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A New Method for Denture Identification

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Three denture marking methods were performed on specimen plates which were prepared using a heat-cured acrylic resin. The first method (LA) was to place a label into a suitable space on the specimen, and then cover it with autopolymerizing acrylic resin. The second method (DA) was to print the mark directly on the specimen, and then cover it with autopolymerizing acrylic resin. The third method (DB) was to print the mark directly on the specimen, and then cover it with bonding resin. To investigate the durability of these methods, specimens were immersed in NaOCl, denture cleanser, and coffee. Photographs of the specimens were taken and RGB values were measured. Differences in durability were analyzed by Friedman test. The RGB values were significantly different between LA and DB, but those of DA changed little. The results made it clear that DA was a more durable denture marking method than LA — which is a method generally used.

Keywords: Denture, Identification, Durability

INTRODUCTION

Many articles on denture marking have been published. Marking dentures has been well documented as a useful aid — if not an absolutely necessary means — in the identification of the following: victims of fatal disasters, misplaced dentures in hospitals, nursing homes, and institutions, as well as patients who suffer from unconsciousness or psychiatric problems such as traumatic or senile loss of memory[1-5]. In particular, misplaced or mistaken dentures in hospitals or nursing homes for the elderly can be a considerable problem. On this ground, denture identification systems are important for patients in these facilities.

To date, several techniques have been undertaken. One method is to write one's name on the base of the denture with a waterproof marker or a graphite pencil after abrading the denture surface[6]. Another method is to place one's own label into a suitable space on the denture, and the label subsequently covered with an autopolymerizing acrylic resin[7-12]. The acrylic resin is trimmed and finished in the usual manner.

However, these methods require a suitable cavity cut to be prepared in the denture, which is then filled with clear acrylic resin. Furthermore, the label needs to be sealed by something like sellotape because the acrylic resin monomer will smear the characters, making it impossible for the label to be read. Accordingly too, these marking methods require additional laboratory time and expense, and only a limited number of letters is allowed.

Against this backdrop of drawbacks against the abovementioned denture marking techniques, this study was undertaken to examine a method of printing personal identification labels directly on the surfaces of dentures. This method made it possible to identify dentures more easily. However, the durability of this method has not been clarified, and it has not been demonstrated if this method is useful and feasible in clinical practice. The aim of this study, therefore, was to investigate the durability of this method.

MATERIALS AND METHODS

Method of printing personal identification label directly on denture surface

To investigate the durability of the method of printing personal identification labels directly on the surfaces of dentures, nine specimen plates (64×10×3.3 mm) were prepared using a heat-cured acrylic resin (Acron, GC Co., Tokyo, Japan).

The method of printing personal identification labels directly on the surfaces of dentures is described as follows. Personal identification details were input into a computer using an image editing software program (Adobe Photoshop, Adobe, San Jose, California), whereby the letters were reversed. The reversed mark was printed on paper with a laser printer (DocuCentre Color a250, Fuji Xerox Co., Tokyo, Japan). Then, methyl methacrylate monomer (MMA monomer) (Acron) was applied on the area of the specimen plate where the mark would be located. The paper with the mark was pressed on the specimen plate before MMA monomer on the external surface of the specimen plate evaporated. The mark was thereby printed on the specimen plate (Fig. 1).

Three denture marking methods examined in this study

Three denture marking methods were performed on each specimen plate (Table 1). The first method (LA)

