EASTERN DENTISTS INSURANCE COMPANY

Clinical Dentistry Advisor 2019

# *Gingival Displacement Methods and Soft Tissue Management- A Review*

**PREPARED BY:**
**S. N. Ahmed and A. Prudenti**

## Introduction

The success of any fixed prosthesis starts with the accuracy of the impression. Obtaining an impression that accurately captures the prepared margin and cervical finish line is paramount in the fabrication of well-fitting indirect restorations. A vital component in impression making is retraction of gingiva. Atraumatic gingival displacement allows access for impression material to accurately record the finish line and provides sufficient thickness of impression material in the gingival sulcus to prevent tearing during removal.[1] Making an optimal impression for indirect restorations remains one of dentistry's most challenging procedures.[2,3] Clinicians must be able to properly select gingival displacement procedures and impression materials, as well as evaluate the quality of their impressions.[4-7] These play a critical role in the success or failure of the final restoration.[4,5]

Modern impression materials have improved the accuracy of impression making.[8,9] Despite these improvements, many studies have reported that impressions sent to dental laboratories for fabrication of indirect restorations still remain inadequate.[4,5,10,11,12] To date all impression materials require control of the gingival tissues adjacent to the preparation, adequate placement of the material around the finish line, and the use of an appropriate impression tray.[3] Stewardson in 2005 recognized that a lack of impression making principles is one of the major causes of unacceptable indirect restorations.[13]

## History of Impression Quality

Historically, studies have shown that clinicians consistently make inadequate impressions.[14] In 1984, Aquilino and Taylor[11] recognized the discrepancy between dental education, private practice, and what was being sent to dental laboratories. The study expresses concerns that recent graduates are gaining less laboratory experience and exposure in school, and that they quickly abandon the sound principles they were taught in school once they get out into private practice.

Winstanely et al.[10] evaluated 290 impressions from four commercial dental laboratories. They reported that an acceptable restoration could be fabricated on 57% of the impressions evaluated, and that 20% of the impressions would be impossible or doubtful to fabricate an acceptable final restoration. In this study, the major cause of defective impressions was indiscernible recording of the finish line. Irreversible hydrocolloid was the material used for most all of the impressions evaluated in this study.

Albashaireh et al.[15] evaluated 136 impressions sent to commercial laboratories for fabrication of fixed restorations. They the quality of impressions made and found that 50% of impressions/dies to be unsatisfactory or unusable.

Samet et al.[4] evaluated 193 impressions from 11 different laboratories. Using a more detailed evaluation criterion they found that 89% of all impressions evaluated had at least one detectable error. This study also found that 51% of the defects involved the cervical finish line.

In 2007 Beier et al.[2] evaluated 1,466 impressions and found a remarkably low unacceptable rate of 3%. An explanation for this low unacceptable rate may be due to the strict protocol the clinicians followed, using retraction cord and controlling for moisture. Findings in other studies clearly demonstrates that a similar attention to detail does not occur constantly in most practices.

## Margin Design and Placement

Although clinicians should make decisions for margin design and margin location based on factors such as material, access, and esthetics, it was noted by Hunter et al. in 1990 that most dentists probably have a "preferred" design they feel comfortable preparing.[16] No matter what margin is chosen, the advantages of improved control of contours, esthetics, structural rigidity, ease of evaluating preparations, and clearer impressions allowed by wider margins must be considered.[2,16] Donovan and Chee[17] in 2004 state that the following criteria for margin selection should be considered: 1) the selected margin must provide a predictable level of integrity, 2) to minimize plaque accumulation, the selected margin must present smooth materials to the gingival sulcus, and 3) in some situations, the margin also must provide acceptable esthetics.

