THE JOURNAL OF PROSTHETIC DENTISTRY

SYSTEMATIC REVIEW

Evaluation of the marginal fit of single-unit, complete-coverage ceramic restorations fabricated after digital and conventional impressions: A systematic review and meta-analysis

Panagiotis Tsirogiannis, DDS,[a] Daniel R. Reissmann, DDS,[b] and Guido Heydecke, DDS[c]

ABSTRACT

Statement of problem. In existing published reports, some studies indicate the superiority of digital impression systems in terms of the marginal accuracy of ceramic restorations, whereas others show that the conventional method provides restorations with better marginal fit than fully digital fabrication. Which impression method provides the lowest mean values for marginal adaptation is inconclusive. The findings from those studies cannot be easily generalized, and in vivo studies that could provide valid and meaningful information are limited in the existing publications.

Purpose. The purpose of this study was to systematically review existing reports and evaluate the marginal fit of ceramic single-tooth restorations after either digital or conventional impression methods by combining the available evidence in a meta-analysis.

Material and methods. The search strategy for this systematic review of the publications was based on a Population, Intervention, Comparison, and Outcome (PICO) framework. For the statistical analysis, the mean marginal fit values of each study were extracted and categorized according to the impression method to calculate the mean value, together with the 95% confidence intervals (CI) of each category, and to evaluate the impact of each impression method on the marginal adaptation by comparing digital and conventional techniques separately for in vitro and in vivo studies.

Results. Twelve studies were included in the meta-analysis from the 63 identified records after database searching. For the in vitro studies, where ceramic restorations were fabricated after conventional impressions, the mean value of the marginal fit was 58.9 μm (95% CI: 41.1-76.7 μm), whereas after digital impressions, it was 63.3 μm (95% CI: 50.5-76.0 μm). In the in vivo studies, the mean marginal discrepancy of the restorations after digital impressions was 56.1 μm (95% CI: 46.3-65.8 μm), whereas after conventional impressions, it was 79.2 μm (95% CI: 59.6-98.9 μm)

Conclusion. No significant difference was observed regarding the marginal discrepancy of single-unit ceramic restorations fabricated after digital or conventional impressions. (J Prosthet Dent 2016;116:328-335)

In prosthetic dentistry, the interest in and need for nonmetallic and more biocompatible materials that fulfill high esthetic demands have steadily increased.[1] The development of ceramic materials has allowed the fabrication of ceramic crowns with similar or even better properties in terms of esthetics, biocompatibility, and longevity than metal ceramic crowns.[2] As far as longevity is concerned, accuracy remains the major factor for a ceramic restoration's successful clinical performance and high survival rate.[3,4] In addition, marginal discrepancy between restoration and prepared tooth may have weakening effects on the ceramic and may lead to periodontal inflammation, increased plaque retention, development of recurrent caries or pulp lesions, and bone resorption.[5-7] The factors that have been documented to influence the marginal fit of a dental restoration are the preparation design, location of the preparation finish line (subgingival or supragingival), restorative material, fabrication method, and impression material and technique.[2,5,8-15]

Although elastomer impression materials in combination with conventional single or 2-step impression

[a]Postgraduate student, Department of Prosthetic Dentistry, Center for Dental and Oral Medicine, University Medical Center Hamburg-Eppendorf, Hamburg, Germany.
[b]Associate Professor, Department of Prosthetic Dentistry, Center for Dental and Oral Medicine, University Medical Center Hamburg-Eppendorf, Hamburg, Germany.
[c]Professor, Department of Prosthetic Dentistry, Center for Dental and Oral Medicine, University Medical Center Hamburg-Eppendorf, Hamburg, Germany.

Clinical Implications

Both the digital workflow and the conventional method allow clinical acceptability in terms of marginal adaptation when a single-unit ceramic restoration is fabricated.

techniques are still predominant, digital scanners are increasingly used for the 3-dimensional (3D) capturing and digitization of the prepared teeth. This approach allows for the later fabrication of a ceramic crown in a complete digital workflow. Various digital impression systems are available. Each of them operates according to a different principle, including the active triangulation technique in combination with optical microscopy (CEREC), the parallel confocal imaging technique (iTero), and the active wavefront sampling with structured light projection (Lava COS).[16] Among the possible digitization methods, the direct digitization either of the prepared tooth or of its impression was found to have significantly higher accuracy than the indirect procedure of impression making and cast digitization.[17]

