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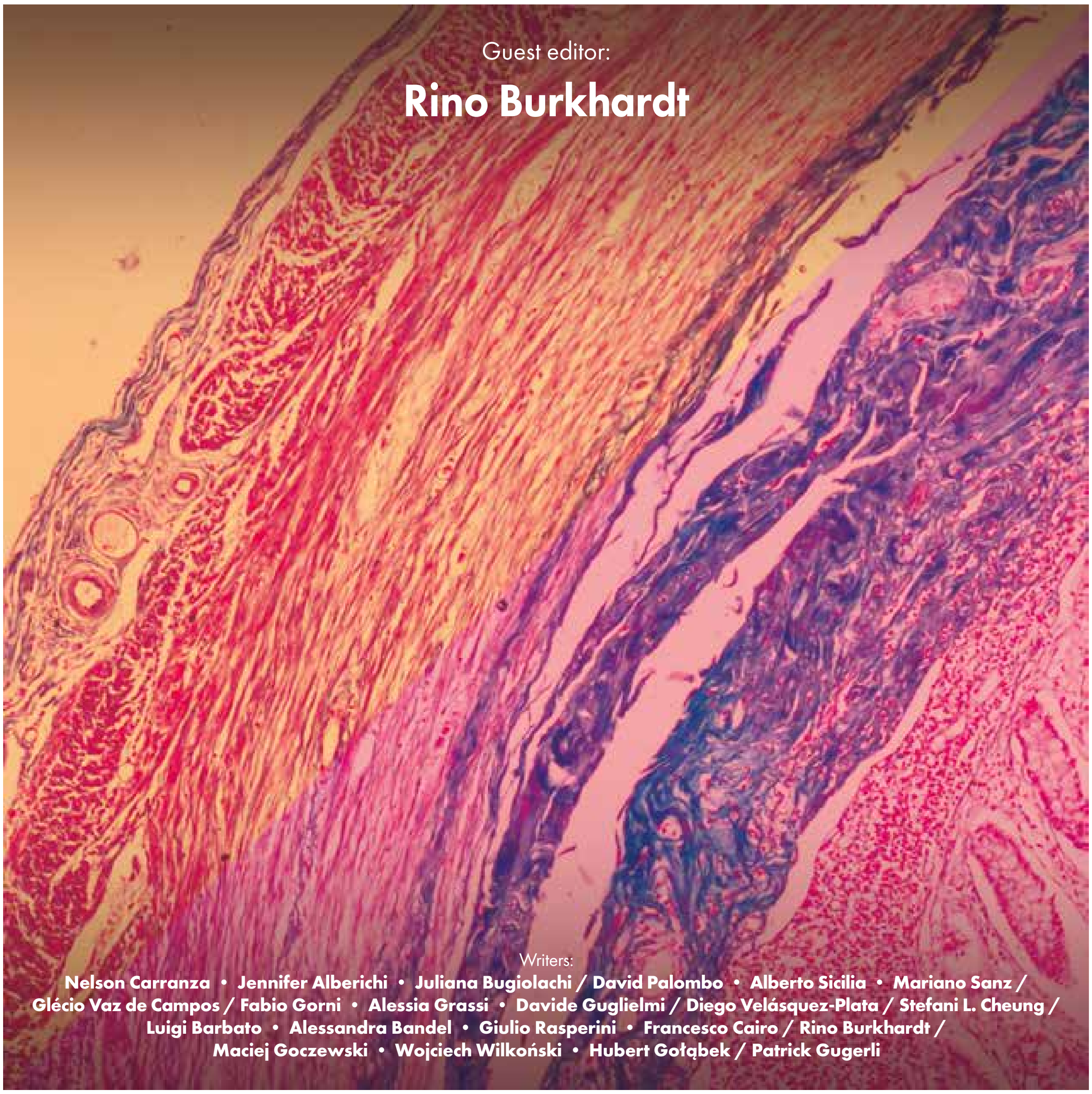

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PRACTICAL AND BIOLOGICAL CONSIDERATIONS IN INCORPORATING MICROSURGERY TO DAILY WORKFLOWS.

DIEGO VELÁSQUEZ-PLATA.

Diego Velásquez-Plata. DDS, MSD. Private Practice, Fenton, Michigan. Adjunct Clinical Assistant Professor. Department of Periodontics and Oral Medicine. The University of Michigan School of Dentistry.