## Subgingival Margins

When a subgingival margin is indicated, current recommendations indicate placing margins 0.5 mm apical to the free gingival margin, or sounding of the alveolar crest to make sure the biologic width is not violated.[17,18,19] Kois in 1994 mentions the relationship of the margin location to the bone as being more critical than the distance below the free gingival margin.[19]

## Biologic Width

In 1961, Gargiulo et al.[20] first described the concept of biologic width when he measured the average length of the gingival attachment to the root, the junctional epithelium, and the sulcus depth in human cadavers. When Loe[21] published his article in 1968 on the reaction of gingival tissues to restorative procedures, the iatrogenic biologic

response to the periodontium was revealed.[18] Most consider the total biologic width to be approximately 2-3 mm to maintain normal gingival and osseous health, with 1 mm of gingival attachment, 1 mm of junctional epithelium, and 1mm of sulcus depth. This is an average measurement though, as junctional epithelium measurements vary.[18,20] Sounding the osseous crest has been recommended as the most accurate way to determinant how far subgingival margins can be placed without violating the biologic width.[19] When subgingival margins are needed, attention must be paid to ensure proper location and accurate recording of these margins to ensure well-fitting restorations and periodontal health.

## Gingival Displacement

Gingival displacement is defined as "the deflection of the marginal gingiva away from the tooth," according to The Glossary of Prosthodontic Terms.[22] In 1984, Nemetz et al.[23] described the basic criteria for acceptable gingival displacement as: 1) the creation of sufficient lateral and vertical space between the finish line and gingival tissues to allow the preparation margin to be recorded in an impression medium, 2) provide absolute control of gingival fluid seepage and hemorrhage, 3) no significant, irreversible soft or hard tissue damage resulting from the procedure, and 4) not produce any potentially dangerous side effects. To accomplish proper gingival displacement, techniques classified as mechanical, chemical, surgical, or a combination of these methods are used.[6,23,24]

## Gingival Retraction Cords and Medicaments

The most traditional method, and most frequently utilized[25,26] is the chemicomechanical technique for gingival displacement described by Schillingburg.[27] This technique utilizes 1 or 2 retraction cords placed in the gingival sulcus, with the addition of a hemostatic medicament. The two main types of gingival retraction cords being used by clinicians are braided and knitted retraction cords.[6,25,26,28] Braided retraction cords are made by weaving a tight pattern that resists fraying during placement, and can be placed with smooth or serrated edge packing instruments.[29] Braided cords may not absorb medicaments as easily as knitted retraction cords, and knitted cords should be placed with non-serrated instruments to prevent fraying. Knitted cord has the ability to increase in size after placement in the sulcus, adding to the retraction of the gingiva. There has been an increase in the popularity of knitted cord.[30] The selection of cord type being used is mainly a selection based on provider preference, as there has been no substantial evidence supporting a difference in performance. There is also a lack of standardization in cord size and efficacy between manufacturers.[6,24]

There are a number of medicaments that can be used along with retraction cord during the gingival displacement procedure. Medicaments that are currently available in solution or impregnated in cord are: aluminum chloride, aluminum sulfate, aluminum potassium sulfate, ferric sulfate, ferric subsulfate, and epinephrine.[6,31] These medicaments do not seem to have a reported effect on the polymerization of PVS or PE materials.[8,32,33] Epinephrine, however, has been linked to adverse clinical side effect such as anxiety, tachycardia, and increased respiratory rate.[28,31,34-36] There is research which shows a spike in epinephrine levels in blood upon placement of retraction cord which contains epinephrine.[37] Safer medicaments, such as aluminum chloride, have shown similar clinical abilities to displace gingiva as epinephrine containing cord.[38,39]

## Classic Displacement Methods

Shillingburg[27] in his text "Fundamentals of Fixed Prosthodontics," describes the chemico-mechanical technique for gingival displacement. It is taught as the most traditional method of gingival displacement in dental institutions. This technique utilizes 1 or 2 cords placed in the gingival sulcus, with the addition of a hemostatic medicament. The single- or double- cord techniques, are the methods utilized by 98% of prosthodontists.[26] The single cord technique has been recommended with margins less than 0.5mm subgingival and when there is no hemorrhage.[6,23,24] The technique was described to place the largest diameter cord that fits in the sulcus, and then to remove the cord just prior to making the impression. Some believe this technique is overused and under delivers due to the frequent presence of blood and fluids which are expressed when the cord is removed.[3] A variation that has been used is to leave the single cord in place during impression making, and this can be a valid technique if the margins are clearly exposed with the cord in-place.

