Understand Your Objectives

By Dr. James L. Lockwood and Russell T. DeVreugd
Treatment plan wax-up and provisional restorations as predictors for success

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Restoration of 28 teeth is a demanding procedure that requires predictability for success. Achieving predictability is particularly challenging with patients who exhibit destructive parafunctional habits. A successful treatment outcome begins with collaboration between the dentist, technician and patient to clarify treatment objectives. These objectives are then transformed into a treatment plan wax-up, and then into provisional restorations, which become essential components of predictability.

INTRODUCTION
Restorative predictability is obtained by paying careful attention to several variables. These include: dental and medical history, comprehensive examination, accurately mounted study models, x-rays, imaging, diagnosis, collaborative treatment planning, treatment plan wax-up, preparations, impressions, bite registrations, provisional restorations, final restorations and often a biteguard. Also, taking the time to get to know the patient, including the patient’s unique temperament, circumstances and desires, helps tremendously when planning treatment.

Many articles have been published detailing various clinical steps of full-mouth rehabilitation. Each patient’s situation requires an individualized treatment protocol. Therefore, it is not the purpose of this article to review every treatment step. Instead, this article will detail the unique functional and esthetic challenges this patient presented with, and how these challenges were met with a high degree of predictability using a treatment plan wax-up and provisional restorations (Figs. 1-3).

CASE PRESENTATION
A 52-year-old female patient’s chief concern was generalized deteriorating dentition (Figs. 4-5). Several prior dental opinions had diagnosed dental destruction from attrition and had advised 28 crowns. Treatment had begun in another office and teeth 7-10 were restored with crowns. These crowns were lengthened incisally. Unfortunately, this new length was incompatible with established crossover parafunctional habits (Figs. 6-7). The new crowns had broken or dislodged several times. This prompted the patient to stop the restorative process and seek another opinion.

A comprehensive examination was performed, including a pre-clinical conversation, clinical examination, mounted study models, x-rays and photography. The dental examination revealed generalized attrition with severe parafunctional faceting. In addition, many teeth had deteriorating dentistry, decay and fracturing into dentin. Tooth 19 had a hopeless prognosis due to root fracturing. Periodontal findings included slight periodontitis. Temporomandibular joints were healthy. Jaw muscles were large and strong, but bimanual manipulation of the mandible was readily achieved. Centric relation was consistent with centric occlusion. Occlusal examination revealed bilateral working, balancing, protrusion and crossover interferences. It was our concern that even after achieving an ideal occlusion, the patient could continue to exhibit parafunctional habits. Therefore, a new occlusal morphology was necessary to accommodate these potentially lifelong parafunctional movements without interference. To achieve this, the DeVreugd Compass was used as a morphological engineering tool.

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Fig. 1. Pre-treatment anterior view.

Fig. 2. Provisional restorations anterior view.

Fig. 3. Porcelain restorations anterior view.

Fig. 4. Pre-treatment condition of maxillary teeth.

Fig. 5. Pre-treatment condition of mandibular teeth.

Fig. 6. Pre-treatment models showing mandibular movement to right crossover and excess force on upper right lateral incisor.
The patient was largely symptom-free. She was aware of her dental demise, her role in its demise, and she viewed her oral rehabilitation as an opportunity to achieve dental stability and improved esthetics. She displayed trust, ownership, appreciation and a positive attitude, the hallmarks of an effective doctor-patient relationship, and thus was deemed a good candidate for comprehensive dental care. Based on collaboration between the dentist, technician and patient, a treatment plan of 28 crowns was agreed upon.

**TREATMENT PLANNING – TREATMENT PLAN WAX-UP**

Analysis of mounted study models revealed extensive attrition with parafunctional faceting. On duplicate models, 28 teeth were prepared for crowns and waxed to ideal condition using the Broadrick Flag for Curves of Spec and Wilson, and the DeVreugd Occlusal Compass for occlusal morphology. Esthetic input from the patient was considered at this time. The book, *Natural Esthetics* by Dario Adolfi served as a valuable communication tool for tooth form, texture and maverick effects. To achieve the desired esthetic outcome, the vertical dimension was increased on the articulator 1/2mm at the incisal edges. Also, subtle crown lengthening was performed on the models for some of the maxillary anterior teeth.

Prior to beginning the treatment plan wax-up, models were observed under a microscope and all-wear facets were outlined (Fig. 8). The DeVreugd Compass was placed on centric stops and revealed several areas where excursive occlusal clearance was compromised (Fig. 9). This shows the patient’s mandibular movements and provides an occlusal roadmap for morphological ridge and groove direction. As the impressions were taken in a static position, the noted incline plane interferences prevented total

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intercuspation on the models. After the incline plane interferences were adjusted, centric stops were identified on the maxillary and mandibular casts (Fig. 10). Of particular interest were parafunctional facets in lateroretrusive (red) directions. This is a mandibular movement for which most articulators have no condylar adjustment.

