# Digital vs. Conventional Splint Fabrication: Assessing Cost, Fit, Contact Accuracy, and Time Efficiency

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## Introduction

Splints are crucial in managing occlusal disorders and temporomandibular joint disorders (TMD) in dental practice. Traditional fabrication methods are time-intensive, operator-dependent, and may lead to inconsistent outcomes. Digital splint fabrication offers a potentially faster, more precise, and consistent alternative. This study compares digital (Method B) and conventional (Method A) splint fabrication, evaluating cost, fit, occlusion accuracy, fabrication time, and adjustment time.

## Problem

Splints are widely utilized in dental practice to manage occlusal disorders, provide protection for teeth, and address temporomandibular joint disorders (TMD). However, traditional splint fabrication methods present challenges due to their variability and reliance on clinician technique, which can result in inconsistent quality and outcomes. Also, conventional impressions techniques are not always favored by the patient and are often time-intensive and typically require significant adjustments to achieve an optimal fit.

Recent advancements in digital dentistry have introduced digital splint fabrication, which offers a potentially faster, more precise, and operator-independent approach to splint creation. This study aims to compare digital (Method B) and conventional (Method A) splint fabrication methods, evaluating them based on Cost, Fit, Occlusion point of contacts in CR, Occlusion Excursive contacts, Occlusion Intensity of contacts, Fabrication time, and Adjustment time.

## Hypothesis

Digital splint fabrication (Method B) is expected to demonstrate superior performance across most aspects of splint fabrication compared to conventional splint fabrication (Method A), offering advantages in cost, fit, contact accuracy, and fabrication time, with potentially comparable adjustment time.

## Methods

A total of 10 Kilgore 200 series hard tissue models were utilized as simulated patients for this study. For each simulated patient, two splints were fabricated: one using the digital method (Method B) and one using the conventional method (Method A). To maintain consistency, the same provider created both the digital and conventional splints for each simulated patient, using standardized simulated facebow and centric relation (CR) records. All splints were mounted on a Denar Mark 320 articulator.

For the digital method, splints were designed using 3Shape Splint Design Studio software and scanned with the 3Shape TRIOS 5 scanner. The digital splints were 3D printed using Formlabs' Form 3B printer with Dental LT Clear Resin,

a material specifically designed for hard splints. The conventional method involved taking alginate impressions, pouring Type IV dental stone to create working models, and then sending the models to a laboratory for splint fabrication.

Key parameters evaluated included cost, fit, contact in centric relation, excursive contact, intensity of contact, fabrication time, adjustment time, and an overall score. Descriptive statistics (mean, median, standard deviation) were calculated, and independent t-tests were conducted to compare the two methods.

**Fit:**
- 5 – No adjustments needed, Excellent fit, stable, no gaps, not loose
- 4 – Minor Adjustments needed (<5 min)
- 3 – Moderate Adjustments needed (5-15 min)
- 2 – Major Adjustments needed (15-30 min)
- 1 – Unacceptable (>30 min)

**Occlusion Point of Contact in CR:**
- 5 – No adjustments needed, point centric contacts present against all opposing teeth
- 4 – Even intensity centric contacts present against >80% opposing teeth
- 3 – Even intensity centric contacts present against 60-80% opposing teeth
- 2 – Even intensity centric contacts present against 40-60% opposing teeth
- 1 – Even intensity centric contacts present against <40% opposing teeth

**Occlusion Excursive Contact:**
- 5 – No adjustments needed. No posterior excursive contacts. Canine guidance and Anterior guidance present
- 4 – Minor Adjustments needed (<5 min)
- 3 – Moderate Adjustments needed (5-15 min)
- 2 – Major Adjustments needed (15-30 min)
- 1 – Unacceptable (>30 min)

**Occlusion Intensity of Contacts:**
- 5 – No adjustments needed, even intensity centric contacts present against all opposing teeth
- 4 – Even intensity centric contacts present against >80% opposing teeth
- 3 – Even intensity centric contacts present against 60-80% opposing teeth
- 2 – Even intensity centric contacts present against 40-60% opposing teeth
- 1 – Even intensity centric contacts present against <40% opposing teeth

**Fabrication Time** (For control: Impression, pouring casts, trimming, mounting) + (For intervention: Scanning and designing time)
- 5 – <30 minutes
- 4 – 30-45 min
- 3 – 45-60 min
- 2 – 60-90 min
- 1 – >90 min

**Adjustment Time:**
- 5 – <10 minutes
- 4 – 10-20 min
- 3 – 20-30 min
- 2 – 30-45 min
- 1 – >45 min

## Results

**1. Fit**: Method B (digital) demonstrated a slightly higher mean fit score (4.70) compared to Method A (3.80), although the difference was not statistically significant (p = 0.122).

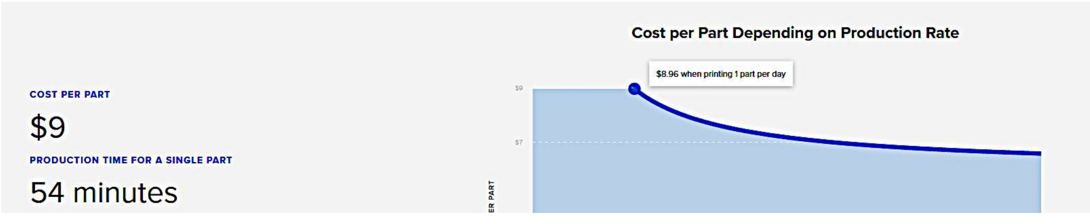
**2. Contact in CR and Excursive Contact**: There were no significant differences in contact in CR (p = 0.861) or excursive contact (p = 0.315) between the two methods, although Method B showed marginally better performance.