The double cord technique utilizes a small diameter cord which is first placed into the sulcus, followed by a second, larger diameter cord. This technique can be used in all situations, but is especially recommended for situations with deeper subgingival margins, less than ideal soft tissue health, and when a single cord does not provide sufficient lateral tissue displacement.[6,23,24] Immediately before the impression material is introduced, the second (larger diameter) cord is removed from the sulcus, while leaving the smaller cord in place. With the smaller cord in place, it maintains the ability to absorb gingival crevicular fluid, control hemorrhage, and maintain the gingival tissues in a displaced position.[6,23] This technique has been referred to as the standard by which all other methods should be compared, and is the method of choice for 43% of prosthodontists surveyed.[7,34]

In 1994, Laufer et al.40 demonstrated that there was an increased incidence of voids along the margins and greater impression material distortion when the sulcular width was less than 0.2 mm. In 2008, Finger et al.[41] showed that a 0.2 mm sulcus width could be fully reproduced with all types of impression materials, but for sulcular widths of less than 0.2 mm, the use of a light body wash along with a higher viscosity tray material produced more accurate recording than monophase techniques. In 1997, Baharav et al.[42] showed that retraction cord needs to be left in place for a minimum of 4 minutes in order to maintain a sulcular width of 0.2 mm for up to 20 seconds after the cord is removed, but that the sulcular width would remain above the 0.2 mm width for nearly twice as long when the cords were left in place for 8 minutes. Csempesz et al. [43] calculated 20 minutes as the optimum time for retraction cords to become completely hydrated with a medicament. It is recommended that retraction cord be placed into the gingival sulcus with gentle pressure.

## Alternative Methods

The most common method used to displace gingival tissue is the use of retraction cords. There are alternative gingival displacement methods currently available. Electrosurgery is a technique used to reduce excessive tissue, expose gingival margins and control intra- operative hemorrhaging by removing several layers of epithelial cells. Baba et al.[6] reported that when used correctly, has no adverse effects on healing. Contraindications to electrosurgery include patients with pacemakers

and/or implanted cardioverter defibrillators, and should be used with caution around metallic restorative materials and implants. Electrosurgery does remove tissue, and the effects of its use can change soft tissue contours.[7,13,44]

Soft tissue lasers have been used in a similar fashion as electrosurgery, where gingival tissues are removed.[7,13,44] Less inflammation, reduced hemorrhage, and faster and painless healing have been reported with this method.[44,45] However, the amount of time taken to complete the procedure with lasers has been reported to be much longer than electorsurgery.[7]

Cordless techniques for gingival retraction have been introduced recently with the promise of many advantages, such as the reduction in chair time, less invasive, greater patient comfort and requiring little to no additional anesthesia.[6,46,47] Clinical trials which have evaluated the effects of cordless gingival displacement techniques compared to traditional corded techniques have shown varying results.[48] Shrivastava, et al.[49] showed that three evaluated displacement systems produced significant horizontal gingival displacement above the acceptable value needed for impression accuracy of 0.2 mm, where retraction cord soaked in 15% aluminum chloride produced maximum displacement (0.74 mm), followed by expasyl paste (0.48 mm), and magic foam cord produced the least displacement (0.41 mm). Another study showed that the same three techniques caused temporary gingival inflammation, but the cordless techniques did not induce bleeding during or after gingival displacement.[48,50] Cordless systems have been documented to be more comfortable to patients and user-friendly to the operator.[46,51] Compared to mechanochemical methods, however, cordless techniques have shown a compromised ability of these materials to move vertically in the sulcus and displace deeper gingival margins.[46,52]

Acar, et al.[53] showed that when medicament impregnated cord, displacement paste, and pressure cap were all used simultaneously, better results for gingival displacement were achieved, but it was time consuming and clinically difficult.