The DeVreugd Compass is separated by colors: Black = protrusion, yellow = lateroprotrusion, blue = laterotrusion, red = lateroretrusion, and green = mediotrusion. Each color represents mandibular pathways to and from centric. The compass is a useful guide for creating morphology as well as adjusting models to complete intercuspation prior to treatment plan wax-ups. The objective is to create freedom to and from centric while speaking, chewing and swallowing, and to avoid incline plane contact during parafunctional movements. The models were held in a position that allows centric stops to be viewed from the various mandibular movements on a 90-degree angle. Any morphological obstacles that blocked our view back to centric were removed. Once the models were adjusted, the existing restorations were examined for contours. All over-contoured teeth were recontoured before beginning the wax-up.

Treatment plan wax-up began with the mandibular anterior sextant by reducing the stone teeth approximately 1mm on all surfaces and then waxing them to finish form (Figs. 11-16). The maxillary linguals were modified as necessary. Next, the maxillary anterior sextant was prepared and waxed with consideration for tissue reduction, which added tooth length (Figs. 17-21). Once the anterior guidance was established, the mandibular posterior sextants were prepared and waxed, obtaining ideal

“**The compass is a useful guide for creating morphology as well as adjusting models to complete intercuspation prior to treatment plan wax-ups.”**
Fig. 15. Before mandibular treatment plan wax-up lingual view.

Fig. 16. After mandibular treatment plan wax-up lingual view.

Fig. 17. Beginning of maxillary treatment plan wax-up showing location of free gingival margins.

Fig. 18. Before maxillary treatment plan wax-up facial view.

Fig. 19. After maxillary treatment plan wax-up facial view.

Fig. 20. Before maxillary treatment plan wax-up lingual view.
curves of Spee and Wilson (Fig. 22-25). The maxillary posterior teeth were adjusted as necessary, and then prepared and waxed. The wax-ups were evaluated using the DeVreugd Compass as a reference (Figs. 26-27).

TREATMENT PLANNING – TREATMENT SEQUENCING
After the treatment plan wax-up verified that an ideal restorative outcome was achievable, the following treatment steps were planned:

1. Caries/periodontal control.
2. Referral to periodontist for esthetic crown lengthening and tooth 19 removal/implant placement.
5. Fabrication and placement of final restorations.
6. Fabrication and placement of biteguard.

PROVISIONAL RESTORATIONS
High-quality provisional restorations are essential to achieve predictability with comprehensive cases involving severe parafunctional habits. Sextant-segmented indirect methacrylate-based acrylic
Fig. 25. Treatment plan wax-up showing curves of Spee and Wilson from posterior.

Fig. 26. DeVreugd Compass over mandibular left treatment plan wax-up.

Fig. 27. DeVreugd Compass over maxillary left treatment plan wax-up.

Fig. 28. Pre-treatment view showing square crowns.

Fig. 29. Treatment plan wax-up showing square tapering incisors.

Fig. 30. Provisional restoration wax-up showing tapering ovoid incisors.
provisionals were fabricated based on a revision of the treatment plan wax-up. These restorations were cemented with reinforced zinc-oxide eugenol cement. Function, phonetics and esthetics were evaluated. Success in these areas was achieved with the provisional restorations, and therefore predicts a successful final restoration.

The form of the maxillary incisors was modified slightly from the treatment plan wax-up based on interaction with the patient. The technician had the opportunity to meet with the patient and assess harmony between facial features and tooth form. The pre-op restorations were square in form (Fig. 28). The treatment plan wax-up reflected a square tapering form (Fig. 29). Upon viewing the patient’s facial features, it was decided that 7-10 would be changed to a more complimentary ovoid shape.

Tooth form adjustments were made in the wax-ups for provisional restorations (Fig. 30).

The lab received a set of articulated models with the final preparations in order to fabricate the indirect provisionals. The mandibular teeth were waxed using the cross-mounted maxillary model of the treatment plan wax-ups (Fig. 31). Next, the maxillary teeth were waxed to the mandibular wax-ups (Fig. 32).

Silicone impressions were taken of the wax-ups and used in fabrication of the provisionals. Heat/pressure-cured methacrylate-based resin was used. The prepared teeth were coated with a thin layer of wax. The models were coated with a thin layer of Vaseline. The proper shade of dentin was mixed, poured into the silicone index and placed on the models. They
Fig. 35. Maxillary provisional restorations on models.

Fig. 36. Mandibular provisional restorations on models.

Fig. 37. Provisional restorations in mouth – anterior view in centric occlusion.

Fig. 38. Provisional restorations in mouth – anterior view in protrusive.

Fig. 39. Provisional restorations in mouth – smile.

Fig. 40. Treatment plan wax up – anterior view in protrusive.
The dentin was cut back to allow room for the incisal overlay. The incisal powders were mixed and placed in the silicone following the same procedures of the dentin above. When the models came out of the pressure pot, they were run under warm water to soften the wax and to make removing the provisionals from the models easier. The provisionals were then trimmed, finished and polished (Figs. 33-36). Clinically, the provisional restorations functioned well and achieved harmony with the facial form (Figs. 37-39).