However, which impression material and method, conventional or digital, produces the most accurate results in terms of marginal fit of the fabricated ceramic crowns is still controversial. Marginal discrepancies of between 1 and 161 μm have been reported for ceramic crowns fabricated after conventional impressions, whereas the marginal discrepancies detected for ceramic crowns fabricated after digital impressions were between 17 and 118 μm.[18-26] These values are quite similar and within the acceptable range as stated in the current publications. Although different authors state that 75, 100, 160, and even 200 μm would also be within the acceptable range,[27] recently, a marginal discrepancy of up to 120 μm has been suggested as an acceptable limit.[28]

Even though ceramic crowns fabricated after digital and conventional impressions have been reported to have acceptable adaptation, the values reported are typically the means found by the studies. However, there is always a range of marginal discrepancy values. A significant proportion of the restorations could have a substantially wider discrepancy and unacceptable marginal fit. This proportion should be larger with higher means. Therefore, identifying the impression method with the lowest mean values for marginal fit is still essential, or at least detecting whether the results of new digital methods are equivalent to those of the established conventional impression techniques. The results of the most current studies are inconsistent. Some studies indicate the superiority of the digital workflow,[29] and others show that the conventional method provides better marginal fit than the fully digital fabrication.[30] One reason for the contradictory findings might be that different digital systems also differ with respect to marginal accuracy.[31] Furthermore, some in vitro studies evaluated copings instead of crowns. The generalizability of the findings of those studies is limited, and in vivo studies that could provide valid and meaningful information are limited in the existing publications. Moreover, specimen size in most available studies is small, resulting in inconclusive evidence. One solution to the lack of conclusiveness is to combine available evidence in a meta-analysis.

The purpose of this study was to systematically review the existing publications and evaluate the results of the conducted studies in terms of the marginal fit of the subsequently fabricated ceramic single-tooth restorations after either digital or conventional impression methods.

Population

- Crown **OR** Dental Crown **OR** Tooth Crown **OR** Jacket Crown **OR** Full Jacket Crown **OR** Dental Prosthesis **OR** Single Crown **OR** Single Unit **OR** Fixed Prosthesis **OR** Fixed Restoration **OR** Fixed Prosthodontics **OR** Fixed Dental Prosthesis **OR** FDP **OR** Tooth Reconstruction

AND **Intervention**

- Digital Impression **OR** Optical Impression **OR** Digital Scanner **OR** Oral Scanner **OR** Intraoral Scanner **OR** In Mouth Scanner **OR** Optical Scanner **OR** Dental Scanner **OR** iTERO **OR** CEREC **OR** CERCON **OR** 3M Lava Oral Scanner **OR** ios FastScan **OR** MIA3D **OR** In Eos Blue Desktop Scanner **OR** E4D **OR** TRIOS Digital Impression **OR** 3M True Definition Scanner

AND **Comparison**

- Impression Technique **OR** Conventional Impression **OR** Silicon Impression Material **OR** Polyether Impression Material **OR** Elastomer Impression Material

AND **Outcome**

- Fit **OR** Precision of Fit **OR** Passive Fit **OR** Marginal Fit **OR** Internal Fit **OR** Marginal Gap **OR** Internal Gap **OR** Marginal Adaptation **OR** Internal Adaptation **OR** Marginal Accuracy **OR** Internal Accuracy **OR** Marginal Integration **OR** Internal Integration **OR** Marginal Discrepancy **OR** Internal Discrepancy **OR** Marginal Precision **OR** Internal Precision

Figure 1. PICO search strategy (MeSH terms).

MATERIAL AND METHODS

The present study was designed as a systematic review of the publications. The search strategy based on a Population, Intervention, Comparison, and Outcome (PICO) framework and included an electronic search of studies published from January 1989 through December 2014. Search terms were a combination of the appropriate Medical Subject Headings (MeSH) terms and free-text words in simple or multiple conjunctions and were grouped into PICO (Fig. 1).

Additional to the subject headings criteria, the following inclusion criteria were also applied. Included studies should have been published in the English language. At least 5 ceramic single tooth restorations should have been fabricated and examined in each study. Meanwhile tooth replicas or natural teeth were accepted

Table 1. Modified methodological index for nonrandomized studies (MINORS)