SUMMARY

INCORPORATION OF A MICROSURGICAL OPERATIONAL APPROACH to a periodontal and dental implant practice will benefit significantly from the execution of a well thought out process that encompasses all stakeholders and their particular workflow ecosystems.

The workflow domain of a microsurgical periodontal and dental implant practice has been structured in three well defined spheres, each having unique characteristics that delineate their work culture, constitution, and *modus operandi*.

The first sphere relates to patient flow. All activities surrounding interactions with patients from the time the first contact with the practice is established all the way until the patient is discharged upon completion of therapy. The second sphere harbors the operating room (OR) flow. The physical locale that integrates equipment and armamentarium essential for the performance of microsurgical procedures. The third sphere gathers the microsurgical team (MT) flow. Human assets behind the workforce that turns the principles behind microsurgery into a tangible reality.

The purpose of this article is to describe and frame practical and biological considerations that when observed will lead to an organic assimilation of microsurgical applications in the clinical setting.

Correspondence to:

Diego Velásquez-Plata
dvelasq@umich.edu

Diego Velásquez-Plata

INTRODUCTION

WORKFLOW IS A COMPOUND WORD that describes a sequence of events that take place from the beginning of a task to its end. Well thought out workflows have an inherent potential to increase efficiency, maximize productivity and enhance quality of outputs. The adoption and application of effective workflow protocols ought to render complex processes into repetitive actions with predictable outcomes.

The incorporation of the operating microscope (OM) in a clinical setting challenges legacy protocols and can be a negative disruptor in the absence of established guardrails in the form of principles and practices designed to facilitate the adoption of this technology by all the proper stakeholders, namely patients and care providers.

Failure to understand, implement and follow workflow precepts will translate into a significant hindrance to fully take advantage of the utilization of the OM. The occasional or intermittent use of this instrument results in a negative economy of movements, time mismanagement and inefficient patient care. Clinicians who sporadically work with the OM will struggle to develop ergonomic competency and refine visual and proprioceptive skills that are necessary to operate at the highest level (Carr and Murgel 2010).

The purpose of this article is to describe and frame practical and biological considerations that when observed will lead to an organic assimilation of microsurgical applications in the clinical setting.

WORKFLOW DOMAIN

THE WORKFLOW DOMAIN of a micro-surgically oriented clinical setting is fundamentally structured in three well defined and integrated spheres, each with a unique set of identifiers and components. These spheres are part of a symbiotic workforce ecosystem, a strongly interconnected assemblage, that sustains all activities performed pursuing the optimization of patient care delivery (Figure 1).

These workflow spheres are:

- Patient flow
- Operating Room (OR) flow
- Microsurgical Team (MT) flow

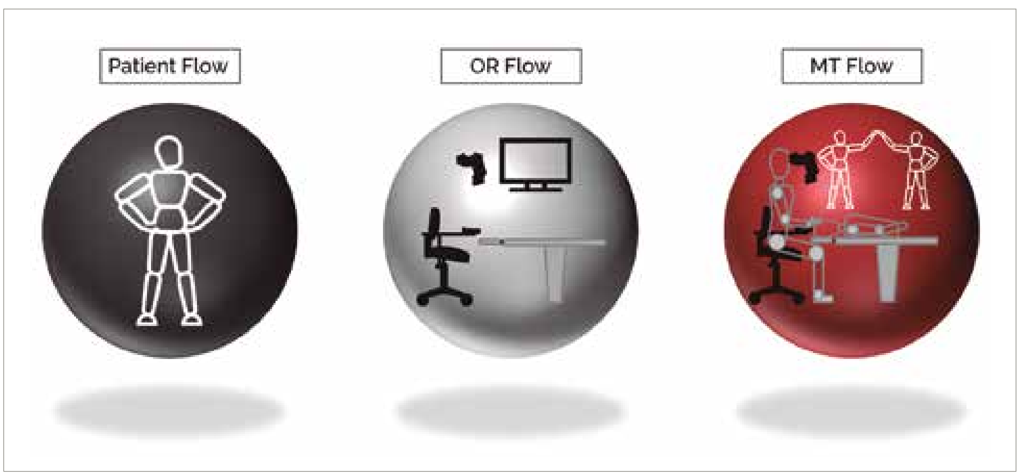

Figure 1.
Workflow Domain and its three constitutional spheres: patient flow, operating room (OR) flow, microsurgical team (MT) flow.

