Original Article

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Precision Redefined: A Scoping Review on OccluSense and the Changing Face of Occlusal Equilibration

Dentistry Section

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ABSTRACT

Introduction: Occlusal analysis is an integral component of prosthodontic diagnosis and treatment planning and has traditionally relied on articulating paper for identifying occlusal contacts. However, its subjective nature and inability to quantify occlusal force and timing limit clinical accuracy. Recent advancements in digital dentistry have introduced systems such as OccluSense and T-scan, which provide objective assessment of occlusal contact dynamics.

Aim: To evaluate and compare conventional and digital occlusal analysis methods- articulating paper, OccluSense, and T-scan- with respect to their validity, reliability, and digital integration in occlusal equilibration for Fixed Dental Prostheses (FDP).

Materials and Methods: A scoping review was conducted using PubMed and Scopus database to include articles published between 2010 and 2025 and written in English. The review was conducted till 16 June, 2025. The included studies assessed the effectiveness of T-scan, OccluSense, and articulating paper in occlusal equilibration during prosthodontic practice. A total of 22 articles including reviews, clinical trials, comparative studies, and in-vitro research results, met the inclusion criteria

Result: Of the 22 studies that were reviewed, nine looked at digital integration, twelve at reliability, and nine at validity. For occlusal equilibration in FDPs, digital technologies such as T-scan and OccluSense demonstrated better accuracy, repeatability and workflow compatibility, providing more clinical utility than articulating paper.

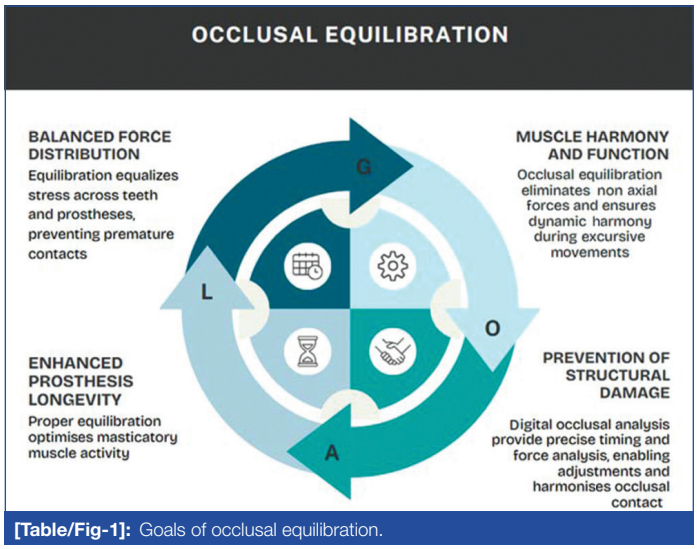
Conclusion: Digital occlusal analysis systems such as T-scan and OccluSense demonstrate superior accuracy, reliability, and repeatability compared to conventional articulating paper. They provide objective, quantifiable data on occlusal contacts and timing, improving clinical decision-making and workflow in occlusal equilibration for fixed dental prostheses.

Keywords: Articulating paper, Digital dentistry, Occlusion, Reliability, T-scan, Validity

INTRODUCTION

Preserving oral function and ensuring the long-term viability of FDPs depend on accurate occlusal contact measurements. A key goal to reduce issues such as prosthesis failure, Temporomandibular Disorders (TMD), and patient pain requires reduction of occlusal interferences thus substantiating the value of occlusal equilibration, [1-5] as depicted in [Table/Fig-1]. The lifespan of prosthesis and neuromuscular harmony may be compromised by improper detection and repair of occlusal abnormalities [1,4]. Recent studies emphasise that unbalanced occlusal contacts can overload posterior teeth and implant-supported prostheses, contributing to structural complications and functional disturbances. Evidence also shows that occlusal contact distribution naturally varies across arches, with posterior regions consistently demonstrating the highest number of contact points, highlighting the importance of accurate force-based evaluation in clinical settings. Digital and conventional studies have further shown that inaccurate identification of premature contacts may lead to increased neuromuscular strain and compromised masticatory function, underscoring the need for precise diagnostic tools [1,6].

