Digital Versus Conventional Implant Impressions: A Systematic Review

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PURPOSE

To systematically review in vitro and clinical studies comparing quantitatively the 3D accuracy (global implant deviations) of digital vs conventional implant impressions for partially and completely edentulous patients.

MATERIALS AND METHODS

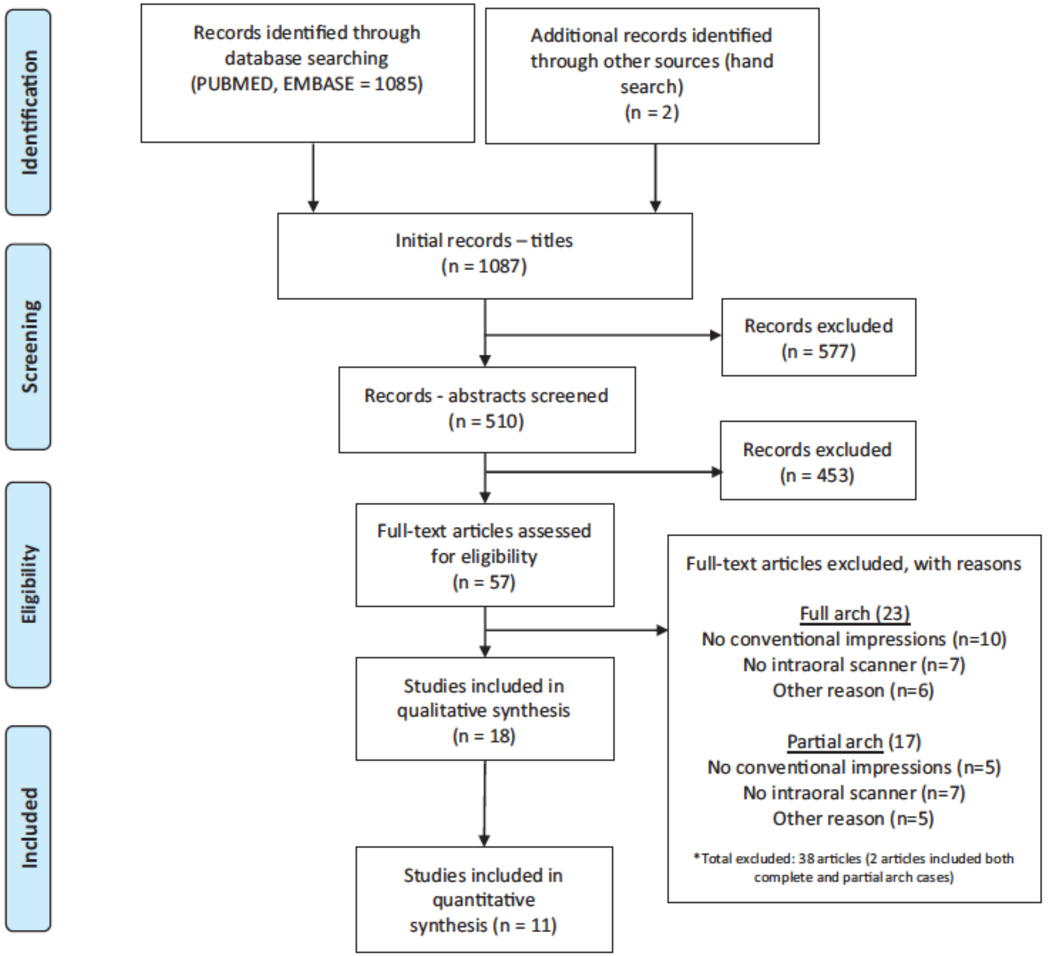
A systematic approach was followed according to the PRISMA statement. The focused question of the search was in a PICO format as follows: "In partially and completely edentulous patients, do digital scans/impressions demonstrate similar accuracy outcomes compared to conventional implant impressions?"

Search strategy

An electronic MEDLINE (PubMed) and EMBASE search was performed for in vitro and clinical studies reporting on the 3D accuracy between digital and conventional implant impressions. Secondary outcomes were the effect of implant angulation, type of conventional impression technique, and type of intraoral scanner on the accuracy of implant impressions.

Inclusion criteria: clinical studies and in vitro studies that compared the 3D accuracy for both digital and conventional impressions for completely or partially edentulous patients / scenarios with two or more dental implants were included.

