

Awareness of zinc toxicity in denture adhesives among dental practitioners in Puducherry - A cross-sectional study

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Abstract

Background: Denture adhesives should never be used as a solution for ill-fitting dentures on a long-term basis owing to zinc overdose and its deleterious effects. Dentists need to be made aware of the consequences of denture adhesives overusage so that they can dissipate the same information to the patients. Early detection and patient education may help in a reversal of symptoms by withdrawing the usage of denture adhesives or treating with copper supplementation.

Aim: The aim of the study was to assess the awareness of dentist in Puducherry regarding the effects of zinc toxicity.

Materials and Methods: This cross-sectional questionnaire study was conducted on 64 dentists from Puducherry. They were requested to complete the comprehensive self-administered questionnaire regarding their awareness about denture adhesives.

Statistical Analysis used: Means and percentages were calculated using Statistical Package for the Social Sciences 13.01 program.

Results and Conclusions: It was found that dentists knowledge was limited regarding the harmful effects of denture adhesives, thereby leading to misdiagnosis of the toxic symptoms. Dentists are in a position to prevent it early by educating patients directly or using social media such as radio, television, or awareness camps on the use of denture adhesives and to detect early signs of copper deficiency in patients who may be using zinc-containing denture adhesive to excess.

Introduction

Denture adhesives are commonly used in dentistry for increasing retention of complete dentures. In the recent past, it has surfaced into controversy due to one of its component, zinc which causes serious impact on health.^[1-3] Zinc is added in the polymer salt to enhance the adhesive properties, and it also reduces inflammation, bacteria, and plaque formation in the oral cavity. The recommended allowance of zinc for adult males and females is 11 mg and 8 mg per day, respectively.^[4] According to manufacturer's instructions, a thin film or series of dots should be applied on denture surface amounting to 0.5-1.5 g of adhesive. However, owing to inadequate and unclear information among dental practitioners regarding the appropriate dosage and harmful effects of zinc, the instructions are not conveyed properly to the patients. A study done by Mutluay *et al.*^[3] revealed that the estimated daily zinc exposure from denture adhesive misuse was found to be 350-1700 mg per day.

While in mouth constantly as a component of denture adhesive, the zinc leaches out and gets absorbed through the digestive tract and into bloodstream. Therefore, more the amount of denture adhesive used, the more is the absorption. This excess of zinc (hyperzincemia) tends to reduce copper absorption and can cause hypocupremia (copper deficiency), leading to neurological problems, blood abnormalities such as anemia, pancytopenia, and irreversible myelopathy.^[4-7] The recovery from hypocupremia with copper replacement therapy or withdrawal of zinc-based denture adhesives appears to be controversial.^[8] A literature review revealed that there are very limited data regarding denture adhesives being a potential source for zinc toxicity in dental journals, whereas many case reports and cohorts^[1,2,5,9-11] on neurologic and blood abnormalities of denture adhesives were found in the field of neurology. This study was planned to assess the awareness of dentist regarding

the effects of zinc toxicity since the consequences of long-term overuse are serious. Therefore, the objective of the study was to assess the awareness of dental practitioners regarding the long-term usage of denture adhesives.

Materials and Methods

This cross-sectional study was conducted using a questionnaire involving 64 dental practitioners of Puducherry. General and specialist dental practitioners, gender (males and females), of different age groups (21-30, 31-40, 41-50, and >50 years), and varied experience (1-10, 11-20, >20 years) practising in Puducherry, and willing to be part of the study were included in the study. The sample frame is collected from local Indian Dental Association, Puducherry branch, which includes 150 practitioners. Cluster random sampling was done to select the practitioners involved in the study so that different localities are covered. They were approached by the investigators, explained about the study, and informed consent was obtained. The age of the dental practitioners ranged from 42.2% from 21 to 30 years, 53.1% from 31 to 40 years, and 4.7% from 41 to 50 years. Around 71.9% of male and 28.1% of female practitioners participated in the study. About 20.3% of them were general practitioners, and 79.7% were specialists with practice experience <10 years (84.4%), 11-20 years (6.2%), and more than 20 years (9.4%).

