



RESEARCH ARTICLE

AWARENESS AND KNOWLEDGE OF TITANIUM ALLERGY AMONG DENTAL STUDENTS IN VARIOUS INSTITUTIONS – A SURVEY.

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Key words:-

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Abstract

Aim: To evaluate titanium allergy in prosthodontics and its effects on human health

Objective: To study the use of titanium in dental procedures and its action in allergic reactions

Background: In dentistry, titanium is considered as a material of choice for various dental procedures such as dental implants, partial dentures and fabrication of crowns. Titanium can form passive, stable oxide film as it has a high resistance to corrosion in physiological environment and excellent biocompatibility. Titanium may act as an allergen that induces clinically relevant hypersensitivity and other immune dysfunctions when exposed to sensitive patients. The use of titanium as biomedical devices may stimulate type I or type IV reactions in allergic patients that can be characterized by various conditions such as skin rashes and non-specific immune suppression

Materials and Method: A questionnaire survey was conducted among 100 dental students from various institutions. All participants were provided with a list of 10 questions related to titanium allergy. Data was collected and statistic analysis was done.

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Introduction:-

Titanium is one of the metals that can be found abundantly in the Earth's crust, following aluminum, iron and magnesium. The use of titanium in various medical and dental procedures began in the 1970s, in which it is used in orthopedic devices and oral implants due its high biocompatibility.^[1] In the past few decades, titanium and its alloys have been successfully used in dental implants and its prosthesis components.

Titanium is an inert metal that can stimulate toxicity or type I to type IV hypersensitivity with symptoms ranging from slight pain, skin rashes to implant failure.^{[5][6]} Titanium allergy has been reported in approximately 0.6 to 5% of the general population.^[7] Titanium allergy may be one of the primary causes for implant failures in sensitive patients, also called as cluster patients.^[8]

Most of the patients affected by titanium allergy are normally those who are also allergic to other metals.^[9] Allergy evaluation is normally recommended to those patients undergoing dental implant procedures prior. Epicutaneous patch test is one of the tests that can be done to diagnose titanium allergy. It is tested on the patient's back by applying the allergen.^[10] It has an efficiency of approximately 75% in diagnosing a metal allergy, which can also used for titanium allergy.^[8] Blood test is another test used in diagnosis of titanium allergy, which has a higher sensitivity but lower specificity than epicutaneous patch test. It is done based on lymphoblastic transformation.^[11]

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Pure titanium (CpTi) is commonly used for the application of endosseous dental implants as a replacement for stainless steel, which is the first metallic biomaterial used as an implant. CpTi can be graded into 1 to 5, in which grade 1 to 4 are unalloyed while grade 5 is alloyed with 6% aluminium and 4% vanadium (Ti6Al4V).^[26] Placement of titanium implants and their permanence in the body increases the internal exposure and accumulation of titanium ions in tissues surrounding the dental and orthopedic implants, including the regional lymph nodes and pulmonary tissues. Various studies have proven the concentration of titanium ions in peri-implant tissues, along with discolorations after the insertion of titanium implants.^{[27][28][29][30][31]} Allergic reactions due titanium implant are usually diagnosed on the basis of signs and symptoms of titanium allergy such as skin rashes, urticaria and swelling in the orofacial region.^[32]

Materials and Method:-

A questionnaire-based study was done among dental students from various institutions in India. A total of 100 participants took part in the survey. All participants were provided with a questionnaires related to titanium allergy. The participants were told to choose only one answer based on their personal opinion.

