Review Article

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Failures in Digital Impression Technique

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Abstract

A digital impression technique has revolutionized dental diagnostics and restorations by offering enhanced precision, faster workflow and improved patient comfort. However like any technological advancements it is not immune to challenges. Failures in digital impression techniques can arise due to various factors including operator error, equipment malfunction, inadequate scan data, etc. These failures can result in inadequate impression, poor fit of restoration, delay in treatment. This abstract explores the common causes of failure in digital impression techniques, including issues related to scanning protocols, patient-related factors (such as motion or anatomy), and technical limitations of the equipment used. Furthermore, it emphasizes the importance of proper training, calibration, and troubleshooting to mitigate these issues and enhance the reliability of digital impressions. Understanding these failure points is crucial for dental professionals to optimize the use of digital technologies and ensure optimal patient outcomes.

Keywords: Digital impression; Failure; Accuracy; Dental technology; Scanning errors; Patient movement; Equipment calibration; Treatment outcomes; Dental impressions.

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INTRODUCTION

While digital impression techniques have revolutionized the field of dentistry by providing more accurate, efficient, and comfortable alternatives to traditional impression methods, they are not without limitations. Despite the advanced technology behind digital intraoral scanners, several challenges and potential sources of failure can occur during the impression-taking process. These failures can affect theaccuracy of the captured data, leading to complications in treatment planning and the production of restorations. The most common causes of failure in digital impressions include scanner limitations, incomplete or distorted data, errors in software or data transfer, patient-related factors, and issues with the initial investment and technology adoption.

One of the primary causes of failure in digital impressions is the limitations of intraoralscanners. While modern scanners are capable of capturing high-resolution images, they may struggle in certain clinical situations.

Another significant source of failure is incomplete or inaccurate data. In some cases,intraoral scanners may miss certain areas of the oral cavity, leading to gaps or inaccuracies in the digital model. This can occur due to insufficient lighting, rapid movements during the scanning process, or patient discomfort that results in unintended shifts or changes in mouth position. Inaccuracies in the captured data can result in poorly fitting restorations, requiring additional scans or adjustments.

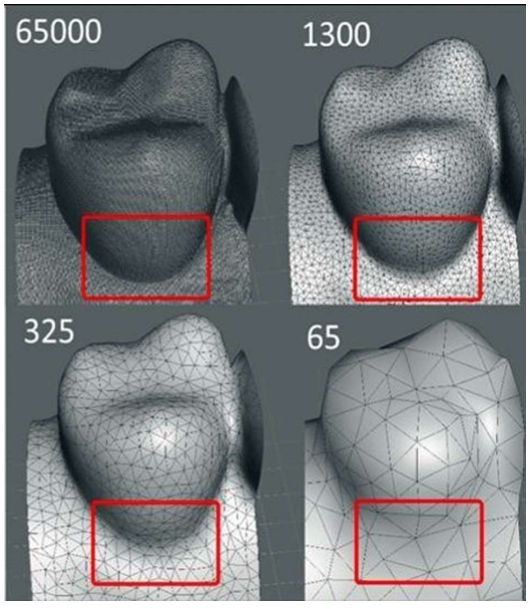
Patient related factors can also influence the success of digital impressions. Certain patients, particularly those with physical disabilities, severe gag reflexes, or difficulties holding still, may make it challenging for the dentist to obtain a clean, accurate scan. These factors increase the likelihood of motion artifacts or incomplete data capture, which may necessitate a repeat scan.

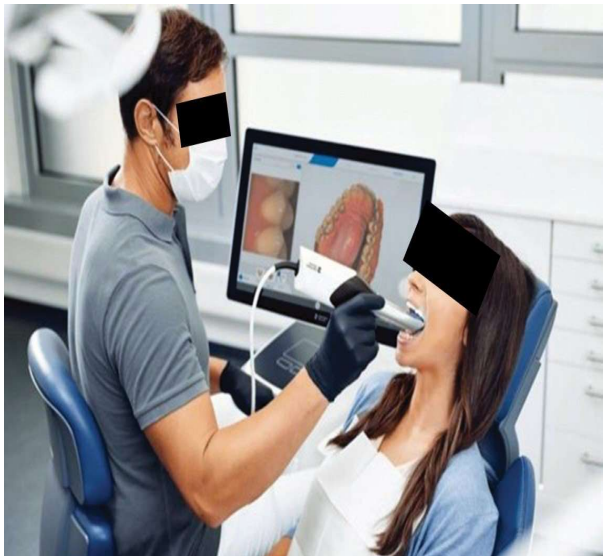
Finally, while digital impression systems offer long-term cost savings and increased workflow efficiency, the high initial cost of purchasing and maintaining these technologies remains a barrier for many practices. The significant financial investment required for both equipment and staff training may lead to suboptimal use of the technology, with inexperienced operators potentially contributing to scanning error.

