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Integration of digital workflow in dentistry and its clinical and laboratory impacts on the predictability of aesthetic-functional rehabilitations.

Integration of digital workflow in dentistry and its clinical and laboratory impacts on the predictability of aesthetic-functional rehabilitations

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SUMMARY

The digital workflow has transformed how restorative treatments are planned and executed in dentistry. Intraoral scanning, planning software, and CAD/CAM systems have become part of the routine in clinics and laboratories, leading to gains in traceability and reproducibility.
In aesthetic-functional rehabilitation, however, the adoption of these tools only produces consistent results when there is real coordination between clinical and laboratory stages, with standardized documentation and shared technical decisions from the beginning of the case. This article presents a narrative literature review focused on the analysis of the components of the integrated digital workflow: the fusion of digital data (STL files, DICOM, and clinical photographs), the logic of reverse planning, and communication protocols between clinic and laboratory. Practical effects such as the reduction of fitting cycles during trials, more precise control of marginal adaptation, and the reduction of clinical sessions are discussed. The role of the trained professional who articulates clinical and laboratory knowledge is also addressed. The analysis indicates that the results in complex rehabilitations depend less on the technological level of the equipment and more on how processes and professionals are articulated throughout the treatment.

Keywords: Digital workflow; oral rehabilitation; clinical-laboratory integration; CAD/CAM; clinical predictability.

ABSTRACT

Digital workflows have changed how restorative treatments are planned and executed in dentistry. Intraoral scanning, planning software, and CAD/CAM systems have become part of the clinical and laboratory routine, improving traceability and reproducibility. In aesthetic-functional rehabilitation, however, the adoption of these tools only produces consistent results when there is real coordination between clinical and laboratory stages, with standardized documentation and shared technical decisions from the beginning of the case. This article presents a narrative literature review focused on the analysis of integrated digital workflow components: digital data fusion (STL, DICOM files and clinical photographs), reverse planning logic, and communication protocols between clinic and laboratory. Practical effects such as the reduction of adjustment cycles during try-in, more precise control of marginal adaptation, and fewer clinical sessions are discussed. The role of professionals with training that articulates clinical and laboratory knowledge is also addressed. The analysis indicates that outcomes in rehabilitation complexes depend less on the technological level of the equipment and more on how processes and professionals are articulated throughout the treatment.
Keywords: Digital workflow; oral rehabilitation; clinical-laboratory integration; CAD/CAM; clinical predictability.

1 INTRODUCTION

Over the past fifteen years, restorative dentistry has undergone technical transformations that

These changes altered both clinical routines and laboratory processes. Intraoral scanning replaced...

In many contexts, conventional molding with silicones and alginates. Software for

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Virtual planning allowed for the simulation of treatments before any intervention. The systems CAD/CAM brought the fabrication of restorations into dental offices and laboratories with Dimensional control, previously restricted to industry, has been improved. These changes have reduced manual steps. Operator-dependent variables were reduced, and the capacity for documenting cases was expanded. (CORREIA et al., 2006; MIYAZAKI et al., 2009).

In the previous work model, based on physical templates and communication via index cards In writing, the relationship between clinic and laboratory followed a predictable pattern of problems. The clinician The mold was sent, the laboratory interpreted the available information, and the piece was returned for testing. If marginal adaptation was compromised, or if the color did not match expectations, This initiated a cycle of adjustments that could extend over several sessions. Bubbles in the plaster cast, distortions in the molding material, incomplete notes on color and shape: each of these flaws generated rework and prolonged treatment. The digitization of processes promised to eliminate some of these. variables, and in fact eliminated some of them. The question that remains, and which this article examines, is Under what conditions is this promise fulfilled in clinical practice (ZAVOLSKI et al., 2021).

In aesthetic-functional rehabilitation, the requirements are particularly demanding. A case of anterior facets, for example, require simultaneous control of material thickness (for to preserve dental structure), shape (to harmonize with lips and face), color (to mimic the adjacent teeth) and function (so as not to interfere with disocclusion guides). If the scan does not By properly capturing the preparation termination line, the laboratory will produce a piece with Cervical maladaptation. If the reference photographs do not show the relationship of the teeth to the lip. At rest and with a broad smile, the ceramist will work blindly in defining length and incisal contour. If the occlusal record is inaccurate, the protrusive contacts will only be... identified in the clinical trial, requiring adjustments that may compromise the integrity of the ceramic (JODA; BRÄGGER, 2015).