Methodological index for included studies
1. Clearly stated aim. 0: not reported, 1: reported but inadequate, 2: reported and adequate.
2. Contemporary groups. 0: not reported, 1: reported but inadequate, 2: reported and adequate.
3. Impression method. 0: not reported, 1: reported but inadequate, 2: reported and adequate.
4. Control groups with other impression materials. 0: not reported, 1: reported and adequate comparison with other digital methods, 2: reported and adequate comparison with conventional methods.
5. Definitive restoration. 0: not reported, 1: framework, 2: crown.
6. Retentive element. 0: not reported, 1: master die/tooth replica, 2: natural tooth.
7. Adequate number of observations. 0: 5-9, 1: 10-14, 2: 15+.
8. Preparation method. 0: not reported, 1: reported but inadequate, 2: reported and adequate.
9. Power analysis. Justification of specimen size for both experimental and control groups needed to determine statistical significance 0: not reported, 1: reported but inadequate, 2: reported and adequate.
10. Statistical analysis. 0: not reported, 1: reported but inadequate, 2: reported and adequate.
Additional criteria for included in vivo studies
Prospective collection of data. 0: not reported, 1: reported but inadequate, 2: reported and adequate.
Baseline equivalence of groups. 0: not reported, 1: reported but inadequate, 2: reported and adequate.

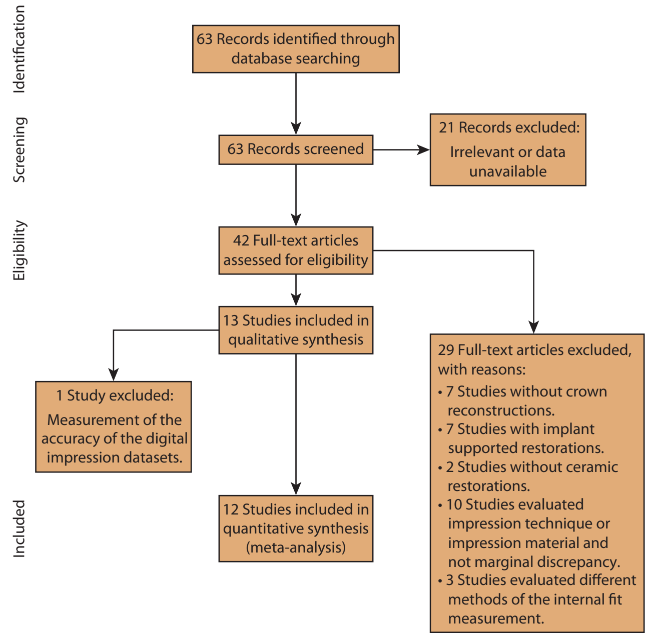

Figure 2. Search results. Studies that were included and excluded.

for in vitro studies and only natural teeth for in vivo studies. Finally, details regarding the impression method must have been reported.

The individual information of each study regarding the year of publication, study type, details of the reconstructions examined, and whether the study was in vitro or in vivo were retrieved. After the exclusion of the values that referred to nonceramic restorations, data concerning the impression technique, the type of the single unit restoration, the marginal fit of the examined ceramic restorations, and the preparation design of the retentive element were afterwards extracted from the included studies (Supplemental Tables 1, 2).

To assess the methodological quality (risk of bias) of the included studies, a modified Methodological Index for Non-Randomized Studies (MINORS) scale for in vitro experiments was developed (Table 1). Two reviewers (P.T. and G.P.) independently conducted a quality assessment of the included articles. Similarly to the original MINORS scale,[32] the adapted scale consisted of 10 items, with 2 additional items proposed for in vivo studies. Each item is scored from 0 to 2; for most items, 0 indicates that the content of the item is not reported, 1 indicates that the content is reported but inadequately, and 2 indicates that it is sufficiently reported. Discrepancies between the 2 reviewers were discussed until both came to an agreement and the final score was calculated. The maximum possible score for the in vitro studies was 20 and for the in vivo 24.

The analytic approach to investigating the marginal fit of ceramic single-unit restorations fabricated after conventional and digital impressions consisted, firstly, of the calculation of the heterogeneity of the results by means of the I^2 statistics. According to Higgins et al,[33] calculation of heterogeneity is essential in determining the generalizability of the findings of a meta-analysis, with I^2 values of 25%, 50%, and 75% being assigned to adjectives of low, moderate, and high heterogeneity, respectively.

All following calculations were separately performed for the in vitro and the in vivo studies. No discrimination among the different ceramic materials was made, as the number of the examined restorations was relatively low in each of the in vitro studies. For our statistical analysis, the mean marginal fit values of each study were extracted and categorized according to the impression method to calculate the mean value together with the 95% confidence intervals (CI) of each category. Findings were presented as forest plots.

In the first unadjusted part of the meta-regression, the impact of the impression method on the marginal fit was evaluated by comparing digital and conventional techniques separately for in vitro and in vivo studies. In the adjusted analysis, the effect of the impression method for the 2 different preparation designs was statistically controlled. The Knapp-Hartung modification was used in the regression analysis for more adequate error rates, as the specimen size was relatively low (12 studies included).

