Research article

Availability, type, brand, and price as preference of shade matching tools for dentists in Jakarta's dental sector: a cross-sectional study

Octarina Octarina[1]*
Carinna Tirtania[2]
Stella Maria Fidela Maringka[2]
Astri Rinanti[3]
Fathilah Abdul Razak[4]

[1]Department of Dental Materials, Faculty of Dentistry, Universitas Trisakti, Jakarta 11440, Indonesia
[2]Undergraduate Study Program Faculty of Dentistry, Universitas Trisakti, Indonesia
[3]Department of Environmental Engineering, Faculty of Landscape Architecture and Environmental Technology, Universitas Trisakti, Indonesia
[4]School of Dentistry, Management and Science University, 40100 Shah Alam, Selangor, Malaysia

***Correspondence**
Email | octarina@trisakti.ac.id

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ABSTRACT

Introduction: Shade selection in aesthetic dental procedures remains a challenge in dentistry. This challenge arises due to the high complexity of natural tooth color. The use of a shade guide as a form of communication between dentists and dental technicians is highly subjective, leading to the emergence of digital methods that offer a higher level of accuracy and consistency. The purpose of this research is to assess the type, brand, and price as preference of shade matching tools for dentists in Jakarta's dental sector. **Methods:** The survey was conducted as a descriptive observational study using cluster sampling through questionnaires and a review of shade matching product catalogs from 30 dental suppliers, 4 dental clinics, and 7 dental laboratories in Jakarta. **Results:** There is a variety in the price and availability of shade matching products sold by dental suppliers in Jakarta, with VITA branded products dominating the market, including VITAPAN Classical (25%), VITA Classical (15%), VITA 3D Master (12%), and Ivoclar Vivadent (12%). In both clinics and dental laboratories, all respondents reported using visual methods, with VITA Classical and VITA 3D Master being the most commonly used products. **Conclusion:** Shade matching products available from dental suppliers, as well as their use in clinics and laboratories in Jakarta, are predominantly based on visual methods, with VITA Classical and VITA 3D Master being the most preferred shade guides. Digital shade matching methods are rarely encountered, mainly due to product complexity, cost, distribution limitations, and lack of training.

Keywords

Color, dental clinics and laboratories, digital dentistry, shade guide, shade matching

Ketersediaan, tipe, merk, dan harga sebagai preferensi alat pencocokan warna oleh dokter gigi di sektor kedokteran gigi jakarta: survei potong lintang

ABSTRAK

Pendahuluan: *Pemilihan warna dalam prosedur estetika menjadi tantangan dalam kedokteran gigi. Tantangan ini muncul karena warna alami gigi memiliki kompleksitas yang tinggi. Penggunaan shade guide sebagai bentuk komunikasi antara dokter gigi maupun teknisi laboratorium bersifat sangat subjektif sehingga muncul metode digital yang menawarkan tingkat akurasi dan konsistensi yang lebih tinggi. Tujuan penelitian ini adalah untuk mengevaluasi jenis, merek, dan harga sebagai preferensi alat pemilihan warna bagi dokter gigi di Jakarta.* ***Metode:*** *Survei dilakukan sebagai penelitian observasional deskriptif menggunakan sampling klaster dengan mengajukan pertanyaan serta penelahaan katalog produk shade matching pada 30 dental supplier, 4 klinik gigi, dan 7 laboratorium gigi yang ada di Jakarta.* ***Hasil:*** *Terdapat berbagai variasi dalam harga dan ketersediaan produk shade matching yang di jual dental supplier di Jakarta, dengan dominasi produk bermerek VITA, yaitu VITAPAN Classic (25%), VITA classical (15%), VITA 3D Master (12%) dan Ivoclar Vivadent (12%). Pada klinik dan laboratorium gigi didapatkan hasil bahwa seluruhnya menggunakan metode visual dengan produk yang paling banyak digunakan yaitu VITA Classical (27%) dan 3D Master (36%).* ***Simpulan:*** *Produk shade matching yang tersedia di dental supplier serta penggunaannya di klinik dan laboratorium Jakarta didominasi metode visual dengan VITA Classical dan 3D Master menjadi shade guide yang paling digemari. Metode pencocokan warna dengan metode digital jarang ditemui disebabkan kompleksitas produk, kendala harga, distribusi, dan kurangnya pelatihan.*