**3. Intensity of Contact**: Both methods showed similar intensity of contact, with no significant difference (p = 0.571).

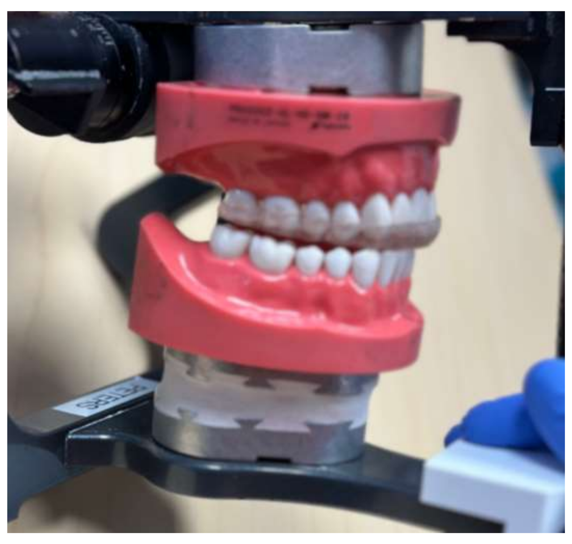
**4. Fabrication Time**: Method B had a significantly shorter fabrication time (mean of 4.20) compared to Method A (1.70), with a statistically significant difference (p < 0.001).

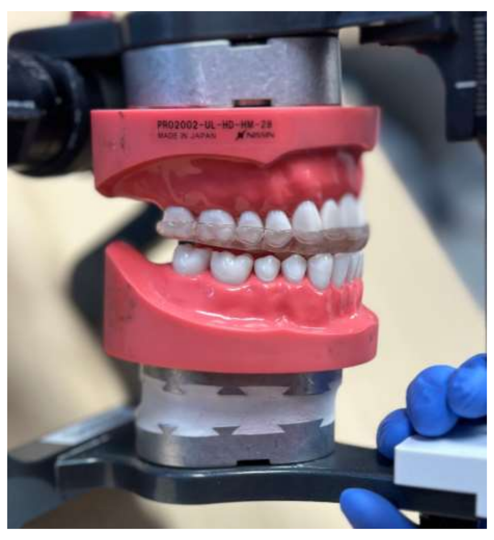
**5. Adjustment Time**: Although Method B required slightly more adjustment time on average (2.30 vs. 1.50), this difference was not statistically significant (p = 0.079).

**6. Cost**: The digital fabrication method was substantially less expensive, costing $9 per splint, compared to $131 per splint for the conventional method.


**7. Total Score**: Method B had a higher total score (3.02) compared to Method A (2.20), indicating a slight overall improvement with the digital method, though this difference was not statistically significant.





Descriptives

| | Method Type | Fit | Contact in CR | Excursive contact | Intensity of contact | Fabrication time | Adjustment time | Total Score |
|---|---|---|---|---|---|---|---|---|
| N | A | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | B | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Mean | A | 3.80 | 1.80 | 2.80 | 1.60 | 1.70 | 1.50 | 2.20 |
| | B | 4.70 | 1.90 | 3.60 | 1.40 | 4.20 | 2.30 | 3.02 |
| Median | A | 4.50 | 1.00 | 3.00 | 1.00 | 1.00 | 1.00 | 2.00 |
| | B | 5.00 | 1.00 | 4.50 | 1.00 | 4.00 | 2.00 | 3.17 |
| Standard deviation | A | 1.62 | 1.32 | 1.75 | 0.843 | 1.34 | 0.707 | 0.948 |
| | B | 0.675 | 1.20 | 1.71 | 0.699 | 0.422 | 1.16 | 0.659 |

Independent Samples T-Test

| | | Statistic | df | p | Mean difference | SE difference |
|---|---|---|---|---|---|---|
| Fit | Student's t | −1.622 ᵃ | 18.0 | 0.122 | −0.9000 | 0.555 |
| Contact in CR | Student's t | −0.178 | 18.0 | 0.861 | −0.1000 | 0.563 |
| Excursive contact | Student's t | −1.033 | 18.0 | 0.315 | −0.8000 | 0.775 |
| Intensity of contact | Student's t | 0.577 | 18.0 | 0.571 | 0.2000 | 0.346 |
| Fabrication time | Student's t | −5.637 ᵃ | 18.0 | < .001 | −2.5000 | 0.443 |
| Adjustment time | Student's t | −1.863 | 18.0 | 0.079 | −0.8000 | 0.429 |

*Note.* $H_a$ $\mu_A \neq \mu_B$

ᵃ Levene's test is significant (p < .05), suggesting a violation of the assumption of equal variances

## Conclusion

Digital splint fabrication (Method B) demonstrated comparable or slightly improved performance in fit and total score compared to conventional fabrication (Method A), with the added benefit of significantly faster fabrication times. While digital splints may require marginally more adjustment time, their efficiency, convenience, and substantially lower cost make them a viable and potentially superior option in clinical practice. Further research is recommended to address the minor discrepancies in contact intensity and explore the impact of 3D printing factors such as material shrinkage on fit accuracy.

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