All analyses were performed using a statistical software package (Stata Statistical Software, Release 12; StataCorp LP) (α=.05).

Table 2. Evaluation of risk of bias

Evaluation	In vitro								In vivo			
	An (2014)	Anadioti (2014)	Ng (2014)	Seelbach (2012)	Souza (2012)	Baig (2010)	Romeo (2009)	Lee (2008)	Pradies (2014)	Brawek (2013)	Scotti (2011)	Syrek (2010)
Clearly stated aim	2	2	2	2	2	2	2	2	2	2	2	2
Contemporary groups	2	2	2	2	0	2	0	2	2	2	0	2
Impression method	2	2	2	2	2	2	2	2	2	2	2	2
Control groups with other impression materials	2	2	2	2	0	2	0	1	2	1	0	2
Definitive restoration	1	2	2	2	2	2	2	2	2	2	2	2
Retentive element	1	1	1	1	1	1	2	1	2	2	2	1
Adequate number of observations	1	2	2	1	1	1	0	1	2	2	2	1
Preparation method	2	0	2	2	2	2	2	2	2	2	2	2
Power analysis	0	0	0	0	0	1	0	0	2	0	2	2
Statistical analysis	2	2	1	2	2	2	1	2	2	2	2	2
Prospective collection of data	-	-	-	-	-	-	-	-	2	2	2	2
Baseline equivalence of groups	-	-	-	-	-	-	-	-	2	1	1	2
Total Score	15	15	16	16	12	17	11	15	24	20	19	22

0=high risk; 1=unclear risk; 2=low risk.

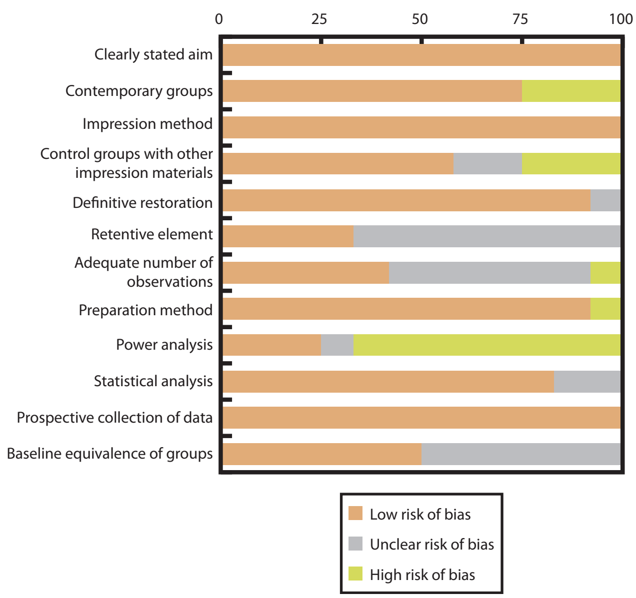

Figure 3. Risk of bias according to modified MINORS.

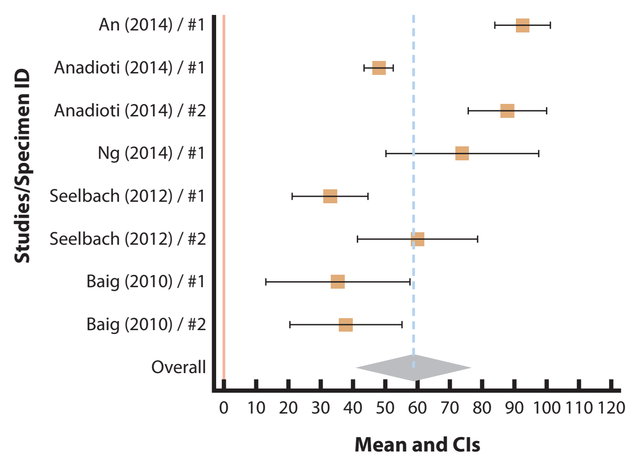

Figure 4. Means and CIs of marginal fit values of ceramic restorations fabricated after conventional impressions in in vitro studies. Blue line indicates category's mean value. CI, confidence interval.