Patient Flow

This workflow focuses on any type of patient interaction with the patient care center. From the moment the patient contacts the clinical office and establishes communication with the patient care coordinators, to the moment the patient is admitted for preoperative assessments, surgical interventions, recovery, discharge and postoperative care, every team member is to be trained to positively enhance the patient experience.

Triaging patients based on their clinical condition, needs and desires facilitates scheduling. Allotting adequate time for treatment execution depending on the complexity of the procedure to be performed is of paramount importance to avoid disruptions on assigned appointment times. It is important to recognize that when the microsurgery clinical team is in the early stages of formation, speed and efficiency of performance are not optimal yet and therefore, this needs to be considered by those in charge of scheduling. Adding extra time to buffer normal delays during this period is advisable. This is a temporary stage. As competency of all participating members increases, efficiency will follow. Executing all sorts of surgical procedures utilizing the OM from beginning to end will take place in a routine fashion. With appropriate training and increased collective experience, high performing teams will be able to complete surgical interventions even faster with the OM than without it. Ultimately, the patient experience will be optimized.

Microsurgical team members are to claim ownership of their individual responsibilities. Creating time to communally review and debrief the schedule ahead will help anticipate potential disruptions on care delivery, identify specific needs for each patient and eliminate procedural and organizational errors.

Patient positioning is to be procured to provide both comfort and facilitate access to the area to be surgically treated. Protection of the eyes and airways should be routine. The position of the patient's head should be such that allows for easy visual and operational access and will be manipulated according to the location of the target area. Having good head support will be conducive to tilting and turning maneuvers generated by neck and/or body partial rotations.

Open lines of communication are vital to facilitate patient discharge after recovery or transfer to relatives or legal guardians as needed. Distribution of detailed home care instructions both in written and oral forms is to take place during patient discharge.

Operating Room (OR) Flow

The microsurgical operating room physical facility includes a dental chair for the patient, chairs for the surgical assistants, a chair for the microsurgeon, the operating microscope and its accessories, monitors integrated to the computer network for accessing patient data and to the operating microscope to help visualize the operating field (this is a set up followed when a co-observer tube is not available to provide direct vision through the OM to the surgical assistants), delivery systems and working surfaces to set up surgical equipment and surgical trays on which microsurgical instruments are laid out (Figure 2).

It is of paramount importance to follow ergonomic operatory room design principles to maximize delivery of care when utilizing the OM. In pursuit of this goal, the operating microscope should be kept off the floor. Floor mounted or caster supported microscopes are not recommended since this set up occupies space needed by the surgical assistants to facilitate access to the operating field. Instead, the OM ought to be either wall or ceiling mounted. Due to the heavy weight and structural engineering demands, technical expert advice must be sought and followed when having these instruments installed on walls/ceilings of the operating room.

Chairs for the members of the microsurgical team must be designed in such fashion that adequate lower back and arm support is provided to nourish ergonomically sound positions, minimize muscular fatigue and optimize comfort while delivering care (Harwell and Ferguson 1983).

Figure 2.
Operating room showcasing equipment and armamentarium necessary to support delivery of microsurgical patient care.

The OR must be spacious enough to allow for accommodation of all microsurgical team members when adopting different positions to access the surgical field. Although access to most working areas in the oral cavity can be achieved by having the patient positioned accordingly to facilitate access, in periodontics and implant related surgical procedures, sometimes the members of the microsurgical team must adopt different positions to facilitate visual and physical access to the area being treated.

Only instruments and biomaterials that will be utilized per specific procedure are to be kept in the OR to avoid cluttering and confusion when selecting specific instruments or biomaterials. Instrument trays are to be organized in such way that only the instruments needed for specific procedures are on the closest surfaces to the microsurgical assistant in charge of facilitating the instrument exchange with the microsurgeon.

Surfaces are to be easily cleaned to facilitate room turnover. When the facility has several rooms, each equipped with an OM, timing for room turnover is not as critical since other rooms can be set up in advance to accommodate the next patient to receive care.

