“Because quality treatment matters to me”

What research and practitioners tell us about intraoral scanners and treatment quality

3shape

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1 Introduction

Digital vs analog impressions

Despite the use of intraoral scanners growing in dentistry, most doctors remain reluctant to embrace the technology. A chief concern is: can I provide my patients with the same quality of care when my treatment is based on a digital impression?

What the main concerns are

Since their introduction, doctors have been concerned about intraoral scanners not being able to document subgingival margins accurately and not having physical models to verify a restoration's fit before seating. Moreover, with CAD/CAM, there has always been worries around resulting restorations not being as esthetic or robust as handcrafted ones.

These concerns are why clinical studies and colleagues sharing cases that document successful digital workflows are so important for evaluating treatment quality based on digital workflows. It is also why what your peers say should assist you in your decision process.

The purpose of this book

Whatever intraoral scanner makers tell you, if what they say is not based on a study or a quote from a dental colleague with no conflict of interest, then it is just marketing.

To ensure that your treatments always meet your highest quality standards, the impression that you base your treatment on must be accurate and your design and production partner must be able to receive and work with that impression with no loss to its accuracy.

This ebook examines what dental professionals are saying about treatment quality based on digital dentistry driven by intraoral scanning. The book cites only professionals and clinical studies.

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A bit of background

Over the past decade, the use of intraoral scanners have become more commonplace. Imaging technology has improved significantly from the early days. Better imaging has resulted in, for example, powder no longer being needed when scanning. Although in certain cases, it can still be recommended. Likewise, software and user interfaces have become much more user friendly.

In addition, huge advances in IT and data sharing have made the sending of images between lab and practice nearly seamless. The ease in data sharing has also radically improved communications amongst treatment partners.

At the same time, intraoral scanner development is moving at breakneck speed. There are wireless intraoral scanners now available as well as new models that include caries-detection technology.

The good news is that some companies include future updates to their intraoral scanners via subscription models; safeguarding solutions so that they remain future-proof.

How do you determine treatment quality?

To ensure a quality outcome, structures such as the treatment facilities, equipment, and staff must all meet proper standards. A successful treatment is also reliant on appropriate planning and the following of established treatment protocols.

Similarly, in cases with unsatisfactory results, where the case went wrong must be documented too. Digital technology enables this.

Unlike analog workflows, planning, design, and production, and in the case of surgeries, the insertions are pre-planned using surface and CBCT data. The data is stored and never change. Analog workflows on the other hand, require the review of gypsum models that in the meantime could have been lost, chipped, or contaminated.

In an interview with surgeon, Dr. Sonia Leziy, she states:
"I'm an experienced clinician — and I think I do good work; I have good hand/eye coordination. However, the brain sometimes does not connect too well with the hand. We do make mistakes — all of us, regardless of our level of experience. Limited access, challenging patients and surgical sites, and restricted intra-arch space are among some of the factors that strengthen why (digitally enabled) guided protocols are so important. Guided surgery takes the mistakes out of my hands during the clinical event, and that is important because I can sit at my computer in a non-stressful environment and make all the decisions there."

Digital workflows not only enable proper planning, but also the proper documentation of the treatment.

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What accuracy studies tell us

From their initial introduction to the market, clinicians have sought to verify intraoral scanning accuracy. Unfortunately, conducting a study with a tool (IO scanner) operated by a human hand can inherently present challenges. Besides possible human error when scanning, scan strategy can impact accuracy results significantly. Moreover, the patient will always be a variable and a reason that most studies are conducted in-vitro.

The difference between a conventional impression and digital impression is that **analog impression material records a space by using physical pressure. A digital impression documents anatomy by imaging the margin shape with an optical system**.

Because of this, depending on the intraoral scanner, it may be difficult to scan challenging subgingival conditions. As a result, scan and preparation strategies need to be adjusted to meet these challenges.