RESULTS

A search of MEDLINE (PubMed) identified 63 articles. After title and abstract screening, 21 articles were excluded for not meeting the inclusion criteria or because the data could not be extracted and 42 articles provided sufficient information. A full report of these articles was then obtained, and full screening followed. Of the 42 full-text articles examined, only 12 met the inclusion criteria and were included in the final analysis (Fig. 2). As far as the in vivo studies were concerned, all measurements were made on natural teeth, with the exception of 1 study in which the investigators measured the crowns' marginal fit on a duplicated master of the patients' teeth. The reasons each of the 30 articles was excluded are categorized as follows: 7 studies did not examine complete crowns.[34-40] Implant supported restorations were evaluated in 7 other studies[41-47] whereas in 2 articles no ceramic restorations were fabricated.[11,48] Ten of the excluded studies did not evaluate the marginal adaptation of the fabricated restoration but different properties of the impression technique or the impression material used such as accuracy, time efficiency, or camera misalignment.[49-58] Studies that measured internal fit discrepancies[59-61] or evaluated the accuracy of the digital impression datasets were also excluded.[17]

As shown in Table 2, the in vivo studies demonstrated an overall lower risk of bias compared with the in vitro studies. Only 1 study achieved the highest possible score, whereas 2 studies scored quite low. However, all studies had a clearly stated aim, and the impression technique

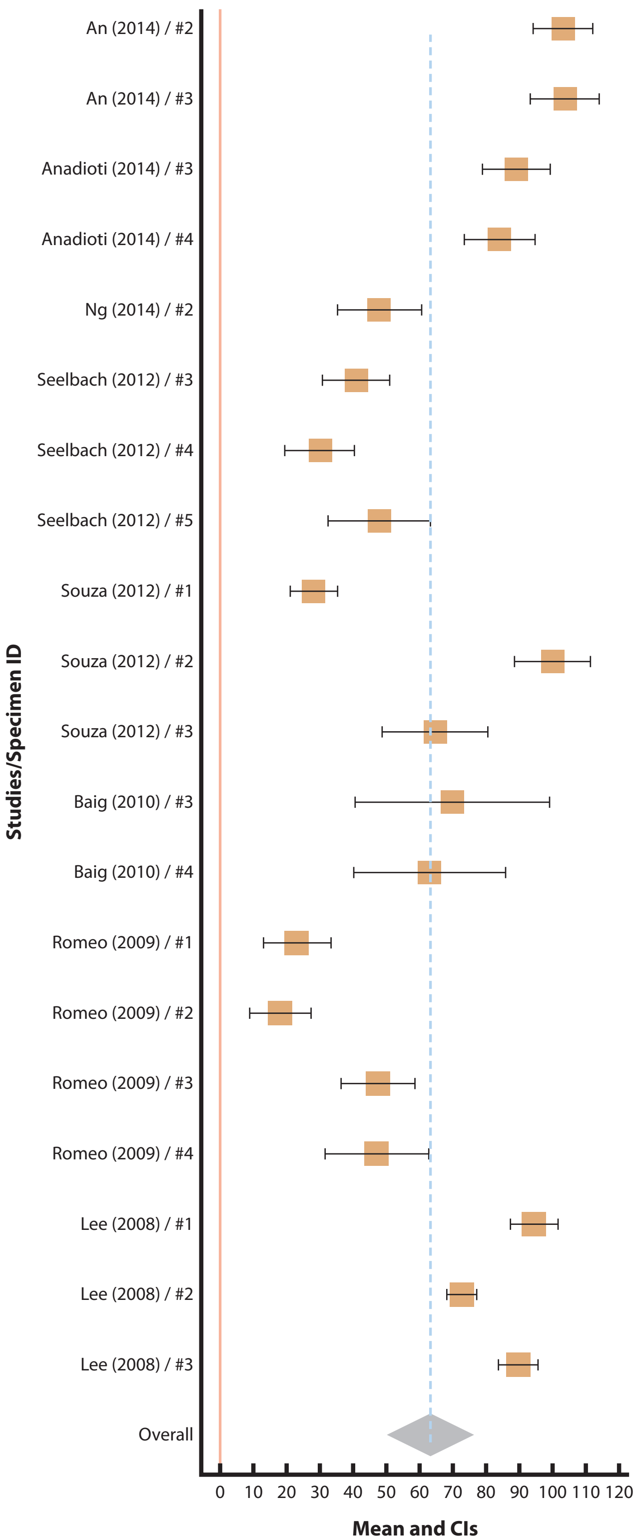

Figure 5. Means and CIs of marginal fit values of ceramic restorations fabricated after digital impressions in in vitro studies. Blue line indicates category's mean value. CI, confidence interval.

