

Bi-layered Single-Piece Dental Implant

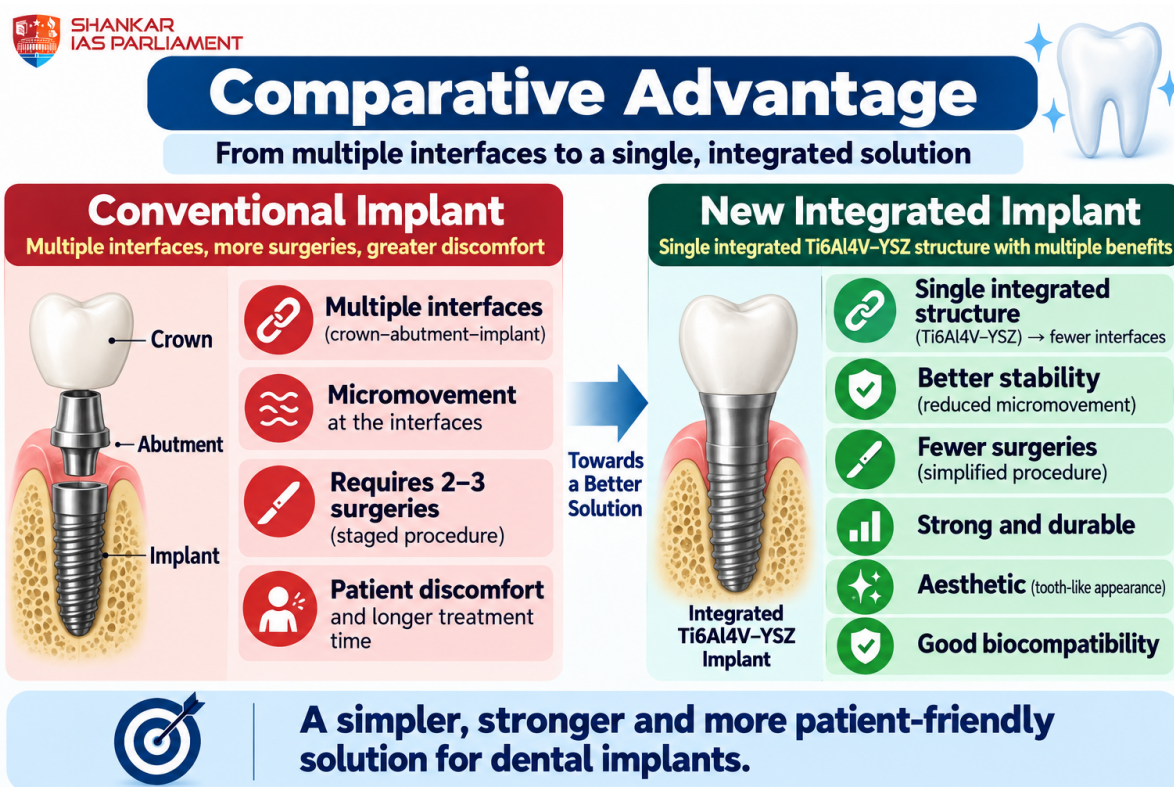
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Why in News?

Recently, Researchers at International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), have developed a bi-layered single-piece dental implant.

A Bi-Layered, Single-Piece Dental Implant

- **Integration of** - Ti6Al4V titanium alloy and yttria-stabilized zirconia (YSZ) **within a single** structure.
- **Aim** - To reduce the need for **surgical interventions**, improve implant stability, and enhance biocompatibility.



- **Manufacturing Technology**
- **Spark Plasma Sintering (SPS)** - It using a tapered graphite die facilitated single-step densification of Ti6Al4V and YSZ composites.
- A density of 99.5% was achieved, resulting in strong, defect-free, reproducible, and

scalable materials.

- **Key Scientific Findings** - A stable ceramic-metal interface was observed, characterized by the absence of cracks, pores, or delamination, minimal diffusion, and a fine-grained transition zone.
- **Mechanical Properties** - It exhibited a density of 99.5%, hardness of 1350 HV, compressive strength of approximately 1550 MPa, and flexural strength of approximately 310 MPa, which are equal to or exceed those of commercial implants.
- **Biocompatibility** - The MTT assay demonstrated greater than 90% metabolic activity, indicating non-cytotoxicity.
- The hemolysis test showed negligible red blood cell damage, confirming biological safety.

Conventional Dental Implant

- A conventional dental implant typically consists of three primary **components**:
 - **Fixture** - Embedded in jawbone
 - **Abutment** - Connects fixture and crown
 - **Crown** - Replaces visible tooth
- **Challenges**
 - Micromovement may occur at the abutment to fixture interface.
 - Such micromovement can disrupt osseointegration, potentially resulting in implant loosening.
 - Placement of conventional implants typically requires two to three separate surgical procedures.
 - It often leads to increased discomfort, higher costs, and greater clinical complexity.

- **Significance**
- **Healthcare Impact** - It reduces surgical complexity and enhances the stability of dental implants.
- **Technological Advancement** - It demonstrates the capability to develop indigenous biomaterials and apply powder metallurgy techniques.
- **Industrial Relevance** - It is reproducible and scalable, enabling the production of high-performance dental implants domestically.
- **Atmanirbhar Bharat** - It supports the development of indigenous biomedical devices and promotes affordable dental healthcare.

Reference

[PIB | Bi-Layered Single-Piece Dental Implant](#)