Dr. Douglas Watt

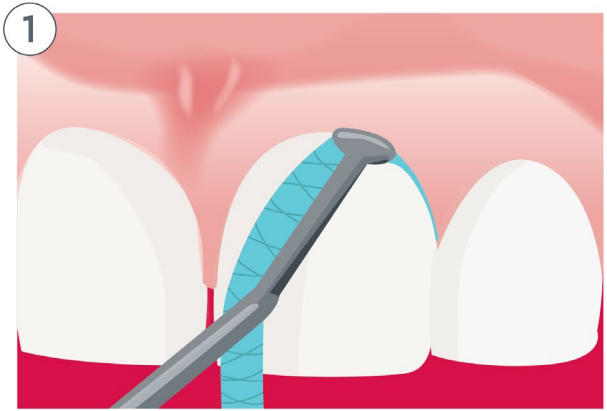
The Dr. Watt method

An example of adapting to the technology is given by UK practitioner, Dr. Douglas Watt in a case study he presented.

Dr. Watt found that the biggest challenge during a clinical case, “was scanning adjacent subgingival margins and getting a clear marginal definition all the way round the preparation.”

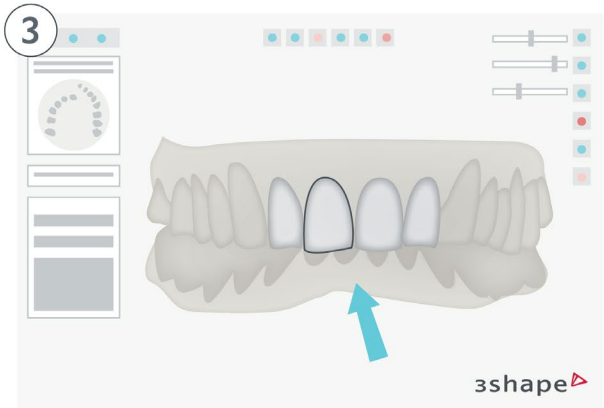
Dr. Watt discovered that by placing the retraction cord one tooth at a time, scanning it, and then removing the retraction cord from that tooth and placing it in the next tooth, he was able to avoid the cord displacing the papilla over the margin of the tooth in front.

Dr. Watt was then able to scan individual tooth preps and stitch the scans together into one scan. Stating that: “the major benefit of using a scanner in this situation is that if there is an area lacking definition, you can simply delete and rescan this area. With a conventional impression, it would have meant replacing some cord and retaking the impression, possibly multiple times.” This would be a nightmare for both the patient and treatment provider.

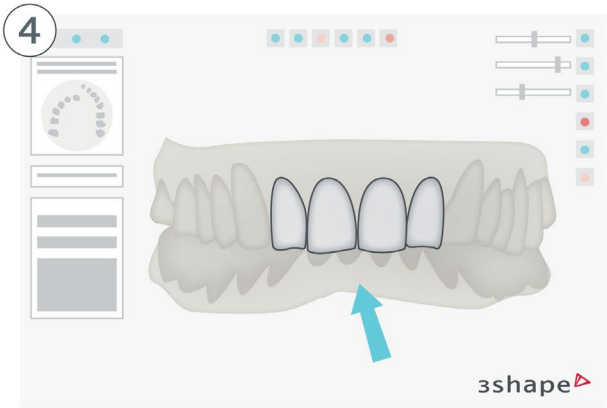


Place retraction cord

Scan and move on to next tooth



First get individual tooth scans...



...then stitch scans together into one

Dr. Watt method

What the clinical accuracy studies say

As mentioned, there are many clinical studies available concerning intraoral scanning. The following are a few conclusions from some of them.

> *Within the limitations of this study, the zirconia copings fabricated with CAD-CAM using different digitization methods and Ni-Cr copings fabricated using the lost-wax technique and casting produced clinically acceptable marginal and internal discrepancies. No significant differences were found.*[1]

> *In dentate situations, the two tested IOS systems achieved a clinically satisfying accuracy for capturing gingival contour in anterior maxilla, with a comparable or superior precision to the conventional impression. Intraoral digital impressions could be a recommended method to record 3-dimensional gingival contour in the esthetic zone.*[2]

> *Within the limitations of this in vivo study, all of the digital impression systems were capable of measuring quadrant impression with clinically satisfying precision. There are differences in precision between different digital impression systems, but while statistically significant, they all fall within a range which allows the successful production of restorations in the digital workflow.*[3]

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1. *Evaluation of the fit of zirconia copings fabricated by direct and indirect digital scanning procedures*, Bora Lee, DDS,a Kyung Chul Oh, DDS, PhD,b Daewon Haam, DDS, MS,c Joon-Hee Lee, PhD,d and Hong-Seok Moon, DDS, MSDe; J Prosthet Dent . 2018 Aug;120(2):225-231. doi: 10.1016/j.prosdent.2017.08.003. Epub 2018 Feb 7.