Table 3. Metaregression results for in vitro studies[a]

Metaregression	N Specimens	Coefficient	95% CI		*P*
Unadjusted	28				
Impression method[b]		−4.5	−28.3	19.4	.705
Adjusted	24[c]				
Impression method[b]		−4.2	−33.0	24.5	.763
Preparation design[d]		−6.5	−34.8	21.7	.635

[a]Coefficient indicates discrepancy (µm) between digital and conventional impression method. [b]Digital versus conventional. [c]Data concerning preparation design were unavailable in 4 studies. [d]Rounded shoulder versus chamfer.

and materials were described adequately. Summarized results (Fig. 3) indicate the high quality of the included studies with a high risk of bias being present only for specific items.

Among the in vitro studies, 7 different optical scanners were used, although in the majority of the studies, a master die of a posterior tooth was used as retentive element for the fabrication of the ceramic restoration (Supplemental Table 1). Heterogeneity among the in vitro studies where digital impressions were used was 97.3%, whereas for the elastomer group the heterogeneity value was 94.7%.

In the in vivo studies, the results seemed to be more homogeneous (Supplemental Table 2). Among these studies, only 2 different intraoral scanners were evaluated, whereas the majority of the retentive elements were natural teeth in the posterior region. I^2 tests revealed 50.8% heterogeneity at the calculation of the mean value of the crowns' marginal fit after digital impressions, and the heterogeneity score was 44.4% for the conventional impression group.

For the in vitro studies, where ceramic restorations were fabricated after conventional impressions, the mean value of the marginal fit was 58.9 µm (95% CI: 41.1-76.7 µm) (Fig. 4), whereas after digital impressions it was 63.3 µm (95% CI: 50.5-76.0 µm) (Fig. 5). When the impact of the impression method and the preparation design on the marginal fit of ceramic restorations were investigated, analysis showed no statistically significant superiority of one impression method or preparation technique over the other (Table 3).

In the in vivo studies, the mean marginal discrepancy of the restorations after digital impressions was 56.1 µm (95% CI: 46.3-65.8 µm) (Fig. 6), whereas after conventional impressions 79.2 µm (95% CI: 59.6-98.9 µm) (Fig. 7). Even though the digital impression method resulted in the meta-regression analysis after adjustment for preparation design of on average 27.2 µm smaller marginal discrepancies than the conventional impression method (Table 4), this effect was not statistical significant (P=.084).

DISCUSSION

The findings of this systematic review and meta-analysis indicate no significant differences in the clinical

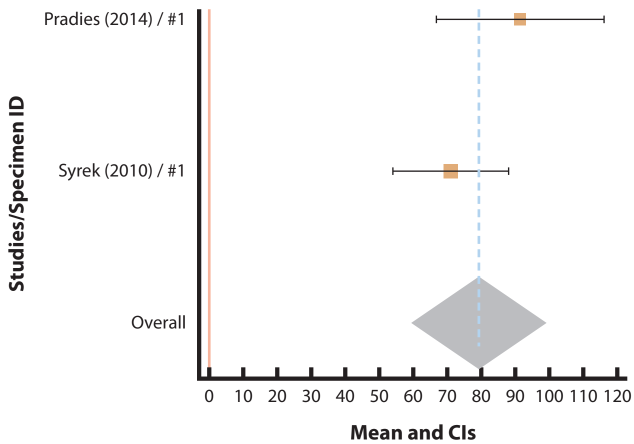

Figure 6. Means and CIs of marginal fit values of ceramic restorations fabricated after conventional impressions in in vivo studies. Blue line indicates category's mean value. CI, confidence interval.

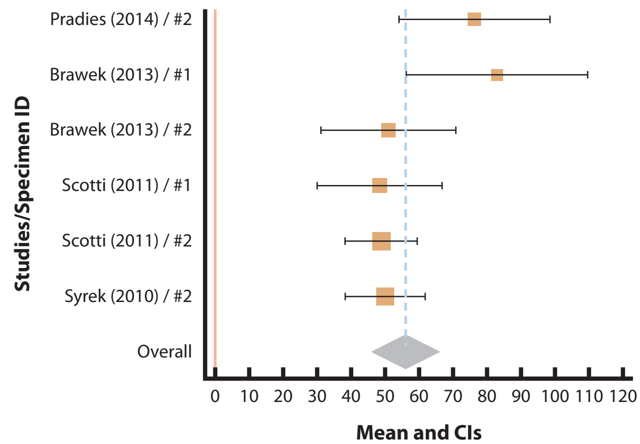

Figure 7. Means and CIs of marginal fit values of ceramic restorations fabricated after digital impressions in in vivo studies. Blue line indicates category's mean value. CI, confidence interval.

performance of ceramic single-unit restorations as far as the marginal adaptation is concerned and when they are fabricated after either digital or conventional impressions.

