Development and analysis of Strontia implant

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Key Words: Strontia Nanopowder, Gelatin, Xrd, Ftir, Anti- Microbial Activity

STATEMENT OF THE PROBLEM

Biomaterial is any substance which is fabricated to work with the biological system either for therapeutic or diagnostic application in medical field. Strontia nanopowder is synthesized by wet process. Now we get Strontia by the reaction of Strontium chloride hexahydrate with Potassium hydroxide pellets followed by dehydration and calcination. The obtained nanopowder is characterized by XRD, FTIR and tested for anti- microbial activity. XRD helps in showing the unit cell dimensions and helps in phase identification of crystalline materials. FTIR helps to identify functional groups. The Strontia obtained is biocompatible, has anti- inflammatory, anti- microbial and osseointegration properties which can be used for making implants. The preliminary implant is developed by blending Gelatin to the synthesized powder and heated in muffle furnace. The developed preliminary implant is thus tested for various properties. Since the developed preliminary implant has good osseointegration property, biocompatibility and anti-microbial activity it can be used in the medical field.

INTRODUCTION

Biomaterial by definition is a non-drug substance suitable for inclusion in systems which augment or replace the function of body tissues or organs. Development of many new and novel products has lead to the growth of the field and gained importance in the society. Field mainly contains material science, tissue engineering, etc. As early as centuries ago, artificial materials & devices have been developed to a point where they replace various components of the human body. The materials are capable of being in contact with body fluids and tissues for prolonged period of time, eliciting little if any adverse reactions.

Biomaterials are biocompatible, non-toxic, non-carcinogenic, non-immunogenic, etc synthetic substance with adequate physical and mechanical properties used widely in medical applications to augment or replace a natural body function (therapeutic uses) that can be wholly implanted or partially implanted or used as external devices.

BACKGROUND

Trauma, degeneration and ailment make surgical repair or replacement necessary. When a person has a joint pain, the main concern is the pain relief and to lead a healthy and functional life style. This usually requires replacement of skeletal parts that include knees, hips, finger joints, elbows, vertebrae, teeth, repair of the mandible, etc.

HISTORICAL DEVELOPMENT

Earliest biomaterial applications were as far back as ancient Phoenicia where loose teeth were bound together with gold wires for tying artificial ones to neighbouring teeth. In early 1900 bone plates were implemented to stabilize bone fractures and to accelerate their healing. While by the time of the 1950's to1960's, blood vessel replacement were in clinical trials, artificial heart valves and hip joints were in development.

MATERIALS & METHODOLOGY

Materials

Strontium chloride hexahydrate, Potassium hydroxide pellets, Toluene and ethanol were purchased from Fischer Scientific. All the chemicals purchased were of analytical grade.

Methodology

Synthesis of Strontia Nanopowder

25g, 446.43 mmol of Potassium hydroxide pellets were mixed in water and Toluene in the ratio 1:15 followed by addition of 59.52 g, 223.24 mmol of Strontium chloride hexahydrate dissolved in water and is stirred for 2 hrs. The obtained solution is heated at 100°C in water bath for 8 hrs. The resultant obtained is kept overnight and filtered. The obtained filtrate is Strontium hydroxide which is washed with a mixture of Toluene and ethanol. This Strontium hydroxide is kept in hot air oven at 100°C for 24 hrs. The obtained powder is calcined at 700°C in muffle furnace. The white powder obtained is Strontia nanopowder.

The governing equation is given by,

$SrCl2.6H2O+2.4KOH \rightarrow Sr(OH)2+2KCl+6H2O$

$Sr(OH)2 \rightarrow SrO+ H2O$

Development of preliminary implant

The synthesized Strontia nanopowder was blended with binder and is made to form a thick paste and is brought to a preliminary shape using a mould. This preliminary molded implant is kept in muffle furnace at high temperature. The binder is removed while subjecting it to high heat and thus the preliminary implant is strengthened.

RESULTS & CONCLUSION

X-Ray Diffraction (XRD)

Strong and sharp peaks show the crystalline structure and purity of Strontia nanoparticles. The peaks were studied using X'pert Highscore software. Analysis confirmed Orthorhombic phase of Strontia nanoparticles and the size of nanoparticles were calculated to be 32.6nm.

Fourier Transform Infrared Spectroscopy (FTIR)

The band observed at 630 cm-1 and the peak at 853.95 cm-1 shows the SrO bond. The peak at 1444.08 cm-1 shows the presence of OH after the absorption of moisture from atmosphere during the synthesis.

Anti-microbial Activity

Anti- microbial activity test is done to check the activity of the prepared sample in resisting the bacterial activity.

Bacillus subtilis, a gram positive, rod shaped bacteria which is found to be present in the GI tract of humans was used to evaluate the anti- microbial activity. The prepared sample was inoculated in the petri plate and was left for 24 hrs in the incubator. The zone formed around the synthesized sample showed good resisting activity and the zone formed around was found to be about 2 cm.

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