The OR atmosphere should be in line with the performance of microsurgical therapy. Creating an environment that is conducive to executing delicate and high precision procedures is crucial. Setting a comfortable room temperature, dimming lights, eliminating acute loud noises and conversations inside and outside of the OR will contribute to foster a supportive ambiance for surgical care delivery (Hernesniemi et al. 2005). If music is played, music curation is to be pursued selecting tunes thar are consistent with promoting a calming experience that suits the whole surgical team.

Implementation of systems that reduce distractions and interruptions in the surgical flow process by standardizing everyday work practices is to be relentlessly pursued. Industrial models of efficient systems have been proposed, adapted, and implemented to healthcare settings (Young and McClean 2008). One such model is the Toyota Productivity System (TPS) which is "…designed to transform waste, excess inventory, waiting/delays, overproduction, unnecessary transporting, unnecessary motion, defects/mistakes, excess possessing and confusion, into value from the customer's perspective (Leming-Lee et al 2019). This tool is being utilized in the healthcare industry to reduce inventory, create space and reduce time spent searching for and getting equipment, instruments and biomaterials utilized in surgery (Wiegmann et al. 2007; Breen et al. 2020).

Microsurgical Team (MT) flow

During initial implementation of the OM into periodontal and implant surgical procedures, slower times in task execution are the rule rather than the exception. This is mainly due to four factors:

1. Psychomotor behavioral change: the introduction of magnification will alter the depth and size of the operational field. Getting comfortable and efficient with this perceptive dimensional change will be accelerated with frequent utilization of the OM.
2. Richer awareness of surgical field: due to enhancement of visual acuity related to working at higher magnification, clear visualization and identification of structures such as subtle bone irregularities, accretions, craze lines, remnant granulation tissue and others, will demand an operational response to eliminate or correct them. This issue is corrected with practice, and it will not become a factor any longer in performance speed.
3. Field of vision adjustments: when working on different arches and surfaces (i.e. mesial, lingual, buccal, distal, occlusal), distinct visual planes will need to be accessed during the same surgical procedure. Patient and operator positioning needs to be adjusted accordingly in order to facilitate direct or indirect visual access with the OM. Implementing a system that minimizes the movement of the patient's head and body position in the chair will translate into more accurate operational moves, thus maximizing performance efficiency.
4. Movement economy optimization: It is very important to maximize movement efficiency which is at the core of enhancing motion economy. When working under the microscope, the operator needs to maximize all efforts to avoid withdrawing the hands from the surgical field, performing movements within motion class I-IV under the ergonomic motion classification andavoiding movements that involve twisting the torso usually involved with reaching out for instruments or materials (a motion class V) (Velasquez-Plata, 2022) (Table 1).

Table 1. Ergonomic classification of operational movements.

Motion Class	Movement
I	Moving only fingers
II	Moving only fingers and wrists
III	Movement originated from the elbow
IV	Movement originating from the shoulder
V	Movement that involves twisting or bending at the waist.

Regardless of the reasons related to slower operation executions, the microsurgical team must factor in these delays in care delivery when allocating time units to procedural slots in the daily schedule. This temporary alteration needs to be understood as such: temporary. The duration of this phase will vary among practitioners and their teams. One thing is certain: the sporadic utilization of the OM will prolong this stage.

The microsurgical team (MT) is formed by microsurgical assistants and the microsurgeon.

Microsurgical Assistant

The ideal microsurgical assistant must be knowledgeable of all procedural, technical and safety related aspects of her occupation, proficient and intuitive in reading clinical situations, anticipating procedural sequences and related demands by the microsurgeon. This encompassing awareness will optimize economy of movements by minimizing the time in which the microsurgeon's eyes and hands are diverted away from the binocular eyepiece. (Goczewski 2021).

In order to achieve this goal, the six handed operational model is recommended:

The first assistant will be occupied with retraction, suction, and irrigation to help maintain tissues hydrated, minimize tissue adhesion to the instruments, and enhance visualization by removing blood and debris from the surgical field.

The second assistant oversees handing over instruments, preparation of biomaterials, selection of armamentarium, and troubleshooting unexpected issues that arise while providing patient care such as mechanical malfunction of equipment.

A third assistant or a "roving dental assistant" is a workflow enhancer. This roving assistant supports the two microsurgical assistants by attending to their needs while providing patient care. Foot traffic is thereby reduced which can also translate into less airflow disruptions which could reduce airborne contaminants and reduce distractions that could lead to errors (Rovaldi and King 2015).