Awareness and Knowledge of Titanium Allergy among Dental Students in Various Institutions – A Survey

1. Have you come across patients with titanium allergy?
 - ☐ Yes
 - ☐ No
2. How often do you have patients with titanium allergy?
 - ☐ Very often
 - ☐ Often
 - ☐ Rarely
 - ☐ None
3. Are you aware of titanium allergy?
 - ☐ Yes
 - ☐ No
4. Do you ask patients if they are allergic to any kind of metal prior to a procedure?
 - ☐ Yes
 - ☐ No
5. Do your patients normally show signs of titanium allergy after a procedure?
 - ☐ Yes
 - ☐ No
 - ☐ Sometimes
6. What kind of treatment would you suggest for allergic patients?
 - ☐ Prescription medicine containing anti-histamine
 - ☐ Mild ointment
 - ☐ Avoid titanium dioxide-containing products
 - ☐ Natural cures (Ex: Lime juice and honey)
 - ☐ Other
7. Do you think it is safe for titanium to be used in most dental materials?
 - ☐ Yes
 - ☐ No
 - ☐ Not sure
8. Do you know about the various methods to diagnose titanium allergy?
 - ☐ Yes
 - ☐ No

9. How would you rate the incidence of patients with titanium allergy?

- ☐ High
- ☐ Moderate
- ☐ Low

10. What is the most common symptom of titanium allergy?

- ☐ Rashes
- ☐ Itching
- ☐ Redness
- ☐ Muscle pain
- ☐ Other

Results:-

Question 1	Percentage of Participants (%)
Yes	29
No	71

Table 1:- “Have you come across patients with titanium allergy?”

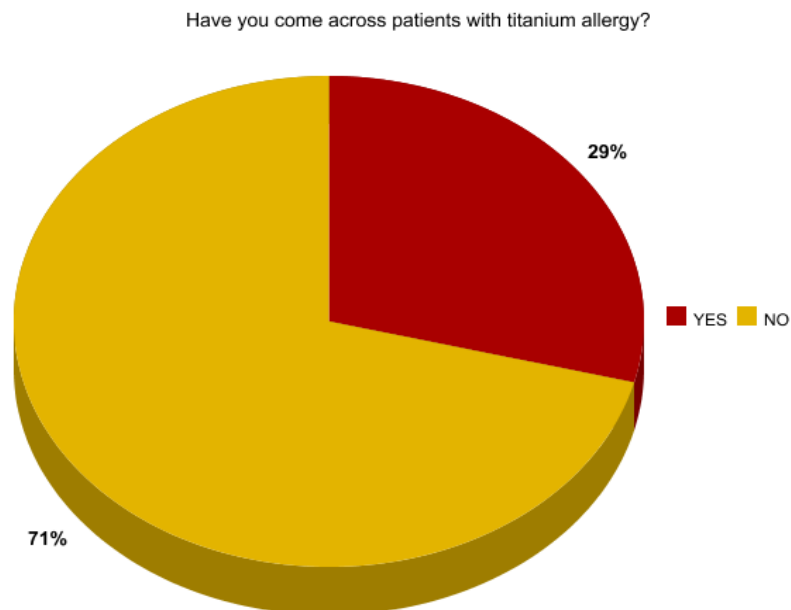


Figure 1:- “Have you come across patients with titanium allergy?”

Question 2	Percentage of Participants (%)
Very often	0
Often	10
Rarely	35
None	55

Table 2:- “How often do you have patients with titanium allergy?”

How often do you have patients with titanium allergy?