2. *Evaluation of intraoral digital impressions for obtaining gingival contour in the esthetic zone: accuracy outcomes,* Donghao Wei1 & Ping Di1 & Jiehua Tian1 & Yijiao Zhao2,3,4 & Ye Lin1; Clin Oral Investig. 2020 Apr;24(4):1401-1410. doi: 10.1007/s00784-019-03105-6. Epub 2019 Nov 21.

3. *In vivo precision of conventional and digital methods for obtaining quadrant dental impressions*, Ender, Andreas; Zimmermann, Moritz; Attin, Thomas; Mehl, Albert; Clin Oral Investig . 2016 Sep;20(7):1495-504. doi: 10.1007/s00784-015-1641-y. Epub 2015 Nov 7

In summary

The curtain that doctors have been hiding behind: the one that says digital is no good or the quality isn't there, no longer exists.

Dr. Vincent Prestipino, Prosthodontist

As seen from these studies, digital impressions deliver equal if not better results when compared with analog impressions.

3Shape has a library of clinical studies involving intraoral scanners and digital workflows. Please feel free to review them (may require subscriptions).

4 What case studies tell us

What case studies tell us

Clinical cases are a terrific tool for gaining a better understanding of digital dentistry workflows. They involve real patients undergoing real treatment. They document “before and after” results.

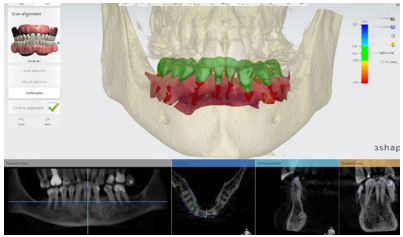
The old saying, “seeing is believing” certainly applies to clinical cases but they also provide an extremely important resource for best practices and protocols.

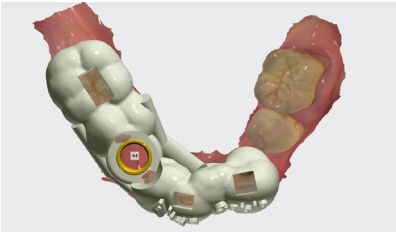
In many of the cases that doctors have shared with 3Shape, they conclude their case with a summary of how digital tools benefitted the described treatment in the case.

These summaries provide an excellent resource for evaluating “reasons to go digital with your dentistry.” Intraoral scanning, as documented in these cases, is used to not only kickstart great treatment results, but in many cases, lead to an improved quality and predictability of the treatment when compared with a conventional workflow.

Dr. Mak

Australian practitioner, Dr. Anthony Mak talking about one of his published clinical cases says that his case "illustrates how advances in digital technologies can provide clinicians with the tools for diagnosis, treatment planning, the execution and provision of dental restorative procedures in a truly transformative way.





Simplification of clinical protocols, increased accuracy over conventional analog techniques and improved patient comfort and outcomes are compelling benefits of a full digital workflow in the field of restorative and implant dentistry."

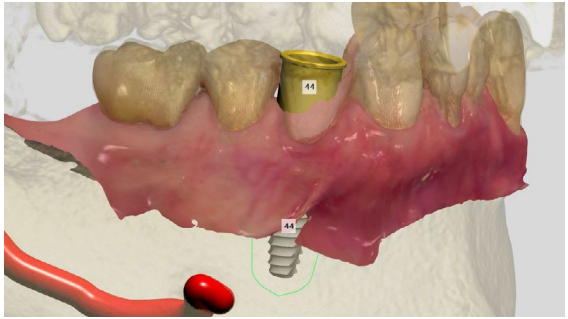
In an implant case shared by Dr. Mak, he was able to use the data or information from the CBCT scan and intraoral surface scans and combine them in CAD software to simplify his workflows including creating diagnostic facially driven mock-ups, restoration-driven implant treatment planning, and the design and fabrication of a surgical guide.

