

INTERVIEW



An interview with

Toru Nikaido

INTRODUCTION

Dr. Nikaido graduated as a dental surgeon at Hokkaido University in 1985. In 1990, he completed his PhD at Tokyo Medical and Dental University (TMDU), under the supervision of Professor Dr. Nabuo Nakabayashi. Until last year he was a professor, with the position of “Senior Lecturer”, in the area of Cariology and Operative Dentistry, at Department of Oral Health Sciences, TMDU Graduate School of Medical and Dental Sciences. In 2019, he transferred to the Asahi University School of Dentistry, where he works in the Division of Oral Functional Sciences and Rehabilitation, Department of Operative Dentistry.

His research topics approach basic and clinical aspects of Adhesive Dentistry, Operative Dentistry and Preventive Dentistry. He is on the editorial board of scientific journals: Dental Materials Journal and Journal of Adhesive Dentistry. He is currently the Associate Editor for Asian Pacific Journal of Dentistry. He was a guest scientist at National Institute of Standards and Technology, USA, in 1995. He was a visiting professor at State University of Campinas, Brazil, in 2003, and at Chulalongkorn University, in Thailand, in 2008. He published more than 150 articles of high scientific level.

Marcelo Giannini — Interview coordinator

Although the use of self-etching adhesives is increasing worldwide, several clinicians still use the acid etching of the dentin tissue in their daily practice. In this case, the collapse of the collagen fibrils network is always a concern, and the wet bonding is generally recommended. However, special solvents were developed, as well new monomers blends are available in the recent adhesive formulations. Do you think that the blot drying technique should be still recommended for the new adhesives? (Carlos Rocha Gomes Torres)

Generally, blot dry technique is not ideally put into practice. Shapes of the cavities after caries removal are variable. If you prepare a class I cavity, the cavity is composed of cavity floor and cavity walls. The direction of each surface of the cavity are dimensionally different. The blot dry technique requests each surface at the same time. We can get a blot dry at the laboratory situation because the dentin surface is always flat. However, it is impossible to control moist condition in the cavity. If blot dry can be kept at the cavity floor, other cavity wall may be too dry. If the blot dry can be achieved at the cavity wall, cavity floor must be overwet. Recently, new adhesives, which contains a hydrophilic methacrylate and special solvents, were commercialized. The bonding performance to phosphoric acid etched dentin

may be improved, however, phosphoric acid etching is too drastic for dentin. The monomers cannot penetrate into the demineralized dentin completely¹. After curing the penetrated monomers within the demineralized dentin, the hybrid layer must contain defect within the hybrid, resulting in deterioration of the hybrid layer and decreasing the long-term bonding durability. Dentin should not be etched with phosphoric acid with/without using the new adhesives including additional monomers.

2) The durability of the bonding to the tooth structure is currently one of the main concerns. Several attempts to inactivate the dentin metalloproteinases were proposed, and one of the most popular one is the use of chlorhexidine gluconate. Based on in vitro studies that shown its ability to reduce the collagen degradation, some clinicians and professors started to use and recommend this additional step. However, the studies still show that degradation, although reduced, was not completely prevented. Do you think that use of chlorhexidine can produce a relevant clinical effect on an adhesive composite restoration? Are there any advances on this area? (Carlos Rocha Gomes Torres)

The *in vitro* study clearly demonstrated that chlorhexidine has a possibility to reduce collagen degradation. However, if the chlorhexidine treatment is added before the bonding procedures, eventually number of the bonding steps increased. Complication of the bonding systems may be not accepted from the practitioners. Also, the issue of the collagen degradation has been always discussed in acid etch systems, but not self-etch systems. If a self-etch adhesive system is used, collagen exposure is limited. After polymerization of the adhesive, the demineralized collagen can be capsulized by cured

adhesive, resulting in protection of the demineralized collagen from the hydrolytic degradation.

3) The use of universal adhesives is becoming more popular. They claim to be able to promote excellent bonding to all kind of natural tissues and restorative materials. Based on your background, do you think that universal adhesives could produce equivalent results in relation to a separate application of silane, metallic or zirconia primers? (Carlos Rocha Gomes Torres)

The universal adhesive is very improved in bonding to enamel, dentin, and restorative materials. However, it is very difficult to bond to all the substrates perfectly, because the key technology to each substrate is different. Also, the most important substrate is dentin, because of minimal intervention policy and protection of pulp. The best adhesive procedures should be selected to achieve good bonding to dentin. From this stand point, separated application of silane, metallic or zirconia primers should provide more reliable results at this time.

