ORIGINAL ARTICLES

Tooth shades suitable for the Japanese elderly; Preliminary report

YAMAMOTO HIROAKI[1], WATANABE RYO[1], ADACHI KOTONO[1],
HASEGAWA KEI[1], SAKAKIBARA KEI[1], UNO MITSUNORI[1],
IWAHORI MASATOSHI[1], MIYAO MOTONOBU[1], FUKUI TATSUYA[2],
YAMAUCHI MUTSUO[3], OTOMO KATSUYUKI[3]

Shade measurement was performed on the upper and lower anterior teeth of Japanese elderly, and examinations were conducted to identify a standard for the shade selection of dentures and partial dentures elderly Japanese patients.

The subjects were 23 elderly Japanese dentulous people over 60 years old (mean age 68.4 ± 4.2 years), and 13 young Japanese people with teeth color deemed to be clinically normal (mean age 21.6 ± 2.3 years). ShadeEye NCC (Shofu, Japan) was used for colorimetry. The measurement site was the upper and lower anterior teeth.

Measurements showed a clear difference in the shade selected by the ShadeEye between the young and the elderly. In the elderly, C4 was determined to be the standard for upper and lower canines, C2 and C3 for upper and lower lateral incisors, and C3 for upper and lower central incisors.

These results are thought to have implications for the effective selection of tooth shade in relation to tooth type among elderly Japanese.

Key words : anterior tooth, shade, elderly Japanese, colorimeter

Introduction

In recent years, the demand for esthetic dentistry has been increasing, including among the elderly[1,2]. In esthetic dentistry, it is essential to select tooth shades that suit the individual[3]. Shade selection for artificial teeth and crown restorations is generally performed using commercially available shade guides[4]. However, shade determination can be more difficult with older people as tooth color changes occur more frequently than in younger people[5]. Accordingly, a shade standard suitable for the elderly is needed to facilitate better shade selection. Previous reports examining anterior tooth color in the elderly have revealed that the central incisors become darker, yellower, and more reddish with age[6,7]; the incisor-canine color difference (ΔE ;)

significantly decreases[8]; and that teeth overall become a darker yellow and more reddish. Significantly, it was concluded that the CIE L*a*b* system is most strongly related to tooth color in aging[9].

In the studies described above[5-9], tooth color in the elderly was examined using CIE L*a*b* values. However, few studies have investigated tooth shades in the elderly according to the shade guides generally used for shade determination in the clinical setting. In particular, only Rodrigues et al.[10] have reported shade determination of the maxillary anterior teeth using the Vita Lumin shade guide, finding that both A1 and A2 were most frequently selected among young people, whereas A2 was most frequently selected for middle-aged and older adults.

Furthermore, shade determination using a shade

[1] *Department of Prosthodontics, Division of Oral Functional Sciences and Rehabilitation, Asahi University School of Dentistry*
Hozumi 1851, Mizuho, Gifu 501-0296, JAPAN
[2] *Fukui Dental Clinic*
Nakahachiya 4490-2, Hachiyamachi, Minokamo, Gifu 505-0005,
JAPAN
[3] *Asahi University*
Hozumi 1851, Mizuho, Gifu 501-0296, JAPAN

guide may not always be accurate[4]. In recent years, small, lightweight colorimeters have become available for determining tooth color with relative ease[11, 12]. As shade determination has been reported to be more accurate when using a colorimeter than when using a shade guide[12], we anticipated that a colorimeter would be useful for achieving better shade determination of teeth with complicated color tones in elderly people.

In this study, we investigated the use of a colorimeter for tooth shade determination in elderly Japanese, and examined whether the measurement results could be used as a viable criteria for shade selection in this population.

Materials and methods

The participants were comprised of 23 dentulous elderly Japanese aged 60 years or older (14 men and 9 women, mean age 68.4 ± 4.2 years) and 13 young Japanese adults (2 men and 11 women, mean age 21.6 ± 2.3 years) whose tooth color was considered clinically normal. The number of measurements for each type of tooth was not constant because almost none of the elderly participants had complete dentition. ShadeEye-NCC (Shofu, Kyoto, Japan) (Fig. 1) was used for colorimetry and the upper and lower anterior teeth of all participants were measured.