COMMON CAUSES OF FAILURES

1. Inadequate scanner calibration
2. Poor patient positioning
3. Inadequate image resolution
4. Environmental factors
5. Inadequate patient co-operation

- **Inadequate Scanner Calibration**



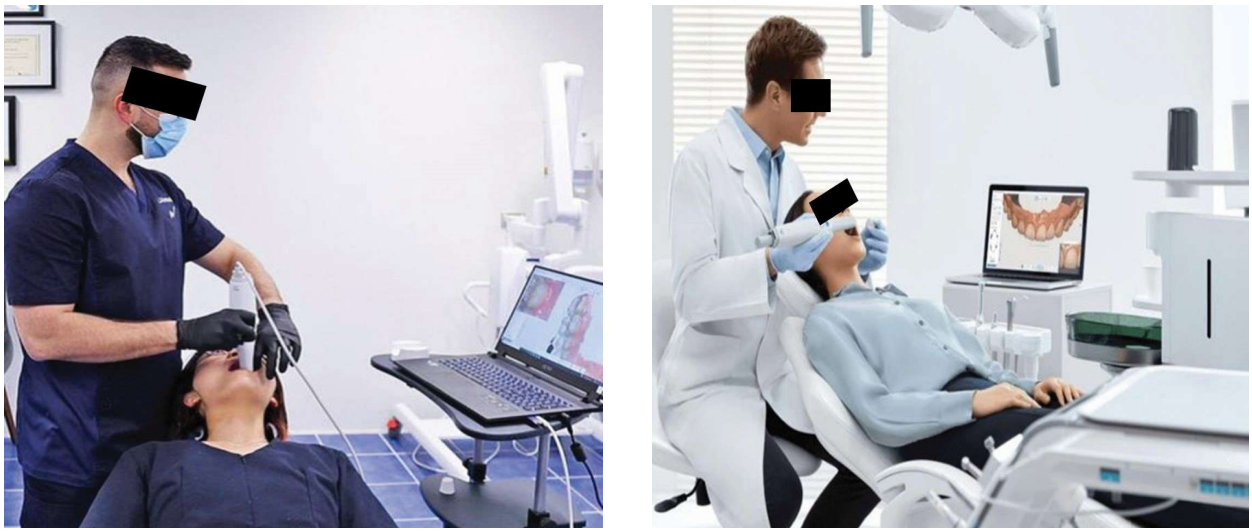


Source: *provided by author*

Inadequate calibration of intraoral scanners is a critical factor contributing to errors in digital impressions. Calibration ensures that the scanner captures precise data, but when this process is not properly conducted, it can lead to distorted or inaccurate scans. Miscalibration may result in poorly fitting restorations, loss of fine detail, and inconsistent performance across scans.

Factors like distorted tooth surfaces, incorrect occlusion, and inaccurate tooth measurements can all arise from improper calibration. Regular and proper calibration is essential to maintain the accuracy of digital impressions and avoid delays in treatment or the need for re-scanning.

