

## Personal Protective Equipment for Acrylic Workers at Dental Laboratories in Surabaya, Indonesia

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### Abstract

Acrylic is still widely used in dental laboratory for producing dentures or removable orthodontic appliances. This substance may cause irritation to the eyes, skin, throat and respiratory system. The aim of this study was to observe the availability and use of personal protection equipment (PPE) for acrylic workers at dental laboratories in Surabaya, Indonesia. This descriptive observational study was conducted at dental laboratories in Surabaya. Questionnaires were used as the means of data collection.

Result showed that 100% of dental laboratories in Surabaya were shown to provide disposable paper masks and goggles. 70.49% of acrylic workers always wear respiratory masks, 49.18% invariably don eye protection. 84.61% of dental laboratories provide lab coats and gloves, but only 57.37% of workers wear lab coats, while 27.86% always wear gloves. 30.76% of Surabaya-based dental laboratories supplied ear plugs and 15.38% provided ear muffs to employees. Nevertheless, only 1.63% of workers always wear ear protection. It is concluded that not all laboratories provide PPE, while not all acrylic workers wear the PPE supplied by dental laboratories in Surabaya, Indonesia.

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### Introduction

To date, various acrylic-based prosthetic or orthodontic appliances are still widely required at dental laboratories. Acrylic resins were first developed in 1930. Acrylic resin can cause irritation of the eyes, skin and throat, in addition to coughs and shortness of breath. Moreover, it includes chemicals in a list of specific health hazards as they are flammable and reactive.<sup>1</sup> Prolonged exposure to the monomer can also induce contact dermatitis, a condition often experienced by dentists and dental laboratory technicians because of the high concentration of monomer that can cause irritation.<sup>2</sup> In addition, acrylic materials have the potential to be harmful in the laboratory due to acrylic dust being inhaled and the noise and vibrations produced during

grinding.

Workplaces that produce dust can cause discomfort at work, visual impairment, reduced lung function and even general poisoning. Dust in the dental laboratory, generated by abrasive materials, acrylic, gypsum and others,<sup>3</sup> can result in negative health effects, one of which is pneumoconiosis. This is a respiratory condition caused by excessive inhaled dust leading to fibrotic nodular changes in the lungs, a symptom that may develop slowly and causes breathing difficulties including coughing, inflammation and shortness of breath.<sup>4</sup>

Occupational health and safety is a necessary precondition to preventing accidents in the work environment which can hinder and disrupt work plans and processes.<sup>5</sup> If the level of safety is high, accidents can be minimized, including those that cause illness, disability, and even death. Conversely, if safety standards are low, it will adversely affect health resulting in decreased productivity.<sup>6</sup>

Personal protective equipment (PPE) appropriate to the occupational hazards and risks potentially threatening the safety of workers (dental technicians), the environment and the people affected by it must be available in the

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workplace.<sup>6</sup> There are several kinds of PPE for methyl methacrylate, namely: eye protection, ear protection, body protection, hand protection and respiratory system protection.<sup>1</sup>

In Surabaya, dental laboratories are listed in PTGI (Persatuan Teknik Gigi Indonesia). With the growing number of graduates from the Dental Health Technology Study Program, the possibility of the number of dental laboratories increasing exists. The purpose of this study was to determine the availability and use of a variety of PPE for acrylic workers in dental laboratories in Surabaya, Indonesia.

### Materials and methods

This descriptive observational study was carried out between March and May 2017. Data was collected through a questionnaire distributed at a dental laboratory in Surabaya registered in PTGI. The variables studied in this research include the availability of personal protective equipment and the use of personal protective equipment in Surabaya-based dental laboratories. The study involved visits to a dental laboratory, the conducting of interviews with laboratory employees and the completing of questionnaires by dental laboratory owners. The data was subsequently collected, tabulated and analyzed descriptively.

### Results

Of the 25 PTGI-listed dental laboratories in Surabaya, only 13 participated in this study, the results of which can be seen in Tables 1 and 2. From the contents of Table 1, it is clear that all dental laboratories in Surabaya provide goggles and masks (of the disposable paper variety), while 84.61% provide various forms of body and hand protection.