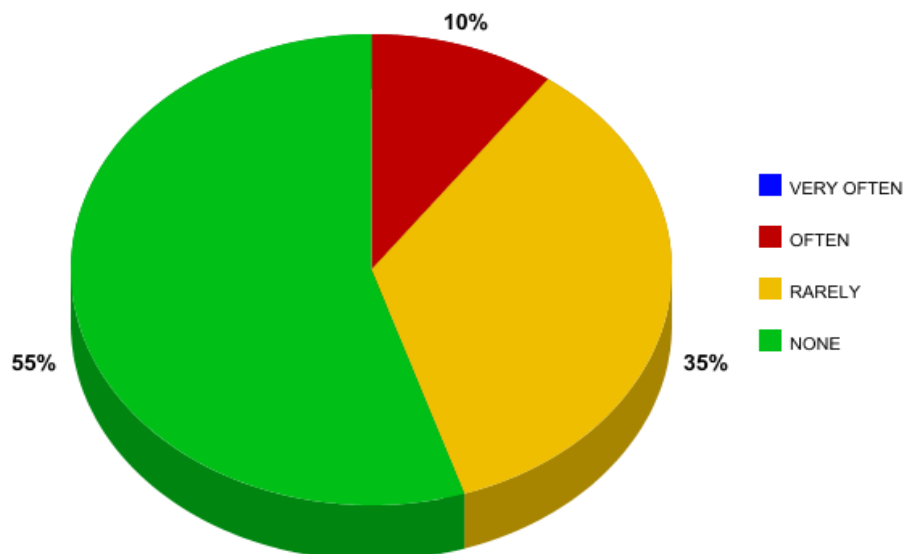


Figure 2:- "How often do you have patients with titanium allergy?"

Question 3	Percentage of Participants (%)
Yes	10
No	90

Table 3:- "Are you aware of titanium allergy?"

Are you aware of titanium allergy?

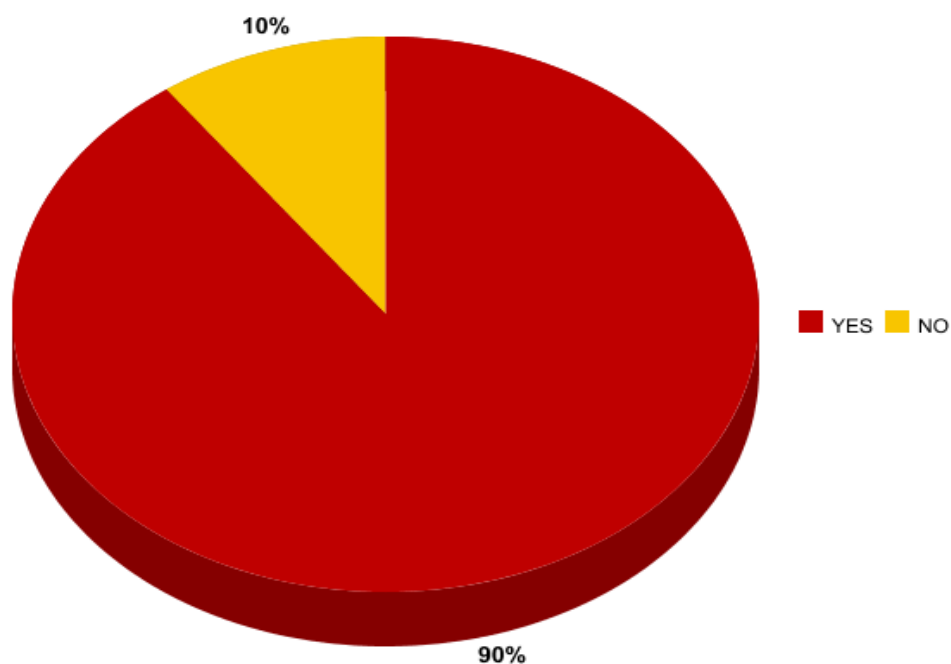


Figure 3:- "Are you aware of titanium allergy?"

Question 4	Percentage of Participants (%)
Yes	79
No	21

Table 4:- “Do you ask patients if they are allergic to any kind of metal prior to a procedure?”
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Figure 4:- “Do you ask patients if they are allergic to any kind of metal prior to a procedure?”

Question 5	Percentage of Participants (%)
Yes	8
No	72
Sometimes	20

Table 5:- “Do your patients normally show signs of titanium allergy after a procedure?”