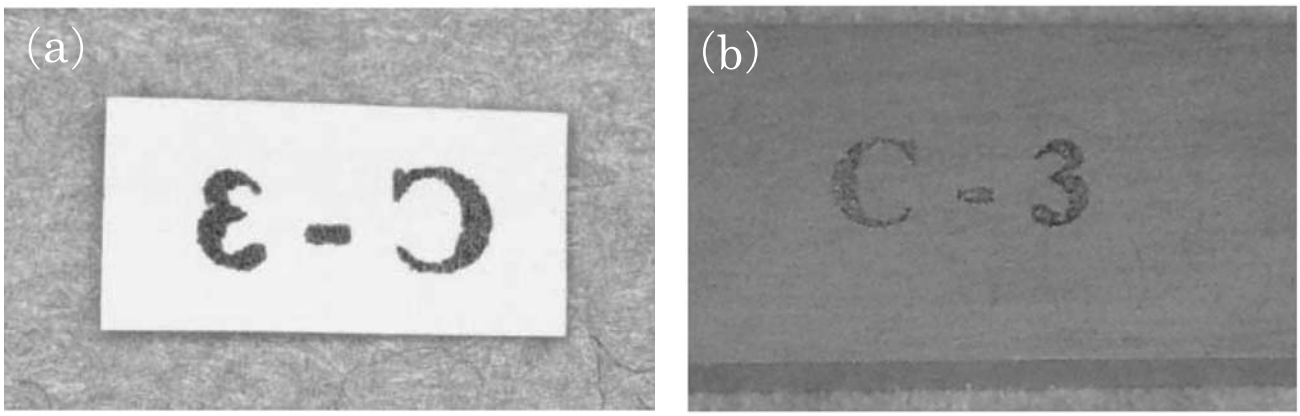

Fig. 1 Printing the mark directly on a specimen plate: (a) Printed identification in reverse image on paper; (b) Label printed on a specimen plate.

Table 1 The three denture marking methods performed on each specimen plate

	LA	DA	DB
Preparing	Cut a specimen plate		
	↓		
Identification	Make a label	Print a mark	Print a mark
	↓	↓	↓
Marking	Cover the label with sellotape and put in plate	Put MMA-monomer and press the mark on plate	Put MMA-monomer and press the mark on plate
	↓	↓	↓
Cover	Acrylic resin	Acrylic resin	Bonding resin
	↓	↓	
	Polish	Polish	
Laboratory time	6 minutes	4.5 minutes	1.5 minutes

Table 2 List of brand names and contents of the three immersion solutions

Immersing solution	Brand name	Manufacture	Immersing time
0.03% NaOCl	Purelox	Oyalox Co., Tokyo, Japan	30 minutes
Denture cleanser	Pica	Shofu Inc., Kyoto, Japan	1 hour
0.015g/ml coffee	Blendy	Ajinomoto General Foods Inc., Tokyo, Japan	10 minutes (60℃)

was used as a control. With the LA method, the label was placed in a suitable space on the specimen plate. On the specimen plate, a depression approximately 1 mm deep was cut, which was slightly wider than the size of the label. The label was made using a label writer (Name Land label writer KL-M20, Casio, Tokyo, Japan), and then the label was covered with a sellotape. This label was placed into the designated space on the specimen plate, and then covered with an autopolymerizing acrylic resin (Unifast, GC Co., Tokyo, Japan). The acrylic resin was trimmed and finished in the usual manner.

The second method (DA) was to print the mark directly on the surface of the specimen plate, and then cover the mark with an autopolymerizing acrylic resin. With the DA method, the specimen plate was not cut. The acrylic resin was finished in the usual manner.

The third method (DB) was to print the mark directly on the surface of the specimen plate, and then cover the mark with a bonding resin (Clearfil Mega Bond, Kuraray Medical Inc., Okayama, Japan). This bonding resin is sold in various countries as SE Bond. After applying the bonding resin on the surface of the printed specimen plate, the bonding resin was covered with a polyethylene sheet (GC Co., Tokyo, Japan), and then hardened with a light curing unit (XL3000, 3M Co., Tokyo, Japan).

Testing the durability of denture marking methods

To investigate the durability of the three marking methods, three specimen plates were immersed in NaOCl solution, three specimen plates in denture cleanser, and three specimen plates in coffee. Table 2 lists the brand names and contents of these three immersion solutions.