Shade determination was performed in a clinical setting. Prior to shade determination, the extraneous coloring of the teeth was removed as much as possible. In accordance with the colorimeter manual, a colorimetric chip was placed close to the cervical margin of the tooth to determine color shade. This study was approved by the Asahi University Ethics Committee (No. 31035). All participants provided written informed consent before participating in this study.

Results

Upper canines

In the young participants, the A, C, and D shades were almost uniformly distributed; A3.5, C3, and D3 were the most frequently selected. In the elderly participants, C shades were most frequently selected, especially C4 (Fig. 2).

Upper lateral incisors

In the young participants, C and D shades were frequently selected, with C1 and D2 being the most frequent. In the elderly participants, C shades were frequently selected, especially C2 and C3 (Fig. 3).

Upper central incisors

In the young participants, A and D shades were selected most frequently particularly A1 and D2. In elderly subjects, A and C shades were most frequently selected, especially C3 (Fig. 4).

Lower canines

In the young participants, A shades were most frequently selected, particularly A3 and A3.5. In elderly participants, A and C shades were most frequently selected, especially C4 (Fig. 5).

Fig. 1 Colorimeter used in this study (ShadeEye NCC, Shofu, Japan)
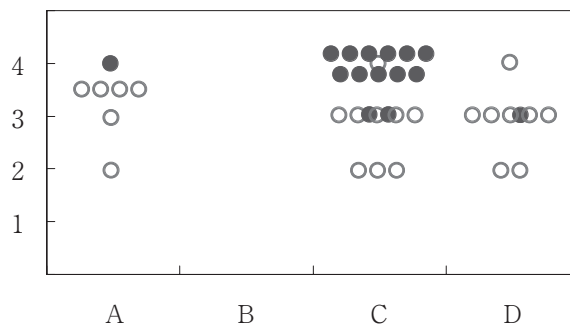

Fig. 2 Shade of upper canines selected in young and elderly

Open circle represent young and closed circle represent elderly respectively.

Abbreviations in the following figures are the same.

Lower lateral incisors

In the young participants, A shades were most prevalent, but no particular shade was more dominant. In the elderly participants, C shades were frequently selected, especially C2 and C3 (Fig. 6).

Lower central incisors

In the young participants, the distributions of the

A, C, and D shades were prominent, with A1 and D2 frequently selected. In the elderly participants, A and C shades were frequently selected, especially C3 (Fig. 7).

Discussion

In this study, most of the young participants were women, whereas most of the elderly participants were men. Gender differences in tooth color have been reported[5-7, 9, 10] but men and women were grouped together in this study to consider tooth shades in the elderly as a whole, without differentiating according to sex. Although ambient light can affect tooth color measurements using a colorimeter[14], it was not considered a particularly limiting factor in the present study because shade determination in the clinical setting was assumed.

The results clearly demonstrated differences in shade selection between the young adult and elderly participants, with specific shades frequently selected in both groups depending on tooth type.
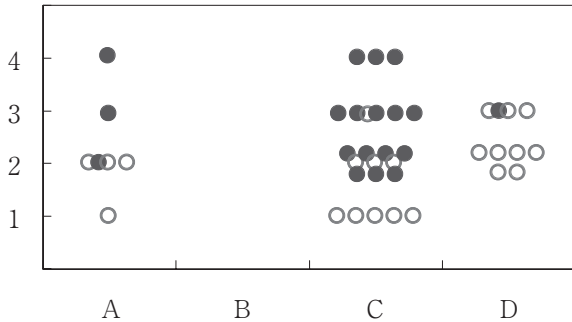

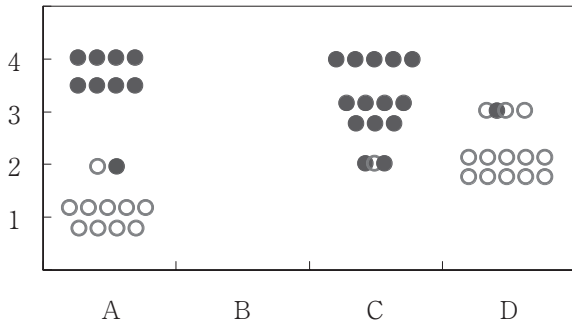Fig. 3 Shade of upper lateral incisors selected in young and elderly