When the observed values were interpreted, the indicated discrepancy was not statistically significant and not clinically important. The overall mean values of the marginal fit remained under the 120-μm threshold of clinical acceptability proposed by McLean and von Fraunhofer.[28]

Although some factors may have had a slight influence on the results, the overall risk of bias of the included studies remained relatively low after the quality assessment. Although the proposed index for evaluating the methodological quality of the included studies was based on the original MINORS scale, it has not been validated with regard to content or scoring, which may be a limitation of this study. Another limitation was the high inconsistency among the effects across the observed studies leading to high heterogeneity I^2 values. Heterogeneity above 75% is considered high.[33] The metaregression of the in vitro study heterogeneity was close to 95%. This finding might be due to the 7 different intraoral scanners in the studies, with the 5 different ceramic materials and the 2 different conventional impression methods (single-step and two-step). However, in all in vivo studies, the same intraoral scanner was used, and all restorations were made of zirconium oxide. As a result of these more consistent effects, heterogeneity was moderate and calculated at around 50%. Furthermore, when the authors took into account the various intraoral scanners[16] and the various ceramic materials,[2] the number of studies identified in the review was low and not enough to consider the scanner and the material as predictor variables in the meta-analyses; no conclusions or recommendations with respect to these issues

Table 4. Metaregression results for in vivo studies[a]

Metaregression	N Studies	Coefficient	95% CI		P
Unadjusted	8				
Impression method[b]		22.9	−6.2	51.9	.102
Adjusted	8				
Impression method[b]		27.2	−5.3	59.7	.084
Preparation design[c]		11.9	−17.5	41.2	.348

[a]Coefficient indicates discrepancy (μm) between digital and conventional impression methods.
[b]Digital versus conventional. [c]Rounded shoulder versus chamfer.

could be drawn. Future studies are needed to substantiate the findings of this review and to identify other potential factors for marginal adaptation, such as the fabrication method of the restoration.

Among the existing intraoral digital impression systems, CEREC, LAVA C.O.S., E4D, and iTERO are the most commonly used in clinical practice and the most studied in the existing publications. Although they have major differences in their functioning principle, with some of them requiring additional coating agents for data capture (LAVA C.O.S., CEREC previous generations), they all perform within the clinical acceptable range.[62,63] Among the possible digital workflows and digitization methods, direct intraoral scanning seem to provide the most accurate results.[17] In this study, most digital impressions were performed by a direct scanning. As a result, a comparison in terms of accuracy with other digitization methods was not possible. In the existing publications, however, and in terms of longevity, both the direct and the indirect workflow provide almost equal results.[64,65] These results, in combination with the findings of our study, suggest that the digital workflow not only exceeds the standards of clinical acceptability but also performs equally to the conventional elastomer impressions.

CONCLUSIONS

Based on the results of the current analyses, no significant difference was found regarding the marginal discrepancy of single unit ceramic restorations fabricated after digital and conventional impressions. Both the digital workflow and the conventional method ensure the clinically fully acceptable fabrication of single-unit ceramic restorations.

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Corresponding author:
Dr Panagiotis Tsirogiannis
University Medical Center Hamburg
Eppendorf, Martinistrasse
52, 20246 Hamburg
GERMANY
Email: tsirogiannis.contact@gmail.com

Acknowledgments
The authors thank G. Poulopoulos for assistance and contribution to the quality assessment of the included studies.

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Supplemental Table 1. Characteristics of included in vitro studies

