

MERCURY HIGIENE PRACTICE AMONG PRACTICING DENTISTS AND UNDERGRADUATE DENTAL STUDENTS OF INDIA

As rotinas com relação à higiene do mercúrio entre cirurgiões-dentistas e acadêmicos de Odontologia na Índia

**Suhas Kulkarni¹, Santhosh Kumar Tadakamadla², Keerti Jain³, Disha Goyal⁴,
Goutham Balasubramanyam⁵, Prabu Duraiswamy⁶**

¹ MDS. Professor and Head. Department of Preventive and Community Dentistry Darshan Dental College and Hospital Udaipur, Rajasthan, India.

² MDS. Pos graduate student. Department of Preventive and Community Dentistry Darshan Dental College and Hospital Udaipur, Rajasthan, India. e-mail: santosh_dentist@yahoo.com

³ BDS. Department of Preventive and Community Dentistry Darshan Dental College and Hospital Udaipur, Rajasthan, India.

⁴ BDS. Department of Preventive and Community Dentistry Darshan Dental College and Hospital Udaipur, Rajasthan, India.

⁵ MDS, Senior lecturer, Department of Preventive and Community Dentistry Darshan Dental College and Hospital Udaipur, Rajasthan, India.

⁶ MDS. Reader. Department of Preventive and Community Dentistry Darshan Dental College and Hospital Udaipur, Rajasthan, India.

Abstract

OBJECTIVES: To assess mercury hygiene practices among dental undergraduate students and practicing dentists. **MATERIAL AND METHOD:** A questionnaire was designed to assess the dental students and practicing dentist's perception for mercury hygiene practices as recommend by ADA. Final sample size accounted to 350 dentists and dental undergraduate students in their clinical years. **RESULTS:** Results revealed that neither of the dentists nor the dental students was following the recommended guidelines while working with amalgam. It was assessed that more than 80% of the sample believed mercury is hazardous to dentist, and more than half of the subjects was in favor that mercury is toxic to patients. **CONCLUSIONS:** Dentists and dental personnel are at risk of mercury exposure and this should be taken as a serious matter of concern. In spite of the results of this research, reasonable precautionary measures should be implemented by the dental personnel to assure safety of the patients, dentist and dental team members.

Keywords: Mercury hygiene; Dentistry; Dental practice in India; Amalgam.

Resumo

OBJETIVOS: Avaliar as práticas de higiene em relação ao mercúrio entre cirurgiões-dentistas e acadêmicos de Odontologia indianos. **MATERIAL E MÉTODO:** Utilizou-se um questionário para avaliar as práticas de higiene do mercúrio entre profissionais e acadêmicos de Odontologia indianos, conforme preconiza a ADA. A amostra constituiu-se de 350 dentistas e estudantes de Odontologia indianos, durante sua prática clínica acadêmica. **RESULTADOS:** Os resultados indicaram que nem os dentistas nem os estudantes seguem as recomendações de higiene quando trabalham com amálgama. Porém, observou-se que mais de 80% dos entrevistados acreditam que o mercúrio é nocivo ao dentista e mais da metade deles acreditam que o mercúrio é tóxico para os pacientes. **CONCLUSÕES:** Dentistas e pessoal auxiliar ligado à Odontologia correm risco de exposição ao mercúrio. Este assunto deveria ser encarado com a máxima seriedade e motivo de preocupação. Ao contrário do que foi verificado nesta pesquisa, medidas de precaução deveriam ser implementadas pelo pessoal ligado à Odontologia para assegurar segurança aos pacientes, dentistas e equipes odontológicas.

Palavras-chave: Higiene do mercúrio; Odontologia; Amálgama; Prática odontológica na Índia.

INTRODUCTION

Dental amalgam is a widely used restorative material. Element mercury is an important component of the dental amalgam. It also contains silver, tin, copper, palladium and zinc so as to improve handling characteristics and clinical performances (1). Due to certain controversy and toxicity there is an evidence of decrease of its use in the U.S. But its cost, durability, long term performance and ease of manipulation still makes amalgam the first choice material of many dentists for restoring posterior teeth (2).

The concern centers around the long-term health effects of constant mercury exposure, especially in causing chronic illnesses, autoimmune disorders, neurodegenerative diseases, birth defects, and mental disorders. Controversy over the health from the use of silver amalgam began shortly after its introduction into the western world Nearly 200 years ago.