What differentiates a digital workflow that works from one that merely replaces analog means? The quality of the connection between the stages of digital files is paramount. This article analyzes the... Components of this connection: how data is captured and combined, how the planning works. organizes clinical and laboratory decisions, such as how communication between professionals can be... Structured to reduce ambiguities, and what is the training profile that this work model... demand. The analysis begins with a narrative review of the literature and seeks to offer a discussion. applied, with examples illustrating where processes typically fail and where coordination is needed. Proper action produces measurable results.

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2 METHODOLOGY

This study constitutes a narrative literature review, with a qualitative approach and character. descriptive. The choice of this method is justified by the objective of discussing concepts, processes and trends related to digital workflow in aesthetic-functional rehabilitation, without the intention of carrying out Statistical analysis, meta-analysis, or quantitative comparison of clinical data. Narrative reviews. They are appropriate when the goal is to map a field of knowledge, identify gaps, and propose... Conceptual articulations, although they do not offer the same level of evidence as reviews. systematic.

The literature search was conducted in the SciELO, PubMed, and Google Scholar databases. Using keywords in Portuguese and English: digital workflow, oral rehabilitation, oral rehabilitation, CAD/CAM, digital planning, clinical-laboratory integration Clinical-laboratory integration. Scientific articles, literature reviews, and studies were included. clinicians who addressed technical and operational aspects of digital workflow in restorative dentistry and rehabilitative. Duplicate publications and texts unrelated to the topic were excluded. Materials of a purely commercial or promotional nature.

It is important to note that, since this is a narrative review, the statements throughout the text They seek to describe trends and patterns identified in the consulted literature, without the intention of... to establish definitive causal relationships or precise quantifications. When numerical data are The figures mentioned reflect findings from specific studies cited, and not statistical generalizations.

3. THEORETICAL FOUNDATION

The digital workflow in aesthetic-functional rehabilitation can be broken down into four major areas. Components: data capture, virtual planning, communication between clinic and laboratory. and laboratory execution. Each of these components has specific technical requirements and known points of vulnerability. The literature on the subject has documented both the gains provided by digitalization, as well as the necessary conditions for these gains to materialize. This section examines each component, highlighting practical aspects and situations in which they can be implemented. Typical failures occur.

3.1 Digital data capture and information fusion

Data capture is the starting point of the digital workflow and determines the quality of all processes. the following steps. In the context of aesthetic-functional rehabilitation, capturing data means obtaining Three-dimensional records of the dental arch (via intraoral scanning), information about bone structures. and radicular (via cone beam computed tomography), and aesthetic and facial references (via (standardized clinical photographs). Each of these sources generates files in specific formats:

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STL for surface models, DICOM for tomographic volumes, JPEG for images. photographic (CORREIA et al., 2006).

Intraoral scanning offers clear advantages over conventional impression taking: it eliminates The need for printing materials reduces patient discomfort and allows for immediate checking. The quality of the recording is ensured and it generates files that can be transmitted electronically. However, the This method has limitations that need to be acknowledged. In preparations with subgingival margins In deep lesions, optical reading may be compromised by the presence of crevicular fluid or bleeding. Highly polished surfaces, such as metal restorations, generate reflections that make capturing images difficult. In full-arch scans, accuracy tends to be lower than in scans of quadrant, due to the accumulation of small errors throughout the scan. A case study illustrates this. Problem: In a full arch restoration with crown preparations on all posterior teeth, The accumulated discrepancy between the first and last molars can reach clinically significant values. significant if the scanning protocol does not include intermediate checks (ZAVOLSKI et al., 2021).

Data fusion, also called data matching or overlay, represents a The technical differentiating factor of contemporary digital workflow. Planning software allows for aligning the STL model (dental surface geometry), DICOM volume (bone and root anatomy) and the Clinical photographs (aesthetic references) in a single virtual environment. This alignment makes it possible analyses that would be impossible with each source in isolation. For example: by overlaying the scan. By using intraoral tomography, the planner can verify if the planned position for an implant is being respected. the root anatomy of adjacent teeth. By incorporating the smile photograph, it is possible to assess whether the The proposed length for the anterior crowns harmonizes with the line of the upper lip.

