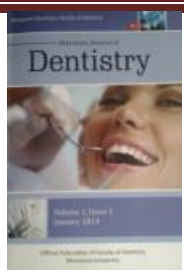

Dentin Surface Pretreatment with Dimethyl-Sulfoxide Primer

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Abstract:
Despite the evolution in adhesive dentistry over the past decades,[1] degradation of tooth-bonded interfaces still contributes to the reduced long-term clinical success of adhesive restorations.[2]
Etch-and-rinse approach still relies on traditional wet-bonding technique to couple relatively hydrophilic adhesives to the hydrated dentin substrate in clinically relevant protocols. A partially wet dentin substrate has been consensually advocated to maintain the demineralized collagen matrix expanded for proper resin infiltration by relatively hydrophilic monomers.[3]Nevertheless, management of adequate moisture is not easily accomplished, and either excess or lack of dentin moisture may compromise resin–dentin bonding.[4, 5]
Recently, dimethyl sulfoxide (DMSO) has been introduced as a new potential solvent to be used in adhesive dentistry.[6, 7]DMSO [(CH3)2SO] is a polar aprotic solvent that dissolves both polar and non-polar compounds. It is a polyfunctional molecule, with a highly polar S=O group and two hydrophobic methyl groups , fully miscible in most solvents and monomers used in adhesive dentistry .[8] DMSO is perhaps the best currently known penetration enhancer for medical purposes[9] with the ability to dissociate the highly cross linked collagen into a sparser network of apparent fibrils.[10] In addition, dissociation of water self-associative tendency by DMSO [11] improves wettability of demineralized dentin ,[12] monomer diffusion into the collagen matrix [6]and concomitantly re-expands collapsed collagen to a fairly modest level.[13]
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Introduction

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Materials and Methods

The teeth will be divided into 2 groups according to the applied adhesive (n=28); Group A: etch-and-rinse adhesive, Group B: universal adhesive (etch-and rinse mode). Each group will be further subdivided into 2 sub-groups according to the surface pretreatment method (n=14); sub-group A: without application of DMSO primer, sub-group B: with application of 50%DMSO dissolved in distilled water. The rational for using 50%(v/v) DMSO was based on previous studies used the same concentration, albeit only the aqueous solutions.[14, 15] Then each sub-group will be divided into 2 divisions according to the testing time; (n=7), division A: specimen will be tested immediately, division B: tested after 37ºC artificial saliva storage for 6 months

Results:

Microtensile-bond strength test:

Etch-and-rinse adhesive with DMSO pretreatment was statistically significant from control group ($p<0.05$). While in universal adhesive with DMSO pretreatment showed no significant result from control group.

Modes of Failure

Mixed failure was predominant among test group

Nanoleakage Expression

Etch-and-rinse adhesives showed decrease in silver impregnation ,while universal adhesive showed insignificant change in silver impregnation

Discussion:

Recently, DMSO was found to be useful in improving and preserving the long-term coronal dentin adhesive bond strength.[16] This positive effect was attributed to improved wetting of collagen by the adhesive.[13] Nevertheless, the collapsed of dried collagen matrix caused by air-drying can be reversible, as previously reported with the use of DMSO-water solutions.[17, 18]

Conclusion:

DMSO prevent sever reduction in bond strength of etch-and-rinse adhesives and universal adhesives.