A comprehensive review of evidence published in 1999 by Burt and Eklund (3) concluded that there was no sufficient evidence to support a casual relationship between dental amalgam restoration and human health problems. Kingman A et al. (4) have not found significant association between neuropsychological function and various amalgam exposure indices, including urine mercury level, number of amalgam restorations, total number of amalgam surfaces and number of occlusal amalgam surfaces.

There is evidence that handling mercury causes the least threat to the patient, but could be a threat to the dentist if not practiced properly. Despite of the long history and popularity, there had been periodic concern about adverse health effects arising from the exposure of minute level of mercury released from amalgam.

It is a known fact that amalgam restoration on typhodonts and extracted tooth is an important activity for the pre clinical students. Improper mercury handling contributes to the mercury vapors in the environment, which on inhalation is rapidly absorbed in to the blood stream from the lungs causing an array of hazards. Osborne (5) reported that mercury vapors were detected in the breath of patients who had amalgam in their mouths.

Dentists are exposed to mercury vapors through direct skin contact with mercury (or freshly mixed dental amalgam) or through exposure from potential sources of mercury vapors that are accidental: mercury spill, malfunctioning amalgamators, leaky amalgam capsule, malfunctioning bulk mercury dispensers (although ADA recommends against the use of bulk elemental mercury), trituration placement and condensation of amalgam, polishing and removal of amalgam, vaporization of mercury from contaminated instruments and often storage of amalgam scrap or used capsule (6).

A calculation shows that it would take over 10,000 years for 12 average-sized amalgams to release all their mercury at the rate of 1.7pg per

day. Actual tracheal measurements of mercury concentrates have been made by Longworth et al. (7), and have been found it to be in the range of 1-6 ug/m³ during inhalation and less than 1 pg/m³ when subjects breathed through their nose.

Dental amalgam fillings interact in a complex way with the oral environment as they are subjected to chemical, biological, mechanical, and thermal forces (2). Since dentists work continually with amalgam they usually have higher risk and level of mercury than the general population. The level of mercury in urine and blood arises from the time when dental students first work with amalgam and lasts throughout their experience.

A study was done to examine the health effects of mercury in the UK which compared the urinary mercury excretion level in dentists and in a controlled group which showed that dentists were more likely to have disorder of the kidney and memory disturbances than the general population (8).

Whereas some of the studies have revealed that mercury exposures among dental professionals have been decreasing, this result may be due to improved mercury hygiene techniques. Average mercury urine level among dentists were 19.5 mg/l in 1980 and 6.7 mg/l in 1986 and in 1991 it was 4.9 mg/l. Mainly exposure to mercury vapors is during amalgam filling which is reduced due to the appropriate hygiene procedures (9, 10) and the concentration of mercury may be generated during restorative procedures, are eliminated by 90% because of the use of high suction (11).

The ADA established the recommendations for appropriate mercury hygiene within the dental offices, but they are not practiced properly. Moreover there is no regulatory authority especially in developing countries like India to keep a check on mercury hygiene practices.

The aim of the study is to assess mercury hygiene practices among dental undergraduate students and practicing dentists and to determine if any difference exists in the hygiene practices between the students and practicing dentists of Udaipur City, India.

MATERIAL AND METHOD

A questionnaire of 19 items was written in English which was designed to assess the dental students and practicing dentist's perception for mercury hygiene practices as recommend by ADA. The target sample comprised of all the students of

clinical years pursuing their career in dental colleges and practicing dentist's of Udaipur city who were using amalgam as a restorative material. Subsequently, 378 questionnaires were distributed to the students and dental professionals in private clinics. The questionnaires where some of the questions were left unanswered were rendered incomplete and were excluded from the study. Thus the final sample as size accounted to 350 subjects (292 students and 58 practicing dentists).

The questionnaire consisted of two parts, first part intended to assess measures taken in the clinical setup to control and prevent mercury contamination. Second part includes measures taken by the care giver himself while working with the amalgam. Both the questionnaire parts were preceded by demographic information about age and sex. The first part of the questionnaire was not filled by the student category as they don't have private clinic set up. In clinical setup we included the questions regarding the number of restorations done, flooring, filtration, sterilization, technique, and periodic monitoring of mercury. Second part of the questionnaire included universal precautions like use of face masks, gloves, eye gear, changing clothes after each patient, their attitude towards using rubber dam and high volume suction. It also included the questions regarding the mercury spills.