Table 2 shows that 70.49% of workers always wear a respiratory protector and 49.18% of workers always use eye protection. In contrast, 83.60% of workers handling acrylic in dental laboratories in Surabaya never wear ear protective equipment. Table 3 shows that the work accidents that befall individuals who handle acrylic in dental laboratories include: hand injuries sustained while grinding, trapped hands, acrylic-related allergies and trauma to the eyes resulting from exposure to dust.

Eye protector		Ear protector		Respiratory protector		Body protector	Hand protector
Googles	Face shield	Ear plug	Ear muff	Paper mask	Filtered mask	Lab coat	glove
100%	38.46%	30.76%	15.38%	100%	0%	84.61%	84.61%

**Table 1.** Protective Personal Equipment for Acrylic Workers Availability in 13 Dental Laboratories in Surabaya.

Eye protector			Ear protector			Respiratory protector			Body protector			Hand protector		
S	KK	TP	S	KK	TP	S	KK	TP	S	KK	TP	S	KK	TP
49.1	47.5	3.27	1.63	14.7	83.6	70.4	26.2	4.91	57.3	18.0	24.59	27.8	55.73	16.39
8%	4%	%	%	5%	%	9%	2%	%	7%	3%	%	6%	%	%

Notes: S always; KK sometimes; TP never

**Table 2.** Protective Personal Equipment using by Acrylic Workers in 13 Dental Laboratories in Surabaya.

2014-2015	2015-2016
1. Acrylic dust entered the eye, skin peeled off due to acrylic exposure	Red skin, acrylic liquid spills
2. None	None
3. None	Skin peeled off due to acrylic exposing
4. None	None
5. Hand injury due to grinder, cone or brush, Acrylic dust entered the eye	None
6. Finger injury due to scalpel, liquid and hot wax exposure	The eyes are exposed to acrylic grinding flakes, shortness of breath due to acrylic monomer
7. Hand injury due to fire from spiritus brander	None
8. Itchy hands due to allergic reaction to acrylic	Acrylic dust entered the eye
9. Finger punctured by wire, acrylic dust entered the eye, fingernail injury due to cone and grinder exposure	Hand injury due to scalpel and pinched by cutting plier
10. Acrylic dust entered the eye	Acrylic monomer entered the eye
11. None	None
12. Hand injury due to grinder	Dizziness inhaling acrylic monomer vapors
13. None	None

**Table 3.** Work Accidents Affecting Acrylic Workers in 13 Dental Laboratories in Surabaya 2014-2015 and 2015-2016.

### Discussion

Of the 25 PTGI-registered dental laboratories in Surabaya, only 13 participated in the study. A number of dental laboratories were unwilling to contribute to this research for the

following reasons: fear of revealing confidential information about dental laboratories, distracting dental laboratory workers and lack of time to conduct interviews or complete questionnaires. Those dental laboratories which did participate in this study considered its results of this study to be important for the learning process, for assessing the quality of the laboratory and for supporting its promotion.

Of the 13 participating dental laboratories, only five provided eye protection, two provided ear protection, 11 provided body and hand protection, while nine provided no ear protection, two did not provide body protection, with a further two not providing hand protection. All laboratories provided goggles and masks (disposable paper masks), but none provided masks fitted with filters and only 15.38% of dental laboratories supplied ear muffs.

PPE for the eyes is very important because it shields them from airborne materials, such as small objects, dust, gas or chemical vapors that can cause irritation. The results showed that 49.18% of acrylic workers always wore eye protection. However, from the contents of Table 3, it appears that in 2014-2016 there were seven dental laboratories whose acrylic-related workers were involved in an accident affecting the eyes, including: eye irritation due to the concurrence of acrylic dust, acrylic chips and monomer vapors. Therefore, such individuals should be disciplined in donning appropriate eye protection. There are two types of eye protection. Goggles only protect the eye, whereas face shields protect both the eyes and entire face from acrylic dust, acrylic chips and exposure to splashes when involved in acrylic finishing and polishing.