Articulating paper has been the most popular instrument for identifying occlusal contacts since its invention in the early 1900s because of its low cost and ease of use [2]. Despite being a mainstay in many practices, it has significant limitations. It is intrinsically subjective and sensitive to inter-operator variability due to its incapacity to measure force or time [2,3,6]. According to a study done in 2012, just 14% of larger marks indicate high-pressure interactions, indicating a limited link between paper mark size and actual occlusal force [3]. Furthermore, articulating paper is not compatible with contemporary prosthodontic workflows, nor is it reusable nor can it be stored digitally [7,8].



[Table/Fig-1]: Goals of occlusal equilibration.

To address these shortcomings, digital occlusal analysers such as T-scan and OccluSense have emerged. The T-scan system, introduced in 1987, provides dynamic, time-sequenced recordings of occlusal force with high sensitivity and repeatability, enabling the quantification of both contact timing and relative force levels [8-10]. It allows clinicians to detect force variations as small as 2-5% and visualise contact timing down to 0.01 seconds, thus providing a more objective foundation for occlusal adjustments [9,10]. Meanwhile, OccluSense, introduced in 2018-2019, integrates the visual characteristics of articulating film with wireless digital force mapping to bridge the gap between traditional and digital modalities [8,11,12]. Its intuitive interface and compatibility with mobile devices have made it increasingly viable for clinical use.

There is ample literature comparing the performance indicators of digital tools, despite their increasing use. Although these systems' validity [1,3,11], reliability [4,8,12], and digital integration [9,8,13] have all been evaluated independently in a number of investigations, a comprehensive review of their relative clinical performance remains to be carried out. Occlusal evaluation techniques vary significantly in accuracy and clinical utility, according to recent studies [11]. Despite being widely used, articulating paper has drawbacks that make it less reliable for precise occlusal adjustments, such as false contacts brought on by thickness and subjective mark interpretation [14-16]. T-scan and other digital occlusal analysers offer quantitative, time-sequenced force data that enhance masticatory function and occlusion balance [17,18]. These results highlight the necessity of thorough comparisons between traditional and digital occlusal assessment methods in order to direct the most effective possible clinical practice. To the best of present knowledge, no scoping review has compared OccluSense, T-scan and articulating paper across these crucial categories in order to thoroughly examine the development of occlusal evaluation technologies.

By analysing the differences between these approaches in terms of validity, reliability and digital integration, present review aimed to bridge that gap and evaluate how well they deliver objective and reproducible results in occlusal equilibration for prosthodontic applications. By consolidating evidence across these systems and evaluating their effectiveness in detecting force, timing, and contact distribution, present review aimed to clarify their comparative strengths and guide clinicians in selecting the most reliable and clinically meaningful method for occlusal equilibration within Prosthodontic practice.

MATERIALS AND METHODS

Search strategy and selection criteria: A systematic search was conducted on the PubMed and Scopus databases. The search strategy combined the keywords "OccluSense", "T-scan", "articulating paper", "occlusion", "digital dentistry", "FDP", "reliability", and "validity" using Boolean operators (AND/OR), searches were adapted for each database, and filters were applied to include articles published between 2010 and 2025 and written in English.