Pre testing of questionnaire was done among 50 students and 25 dentists to assess the validity of the questionnaire and it was found that it took about 20 minutes to complete the questionnaire. For checking the reliability, the questionnaires were redistributed after 15 days among 70 students and 30 professionals. Reliability for various questions in the questionnaire ranged from 84.6% to 92% with 84.6% and 92% being for questions.

Regarding mercury spill and regarding universal precautions like wearing gloves respectively. Statistical analysis was done using statistical package for social sciences (version 11.0). Chi-square analysis was used to analyze the discrete data.

RESULTS

Results revealed that neither the dentists nor the dental students were following the recommended guidelines while working with amalgam. As illustrated in Table 1, especially when the placement of the rubber dam was concerned, only 1.8% of students and 6.9% of dentists always used rubber dam whereas 76.5% of students and 69% of

dentists have never used. Regarding the use of high volume suction, 11.7% of students and 12.1% of dentists always used high volume suction. More than 90% of the study individuals followed the universal recommendations of wearing gloves and face masks but only half of the total respondents used eye

protection while working with amalgam, it was also found that major percentage of total population did not prefer having drinks and snacks at their working areas. 90.4% of the students and 98.3% of the dentists always asked the patient not to swallow the spilled mercury while maxillary cavity preparation.

TABLE 1 - Preventive measures undertaken while working with amalgam by dentists and dental undergraduate students

Barriertechnique and precautionary measures	Students (in %)				Dentist (in %)			
	Always	Sometimes	Rarely	Never	Always	Sometimes	Rarely	Never
Wearing gloves	97.5	0.7	1.1	0.7	96.6	1.7	1.7	-
Wearing face masks*	97.2	1.4	0.7	0.7	86.6	12.1	-	1.7
Eye protection*	53.0	13.5	5.3	28.1	53.4	31.0	5.2	10.3
Change of clothing*	10.3	11.0	7.8	70.8	25.9	19.0	-	65.2
Drinking and eating in clinics	4.3	5.3	12.1	78.3	12.1	6.9	6.9	74.1
Rubber dam placement	1.8	10.3	11.7	76.5	6.9	19.0	5.2	69.0
High volume suction	11.7	23.8	9.3	55.2	12.1	34.5	3.4	50.0
Preamalgamated capsuled alloys*	7.1	10.3	10.0	72.6	6.9	31.0	15.5	46.6
Asking not to swallow spilled mercury in maxillary cavity	90.4	5.3	-	4.3	98.3	1.7	-	-

* P < 0.05 (chi square analysis)

Only 10% of students and a quarter of dentists preferred changing clothes after each patient and chi square analyses revealed significant differences (P=0.001) between the two categories. 7% of students and dentists were using pre-amalgamated capsule alloys. Whereas nearly three quarters (72.6%) of the students and half (46.6%) of the dentists never used pre-amalgamated capsules.

Majority of the dentists and students preferred steam sterilizer over dry heat sterilizer in addition to closing amalgam cap after use.

As presented in Table 2, it was assessed that nearly 80% of the dentists (83% males and 75.5% females) believed mercury is hazardous to dentist, and more than half the subjects were in favor of the statement "mercury is toxic to patients."

TABLE 2 - Measures taken by dentists in the clinical up set to control mercury contamination according to gender

Clinical set up	Males (in %)		Females (in %)	
	Yes	No	Yes	No
Mercury hazardous to dentists	83	17	75.5	24.5
Mercury toxicity to patients	60.5	39.5	62	38
Change of AC filter	88.5	11.5	66.7	33.3
Closing amalgam cap after use	93.0	7.0	94.1	5.9
Protective lid in amalgamator	61.5	38.5	66.7	33.3
Periodic mercury vapor monitoring	30.8	69.2	-	100
Use of radiographic fixer solution while discarding amalgam	-	100.0	-	100.0
Sleek flooring	97.5	4.3	96.1	3.9
Coarse flooring	4.3	97.5	3.9	96.1
Steam sterilizer	80.8	19.2	100.0	-
Dry heat sterilizer	19.2	80.8	-	100.0
Efficient ventilation	96.2	3.8	100.0	-

The results showed that most of the dentists were especially deficient in monitoring periodic mercury vapors where 30% of males and none of the females gave a positive response. 96% of males and 100% of female dentists preferred efficient ventilation and sleek flooring at their clinics. 88.5% of males and 66.7% of females were concerned regarding the changing of AC filters at their clinics. It was clear from the study that none of the practicing dentists knew how to dispose the waste mercury.