Failures in data capture or fusion produce cascading effects. A frequent example: The clinician performs the scan, but does not adequately record the occlusal relationship at maximum. habitual intercuspation. The file is sent to the laboratory, which assembles the virtual model in Digital articulator based on generic parameters. The restoration is designed and manufactured. In Clinical examination reveals that occlusal contacts do not correspond to reality, requiring extensive adjustments that They consume chair time and can weaken the part. The problem wasn't with the scanner, it was with the software. or on the milling machine. It was missing a piece of data that the subsequent flow couldn't compensate for. (ROSSI et al., 2020).

Clinical photographs deserve specific attention. In aesthetic rehabilitations, the ceramist It needs visual references that go beyond the three-dimensional model. Color, texture, translucency, Individual characterizations: none of this information is present in the STL file. One The minimum photographic protocol for anterior facet cases would include: frontal view at rest, face Frontal view with a wide smile, anterior teeth brought closer together with a retractor, color registration with a scale.

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standardized under natural light. When these images are not provided, or when they are taken in a way inconsistent (variable lighting, different angles between sessions), the laboratory works with Incomplete information means the aesthetic result depends more on assumptions than on planning.

3.2 Digital planning and reverse planning logic

Digital planning occupies a central position in the workflow because it is at this stage that The captured data is converted into decisions. Shape of the restorations, position of the margins, Material thickness, occlusal guides, relationship with soft tissues: all these variables are defined. in the virtual environment before any clinical or laboratory procedure. The possibility of visualizing The result should be obtained in advance, and alternatives can be simulated before compromising dental structure. This represents a qualitative shift from the traditional model, in which many decisions were... taken only during the procedure (MIYAZAKI et al., 2009).

The logic of reverse planning consists of starting from the desired outcome to define the... Intermediate steps. Instead of preparing the tooth and then deciding which restoration fits in the space. remaining aspects, the planner first defines the ideal form of the restoration (considering aesthetics, (function and patient expectations) and then determines how much tooth structure needs to be removed. to accommodate it. This reversal of sequence allows us to identify beforehand whether the case is feasible with Minimally invasive preparations may be required, or more extensive reductions will be necessary. In a case of closure... For example, with diastemas and facets, reverse planning shows in advance whether the The thickness of ceramic needed to fill the space is compatible with glaze preparations or whether there will be dentin exposure (COACHMAN; CALAMITA; SCHAYDER, 2012).

Smile design protocols formalized part of this reasoning by proposing a sequence. An analysis that goes from the face to the tooth: facial proportions, midline, buccal corridor, smile line, Proportion between teeth, individual shapes. These protocols are valuable in structuring the collection of information and facilitating communication with the patient about the expected outcome. However, when Treated merely as a sales presentation tool, they lose their technical function. The value of Planning is about the ability to anticipate problems, not about producing attractive images. A simulated smile that ignores limitations of prosthetic space or gingival anatomy can lead to... expectations that are impossible to meet.

A critical aspect of digital planning is translating virtual decisions into parameters. executable files. The design of a crown in the software needs to consider the minimum thickness of the material. Selected ceramic (which varies depending on the system), the space required for the cement line, the anatomy of the cusps and fossae in relation to the opposing teeth, the position of the margin in relation to the gingival tissue. If the planner designs a restoration with a 0.3 mm occlusal thickness, why The available space is limited, but the selected material requires a minimum thickness of 0.5 mm to withstand the...

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Under masticatory load, the piece will fracture in clinical use. This type of failure is not detected by the software. automatically; it depends on the technical knowledge of the person operating the system.

Virtual simulation also allows for the creation of mock-ups (clinical trials in resin). These are procedures that materialize the treatment plan in the patient's mouth before the final preparations. The mock-up It functions as a validation test: the patient can evaluate the shape and length of their teeth in In a real-life situation involving speech and smiling, the clinician can verify occlusal and phonetic relationships and make any necessary adjustments. They can be incorporated into digital planning before any irreversible damage occurs. When this This step is suppressed due to time pressure or over-reliance on screen simulation, increasing the risk of... Rework increases.