The participants were requested to complete the comprehensive self-administered questionnaire which comprised of 20 close-ended questions [Table 1]. The questionnaire dealt with various questions related to the ingredients of denture adhesives, role of zinc, different brands, indications and contraindications for prescription, dosage, frequency, method of application, deleterious effects, precautions, and investigations. The questionnaires were in simple English for ease of understanding. Face validity and content validity were checked by a panel of 3 subject experts. The subject experts advised that all the items are relevant to the questionnaires.

The questionnaire was pretested on 15 dental practitioners, and it was validated for the study. Minor grammatical corrections suggested were incorporated in the questionnaire. After completion of the questionnaire, the results obtained were subjected for statistical analysis, and appropriate conclusions were drawn.

Results

This study deals with the awareness of zinc toxicity in denture adhesives among dental practitioners in Puducherry. The data details are given in Table 2. It was observed that 53.1% of the dental practitioners knew the composition of denture adhesive that they prescribe. Most of them (60.9%) knew that zinc is added in denture adhesive to enhance the adhesive property, whereas many of them (75%) did not know the adverse reactions caused by zinc. Dentists felt that they advise denture adhesive because it gives confidence to the patient because of enhanced retention (51.6%), compensates ridge resorption (35.9%), and hides flaws (7.8%) and since they are

Table 1: Questionnaire (awareness about toxicity of denture adhesives among dental practitioners in Puducherry - a cross-sectional study)

Name:	Optional
Age (in years):	21-30/31-40/41-50/>50
Sex:	Male/female
Qualification:	General practitioner/specialist
Years of experience:	1-10/11-20/>20
DCI register number and year:	Optional
1. What are the ingredients present in the denture adhesive you prescribe	<ul style="list-style-type: none"> Ca and Zn salt copolymer, carboxymethyl cellulose, methyl-maleic acid copolymer Sodium phosphate, calcium sulfate, zinc oxide Zinc oxide, lanolin, polymerized rosin Don't know
2. What is the role of zinc in denture adhesive?	<ul style="list-style-type: none"> Enhances the adhesive properties Enhances the taste Enhances the smell Don't know
3. The adverse reaction of zinc in denture includes	<ul style="list-style-type: none"> Displaces copper and causes copper deficiency Displaces vitamin D and causes calcium deficiency Causes protein deficiency Don't know
4. What are the indications for prescribing denture adhesives in your practice?	<ul style="list-style-type: none"> It gives confidence to the patient because of enhanced retention It compensates for the space that develops over time between denture bases and the underlying mucosa due to ridge resorption It hides flaws in the denture what I make I am not very confident with complete denture making
5. What are the contraindications for prescribing denture adhesives in your practice?	<ul style="list-style-type: none"> They increase the vertical dimension They give false sense of reassurance to the patient They increase opportunistic infections All the above
6. How much dose you prescribe for one application of denture adhesive for the patient?	<ul style="list-style-type: none"> 5-10 mg 10-15 mg 15-20 mg Never mentioned the dose

(Contd...)

Table 1: (Continued)

7. What deleterious effects of over usage of denture adhesive did you notice in your patient?

- Numbness, tingling, weakness of extremities
- Numbness, tingling of oral cavity
- Never noticed
- I am not aware about the symptoms

8. If your patients ask for denture adhesives do you find out from where they have known about adhesives

- Peer group usage
- Dentist prescription
- Over the counter prescription in pharmacy
- information on internet

9. How frequently do you advise the patient to use denture adhesive

- All the time
- Occasionally when going out
- During eating
- Never advised

10. What instruction do you give to the patient already using denture adhesive

- Avoid using it unless prescribed by the dentist
- Explain the cause and convince for remake of a new denture
- Advise to gradually taper the use and dependence on adhesives
- To clean the denture adhesive daily after use

11. In which all clinical situations do you advise for denture adhesives

- Xerostomia (due to medications, irradiation, systemic diseases, salivary gland dysfunction or disease)
- First-time denture wearers
- Ill-fitting dentures
- Resorbed ridges

12. Which form of denture adhesive you prescribe?

- Powder
- Cream
- Liquid
- Not specific

13. What advice will you give for usage of paste adhesives to your patients?

- 3 or 4 pea-sized increments on the tissue surface of denture
- Coat the paste adhesive all over the tissue surface of the denture
- Apply directly on the tissue
- Apply as per the convenience of the patient

14. What advice will you give for usage of powder adhesives to your patients?

- Wet the base of denture and then sprinkle the powder sparingly

(Contd...)