After the end of patent of MDP molecule by Kuraray, almost all manufacturers started to use this monomer on their adhesive formulations. Do you think that all MDP containing adhesives would have the same benefits of the original formulation? Is there any phosphate containing monomer molecule as effective as MDP? (Carlos Rocha Gomes Torres)

At this time, MDP is believed to be the best among the functional monomers. From the previous study, GPDM used in the Optibond XTR (Kerr) is also a good monomer^{2,3}. However, MDP is just a key material

for dentin bonding systems. Generally, dentin adhesives are composed of several ingredients, such as hydrophilic and hydrophobic monomers, solvents and catalysts. These ingredients may influence bonding performance to tooth substrates⁴. Matsui et al. (2015) reported that addition of MDP in adhesive resin affected the mechanical property of the bonding resin. Kakiuchi et al. (2018) also reported the similar results in their study⁵, but combination of MDP and NaF in adhesive resin inhibit reduction of the mechanical property of the adhesive resin.

The values bond strength to the dentin are always used by the manufacturers on their adhesive merchandize, to indicate the quality of their products. However, depending of how the measurement was performed, completely different values can be obtained. Do you think there is a minimal bond strength value an adhesive formulation would produce to guarantee the quality of a commercial product? Do you think that clinically, restorations performed with an adhesive that showed 20 MPa of bond strength to the dentin would last longer than one that showed 40 MPa, with the same method of evaluation? (Carlos Rocha Gomes Torres)

The dentin bond strength obtained from the test is not a absolute value, which is influenced by

condition of specimen preparations and also testing, such as species, dentin region (superficial/middle/deep, coronal/root, young/adult, incisor/molar, etc.), species (human/bovine), adhesion area (large/small), crosshead speed, medium (water/artificial saliva). Urabe et al. (2000) evaluated biological adhesion at the interface between enamel and dentin using micro-tensile bond strength test⁶. They made a dumbbell-shaped specimens for testing. The microtensile bond strength of human dentin-enamel junction region was around 50 MPa. Maybe this is one of the goal for dentin bonding system.

6) Most in vitro bond strength tests are performed in health dentin. However, in real life, dentin is generally caries affected or sometimes hypermineralized due to the tubular sclerosis. How can we improve the bonding to those abnormal substrates? (Carlos Rocha Gomes Torres)

Generally, recent dentin bonding system give higher bond strength to sound dentin than caries-affected dentin/hypermineralized dentin. For development of dentin bonding system, sound dentin is usually used as a adhesive substrate. Therefore, compositions of the bonding system, such as concentration of monomer, pH and application time for proper bonding performance were determined

to obtain good bonding to sound dentin. If caries-affected dentin is used as a substrate for development of dentin bonding system, compositions may be changed and bonding performance to caries-affected dentin should be improved. However, characteristics of caries-affected dentin is variable and difficult to be standardized^{7,8}. We made attempt to development artificial caries-affected dentin, however, it was not so easy.

7) Do you prefer etch-and-rinse or self-etching dentin adhesives? (Marcelo Giannini)

Off course, I prefer self-etching dentin adhesive systems. But I am afraid of the recent classifications of the bonding systems. Self-etching adhesive systems should be separated into two-step and one-step adhesive systems, because of the totally different bonding mechanisms⁹. From the previous studies on adhesive/dentin interface using SEM/TEM, acid-base resistant zone (ABRZ) was discovered beneath the hybrid layer using self-etch adhesive systems. However, this zone was not observed in acid etch adhesive system. Formation of ABRZ at the interface is very important in clinic to protect restoration margin from secondary caries. Reliable interface was created using 2-step self-etch adhesive systems containing MDP¹⁰.

For enamel bonding, selective acid etching is always controversial issue in self-etch adhesive system. The two-step MDP-containing adhesive system gives good adhesive/enamel interface. However, the one-step adhesive system always gives some defect at the interface after acid challenge. From this fact, selective acid etching is mandatory procedure for one-step self-etch adhesive system.

8) What is the future of Adhesive Dentistry? (Marcelo Giannini)

The next bonding system will become “Zero step” system. A flow-able resin composite and a universal adhesive will be combined. The “Zero step” restoration is one of the future of Adhesive Dentistry. Self-adhesive resin cement is clinically accepted.

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