These immersion experiments were repeated 90 times. Photographs were taken using a camera (Nikon F601, Nikon, Tokyo, Japan) before immersion, after 5, 10, 20, 30, 40, 50, 60, 70, 80, and 90 times of immersion with a standard specimen plate. Photographs were taken after washing the specimen plates immersed in each solution by water.

To evaluate the changes in denture marking, these photographs were input into a computer using an image editing software program (Adobe Photoshop). RGB values were measured at four areas for each denture marking method on each specimen plate, whereas measurement was done for 12 areas on a standard specimen plate. For each denture marking method, its RGB values against those of the standard specimen plate were calculated, and then the ratios of change (RC) in comparison to before immersion were calculated.

Statistical analysis

Differences in the durability of the three denture marking methods were analyzed by Friedman test. This was done to investigate the differences in RC of the RGB values for the three denture marking methods.

RESULTS

Immersion in NaOCl solution

Figure 2 shows the mean RC values of the RGB values when the specimen plates were immersed in NaOCl solution. The R values were 0.073% on LA, 0.011% on DA, and 0.016% on DB. Statistical analysis showed that the R values between LA and DA differed significantly ($p<0.01$), as well as between LA and DB ($p<0.01$). In summary for the R values, that of LA changed the most.

The G values were 0.100% on LA, 0.015% on DA, and 0.050% on DB. G values were significantly different between LA and DA ($p<0.01$) as well as between LA and DB ($p<0.05$). In summary for the G values, that of LA changed the most.

The B values were 0.031% on LA, 0.028% on DA, and 0.110% on DB. B values were significantly different between LA and DB ($p<0.01$) as well as between DA and DB ($p<0.01$). In summary for the B values, that of DB changed the most.

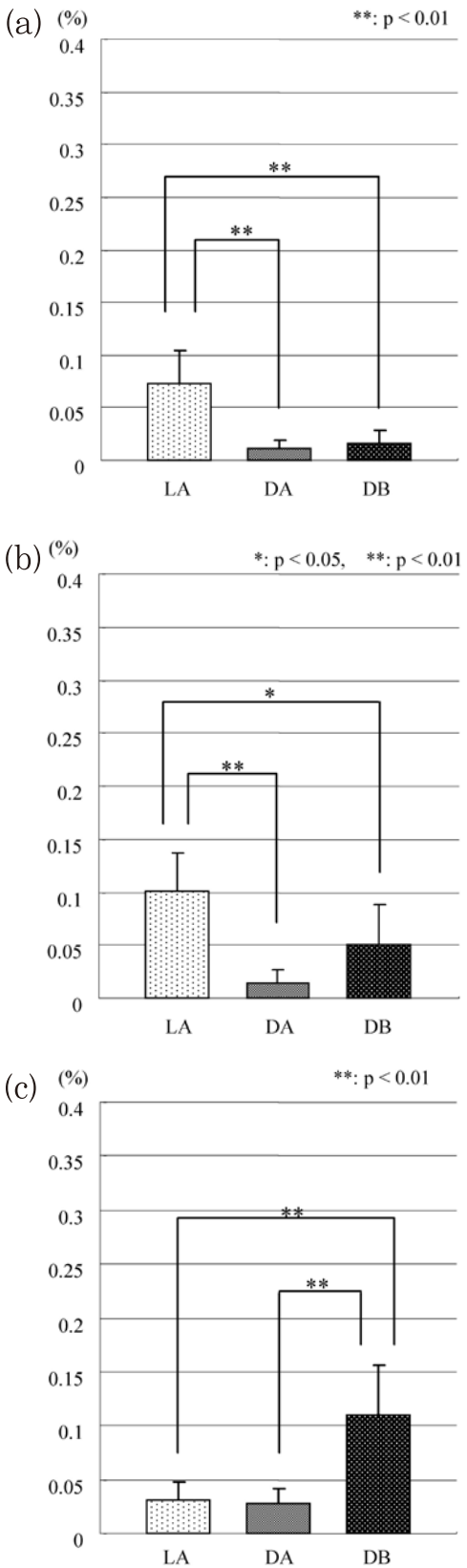

Fig. 2 Mean values of RC of the RGB values when specimen plates were immersed in NaOCl solution: (a) Mean value of RC of R; (b) Mean value of RC of G; (c) Mean value of RC of B.

