Digital workflow and application of PRF and ozone therapy in oral rehabilitation

By Dr Miguel Stanley, Dr Ana Paz, Dr Catarina Rodrigues & Dr Diogo Mendes, Portugal

There are numerous technologies that simplify the daily work, such as intraoral, extraoral and face scanners, CBCT (cone beam computed tomography) with a low radiation dose, and software processing and production, better known as CAD/ CAM (computer-aided design/computer-aided manufacture) which together with new aesthetic materials and prototyping tools (milling machines and 3D printers) is rapidly transforming dental medicine. This case report has the aim of presenting an example of prosthetic digital workflow, with the integration of several technologies that help us achieve treatment success.

Introduction

The digital revolution has changed the world and dental medicine is no exception. We live in the digital era, we have the materials and techniques that allow us to develop a totally digital workflow, allowing dental medicine to grow to a new level, becoming faster and more efficient, when combined with scientific and clinical knowledge.

Clinical case

In November 2017, a 39-year-old female patient came to an initial appointment at White Clinic owing to tooth pain (tooth #16). A clinical and radiographic examination were performed, including periapical and panoramic radiographs, CBCT scan (Carestream 9500, Carestream Dental), and intra- and extraoral photographic pictures (Figs. 1a & b). In the clinical and radiographic evaluation, it was observed that tooth #16 presented an invasive cervical resorption at the mesiobuccal root. The treatment plan established was dental extraction with immediate implant placement. The tooth had been previously re-treated endodontically and restored with a definitive ceramic crown. Due to the current situation of the tooth, although the protocol in White Clinic is to preserve teeth, it had indication for immediate extraction.

Once the implant bed had been prepared, a 7 x 10 mm implant (Anyspeed, MegaGen) was placed. After placement, the ISQ (Implant Stability Quotient) was measured with a stability meter (Mega IQ, MegaGen), and the value was 72. According to the ISQ scale, this represents high stability (Fig. 2). A 1 x 7 mm healing screw (Anyspeed) was placed, along with a plug of A-PRF (advanced platelet-rich fibrin, PRF process by Choukroun, Figs. 3a & b). Afterwards, bone densification was performed through a sequence of Denosil drills (Denasil Burs, Vernah, Fig. 4a). This type of drill allows the clinician to perform a bone densification process.

One week after the preparation, the definitive crown in monolithic zirconia was attached and the occlusion tested using T-Scan technology (Teknika was attached and the occlusion was checked. The main success indicator for dental implants is primary stability, which is one of the prerequisites for achieving osseointegration. This is affected by factors such as bone quantity and quality, surgical placement procedure, and implant shape and coating.

In March 2018, four months after the surgery, the prosthetic phase was started. An impression was taken with an intraoral scanner (CS 3600, Carestream Dental) using scan bodies for an impression at the implant level (MegaGen; Figs. 5a & b) and intraoral scanner (CS 3600, Carestream Dental) using scan body for an impression at the implant level (MegaGen; Figs. 11a & b). The information was sent to the Anatomic Laboratory (MegaGen), where a master was designed using a CAD program. The design of the crown had been finished, the information was sent to a milling machine (Amarinn Gmbh) and the crown was milled (Fig. 12).

One week after the preparation, the implant placed, along with a plug of A-PRF (advanced platelet-rich fibrin, PRF process by Choukroun) in order to accelerate the healing process, and sutured with 4/0 polypropylene (6/0 nylon, Figs. 7-10). After the surgical procedure, the White Clinic postoperative protocol was applied: application for eight minutes of the ATP8 laser (Swiss Bo Innov), based on the principle of Low Level Laser Therapy that acts on the cellular metabolism and provides a better and faster postoperative healing.

