

Basic researches and clinical applications on the sintered alumina core infiltrated with glass



Yonglie Chao DDS, M. Med

1. Graduated from Faculty of Stomatology, Sichuan Medical College in 1968
2. Visiting scholar and a guest professor at University of Toronto in 1984~1986
3. Visiting scholar and a guest professor at University of Groningen in 1994
4. Professor in Department of Prosthodontics since 1993
5. He was the former chairman of Department of Prosthodontics and the former vice dean of College of Stomatology, West China University of Medical Sciences. Now, he is a professor in Department of Prosthodontics, West China College of Stomatology, Sichuan University
6. President of Chinese Prosthodontic Society(CPS), Chinese Stomatological Association (CSA) between Sept. 2002 to Aug. 2006
7. Vice president of Asian Academy of Prosthodontics(AAP) between 2001~2005
8. Professionally interested in all-ceramic restorations, metal-ceramic restorations

Aesthetic concerns and increasing demand for high strength have led to the introduction of all-ceramic restorations. Among those all-ceramic restorations, the distinguishing features of sintered alumina core infiltrated with glass are noted for high strength and simple slip-casting technique. In-Ceram restorations have three to four times higher flexural strength than conventional ceramic ones and also enjoys much higher fractural toughness.

In this study, a brief introduction of In-Ceram alumina and clinical results were viewed. In-Ceram products consist of Vita In-Ceram Alumina, Spinell, Zirconia and In-Ceram/Celay. The slip-casting technique was used for fabricating alumina core and anterior bridge frameworks with short span. A dispersion of alumina particles in a special liquid called as slip, is painted on a gypsum die, which called casting. The slip-casting alumina is first sintered, and then infiltrated with glass in the second fire to perform the core or bridge frameworks. The decorating porcelain is then coated onto the cores. The good dimensional stability and high strength have been analysed. For example, In-Ceram Alumina offers a lower shrinkage of 0.21-0.28%, a higher flexural strength of σ_3p 430MPa(Kappert) and fractural toughness of K1C 3.86 MPa.m^{1/2}. The infiltrated glass exists a thermal expansion ratio of $7.59 \times 10^{-6} / ^\circ\text{C}$ (600 $^\circ\text{C}$) and the ratio of the Alumina $7.95 \times 10^{-6} / ^\circ\text{C}$ (600 $^\circ\text{C}$), excellent marginal fit of 57 μm (Shearer).

We developed GI system of the alumina core infiltrated with glass in China. GI system exhibits easy handling, feasible and

better color match for person with yellow skin. The die material remains a setting time of 10min, setting expansion of 0.29% (24hrs). The alumina shrinkages within the limit of 0.30%. The infiltrated glass exists a thermal expansion ratio of $7.20 \times 10^{-6} / ^\circ\text{C}$ (25-500 $^\circ\text{C}$) and the ratio of the core $6.997 \times 10^{-6} / ^\circ\text{C}$ (25-500 $^\circ\text{C}$). The infiltration needs 1.5 hrs and 3 hrs to be completed for a core or short span bridgeworks. GI system offers highly flexural strength of σ_3p 390 MPa and fractural toughness of K1C 3.24 MPa.m^{1/2}, higher elastic modulus of 92.0 GPa, excellent marginal fit of 51 μm , natural aesthetics and encouraging clinical results.

The clinical examinations were performed basically according to the criterion established by California Dental Association. It includes marginal integration, outline, surface smoothness and color match. In addition to those, wear of the restoration, gingival index (loe & Silness 1967) and plaque index (Silness & Loe 1964) were to evaluate wear-ability, irritation to the gingival and plaque adhesion. The three-years results showed marginal integration of 95.2%, best outline of 90.5%, surface smoothness of 100%, color match of 89.9%, almost no wear of the restoration, no statistic differences of gingival index and plaque index between prior and after cementation.

There is no doubt, a renaissance of all-ceramic restorations. But the longitudinal research of glass-infiltrated, sintered alumina restorations continues for a long time.