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## Analysis of serum metal ion levels in dental implant patients

**Dr Ravinder Singh Saini**

Associate Professor, COAMS, King Khalid University, Abha, Saudi Arabia  
Corresponding author email: [dr\\_ravi\\_saini@yahoo.com](mailto:dr_ravi_saini@yahoo.com)

**Dr. Kanwalpreet Kaur**

MDS, Pediatric and Preventive Dentistry, Consultant Pediatric Dentist, Ludhiana, Punjab

**Abstract**---Background: Dental implants have been widely used for the replacement of missing teeth in fully and partially edentulous patients. Titanium (Ti) has been the material of choice for dental implants due to its superior corrosion resistance behaviour and desirable mechanical properties. Hence; the present study was undertaken for assessing the serum metal ion levels in Dental Implant Patients. Materials & methods: A total of 20 subjects with missing mandibular first molar and scheduled for prosthetic rehabilitation for same using dental implant therapy were enrolled. Blood samples were obtained at baseline and sent to laboratory where auto-analyser was used for evaluation of metal ions levels. All the dental implant procedures were carried out under the hands of skilled implantologists. After placement of dental implants, blood samples were obtained at 8 weeks and 6 months follow-up. Metal ions were assessed at subsequent follow-ups. All the results were analysed by SPSS software. Results: Mean serum titanium concentration at baseline, 8 weeks and 6 months was found to be 2.39 mg/dL, 2.35 mg/dL and 2.38 mg/dL respectively. Mean serum aluminium concentration at baseline, 8 weeks and 6 months was found to be 4.19 mg/dL, 4.16 mg/dL and 4.18 mg/dL respectively. Non-significant results were obtained while comparing the means serum titanium and aluminium levels at different time intervals. Conclusion: Serum metal ion levels is unaffected among patients undergoing dental implant therapy.

**Keywords**---Metal, Ions, Dental.

## Introduction

Dental implants have been widely used for the replacement of missing teeth in fully and partially edentulous patients. According to the American Academy of Implant Dentistry, 3 million people in the United States have dental implants and that number is growing by 500,000 a year. The use of endosseous dental implants was initiated by the discovery that these implants could be anchored in the jawbone with direct bone contact.<sup>1-3</sup> In 1991, Zarb and Albrektsson described the osseointegration phenomena as “a process in which a clinically asymptomatic rigid fixation of alloplastic material is achieved and maintained in bone during functional loading” For proper osseointegration, several factors must be controlled, including biocompatibility of the implant material, design and surface of the implant, the condition of the tissues in the implant site, the surgical techniques, and loading procedures. Biocompatibility of an implant material is closely related to its susceptibility to corrosion. Therefore, titanium (Ti) has been the material of choice for dental implants due to its superior corrosion resistance behaviour and desirable mechanical properties.<sup>4-6</sup> Until recently, noble alloys were considered to be chemically inert in the body and in the oral environment in particular. Therefore, they were not considered to be vulnerable or susceptible to corrosion attack in the oral environment. Corrosion can be characterized by gradual degradation of materials by processes of the electrochemical events. The bio-compatibility for the metal and metal alloy dental implants is based on the material ability to be immune to corrosion attack, its mechanical properties, and response to host factors. The most commonly used components in implant alloys are titanium, vanadium, and aluminum.<sup>6-9</sup> Most dental implants nowadays are alloyed with aluminium and vanadium to improve the mechanical properties. The release of these metals from dental implants into the bloodstream, and their clinical effects have not been studied adequately.<sup>5,6</sup> Hence; the present study was undertaken for assessing the serum metal ion levels in Dental Implant Patients.

## Materials & Methods

The present study was undertaken for assessing the serum metal ion levels in Dental Implant Patients. A total of 20 subjects with missing mandibular first molar and scheduled for prosthetic rehabilitation for same using dental implant therapy were enrolled. Complete demographic and clinical details of all the subjects were obtained. Prior to placement of the implant, serum samples were collected from each patient to establish the baseline levels of the titanium and aluminium ions. Blood samples were obtained at baseline and sent to laboratory where auto-analyser was used for evaluation of metal ions levels. All the dental implant procedures were carried out under the hands of skilled implantologists. After placement of dental implants, blood samples were obtained at 8 weeks and 6 months follow-up. Metal ions were assessed at subsequent follow-ups. All the results were analysed by SPSS software.