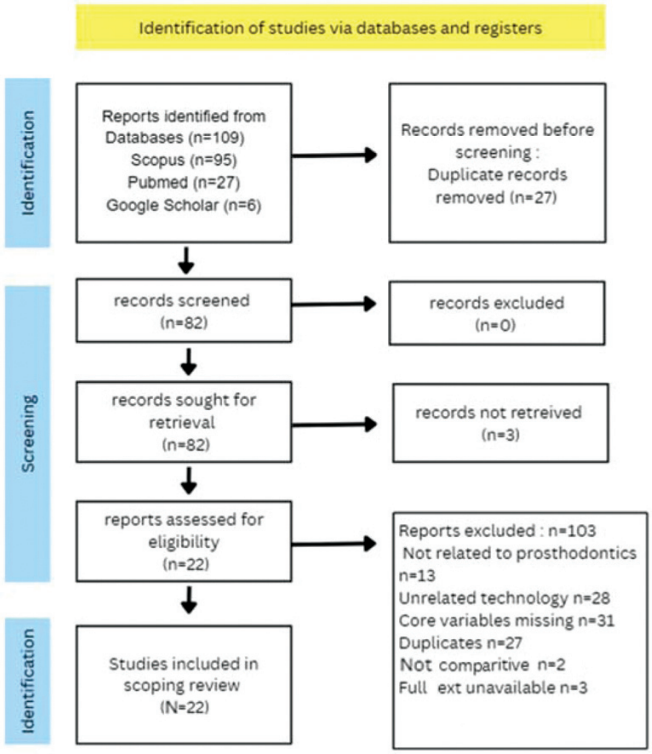
The current scoping review was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. The review was conducted till 16 June, 2025. The PRISMA flowchart for study selection has been presented in [Table/Fig-2].

Inclusion and Exclusion criteria: The inclusion criteria for present scoping review were studies published between 2010 and 2024 in English, specifically focusing on occlusal analysis using OccluSense, T-scan, or articulating paper in the context of FDPs and addressing the focus question. Eligible study types comprised narrative reviews, comparative studies, in-vitro and in-vivo studies, and case series. Studies were excluded if they were, not in English, lacked a clinical focus, were unrelated to FDPs, omitted core variables, or involved outdated or unrelated technology. The eligibility criteria of articles based on the (Population, Intervention, Comparison, and Outcome) (PICO) framework has been depicted presented in [Table/Fig-3].

RESULTS

total of 125 records were identified through database searches (PubMed=27, Scopus=95, Google Scholar=6). After the removal of 27 duplicate articles, 82 records remained for screening. These records were screened by title and abstract, leading to the exclusion of 13 articles not related to prosthodontics, 28 using unrelated technologies, 31 missing core variables, two non comparative studies, and three with no full-text availability. This resulted in the exclusion of 103 articles, with 22 articles meeting the inclusion criteria. Thus, a total of 22 articles were included in present scoping review [1-22].

Characteristics of studies included: The majority of the 22 articles that were part of this review were comparative or interventional



[Table/Fig-2]: PRISMA flowchart for study selection.

Domain	Description
Population	Patients receiving FDPs requiring occlusal equilibration
Intervention	Occlusal analysis using OccluSense
Comparison	Occlusal analysis using articulating paper, T-scan and OccluSense
Outcome	Clinical efficiency in terms of validity, reliability, and digital integration for occlusal equilibration
Study design	Randomised controlled trials, controlled clinical trials, prospective studies, retrospective studies

[Table/Fig-3]: Search strategy using PICOS strategy.

in nature. These articles comprised clinical investigations, in-vitro and in-vivo research, review articles, case reports, comparative studies, and evaluations of products or techniques. The research which were published between 2010 and 2025, were included. Participant numbers varied from 20 to more than 200, and sample sizes ranged from small in-vitro research to larger clinical or survey-based investigations.

The included articles evaluated each technology's clinical efficacy, accuracy, reproducibility, and ability to offer objective, predictable occlusal equilibration. Findings repeatedly demonstrated that digital tools like T-scan and OccluSense offered better results in terms of repeatability, force analysis, and integration than traditional articulating paper, which was commonly used but had reliability and force discrimination issues. The comparative evaluation focused on the performance of OccluSense, T-scan, and articulating paper across three key domains: validity, reliability, and digital integration, specifically in the context of FDP. These aspects has been depicted further elaborated in [Table/Fig-4].