Kata kunci

Kedokteran gigi digital, klinik gigi dan laboratorium, shade guide, shade matching, warna

INTRODUCTION

Color is a visual perception phenomenon that occurs in response to the reflection or transmission of light through an object. Accurate tooth shade determination presents a significant challenge in dentistry, particularly in aesthetic procedures such as the fabrication of veneers, crowns, and dentures. This challenge arises due to the high complexity of natural tooth color, which is influenced by multiple factors including enamel thickness, dentin color, translucency, and light interaction.[1,2] Visual color evaluation is inherently subjective and is affected by various factors such as age, gender, ambient lighting, observer experience, and eye fatigue.[3,4] Inaccuracies in shade selection can result in unsatisfactory restorations for both patients and practitioners.[5,6]

The conventional method for shade matching involves visual comparison using a shade guide for color communication.[7] Although shade guides assist dental professionals, they have limitations, and their use as an intermediary tool often introduces potential errors. These errors can arise either during shade selection by the dentist or during color replication by the dental technician, particularly when different types of shade guides are used.[1,8] Commercially available shade guides are generally used as the standard reference in tooth shade matching. However, they do not comprehensively represent the full range of natural tooth color variations, and the color distribution provided is often not systematically organized.[9,10] Additionally, lighting conditions in dental clinics are frequently suboptimal, further complicating the shade selection process.[5,11] In dental practice, three primary light sources are typically used: operatory lamps, natural daylight, and fluorescent lights. Optimal conditions for shade selection involve lighting with a color temperature between 5500 to 6500 K and a Color Rendering Index (CRI) above 90.[12,13]

Such discrepancies may lead to time-consuming revisions, increased costs, and delays in restoration completion. Placing dental clinics and laboratories in the same or adjacent locations allows for direct and real-time shade verification, enabling technicians to observe the clinical condition of the patient firsthand. This not only minimizes the risk of shade matching errors but also expedites revision processes when necessary, ultimately enhancing workflow efficiency and patient satisfaction with the final restoration.

To address the limitations commonly associated with visual shade selection methods, contact-based shade matching devices such as spectrophotometers and colorimeters have been developed as more accurate and objective solutions.[14,15] These devices operate by calibrating each shade and assigning a specific value according to a defined color scale, providing a standardized and reproducible method for shade determination. These devices are capable of capturing color data with a higher degree of precision and minimizing errors that may arise from external variables such as lighting conditions or visual fatigue.[16] This technology provides more consistent and reproducible results, enabling dentists to select restorative shades that more accurately correspond to the patient's natural tooth color.[17,18,19]

The rapid growth in the number of dental clinics and laboratories in Jakarta has led to variation in the tools and technologies used for shade matching. Despite significant advances in dental technology, there is still insufficient data on the most commonly used shade matching devices. This study offers clear novelty by being the first to map the availability, pricing, and brand distribution of shade matching tools from the perspective of 30 dental suppliers in Jakarta, while simultaneously analyzing their actual use in clinics and laboratories.

The finding that only one supplier provides a digital shade-matching device demonstrates the extremely low adoption of digital technology in Jakarta due to high costs, limited distribution, and insufficient training. The novelty of this research was the three-sector approach that provides a comprehensive market and usage landscape that has not been previously reported in Indonesian dental research. The purpose of this research is to assess the availability of shade matching products and tools in Jakarta's dental sector.

METHODS

This study employed a descriptive exploratory survey method with the objective of exploring the shade matching products available from dental suppliers in the Jakarta Capital Region (DKI Jakarta) and the usage of shade matching products in dental clinics and laboratories, specifically in South Jakarta and West Jakarta. The selection of West Jakarta and South Jakarta as the research locations was based on accessibility considerations. Clinics in these areas are relatively easy for the researchers to reach, allowing for more efficient data collection and better logistical management.

The research utilized a purposive sampling method to select participants who met the inclusion criteria and were relevant to the research objectives. The research was conducted in October 2024 and January 2025. Data collected from questionnaires and product catalogs were compiled and processed using Microsoft Excel. Descriptive statistical analysis was used to calculate frequency distributions, percentages, and to visualize the data in the form of charts and tables to highlight trends in product availability, pricing, and user preferences.