While delivering microsurgical care, assistants have two ways to have visual access to the surgical field:

1. Utilizing a co-observation tube that allows the assistant to observe the surgical field directly and simultaneously with the surgeon. While this option gives direct and simultaneous access to the operating target, in periodontal and implant procedures is not unusual to have bodily movements of the microscope to adjust to different angulations and visual paths. These movements will require the adjustment of not only the microsurgeon but also the assistant utilizing the co-observation tube. At the same time, this component may interfere with interaction with the surroundings of the surgical field by partly blocking the peripheral view.
2. Utilizing high-definition monitors strategically mounted to provide live broadcast of the surgical field matching the optical reality of the microsurgeon. This visual information translates into immediate feedback so the assistants can engage in subtle microscope relocation, focus and magnification adjustments. There is freedom of movement and unimpeded visual access to the surgical field since the monitors are not in proximity or attached to the OM. Unobstructed visual access should always be maintained to help monitor moves and action occurring in the operating field. Constant calibration of image quality will enhance the visual experience by the team and optimize documentation when being acquired. (Figure 3).

Strengthening operational workflows requires an unambiguous definition of roles, accurate distribution of tasks among the microsurgical assisting personnel and purposeful practice of these functions and responsibilities by the whole team, so these activities can be harmoniously executed.

Movement economy will be maximized by a seamless integration and delivery of maneuvers that lead to accurate and efficient performance. Accurate timing in instrument hand over, anticipating the direction of the active surface that is going to be used, knowing when and when not to suction, what suction diameter tip to use, when to irrigate, when to retract, when to reach for a suture thread to facilitate knot construction, when to blow air and water to clear a mirror surface when using indirect vision. (Figures 4 and 5)

Tasks like focus adjustment, minor movements of the microscope body, changing magnification levels and so on, can unnecessarily take away the hands of the operator from the surgical field and consequentially slowing down the execution of the task being performed. (Figure 3)

Figure 3.
Microsurgical assistant utilizing indirect visualization of the operating field enabling timely adjustments of the operating microscope.

Figure 4.
Seamless instrument retrieval from the microsurgeon's hand showing the next instrument to be utilized readily available.

Figure 5.
Flawless instrument hand over performed with one hand thus optimizing movement economy during microsurgical instrumentation exchange.

The positioning that the assistants adopt in the operating room is fluid and will vary depending on the area being operated on. Functions will be performed in a sitting or standing position depending on visual access and task being executed. The surgical assistants should have an ergonomically suited chair that will offer a solid contact with the ground surface, provide support and freedom of movement to both reach different surfaces and areas of the operating room and readily allow for exiting the chair confines to adopt a standing position as needed.

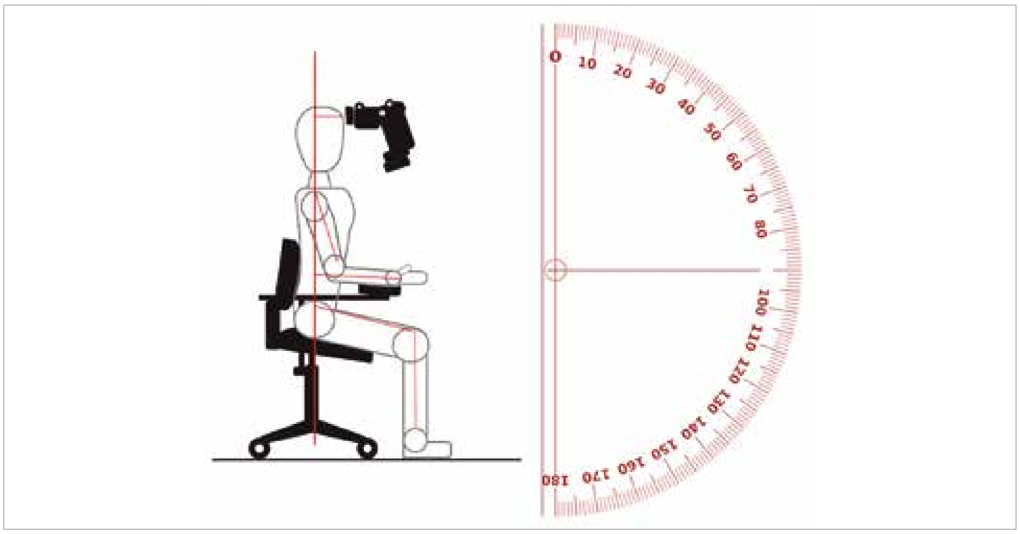

Figure 6.
Microsurgeon seating position following the 90-degree concept.