Regarding the methods opted for cleaning accidental mercury spill approximately one third of the dentists (30% males and 36% females) preferred paint brush while only 20% of them used vacuum cleaners. Majority of the dentists did not prefer pouring mercury and allowed it to drain and even avoided walking around with mercury contaminated shoes, as mentioned in Table 3.

TABLE 3 - Measures undertaken in management of mercury spill by dentists according to gender

Mercury spill	Males (in %)		Females (in %)	
	Yes	No	Yes	No
Use of vacuum cleaner	19.9	80.1	18.3	81.7
Use of household product containing ammonia and chlorine	20.2	79.8	23.5	76.5
Pour mercury or allow it to drain	18.8	81.2	23.5	76.5
Use of paint brush	30.1	69.9	36.6	63.4
Walk around with contaminated shoes	21.5	78.5	20.9	79.0

DISCUSSION

Though there is extensive literature available regarding the toxic effects of mercury it is still practiced in Indian subcontinent due to insufficient knowledge and due to various socio-cultural preferences of patients. Furthermore, the reason for use of amalgam among dental students is attributed to the undergraduate curriculum set by the Dental Council of India.

The results of the study are limited by the fact that the sample procured does not represent the whole dental community of the country. It has been estimated that approximately one half of the 200 million restorative procedures performed in 1990 utilized amalgam as the material of choice, whereas it was observed from the present study that the number has declined to 20% of the total restorations done. The rational explanation for this observation is due to shift in cultural preferences for composite amalgam restorations.

The recent debate on amalgam toxicity has affected the opinion of dentists regarding the issue of amalgam safety, 7% believed that amalgam causes harm to the patient according to a survey by Sadig (1) whereas Khairuldean (12) reported 37.2% a decade ago.

Moreover, according to Schuman and Presser (13) minority opinions can have a great impact on the practice of dentistry. The magnitude of the direct human health impacts on dental workers and patients from dental mercury is currently a debated topic. A study from Saudi Arabia (1) reported that 57.4% dentists believed that amalgam might constitute health hazards to dentists and dental personnel in contrary to a study that reported 88% (13). In accordance to the previous study, our survey revealed that more than 80% of dentists believed that mercury is hazardous to both dentist and patients. Teisinger et al. (14) recommended that prophylactic measures should be taken by the dental personnel to lower the risk.

The recent concern is over the release of mercury from dental amalgam fillings. However, studies have intensified with the discovery that small amount of mercury vapors will be released from the amalgam restoration and thus eventually absorbed from the body tissues. An estimation of 75-80% of the inhaled mercury level which reaches pulmonary alveoli will be absorbed into the blood. World Health Organization notes that exposure can be greatly increased in patients by personal habits such as bruxism or gum chewing. World Health Organization in its review in 2003 estimated world mercury exposure to range from 3Ng – 9Ng / day (15).

A study measured the intra oral vapor level over 24 hours period in patients with at least nine amalgam restorations which was estimated to be 1.7 Ng (ranged from 0.4-4Ng) which is approximately 1% of threshold level value of 300-500 Ng / day established by WHO based on a maximum allowable environmental level of 50 Ng/day in the work places (16).

Furthermore, we have observed that both the dentists and students followed universal precautions for infection control like wearing of gloves, face masks whereas use of eye gear was comparatively less adopted. It is seen that use of rubber dam is seen deficient among both the groups. Only 1.8% of students and 6.9% of dentists always used rubber dam during restorative procedures.

When the cause was analyzed, it gave varying responses. About more than 50% of the dentists believed that it was a time consuming procedure. According to some of the respondents it was not an important procedure, while others lacked the experience in applying rubber dam and most of the students did not know how to use rubber dam. It is evident that amalgam contaminates instruments when not properly cleaned and then sterilized, furthermore, scrap amalgam frequently clings to the lumen of amalgam carrier and sticks to the condenser, carving and the finishing instruments. This residual waste amalgam when autoclaved will generate high level of mercury vapors (17). We have observed that 80% of the respondents preferred using steam sterilizers at their clinics. World health Organization has cautioned against heating dental amalgam and stated that open heating of amalgam should never be carried out (18). It is thus recommended the use of coolants when polishing or removing amalgam as friction generates heat and releases mercury vapor.