Before the full-scale data collection, a pilot test was conducted involving three general dentists who own and operate private dental clinics in West Jakarta. These participants were not included in the main study sample. The purpose of the pilot test was to ensure that the questionnaire items were clearly understood and that respondents would be able to provide relevant and accurate answers. No major difficulties were reported during the pilot, and the questionnaire was considered appropriate for use in the main study.

A total of 30 dental suppliers were selected using purposive sampling. Suppliers were included if they were located in Jakarta, had operated for at least five years, sold restorative or shade-matching products, provided an accessible product catalog, and responded to the research communication. Suppliers that did not sell shade-matching products, were unresponsive, or lacked verifiable catalog information were excluded. The final sample reflects all suppliers that met the eligibility criteria and were able to provide complete data for analysis.

Data collection was carried out through direct communication with the suppliers via online chat platforms, as well as by reviewing the product catalogs provided by each supplier to obtain detailed information about the types, quantities, and brands of shade matching products available. The inclusion criteria for this study were dental suppliers based in Jakarta who responded to WhatsApp messages and provided accessible product catalogs for review.

Table 1. Research instrument –*dental supplier survey*

No	Aspects inquired	Question	Objectives
1	Availability of shade matching products	Does your company currently sell shade matching products?	To identify whether shade matching products are included in the sales catalog
2	Types and brands of shade matching products sold	What brands of shade matching products are available at your company? Would you be willing to specify the brand names?	To determine the variety and types of brands available on the market through dental suppliers
3	Price of shade matching products	What is the price range of the shade matching products available at your company?	To collect information on product pricing as part of a market analysis

The questions posed to the dental suppliers during data collection covered three main aspects: (1) whether the supplier includes shade matching products in their sales catalog; (2) which brands of shade matching products are available and whether the supplier was willing to specify them by name; and (3) the price range for each shade matching product offered (Table 1).

This part of the study was conducted in South Jakarta and West Jakarta, involving a total of 29 facilities—comprising 20 dental clinics and 9 dental laboratories. However, of all

participants, only 4 dental clinics had in-house laboratories, and 7 dental laboratories were willing to provide information regarding the shade guide products used in their practice. The inclusion criteria in this study covered dental clinics and dental laboratories located in Jakarta that were willing to respond to WhatsApp messages. For dental clinics, additional criteria included the provision of specialized dental services, having dentists with clearly documented and verifiable educational backgrounds, serving patients from middle to upper socioeconomic groups, and implementing appropriate health protocols supported by adequate facilities to ensure the quality of care provided. Subjects were selected purposively based on relevant criteria. The selected clinics offered specialist services, including restorative and esthetic dental care, and primarily catered to middle- to upper-income patients, with a minimum restoration fee of IDR 500,000.

In addition, these clinics demonstrated significant digital presence, indicated by having more than 1,000 followers on social media, professional dentist profiles on digital platforms, and active official websites. Reputation and public trust were also selection criteria, reflected in partnerships with various health insurance providers, a minimum Google review rating of 4.5 stars, and a track record of serving celebrity and influencer clients. The selected clinics also adhered well to health protocols, supporting their credibility and quality of service.

These inclusion criteria related to clinic reputation and dentist credibility were intentionally applied to ensure that the participating clinics represent a higher standard of esthetic dental care, where shade selection is more likely to be a key consideration in restorative procedures. The fundamental aim was to explore the preference and usage of shade matching products specifically in clinical settings with greater esthetic demand and higher service quality. Clinics with strong reputations and a robust digital presence are generally more exposed to a wider range of shade matching products, both conventional and digital, making them more relevant for capturing current brand usage trends in the field.

The limited sample size in this study was influenced by the low response rate from clinics and laboratories when requested to provide information about the use of shade guides in their practice. Many facilities either did not respond or declined to share data, primarily due to concerns over privacy, limited time, or communication barriers.

Data in this study were collected using three main approaches: (1) examination of the official websites of the clinics and laboratories, (2) content analysis of social media uploads, and (3) direct communication with clinic and laboratory representatives via online messaging applications. The questions posed to the dental clinics focused on three main aspects:(1) whether the clinic has an in-house dental laboratory; (2) whether the clinic uses a shade guide in dental procedures and restorative shade selection for patients; and (3) which shade guide brands are used in their clinical practice (Table 2).