Table 1: (Continued)

- Wet the base of denture and then sprinkle the powder liberally
- Without wetting, sprinkle the powder sparingly all over the base of denture
- Without wetting, sprinkle the powder liberally all over the base of denture

15. Ingestion of excess zinc can cause

- Copper deficiency
- Vitamin D deficiency
- Protein deficiency
- Salivary amylase deficiency

16. Long-term overdose of denture adhesives can cause

- Polyneuropathy
- Myelopolyneuropathy
- Pancytopenia
- All of the above

17. Which of the denture adhesive brands available in market is free of zinc?

- Super poligrip original (GSK)
- Fixodent original (P and G)
- Fittydent super adhesive cream (fittydentint)
- Don't know

18. What safety precautions to watch out for while you advise your patients before using adhesive

- Hypersensitivity
- Contact allergy
- Numbness, tingling, weakness of extremities
- Don't know

19. The recommended daily allowance of zinc is

- 8 mg in females and 11 mg in males
- 18 mg in females and 21mg in males
- 28 mg in females and 31 mg in males
- I don't know

20. If you are suspecting zinc toxicity what investigation will you advise for the patient?

- Serum copper
- Serum zinc concentration
- a and b

21. How to avoid usage of zinc adhesives available in market?

- Use of zinc-free alternative denture adhesives
- Encourage the patient to opt for a new denture
- Give option of rebasing or relining of denture
- Educate the patient about the harmful effects of zinc-based denture adhesives

Table 2: Demographic details

Variables	Frequency (%)	Valid percent	Cumulative percent
Age (in years)			
21-30	27 (42.2)	42.2	42.2
31-40	34 (53.1)	53.1	95.3
41-50	3 (4.7)	4.7	100.0
Total	64 (100.0)	100.0	
Gender			
Male	46 (71.9)	71.9	71.9
Female	18 (28.1)	28.1	100.0
Total	64 (100.0)	100.0	
Qualification			
GP	13 (20.3)	20.3	20.3
Specialist	51 (79.7)	79.7	100.0
Total	64 (100.0)	100.0	
Experience in years			
<10	54 (84.4)	84.4	84.4
11-20	4 (6.2)	6.2	90.6
>20	6 (9.4)	9.4	100.0
Total	64 (100.0)	100.0	

not very confident with complete denture making (4.7%). Dentists felt that denture adhesive should not be used since it increases opportunistic infections (48.4%), it gives a false sense of reassurance to the patient (10.9%), and it increases vertical dimension (3.1%), whereas 37.5% felt that it causes all the above. Most of them (73.4%) had never mentioned the recommended usage dose to the patient although some of them (26.6%) knew the correct dose. Most of them (54.7%) had never noticed or were not aware about symptoms caused by denture adhesives; however, only some of them (25%) knew that it causes numbness, tingling, and weakness of extremities. Dentists found that patients had got to know about denture adhesives from peers (39%) as well as dentist prescriptions (39.1%), internet (20.3%), or over the contour prescription (1.6%). Most of the practitioners had never advised denture adhesives (37.5%), whereas others had advised it during eating (17.2%) and while going out (28.1%), and a few of them had even advised to be used all the time. The main reason for advising the use was for first-time denture wearers (37.5%) and ill-fitting dentures (34.3). In patients already using denture adhesives, dentists have suggested to the patients to clean the denture adhesive daily after use (35.9%), to avoid the usage unless prescribed by the dentist (25%), to not get dependent (23.4%), or to remake the denture (15.6%). Only 42.2% of dentists knew the correct method of usage of paste adhesive, whereas 56.2% knew the correct method of the usage of powder adhesive. Very few of them (15.6%) were aware of the fact that excess of zinc causes copper deficiency, whereas surprisingly 70.3% knew that it causes neurological problems, but around 81.2% of them did not know the safety precautions to watch out for in the patients before advising

denture adhesive. Most of them (75%) did not know any brand of zinc-free denture adhesive available in the market. Dentists were also not aware of the recommended daily allowance of zinc in females and males. About 92.2% of the dentist were not aware of the investigation to be advised in case if zinc toxicity is expected. However, most of them (51.6%) felt that zinc-based adhesives usage can be avoided by educating the patients about the harmful effects of zinc in that.