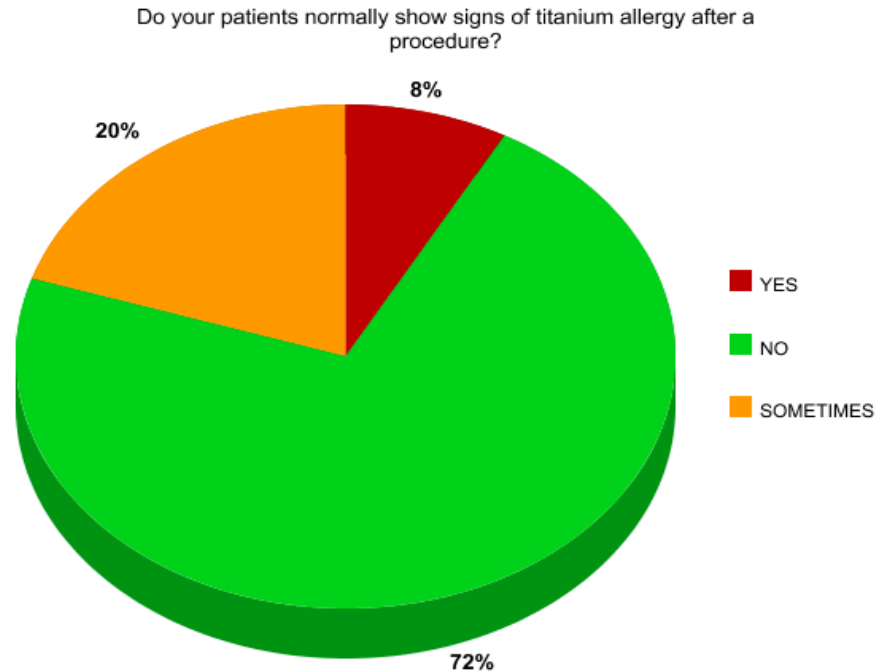


Figure 5:- “Do your patients normally show signs of titanium allergy after a procedure?”

Question 6	Percentage of Participants (%)
Prescription medicine containing anti-histamine	44
Mild ointment	25
Avoid titanium dioxide-containing products	18
Natural cures (Ex: Lime juice and honey)	13
Other	0

Table 6:- “What kind of treatment would you suggest for allergic patients?”

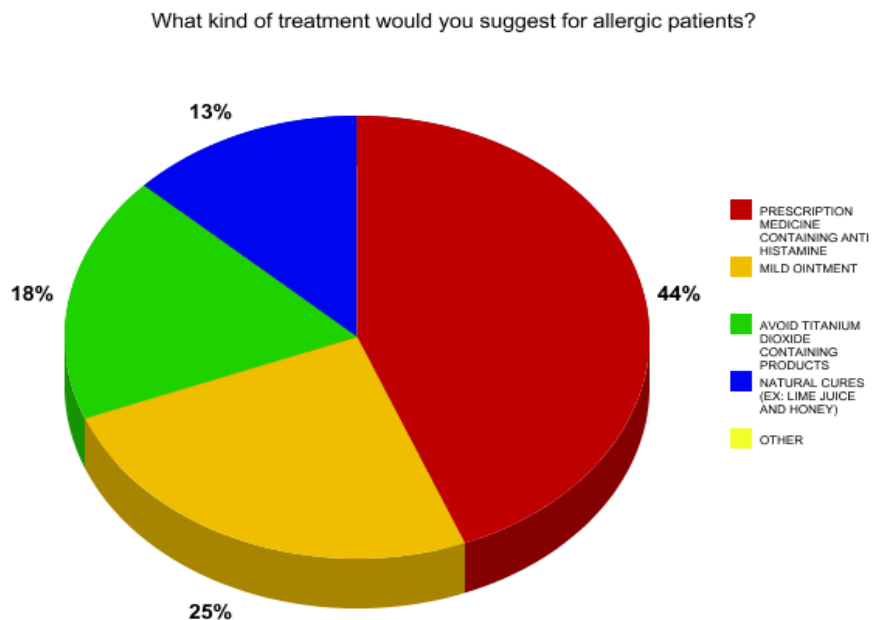


Figure 6:- “What kind of treatment would you suggest for allergic patients?”