Database	Keywords and operator used	Articles hit
PubMed	(("OccluSense" OR "digital occlusal analysis" OR T-scan) AND ("articulating paper" OR "occlusion" OR "occlusal indicator") AND ("occlusal contacts" OR "occlusal equilibration") AND ("accuracy" OR "validity" OR "reliability" OR "digital integration")	27
Scopus	(TITLE-ABS-KEY ("OccluSense" OR "digital occlusal analysis" OR "T-scan" OR "dental occlusion") AND TITLE-ABS-KEY ("articulating paper" OR "occlusion" OR "occlusal indicator*") AND TITLE-ABS-KEY ("occlusal contact*" OR "occlusal equilibration") AND TITLE-ABS-KEY ("accuracy" OR valid* OR reliab* OR "digital integration")) AND Pubyear > 2009 AND Pubyear < 2026	97

Google Scholar	OccluSense AND T-scan AND articulating paper AND occlusion AND digital dentistry AND FDP AND reliability AND validity	6

[Table/Fig-4]: Search strategy across databases.

DISCUSSION

Occlusal equilibration plays a critical role in attaining patient satisfaction, by maximising masticatory efficiency, reducing Temporomandibular Disorders (TMDs), and improving long-term restorative success. Traditional articulating paper has been a guide for clinicians for a long time in identifying high-force contacts through visible markings [3], but its limitations lead to the evolution towards digital systems like T-scan and OccluSense, which provide dynamic insights and quantifiable force data. These advances have changed occlusal analysis from subjective interpretation to objective measurement, allowing for accurate modifications that enhance patient comfort and clinical results. The present review synthesises evidence on their performance to equip clinicians with clearer guidance for selecting optimal tools in prosthodontic practice.

As shown in the [Table/Fig-4], for evaluated parameters, digital occlusal analysis systems consistently demonstrate advantages over articulating paper across several clinically relevant parameters. T-scan provides high sensitivity by quantifying occlusal force across 256 force levels, allowing proper discrimination of force level distrubtion [10,17]. This system also quantifies dynamic occlusion parameters like Occlusion Time (OT) and Disocclusion Time (DT). Basson E et al., demonstrated a significant reduction in DT following Immediate complete anterior guidance therapy, while Reich KM et al., confirmed reproducible time sequenced occlusal recordings across observers [1,18].

Repeatability and objectivity of T-scan recordings are supported by Reich KM et al., who reported intra-observer reliability of 0.66 and inter-observer reliability of 0.58, which were consistenly higher than conventional indicators like articulating paper [1]. Similarly, Ayuso-Montero R et al., demonstrated good inter-observer reliability (ICC=0.79) for occlusal contact area assessment using T-scan [22]. The Characteristics of studies by evaluation domain in context of Fixed Dental Prosthesis (FDP) and article data have been presented in [Table/Fig-5,6] [1-22].