Another technique that has proven clinical benefits, such as higher ISQ values and marginal bone resorption, is ozone therapy (Ozone DTA, Apoza). The use of ozone therapy in oral rehabilitation with implants is ozone therapy. This ozone-based tool has an antibacterial effect resulting from the oxidative action on cells, damaging the cytoplasmic membranes of certain organisms, such as bacteria, viruses, fungi, but without, however, the ability to damage healthy human cells.11,12,13 Thus, ozone has the following advantages: accelerates the healing of soft tissue (increases the rate of physiological healing), controls opportunistic infections, reduces scarring time after extraction (forms a pseudomembrane over the alveolus and protects it from physical and mechanical aggression) and aids in bone regeneration.14 The literature suggests that ozone therapy has the greatest potential in preventing and managing infections and improving bone regeneration.15,16 The use of ozone therapy in post-extraction socket must be prepared conventionally and disinfected with ozone for about 40 seconds, followed by placement of the implant. In this way, we avoid infections and improve bone regeneration. Furthermore, positive effects on bone regeneration and implant surgery have been suggested when PRF is applied. Given its ease of preparation, low cost and biological properties, PRF can be considered as a reliable treatment option. Although the application of PRF during implant placement or for the treatment of peri-implant defects is quite recent, several studies have already shown clinical benefits, such as higher ISQ values and marginal bone resorption.17

Discussion

The main success indicator for dental implants is primary stability, which is one of the prerequisites for achieving osseointegration. This is affected by factors such as bone quantity and quality, surgical placement procedure, and implant shape and coating.

This stability can be measured with a device that analyses the resonance frequency of the implant after its placement. The software converts the received hertz waves to a numerical value called ISQ on a scale ranging from 1 to 100. The manufacturer’s instructions suggest that a stable implant has an ISQ higher than 65 and an unstable implant less than 50. However, these values differ from one author to another. Nowadays, we have several options that can help us achieve a successful rehabilitation with implants. One of them is the use of a fibrin membrane rich in platelets (PRF). This has the ability to reduce the healing period and improve bone regeneration. The use of PRF as a covering membrane allows rapid epithelisation of the site surface and represents an effective barrier against the penetration of epithelial cells within the bone defect.

Orcio and Aladominho evaluated the impact of implant coating with L-PRF (leukocyte- and platelet-rich fibrin). The stability of the implant was measured by ISQ. The use of L-PRF in the implant insertion resulted in statistically significant ISQ values that continuously increased over time. Boora et al reported early bone remodelling around implants coated or not with L-PRF at the insertion. Implants coated with L-PRF showed 50% less initial bone loss after both one and three months, respectively. Nowadays, centrifugation protocols have been optimised, the low speed concept of centrifugation, resulting in A-PRF and F-PRF. These new protocols seek to obtain a greater number of platelets, in order to increase the healing capacity, and leukocytes, therefore also increasing the regenerative capacity.

Furthermore, positive effects on bone regeneration and implant surgery have been suggested when PRF is applied. Given its ease of preparation, low cost and biological properties, PRF can be considered as a reliable treatment option. Although the application of PRF during implant placement or for the treatment of peri-implant defects is quite recent, several studies have already shown clinical benefits, such as higher ISQ values and marginal bone resorption.

Another technique that has proven to be an asset in the success of oral rehabilitation with implants is ozone therapy. This ozone-based tool has an antibacterial effect resulting from the oxidative action on cells, damaging the cytoplasmic membranes of certain organisms, such as bacteria, viruses, fungi and parasites, but without, however, the ability to damage healthy human cells.11,12,13 Thus, ozone has the following advantages: accelerates the healing of soft tissue (increases the rate of physiological healing), controls opportunistic infections, reduces scarring time after extraction (forms a pseudomembrane over the alveolus and protects it from physical and mechanical aggression) and aids in bone regeneration.14 The literature suggests that ozone therapy has the greatest potential in preventing and managing infections and improving bone regeneration.15,16 The use of ozone therapy in post-extraction socket must be prepared conventionally and disinfected with ozone for about 40 seconds, followed by placement of the implant. In this way, we avoid infections and improve bone regeneration. Furthermore, positive effects on bone regeneration and implant surgery have been suggested when PRF is applied. Given its ease of preparation, low cost and biological properties, PRF can be considered as a reliable treatment option. Although the application of PRF during implant placement or for the treatment of peri-implant defects is quite recent, several studies have already shown clinical benefits, such as higher ISQ values and marginal bone resorption.