Exclusion criteria: case report/series, insufficient information regarding number of patients or follow-up and/or criteria, multiple publications on the same patient population, no author response in case of inquiry, and finally studies not in English language.



Search strategy flow chart

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RESULTS

Completely edentulous

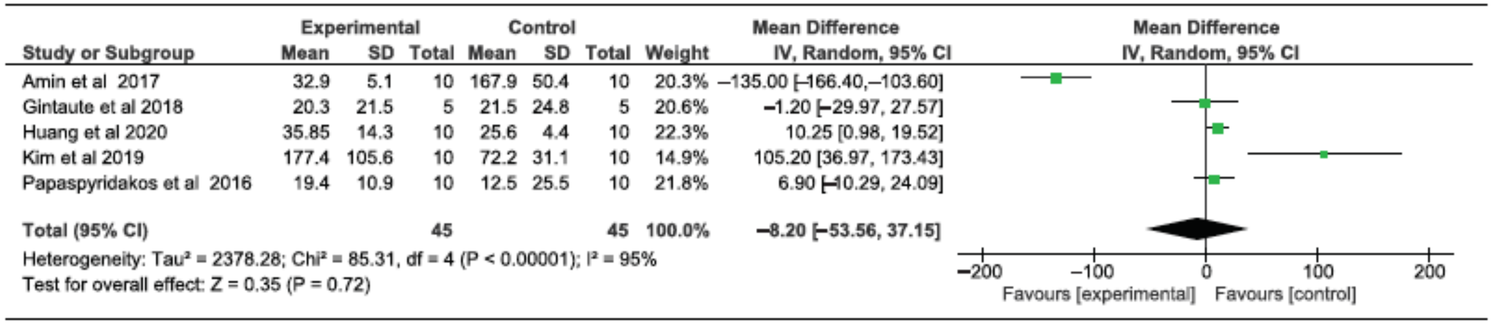
The inclusion criteria were met by 9 in vitro studies and 1 clinical study reporting on completely edentulous impressions.

Quantitative meta-analysis was performed for 5 completely edentulous. The studies exhibited high values for heterogeneity. A random effects model was conducted to estimate the effect size.

Based on 5 in vitro studies on completely edentulous impressions, the mean **3D implant deviation** between conventional and digital impressions was **8.20 µm** (95% CI: −53.56, 37.15) and the digital impressions had nominally less deviation (p = 0.72).

The effect of different scanners was not statistically significant on the completely edentulous impressions (p = 0.82).

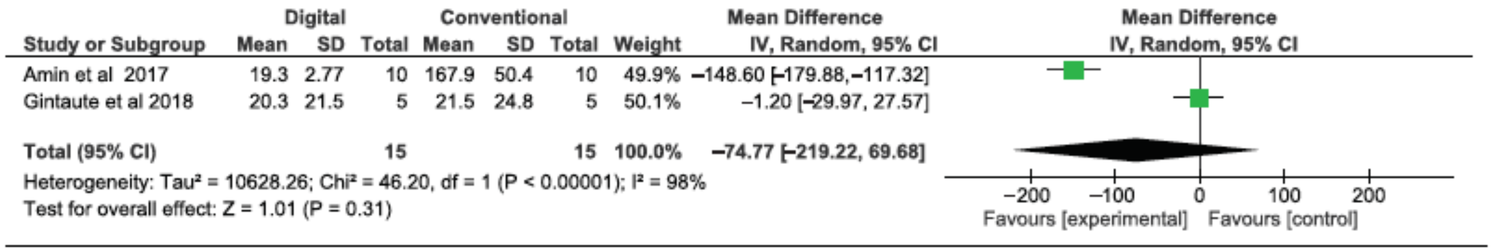
Comparison of overall accuracy between digital scans and conventional impressions in completely edentulous patients



Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Amin et al 2017	32.9	5.1	10	167.9	50.4	10	20.3%	−135.00 [−166.40,−103.60]
Gintaute et al 2018	20.3	21.5	5	21.5	24.8	5	20.6%	−1.20 [−29.97, 27.57]
Huang et al 2020	35.85	14.3	10	25.6	4.4	10	22.3%	10.25 [0.98, 19.52]
Kim et al 2019	177.4	105.6	10	72.2	31.1	10	14.9%	105.20 [36.97, 173.43]
Papaspyridakos et al 2016	19.4	10.9	10	12.5	25.5	10	21.8%	6.90 [−10.29, 24.09]
Total (95% CI)			**45**			**45**	**100.0%**	**−8.20 [−53.56, 37.15]**