Unfortunately nearly about half of the respondents did not know where the amalgam waste and used capsules should be disposed off in their offices. They said that the assistant took care of it and it was found that none of the dentists discarded their wastes properly in a closed container with radiographic fixer solution.

Training of all the personnel concerning the need for appropriate hygiene practices when working with amalgam and amalgam contaminated instruments should be given. Training should also include the presentation of relevant environmental and waste management regulations.

Most of the signs and symptoms of mercury toxicity have been associated with long term occupational exposure to air concentration of mercury more than 50 fg/m³ which is reflected by urinary mercury concentration more than 100ngm / ml while clinical significance have not been reported below the air concentration of 100 fg / m³. One large study of Swedish women was reported in which none of the correlation between number of amalgam fillings and clinical symptoms or complaints were found to be positive (19).

The toxicity of elemental mercury and its compounds are widely recognized. Experimental studies on animals and biopsy observations in humans based on occupational exposure to organic mercury can affect the immune system to produce a nephrotic syndrome. Research indicates large strain differences in susceptibility to auto immune response to mercury (18). Acute inhalation of mercury vapor may result in toxicity which leads to fever including chills, nausea, general malaise, and tightness in the chest, dyspnea, cough, stomatitis, gingivitis, salivation, and diarrhea (20).

Chronic exposure to mercury may result in weakness, fatigue, anorexia and weight loss. A tremor may develop beginning with the fingers, eyelids, and lips which may progress to generalize trembling of the entire body and violent chronic spasms of the extremities.

Behavioral and personality changes may develop including increased excitability, memory loss and insomnia. The skin may exhibit abnormal blushing, dermatographia, excessive sweating and irregular macular rashes. Severe salivation and gingivitis are also characteristic features of chronic toxicity (21, 22).

Another manifestation of chronic mercury exposure is characterized by apathy, anorexia, flush, fever, a nephrotic syndrome with albuminuria and generalized edema, diaphoresis, photophobia and a pruritic and sometimes painful scaling or peeling of the skin of the hands and feet with bullous lesions (22).

Results revealed that the 96.4% of the dentists take care of proper ventilation and fresh air exchange at their clinics, but it is reported that air conditioning filters were not replaced periodically. Such conditions lead to increased possibility of indirect mercury exposure. In Sweden the threshold limit for the breathing zone of dental personnel has been established at 30mg Hg/m³ of air (23).

It was recorded that only handful of dentists were periodically monitoring the mercury vapors. Hence, practitioners are recommended for routine monitoring of air mercury levels. 66.6% of the dentists were using protective lid amalgamator. Mercury contaminated lid may include scrap amalgam. A defective gap in the lid may allow the mercury vapors to escape in the air again increasing threat for mercury exposure.

Furthermore it was found that only a few dentists were using proper work area designed to facilitate spill contamination and clean up. Flooring should be nonabsorbent, seamless and easy to decontaminate. Slick flooring should be preferred in the clinics. Use of carpet is strictly prohibited. Even chemical decontamination of carpeting may not be effected, as mercury droplets can seep through the carpet and remain inaccessible to the decontaminant. According to ADA classification a spill is considered small if less than 10gm of mercury is present whereas a large mercury spill has more than 10gm of mercury. Mercury should not be vacuumed with the high-volume evacuation system, as this will release mercury to the wastewater stream. Use of household vacuum cleaners should be prohibited to clean up mercury spills as this can volatilize mercury that will contaminate the vacuum.

Management of small mercury spill can be done by using mercury cleanup kits, while a large spill requires an experienced environmental contractor.

CONCLUSION

Dentists and dental personnel are at risk of mercury exposure and this should be taken as a serious matter of concern. More than 60% of the respondents asserted amalgam risk towards the patient's health. However, reasonable precautionary measures should be implemented by the dental personnel to assure safety of the patients, dentist and dental team members. Furthermore some of the standard mercury hygiene practices those were recommended by ADA were markedly deficient among the study population. Recommendations may be superseded by new developments in these fields and compliance of dentists to recommended amalgam hygiene practices must be periodically checked by the authorities concerned.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Dr HR Dayakara, Principal and Dr. K.T. Chandrashekar, Vice Principal of Darshan Dental College and Hospital, for their kind support in conducting the study.