In modern-digital dentistry, the four basic phases of work are image acquisition (through scanning), data preparation/processing (through CAD software), production (CAM systems), and clinical application in patients. The dental preparation can
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be scanned outside the oral cavity, on the plaster model, or inside the oral cavity by an intraoral scanning system. Optical impressions have several advantages over conventional impressions. Among them, the most important is the reduction of patient stress and discomfort. Moreover, optical impressions are time-efficient and can simplify clinical procedures for the dentist, especially for complex impressions (in patients with undercuts and/or in oral implantology, when multiple implants are present). In addition, optical impressions eliminate plaster models, saving time and space, and allow for better communication with the dental technician.

Finally, optical impressions improve communication with patients and are therefore a powerful marketing tool for the modern dental clinic. Regarding accuracy as compared with conventional impressions, optical impressions are equally accurate for individual restorations or three- to four-unit bridges on natural teeth and on implants. Conversely, conventional impressions still appear to be the best solution currently for long-span restorations, such as fixed full prostheses on natural teeth and implants with a higher number of prosthetic abutments. Significant differences in trueness have been found among different optical impressions. For each scanner, the trueness was higher in a partially edentulous model than in a fully edentulous model.

Conversely, the disadvantages of using optical impressions are the difficulty in detecting deep margins in prepared teeth and in the case of bleeding, the learning curve, and the purchasing and maintenance costs. Nowadays, we also have the possibility to superimpose the information related to the teeth and gingivae, received from the intraoral scan, over the bone-related information acquired with CBCT. It is therefore possible to plan the optimal positioning of implants with software to guide the surgery. Planning data is transferred to a surgical template that can be physically fabricated in various ways and with different materials. This guide will help the surgeon correctly position the implants without needing to raise a flap.

Conclusion

The use of new technologies in dentistry, such as the application of PRF, ozone therapy and intraoral scanners, has contributed significantly to the success of rehabilitation with dental implants, reducing the time for implant placement and for their restoration.

Editorial note

A list of references can be obtained from the publisher.

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Fig. 5a
Fig. 5b
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Fig. 11b
Fig. 12
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Fig. 13c
Fig. 13d
Fig. 14
Fig. 15a
Fig. 15b
Fig. 15c
Fig. 15d
Fig. 15e
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Fig. 16d
Fig. 16e
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Fig. 17b
Fig. 17c
Fig. 17d
Fig. 17e
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Programme outline: Microbiology of endodontic disease and its relationship with the host immune response.
Hands-on: Rotary NiTi and advanced thermoplastic obturation techniques.

Module 3  |  12-15 September 2019 (4 days)  |  Traumatic Injury, Pain and its Management
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Module 4  |  December 2019 (4 days)  |  Dental Resorption and Pattern of Tooth Fracture & Implant Prosthodontics
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Hands-on: Reciprocating NiTi and Carrier based thermoplastic obturation techniques & Implant prosthetic and surgery on phantom heads.

Module 5  |  March 2020 (4 days)  |  Restoration of Endodontically Treated Teeth
Hands-on: Placement of core restorations and post retained restorations.

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Revolutionary Technology in Additive Manufacturing – by 3D Systems

By 3D Systems

NextDent™ 5000 by 3D Systems, a high-speed 3D printer – powered by Figure 4™ technology helps dental laboratories and clinics redefine their workflow to achieve improved accuracy, repeatability and productivity with lower total cost of operations. When used in conjunction with the company’s robust portfolio of certified NextDent materials, dental labs and clinics are able to address the broadest range of indications from a single printer available today. This plug-and-play solution integrates with the industry’s state-of-the-art intra-oral scanning and software solutions delivering a much more precise result than available with manual production. The benefits of the NextDent 5000 solution extend to the patient – reducing the time required to produce orthodontic and prosthodontic devices, and the number of office visits needed to complete treatment. This end-to-end solution combining materials, technology, software and services will help dental labs and clinics bridge from traditional methods to a digital workflow, revolutionizing their business.