Heterogeneity: Tau² = 2378.28; Chi² = 85.31, df = 4 (P < 0.00001); I² = 95%
Test for overall effect: Z = 0.35 (P = 0.72)

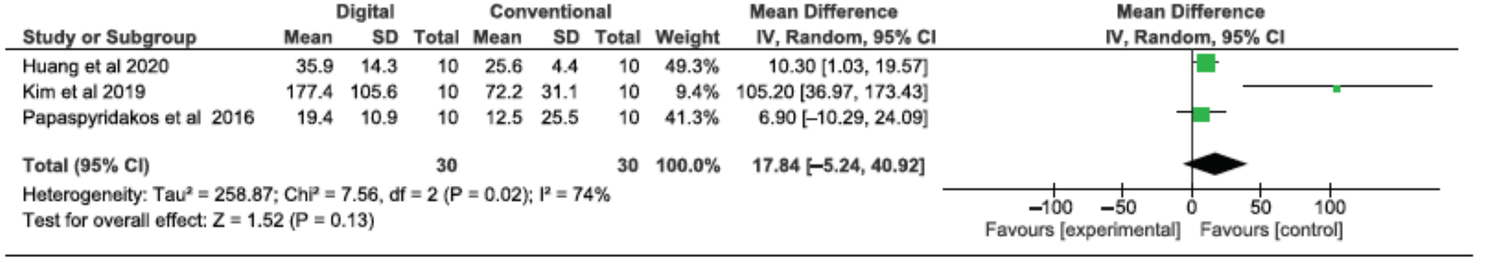
Comparison of accuracy between digital scans (True Definition IOS) and conventional impressions in completely edentulous patients



Study or Subgroup	Digital Mean	SD	Total	Conventional Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Amin et al 2017	19.3	2.77	10	167.9	50.4	10	49.9%	−148.60 [−179.88,−117.32]
Gintaute et al 2018	20.3	21.5	5	21.5	24.8	5	50.1%	−1.20 [−29.97, 27.57]
Total (95% CI)			**15**			**15**	**100.0%**	**−74.77 [−219.22, 69.68]**

Heterogeneity: Tau² = 10628.26; Chi² = 46.20, df = 1 (P < 0.00001); I² = 98%
Test for overall effect: Z = 1.01 (P = 0.31)

Comparison of accuracy between digital scans (Trios IOS) and conventional impressions in completely edentulous patients



Study or Subgroup	Digital Mean	SD	Total	Conventional Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Huang et al 2020	35.9	14.3	10	25.6	4.4	10	49.3%	10.30 [1.03, 19.57]
Kim et al 2019	177.4	105.6	10	72.2	31.1	10	9.4%	105.20 [36.97, 173.43]
Papaspyridakos et al 2016	19.4	10.9	10	12.5	25.5	10	41.3%	6.90 [−10.29, 24.09]
Total (95% CI)			**30**			**30**	**100.0%**	**17.84 [−5.24, 40.92]**

Heterogeneity: Tau² = 258.87; Chi² = 7.56, df = 2 (P = 0.02); I² = 74%
Test for overall effect: Z = 1.52 (P = 0.13)

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RESULTS

Partially edentulous

The inclusion criteria were met by 6 in vitro and 2 clinical studies reporting on partially edentulous impressions. Quantitative meta-analysis was performed for 6 partially edentulous studies. The studies exhibited high values for heterogeneity. A random effects model was conducted to estimate the effect size.

Based on 1 clinical and 5 in vitro studies, the **mean 3D implant deviation** between conventional and digital impressions was **52.31 µm** (95% CI: 6.30, 98.33) and the conventional impressions had nominally less deviation (p = 0.03). Five in vitro and 2 clinical studies were not included in the quantitative analysis due to heterogeneity in the methodology.

Implant angulation affected the accuracy in favor of the partially edentulous conventional impressions.