REFERENCES

1. Sadig W. Preliminary study on dentists' perception and safety measures towards the use of dental amalgam in Riyadh private clinics. *Saudi Dent J.* 2007;19(3):164-170.
2. Roberts HW, Marek M, Kuehne JC, Ragain JC. Disinfectants' effect on mercury release from amalgam. *J Am Dent Assoc.* 2005 Jul;136(7):915-9.
3. Burt BA, Eklund SA. (Ed.). *Dentistry, dental practice and the community.* 5th ed. Philadelphia: W.B.Saunders; 1999.
4. Kingman A, Albers JW, Arezzo JC, Garabrant DH, Michalek JE. Amalgam exposure and neurological function. *Neurotoxicology.* 2005 Mar;26(2):241-55.
5. Osborne JW. Dental amalgam and mercury vapor release. *Adv Dent Res.* 1992 Sep;6:135-8.
6. Davis MW. A review of the ADA mercury hygiene recommendations. *Dent Today.* 2003 Jan;22(1):86-91.
7. Longworths, Kolbeck K-G, Akesson A. Mercury exposure from dental fillings II. Release and absorption. *Swed Dent J.* 1988;12(1-2):71-2.
8. Ngim CH, Foo SC, Boey KW, Jeyaratnam J. Chronic neurobehavioral effects of elemental mercury in dentists. *Br J Ind Med.* 1992 Nov;49(11):782-90
9. Hongo T, Abe T, Ohtsuka R, Komai M, Okiyama T, Amano K, et al. Urinary mercury monitoring of university staff and students occasionally exposed to mercury vapor. *Ind Health.* 1994;32(1):17-27.

10. Pohl L, Bergman M. The dentist's exposure to elemental mercury vapor during clinical work with amalgam. *Acta Odontol Scand*. 1995 Feb;53(1):44-8.
11. Engle JH, Ferracane JL, Wichmann J, Okabe T. Quantitation of total mercury vapor released during dental procedures. *Dent Mater*. 1992 May;8(3):176-80.
12. Sadig W, Khairuldean N. Amalgam safety and alternative restorative material: a cross sectional survey among dentists. *Saudi Dent J*. 1996;8(1):27-30.
13. Schuman H, Scott J. Problems in the use of survey questions to measure public opinion. *Science*. 1987;236(4804):957-959.
14. Teisinger J, Fiserova-Bergerova V. Pulmonary relation and excretion of mercury vapors in man. *Ind Med Surg*. 1965 Jul;34:580-4.
15. World Health Organisation. Elemental Mercury and Inorganic Mercury. *Compounds: Human Health Aspects*; 2003. p. 11.
16. Berglund A. Estimation of a 24-hour study of the daily dose of intra-oral mercury vapor inhaled after release from dental amalgam. *J Dent Res*. 1990 Oct;69(10):1646-51.
17. American Dental Association. Association statement of dental amalgam. Preliminary Study on the Use of Dental Amalgam. *ADA News*. 2003;32(1):12.
18. World Dental Federation & World Health Organization. Consensus statement on dental amalgam. *FDI World*. 1995;4(4):9-10.
19. National Institute of Dental Research. Health effects of dental amalgams in children. *Nih Juide*. 1995;24(11).
20. The American Conference of Governmental Industrial Hygienists ACGIH. Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati OH: American Conference of Governmental Industrial Hygienists; 1991.
21. Hathaway GJ, Proctor NH, Hughes JP, Fischman ML. Proctor and Hughes' chemical hazards of the workplace. 3rd ed. New York: Van Nostrand Reinhold; 1991.
22. Gosselin RE, Smith RP, and Hodge HC. Clinical toxicology of commercial products. 5th ed. Baltimore: Williams & Wilkins; 1984.
23. Arenholt-Bindslev D. Dental amalgam-Environmental aspects. *Adv Dent Res*. 1992 Sep;6:125-30.

Received: 09/14/2007

Recebido: 14/09/2007

Accepted: 09/20/2007

Aceito: 20/09/2007