Table 2. Research instrument – dental clinic and laboratory survey

No	Aspects inquired	Question	Objectives
1	Affiliation with a dental laboratory	Is your dental clinic affiliated with an internal (in-house) dental laboratory?	To identify whether the clinic has its own laboratory facilities to support treatments
2	Used of shade guides in dental treatments	Does your clinic use shade guides in dental treatments and in selecting the shade for restoration?	To determine the use of shade guides in dental restoration shade selection
3	Brands of shade guide used	What brand(s) of shade guides does your clinic use in clinical practice?	To identify the brands of shade guides used in restorative procedures in dental clinics

The inclusion of a question regarding affiliation with a dental laboratory was intentionally made to provide additional context in understanding the operational systems of the clinics studied, particularly in distinguishing whether they have their own in-house laboratories or collaborate with external ones. Clinics with internal laboratories generally have easier and faster access to the shade matching process, including product selection decisions and

coordination with dental technicians. In contrast, clinics without their own laboratories rely more heavily on external parties, which can affect product availability, the flexibility of shade selection, and the overall workflow of esthetic restorations.

RESULTS

This study did not employ comparative statistical analyses, as it was designed as a preliminary descriptive study. The primary objective was to identify the types and brands of shade matching products available in the market, specifically those distributed by dental suppliers in Jakarta. In addition, the study aimed to provide an overview of the types of shade matching methods, both visual and digital, currently used by dental clinics and laboratories. Given its exploratory nature, the analysis was focused on frequency distribution and descriptive patterns to map the current landscape rather than to establish statistical associations or causal relationships.

This study involved a survey of 30 dental suppliers in Jakarta to identify the availability and pricing of shade matching products. The findings are presented in the following diagram. Based on the analysis of the price range distribution diagram of shade matching products from various dental suppliers, a significant variation was observed in pricing among different brands and product types, as well as in the number of dental suppliers offering these products. The highest-priced product was the VITA Easyshade V, with prices reaching up to IDR 35,000,000, followed by the VITA Linearguide 3D-Master and Ivoclar Vivadent Shade Guide ND, each offered at approximately IDR 3,000,000. These three products were available from only one dental supplier, indicating limited use in dental clinics and laboratories in the Jakarta area, possibly due to their high cost or more specific user needs.

In contrast, the most widely available and affordable product was the VITAPAN Classical, sold within a price range of IDR 89,000 to IDR 500,000 and available from eight dental suppliers. The high distribution level of this product reflects broad adoption in the field, which may be attributed to user familiarity, ease of use, and economic pricing. Other products with high distribution include VITA Classical A1-D4 (available from five suppliers), VITA 3D-Master, and the Ivoclar Vivadent A-D Shade Guide (each available from four suppliers). This indicates that VITA and Ivoclar brands dominate the shade matching market in terms of availability and user preference.