Question 7	Percentage of Participants (%)
Yes	34
No	27
Not sure	39

Table 7:- “Do you think it is safe for titanium to be used in most dental materials?”

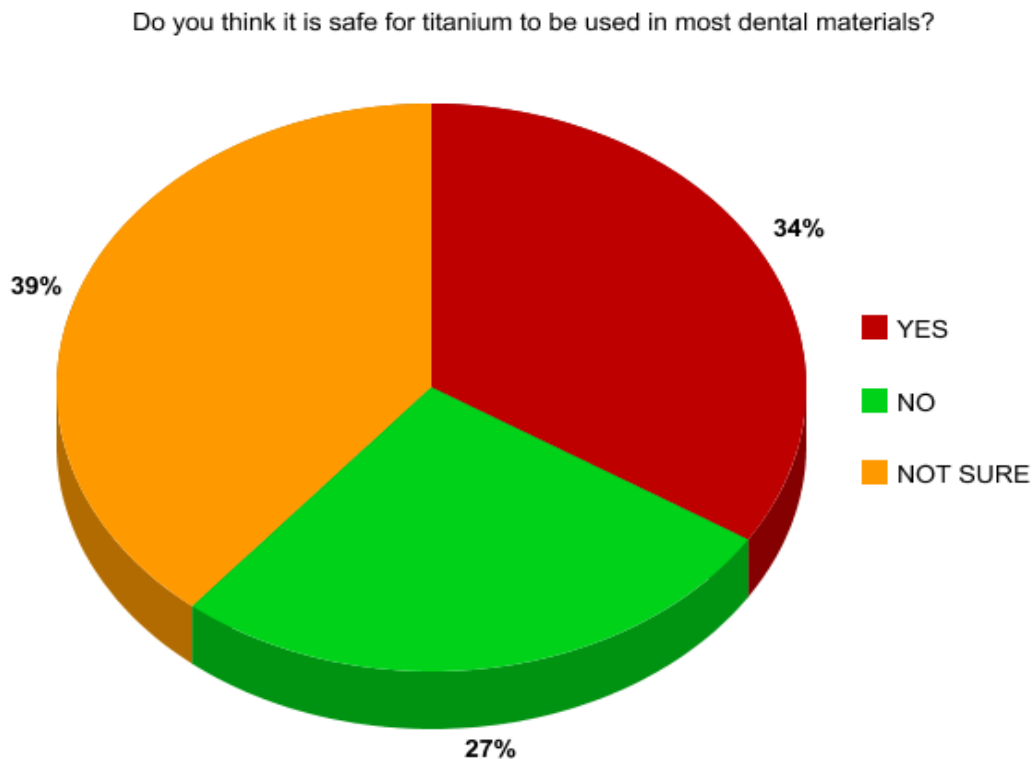


Figure 7:- “Do you think it is safe for titanium to be used in most dental materials?”

Question 8	Percentage of Participants (%)
Yes	85
No	15

Table 8:- “Do you know about the various methods to diagnose titanium allergy?”

