Color in zirconia-base restorations
Farhad Tabatabaian1, Minoo Mahshid2, Habib Mirzaei Amirabad3
1, 2 Department of Prosthodontics, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran; 3 Dentist

Introduction
Recently the use of zirconia crown due to the appropriate biocompatibility and high strength has been increased in restorative dentistry. Advanced CAD/CAM systems have been well established in prosthodontics in order to fabricate zirconia restorations. From esthetic point of view, zirconia crowns have advantages compared with metal ceramic crowns, which is caused by the metal margin and its show beyond the gingiva. However the requirement to achieve natural looking restorations is still challenging and the shade matching of the restorations with the natural dentition is difficult due to the complex optical characteristics of natural tooth. Successful color selection depends on dentist perception of color, light source for color evaluation, surface characteristics of tooth and restorative material, and having knowledge of basic principles of color perception. Moreover, dentists should be able to clearly communicate instructions with dental technicians. The practical steps include: to select the best possible shade using a shade guide and/or an electronic shade taking device and to reproduce this shade with an appropriate dental material.

Shade selection in zirconia-base restorations seems to be unpredictable, because of the different factors which affect the target color of restoration. These factors include: dental core (background), cement, zirconia core, porcelain layers of dentin and enamel, glue, and manufacturing processes. The color measurement, perceptual threshold, shade selection, measuring devices, and shade reproduction in zirconia-base restorations are demonstrated as follows.

Color measurement
First dental shade guide, which was introduced to dentistry, was the Vitapan Classical with 16 Tabs. Though this shade guide is easily used, it is not supported logically by the literature. The CIELab color system was developed in prosthodontics in order to fabricate zirconia restorations. From esthetic point of view, zirconia crowns have advantages compared with metal ceramic crowns, which is caused by the metal margin and its show beyond the gingiva. However the requirement to achieve natural looking restorations is still challenging and the shade matching of the restorations with the natural dentition is difficult due to the complex optical characteristics of natural tooth. Successful color selection depends on dentist perception of color, light source for color evaluation, surface characteristics of tooth and restorative material, and having knowledge of basic principles of color perception. Moreover, dentists should be able to clearly communicate instructions with dental technicians. The practical steps include: to select the best possible shade using a shade guide and/or an electronic shade taking device and to reproduce this shade with an appropriate dental material.

Shade reproduction in zirconia-base restorations
Use of zirconia frameworks are gaining popularities due to good mechanical and physical properties of zirconia and its biocompatibility. Also CAD/CAM systems have been employed to fabricate zirconia substructures. From esthetic point of view, zirconia in white and optically acts as a semi translucent material (4). Translucency may be positive or negative effect in different cases. For example over a discoloured tooth or amalgam core, a highly masking material with opacity is needed and on a natural dentin core a translucent material is indicated. Veneering porcelain on zirconia core can reduce translucency (5). To compensate for the possible negative effect of the white color of zirconia on the target color, use of liner or glazing or pre-colored zirconia has been proposed (6). Target color of zirconia restoration depends on both core and veneer thickness (7). Color of opaque cements like zinc phosphate cannot be compensated perfectly by the veneering porcelain (9). Increasing zirconia core thickness from 0.4 mm to 0.8 mm affects the target color, but increasing from 0.8 mm to 1.0 mm has no impact on the target color (10). Wang et al (11) suggested a computer color matching system for zirconia-base restorations which enables dentists to provide patients with restorations that match a targeted color tooth more reliably. Laboratory technicians and dentists will be able to measure tooth color and generate a formula that will allow them to reproduce a patient’s tooth color. This system is similar to what is now used in textile industry. It seems that color in zirconia-base restorations needs specific shade guides and more investigations in future.

Conclusions
1. There is not sufficient data on the color of zirconia restorations in the literature.
2. For shade selection using traditional shade guides and shade taking devices are both necessary.
3. New shade guides for zirconia restorations should be developed.
4. Prosthodontics will be directed to create the target color for zirconia restorations with minimum error by precise and accurate formulations.

References
5. Wang Y, Minoo Mahshid, Sinmazisik G, Demirbas B, Tarcin B. Influence of den...