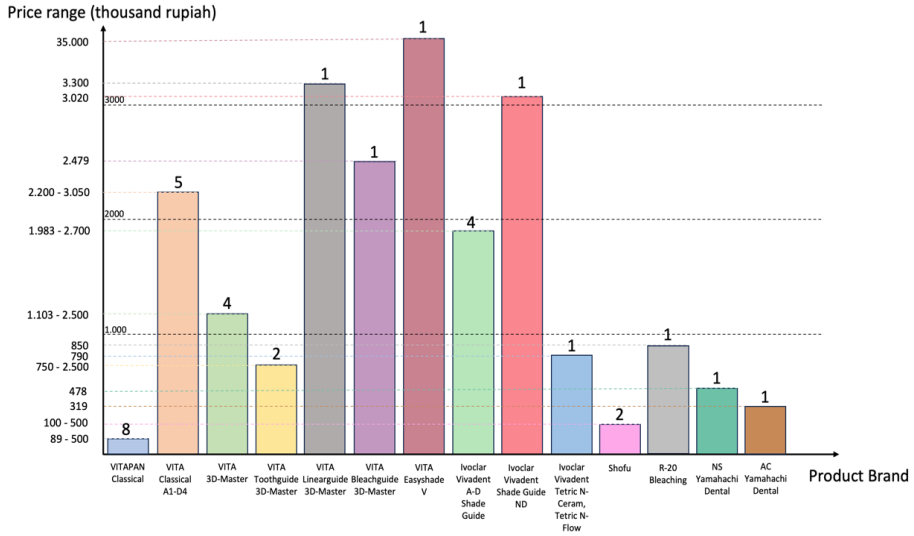

Figure 1. Price range of shade matching products from various dental suppliers

However, certain products from well-known brands—such as the VITA Toothguide 3D-Master, VITA Bleachguide 3D-Master, and Ivoclar Vivadent Tetric N-Ceram and Tetric N-Flow—are distributed by only one to two dental suppliers. This limited distribution may be attributed to the complexity of use or relatively low adoption among practitioners. Other products, such as those from Shofu, R-20 Bleaching, NS Yamahachi Dental, and AC Yamahachi Dental, are also available from only one to two suppliers and fall within the low to mid-price range, reflecting relatively low market preference.

Based on the percentage distribution diagram of shade matching products sold by various dental suppliers (Figure 1), there is a clear imbalance in the market distribution of shade matching products, with certain products dominating sales while others are used only to a limited extent. The VITAPAN Classical emerged as the most widely distributed shade matching product, accounting for 25% of the total market share. This underscores its market dominance, which is likely influenced by its affordability, high user familiarity, and ease of use.

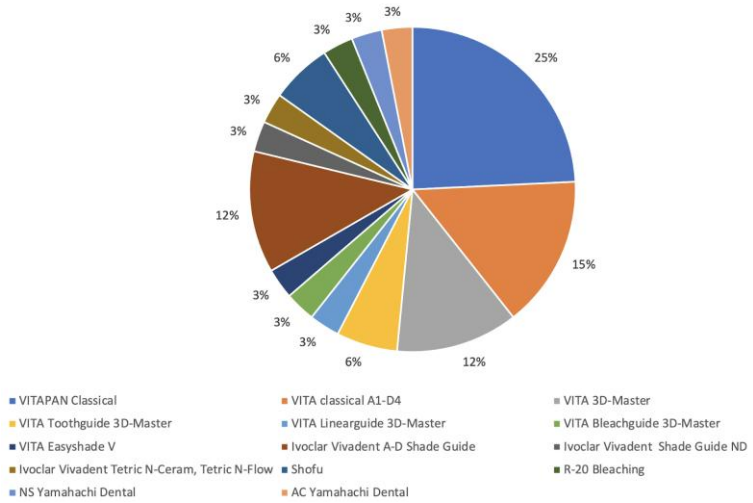

Figure 2. Percentage distribution of shade matching products sold by various dental supplier

Following this, the VITA Classical A1-D4 ranks second, with a distribution percentage of 15%, followed by VITA 3D-Master and Ivoclar Vivadent A-D Shade Guide, each accounting for 12%. The high distribution levels of products from VITA and Ivoclar indicate that these brands possess strong market trust and penetration among dental suppliers. Other products, such as the VITA Toothguide 3D-Master, VITA Linearguide 3D-Master, VITA Bleachguide 3D-Master, Ivoclar Vivadent Shade Guide ND, Ivoclar Vivadent Tetric N-Ceram, Tetric N-Flow, and brands such as Shofu, NS Yamahachi Dental, R-20 Bleaching, and AC Yamahachi Dental, each represents only 3% to 6% of the total distribution (Figure 2). The low distribution percentages of these products suggest limited market demand or a more restricted user base, potentially due to factors such as product complexity, limited availability, or market preference for more well-established brands.

A survey on the use of shade matching products was conducted among four dental clinics with in-house laboratories and seven dental laboratories located in South and West Jakarta, all of which were willing to provide information regarding the shade guides they use. Figure 3 illustrates the distribution of responding and non-responding facilities based on ownership category (clinic only, laboratory only, or both).

Among the non-responding group, the majority were facilities that operated both a clinic and a laboratory (53%), followed by clinic-only facilities (35%), and laboratory-only facilities (12%). In contrast, within the responding group, the majority were standalone dental

laboratories (64%), while the remaining 36% were integrated facilities with both clinics and laboratories. No standalone clinics were represented among the respondents.