## Results

Mean serum titanium concentration at baseline, 8 weeks and 6 months was found to be 2.39 mg/dL, 2.35 mg/dL and 2.38 mg/dL respectively. Mean serum aluminium concentration at baseline, 8 weeks and 6 months was found to be 4.19

mg/dL, 4.16 mg/dL and 4.18 mg/dL respectively. Non-significant results were obtained while comparing the means serum titanium and aluminium levels at different time intervals.

Table 1: Comparison of serum metal ion concentration

Metal ion	Baseline	8 weeks	6 months	p- value
Mean serum Titanium (mg/dL)	2.39	2.35	2.38	0.121
Mean serum aluminium (mg/dL)	4.19	4.16	4.18	0.398

## Discussion

Titanium is the most widely used material for oral implants and is considered to be highly biocompatible. After the discovery of osseointegration by a Swedish orthopedic surgeon, Per-Ingvar Branemark(1957), titanium was considered as a good biomaterial, with corrosion resistance without cytotoxicity, together with high material strength with excellent fatigue and wear resistance.<sup>6- 8</sup> The interactions of dental implants with biological tissues are characterized by means of titanium dioxide (TiO<sub>2</sub>) layer. When the stable oxide layer is broken down or removed and is unable to reform on parts of the surface, titanium can be as corrosive as many other base metals. TiO<sub>2</sub> layer can be destroyed during movements between implant and bone tissue under loading conditions. This destruction causes corrosion of the implant, thus, weakening it; and can induce the leak of small metallic particles or ions into living tissues.<sup>7- 10</sup> Hence; the present study was undertaken for assessing the serum metal ion levels in Dental Implant Patients.

Mean serum titanium concentration at baseline, 8 weeks and 6 months was found to be 2.39 mg/dL, 2.35 mg/dL and 2.38 mg/dL respectively. Mean serum aluminium concentration at baseline, 8 weeks and 6 months was found to be 4.19 mg/dL, 4.16 mg/dL and 4.18 mg/dL respectively. Gopi G et al evaluated the release of titanium, aluminium, and vanadium from dental implants by comparing the preoperative and postoperative serum levels of these ions. Serum samples were collected from 30 patients undergoing dental implant placement preoperatively and postoperatively at intervals of 6 weeks, 3, 6, and 12 months. These samples were analyzed for titanium, aluminium, and vanadium levels using Inductively Coupled Plasma Optical Emission Spectrometry. The difference in preoperative and postoperative serum levels was measured and statistically analyzed using the paired t-test. There was a slight difference in the postoperative levels of titanium and aluminium (2.30 and 4.07 mg/dl) as compared to the preoperative levels (2.28 and 2.30 mg/dl), which was statistically insignificant (P > 0.5). The serum levels of vanadium were too insignificant to be detected by the instrument (<0.0088 mg/dl). Mild increase in the titanium and aluminium levels in blood serum was noted.<sup>11</sup>

Non-significant results were obtained while comparing the means serum titanium and aluminium levels at different time intervals. Temiz M et al evaluated the effect of total implant-bone surface contact area of dental implants applied on partial or total edentulous patients on the increase in the level of blood titanium level. Changes of the blood titanium levels were evaluated after placement of the dental

implants in 30 patients including 15 females and 15 males. Patients were divided into 3 groups as dental implants were applied on only maxilla, only mandible, or both of them. Taking into the consideration anatomic formation and prosthetic indication, dental implant-bone total contact area was calculated and saved for each patient after dental implants placement. Blood samples of the patients taken preoperatively and postoperatively at 12 weeks were analyzed by ICP-MS device. Blood titanium levels of preoperative and postoperative blood samples were analyzed for each patient and results were evaluated statistically. In the evaluation after analyzing blood titanium level changes, while a statistically significant decrease was observed in Group 1 patients, a statistically significant increase was observed in Group 2 and Group 3 patients to blood titanium level. A statistically significant difference was observed between Group 1 and Group 2 and between Group 1 and Group 3 patients of blood titanium levels. The change of the blood titanium level was not related to total implant-bone surface area, number of the implants, and gender. In our study, no correlation was found between change of blood titanium level and total contact area with bone of dental implants.<sup>12</sup>

### Conclusion

Serum metal ion levels is unaffected among patients undergoing dental implant therapy.

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