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10-Minute EBD: Digital Scans or Conventional Impressions: Which Results in Better Crowns?

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Digital Scans or Conventional Impressions: Which Results in Better Crowns?

By Laura Tsu, DDS

Successful crown design and fabrication are critically dependent on accurate final impressions. If the final impression distorts or misrepresents the anatomy of the crown preparation, the resulting crown may be fabricated with a poor marginal and internal fit, costing the practitioner and the lab time, money, and materials. However, with an accurate final impression, a lab can create a well-adapted crown providing a successful outcome to all involved parties.

The development of a digital workflow and CAD/CAM technology has disrupted the conventional process of fixed prosthodontics. Practitioners may wonder whether goopy impressions and triple trays will become a relic of the past. CAD/CAM, an abbreviation for computer-aided design and computer-aided manufacturing, has seen increasing popularity in dentistry in the past few decades. Lingering questions do remain regarding how the digital workflow compares to long-standing conventional impression techniques.

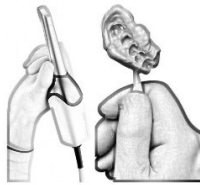
Here, we will focus on the outcomes of digital scans vs. conventional impressions for the fabrication of single-unit crowns. Features such as marginal and internal fit will be investigated as they determine whether a crown seats completely, has a closed margin, and has a high likelihood of long-term clinical success.

PICO question

For our clinical query, the following PICO question was formulated:

For patients needing single-unit crowns, does a digital scanning technique compared to a conventional impression technique result in an optimal marginal and internal fit of the crown?

Clinical Scenario



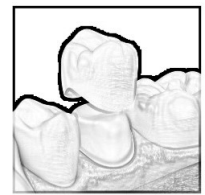
The advent of digital impression scanning technology raises questions if this or traditional techniques result in better crowns.

Literature Search Strategies



PubMed database MeSH terms "computer-aided design" and "dental impression materials."

Evidence Summary



Scanned impressions meet or exceed performance of traditional impressions. Single-unit crowns from digital scans presented a clinically acceptable marginal fit. The internal fit of these crowns is comparable to those of crowns fabricated from conventional impressions.

"For patients needing single-unit crowns, does a digital scanning technique compared to a conventional impression technique result in an optimal marginal and internal fit of the crown?"

P = Population: Patients needing single-unit crowns.

I = Intervention: Digital scanning technique.

C = Comparison: Conventional impression technique.

O = Outcome: Result in an appropriate marginal and internal fit of the crown.

Literature search pathway

For the literature search, PubMed was utilized because of its indexing of high-quality peer-reviewed journals and its MeSH database. The MeSH

(medical subject heading) database resembles a medical thesaurus, and selecting applicable MeSH terms allows us to build searches and retrieve relevant articles quickly. Two applicable MeSH terms were utilized in our literature search, including "computer-aided design" and "dental impression materials." Results were further filtered by article types to include only systematic reviews and meta-analyses. These types of articles represent the highest levels of evidence because they appraise and synthesize multiple articles relating to the topic at hand. To filter out the outdated articles and find the most recent results, a time frame from 2016 to the present day was applied. Articles that addressed digital scans and conventional impressions for the fabrication of single-unit crowns were

selected. Other articles that investigated dental bridges or implant crowns were omitted.

Evidence summary

Articles generally concluded that crowns fabricated from digital scans exhibited clinically acceptable marginal and internal fit. For instance, Ahlholm et al.¹ conducted their systematic review with 19 articles that met criteria after screening scientific literature databases. After analyzing the articles, they noted that all marginal gaps of crowns fabricated from digital impressions were within a clinically acceptable range, which meant gaps were less than 120 μ m. In another systematic review and meta-analysis, Hasanzade et al.² screened through 514 potentially relevant articles and identified eight *in-vivo* and 21 *in-vitro* studies that satisfied all inclusion criteria. In the included *in-vivo* studies, Hasanzade et al.² noted that the digital technique had similar marginal adaptation compared to the conventional technique. Internal adaptation of crowns from digital scans was comparable to that of crowns from traditional impressions in the studies from Ahlholm et al.¹ and Hasanzade et al.²

In other articles, there were noted differences between the marginal or internal fit of the crown between the two impression techniques; usually, differences were in favor of digital scans for the single-unit crowns. For example, in the systematic review and meta-analysis by Chochlidakis et al.,³ 11 studies met all of the inclusion criteria. Two of the articles were clinical studies, and the other nine were *in-vitro* studies. Their data analysis of the two techniques suggested that digital scans rather than conventional impressions resulted in crowns of slightly better marginal and internal fit. However, the difference was not enough to be statistically significant. Then, Hasanzade et al.² concluded there were statistically significant

findings of better internal adaptation with crowns from digital impressions in the *in-vivo* studies that were reviewed. As for the *in-vitro* studies that Hasanzade et al.² analyzed, the digital workflow resulted in significantly better marginal adaptation. Digital impressions occasionally outperform conventional impressions in select articles, though this was not consistent in all the reviewed articles.

Many articles mentioned the expectation of heterogeneous data between the different studies, meaning that there could be dissimilarities in the data samples and the results. They included *in-vivo* and *in-vitro* studies in each systematic review, and meta-analyses were performed with different crown materials, crown designs, measuring armamentarium, intraoral scanners, conventional impression techniques, and impression materials. Then, with each systematic review and meta-analysis analyzing multiple papers, there is unavoidable variability amongst all articles. Hasanzade et al.² did address this variability in their meta-analysis. They calculated the I2 statistic, which describes the percentage of variation across the studies due to heterogeneity. With the data analyzing marginal fit, I2 equaled 66.5%, representing substantial heterogeneity. With the data analyzing internal fit, I2 equaled 0%, which means heterogeneity is probably not as important. The authors suggested that marginal fit may have more varying results due to the different margin designs, variation in digital scanners, and differences in crown fabrication.

Conclusion

In these findings, single-unit crowns from digital scans presented a clinically acceptable marginal fit. The internal fit of these crowns is comparable to those of crowns fabricated from conventional impressions. Sometimes, digital scanning was even

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more accurate than traditional impression techniques, leading to a more precise marginal and internal fit of the single-unit crowns. Therefore, single-unit crowns fabricated from a digital scan are within the standard of care regarding internal and marginal fit.

Other than the impression technique, a successful prosthesis also depends on the fabrication process. A number of the studies referenced here address different fabrication methods, specifically digital milling vs. conventional processes. The digital workflow reduces the number of steps in crown fabrication; e.g., no pouring of a cast and no wax patterns. This simplified process can decrease the opportunities for error, another benefit to a digital workflow. The topic of digital fabrication, in and of itself, is large enough to explore separately.

There have been conflicting conclusions regarding marginal and internal adaptation in previous articles. This subject is unquestionably intertwined with the advances in dental technology, and more up-to-date research and further investigation of this matter can better support the findings discussed here. In addition,

if researchers performed similarly designed experiments with different intraoral scanners or with different margin designs, perhaps the heterogeneity of samples and results could be decreased. As the dental technology of digital scanning and digital fabrication becomes more widespread, practitioners will benefit from remaining up to date on the literature to provide informed suggestions for patient care. ●

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About the Author

Laura Tsu, DDS, completed her dental degree at the University of the Pacific, Arthur A. Dugoni School of Dentistry. Upon graduation, she served as a general dentist in the U.S. Army, stationed in South Korea and Fort Hood, Texas. After her service, she practiced as an associate in Texas before applying to residency. She is currently a first-year resident at UT Health San Antonio School of Dentistry, pursuing a master's degree in oral and maxillofacial radiology.



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