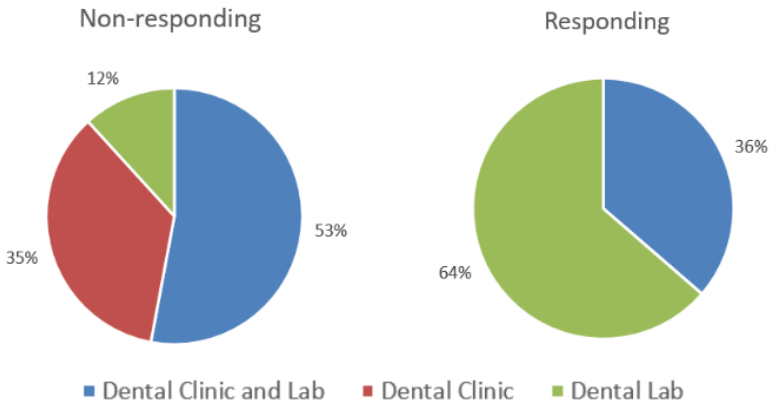

Figure 3. Ownership of Dental Laboratories and Clinics (in-house Lab)

Based on the data collected regarding the various shade guide products used in responding dental clinics and laboratories in South and West Jakarta (Figure 4), it is evident that the VITA 3D Master is the most commonly used shade guide, accounting for 36% of the total respondents. This suggests that many practitioners prefer this color guide due to its high color gradation accuracy and systematic approach in tooth color selection. It is followed by VITA Classical, used by 27% of facilities, indicating that this conventional shade system remains popular among practitioners. The VITA Lumin Vacuum is used by 14%, while VITAPAN Classic is used by 9%. Shade guides from Ivoclar and VITAPAN 3D Master are each utilized by 5% of respondents. Products from Ortholux are noted as the least used, with each accounting for only 4% of the distribution. Overall, these results highlight the dominance of VITA products as the primary shade guides used in the field, particularly the 3D Master and Classical versions.

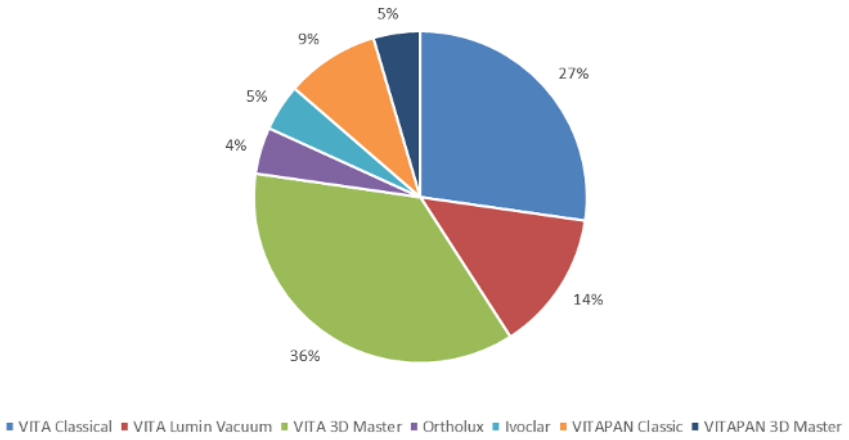

Figure 4. Shade guide products used in dental clinics and laboratories in South and West Jakarta

Figure 5 displays the results from 10 responding dental clinics regarding the service fees for zirconia-based prosthesis fabrication. A significant variation in service fees was found among the surveyed clinics. The majority of clinics, 50%, set fees in the range of IDR 5,000,000 – IDR 7,000,000 for zirconia prosthesis fabrication. This suggests that this price range is the most commonly offered standard, likely due to a balance between material costs, labor, and the purchasing power of patients in the area. Meanwhile, 30% of clinics charge

higher fees, ranging from IDR 7,000,000 – IDR 9,000,000. This range is typically found in clinics that offer more premium materials and technology or in locations with higher-income populations. 20% of clinics set fees above IDR 10,000,000, likely reflecting exclusive services, the use of high-quality zirconia (such as multilayer zirconia), or the inclusion of additional aesthetic procedures.