Author's name	Digital scanner type/ model	Domain performance of occlusal indicators	Key finding per domain	Overall result
Reich KM et al., [1]	T-scan system (digital occlusal analyser) compared with wax occlusogram	Reliability: T-scan generated quantitative digital recordings of occlusal contacts that allowed repeated measurements across observers	T-scan demonstrated higher intraobserver (ICC=0.66) and inter-observer (ICC=0.58) reliability than wax occlusogram (ICC=0.36 and 0.34, respectively)	T-scan showed superior reproducibility compared to conventional wax occlusogram
Basson E et al., [2]	Articulating paper (conventionl occlusal indicator)	Validity: Articulating paper produced static visual occlusal markings that required clinician interpretation without force quantification	Dentists correctly identified the two highest force contacts only 4.88% of the time using articulating paper	Articulating paper showed limited validity for identifying high-force occlusal contacts
Rubió-Ferrer G et al., [3]	Articulating paper (conventionl occlusal indicator)	Validity: Articulating paper generated static occlusal markings in which mark size was visually assessed to estimate occlusal force	Articulating paper mark size correlated with actual occlusal force in only 38.3% of cases	Articulating paper demonstrated weak validity in representing true occlusal force distribution
Elboraey AN et al., [4]	OccluSense digital occlusal analysis system	Clinical application /outcomes: OccluSense provided digital assessment of occlusal contacts that enabled monitoring of force distribution during occlusal equilibration	OccluSense-assisted equilibration resulted in improved occlusal force distribution over time in patients with fixed implant-supported prostheses	OccluSense demonstrated clinical utility in facilitating occlusal equilibration for fixed prostheses
Lila-Krasniqi ZD et al., [5]	Occlusal indicators used for clinical occlusal equilibration assessment in fixed dentures	Clinical application/outcomes: Occlusal indicators were used to assess occlusal force distribution and arch relationships in patients with fixed dentures and TMD	Disharmonic arch relationships and unilateral occlusal force overload were associated with TMD in patients with fixed dentures	Precise occlusal equilibration was clinically relevant in reducing occlusal disharmony associated with TMD
Manziuc MM et al., [6]	Articulating paper (40 µm) and OccluSense digital occlusal analysis system	Reliability: Both articulating paper and OccluSense were used to record static and dynamic occlusal contacts for inter-rater comparison	Articulating paper showed near-perfect inter-rater reliability (Cohen's Kappa=1.0), while OccluSense demonstrated high inter-rater agreement (Kappa >0.83) for static and dynamic contacts	Both methods showed good examiner agreement, with articulating paper demonstrating the highest inter-rater reliability in present study
Bozhkova T et al., [7]	Articulating paper; digital occlusal analysers (T-scan and OccluSense)	Clinical usage pattern: Occlusal indicators were evaluated based on clinician-reported usage and preference patterns in routine dental practice	Articulating paper remained the most commonly used occlusal indicator, while interest in digital techniques such as T-scan and OccluSense was increasing	Conventional occlusal indicators were predominant in practice, with growing adoption of digital occlusal analysis systems
Sutter B, [8]	T-scan digital occlusal analyser; OccluSense digital occlusal analysis system	Digital integration and reliability: Digital occlusal indicators were assessed based on sensor characteristics, durability, data output, and workflow usability	T-scan provided validated quantitative force and timing data with greater sensor durability, while OccluSense offered wireless, user-friendly digital occlusal analysis	T-scan demonstrated more robust digital performance characteristics, whereas OccluSense emphasised ease of use and accessibility
Bathiya A and Pisulkar SK [9]	Digital occlusal analysis systems, including OccluSense	Reliability and clinical outcomes: Digital occlusal equilibration was associated with improved force distribution and muscle activity, with OccluSense showing high inter-rater agreement (Kappa > 0.83)	Digital occlusal analysis demonstrated favourable reliability and clinical outcomes in occlusal equilibration	Digital occlusal analysis demonstrated favourable reliability and clinical outcomes in occlusal equilibration
Gade JR et al., [10]	T-scan digital occlusal analyser	Validity: T-scan provided quantitative digital measurement of occlusal timing and relative force levels across occlusal contacts	T-scan enabled occlusal analysis with timing resolution up to 0.003 seconds and measurement across 256 force levels	T-scan demonstrated high-resolution capability for timing and force assessment in occlusal analysis
Dizayee WM and Ikram FS, [11]	OccluSense digital occlusal analysis system and 40 µm articulating paper	Reliability and validity: Occlusal indicators were used to mark occlusal contacts and assess examiner agreement and marking accuracy	OccluSense demonstrated high inter-rater reliability (Cohen's Kappa >0.9), comparable to articulating paper, with improved accuracy in contact marking	OccluSense showed reliable and accurate occlusal contact marking comparable to conventional indicators
Popa S and Ahlers MO, [12]	OccluSense digital occlusal analysis system compared with Arti-Fol	Validity and reliability: OccluSense was used to record and compare occlusal contact markings against a reference articulating film under in-vitro conditions	After modified evaluation, OccluSense showed reliability and validity comparable to Arti-Fol, with deviations observed in molar regions ($p<0.05$)	OccluSense demonstrated acceptable validity and reliability under controlled in-vitro conditions
Chan H et al. [13]	T-scan digital occlusal analyser	Validity: T-scan was used to quantitatively assess occlusal contacts, force distribution, and center of force before and after occlusal equilibration	T-scan demonstrated measurable changes in occlusal balance following equilibration by quantifying force distribution and center of force	T-scan enabled objective assessment of occlusal balance during equilibration procedures