Fig. 4 Shade of upper central incisors selected in young and elderly
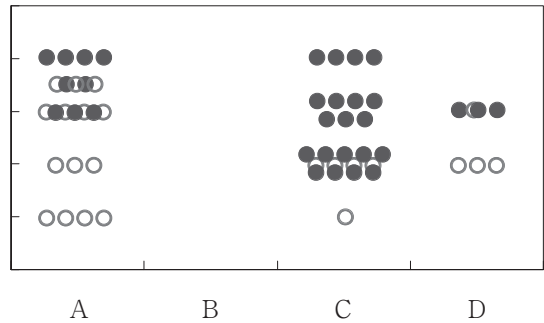

Fig. 6 Shade of lower lateral incisors selected in young and elderly
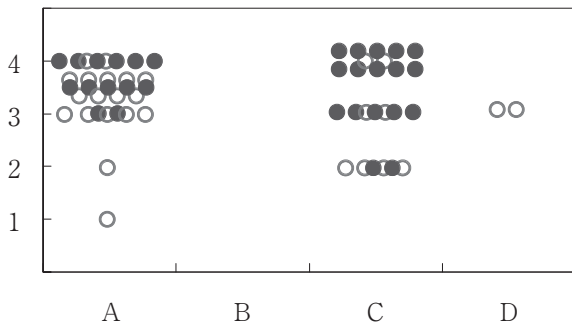

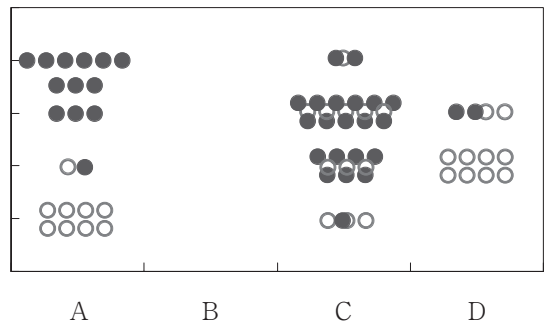Fig. 5 Shade of lower canines selected in young and elderly

Fig. 7 Shade of lower central incisors selected in young and elderly

Rodrigues et al.[10] reported that when performing shade determination of the maxillary central incisors using the Vita Lumin shade guide, A1 and A2 were frequently selected for young people and A2 was frequently selected for middle-aged and older adults. Their results differ from ours, which might be explained by the differences of the study participants, including age, race and diet. Ueda et al.[14] reported that C4 and D2 were more frequently selected when the same colorimeter was used for shade determination of the upper natural anterior teeth in Japanese partial denture wearers with a mean age of 58 years. The results of Ueda et al.[14] are similar to the present results but there are differences in the age categories and selection of B shades.

Our results suggest criteria for shade selection according to tooth type in elderly Japanese. In particular, the first choices could be C4 for canines, C2 and C3 for lateral incisors, and C3 for central incisors (Table 1). However, because only a small number of cases were examined, shade determination in larger cohorts is necessary to confirm our findings. Also, gender should be considered to improve the accuracy of shade selection in elderly men and women.

Sellen et al.[15] reported a study in which 50 dentists were shown color photographs of the teeth of young, middle-aged, and elderly people. The participants were asked to select the shade that matched the photographed teeth. Most of the participants selected A2 for the young people, A3 for the middle-aged and C4 for the elderly. When looking at the shade selection of artificial teeth for dentures in Japan, 90% are A3, and a darker shade such as A3.5 is often selected[16]. Many of the tooth shades selected for the elderly in the present study were C3 and C4, which is consistent with the darker shades for artificial teeth reported by Ueda et al. .

Due to the fact that one study has reported no difference between models in tooth color determination using a colorimeter[13] but other studies have reported differences[17, 18], it is necessary for differences in shade determination to be investigated using other colorimeters. Nevertheless, the colorimetric results differed reliably between the young and elderly, and it is reasonable to assume that the difference in shade due to choice of colorimeter would not be unique to the elderly. Therefore, a reference shade based on the results (Table 1) is a suitable starting point for shade selection.

Conclusion

Tooth color in the young and elderly was determined using a colorimeter and a clear difference was noted in the shades selected between the two age groups. In addition, specific shades were selected according to tooth type. These results are thought to hold implications for shade selection according to tooth type in elderly Japanese.

