ARTIFICIAL TITANIUM BASED IMPLANTS IN CERVICAL SPINE FIXATION FOR C5-C6 EPIDURAL SOL WITH QUADRIPARESIS

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ABSTRACT

Artificial implants in C5-C6 cervical spine were used to treat osteolytic lesions, typically a bone tumour. The condition was caused by Mycobacterium Tuberculosis inhaled into the lungs and getting spread to the spin. A Titanium cage was used for the purpose which involved solid osteoporotic fusions for fats post operative recovery. Titanium, tantalum, magnesium, and zinc are non-toxic elements used in making nanocrystalline biomedical alloys. The variation of TaN in TiAl caused elemental dissolution and re growth of many phases affecting the mechanical complexion of the alloy

Keywords: implants, Ti alloys, TaN- TiAl, Ti-B-Si-C/SS, nanoindentation

1. Implant cages

Artificial implant cages are used extensively in osteoporotic surgery. An ideal cage design would restore healthy alignment and disc height while providing immediate postoperative stability, high fusion rates, and low complications. Recent cage designs have attempted to alleviate complications by fostering early osseointegration and, as a result, fusion by cage surface alteration. The surface roughness of titanium and its alloys can be increased using plasma beam and electron spray techniques. Lytic lesions, sometimes called bone lesions or osteolytic lesions, are softening pieces of bone that appear as a symptom of a specific disease. The cervical spine showed lytic destructive lesions affecting the C2, C3, C4, C5, and C6 vertebrae and their pedicles, as well as a small left paraspinal and anterior epidural soft issue collection at the C5 level, which caused spinal cord compression and compressive myelopathy. The softened area appears as a hole on X-ray images due to lower bone density. **[1]**. The morphology observed in a radiograph is the most important determinants in imaging a bone tumour. The lesions show symptoms of myelopathy due to proximity of posterior epidural space to spinal cord and spinal nerves **[2]**.

The surgery involved anterior decompression of C4-T1 done by Smith Robinson approach **[3]** and instrumentation/fusion and posterior fusion/fixation. The tissue specimen from neck was sent for gram stain, culture histopathology, AFB stain where HPE showed granulomatous lesions with tubercular origin. The condition before surgery was therefore diagnosed as Pott's spine or spinal tuberculosis, which occurs when air containing Mycobacterium Tuberculosis is inhaled into the lungs and gets spread to the spine. The spread being hematogenous (transmitted through

blood). Fig 1 shows the artificial implants in c5-c6 cervical spine fixation which reduce pressure on the nerve(s) by surgically removing tissues pushing on a nerve and stabilize the cervical spine by fusing 2 or more cervical vertebrae together.

