in 3Y-TZP systems is attempted by adding small quantities of silica, using yttria-coating instead of co-precipitated powder, reducing grain size and increasing stabilizer content and formation of composites with Aluminum Oxide (Al2O3).There are also advancements made with Zirconia in terms of enhanced surface topography and the modifications providing improved Osseo-integration. Several studies and experiments by modifying zirconia sand blasted, with light grit and plasma anodized, acid etched and ceramic coated zirconia were conducted. These tests have shown stronger bone response to sand blasted and acid etched Zirconia implant surface [25, 26, 27].

Clinical Studies

According to a review by Javed *et al*., Ti cannot be identified as a self-inducing cause of allergic reactions in patients with dental implants. In their opinion, it is the occasional and otherwise negligible impurities (i.e. additional elements besides Ti) that trigger hypersensitivity reactions [28]. Harl off *et al*. examined common dental implant materials (Grade 1 Ti and Ti alloys, including Grade 5) by spectral analysis. Their results showed that all the investigated materials contained low but detectable amounts of various other elements (nickel, chromium, copper, palladium, manganese) that may induce allergic reactions, especially in people with existing metal sensitivity [29]. Wachi *et al*. reported that weakening or deteriorating effects of titanium causes peri-implant mucositis associated with alveolar bone resorption [30]. Olmedo *et al*. reported two cases of reactive lesions of peri-implant mucosa associated with titanium dental implants, one case was diagnosed as pyogenic granuloma and the other case as peripheral giant cell granuloma [31]. Fretwurst *et al*. reported the metal particle in peri-implant soft tissue along with M1 macrophages and the increasing in titanium concentration with lymphocytes detection [32].

Roehling *et al* and Koch *et al* reported about 22% and 30% of the zirconia implants case presented with significant amount of cracks observed at the implant head respectively [33]. Blaschke *et al* reported that dental implants made from zirconia are a feasible alternative to titanium dental implants. Zirconia implants shows tolerable degree of osseointegration and soft tissue response superior to that of titanium dental implants [34]. Pirker *et al* placed a zirconia implant to the maxillary first premolar region immediately and evaluated the clinical outcome of this implant. At 2-year follow-up, a stable implant and an unchanged peri-implant marginal bone level were observed. No bleeding was detected on probing [35].In a split mouth design, Kohal *et al* compared osseointegration and peri-implant soft tissue dimensions between loaded titanium and zirconia implants in a primate model and found no statistical difference between the two materials. Several other animal investigations showed that zirconia implants undergo osseointegration similar or even better than that of titanium implants [36].A cell culture study by Bächle *et al* found that cell attachment and proliferation of osteoblast-like cells on Y-TZP disks of differently treated surfaces were comparable to those of a sandblasted/acid-etched titanium surface [37].

Titanium vs zirconia dental implant:

Only 1% to 6% of titanium implant cases reported with incidence of fracture as compared to Zirconia which is slightly at a higher range of 22% to 30%. Potential causes of implant fracture may be due to implant design; manufacturing defects; or non-passive fit of the framework or physiological and biomechanical overload. Stress or toughness, fatigue failure appeared to be originated from the high stress concentration associated with the toreador with the segment of the implant that was not internally buttressed by the abutment screw [38].

Furthermore, Green *et al*. suggested that cytotoxic reaction was initiated as a result of galvanic corrosion between non-precious metal alloy restorations supported on titanium implants along with fatigue crack initiation. These sequel of events leads to accelerated peri-implant bone resorption and consequent increase in bending forces on implants with the immediate failure of the implants placed at the site [39]. Cause of these Ti implant failures also can be due to poor oral hygiene, uncontrolled deposition of plaque, and calculus around the implant which results in peri-implantitis or occlusal problems. The allergy response to dental implant materials and toxicity of the particle released from implant system are reported to have a role in implant failure. Various studies on titanium and its alloys as well as implant surface treatment materials showed bone loss due to inflammation reactions due to implant corrosion, hypersensitivity to titanium and allergic reactions and yellow nail syndrome [40].

Zirconia as a brittle ceramic material with a significant sensitivity is more susceptible to deterioration of the surface or influence surface defects. The associated literature also reveals that while zirconia is a "strong" material under compressive stress, it does not have adequate flexures and will fracture. Zirconia implants are made as one-piece design implying they should have cemented crowns and it would not be possible to do full mouth treatments where replacing of missing entire or quadrants teeth.Hence a strict quality control is recommended during the manufacturing process to improve the clinical outcomes of zirconia implants. All the stress concentration sites should be dodged or minimized when designing zirconia implants. Sharp thread design, as well as internal line angles at the junction of threads with the implant body should be reduced. Thread depth should be also considered. Bone clearance was often restricted by deep thread depths of the implant material during the surgical implant placement, especially in the case of dense bone. As a result unnecessary bending forces of the implant produced eventually causes failure and fracture. They were also found to have low, well distributed, and similar stress distribution when compared with titanium implants [40, 41].