There are no conflicts of interest to disclose in this study.

References

1) Goldstein RE, Niessen LC. Issues in esthetic dentistry for older adults. J Esthet Dent. 1998; 10: 235-242.
2) Lajnert V, Pavičić D K, Gržić R, Kovač Z, Pahor D, Kuis D, Simonić-Kocijan S, Antonić R, Bakarčić D. Influences of age and maxillary anterior teeth status on patient's satisfaction with dental appearance and tooth colour. Gerodontology. 2011; 29: e674-e679.
3) Kalantari MH, Ghoraishian S A, Mohaghegh M. Evaluation of accuracy of shade selection using two spectrophotometer systems: Vita Easyshade and Degudent Shadepilot. Eur J Dent. 2017; 11: 196-200.
4) Alomari M, Chadwick RG. Factors influencing the shade matching performance of dentists and dental technicians when using two different shade guides. Br Dent J. 2011; 9: 211: E23. doi: 10.1038/sj.bdj.2011.1006.
5) Demirel MG, Tuncdemir MT. Influence of age, gender, and educational background on tooth color. Niger J Clin Pract. 2019; 22: 162-166. doi: 10.4103/njcp. njcp_442_18.
6) Kim H-K.A study on the color distribution of natural teeth by age and gender in the Korean population with an intraoral spectrophotometer. J Esthet Restor Dent. 2018; 30: 408-414.
7) Gozalo-Diaz D, Johnston WM, Wee AG. Estimating

Table 1. Recommended shade for Japanese elderly from our experimental results

Tooth type	Recommended shade
Canine	C4
Lateral incisor	C2,C3
Central incisor	C3

the color of maxillary central incisors based on age and gender. J Prosthet Dent. 2008; 100: 93-8. doi: 10.1016/S0022-3913（08）60155-9.

8）Falcone ME, Kelly JR, Rungruanganut P. In vivo color relationships between the maxillary central incisors and canines as a function of age. Int J Prosthodont. 2016; 29: 496-502. doi: 10.11607/ijp.4826.

9）Gómez-Polo C, Montero J, Gómez-Polo M, de Parga JA, Celemin-Viñuela A. Natural tooth color estimation based on age and gender. J Prosthodont. 2017; 26: 107-114. doi: 10.1111/jopr.12345. Epub 2015 Sep 15

10）Rodrigues S, Shetty SR, Prithviraj DR. An evaluation of shade differences between natural anterior teeth in different age groups and gender using commercially available shade guides. J Indian Prosthodont Soc. 2012; 12: 222-30. doi: 10.1007/s13191-012-0134-9. Epub 2012 Jun 22.

11）Yilmaz B, Karaagaclioglu L. In vitro evaluation of color replication of metal ceramic specimens using visual and instrumental color determinations. J Prosthet Dent. 2011; 105, 21-27.

12）Bahannan SA. Shade matching quality among dental students using visual and instrumental methods. J Dent. 2014; 42: 48-52.

13）Sarafianou A, Kamposiora P, Papavasiliou G, Goula H. Matching repeatability and interdevice agreement of 2 intraoral spectrophotometers. J Prosthet Dent. 2012; 107: 178-85.

14）Ueda T, Takagi I, Ueda-Kodaira Y, Sugiyama T, Hirose N, Ogami K, Mori K, Sakurai K. Color differences between artificial and natural teeth in removable partial denture wearers. Bull Tokyo Dent Coll. 2010; 51: 65-68.

15）Sellen PN, Jagger DC, Harrison A. The selection of anterior teeth appropriate for the age and sex of the individual. How variable are dental staff in their choice? J Oral Rehabil. 2002; 29: 853-857.

16）Kato T, Wada H. Distribution of clinical shade. J Jpn Academy Color Dent. 2005; 11: 45-48（in Japanese with English abstract）.

17）Tsiliagkou A, Diamantopoulou S, Papazoglou E, Kakaboura A. Evaluation of reliability and validity of three dental color-matching devices. Int J Esthet Dent. 2016; 11: 110-124.

18）Yuan K, Sun X, Wang F, Wang H, Chen Ji-h. In vitro and in vivo evaluations of three computer-aided shade matching instruments. Oper Dent. 2012; 37: 219-227.