"With 3D Systems’ NextDent solution, dental laboratories and clinics are now able to produce dental devices at dramatically increased speed – up to 4X faster than other available solutions – while reducing material waste and capital equipment expenditure as well as reliance upon milling centers," said Rick Jacobs, vice president, general manager, dental, 3D Systems. "Benefits also extend to the patient by reducing the time it takes to produce prosthodontics and orthodontics, as well as the number of required office visits."

This new solution is already demonstrating its ability to truly revolutionize the dental workflow.

"The NextDent 5000 is the fastest dental 3D printer I’ve ever seen, with accuracy and precision that result in extremely fine detail,” said Adrienne Slevin, director of education and technology, Dental Arts Laboratories.

"I’ve also found it very simple to use. The 3D Sprint™ software is so robust – it handles objects that none of my other printers will accept. The post-processing is equally simple and straightforward."

Dental Arts Laboratories has been able to achieve print speeds more than 4X faster than comparable printers – completing print runs for some indications in as little as 28 minutes. 3D Systems’ 3D Sprint software, which is bundled with the NextDent 5000, provides Dental Arts Laboratories with a complete CAD optimization and print management tool, helping to more efficiently produce dental devices.

The NextDent 5000 is powered by 3D Systems’ proprietary Figure 4™ technology, which facilitates high-speed, 3D printing of dental devices and fixtures. The printer is compatible with industry-leading, intra-oral scanning and dental software solutions, delivering more precise results than conventional manual production techniques. This end-to-end digital workflow also provides higher and more predictable uptime, with a significant reduction in risk for the operator.

3D Systems is also providing 18 new NextDent materials for an unprecedented total of 50 different options. All NextDent materials are biocompatible and CE-certified to cover a broad range of dental applications for lab managers, dental technicians, dental prosthetic technicians and clinical prosthodontists and orthodontists.

"As of this week, we’re shipping the NextDent 5000 for Dental. I’m pleased with how it has performed through the testing phases, and that dental labs and clinics are seeing the power of 3D printers redefine digital dentistry,” said Yvonne Ishoi, president and chief executive officer, 3D Systems. "With the addition of these printers, our systems offer the industry’s widest range of regulatory-approved 3D printing materials and technologies that allow dental labs and clinics of every size to improve their customer service and competitiveness with more accurate dental devices, delivered faster than ever before."

For further information, please contact:

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Why occlusion matters?

By Vivek Gupta, UK

Occlusion is the cornerstone of successful dentistry, however, it is also perhaps the most misunderstood subject in dentistry. Why do restorations done with occlusal understanding last the test of time, whilst a lack of occlusal understanding causes iatrogenic damage to patients?

90% of the patients have occlusal disease, so learning the Principles of Occlusion and about Occlusal Assessments will allow you, as a dentist, to begin to treat occlusal disease, confidently and competently.

Understanding the language of occlusion and the schools of thought that exist will allow you to fully integrate the 5 principles of occlusion into your daily dentistry.

Knowing the theory of levers will allow dentists to explain clearly and logically to patients that some of the treatment or care protocols that are planned are given to inform and educate correctly about iatrogenic disease. Allowing them to make informed and legally correct choices, whilst allowing the clinician to practise defensive but correct dentistry.

Large VH and HV slides, when to treat and when to refer is fundamentally important. Understanding how this works and how these can be used to treat patients will reduce treatment or restoration failure.

Knowing when to use splint therapy, types of splints and duration and protocol of treatment will allow you to provide excellent care for all your patients bringing a whole new area of treatment available for your patients.
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Module 2  |  31 October - 03 November 2019 (4 days)  |  Treatment Planning and Surgical Treatment
Programme outline: implant design, radiographic techniques, implant surgery, implant specific treatment planning. Basic practice management.

Module 3  |  22-26 January 2020 (4 days)  |  Restorative Aspects of Implantology
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Module 5  |  11-14 June 2020 (4 days)  |  Medical Compromised Patient and Soft and Hard Tissue Management
Aesthetic and Restorative Challenging Patient
Programme outline: medications related osteonecrosis, GBR techniques, soft tissue management, implant aesthetics, ceramics and implants.