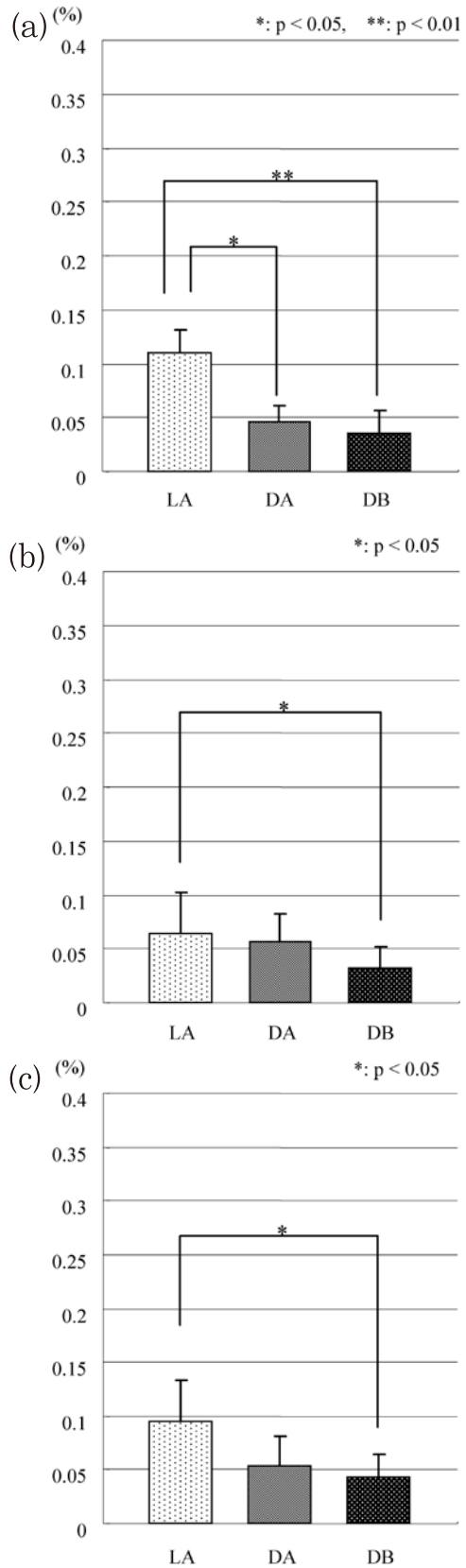

Fig. 3 Mean values of RC of the RGB values when specimen plates were immersed in denture cleanser: (a) Mean value of RC of R; (b) Mean value of RC of G; (c) Mean value of RC of B.