## Conclusion

Accurate impressions that capture the prepared margin and finish line are paramount to achieve successful, well-fitting indirect restorations. A vital component in impression making is atraumatic gingival displacement. We know that making an optimal impression for indirect restorations remains one of dentistry's most challenging procedures and that most impressions sent to dental laboratories have flaws.[2-5,10-12]

Modern impression materials and techniques have improved the accuracy of impression making, however, the fundamentals for all current techniques still require control of the gingival tissues adjacent to the preparation, moisture control, adequate placement of the material around the finish line, and the use of an appropriate impression tray.[3,8,9]

**References**


1. Rajambigai MA, Raja SR, Soundar SI, Kandasamy M. Quick, painless, and atraumatic gingival retraction: An overview of advanced materials. J Pharm Bioallied Sci. 2016 Oct;8(Suppl 1):S5-S7.
2. Beier US, Grunert I, Kulmer S, Dumfahrt H. Quality of impressions using hydrophilic polyvinyl siloxane in a clinical study of 249 patients. Int J Prosthodont 2007;20(3):270-4.
3. Christensen GJ. Have fixed-prosthodontic impressions become easier? J Am Dent Assoc 2003;134(8):1121-3.
4. Samet N, Shohat M, Livny A, Weiss EI. A clinical evaluation of fixed partial denture impressions. J Prosthet Dent 2005;94(2):112-7.
5. Rau C, Donovan T, Boushell L, Delgado A, Ritter A. The Quality of Fixed Prosthodontic Impressions: An Assessment of Crown and Bridge Impressions Received at Commercial Laboratories. ProQuest 2015; UMI 1589096.
6. Baba NZ, Goodacre CJ, Jekki R, Won J. Gingival displacement for impression making in fixed prosthodontics: contemporary principles, materials, and techniques. Dent Clin North Am 2014;58(1):45-68.
7. Christensen GJ. Simplifying and improving soft-tissue management for fixed- prosthodontic impressions. J Am Dent Assoc 2013;144(2):198-200.
8. Donovan TE, Chee WW. A review of contemporary impression materials and techniques. Dent Clin North Am 2004;48(2):vi-vii, 445-70.
9. Rubel BS. Impression materials: a comparative review of impression materials most commonly used in restorative dentistry. Dent Clin North Am 2007;51(3):629-42, vi.
10. Winstanley RB, Carrotte PV, Johnson A. The quality of impressions for crowns and bridges received at commercial dental laboratories. Br Dent J 1997;183(6):209-13.
11. Aquilino SA, Taylor TD. Prosthodontic laboratory and curriculum survey. Part III: Fixed prosthodontic laboratory survey. J Prosthet Dent 1984;52(6):879-85.
12. Jenkins SJ, Lynch CD, Sloan AJ, Gilmour AS. Quality of prescription and fabrication of single-unit crowns by general dental practitioners in Wales. J Oral Rehabil 2009;36(2):150-6.
13. Stewardson DA. Trends in indirect dentistry: 5. Impression materials and techniques. Dent Update 2005;32(7):374-6, 79-80, 82-4 passim.
14. Leeper SH. Dentist and laboratory: a "love-hate" relationship. Dent Clin North Am 1979;23(1):87-99.
15. Albashaireh ZS, Alnegrish AS. Assessing the quality of clinical procedures and technical standards of dental laboratories in fixed partial denture therapy. Int J Prosthodont 1999;12(3):236-41.
16. Hunter AJ, Hunter AR. Gingival crown margin configurations: a review and discussion. Part I: Terminology and widths. J Prosthet Dent 1990;64(5):548-52.
17. Donovan TE, Chee WW. Cervical margin design with contemporary esthetic restorations. Dent Clin North Am 2004;48(2):vi, 417-31.
18. Block PL. Restorative margins and periodontal health: a new look at an old perspective. J Prosthet Dent 1987;57(6):683-9.
19. Kois JC. Altering gingival levels: The restorative connection Part I: Biologic variables. J Esthet Dent 1994;6:3-9.
20. Gargiulo AW, Wentz, F.M., and Orban, B. Dimensions and relations of the dentogingival junction in man. J Periodontol 1961;32:261-7.
21. Loe H. Reactions to marginal periodontal tissues to restorative procedures. Int Dent J 1968;18(4):759-78.
22. The glossary of prosthodontic terms. J Prosthet Dent 2005;94(1):10-92.
23. Nemetz H, Donovan T, Landesman H. Exposing the gingival margin: a systematic approach for the control of hemorrhage. J Prosthet Dent 1984;51(5):647-51.
24. Donovan TE, Chee WW. Current concepts in gingival displacement. Dent Clin North Am 2004;48(2):vi, 433-44.
25. Ahmed S, Donovan TE. A survey of dentists as to gingival displacement procedures used in their practice. J Prosthet Dent 2015;In Press.
26. Hansen PA, Tira DE, Barlow J. Current methods of finish-line exposure by practicing prosthodontists. J Prosthodont 1999;8(3):163-70.
27. Shillingburg HT. Fundamentals of fixed prosthodontics. 3rd ed. Chicago: Quintessence Pub. Co.; 1997.
28. Shillingburg HT, Jr., Hatch RA, Keenan MP, Hemphill MW. Impression materials and techniques used for cast restorations in eight states. J Am Dent Assoc 1980;100(5):696-9.
29. Kumbuloglu O, User A, Toksavul S, Boyacioglu H. Clinical evaluation of different gingival retraction cords. Quintessence Int 2007;38(2):e92-8.
30. Morgano SM, Malone WF, Gregoire SE, Goldenberg BS. Tissue management with dental impression materials. Am J Dent 1989;2(5):279-84.
31. Donovan TE, Gandara BK, Nemetz H. Review and survey of medicaments used with gingival retraction cords. J Prosthet Dent 1985;53(4):525-31.
32. de Camargo LM, Chee WW, Donovan TE. Inhibition of polymerization of polyvinyl siloxanes by medicaments used on gingival retraction cords. J Prosthet Dent 1993;70(2):114-7.
33. Machado CE, Guedes CG. Effects of sulfur-based hemostatic agents and gingival retraction cords handled with latex gloves on the polymerization of polyvinyl siloxane impression materials. J Appl Oral Sci 2011;19(6):628-33.
34. Benson BW, Bomberg TJ, Hatch RA, Hoffman W, Jr. Tissue displacement methods in fixed prosthodontics. J Prosthet Dent 1986;55(2):175-81.
35. Bader JD, Bonito AJ, Shugars DA. A systematic review of cardiovascular effects of epinephrine on hypertensive dental patients. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002;93(6):647-53.