Module 6  |  03-06 September 2020 (4 days)  |  Rare Complications and Techniques
Programme outline: rare complications, combination implants and teeth, live patient treatment, written and oral examination and case presentations.

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The shape of an anterior restoration significantly influences the symmetry of the gingival contours. Provisionals that have proved to be suitable both in terms of their function and aesthetics allow permanent restorations to be precisely manufactured with the help of digital methods.

Unfavorably positioned teeth and/or an asymmetric contour of the soft tissue represent a considerable challenge in the already difficult anterior zone. In order to achieve a natural-looking result, the shape and shade of the restoration have to be suitably matched to the remaining teeth and furthermore the soft tissue needs to be properly conditioned. In many cases, provisional restorations are initially used by the dental team so that the special requirements of the gingiva can be effectively addressed.

Case study
The 33-year-old patient consulted our practice about having defective dental braces removed after three years of orthodontic treatment. He asked us to treat the carious lesions in his teeth and enhance the appearance of his smile. The first aesthetic analysis revealed an unfavorable length-to-width ratio of the anterior teeth (Fig. 1). As a result, the patient wished to have his front teeth lengthened. The upper left canine had to be endodontically treated due to advanced necrosis of the pulp tissue.

Planning
Our plan was to reconstruct the upper anterior teeth. In choosing the most suitable material for the restorations, we had to take into account the fact that the patient enjoyed eating hard nuts. Furthermore, he reported that he had a habit of grinding his teeth at night and clenching his jaws. Consequently, the anterior crowns would have to be not only functional and aesthetic, but also very strong and tough. We planned to use six all-ceramic crowns to optimize the length-to-width ratio (tooth lengthening) and even out the gingival contour.

Manufacturing technique and selection of the materials
In order to minimize the risk of fracture of the ceramic restorations, we decided to use IPS e.max Press lithium disilicate ceramic, which demonstrates a high toughness of 470 MPa as well as excellent aesthetics. In addition to the monochrome press ingots, this ceramic system includes a polychromatic material (Fig. 2). IPS e.max Press Multi ingots are used to fabricate highly aesthetic monolithic restorations that do not need any characterization. They feature a lifelike progression of the shade and translucency between the dentin and incisal areas.

The press technique, which involves the use of a full-contour wax-up, offers a quick and uncomplicated method of manufacturing crowns. Moreover, the press technique allows us to reproduce delicate gingival contours with utmost precision. In restorations that are built up in layers, the ceramic sometimes shrinks, making it difficult to accurately replicate the gingival contours of the provisionals. In our opinion, the IPS e.max Press Multi ceramic has two decisive advantages. First of all, its true-to-nature shading imitates that of natural teeth in the cervical and in the incisal region. In contrast to the restorations pressed with monochrome ingots, the polychromatic restorations require less time and effort to fabricate, since they do not have to be customized with layering ceramics in the incisal region. Secondly, IPS e.max Press Multi has just the right translucent properties to allow the necessary transmission of light.

Clinical treatment
First, endodontic treatment was performed and the carious lesions were removed. Then the teeth were restored with composite fillings. The front teeth requiring treatment were suitably prepared (Fig. 3) and the provisional crowns were placed (Fig. 4). The right lateral incisor was lengthened. The provisional crowns helped to support the gingival contours and establish a symmetric appearance. Once the desired symmetry of the teeth and gingival tissue was attained, the teeth were prepared for the permanent restorations (Fig. 5) and impressions were taken.

The press technique ensured a symmetrical appearance of the anterior teeth. The lengthening of the upper left canine was guided with the help of digital methods. The IPS Sprue Guide system was used to fabricate highly aesthetic monolithic restorations that do not need any characterization. They feature a lifelike progression of the shade and translucency between the dentin and incisal areas.
ZirCAD MT Multi
The most esthetic high-strength, multi-translucent\(^1\) zirconia

\(^1\) Composed of different material classes
The abutment teeth were separated and the margins and contours were adjusted (Figs 6 to 8).