In order to achieve this level of precision, it is important that the laboratory receive mounted models of the provisionals that accurately cross mount with the models of the preparations.

PFG CROWNS
Twenty-eight PFG restorations were cemented with resin-reinforced glass ionomer cement. The entire crown placement process took about two hours and required almost no occlusal adjustment. Appointments like these are better described as celebration appointments than cementation appointments. Note the similarity and natural progression between the treatment plan wax-up, the provisionals and the final restorations (Figs. 40-42). Taking the time to create this level of precision in planning achieves tremendous restorative predictability (Figs. 43-44).

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were secured tightly with rubber bands and cured in warm water in a pressure pot.

The dentin was cut back to allow room for the incisal overlay. The incisal powders were mixed and placed in the silicone following the same procedures of the dentin above. When the models came out of the pressure pot, they were run under warm water to soften the wax and to make removing the provisionals from the models easier. The provisionals were then trimmed, finished and polished (Figs. 33-36). Clinically, the provisional restorations functioned well and achieved harmony with the facial form (Figs. 37-39).
Fig. 45. Dies, solid models of preparations, models of provisional restorations.

Fig. 46. Custom incisal guide table and model of mandibular provisional restorations.

Fig. 47. Custom incisal guide table and arrows showing directions of mandibular movement.

Fig. 48. Full contour maxillary wax-ups for use as interproximal and occlusal guides when building porcelain.

Fig. 49. Full contour mandibular wax-ups for use as interproximal and occlusal guides when building porcelain.

Fig. 50. Biteguard showing wear on upper right cuspid area.
wax-up of the final restorations (Figs. 48-49). The posterior morphology on both arches, and the maxillary anterior lingual morphology were checked using the DeVreugd Compass.

Silicone indexes of the labial surfaces were made and used as guides for wax reduction for the final framework design. Using these indexes as a guide, wax was cut back leaving no more than 2mm of suspended porcelain. These restorations had 180-degree porcelain shoulder margins.

Manufacturer’s suggestions were followed for investing and casting. The framework was finished using various carbides. The firing protocol of the manufacturer was used for the application of the porcelain. The beige full-contour wax-ups were placed on the working cast. A wax-up was replaced with an opaqued coping and built to full contour.

The opposing wax-ups controlled the occlusion and adjacent wax-ups controlled the mesial/distal contacts. The custom incisal guide table controlled the anterior lingual morphology and length. The final shaping and contouring was accomplished by using the provisional models as a guide. This technique allows for tremendous precision between wax-up and porcelain form, and also yields efficient use of time during porcelain firing.

**BITEGUARD**

Note that the biteguard shows that bruxism is still evident after restoration with ideal occlusion (Figs. 50-53). In terms of predictability, it’s safe to assume that all patients will continue to brux, so it makes sense to engineer dental restorations to accommodate these habits. Finishing a comprehensive case with a biteguard protects restorations, and allows the

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dentist to determine the presence and pattern of continued parafunctional habits, if any.

CONCLUSION
Complex restorative cases demand comprehensive examinations and treatment plans that include wax-ups, provisional restorations and individualized esthetics (Fig. 54). Collaboration between the doctor, technician and patient is essential. By starting with the end in mind, objectives are understood, success is predictable and satisfaction is achieved for all involved.

“Collaboration between the doctor, technician and patient is essential.”

Bio
Dr. James Lockwood is visiting faculty and a mentor at the Pankey Institute for Advanced Dental Education. He also serves as adjunct dental faculty at Grand Rapids Community College and as a clinical consultant to The Dental Advisor. In the past, Lockwood has performed research for the department of Biologic and Material Science and he served as a clinical instructor at the University of Michigan School of Dentistry in Ann Arbor.

He is affiliated with various professional organizations including the American Dental Association, American Academy of Cosmetic Dentistry and the Francis B. Vedder Society for Crown and Bridge Prosthodontics.

Dr. Lockwood shares a practice with his wife, Dr. Adele Gray, in Grand Rapids, Michigan.

Russell T. DeVreugd, CDT, is an international consultant and lecturer in the field of fixed restorative dentistry and has presented courses on occlusion, contour, color and anterior esthetics. DeVreugd has served as a consultant/lecturer for the Department of Biologic and Material Science at the University of Michigan School of Dentistry in Ann Arbor, the undergraduate and graduate prosthodontic programs at the University of California School of Dentistry in San Francisco, and he was appointed Regents Lecturer in 1984-85.

DeVreugd is a contributing author to Quintessence of Dental Technology and to the textbook Science and Practice of Occlusion.” He has presented to many organizations and associations, including the American Academy of Restorative Dentistry, the American Dental Association, American Prosthodontic Society, Pacific Coast Society of Prosthodontics, Dental Center for Postgraduate Courses in Amsterdam and the Karl Haupl Institute in Dusseldorf, Germany. He owns DeVreugd Dental Laboratory and International Dental Seminars in Grand Rapids, Michigan.

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