36.Buchanan WT, Thayer KE. Systemic effects of epinephrine-impregnated retraction cord in fixed partial denture prosthodontics. J Am Dent Assoc 1982;104(4):482-4.
37.Shaw DH, Krejci RF, Todd GL, 3rd, Reinhardt RA. Determination of plasma catecholamines in dogs after experimental gingival retraction with epinephrine- impregnated cord. Arch Oral Biol 1987;32(3):217-9.
38.Weir DJ, Williams BH. Clinical effectiveness of mechanical-chemical tissue displacement methods. J Prosthet Dent 1984;51(3):326-9.
39.Jokstad A. Clinical trial of gingival retraction cords. J Prosthet Dent 1999;81(3):258-61.
40.Laufer BZ, Baharav H, Cardash HS. The linear accuracy of impressions and stone dies as affected by the thickness of the impression margin. Int J Prosthodont 1994;7(3):247-52.
41.Finger WJ, Kurokawa R, Takahashi H, Komatsu M. Sulcus reproduction with elastomeric impression materials: a new in vitro testing method. Dent Mater 2008;24(12):1655-60.
42.Baharav H, Laufer BZ, Langer Y, Cardash HS. The effect of displacement time on the gingival crevice width. Int J Prosthodont 1997;10(3):248-53
43.Csempesz F, Vag J, Fazekas A. In vitro kinetic study of absorbency of retraction cords. J Prosthet Dent 2003;89(1):45-9.
44.Christensen GJ. Laboratories want better impressions. J Am Dent Assoc 2007;138(4):527-9.
45.Abdel Gabbar F, Aboulazm SF. Comparative study on gingival retraction using mechanochemical procedure and pulsed Nd = YAG laser irradiation. Egypt Dent J 1995;41(1):1001-6.
46.Veitz-Keenan A1, Keenan JR1. To cord or not to cord? That is still a question. Evid Based Dent. 2017 Mar;18(1):21-22. doi: 10.1038/sj.ebd.6401222.
47.Perakis N, Belser UC, Magne P. Final impressions: a review of material properties and description of a current technique. Int J Periodont Restorative Dent. 2004;24:109–117.
48.Al Hamad KQ, Azar WZ, Alwaeli HA, Said KN. A clinical study on the effects of cordless and conventional retraction techniques on the gingival and periodontal health. JClin Periodontol 2008;35(12):1053-8.
49.Shrivastava KJ, Bhoyar A, Agarwal S, Shrivastava S, Parlani S, Murthy V. Comparative clinical efficacy evaluation of three gingival displacement systems. J Nat Sci Biol Med. 2015 Aug;6(Suppl 1):S53-7. doi: 10.4103/0976-9668.166082.
50.Sarmento HR, Leite FR, Dantas RV, Ogliari FA, Demarco FF, Faot F. A double-blind randomised clinical trial of two techniques for gingival displacement. J Oral Rehabil. 2014 Apr;41(4):306-13. doi: 10.1111/joor.12142. Epub 2014 Jan 22.
51.Huang C, Somar M, Li K, Mohadeb JV. Efficiency of Cordless Versus Cord Techniques of Gingival Retraction: A Systematic Review. J Prosthodont. 2015 Sep 17. doi: 10.1111/jopr.12352.
52.Beier US, Kranewitter R, Dumfahrt H. Quality of impressions after use of the Magic FoamCord gingival retraction system--a clinical study of 269 abutment teeth. Int J Prosthodont 2009;22(2):143-7.
53.Acar O, Erkut S, Ozcelik TB, Ozdemir E, Akcil M. A clinical comparison of cordless and conventional displacement systems regarding clinical performance and impression quality. J Prosthet Dent 2014;111(5):388-94

