Analysis Of Dental Implants With Bio Ceramic Apatite Wollastonite (AW) And Hydroxyapatite (HA) Coatings By Pulsed Laser Deposition

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INTRODUCTION

After the initial rush of enthusiasm and interest in hydroxyapatite products subsided due to dissolution of the coating and failure at the substrate coating interface, this was a unique attempt to create a next generation indigenous implant with a novel bioceramic coating.

AIM

To compare the bioactivity of AW and HA coatings by the pulsed laser deposition process on titanium alloy dental implants by histomorphometric analysis after implantation into rabbit femurs.

OBJECTIVES

1. To compare the adhesive strength of HA and AW coatings produced by the pulsed laser deposition on titanium alloy plates by scratch test.
2. To establish the safety and biocompatibility of the novel ceramic AW in an in vivo rabbit study model.

MATERIALS & METHODS

A. Synthesis of AW and HA powder by sol-gel route..
B. Optimization of the parameters for best Pulsed Laser deposited coatings on titanium plates by scratch test
C. This was followed by coating on titanium dental implants with the best results.
D. Surgical implantation of coated implants into rabbit femur.

PULSED LASER DEPOSITION

It is a Vacuum deposition technique consisting of bombarding the pellet targets in a vacuum chamber resulting in sputtered atoms/ particles moving through the chamber to condense on the positioned titanium alloy dental implants and plates.

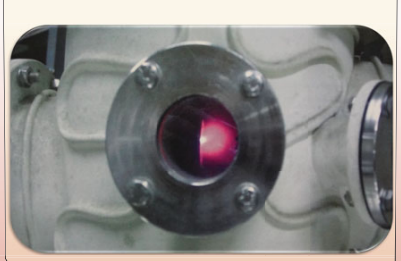


Fig. 1: PULSED LASER DEPOSITION PROCESS

IMPLANTATION IN RABBITS AND ANALYSIS -

6 indigenously coated implants were sterilized by gamma radiation and were implanted in distal femoral condyles in three rabbits.
Histomorphometric analysis was done on the bone-implant interface using stereomicroscope and transmission light microscope.

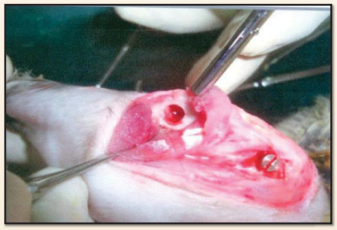


Fig. 2: IMPLANT SITE PREPARATION

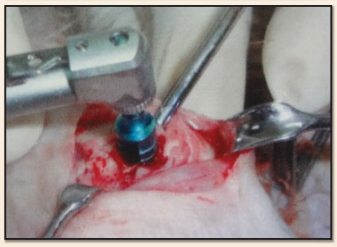


Fig. 3: IMPLANT INSERTION

RESULTS

HISTOMORPHOMETRIC ANALYSIS

Fig. 4: HA – 3 weeks

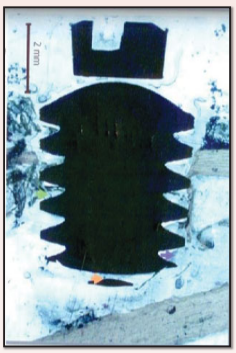
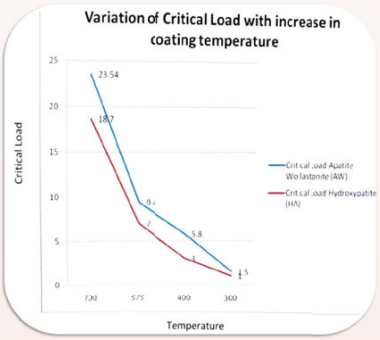


Fig. 5: AW – 3 weeks

Fig. 6: HA – 2 months

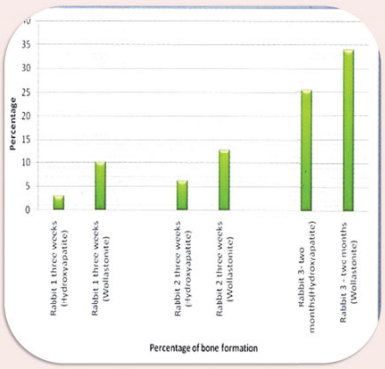
Fig. 7: AW – 2 months

Graph – 1: SCRATCH TEST



There was a direct correlation between increase in decohesion load and increased temperature

Graph – 2: BONE FORMATION



Bone formation at 3 weeks and 2 months was greater for AW coated implants compared to HA coated implants.

CONCLUSIONS

1. Pulsed laser deposition is an effective method to obtain bio-active ceramic coating.
2. AW glass ceramic proved to be more adherent than HA coatings on Ti alloy implant.
3. AW glass ceramic appears to induce faster bone formation than HA in a rabbit model.
4. The AW ceramic coating was non-toxic and bio-compatible.

CONFLICT OF INTEREST

The authors declare no conflict of interest and no financial support was received .