3.3 Clinical-laboratory communication in the digital workflow

Communication between the clinic and the laboratory determines whether planning decisions will be successful. Executed according to the original intention, or will they be reinterpreted along the way? In the model In analog terms, this communication depended on handwritten request forms and phone calls to to clarify doubts and, frequently, the personal relationship between dentist and technician that allowed To compensate for the lack of written information, the digital flow has expanded the amount of data that can... to be transmitted, but it did not automatically solve the problem of clarity (ROSSI et al., 2020).

Sending an STL file to the lab is the digital equivalent of sending a plaster model: It provides the geometry, but does not explain the clinical intent. The laboratory that receives only the The scanning process needs to decide on its own where to position the margins, how to define the axial contours, which occlusal anatomy to reproduce. These decisions, when made without explicit guidance, are based on- whether based on generic standards or the technician's prior experience with that specific clinician. The result may or may not correspond to what the clinician had in mind.

Structured communication in the digital flow includes elements that go beyond the model. Three-dimensional. A functional submission protocol for single posterior crowns would include: STL file of the preparation and adjacent teeth, STL file of the opposing arch, occlusion record. digital or guidance on desired contact relationship, intraoral photographs for reference of color, indication of the ceramic system to be used, specification of the type of edge (chamfer, shoulder, blade) and approximate depth, information on history of bruxism or other relevant functions. When these elements are provided consistently, the technician It works with defined parameters. When these are lacking, it works with assumptions (JODA; BRÄGGER, 2015).

Standardizing file naming and versioning is another aspect. often overlooked. In cases involving multiple steps (initial scan, post-preparation scanning, provisional registration, planning adjustments), the multiplication of

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Files can cause confusion about which version should be used for manufacturing. Laboratories They report situations in which the part was produced based on outdated scans because the The most recent file had a similar name to the previous one and was not correctly identified. Simple naming conventions (including date and content description) avoid this type of problem. error.

Confirmation of critical steps prior to manufacturing represents an additional layer of... safety. Before starting the milling or printing of a final part, the laboratory can Send the clinician an image of the virtual design for approval. This checkpoint allows you to identify Problems with contour, anatomy, or margin positioning arise before material and time resources are considered. consumed. In flows where this confirmation does not exist, discrepancies only appear in the proof. clinical, when the cost of correction is much higher.

3.4 Professional profile and integrated training

The traditional model of dental education has historically maintained a separation. A clear distinction was made between clinical teaching and laboratory knowledge. The undergraduate student learned to preparing teeth, shaping them, cementing them, but rarely followed in detail what happened in The laboratory was used after the mold was sent. The prosthetic technician, in turn, mastered the processes of Casting, ceramicizing, and finishing, but had limited contact with the clinical reality of the cases. that they received. This division produced generations of professionals with complementary blind spots: clinicians who did not understand the laboratory implications of their decisions; technicians who did not They understood the clinical context of the parts they manufactured (CORREIA et al., 2006).

The digital workflow has exposed the limitations of this separation. When the clinician designs a preparation which does not leave sufficient thickness for the material, the flaw will only be identified if someone in the process has the knowledge to recognize it. When the technician defines an incompatible occlusal anatomy. With the patient's chewing function, the problem will appear as interference or discomfort in Proof. Digitization didn't create these problems, but it made their consequences more traceable. In the analog model, many flaws were absorbed through empirical adjustments; in the digital model, they are... recorded in the files and in the rework cycles.

The professional profile that the digital workflow demands is that of someone capable of thinking about the case of From start to finish. This doesn't mean the clinician needs to operate the milling machine or that the technician needs to... treating patients. This means that both need to understand the implications of their decisions in subsequent steps. The clinician who knows the minimum thickness limits of ceramic materials. will plan compatible preparations. The technician who understands the requirements of the previous guide will design Restorations with adequate functional anatomy. Communication between them ceases to be a translation. between distinct worlds and becomes a technical dialogue between professionals who share

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vocabulary and criteria.

This integrated competence can be developed through different paths: clinicians who They seek further training in laboratory processes; technicians who specialize in digital planning and they become actively involved in case decisions; teams that work In a collaborative way, with joint discussions before execution. The common point is overcoming challenges. from a logic of watertight stages in favor of a continuous process reasoning. In centers of Where this articulation exists, reports indicate a reduction in adjustment cycles and greater... Predictability of results.