## Author Biographies

*Dr. Ahmed received her Bachelor's in Dental Surgery degree from Rajiv Gandhi University of Health Sciences, India. After moving to North Carolina, she earned a Master of Science degree from the Department of Operative Dentistry at UNC. She currently serves as the Director of Student Life and Academic Success at the school and works closely with the Dean's office to improve student wellness, academic performance and student support system at UNC Adams School of Dentistry.*

*As a faculty in the Division of Operative Dentistry, she serves as the Director of Pre-clinical Operative Dentistry Curriculum, and Co-Director of educational research group. Her research focuses on dental educational, faculty calibration and dental materials. Her bibliography includes chapters in one of the world's leading textbook in Operative Dentistry: Sturdevant's Art and Science of Operative Dentistry.*

*She has a served as a journal reviewer for Journal of Dental Education, Journal of Esthetic and Restorative Dentistry and Journal of Dental Hygiene. She is an active member of the Academy of Operative Dentistry (AOD), American Dental Education Association (ADEA), and International Association of Dental Research (IADR).*

*Dr. Prudenti received his Masters of Prosthodontics and Certificate in Prosthodontics at the University of North Carolina at Chapel Hill, where he maintains an Adjunct Faculty position in the Department of Restorative Sciences, Division of Prosthodontics. His role involves clinical and lecture instruction to the Prosthodontics residents focusing on the latest digital technologies, dental implant treatments, and functional and esthetic full mouth rehabilitations.*

*Back home on Long Island, NY, Dr. Prudenti focuses his private practice to advanced implant, esthetic, and functional prosthetic rehabilitations specializing in treating patients with challenging dental needs.*

*Dr. Prudenti is an advisor for dental companies and is involved with clinical research projects, product testing and development, and writing and reviewing journal articles. Enthusiastic about continual learning and education, he lectures locally and nationally. He maintains membership with the American College of Prosthodontists, American Dental Association, New York State Dental Association, Suffolk County Dental Society, East End Dental Society, and the Academy of Osseointegration.*