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Socket Friendly Root Analogue Implant

The Future

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ABSTRACT

Replacement of missing teeth with conventional implants made up of titanium is the most popular technique in implantology. To overcome the disadvantages of the conventional implant, immediate implantation technique is being developed. Also, in aesthetically demanding areas, zirconia has shown excellent results as compared to titanium. Zirconia (zirconium dioxide, ZrO₂) shows excellent biocompatibility, biomechanical characteristics and also good osseointegration. Along with the properties mentioned above, there are also previous reports which show the successful use of zirconia as root-analogue implants, which, reproduce the natural anatomy of the extracted tooth.

This article presents a review of root analogue zirconia dental implants as a novel immediate implantation material, which replaces the missing teeth. This could change the implant dentistry scenario in the future.

Keywords: Zirconia, Root Analogue, Immediate Implant, Extraction Socket.

INTRODUCTION

Implants have been a proven treatment modality for replacement of lost teeth. Conventional screws or threaded cylindrical implants have been used exclusively. But due to incongruence with extraction socket, there is a need to use barrier membrane or bone augmentation to prevent down the growth of epithelium or connective tissue between the implant and socket.

Root Analogue Zirconia implant with micro and macro retention, have been developed for immediate, single stage replacement of hopeless teeth as they provide primary stability and excellent osseointegration. This novel approach is minimally invasive, respects the underlying anatomy, aids socket preservation and is time and cost-saving¹ as there is no need for bone drilling, sinus lift, bone augmentation or other traumatic procedures, this technique has good patient acceptance.¹

Zirconia as an Implant Material: A German chemist Martin Heinrich Klaproth accidentally discovered Zirconium dioxide (ZrO₂) in 1789 when he was working with certain procedures of heating some gems.² In 1969, zirconium oxide was first used for medical purposes as a new material, instead of titanium or alumina prostheses, for replacement of hip head.³ Yttria-stabilized tetragonal zirconia polycrystal (YTZP) exhibits favourable fracture toughness (K_{IC} 7 to 1 MPa^m-1/2), a very high flexural strength (900 to 1,200 MPa), and a suitable Young's modulus (210 GPa).⁴ The mechanical properties like elastic modulus of zirconia and high-fracture resistance might contribute to the bone healing and provide mechanical stability.⁵ Also, its ability to undergo transformation toughening had made zirconia as a unique dental ceramic and strong biomaterial.⁶ Zirconia is highly radiopaque and has excellent biocompatibility.⁷ Many in vitro tests were performed to evaluate the biocompatibility by using different cell lines like fibroblasts, blood cells, and osteoblast cells.⁸ Researchers have reported that mutations in cellular genome is not seen with zirconia⁹ and also it creates minimal inflammatory reactions with tissues as compared to other restorative material like titanium.¹⁰

Immediate Implantation

Immediate implant placement is done soon after extraction during the same surgical procedure, early placement of implant is performed after 2-6 weeks delay post extraction and delayed placement of implant is done after 3-6 months or years after tooth loss.¹¹

Some considerations for immediate implantations are:¹²

- 1) The absence of purulent exudation at the extraction sites.
- 2) Preoperative antibiotic therapy should be considered if the infection is suspected.
- 3) Atraumatic removal of the tooth.
- 4) Use the lingual/palatal line to prepare and insert the implant.
- 5) The implant must be immobilized at final placement i.e primary stability should be obtained.
- 6) Adequate soft tissue closure is to be maintained.

Advantages of immediate implant placement:¹³

- 1) The number of surgical procedures and treatment time are reduced.
- 2) Maintenance of ideal soft tissue contours and alveolar bone preservation.
- 3) Simplification of the prosthetic designs and improved prosthetic designs like better finished lines and margins, heights of contours and interproximal architecture.
- 4) Patient's psychological outlook is improved.

Disadvantages of immediate implant placement:¹⁴

- 1) Initial stability of implant is hampered.
- 2) Soft tissue ingrowth.
- 3) Risk of infection, dehiscence.
- 4) Incongruence between extraction sockets.

Immediate Implantation of Root Analogue Zirconia Implant

Hodosh M. and colleagues in 1969 put forward the concept of custom made root analogue implant fabricated with auto polymerised and heat processed polymethacrylate.¹⁵

In 1992, Lundgren and colleagues reintroduced the idea of root analogue implant by using titanium as a material, which showed successful results.¹⁶

Kohal and Klaus (2004) reported a clinical case report regarding immediate placement of zirconia implant.¹⁷ Briefly, after the evaluation of radiographs, a copy of final implant using self-curing acrylic resin was made which was then scanned in a scanning unit and further the resin copy was changed with zirconia and milled.

In a clinical case report, reported by Pirker W. and Kocher A. (2008),¹⁸ root analogue implants were fabricated along with some of the modifications like:

- 1) Zirconia was used for its excellent biocompatibility and improved aesthetics.
- 2) Addition of micro-retention throughout the root surface and macro-retention limited to interdental space to get beyond primary stability and to improve osseointegration.
- 3) The diameter of the implant was reduced next to thin cortical bone to avoid fracture and pressure induced bone loss.
- 4) Single-stage implantation procedure was chosen resulting in immediate, albeit limited, functional load via the crown stump for prevention of bone resorption.

In this case report, a 63 year old patient had undergone extraction of a maxillary right premolar, the root of the extracted tooth was laser scanned, macro retentions were designed, the crown stump was designed on it for further placement of crown and then root analogue implant was milled from zirconium dioxide block. It was then subjected to sandblasting and sintering. On 4th day following extraction, this zirconia analogue was implanted in the extraction socket under finger pressure and gentle tapping with hammer and mallet. Ten days later, a clinically healthy marginal area was seen without post-operative pain or swelling, no bleeding on probing or wound infection was noticed. Radiographs showed no signs of bone resorption.

This type of novel approach could form an alternative method for immediately replacing the missing teeth without other surgeries like sinus lift, socket grafting, etc. It is truly anatomical, minimally invasive and socket friendly.

CONCLUSION

Although, titanium is material of choice for implants, it has some disadvantages like grey metallic colour seen through mucosa when there is soft tissue recession or thin gingival biotype. There are some problems associated with conventional implant technique, like incongruence with extraction socket, time consuming, need for other surgeries, etc.⁵

This new approach towards implantology is evolving. The combination of anatomically identical implants 'Mimicing the natural tooth roots', made up of zirconia with some modifications and surface technologies seem like a good alternative for the future.

However, further studies should be conducted about these type of implants with a larger sample size.

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