4. DISCUSSION

Analyzing the components of the digital flow allows us to identify where the articulation between These steps produce measurable gains, and fragmentation generates costs. This section discusses the impacts. practices observed in the literature and in documented clinical experience, organized around four pillars: reducing rework, optimizing clinical time, laboratory efficiency, and challenges of implementation.

4.1 Reduction of rework and adjustment cycles

Rework in dental prosthetics manifests itself in various ways: pieces that do not fit and Restorations that need to be redone; restorations that require extensive occlusal adjustments in the chair; crowns whose color does not meet expectations and requires recharacterization or replacement. Each cycle of Rework consumes the clinician's time, the laboratory's time, materials, and often the patient's patience. patient. The literature comparing well-structured digital workflows with conventional or fragmented digital workflows identifies relevant differences in this aspect (JODA; BRÄGGER, 2015).

A documented example: in cases of single crowns on implants, studies Comparisons show that digital workflow with transfer scanning and software planning... Dedicated CAD/CAM manufacturing produces parts with more consistent marginal adaptation than... Flow with conventional molding and casting techniques. The difference is not only in precision. The focus is not on the dimensions of the equipment, but on eliminating manual steps that introduce variability: Silicone manipulation, plaster casting, investment embedding, casting, and de-embedding. Each Eliminating a step means one less source of error.

The cutoff point, however, lies in the quality of the input data. If the scanning was done With the mold transfer poorly positioned, the accuracy of the CAD/CAM system only reproduces the Initial error with high fidelity. Data fusion offers a verification layer: by overlaying the Using computed tomography (CT) scans, positional discrepancies can be identified before manufacturing. Laboratories that have implemented this check report a reduction in cases where the crown needs to be

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Reworked due to problems with the insertion axis or relationship with adjacent teeth.

In clinical practice, the reduction of rework appears in three specific areas. First, in Marginal adaptation: well-executed digital pieces arrive at the test with a settlement that requires Verification only, no adjustment. Second, in proximal contacts: the virtual design allows calibration of the Contact pressure with adjacent teeth, avoiding both the absence of contact (which requires the addition of pressure). (of resin or ceramic) as well as excess (which requires grinding). Third, in occlusion: when the registration Digital occlusal analysis is precise, and the planning takes into account mandibular dynamics and contact positions. Static movements and excursive movements correspond to what was planned.

An illustrative case: posterior quadrant rehabilitation with three crowns on teeth. natural. In the conventional workflow, the typical sequence included silicone molding, plaster model, manual waxing, casting or pressing, trial fitting, glazing, installation with new adjustments. In the structured digital workflow: intraoral scanning, antagonist scanning with Bite registration, CAD drawing with defined contact parameters, zirconia milling. Sintering, trial with minimal adjustments, installation. The difference in clinical sessions and time of The documented effect in comparative studies is consistent, although the magnitude varies according to the... context.

4.2 Impacts on clinical times

Clinical time in restorative treatments is distributed among preparatory procedures. (anamnesis, examination, planning), operative procedures (preparations, impressions or scans, tests, cementations) and corrective procedures (occlusion adjustments, touch-ups of contour, replacement of unsuitable parts). The proportion between these categories varies according to Workflow efficiency. In workflows with a high rate of rework, corrective procedures consume a significant portion of the total time. In well-organized workflows, this portion decreases and the Time is focused on the procedures that effectively build the result.

Joda and Brägger (2015) conducted a comparative analysis of flows for implant-supported prostheses. which documents these differences. The digital workflow showed a reduction in chair time on the order of 28% to 35% compared to conventional flow, depending on the type of restoration and level. the complexity of the case. Most of this difference was concentrated in the evidence and adjustment phase, which The digital workflow was substantially shorter.

It is important to qualify these findings. The documented reduction in clinical time refers to well-implemented digital workflows, with consistent capture protocols and structured communication. with the laboratory and trained staff. Improvised digital workflows, in which the scanning is done. Without criteria, the planning is superficial and the communication is informal, not necessarily producing results. time savings. They can even generate new types of rework: corrupted files,

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Software incompatibilities, parts that do not match the design due to export errors.

The learning curve time also needs to be considered. Professionals in The transition from analog to digital workflow often involves reports of an initial increase in processing time. This procedure will continue until the new protocols are incorporated into routine. This initial investment will... It pays off over time, but represents a real barrier to adoption. Clinics that plan the With proper training and gradual implementation, transitions tend to be overcome with less difficulty. impact on productivity.