References

1. Pashley DH, Tay FR, Breschi L, Tjäderhane L, Carvalho RM, Carrilho M, et al. State of the art etch-and-rinse adhesives. Dent Mater. 2011;27(1):1-16.
2. Tjäderhane L, Nascimento FD, Breschi L, Mazzoni A, Tersariol IL, Geraldeli S, et al. Strategies to prevent hydrolytic degradation of the hybrid layer-A review. Dent Mater. 2013;29(10):999-1011.
3. van Dijken JW, Pallesen U. Long-term dentin retention of etch-and-rinse and self-etch adhesives and a resin-modified glass ionomer cement in non-carious cervical lesions. Dent Mater. 2008;24(7):915-22.
4. Manso AP, Marquezini L, Jr., Silva SM, Pashley DH, Tay FR, Carvalho RM. Stability of wet versus dry bonding with different solvent-based adhesives. Dent Mater. 2008;24(4):476-82.
5. Hashimoto M, Tay FR, Svizero NR, de Gee AJ, Feilzer AJ, Sano H, et al. The effects of common errors on sealing ability of total-etch adhesives. Dent Mater. 2006;22(6):560-8.
6. Stape TH, Tjäderhane L, Marques MR, Aguiar FH, Martins LR. Effect of dimethyl sulfoxide wet-bonding technique on hybrid layer quality and dentin bond strength. Dent Mater. 2015;31(6):676-83.
7. Tjäderhane L, Mehtälä P, Scaffa P, Vidal C, Pääkkönen V, Breschi L, et al. The effect of dimethyl sulfoxide (DMSO) on dentin bonding and nanoleakage of etch-and-rinse adhesives. Dent Mater. 2013;29(10):1055-62.
8. Geurtsen W, Lehmann F, Spahl W, Leyhausen G. Cytotoxicity of 35 dental resin composite monomers/additives in permanent 3T3 and three human primary fibroblast cultures. Journal of biomedical materials research. 1998;41(3):474-80.
9. Marren K. Dimethyl sulfoxide: an effective penetration enhancer for topical administration of NSAIDs. The Physician and sportsmedicine. 2011;39(3):75-82.
10. Salim Al-Ani AA, Mutluay M, Stape THS, Tjäderhane L, Tezvergil-Mutluay A. Effect of various dimethyl sulfoxide concentrations on the durability of dentin bonding and hybrid layer quality. Dent Mater J. 2018;37(3):501-5.
11. Darvas M, Pojják K, Horvai G, Jedlovszky P. Molecular dynamics simulation and identification of the truly interfacial molecules (ITIM) analysis of the liquid-vapor interface of dimethyl sulfoxide. The Journal of chemical physics. 2010;132(13):134701.
12. Ekambaram M, Yiu CKY, Matinlinna JPJIJoA, Adhesives. An overview of solvents in resin–dentin bonding. 2015;57:22-33.
13. Mehtälä P, Pashley DH, Tjäderhane L. Effect of dimethyl sulfoxide on dentin collagen. Dent Mater. 2017;33(8):915-22.
14. Stape THS, Seseogullari-Dirihan R, Tjäderhane L, Abuna G, Martins LRM, Tezvergil-Mutluay A. A novel dry-bonding approach to reduce collagen degradation and optimize resin-dentin interfaces. Scientific reports. 2018;8(1):16890.
15. Stape THS, Tjäderhane L, Abuna G, Sinhoreti MAC, Martins LRM, Tezvergil-Mutluay A. Optimization of the etch-and-rinse technique: New perspectives to improve resin-dentin bonding and hybrid layer integrity by reducing residual water using dimethyl sulfoxide pretreatments. Dent Mater. 2018;34(7):967-77.
16. Stape TH, Tjäderhane L, Tezvergil-Mutluay A, Yanikian CR, Szesz AL, Loguercio AD, et al. Dentin bond optimization using the dimethyl sulfoxide-wet bonding strategy: A 2-year in vitro study. Dent Mater. 2016;32(12):1472-81.
17. Pashley DH, Tay FR, Carvalho RM, Rueggeberg FA, Agee KA, Carrilho M, et al. From dry bonding to water-wet bonding to ethanol-wet bonding. A review of the interactions between dentin matrix and solvated resins using a macromodel of the hybrid layer. American journal of dentistry. 2007;20(1):7-20.
18. Dal-Bianco K, Pellizzaro A, Patzlaft R, de Oliveira Bauer JR, Loguercio AD, Reis A. Effects of moisture degree and rubbing action on the immediate resin-dentin bond strength. Dent Mater. 2006;22(12):1150-6.