This approach allowed the shape of the provisional crowns to be exactly replicated. We focused on recreating the subgingival contours, which support the oral soft tissue, so that the restorations would not have to be individually adjusted in the dental office. The crowns were milled from a dimensionally stable wax disc.

In the next step, the wax crowns were reproduced with a pressed ceramic (IPS e.max Press Multi). For the investment procedure, the milled wax crowns were attached to a special prefabricated precision wax component (IPS Multi Wax Pattern). At this stage, it is important to make sure that the attachment joint is not too thick and that it is aligned with the labial surface. This helps to accentuate the unique shade gradations of the material. The wax restoration attached to the Wax Pattern was subsequently secured in the slot of the IPS Multi investment ring base. The position of the sprues was checked with the help of the IPS Spray Guide (Fig. 15). The shade progression within the crown can be adjusted as required. For example, if the incisal portion should be more pronounced, the Wax Pattern is simply moved downward on the investment ring base (max. 2 mm). The preparing, pressing and divestment steps were carried out in the customary way and in line with the instructions of the manufacturer.

**Finishing**

The present restorations can be adjusted if desired in order to accentuate certain individual characteristics. In the present case, the unglazed restorations were tried in the patient’s mouth before the stains and glaze firing. At this stage, most of the clinically important properties were clearly recognizable: tooth axes, suitable pressure on the adjacent soft tissue (e.g. papillae and gingival contour), harmony of the lip line and incisal edges as well as the symmetry of the crown. The patient was satisfied with the optimised length-to-width ratio of the teeth. The main aim now was to reproduce this situation with utmost precision. The inter-occlusal record was sent to the laboratory in order to minimize the work involved in the adjustment of the occlusion. The surface texture of the IPS e.max Press Multi crowns was created with suitable grinding instruments before the glaze firing cycle. The restorations were then characterized with IPS Incolorer stones (cooper, white and anthracite) and glazed. The crowns were manually polished to the desired brilliant sheen (Fig. 12).

**Placment**

The excellent collaboration of the dentist, dental technician and the patient paid off. The restoration was swiftly placed in the practice without having to make any further adjustments. The clinical situation which was created on the model and with the help of provisional restorations could be successfully reproduced in the permanent restoration (Fig. 13). The patient and the dental team were highly satisfied with the result. The entire treatment process was straightforward and efficient.

**Reliable planning for an optimal workflow**

By Dentsply Sirona

Part of creating an optimal workflow involves the ability to reliably plan for variables that differ with each patient. 3D imaging gives the clinician the ability to view anatomical structures not seen in two-dimensional images. The following case study involving a male patient in need of a restoration shows the advantages of utilising 3D imaging and an integrated digital workflow.

**Methods**

In this case, an Orthophos SL 3D from Dentsply Sirona was used for both panoramic and DVT scans. Digital impressions of the patient were taken with a CEREC camera and implant planning took place within the Galileos Implant software. For guided surgery, the team used CEREC Guide 5 milled in-house at their dental laboratory on an iInLab MC X5 milling machine.

**Case Study**

A 32-year-old male patient presented to our practice with gap in the area of teeth 45-47. He wanted this area restored. We used the Orthophos SL 3D to take a panoramic scan for planning purposes.

The patient opted for a treatment plan involving the insertion of two implants and then an implant-supported bridge. Digital imaging, combining DVT with CEREC optical impressions were used to plan the implant surgery in Galileos Implant software. The software creates an implant proposal as well as enables planning of the alignment of the prosthesis. The ability to plan and perform virtual surgery allowed the team to maximise safety and minimise risk. CEREC Guide 2 was chosen in the treatment plan and then milled in our practice to use during surgery.

An additional DVT image was made in the Orthophos SL’s Low Dose Mode as a check post-implantation. Hybrid abutments on to-base for the final restoration were chosen.

**Summary**

Reliable planning makes for an efficient treatment while helping to minimize risk. 3D imaging is an important part of creating a solid plan and the integrated digital workflow offered by using the Orthophos SL along with relevant planning software saves time for the practitioner and is also efficient for the patient by reducing the number of times he/she has to come to the practice.

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