Table 1: Comparison between fragmented and articulated flows

Aspect	Fragmented Flow	Articulated Flow
Identifying errors in clinical	trials or setup.	In the virtual planning phase
Basis of communication:	Notes, phone calls, assumptions.	Documented protocol, organized files
Adjustments to the exam:	Frequent and extensive; Specific, focused on validation.	
Clinical sessions,	multiple tests, rescheduling, predictable sequence, less variation.	
personal experience	High dependence (compensation for failures through skill) Moderate dependence	(process reduces variability)

Source: Prepared by the author based on the literature consulted (2025).

4.3 Laboratory Impacts

The prosthetic laboratory is the point in the workflow where planning decisions are made. They materialize into physical pieces. The quality of what the laboratory receives largely determines, the quality of what he can deliver. In fragmented workflows, the technician often needs Compensating for missing information: decides on occlusal anatomy alone because he has not received guidance; He estimates the color because the photographs were underexposed; he assumes the position of the margin because the Scanning did not show it clearly (MIYAZAKI et al., 2009).

Laboratory compensation has its limits. An experienced technician can make choices. corrected based on patterns learned over years of practice. But this compensation is, therefore... Definition: an informed assumption, not a project execution. When the assumption is not... If it doesn't match the clinician's intention, the result is rework. When it does match, the success was... partially accidental. Flows that depend on systematic laboratory compensation are flows with structural variability.

The articulated digital workflow modifies this dynamic. When the laboratory receives not only The STL file, but also the planning project with defined outlines and occlusal references. Given the specified and standardized photographs, he executes rather than interprets. The difference appears in Consistency of results: less variation between similar cases, less dependence on Individual interpretation by the technician, more predictability in production time because there are fewer trips. and visits to clarify doubts.

One relevant technical aspect is the calibration of CAD/CAM equipment. Milling machines and 3D printers have compensation parameters that need to be adjusted according to the material. used. The diameter of the milling cutter, the milling offset, the sintering shrinkage of the zirconia or of

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Glass-ceramic: all these factors affect the final dimensions of the piece. Laboratories that maintain Rigorous calibration protocols are able to translate the virtual design into a physical part with minimal discrepancy. Laboratories that neglect this maintenance introduce variability that No amount of planning can compensate for that.

Interoperability between systems represents another factor of laboratory impact. The digital dentistry market includes dozens of manufacturers of scanners and software. Planning, CAD software, and manufacturing equipment. Not all of these systems. They communicate transparently. Files exported from one software can lose Information is imported into another format. Proprietary formats may require conversions that... Introduce errors. Open flows, based on standardized formats and interoperable systems, They tend to be more stable than closed flows that depend on ecosystems unique to one place. manufacturer.

4.4 Implementation Challenges

The transition to articulated digital workflows faces barriers of various kinds. Economic barriers are frequently cited: intraoral scanners, planning software, Milling machines and printers represent a significant investment, especially for professionals in... early in a career or in resource-limited contexts. The acquisition cost, however, is only part of it. of the equation. The cost of maintenance, software updates, training, and replacement of The components make up the actual investment over time (ZAVOLSKI et al., 2021).

The barrier to education is equally relevant. Most undergraduate curricula in Dentistry has not yet systematically incorporated the teaching of digital workflows. Professionals Graduates more than ten years ago often had minimal or no contact with scanning. Intraoral and CAD planning during their training. In these cases, training takes place through... of extension courses, training offered by manufacturers, or self-directed learning. A The quality and depth of this supplementary training vary enormously.

The organizational barrier relates to adapting the clinic's and the company's internal processes. laboratory. Implementing a digital workflow doesn't just mean acquiring equipment; it means reorganize how cases are handled. This includes defining lead capture protocols, Establish communication standards, create quality checking routines, train the support team, Adjust scheduling to accommodate new procedures. Clinics that address digitalization. Simply replacing tools without reviewing processes often fails to achieve the desired results. the expected gains.

Cultural resistance also plays a role. Professionals with decades of experience. In analog workflows, they developed compensatory skills that function within that context.

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The transition to digital can be perceived as a threat to this repertoire, or as an invalidation of it. Accumulated knowledge. Communication about the benefits of change needs to acknowledge the value. From prior experience, we can show how it can be integrated into the new model, not replaced by it.