From Table 1, ear protectors, for example plugs, were made available in 30.76% of dental laboratories, while ear muffs were provided in only 15.38% of cases. Of the 61 acrylic workers who participated in the study, only 1.63% consistently wore ear protection, while 83.60% of workers never wore such equipment. Noise in dental laboratories is predominantly generated by micro motors, polishing machines and trimmers and can interfere to a significant degree with communication. A noisy environment forces workers to shout in order to communicate with others. At times, raised voices lead to miscommunication or confusion regarding perceived emotions when speaking. Noise can also cause hearing damage<sup>7</sup>

and, in extreme cases, even deafness.<sup>8</sup> Wearing ear protectors is very important to shielding the ear from noise. Ear plugs represent an ear-protection device that is inserted into the ear canal with the ability to reduce high-frequency sounds (4000 dba) which enter the ear, while ear muffs cover the entire earlobe and can, potentially, reduce 2800-4000 hz sound frequency by 35-45 dba.<sup>3</sup>

Respiratory protective equipment (RPE) is a device that protects the respiratory organs against chemical-based air pollution such as acrylic dust and monomer vapors. This study confirmed that all dental laboratories provide masks (disposable paper masks), although only 70.49% of workers use them consistently. Actually, surgical face mask are not classes as RPE and has no filtering efficiencies required for adequate respiratory protection.<sup>9</sup> Manipulation of acrylic monomers in a room without good ventilation is not recommended as it is harmful to dental technicians, especially to their respiratory organ health. From Table 3, it is clear that employee complaints due to acrylic work include dizziness and shortness of breath when exposed to it. In fact, the use of disposable paper masks is still less effective against acrylic<sup>10</sup> and workers should wear a mask fitted with a filter.

Body protective equipment protects part or whole body from dirt, dust, chemical sparks, radiation, heat and fire. The results show that 84.61% of the 13 dental laboratories provided body protection, but only 27.86 % of workers always wore it. Such individuals should always wear a body protector, as the body may be exposed to acrylic chips or acrylic monomer spillage. Survey in North India found that most of the technicians were not aware of basic infection control protocols.<sup>11</sup> Hand protection (gloves) should be used to minimize the potential of cross contamination in dental laboratory,<sup>12</sup> followed by proper hand hygiene.<sup>13</sup> The contents of Table 1 show that, while the availability of hand protection in Surabaya-based dental laboratories is present in 84.61% of cases, only 27.88% workers wear it consistently. This confirms that acrylic workers' awareness of the importance of occupational health and safety remains low.

Dental technicians are required to use PPE to ensure occupational safety and health, while dental laboratories must provide personal protective equipment for the safety of acrylic workers.<sup>14</sup> Factors affected the selection of PPE

are appropriate for the hazards, comfortable, biocompatibility, longevity, style and cost.<sup>15</sup> In order to maintain optimal protection, potential hazards must be listed, in order that the amount and quality of PPE to be used can be determined. PPE should be comfortable, not interfere with work and provide effective protection relevant to the hazards present in the workplace. PPE will be less useful if inappropriate, deployed in the wrong manner and/or of low quality. In addition, workers often do not wear PPE because they feel less comfortable and self-conscious about their appearance.<sup>16</sup>

To improve occupational health and safety, in addition to providing PPE, dental laboratories must possess a high quality air circulation system, including exhaust extraction. In addition, they should also be provided with fire extinguishers and adequate drainage with significant pressure. All dental technicians should be well-trained in the use and maintenance of the equipment's. First aid kits or medicines should be provided and stored in a manner which avoids contamination by dust, moisture and other factors. The cleanliness and neatness of the workplace should also be well-maintained.<sup>17</sup> Based on our observation, dental laboratories in Surabaya rarely have exhaust systems, fire extinguishers or first aid kits, while their lighting is generally poor, thus increasing the risk of workplace accidents.

### Conclusions

Of the 13 dental laboratories participating in this study all provide disposable paper masks and goggles. 70.49% of acrylic workers always wear a protective respirator and 49.18% of acrylic workers invariably wear eye protection. The provision of counseling regarding the importance of personal protective equipment for their safety and the risk to health posed by acrylic materials in the dental laboratory is essential to promote changes in acrylic worker behavior.

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### Declaration of Interest

The authors report no conflict of interest.

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