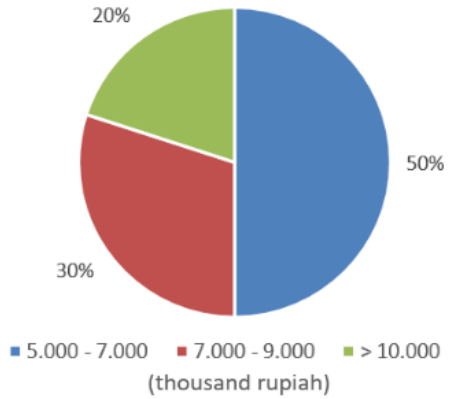

Figure 5. Prothesis fabrication services in dental clinics in South and West Jakarta

DISCUSSION

Based on a survey of 30 dental suppliers based in Jakarta (Figure 1 and 2), it was found that the availability of shade matching products, particularly those based on digital technology, remains very limited in Jakarta. The survey revealed that only one dental supplier offered a digital shade matching product in the form of a spectrophotometer, specifically the VITA Easyshade V.[17] This finding indicates that the adoption of digital technology in tooth shade matching is not yet a common practice among dental equipment distributors in Jakarta.

To the best of the authors' knowledge, there have been no previous studies that comprehensively examine the availability, brand distribution, pricing, and actual clinical use of shade matching tools across dental suppliers, clinics, and laboratories. Most existing studies have primarily focused on the accuracy, reliability, or comparison of visual and digital shade matching methods, rather than mapping market availability and real-world usage patterns within a specific dental ecosystem.[20,21,22] Therefore, this study can be considered a preliminary investigation that provides baseline data on the current landscape of shade matching tools in Jakarta's dental sector. The findings of this study may serve as a reference for future research with larger sample sizes, broader geographic coverage, and more in-depth analytical approaches to further explore trends, barriers, and technological adoption in dental shade matching.

This lack of adoption is attributed to the dominance of imported products in the dental equipment industry (approximately 90%), which impacts both availability and high prices, especially in remote areas.[18] The high initial investment cost, the widespread circulation of counterfeit products that are cheaper but of lower quality, and the lack of training and understanding among dental practitioners all contribute to the slow adoption of this technology. Moreover, limitations in infrastructure and access to digital devices further reinforce the tendency to rely on conventional visual methods. These obstacles not only affect financial aspects but also have implications for the quality of restorative care provided to patients.[23]

From a survey of 4 dental clinics with in-house labs and 7 dental laboratories in Jakarta (Figure 3), it was found that conventional visual shade matching methods are still the

dominant approach. The most commonly used shade guide products are from the VITA brand, particularly the VITA Classical and VITA 3D Master. There have been no previous studies that comprehensively examine the availability, brand distribution, pricing, and actual clinical use of shade matching tools across dental suppliers, clinics, and laboratories. Most existing studies have primarily focused on the accuracy, reliability, or comparison of visual and digital shade matching methods, rather than mapping market availability and real-world usage patterns within a specific dental ecosystem.[20,21,22] These findings indicate that the variety of shade matching products used in dental clinics and laboratories in Jakarta is still limited.

Figure 4 shows that conventional visual shade matching using a shade guide remains the most commonly applied procedure in clinical practice due to its simplicity. There have been no previous studies that comprehensively examine the availability, brand distribution, pricing, and actual clinical use of shade matching tools across dental suppliers, clinics, and laboratories. Most existing studies have primarily focused on the accuracy, reliability, or comparison of visual and digital shade matching methods, rather than mapping market availability and real-world usage patterns within a specific dental ecosystem.[20,21,22] Although the esthetic outcomes of restorations may be inconsistent, these inaccuracies are not always due to flaws in the shade selection method itself.[20] The findings of this study show that the VITA 3D Master shade guide is the most widely used in almost all surveyed clinics and laboratories due to its ease of use and wide availability in the market.[24] These results align with other studies which state that VITAPAN (Vita Zahnfabrik, Bad Säckingen, Germany) is widely regarded as the gold standard for shade selection in esthetic dental restorations.[25]

In general, conventional visual shade guides such as VITA Classical are easy to use and widely available in the market. These products offer an organized arrangement of shades and can visually produce acceptable esthetic results.[7] However, visual methods also have limitations, particularly in terms of accuracy and consistency. Visual shade evaluation is subjective and influenced by several factors such as lighting, operator eye fatigue, clinical experience, and individual differences in color perception.[26,27] As a result, shade selection outcomes can vary, and the risk of bias in restoration shade selection becomes significant.[9,28]

With technological advancements, solutions to overcome these limitations have emerged, one of which is the use of digital devices such as spectrophotometers like the VITA Easyshade V, which can objectively, quickly, and consistently measure the color of a patient's tooth. This device helps reduce reliance on visual observation and can significantly improve the accuracy of restoration shade matching.[12,13,29]