Finally, there is the issue of misaligned expectations. Digital product marketing It often emphasizes ease, speed, and superior results in a way that does not correspond to... The reality of implementation. Professionals who purchase equipment expecting transformation. Those who are immediately interested may become frustrated with the learning curve and the adjustments needed until the workflow is complete. It functions stably. Maturity of expectations is part of the successful adoption process.

4.5 Development prospects

Technological advancements in the field point towards greater automation of processes that are currently possible. They depend on human decision-making. Planning software already incorporates suggestion functions. Automatic contouring, margin positioning, and occlusal anatomy based on databases. from previous cases. Artificial intelligence algorithms are being trained to identify flaws. In scans, suggest planning corrections and anticipate adaptation problems beforehand. manufacturing.

These tools have the potential to reduce some of the variability that currently depends on individual experience. An algorithm that has learned from thousands of cases of posterior crowns can to identify patterns of success and failure that an individual professional, limited to their own... Given the specific circumstances, I wouldn't be able to perceive it. Automating quality checks can create layers of verifications that do not exist in purely manual workflows.

However, automation does not eliminate the need for clinical judgment. Algorithms operate with based on statistical patterns; individual cases often present particularities that They deviate from the norm. A patient with severe parafunction, with atypical occlusal anatomy, or with Specific aesthetic expectations require an evaluation that considers context, not just matching with databases. The professional of the future will likely operate in partnership. with automated tools, using them to speed up routine processes and reserving judgment Humans are needed for decisions that require contextualization.

The trend towards greater interoperability between systems also seems to be well established. Initiatives to standardize file formats and communication protocols between Open planning equipment and platforms respond to a market demand for Flexibility. Professionals and laboratories prefer workflows that don't tie them to a single supplier. and that allow combining the best components from different manufacturers.

From the perspective of professional training, a gradual incorporation can be observed. curriculum. New generations of students tend to have contact with digital flows during the

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Graduation, which will modify the entry profile into the profession. The question that remains is the speed This incorporation and its pedagogical quality. Teaching how to operate a scanner is different from teaching... To think critically about a digital workflow. Training that produces professionals capable of evaluating, Adapting and optimizing processes is more complex than training equipment operators.

5 CONCLUSION

The analysis developed throughout this article allows for some conclusions about the state. The current state of digital workflow in aesthetic-functional rehabilitation and the conditions under which it benefits. The potential of digitalization is realized in clinical practice.

The components of the digital workflow (data capture, virtual planning, communication) Clinical-laboratory, CAD/CAM execution) function as an interdependent system. Gains in One step can be negated by failures in another. A high-precision scan loses its value if... The planning does not take into account the limitations of the selected material. A sophisticated plan is Useless if communication with the laboratory does not transmit the relevant parameters. A milling machine of The latest generation faithfully reproduces both well-designed and poorly designed projects. The result depends on the interaction between all the components, not on the isolated quality of one of them.

The literature consulted and the examples discussed indicate that well-articulated digital flows They produce measurably different results from fragmented flows. Reduction of cycles of adjustment, reduced chair time, greater consistency of marginal adaptation, and less Reliance on laboratory compensation represents documented gains. However, these gains are not... Automatic systems depend on well-defined protocols, structured communication, and equipment. calibrated and professionals with an understanding of the process as a whole.

The training profile that this work model demands combines clinical knowledge. Traditional approach with an understanding of laboratory processes and proficiency in digital tools. Not applicable. It's not about training professionals who can do everything on their own, but about training professionals capable of... engage in technical dialogue with all stages of the workflow, identify where problems occur, and implement corrections. This integrated training is both a present necessity and a A trend for the future of the profession.

For future studies, it would be relevant to quantify the impacts more precisely. economics of implementing articulated flows in different practice contexts (clinics of small-scale, specialized clinics, teaching centers). It would also be useful to investigate the models training programs that most effectively develop the integrated competence discussed in this work, Comparing different curricular and continuing education approaches.

The digital workflow in aesthetic-functional rehabilitation represents a real transformation of... Dental practice, with concrete benefits when implemented coherently. A

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Realizing these benefits depends less on the sophistication of the equipment purchased and more on...

The quality with which processes and professionals interact throughout the treatment.

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