The Microsurgeon

A right-hand dominant microsurgeon will usually seat at 11-12 o'clock position or at 9 o'clock depending on the area to be operated on. The seating position should be adjusted with the 90-degree concepts in mind: hips 90o to the floor, knees are 90o to the hips and forearms are 90o to the upper arms (Michaelides 1996). (Figure 6) The chair being utilized should have either static or gliding/rotating arm support surfaces to facilitate the execution of fine movements. Feet should be completely flat against the floor to provide a stable anchorage to the body. The spine should be in a neutral position, erect and perpendicular to the floor and the eyepiece inclined so the eyes are looking at the horizon and the ears are aligned with the shoulders. All ingredients to adopt an ergonomically healthy posture that can be sustained with nominal effort and can curtail fatigue. Essential ingredients to prevent potentially devastating work-related musculoskeletal disorders (Giagio et al. 2019).

To minimize movement of the OM and the microsurgeon, the patient is engaged and asked to perform jaw, head and or body movements to facilitate visual access to the area being worked on. All of this is performed under low magnification (3-4x). Once the target area is identified, magnification can be increased as needed. In contrast to endodontic therapy delivery, periodontal and implant related surgical applications require multiaxial access which demand positional changes by the operator and the assisting team. Minimization of these positional changes is to be procured by implementing surgical protocols congruent with this principle and mastering indirect vision access (Figure 7).

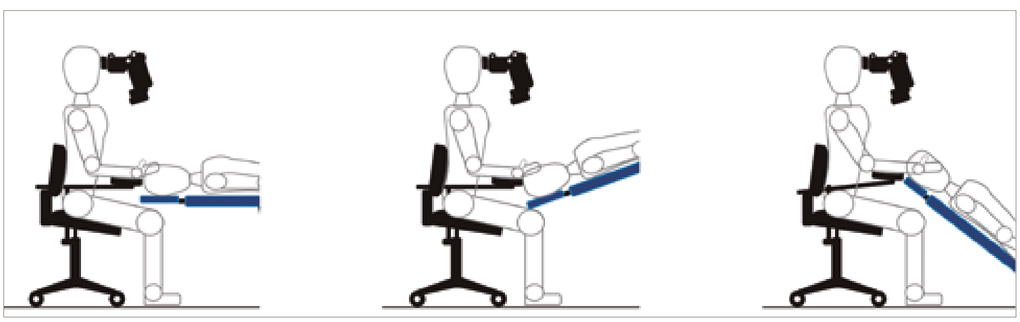

Figure 7.
Different patient positioning to facilitate visual access while utilizing the operating microscope.

CONCLUSION

SUCCESS IN INCORPORATING the OM into the surgical workflow of the periodontal and dental implant practice encompasses the implementation of a series of steps tailored to fit the physical environment of the operating room and the microsurgical team profile and culture.

Clear definition of tasks and job descriptors, exquisite role performance and purposeful and deliberate practice by all members of the microsurgical team, will nourish and maintain a high functioning working unit ready and capable of providing precision driven periodontal and dental implant therapy in the pursuit of excellence as the primary pillar of optimized patient care delivery.

CLINICAL RELEVANCE

DEFINING CLEAR PROTOCOLS to establish optimal workflow are key steps for the successful
integration of microsurgical treatment execution in the periodontal and dental implant practice. Having clear objectives will facilitate the implementation of productivity systems geared towards enhancing efficiency by simplifying processes, maintaining clutter-free work environments, reduce distractions, maximizing safety and stimulating a collective mind set of continuous improvement, all towards pursuing excellence in patient care.

RESEARCH IMPLICATIONS

THIS ARTICLE FACILITATES THE VISUALIZATION AND UNDERSTANDING of workflow concepts applied to the implementation of microsurgically driven patient care protocols in the periodontal and dental implant practice.

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