Jauregi M et al., [14]	OccluSense (60-µm inked sensor) and T-scan 10	Validity and digital integration: Occlusal indicators were assessed for their ability to record occlusal contacts with respect to timing, data output, and arch mapping	OccluSense lacked validated timing, real-time data, and precise arch mapping, whereas T-scan 10 demonstrated higher precision	T-scan 10 showed superior performance characteristics compared to OccluSense in this in-vitro evaluation
Popa AD et al., [15]	T-scan III digital occlusal analyser	Validity: T-scan III was used to record dynamic occlusal force and timing data through digital force mapping	T-scan III provided accurate dynamic force and timing measurements during occlusal analysis	T-scan III demonstrated high capability for dynamic occlusal force and timing assessment
Aung MH and Nyan M, [16]	T-scan 10 digital occlusal analyser	Validity: T-scan 10 was used to assess dynamic occlusal force and timing during clinical occlusal analysis	T-scan 10 provided validated dynamic occlusal force and timing analysis in a clinical setting	T-scan 10 demonstrated strong clinical applicability for dynamic occlusal analysis
Cao R et al., [17]	T-scan 10 digital occlusal analyser and OccluSense	Validity: Occlusal indicators were evaluated for precision and force-level discrimination during occlusal analysis	T-scan 10 demonstrated superior precision (0.8% variance) with 256 force levels compared to OccluSense	T-scan 10 showed higher precision for force-based occlusal assessment than OccluSense in this study
Basson E et al., [18]	T-scan digital occlusal analyser (used for ICAGD assessment)	Validity: T-scan was used to measure dynamic occlusal timing parameters, specifically disclusion time, during occlusal adjustment procedures	T-scan significantly reduced disclusion time from 2.11 s to 0.45 s ($p<0.004$)	T-scan enabled effective monitoring of dynamic occlusal timing changes during occlusal therapy
Sapkota B and Gupta A [19]	Shim stock (12 µm) and articulating paper (40 µm)	Validity: Conventional occlusal indicators were used to assess the accuracy of occlusal contact detection based on material thickness	Shim stock (12 µm) demonstrated significantly better occlusal contact accuracy than 40 µm articulating paper ($p<0.05$)	Thinner conventional occlusal indicators provided more accurate contact detection than thicker articulating paper
Mohamed MH and Soliman SI, [20]	Articulating paper (conventional occlusal indicator)	Clinical application/ outcome: Articulating paper was used to guide occlusal adjustment of implant-supported crowns	Articulating paper-guided occlusal adjustment resulted in a significant reduction of occlusal force on the implant side	Articulating paper was effective for reducing occlusal load on implant crowns in this clinical study
Gözen M and Güntekin N, [21]	OccluSense digital occlusal analysis system and Medit i700 intraoral scanner	Validity: OccluSense was used for digital occlusal analysis and compared with intraoral scanner measurements during occlusal adjustment	Measurements obtained with OccluSense showed good correlation with Medit i700, supporting the usefulness of digital occlusal analysis for occlusal adjustment	OccluSense demonstrated acceptable validity when correlated with intraoral scanner measurements in a clinical setting
Ayuso-Montero R et al., [22]	T-scan digital occlusal analyser	Validity and reliability: T-scan was used to measure occlusal contact area quantitatively at maximum bite force	T-scan demonstrated good validity and reliability for occlusal contact area measurement, with an ICC of 0.79	T-scan provided reliable quantitative assessment of occlusal contact area under maximum bite force conditions

[Table/Fig-5]: Characteristics of studies by evaluation domain in context of FDP [1-22].