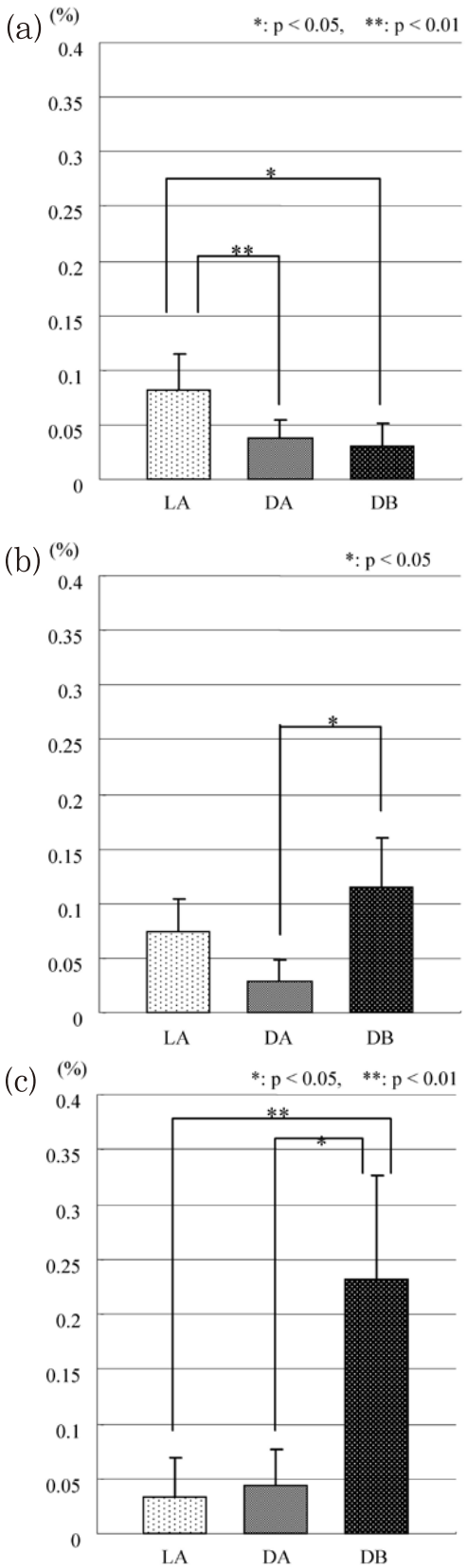

Fig. 4 Mean values of RC of the RGB values when specimen plates were immersed in coffee: (a) Mean value of RC of R; (b) Mean value of RC of G; (c) Mean value of RC of B.

Immersion in denture cleanser solution

Figure 3 shows the mean RC values of the RGB values when the specimen plates were immersed in denture cleanser solution. The R values were 0.111% on LA, 0.046% on DA, and 0.035% on DB. Statistical analysis showed that the R values between LA and DA differed significantly ($p<0.05$), as well as between LA and DB ($p<0.01$). In summary for the R values, that of LA changed the most.

The G values were 0.065% on LA, 0.056% on DA, and 0.032% on DB. G values were significantly different between LA and DB ($p<0.05$). In summary for the G values, that of LA changed the most.

The B values were 0.095% on LA, 0.054% on DA, and 0.043% on DB. B values were significantly different between LA and DB ($p<0.05$). In summary for the B values, that of LA changed the most.

Immersion in coffee

Figure 4 shows the mean RC values of the RGB values when the specimen plates were immersed in coffee. The R values were 0.082% on LA, 0.038% on DA, and 0.031% on DB. Statistical analysis showed that the R values between LA and DA differed significantly ($p<0.01$), as well as between LA and DB ($p<0.05$). In summary for the R values, that of LA changed the most.

The G values were 0.074% on LA, 0.028% on DA, and 0.114% on DB. G values were significantly different between DA and DB ($p<0.05$). In summary for the G values, that of DB changed the most.

The B values were 0.033% on LA, 0.044% on DA, and 0.231% on DB. B values were significantly different between LA and DB ($p<0.01$) as well as between DA and DB ($p<0.05$). In summary for the B values, that of DB changed the most.

DISCUSSION

Numberous published works[6-12] have sought to present the best method for denture identification, whereby these reported methods have been appraised in terms of cost effectiveness, ease of use, absence of adverse effects, and durability. However, these methods require additional laboratory time and expense.

In the present study, we proposed and evaluated a method to print personal identification labels directly on the surfaces of dentures. This method stood out from the currently available denture marking methods in two prominent ways. First, although the current marking methods could mark dentures clearly, it was done at the expense of much time and labor. In contrast, our proposed method required only a simple and easy procedure which did not require much time and labor. Secondly, although printing of identification labels on dentures is currently available and very easy to perform, our proposed method was able to print directly on the denture surface. Nonetheless, it remained to be clarified if the printed identification label could withstand discoloration and denture cleaning activity.

The aim of this study, therefore, was to investigate the durability of the proposed method of printing personal identification labels directly on the surfaces of dentures. To this end, photographs were taken and observed, whereby color changes of the printed label on the specimen plate were evaluated objectively in terms of RGB values.