The variation in zirconia prosthesis fees shown in Figure 5 provides additional context for understanding the limited adoption of digital shade-matching technologies. There have been no previous studies that comprehensively examine the availability, brand distribution, pricing, and actual clinical use of shade matching tools across dental suppliers, clinics, and laboratories. Most existing studies have primarily focused on the accuracy, reliability, or comparison of visual and digital shade matching methods, rather than mapping market availability and real-world usage patterns within a specific dental ecosystem.[20,21,22] Clinics charging higher fees (IDR 7,000,000 and above) likely serve higher-income populations and may have greater capacity to invest in advanced digital tools; however, no clinics in this study reported using digital devices. This indicates that the barrier to digital adoption is not solely economic at the clinic level but may also be influenced by limited availability from suppliers, insufficient training, and low market penetration. Conversely, clinics offering mid-range fees (IDR 5,000,000–7,000,000) appear to rely entirely on visual shade guides, reinforcing the finding that conventional methods remain the default approach regardless of service pricing.

However, the use of digital devices like spectrophotometers in Jakarta especially in private clinics and mid-sized laboratories is still very limited. Identified barriers include the high cost of these devices and limited availability from local distributors. Furthermore, investing in this technology is not yet seen as essential by many practitioners, especially if

conventional shade guides are deemed sufficient for their patient's needs. Additionally, adopting digital shade matching technology requires specific training for dentists and dental laboratory staff.[30] Without adequate understanding of how the device works, such as proper positioning on the tooth, correct lighting settings, and interpretation of the results, advancements in this technology will be hindered. Proper device calibration is also critical to ensure the accuracy of shade matching results.[31]

To encourage the adoption of digital shade matching technology in dental practice in Indonesia, a strategic approach is needed, including education, financial support, and infrastructure development. Training through seminars, workshops, and courses can enhance clinicians' knowledge and skills in using this technology, while subsidy programs or partnerships with digital device manufacturers can help reduce the barrier of high initial investment costs. Developing locally produced products that are tailored to Indonesia's clinical characteristics and materials is also important for increasing availability and reducing costs. Integrating digital technology training into dental education curricula will ensure that future generations are prepared to adopt these innovations.

Although many practitioners are not yet familiar with this technology, the main challenge lies in the variety of devices and differing features among brands, which can be addressed through in-depth training. Furthermore, the distribution of more diverse shade matching products also needs to be considered, as the products currently used in Jakarta are limited to only a few brands. Therefore, distributors should broaden their product offerings so that dentists and dental laboratories have more options for color comparison and are encouraged to adopt the technology more widely.

This study has several limitations. The sample size was relatively small and geographically restricted, including only 30 dental suppliers, 4 dental clinics with in-house laboratories, and 7 dental laboratories located in South and West Jakarta. The low response rate, primarily due to the use of online communication platforms, may have led to selection and non-response bias. In addition, much of the data was obtained from indirect sources such as websites and social media, which may affect the accuracy and reliability of the findings.

To overcome these limitations, future research should involve a wider range of participants from various regions of Jakarta and other major cities in Indonesia. Direct engagement through face-to-face communication is recommended to improve response rates and data accuracy. Furthermore, combining data collection methods such as interviews, observations, and document reviews can enhance the validity and provide a deeper understanding of clinical practices related to shade matching in dentistry.

CONCLUSION

The findings of this study highlight the urgent need to improve access to and adoption of digital shade-matching technologies in Jakarta. The dominance of conventional visual methods and the limited availability of digital devices indicate gaps in distribution, clinician training, and investment in digital dentistry. These results imply that policy makers, dental associations, and distributors must prioritize training, education, and improved product availability to enhance the accuracy and consistency of aesthetic dental restorations. Strengthening this ecosystem may directly elevate clinical outcomes, laboratory communication, and the overall quality of esthetic dentistry services in Indonesia.

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Ethical Approval: 761/S1/KEPK/FKG/6/2024
Institutional Review Board Statement: The study was conducted in accordance with all the provisions of the dental clinics and laboratories, specifically in South Jakarta and West Jakarta. The approval for this A total of 30 dental suppliers
Informed Consent Statement: Informed consent was obtained from all subjects involved in the study
Data Availability Statement: Statement of consent was obtained from all subjects involved in this study.
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