Because Dr. Mak worked digitally, he was able to design the temporary and permanent prosthesis and design of the master die model and then manufacture them with 3D printing or milling.

Tip:

Find a wide range of case studies on

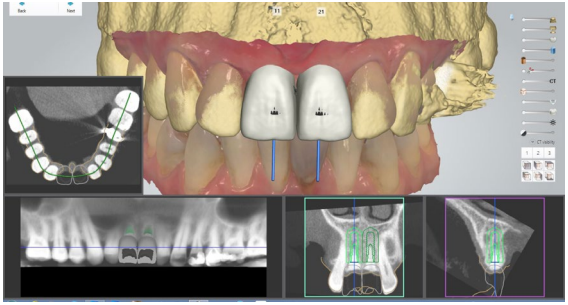
3shape.com



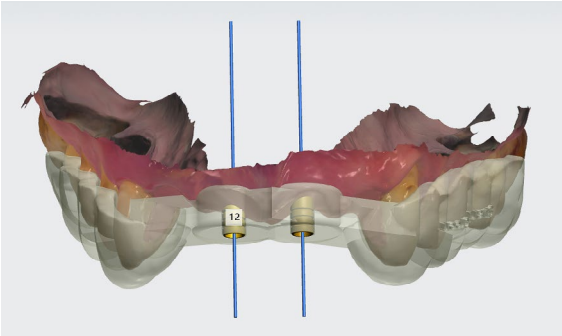
Digital workflows enable the prosthetic design to be visualized, planned, and even designed prior to the patient even attending for the surgical phase of treatment.

Dr. Tan

Fellow Australian practitioner, Dr. Philip Tan states that the "foundational component to implant treatment is the creation of restorations that are indistinguishable from teeth, can be maintained by the patient, last as long as possible and amenable to retreatment if necessary."



Dr. Tan's words can be applied to any restorative treatment. The quality must meet this standard. In a clinical case shared by Dr. Tan, he says that because of digital technologies, he was able to improve the planning processes through enhanced visualization during the planning process as well as improve preparation for the final restoration.



Other voices

The field of implantology has benefited greatly by digital workflows and scanning. USA practitioner, Dr. Jonathan L. Ferencz says that digital dental techniques like intraoral scanning, digital diagnostic wax-ups and CAD/CAM milling are changing the way dentists provide quality treatment. With Dr. Ferencz stating emphatically, “the difference digital dentistry has made to making a crown is tremendous. But the difference it has made in implant dentistry is night and day!”

Dr. Jonathan L. Ferencz

In an online interview between the UK’s, Dr. Ian Buckle and CDT and CEO, Lee Culp, the two discussed digital dentistry. Dr. Buckle commented that the technology “helps us be predictable, it helps us be very productive, and because we can get the work done, it helps us be efficient and appropriate for each patient.”

Dr. Ian Buckle

While Lee Culp, who is involved in numerous university clinical studies, replied that due to digital workflows, “missed margins, contacts, and occlusions have become a rarity and that his internal and external remakes have truly gone down.” He added that digital dentistry is “not just different, It’s definitely better.”

Our remake rate is less than 0.5%. with workflows that start with an intraoral scan. The industry average is 2.5%

Lee Culp, CDT and CEO
Sculpture Studios

Clinical cases are an important resource for discovering best practices and new protocols. By providing the details of a case along with the patient’s background, they can act as guides for practitioners treating similar types of cases.

The many clinical cases available on the 3Shape website and mentioned in this ebook support the advances in treatment quality that digital technologies are providing today’s clinicians.

Digital dentistry, as demonstrated in these cases, is enabling professionals to simplify their clinical protocols, increase accuracy over conventional analog techniques, and improve patient comfort.

5

Don’t forget the partner connection

As the title of this ebook states, treatment quality means everything. Practitioners considering a move to digital workflows can only do so if they are confident enough that their restorations or appliances will fit and function correctly – first time, every time.

That is where communications between your lab and/or treatment provider comes into play.

Clinical and case studies document that digital impressions are as good, if not better, than analog impressions. But that is where any comparison between the two workflows end.

Assuming that both the analog and digital impression are equally functional and correct, then we begin our treatment from the same baseline.