Furthermore, zirconia particles used for surface modifications of titanium implants may have the potential to improve initial bone healing and resistance to removal of torque. The surface roughness of zirconia was found to be comparable with that of titanium implants. It is possible to create distinctive surface changes to zirconia with the help of procedures like CO2 lasers; Ceria stabilized Zirconia or Alumina nano-composites. All these procedures have shown to have high flexural strength, consistency and high resistance to low temperature. A good favorable implant surface along with the tissue interface is necessary for an effective dental implant effect. To fulfill biomechanical requirements, restoring zirconia implants with high-strength ceramics or metal ceramics would be beneficial [12,25].

CONCLUSION

The excellent biocompatibility and physicochemical properties of Ti dental implants position Ti as the gold standard in implant dentistry. While the safety and success of Grade 4 Ti is well documented, Grade 5 offers better physical properties and similarly outstanding biocompatibility and survival. It was observed that hydroxyapatite mechanical failure occurs primarily at the interface between the metal substrate and hydroxyapatite coat (adhesive failure), irrespective of the implant design. Zirconia as a material of choice was introduced as asubstitute to titanium implants. On basis of the available data Zirconia seems to be a suitable implant material because of its tooth-like color, mechanical properties, biocompatibility, and low plaque affinity. Although many in-vitro and in-vivo studies have proved Zirconia dental implants have the potential to become alternative dental implants to titanium dental implants, more structure studies or controlled clinical trials with longer follow-up should be performed to properly evaluate the clinical performance of zirconia implants for routine clinical use.

Acknowldegement: None

Conflict Of Interest: Nil

References

1. BankoğluGüngör M, Aydın C, Yılmaz H, Gül EB.Oldani C, Dominguez A. An overview of zirconia dental implants: basic properties and clinical application of three cases.J Oral Implantol. 2014;40(4):485-94.
2. Titanium as a biomaterial for implants. Titanium as a Biomaterial for Implants, Recent Advances in Arthroplasty, Dr. SamoFokter (Ed.), ISBN: 978-953-307-990-5, 2012. InTech.
3. Steinemann, S. (1980). Corrosion of surgical implants—in vivo and in vitro tests, In: Evaluation of biomaterials. Winter, G.; Leray, J. & de Groot, K., Wiley, ISBN471276588, New York.
4. Van Noort, R. (1987). Titanium: the implant material for today, *Journal of Material Science* 1987; 22: 3801-3811.
5. Li, P.; Kangasniemi, I. & De Groot, K. (1994). Hydroxyapatite Induction by a Gel Derived Titania on a Titanium Substrate. *Journal of the Ceramic Society*. 1994: 77 (5); 1307-1312.
6. Greger M, Widomska M, Snasel V. Structure and properties of dental implants. Brno, Czech Republic, EU. Metal 2012; 5: 23-25.
7. Masa R, Braunitzer. G. Titanium and its alloy in dental implantology. International magazine of oral implantology. 2007; 18 (4); 6-10.
8. Özcan M, Hämmerle C. Titanium as a Reconstruction and Implant Material in Dentistry: Advantages and Pitfalls. Materials (Basel). 2012 Aug 24; 5(9):1528–1545.
9. Özkurt Z, Kazazoğlu E.Zirconia dental implants: a literature review.J Oral Implantol. 2011: 37(3):367-76.
10. Sivaraman K, Chopra A, Narayan AI, Balakrishnan D.Is zirconia a viable alternative to titanium for oral implant? A critical review.J Prosthodont Res. 2018;62 (2):121-133.
11. ADA Council on Scientific Affairs Titanium applications in dentistry. J Am Dent Assoc. 2003;134:347–349.
12. Merritt K., Rodrigo J.J. Immune response to synthetic materials. Sensitization of patients receiving orthopaedic implants. Clin. Orthop. Related Res. 1996; 326:71–79.
13. Tan K.S., Qian L., Rosado R., Flood P.M., Cooper L.F. The role of titanium surface topography on J774A.1 macrophage inflammatory cytokines and nitric oxide production. Biomaterials. 2006; 27:5170–5177.
14. Wang R.R., Fenton A. Titanium for prosthodontic applications: A review of the literature. Quintessence Int. 1996; 27:401–408.
15. Hetrick E.M., Schoenfisch M.H. Reducing implant-related infections: Active release strategies. Chem. Soc. Rev. 2006; 35:780–789.
16. Gittens R.A., Olivares-Navarrete R., Tannenbaum R., Boyan B.D., Schwartz Z. Electrical implications of corrosion for osseointegration of titanium implants. J. Dent. Res. 2011;90:1389–1397.
17. Niinomi M. Mechanical properties of biomedical titanium alloys. Mater. Sci. Eng. A. 1998;243:231–236.
18. Rao, S.; Ushida, T.; Tateishi, T.; Okazaki, Y. & Asao, S. (1996). Effect of Ti, Al, and V ions on the relative growth rate of fibroblasts (L929) and osteoblasts (MC3T3-E1) cells. BioMedical Materials and Engineering 1996; 6 (2, (1996); 79-86.
19. Niinomi, M. Recent titanium R&D for biomedical applications in Japan. JOM *Journa of the Minerals, Metals and Materials Society* 1999; (51)6: 32-34.
20. Gupta S. Zirconia Vs Titanium Implants – Deciding Factors. J Dent Oral DisordTher2016; 4(4): 1-2.
21. S Berner, M Dard, J Gottlow, A Molenberg, M Wieland. Titanium-zirconium: A novel material for dental implants. Eur. Cells Mater. 2009;17(sup 1):16.
22. Patil R. Zirconia versus titanium dental implants: A systematic review. J Dent Implant 2015;5:39-42.
23. J. Chevalier. Low-temperature degradation in zirconia with a porous surface Acta Biomater 2011, 7: 2986-2993.
24. Saridag S, Tak O, Alniacik G. Basic properties and types of zirconia: An overview. World J Stomatol 2013; 2(3): 40-47.
25. Gupta S. A Recent Updates on Zirconia Implants: A Literature Review. Dent Implants Dentures 2016; 1: 113.
26. Borgonovo AE, Censi R, Vavassori V, Dolci M, Calvo-Guirado JL (2013)Evaluation of the Success Criteria for