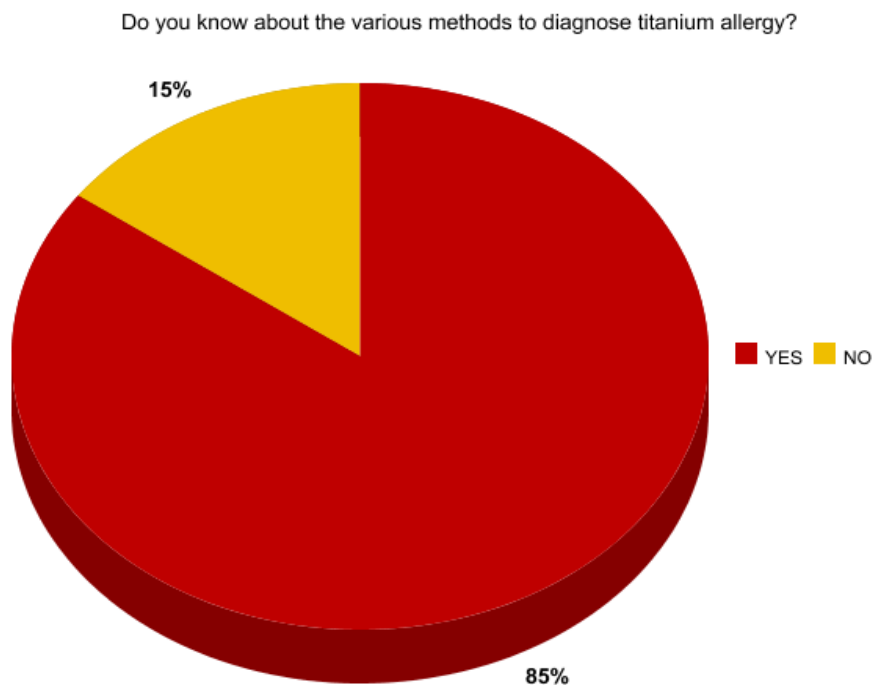


Figure 8:- “Do you know about the various methods to diagnose titanium allergy?”

Question 9	Percentage of Participants (%)
High	10
Moderate	11
Low	79

Table 9:- “How would you rate the incidence of patients with titanium allergy?”

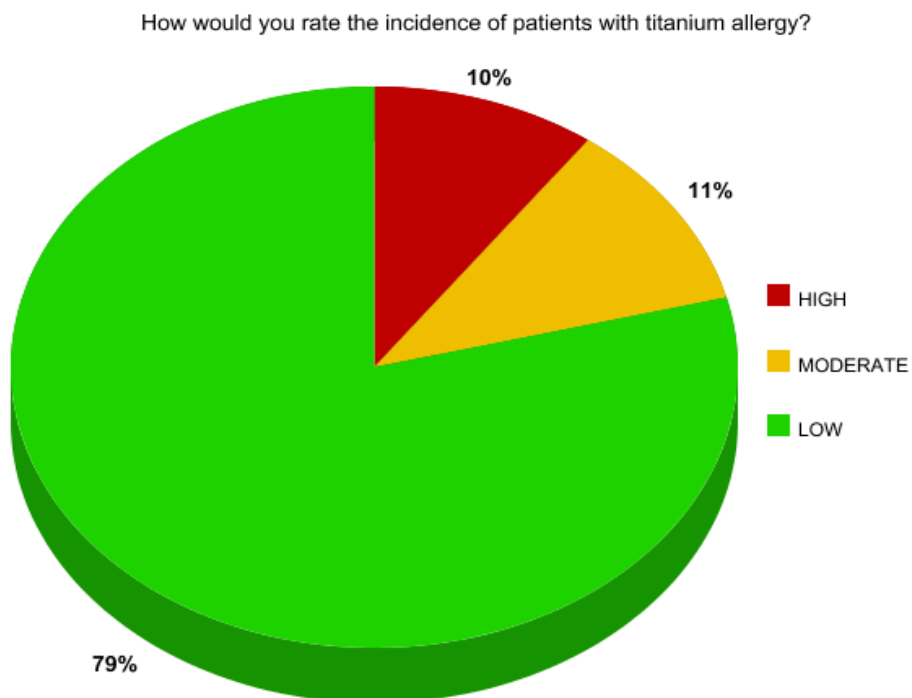


Figure 9:- “How would you rate the incidence of patients with titanium allergy?”

Question 10	Percentage of Participants (%)
Rashes	23
Itching	39
Redness	25
Muscle pain	13
Other	0

Table 10:- “What is the most common symptom of titanium allergy?”