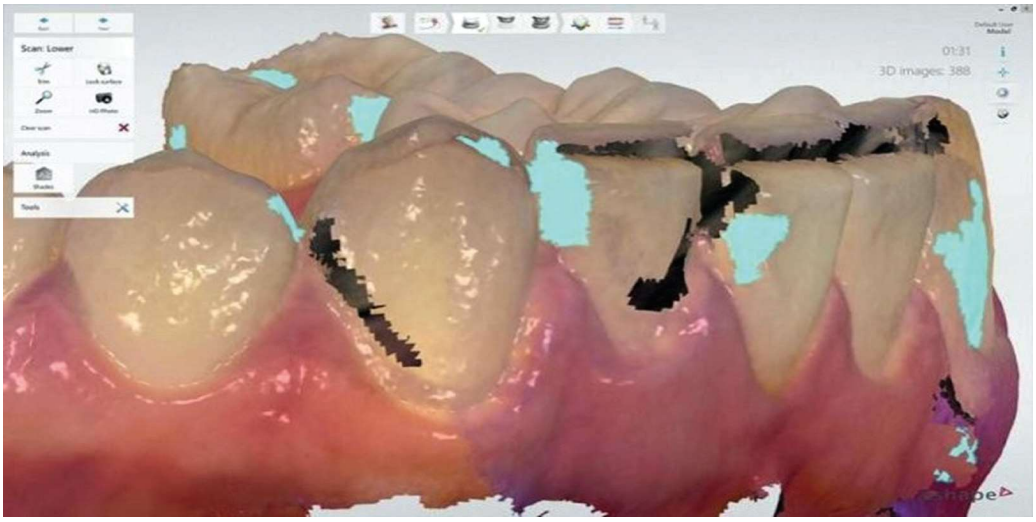
- **Poor Patient Positioning**



Source: *provided by author*

Poor patient positioning is a common cause of failure in digital impression techniques. Inaccurate scans can result when the patient is not properly aligned during the scanning process, leading to distorted or incomplete data capture. Factors like patient movement, difficulty keeping the mouth still, or improper head posture can affect the scanner's ability to capture accurate 3D images. This can result in poor-fitting restorations, requiring additional scans and treatment delays. Proper patient positioning is crucial for ensuring the accuracy and reliability of digital impressions.

- **Inadequate Image Resolution**



In digital impression techniques, inadequate image resolution can lead to failure due to loss of critical details necessary for accurate restorations. Lower resolution may result in misinterpretations of anatomical features, misfit of prosthetics, or inaccurate margins. This failure occurs because high-resolution images are essential for capturing fine details of tooth morphology and gingival contours, which influence the precision of digital models used in treatment planning and fabrication of dental prostheses.

- **Environmental Factor**

Environmental factors can significantly impact the success or failure of digital impression techniques in dentistry. Factors such as ambient temperature, humidity, and lighting conditions play a critical role in the accuracy of the digital scan and the performance of the intraoral scanner. For instance, high humidity can affect the accuracy of the scanner's optical system, while poor lighting can interfere with the scanner's ability to capture detailed images of the tooth surface. Additionally, temperature fluctuations may impact the material properties of impression materials or scanner calibration.

- **Inadequate Patient Co-operation**

Inadequate patient cooperation is a critical factor that can lead to failure in digital impression techniques. Factors such as patient discomfort, inability to remain still, excessive salivation, or gag reflexes can disrupt the scanning process, leading to distorted or incomplete digital impressions. For successful digital impression acquisition, patients need to maintain a stable position and minimize movements, as any motion can result in inaccuracies or failure to capture the full dental arch. Additionally, patients with conditions such as bruxism, severe dental anxiety, or a strong gag reflex may pose additional challenges during the scanning procedure.

IMPACT OF FAILURE

1. Inaccurate restoration
2. Increased chair time
3. Patients dissatisfaction
4. Increased cost

- **Inaccurate Restoration**

Inaccurate impressions lead to restorations (crowns, bridges, dentures) that must be remade.

Additional lab fees for fabricating new restorations.

Cost Consequence: Increased material and laboratory expenses.

- **Patients Dissatisfaction**

Patients' dissatisfaction with failures in digital impression techniques can stem from several factors, including discomfort, inaccurate scans, extended procedure times, or equipment malfunctions. These issues can lead to poor-fitting

restorations or the need for repeated impressions, which increase the overall treatment time and patient frustration. Such failures may also result in delayed appointments, added costs, and a lack of confidence in the technology.

- **Increased Chair Time**

Increased chair time is a common consequence of failures in digital impression techniques. These failures, such as inaccurate scans or equipment malfunctions, often require multiple attempts to obtain a proper impression, leading to prolonged procedure durations. This not only affects patient comfort but also reduces the overall efficiency of dental practices.

- **Increased Cost**

Failures in digital impression techniques can lead to increased costs due tothe need for additional materials, rework, and extended chair time. Repeated impressions and corrections not only delay the treatment process but may also require more staff involvement, which increases labor costs. Additionally, the need for expensive equipment maintenance or recalibration can further contribute to financial strain for dental practices.

CONCLUSION

Failures in digital impression techniques can significantly impact dental procedures, leading to patient dissatisfaction, increased chair time, and higher costs. These issues typically arise due to technical challenges such as inaccurate scans, equipment malfunction, or operator error. When these failures occur, additional attempts may be required, which can extend the overall treatment time, causing discomfort for patients and reducing operational efficiency for dental professionals.

Furthermore, the need for rework or additional materials contributes to increased treatment costs. Despite these challenges, digital impression techniques still offer numerous advantages over traditional methods, such as improved accuracy, comfort, and long-term cost-effectiveness, when properly implemented.

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