Zirconia Dental Implants: A Four-Year Clinical and Radiological Study. Int J Dent 2013; 1: 1-7.
27. Depprich R, Zipprich H, Ommerborn M (2008) Osseointegration of zirconiaimplants: an SEM observation of the bone-implant interface. Head Face Med 2008: 4: 25.
28. Javed F, Ahmed HB, Crespi R, Romanos GE. Role of primary stability for successful osseointegration of dental implants: Factors of influence and evaluation. Interv MedAppl Sci. 2013; 5(4):162-7.
29. Harloff T, Hönle W, Holzwarth U, Bader R, Yhomas P, Schuh A. Titanium allergy or not? "Impurity" of titanium implants materials. Health. 2010;2(4):306–310.
30. Wachi T, Shuto T, Shinohara Y, Matono Y, Makihira S. Release of titanium ions from an implant surface and their effect on cytokine production related to alveolar bone resorption. Toxicology. 2015; 327:1–9.
31. Olmedo DG, Paparella ML, Brandizzi D, Cabrini RL. Reactive lesions of peri-implant mucosa associated with titanium dental implants: a report of 2 cases. Int J Oral Maxillofac Surg. 2010; 39:503–507.
32. Fretwurst T, Buzanich G, Nahles S, Woelber JP, Riesemeier H, Nelson K. Metal elements in tissue with dental peri-implantitis: a pilot study. Clin Oral Implants Res. 2016; 27:1178–1186.
33. Thoma DS, Benic GI, Munoz F, Kohal R, Sanz Martin I, Cantalapiedra AG, *et al*. Marginal bone-level alterations of loaded zirconia and titanium dental implants: an experimental study in the dog mandible. Clinical Oral Implants Research. 2016;27(4):412–420.
34. Blaschke C, Volz U (2006) Soft and hard tissue response to zirconium dioxide dental implants—a clinical study in man. NeuroendocrinolLett. 2006; 27: 69-72.
35. Pirker W, Kocher A (2008) Immediate, non-submerged, root-analogue zirconia implant in single tooth replacement. Int J Oral MaxillofacSurg2008; 37: 293-295.
36. Kohal R.J., Weng D., Bächle M., Strub J.R. Loaded custom-made zirconia and titanium implants show similar osseointegration: An animal experiment. J. Periodontol. 2004;75:1262–1268.
37. Bächle M., Butz F., Hübner U., Bakalinis E., Kohal R.J. Behavior of CAL72 osteoblast-like cells cultured on zirconia ceramics with different surface topographies. Clin. Oral Implants Res. 2007;18:53–59.
38. Osman RB, Swain MV. A Critical Review of Dental Implant Materials with an Emphasis on Titanium versus Zirconia. Materials (Basel). 2015; 8(3):932–958.
39. Green N.T., Machtei E.E., Horwitz J., Peled M. Fracture of dental implants: Literature review and report of a case. Implant Dent. 2002;11:137–143.
40. Kim KT, Eo MY, Nguyen HT, Kim SM. General review of titanium toxicity. Int J Implant Dent. 2019 Dec; 5: 10.
41. Osman R.B., Ma S., Duncan W., de Silva R.K., Siddiqi A., Swain M.V. Fractured Zirconia implants and related implant designs: Scanning electron microscopy analysis. Clin. Oral Implants Res. 2013;24:592–597.

How to cite this article:

Dr. Geetha.K.R, Dr.R.Prabhu, and Stalin Paul Robert *et al* (2020) 'Emphasis on Titanium Versus Zirconia as A Dental Implant Material – A Critical Review', *International Journal of Current Advanced Research,* 09(01), pp. 20940-20944. DOI: http://dx.doi.org/10.24327/ijcar.2020. 20944.4103

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