To print black or colored personal identification labels in this study, it was done using an image editing software coupled with a laser printer or copy machine. Printer toner adhered to the paper, because toner resin was melted by heat and caused the toner to adhere onto the paper.

The principal toner ingredients were namely a coloring agent and a binder resin[13]. The binder is composed of thermoplastic resin and melts easily by use of an organic solvent. In the present study, methyl methacrylate monomer was the organic solvent used for melting the toner binder. Consequently, the binder resin that adhered to the paper melted in the methyl methacrylate monomer on the denture surface. In this manner, identification details borne by the toner on the paper were transcribed to the surface of the denture. For this reason, characters printed on the paper were reversed to facilitate a visually logical transcription from the toner on the paper to the denture surface. On this ground, personal identification labels were created using a graphics software (Adobe Photoshop) and then have the image reversed.

In this study, specimen plates were immersed in NaOCl solution, denture cleanser, and coffee to investigate the durability of the three denture marking methods. Evaluation parameters were the RGB values. The RGB values allow colors to be expressed in combinations of red (R), green (G), and blue (B) on the computer.

After immersion in NaOCl solution, the ratios of change for R and G values were large for LA, but not so for DA and DB. The reason for these results could be that the change in color for LA was caused by the bleaching action of NaOCl solution. Thickness of the autopolymerizing acrylic resin was great for LA. Therefore, there belied a possibility of discoloration of the autopolymerizing acrylic resin on LA by NaOCl solution.

After immersion in denture cleanser solution, the ratios of change for R, G, and B values were large for LA, but not so for DB. The reason for these results could be due to denture cleanser causing the colors to fade out of the specimen plates. There have been reports[14,15] which made it clear that changes in

the color of denture base resin were due to the influence of denture cleansers. Similarly in this study, it was speculated that the denture cleanser exerted the same influence, thereby leading to color changes of the specimen plates. As for DB, the color changes were minor because it was covered with a bonding resin.

After immersion in coffee, the ratios of change for G and B values were large for DB, but not so for DA. The reason for these results could be attributed to the non-polymerized bonding resin surface of DB, whereby discoloration was caused by coffee. On this note, it might be necessary to examine the effect of polishing on the surface of the bonding resin. Nonetheless, it was predicted that when the non-polymerized layer was removed from DB, the discoloration would cease to occur.

According to the results in this study, DB was the easiest method. However, discoloration occurred for DB because of its non-polymerized bonding resin surface. In view of this result, it was therefore suggested that DA was the next best method — in terms of ease of use and durability — to identify dentures. At this juncture, it is noteworthy that by circumventing the non-polymerized bonding resin with a different covering material, there belied a possibility of establishing a better denture marking method than DA.

Several techniques that have been reported entailed the need to carve out space on the denture, and then cover the space with an autopolymerizing acrylic resin. Therefore, these methods required additional laboratory time. Moreover, it was expected that the mechanical strength would be unfavorably affected. If the mechanical strength were affected, the denture might be easily broken. On this ground, we should examine and compare in a future study the mechanical strengths yielded with LA, DA, and DB.

In sharp contrast to conventional denture marking methods that require space to be carved out for labeling, the herein-proposed method of printing personal identification labels directly on the surfaces of dentures did not require any removal of the denture base resin. In other words, the proposed method presented two important advantages: (1) large numbers of letters could be included in the personal identification label without space constraint; and (2) mechanical strength of denture would not be adversely affected.

Furthermore, the proposed method of printing a personal identification label directly on the denture surface was very easy to perform and which did not require much time. Results of this study also made it clear that this method had durability. Taken together, this method is indeed useful for clinical practice.

Hereafter, the next step forward would be to find a strong, long-lasting, and durable method to cover printed personal identification labels on denture surfaces. Moreover, changes in the printed labels over time after a long-term usage should also be investigated.

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