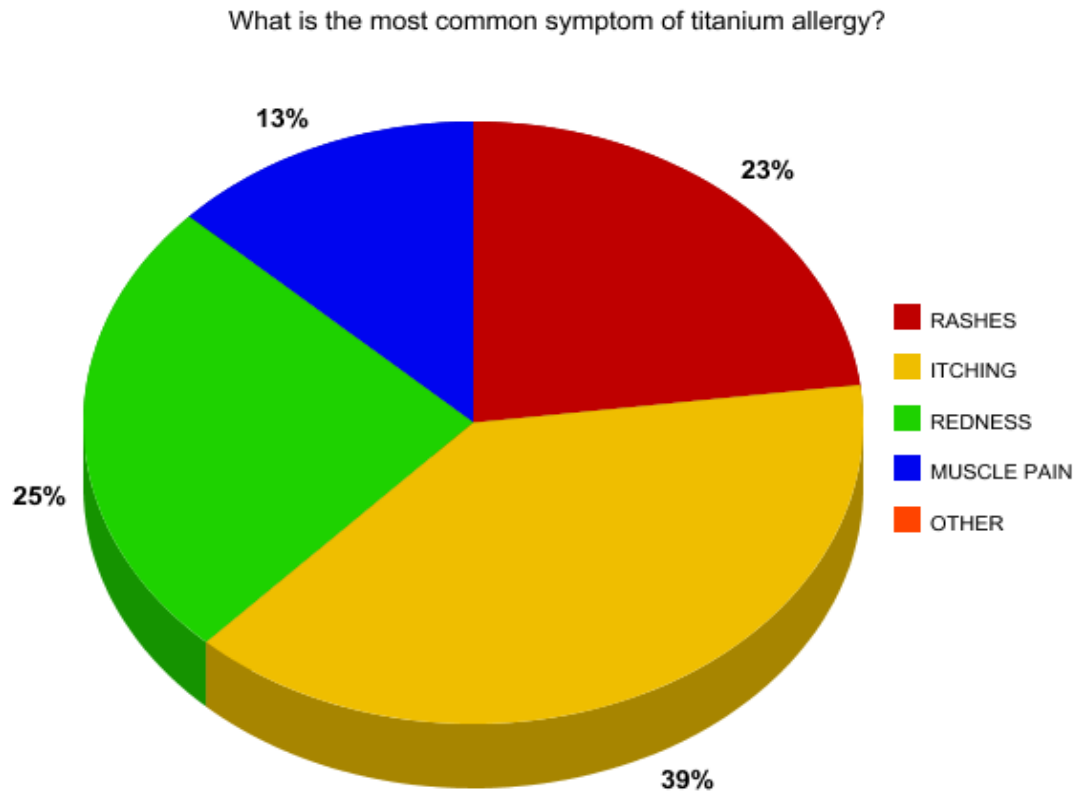


Figure 10:- “What is the most common symptom of titanium allergy?”

The result shows that 29% of the total participants in the survey have come across patients with titanium allergy while the remaining 71% have never encountered patients with titanium allergy before. 10% of the participants often have patients with titanium allergy, 35% of them have hardly seen patients with such problem and the rest 55% of the participants have never treated patients who are allergic to titanium before. It can be seen that most of the participants are aware of titanium allergy in dentistry as 90% of them have heard or seen cases of titanium allergy previously while the remaining 10% show the opposite as they have never met any patient with titanium allergy so far.

It can be seen that 79% of the participants would normally ask their patients if they are allergic to any kind of metal prior to a procedure but 21% of them give the least importance to the history of metal allergy in their patients. Since titanium allergy is rare among dental patients, 72% of the total participants have never had patients showing signs of titanium allergy after a procedure. 20% of the them have only seen it in certain cases and 8% of the participants answered “Yes” to having patients with symptoms of titanium allergy.

Based on their basic knowledge of titanium allergy, 44% of the participants would suggest prescription medicine containing anti-histamine to treat titanium allergy, which is indeed the best treatment for allergic patients compared to the other treatments. 25% of them would suggest their patients to avoid titanium dioxide-containing products and the remaining 13% had chosen natural cures such as lime juice and honey as a way to treat titanium allergy.