With a digital impression you are sharing a file with your lab or treatment provider electronically. With an analog impression, you are snail mailing it to your partner. A digital impression cannot be chipped, cracked, infected, deformed, or misplaced.

The baseline that you are designing your restoration or appliance from, must not distort from the original impression.

> *It's (digital dentistry) not just different, it's definitely better.*
>
> **Lee Culp, CDT and CEO Sculpture Studios**

In the words of Dr. Alan Jurim: "I'm not getting my margins from a stone model, I'm getting my margins from what I feel is the more accurate data, an intraoral scan."

By eliminating analog impressions from your workflow, you remove what most labs consider their biggest source of error – a conventional impression.

Dental labs state that it is much easier and more accurate to work with digital impressions. With CDT, Tate Dobbs saying that "(IO scanner-brand name) accuracy has basically eliminated remakes in his laboratory."

He adds that, "Digital impressions are the solution because they are more accurate and easier to work with. They don't break, distort or take up any storage space."

CDT, Lee Culp elaborates by saying that with the digital workflow, "We can do things faster. We can do things cheaper. And the communication during all that is unprecedented in what we have ever done. The color of the teeth. I've got the tissue, I've got everything. It's like working on a patient for me. It's a wonderful way to work."

Why digital changes everything

Digital technology has surely changed the way we communicate everywhere. Just look at kids.

Likewise, sharing cases, digital impressions, and CAD/CAM have radically changed the way practitioners, dental labs and treatment providers work together.

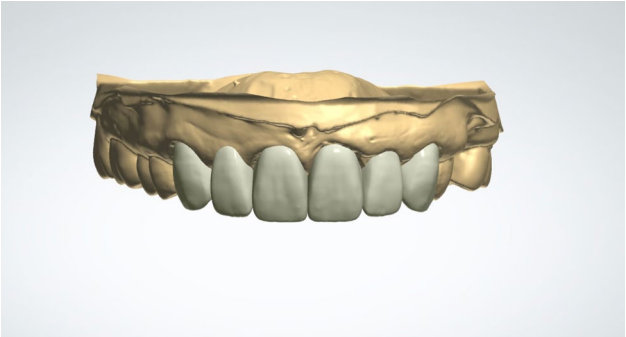
Depending on the solution you use, having a digital workflow can mean everything from **having to email a digital impression or loading them up to a cloud service to examining treatment proposals from your design and production partner via your mobile phone in 3D**. Times have changed.

With treatment quality as a goal, the absolute uncontested advantage of digital over conventional workflows is partner communications.

It begins with not having to snail mail or messenger analog and models back and forth. With digital it is instant. It ends with your design and production team always working with the precise data you initially sent to them. There are no variations, no shrinkage, no breakage, it is just hard data.

In the age of Zoom meetings, sharing screens and files have become commonplace. Likewise, with digital dental workflows you are sharing design proposals and treatment plans while looking at the same screen with your partner. Even if that partner is located on the other side of the country.

A shared clinical case shared by Dr. Caroline Thomas, a southeast USA-based doctor using an Idaho-based lab for her work, illustrates this point. The practice and lab are separated by twenty-five hundred miles.



The lab, CMR, created the patient’s digital design or “wax-up” and then uploaded it into a mobile app. With the app, Dr. Thomas could rotate and manipulate the models to make sure the digital design met her expectations.

Dr. Thomas decided to make a few changes, so she connected to the lab via her laptop. The lab and doctor worked, in real time, with the technician making the requested changes. Once the final design was approved, the lab printed models. This would never be possible in the analog world.

The ability for doctors and labs or treatment providers to communicate sharing the same file has brought new levels of accuracy and predictability to restorations and appliances.

CDT, Lee Culp says that for his lab, “our results have never been better. And our communication is ultimate because we communicate in 3D and not just over the phone. I can go on my phone and see one of the cases a doctor has a question about. Wherever I go in the world, I am always connected to dentistry, digitally. To have all that information in a laboratory, just joins me with the doctor and patient so much closer.”