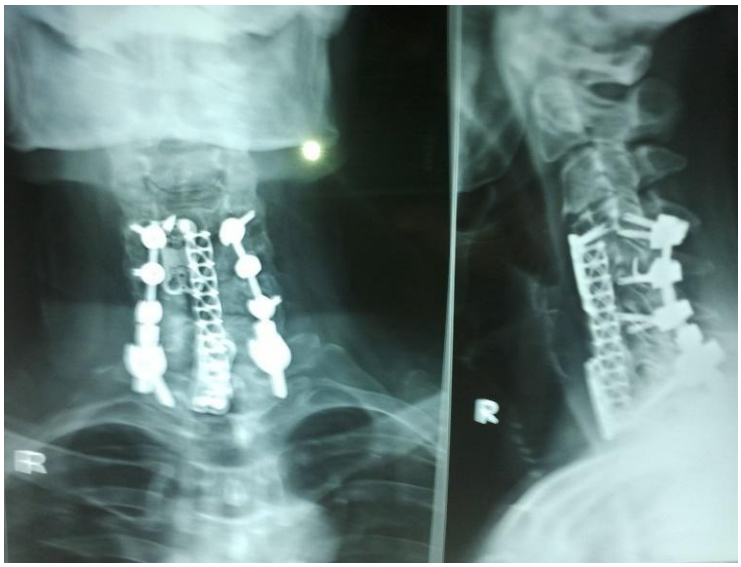

Fig 1. Artificial implants in C5-C6 cervical spine fixation

2. Ti based alloys and composites

Titanium-based composites and super-alloys have been used as protective coatings in the microelectronics and aircraft industries. The high temperature applications of these materials are due to the precipitation hardening of phases at the grain boundaries. TiAl loses some of its ductility when elements like tantalum (Ta), manganese (Mn), and boron (B) are micro alloyed. The TaN acts as a diffusion barrier and insulating layer in copper interconnects. Additionally, they are employed as thin-film resistors. TiAlN hard coatings are fitted to drills and endmills. Nanocrystalline biomedical alloys are made of non-toxic elements such as zinc, titanium, tantalum, and magnesium. The alloy's mechanical composition was impacted by the elemental dissolution and regrowth of several phases due to the fluctuation of TaN in TiAl **[4, 5].**Our of the different compositions, $Ti_{30}Ta_5Mg/Zn$ exhibited the lowest corrosion potential as well as corrosion current among each material group under analysis that has zinc and magnesium added to Ti-Ta alloys, Both the current density and the corrosion potential of the alloy increased with the addition of more tantalum **[4].** Reports have shown that elemental dissolution in multicomponent polymer-derived ceramic (PDC) based mixed-phase hard films and the formation of intermetallic phases in multicomponent Ti-B-Si-C coatings produced by magnetron sputtering **[6, 7]**.

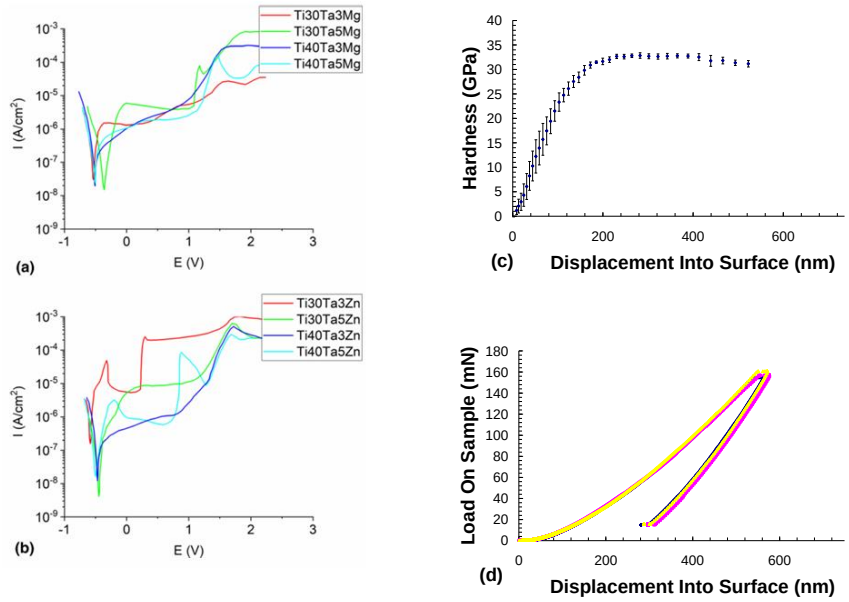

Fig 2 Polarization curves of Ti-Ta-Mg (a) and Ti-Ta-Zn (b) hot-pressed alloys (Open Access CC BY 4.0 **[4]**)(c) Nanoindentation hardness of more than 30 GPa of TiBSiC/SS coatings and (d) the corresponding load -depth plot **[13]**

Fracture analysis was performed on hard coatings deposited on different substrates, and the ensuing stress distributions were analysed. It was observed that the indenter's geometry and shape varied, and that the failure mode during indentation in both the static and sliding modes showed a change from ductile to brittle. The failure morphologies of the scratch adhesion test were examined for analysis. Studies using computers were conducted to model the nanoindentation procedure. **[8-18].** One of the best materials to use in the production of bio implants is titanium, which finds use in dentistry, orthopaedics, and other fields. Titanium has numerous qualities that make it suitable, such as osteoporosis resistance, wear resistance, corrosion resistance, and biocompatibility **[19]**. The Ti-6Al-4V alloy used for bioimplants was reported to have better mechanical and corrosion performance due to low β content and high α′ phases in the microstructure **[20]**. Ti-B-Si-C coatings deposited on stainless steel substrates by magnetron sputtering showed hardness more than 30 GPa (**Fig 2 c, d**)

During nanoindentation, the relationship between the mechanical response in individual grains of superelastic polycrystalline Ti-2448 alloy and its crystallographic orientation is examined. Using spherical and Berkovich indenters, the force-displacement curves are used to calculate the strain recovery, elastic modulus, and hardness. The direction of crystallographic indentation has a significant impact on the strain recovery, which is measured as the indentation depth-recovery ratio **[21].**

3. Conclusions

Ti based alloys has been used for bio-implants like in the case of cervical spine fixation for C5-CR epidural sol with quadriparesis. The other variants of Ti used for bioimplants are TiAl-TaN alloys, Ti-6Al-4V and Ti-Ta-Mg/Zn alloys. The Ti-2448 alloy showed super elastic behaviour whereas nanoindetation of Ti-B-Si-C/SS showed hardness more than 30 GPa.

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