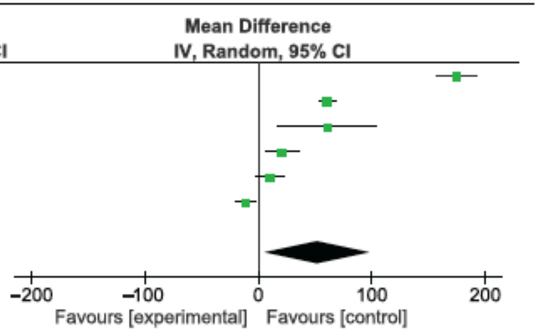
CONCLUSIONS

Digital scans appear to have comparable 3D accuracy with conventional implant impressions based mainly on in vitro studies. However, clinical trials are recommended to investigate the clinical accuracy of digital scans and digitally fabricated interim or prototype prostheses, before digital implant scans can be recommended for routine clinical use.

Overall accuracy (µm) comparing digital impressions versus conventional impressions in partially edentulous patients

	Digital			Conventional				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Alsharbaty et al 2019	360	46	36	185	27.5	36	16.8%	175.00 [157.49, 192.51]
Alshawaf et al 2018	114.2	7.8	10	53.5	9.47	10	17.2%	60.70 [53.10, 68.30]
Basaki et al 2017	116.4	94.6	20	55.6	29.6	20	14.9%	60.80 [17.36, 104.24]
Chew et al 2017	62.8	16.2	5	42	5.3	5	16.9%	20.80 [5.86, 35.74]
Chia et al 2017	39.3	9.2	5	29	10.2	5	17.0%	10.30 [–1.74, 22.34]
Marghalani et al 2018	19.5	7.5	10	30.5	11.5	10	17.1%	–11.00 [–19.51,–2.49]
Total (95% CI)			**86**			**86**	**100.0%**	**52.31 [6.30, 98.33]**

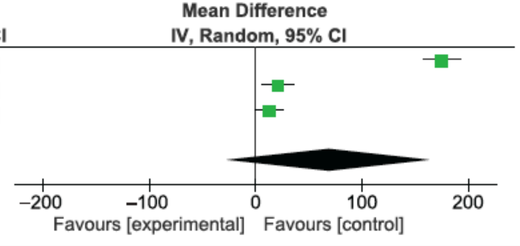
Heterogeneity: Tau² = 3198.13; Chi² = 422.62, df = 5 (P < 0.00001); I² = 99%
Test for overall effect: Z = 2.23 (P = 0.03)



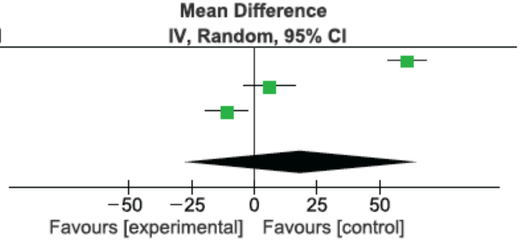
Partially edentulous accuracy (µm) comparing digital impressions versus conventional impressions with inter-implant angulation less than 20 degrees

	Experimental			Control				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Alsharbaty et al 2019	360	46	36	185	27.5	36	33.2%	175.00 [157.49, 192.51]
Chew et al 2017	62.8	16.2	5	42	5.3	5	33.3%	20.80 [5.86, 35.74]
Chia et al 2017	38	8.8	5	25.5	12.1	5	33.4%	12.50 [–0.61, 25.61]
Total (95% CI)			**46**			**46**	**100.0%**	**69.29 [-26.26, 164.85]**

Heterogeneity: Tau² = 7069.84; Chi² = 240.94, df = 2 (P < 0.00001); I² = 99%
Test for overall effect: Z = 1.42 (P = 0.16)



Partially edentulous accuracy (µm) comparing digital impressions versus conventional impressions in mm with inter-implant angulation 20 degrees or more

	Digital			Conventional				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Alshawaf et al 2018	114.2	7.8	10	53.5	9.47	10	33.4%	60.70 [53.10, 68.30]
Chia et al 2017	42	9.9	5	36	6.5	5	33.2%	6.00 [–4.38, 16.38]
Marghalani et al 2018	19.5	7.5	10	30.5	11.5	10	33.4%	–11.00 [–19.51,–2.49]
Total (95% CI)			**25**			**25**	**100.0%**	**18.62 [–27.41, 64.66]**

Heterogeneity: Tau² = 1634.22; Chi² = 166.00, df = 2 (P < 0.00001); I² = 99%
Test for overall effect: Z = 0.79 (P = 0.43)