Although most of the participants have acquired the basic knowledge and awareness on titanium allergy, 39% of them are still unsure about the use of titanium in most dental materials, 34% of the participants believed that it is safe for titanium to be used in most dental materials and the remaining 27% disagreed with the idea of titanium being the material of choice in dentistry. In the study, 85% of the participants know about the various methods to diagnose titanium allergy while the rest 15% are not aware of the tests that can be carried out to diagnose titanium allergy.

Since most of the participants have never had patients with titanium allergy, 79% of them rate the incidence of titanium allergy as low, 11% chose moderate while the remaining 10% agreed that titanium allergy has a high rate of incidence, indicating that they have experienced numerous cases of patients being allergic to titanium. It can be seen that most of the participants do not have a clear understanding on the concept of titanium allergy as 39% of them chose "itching" as the most common symptom of titanium allergy, followed by 25% "redness", 23% "rashes", and 13% "muscle pain" respectively.

Discussion:-

This study was done as a questionnaire survey among 100 dental students in various institutions. Dental patients are constantly exposed to various potential allergens, which may be present in the dental materials and drugs. This study was conducted to assess the awareness and knowledge of titanium allergy among dental students, which is often overlooked due to its low rate of incidence and difficult diagnosis.

The result shows that 29% of the total participants in the survey have come across patients with titanium allergy while the remaining 71% have never encountered patients with titanium allergy before. A similar study by Kadambari Sriram et al done in their institutions, states that 48% of the participants in the survey became aware of titanium allergy in their practice, in which the percentage is higher compared to this study.^[33]

The best treatment for titanium allergy chosen by 44% of the participants was revealed to be prescription medicine containing anti-histamine. In a previous study, 26% of the participants had chosen anti-histamines as the best treatment for dental allergy, following 60% of them who preferred other means of treatment.

In the study, 85% of the participants are aware of the various methods to diagnose titanium allergy, which include epicutaneous test (patch test), skin test (prick test) and blood test (MELISA). The remaining 15% are not aware of the tests that can be carried out to diagnose titanium allergy.

Based on their basic knowledge and understanding of titanium allergy, 39% of them chose "itching" as the most common symptom of titanium allergy, followed by 25% "redness", 23% "rashes", and 13% "muscle pain" respectively. Only 23% of the participants have chosen "rashes" as the most common symptom of titanium allergy. A study done by Muller and Valentine-Thon (2006) involves 56 patients indicates other symptoms of titanium allergy including chronic health problems such as neurological disturbances, muscle and joint pain, severe fatigue syndrome and depression following the placement of titanium-containing dental implants.^[24]

In the study, 90% of the participants are aware of titanium allergy in dentistry, as they have encountered patients with titanium allergy before while the other 10% are unaware of it. A previous study on the awareness of allergic reactions to dental drugs and materials shows that 72% of the participants in the survey are aware of allergic reactions due to dental drugs and materials, in which the number is slightly lower than the result obtained in this study. As all the students in this study are from different institutions, they are not exposed equally to the materials and its usage.

Conclusion:-

The occurrence of an allergy to titanium could be responsible for successive unexplained cases of failure of dental implants in some patients, also known as "cluster patients". It has been reported that the risk of an allergy to titanium is increased in patients who are allergic to other metals. In these patients, an allergy evaluation is recommended, in order to exclude any problem with titanium dental implants.^[8]

Various studies on titanium allergy have shown that titanium can stimulate clinically significant hypersensitivity and other immune dysfunctions when exposed to sensitive patients.^[27] Based on numerous reports, the ability of titanium

to stimulate allergic reactions contradicts with its property of being biologically inert.

Recent reports have proven the ability of titanium to cause allergic reactions. Although titanium allergy due to dental restorations has not yet been widely recognized, many researchers believe that the rate of incidence will increase gradually in the future as titanium has been used in many dental procedures due to its stability.^[11] A recent study was done to establish a new method in identifying the stimulation of lymphocytes and the release of mediators such as cytokines by a metal using flow cytometry in order to diagnose titanium allergy.^[8]

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