6 Tips and tricks

Top 10 ways to ensure your treatment begins with a quality scan

1. Learn the correct scan strategy – you can find 3Shape scan strategy tutorials on the 3Shape Academy YouTube channel.
2. Ensure that you use an ergonomic and comfortable position when scanning.
3. Check the bite registration before sending your case for production, and remember that a full jaw requires two bite scans.
4. Don't keep the scanner in the same place. Rotate, swipe and angle the tip to get a proper scan.
5. Practice your scanning on yourself and colleagues. Remember, if you can scan yourself, you can scan anyone.
6. If scanning is lost, go back to the last known scanned area. The occlusal surface is a good starting point for easy and fast re-snapping.
7. Use the 3Shape Communicate app to get and give feedback on cases from lab and clinic.
8. Scan every patient at least once, to get a good baseline.
9. Scan full arches for future use and to use with comparison tools like TRIOS Patient Monitoring.
10. Share the technology with your patients through the My3Shape app for patient engagement and treatment overviews.

7 Conclusion

7 key takeaways from this book

- Digital workflows enable you to document your treatment to identify best practices and better plan future treatments, review your treatments, save study models, and easily remake restorations and appliances.
- Published clinical studies now document that digital impressions are as good as, if not better than, analog impressions for nearly every indication.
- Dr. Philip Tan, states that because of digital technology he is able to improve the planning processes of his implant treatments through enhanced visualization during the planning process as well as improve preparation for the final restoration.
- CEO of Sculpture Studios and world-renowned CDT, Lee Culp says that because of digital workflows "missed margins, contacts, and occlusions at his lab have become a rarity." His lab's remake rate is now less than 0.5% with workflows based on intraoral scans. The industry average is 2.5%.
- Culp summarizes the key advantage of a digital workflow: "Wherever I go in the world, I am always connected to dentistry, digitally. To have all that information in a laboratory, just joins me with the doctor and patient so much closer."
- With digital impressions you are sharing a file with your lab or treatment provider electronically. With an analog impression, you are snail mailing it to your partner. A digital impression cannot be chipped, cracked, infected, deformed, or misplaced.
- With treatment quality as a goal, the absolute uncontested advantage of digital over conventional workflows is partner communications.

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The return on investment with digital is so amazing and the payoff is so fast and that is just considering the savings on impression material. But there is also reduced chair time, increased accuracy, and what no one ever talks about, the patient experience.

My patients love it and end up referring people, friends of theirs, family that they might not have ordinarily done so. My patients get it, my staff gets it, I get it – go digital!

Dr. Jonathan L. Ferencz

8 Further reading

Let's share some reading tips

With the below material, you can dive deeper into digital dentistry and treatment exellence.

Digital vs Analog

- Analog vs TRIOS video
- A novel in vivo method to evaluate trueness of digital impressions
- Three-dimensional accuracy of digital impression versus conventional method: effect of implant angulation and connection type

Quality

- The effect different substrates have on the trueness and precision of eight different intraoral scanners
- Full arch precision of six intraoral scanners in vitro

Go Digital

- Dr. Valerie Cooper - Why go digital with your denture workflow
- Digital dentistry means you work faster – interview with Dr. Nazariy Mykhaylyuk
- Digital keeps the plan at the center of your treatment – interview with Dr. Timo Suojärvi
- Excite your patients with digital dentistry – interview with Dr. Ian Buckle

Accuracy in impressions

- Accuracy of complete- and partial-arch impressions of actual intraoral scanning systems in vitro
- Investigation of accuracy and reproducibility of abutment position by intraoral scanners

Patient engagement

- Not all same day dentistry solutions are the same
- A patient's experience with the digital practice
- 3Shape TRIOS Smile Design is the reason I went through with the treatment

Partner connection

- Working with 3Shape TRIOS digital impressions in the lab

About 3Shape

3Shape is changing dentistry together with dental professionals across the world by developing innovations that provide superior dental care for patients. Our portfolio of 3D scanners and CAD/CAM software solutions includes the multiple award-winning 3Shape TRIOS intraoral scanner, the 3Shape X1 CBCT scanner, as well as market-leading scanning and design software solutions for both dental practices and labs.

Two graduate students founded 3Shape in Denmark's capital in the year 2000. Today, 3Shape has over 1,600 employees serving customers in over 100 countries from an ever-growing number of 3Shape offices around the world. 3Shape's products and innovations continue to challenge traditional methods, enabling dental professionals to treat more patients more effectively.
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