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Exploring Risk of Titanium Allergy Amongst Implant Patients: A Observational Study

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ABSTRACT

Background: Titanium remains the gold standard for the fabrication of oral implants, even though sensitivity does occur, though its clinical relevance is not yet clear. Placing permanent metal dental implants in allergic patients can provoke type IV or I reactions. Several symptoms have been described, from skin rashes and implant failure, to non-specific immune suppression.

Material and methods: The present observational study was conducted among 300 volunteers of 25-60 years. Test allergen composed of titanium dioxide 0.5% in petroleum base was used to assess the allergic reaction. Results were compared by z-test.

Results: Seven out of the 80 patients with history of allergy shows positive results. One out of 120 without history of allergy shows positive results. p-value is found to be significant (<0.01)

Conclusion: Ti allergy can be detected in dental implant patients, even though its estimated prevalence is low. We suggest an examination of pre-implant patients who have a history of hypersensitivity reactions to metals.

Keywords: Titanium, oral implants, test allergen.

INTRODUCTION

Titanium implants are extensively used to replace the missing natural teeth in prosthodontics, as it is one of the most biocompatible materials. The placement of any material in the body creates an interface which will be a site of dynamic interactions between the material and the body, through which the material may alter the body and vice versa.[1]

According to the American Society for Testing and Materials (ASTM), there are six distinct types of titanium available as implant biomaterials. Amongst these six materials, there are four grades of commercially pure titanium (CpTi) and two titanium (Ti) alloys. The two alloys are Ti-6Al-4V and Ti-6Al-4V-ELI (extra low interstitial alloys). The commercially pure titanium materials are called pure Grade I, Grade II, Grade III and Grade IV titanium. Commercially pure titanium is also referred to as unalloyed titanium and usually contains some trace elements of carbon, oxygen, nitrogen and iron. These trace elements markedly improve the mechanical properties of pure titanium[2] and are found in higher amounts from Grade I to Grade IV.

Despite titanium being one of the most biocompatible materials, it can still cause an allergic

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reaction in a small percentage of population.[1]Assuming that Ti is released from implants, we conducted a cross-sectional observational study aimed at exploring if there is risk of titanium allergy amongst implant patients.

MATERIAL AND METHODS

300 patients aged 25 to 60 years old were invited to participate in the study. When they agreed to participate, individuals or their legal guardians signed an informed consent. The study methodology was explained to all the participants. Test allergen composed of titanium dioxide 0.5% in petroleum base. The inclusion criteria were patients with no history of any systemic diseases and participants with known prior history of allergy to known metal allergens. The exclusion criteria were patients under any immunosuppressant therapy such as corticosteroids, antihistamines, etc. Before the commencement of the study ethical approval was obtained from the ethical committee of the institution. Any possible reactions were observed and if any, were recorded. About 0.5 ml of test allergen was applied after cleaning the area with surgical spirit swab and patients were instructed to keep the test area dry. To prevent any unanticipated consequence to the allergen, the patients were kept under observation for a period of 6 and 8 hours after the application of the allergen. The participant were recalled after 2-3 days, were observed for any allergical reaction and was recorded accordingly. Data was analyzed using SPSS-20 and was statistically analyzed using Z-test for proportions with p value<0.05 considered as significant value.

RESULTS

The present study comprises of 300 hundred patients in which 147(49%) were females and 153(51%) were males. The results of this study arepresented in Table 1. A total of 8 (2.6%) subjects out of the 300 subjects included in this study tested positive to the patch test for titanium dioxide, of which 7(8.75%) had a prior history of allergy to known allergens and 1 (0.83%) had not reported any past history of allergic reactions.

The difference in proportion of positive results with samples having previous history of allergy and those without having previous history of allergy was found to be statistically significant ($p < 0.01$).

Table 1: Positive results in patients (z-test for proportions).

Positive results in patients	n	%	z	p-value
With h/o allergy (n = 80)	7	8.75	2.220	<0.01
Without h/o allergy (n=120)	1	0.83		
Total (300)	8	2.6		

n: Number of subjects who tested positive to an allergic reaction to titanium; The difference in proportion of positive results with samples having previous history of allergy and those without having previous history of allergy was found to be statistically significant ($p < 0.01$)

DISCUSSION

In the 1980s, dental implants became one of the major choices for the treatment of missing teeth. Titanium was used as a material for dental implants at a very early stage in the development of dental implants.[3,4] The high biocompatibility of this metal suggested that titanium was an allergy-free material, and several reports supported the safety of titanium.[5-7] However, Matono et al. and Koike et al. reported that titanium can be erosive if it coexists with other types of metal, or if it is exposed to fluorine ions in acidic environments.[8-10]

Released Ti may be detected not only in tissues surrounding joint replacement, but also in regional lymph nodes in association with Ti screws or mini plates.[11-14]

The literature reports have suggested a general prevalence of around 0.6% in general population and around 5% in subjects who had a history of allergic reactions to metals.[15] Thepresent study found that difference in proportion of positive results with samples having previous history of allergy and those without having previous history of allergy was found to be statistically significant ($p < 0.01$).From these results it may be concluded that titanium appears to be biocompatible to most patients, but a small subgroup of individuals may be capable of developing clinically significant

hypersensitivity reactions. It was observed that the individuals having a prior history of allergy were more susceptible to allergic reaction to titanium.[16]

Hosoki M et al conducted a cohort study in 270 patients. A total of 217 patients (80.4 %) exhibited allergy-positive reactions to at least one type of metal allergen. The total number of allergy-positive reactions for titanium allergens among all 270 patients was 17 (6.3 %). This study concluded that the prevalence of allergy-positive reactions for titanium allergens was lower than for other metal allergens.[17]Satpathy S et al conducted a clinical study in 400 patients.Of the total number of subjects tested, an incidence of 3% was found for allergic reactions to titanium, which confirms to the prevalence of allergic reactions to metals in general population.4 The allergic reaction to metals in subjects who had a previous history of allergic reaction to other metals was found to be 9%, which is slightly higher than the other studies, where a prevalence of 5% have been reported. 0.66% of the individuals who did not give any prior history of allergy tested positive to titanium dioxide.[18]Sicilia A et al evaluated the presence of titanium allergy by the anamnesisand examination of patients, together with the selective use of cutaneous andepicutaneous testing, in patients treated with or intending to receive dental implants ofsuch material.Nine out of the 1500 patients displayed positive (þ) reactions to Ti allergy tests(0.6%): eight in the ACRG (50%), one in the PFG (5.3%)(P¼0.009) and zero in the controlgroup. Five positives were unexplained implant failures (five out of eight).Therefore this study concluded that Ti allergy can be detected in dental implant patients, even though itsestimated prevalence is low (0.6%).[19]

CONCLUSION

From this study it can be concluded that, titanium can induce hypersensitivity response in a group of susceptible patients. Persons who were reporting with a prior history of allergy to various known allergens were more susceptible to presenting with an allergic reaction to titanium. However, the results of the present study showed that titanium allergy exists. The findings of this study report that there is no titanium allergy in patients caused by dental implants. Ti allergy can be detected in dental implant patients, even though itsestimated prevalence is low.We suggest an examination of pre-implant patients who have a history of hypersensitivity reactions to metals.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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