Discussion

The first patent related to denture adhesive was issued in the United States in 1913. In 1935, denture adhesives were first reported by the American Dental Association. Initially, the composition of denture adhesive was a mixture of vegetable gums. The composition of denture adhesives continues to change since then, as the manufacturers try to improve the effectiveness of their products. Calcium salts were added in the 1970s, zinc was added in the 1980s, and in current formulations, combined polymethyl vinyl ether-maleic anhydride zinc are added.^[12] Due to the increase in reported cases of hyperzincemia and hypocupremia associated with these adhesives around 2010, several manufacturers issued warnings and stopped or modified the product. However, despite these events, zinc-containing denture adhesive products continued to be marketed and commonly used by denture users.

The manufacturer of these zinc-containing denture creams claims that their products have low amounts of zinc and average users would absorb only about 2 mg of zinc per day, which is well below the recommended daily allowance of 8-11 mg. Denture adhesives, as a possible source of hyperzincemia, was first reported by Spinazzi *et al.*^[13] and Nations *et al.*^[1] Later, Hedera *et al.*^[2] published a cohort of 11 patients with the syndrome and identified denture adhesive as a source of excessive zinc in 100% of their patients. The fact that cases of hyperzincemia and hypocupremia associated with these products continue to be discovered, despite product warnings and changes in manufacturer guidelines, is likely related to the excessive use of these products due to ill-fitting dentures. The presentation in powder form could be more dangerous to patients since it would be more easily aspirated and could jeopardize the denture wearer's health.^[14]

Our study showed that the knowledge of denture adhesives is limited in dental practitioners and they should be made aware about the toxic effects of usage of zinc. Probable reasons found behind this were lack of awareness among prescribing dentists, lack of information, and counseling to patients regarding usage of dentures by dentists, ill-fitting dentures, and costs associated with getting dental hardware fixed or changed which is corresponding to the study done by Khimani *et al.*^[4] Dentists should advise their denture patients that their prostheses will require periodic relining or remake as residual ridge resorption occurs over time, and in cases of ill-fitting dentures, they might not be the solution major reason that holds back professionals from using these is that they feel adhesive usage as a poor reflection of their clinical skills and prosthetic expertise^[15,16]

which was found in our study also. In Indian population, most of the patients opting for complete dentures belonging to low socioeconomic strata may not be exposed to the social media, so it becomes the responsibility of the treating dentist to warn them about the consequences of long-term usage of denture adhesives and encourage them to use zinc-free adhesives if need be. Furthermore, patients who use denture adhesives from over the counter prescriptions should be educated regarding the harmful effects. Technology and social media should be utilized aggressively to spread the awareness regarding the harmful effects of denture adhesives. Many companies are currently making denture adhesives that no longer contain zinc and are labeled as “zinc-free adhesives” (the zinc has been replaced with salts based on calcium, sodium, and cellulose gum).

The limitations of the study are that it has been done in a small population of dentists in Puducherry. The same study can be done on dentists from various parts of India to reveal the lack of awareness regarding this topic. With a trending era of patient-centered outcome, it becomes mandatory that patient’s opinions and perspectives are valued by the doctors and they are informed and educated about the pros and cons of the usage of denture adhesives. Therefore, patient’s perspective or awareness regarding the use of denture adhesive could be a future implication of the study.

Conclusion

Often patients with complaints of complications due to long-term use of denture adhesives are misdiagnosed or unrecognized. From the above research, the awareness of practitioners regarding zinc toxicity due to long-term overusage of denture adhesives was assessed, and they were enlightened about the signs and symptoms, investigations, and complications due to long-term zinc toxicity. Dentists are in a position to prevent it early by educating patients directly or using social media such as radio, television, or awareness camps on the use of denture adhesives and to detect early signs of copper deficiency in patients who may be using zinc-containing denture adhesive to excess. Still, there is a long way to go for dentists to precipitate their knowledge on the harmful effects of zinc overdoses and spread awareness on risks from denture adhesives.

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