Study/Specimen ID	Retentive Element	Position	Preparation Method	Impression Technique	Restoration	Material	n	Marginal Fit [μm] Mean	±SD
An et al[30] (2014)/#1	Master die	Anterior	Chamfer	Elastomer	Framework	ZrO_2	10	93	14
An et al[30] (2014)/#2	Master die	Anterior	Chamfer	iTero with die	Framework	ZrO_2	10	103	15
An et al[30] (2014)/#3	Master die	Anterior	Chamfer	iTero STL data	Framework	ZrO_2	10	104	17
Anadioti et al[15] (2014)/#1	Master die	Posterior	-	Elastomer	Crown	IPS Emax Press	15	48	9
Anadioti et al[15] (2014)/#2	Master die	Posterior	-	Elastomer	Crown	IPS Emax CAD	15	88	24
Anadioti et al[15] (2014)/#3	Master die	Posterior	-	LAVA COS Scanner	Crown	IPS Emax Press	15	89	20
Anadioti et al[15] (2014)/#4	Master die	Posterior	-	LAVA COS-E4D Scanner	Crown	IPS Emax CAD	15	84	21
Ng et al[29] (2014)/#1	Master die	Posterior	Chamfer	Elastomer	Crown	IPS Emax Press	15	74	47
Ng et al[29] (2014)/#2	Master die	Posterior	Chamfer	LAVA COS Scanner	Crown	IPS Emax Press	15	48	25
Seelbach[67] (2012)/#1	Master die	Posterior	Chamfer	Elastomer single-step	Crown	ZrO_2	10	33	19
Seelbach[67] (2012)/#2	Master die	Posterior	Chamfer	Elastomer two step	Crown	ZrO_2	10	60	30
Seelbach[67] (2012)/#3	Master die	Posterior	Chamfer	iTero	Crown	ZrO_2	10	41	16
Seelbach[67] (2012)/#4	Master die	Posterior	Chamfer	Cerec	Crown	IPS Empress	10	30	17
Seelbach[67] (2012)/#5	Master die	Posterior	Chamfer	LAVA COS Scanner	Crown	ZrO_2	10	48	25
Souza et al[5] (2012)/#1	Master die	Posterior	Rounded shoulder	Cerec	Crown	IPS Empress	10	28	11
Souza et al[5] (2012)/#2	Master die	Posterior	Chamfer	Cerec	Crown	IPS Empress	10	100	18
Souza et al[5] (2012)/#3	Master die	Posterior	Chamfer	Cerec	Crown	IPS Empress	10	65	26
Baig[68] (2010)/#1	Master die	Posterior	Chamfer	Elastomer	Crown	IPS Empress	10	35	36
Baig[68] (2010)/#2	Master die	Posterior	Rounded shoulder	Elastomer	Crown	IPS Empress	10	38	28
Baig[68] (2010)/#3	Master die	Posterior	Chamfer	Cercon	Crown	ZrO_2	10	70	47
Baig[68] (2010)/#4	Master die	Posterior	Rounded shoulder	Cercon	Crown	ZrO_2	10	63	37
Romeo et al[27] (2009)/#1	Natural Tooth	Posterior	Chamfer	Digitizer DCS Dental	Framework	ZrO_2	5	23	12
Romeo et al[27] (2009)/#2	Master die	Posterior	Chamfer	Digitizer DCS Dental	Framework	ZrO_2	5	18	11
Romeo et al[27] (2009)/#3	Natural Tooth	Posterior	Chamfer	Digitizer DCS Dental	Crown	ZrO_2	5	48	13
Romeo et al[27] (2009)/#4	Master die	Posterior	Chamfer	Digitizer DCS Dental	Crown	ZrO_2	5	47	18
Lee et al[46,55] (2008)/#1	Master die	Posterior	Rounded shoulder	Cerec	Crown	Feldspathic ceramic	10	94	12
Lee et al[46,55] (2008)/#2	Master die	Posterior	Rounded shoulder	Procera Scanner Model 50	Framework	Al2O3	10	73	7
Lee et al[46,55] (2008)/#3	Master die	Posterior	Rounded shoulder	Procera Scanner Model 50	Crown	Al2O3	10	90	10

Supplemental Table 2. Characteristics of included in vivo studies

Study/Specimen ID	Retentive Element	Position	Preparation Method	Impression Technique	Restoration	Material	n	Marginal fit [μm] Mean	±SD
Pradies[66] (2014)/#1	Natural Tooth	Posterior	Chamfer	Elastomer	Crown	ZrO2	33	91	72
Pradies[66] (2014)/#2	Natural Tooth	Posterior	Chamfer	LAVA COS Scanner	Crown	ZrO2	33	76	65
Brawek et al[31] (2013)/#1	Natural Tooth	Posterior	Chamfer	Cerec	Crown	ZrO2	14	83	51
Brawek et al[31] (2013)/#2	Natural Tooth	Posterior	Chamfer	LAVA COS Scanner	Crown	ZrO2	14	51	38
Scotti et al[18] (2011)/#1	Natural Tooth	Posterior	Chamfer	LAVA COS Scanner	Crown	ZrO2	13	48	34
Scotti et al[18] (2011)/#2	Natural Tooth	Anterior	Chamfer	LAVA COS Scanner	Crown	ZrO2	24	49	27
Syrek et al[3] (2010)/#1	Natural Tooth	Posterior	Rounded shoulder	Elastomer	Crown	ZrO2	9	71	26
Syrek et al[3] (2010)/#2	Master die	Posterior	Rounded shoulder	LAVA COS Scanner	Crown	ZrO2	9	50	18