Reference/Author (Sample size; Type)	Results
Reich KM et al., [1] (26; Comparative Study)	The intra-observer reliability ICC for the T-scan was 0.66, while the inter-observer reliability ICC was 0.58. These values indicate moderate to good reproducibility and are notably higher than those for wax occlusogram, which had ICCs of 0.36 (intra-observer) and 0.34 (inter-observer).
Basson E et al., [2] (–; Research Article)	Only 4.88% of the time dentists correctly identified the two highest force contacts indicated by the articulating paper, demonstrating the high degree of subjectivity in the visual interpretation of the markings.
Rubió-Ferrer G et al., [3] (–; Original research article)	Only 38.3% of the time articulating paper mark size matches the force of the tooth, indicating a weak correlation with occlusal force percentage.
Elboraey AN et al., [4] (22; Clinical study)	When compared to removable overdentures, fixed implant-supported prostheses showed better results. Occlusense successfully facilitated occlusal equilibration with improvements in force distribution over time.
Lila-Krasniqi ZD et al., [5] (54; Clinical Study)	The significance of precise occlusal equilibration in preventing TMJ disorders was highlighted by the disharmonic arch relationships and occlusal force overload on one side displayed by patients with TMD and fixed dentures.
Manziuc MM et al., [6] (25; Comparative Study)	The study found that the 40 µm articulating paper had nearly perfect inter-rater reliability (Cohen's Kappa = 1.0). OccluSense came in second with values above 0.83 for both static and dynamic contacts.
Bozhkova T et al., [7] (228; Survey Study)	According to the study, articulation paper is still the most widely used occlusal indicator in dental practice, but more dentists are expressing interest in using quantitative digital techniques like T-scan and OccluSense.
Sutter B, [8] (–; product review)	T-scan sensors are thicker (100 microns), more durable, and provide validated, quantitative force and timing data with greater clinical reliability than Occlusense, which provides easy-to-use, wireless digital occlusal analysis.
Bathiya A and Pisulkar SK, [9] (–; Review article)	Digital occlusal equilibration significantly improves force distribution, muscle activity, and oral health-related quality of life ($p<0.05$), OccluSense has high inter-rater agreement (Kappa > 0.83).
Gade JR et al., [10] (–; Review Article)	Despite being more expensive, T-scan provides accurate occlusal analysis with timing and force measurement down to 0.003 seconds and 256 force levels.
Dizayee WM and Ikram FS, [11] (–; Comparative Study)	OccluSense achieved high inter-rater reliability (Cohen's Kappa > 0.9) similar to 40 µm articulating paper but with better accuracy in marking occlusal contacts.
Popa S and Ahlers MO, [12] (–; In-vitro Study)	After a modified evaluation, OccluSense's reliability and validity matched Arti-Fol standards, although there were some deviations in molars ($p<0.05$).
Chan H et al.,[13] (20; In-vivo clinical study)	The T-scan assessed quantitatively occlusal contacts, force distribution, and center of force, proving that the occlusion is balanced before/after equilibration.
Jauregi M et al., [14] (–; An in-vitro study)	OccluSense's 60-µm inked sensor lacks validated timing, real-time data, and precise arch mapping; T-scan 10 offers superior precision.
Popa AD et al., [15] (20; Comparative study)	The gold standard T-scan III provides accurate dynamic force and timing data with digital force mapping.
Aung MH and Nyan M, [16] (–; Case report)	T-scan 10 is the clinical gold standard because it provides better, validated dynamic occlusal force and timing analysis.
Cao R et al., [17] (–; Comparative study)	In contrast to OccluSense, T-scan 10 exhibits superior precision (0.8% variance) with 256 force levels.
Basson E et al., [18] (29; Comparative study)	ICAGD significantly decreased disclusion Time from 2.11 to 0.45 seconds ($p<0.004$).
Sapkota B and Gupta A, [19] (80; Original research)	Shim stock (12 µm) had better occlusal contact accuracy than articulating paper (40 µm) ($p<0.05$).
Mohamed MH and Soliman SI, [20] (18; Original research)	Articulating paper-guided occlusal adjustment on implant crowns demonstrated a significant decrease in force on the implant side.

Gözen M and Güntekin N, [21] (18; Prospective clinical study)	OccluSense and Medit i700 measurements showed a good correlation, indicating digital analysis helps with optimal occlusal adjustments.
Ayuso-Montero R et al., [22] (31; Cross-sectional study)	T-scan is valid and reliable for measuring occlusal contact area at maximum bite force (ICC 0.79).

[Table/Fig-6]: Presentation of article data of the scoping review [1-22].

In contrast, articulating paper lacks quantitative force discrimination with Qadeer S et al., reporting only 38.3% correaltion between mark size and force level [3]. This limitation can lead to inaccurate assessment of contact intensity and inappropriate occlusal adjustments, especially in cases where precise force control is required.

OccluSense offers improved objectivity over articulating paper through digital force visualisation, making it a practical tool for routine clinical use [6,11]. However, its four colour and 64 level force scale limits sensitivity when compared with more advanced digital scale system, particularly for subtle force imbalances [8,14]. However, it does not provide OT and DT measurement which limits its use for routine dynamic analysis.

From the workflow perspective, T-scan supports reusable recordings, real time analysis and exportable 2D and 3D datasets compatible with Computer-aided Design (CAD)/ Computer-aided Manufacturing (CAM) systems, thereby enhancing documentation, patient communication and seamless digital integration with prosthodontic workflows. In contrast, OccluSense, though more clinically practical and accessible, employs single-use sensors and app-based visualisation, which may limit long-term data continuity.

The above-mentioned insights have further developed in the existing literature, validating the data presented in the [Table/Fig-4]. Gözen M and Güntekin N showed strong correlations of Occlusense for post-implant force distribution while critisising paper's poor force-size relationship (citing Saad 2008) and Ayuso-Montero R et al., confirmed T-scan's superior guidance for equilibration over articulating paper [18,21,22]. Notably, OccluSense requires meticulous sensor positioning with standardised centering devices to ensure more reliable inter-measurement agreement.

While Manziuc MM et al., reported near-perfect examiner concordance with posterior contact underestimation by both T-scan and OccluSense [6], this reproducibility edge is consistent with Ayuso-Montero R et al., 79% T-scan inter-observer reliability for contact area assessment [22]. These findings support the clinical usefulness of T-scan and OccluSense for accurate prosthodontic equilibration.

Jauregi M et al., noted, T-scan's reusability surpasses the quality of disposables OccluSense sensors (as they tear often), supporting better record-keeping [14]. Manziuc MM et al., showed near-perfect examiner agreement for both T-scan and OccluSense systems in dynamic occlusal assesments despite missing few posterior teeth contacts enabling reliable clinical documentation and workflow efficiency compared to articulating paper [6].

While digital systems advance occlusal equilibration, limitations persist, such as OccluSense's single-use sensors, T-scan's high cost, and the sensitivity to positioning artifacts in conditions of deep bites observed amongst both occlusal analysers. Literature has insufficient evidence regarding protocols to improve clinical efficiency, gaps in dynamic force validation, comparative trials in different populations, long-term clinical outcomes, and cost-effectiveness analyses. Consequently, this represents a limitation of the present review.

Future Scope

OccluSense has a lot of potential for widespread clinical application as digital technologies develop. In order to confirm its consistency across various prosthodontic scenarios, such as as implant-supported prostheses, full-mouth rehabilitations, and TMD care, future research should concentrate on extensive clinical trials and a variety of patient demographics. Through automated pattern recognition, predictive analytics, and real-time data interpretation, OccluSense's integration with Artificial Intelligence (AI) may improve diagnosis accuracy even more. To ensure more accurate and repeatable results, more thorough in-vivo research is also necessary to set uniform standards for force calibration, sensor response, and repeatability. Together, these developments may establish OccluSense as a key element of patient-centered prosthodontic treatment and digital occlusal analysis in the future.

CONCLUSION(S)

OccluSense functions as an effective and efficient device for occlusal equilibration among FDPs by demonstrating superior reliability and validity to articulating paper. It also has affordable access than T-scan devices. Current research does not provide sufficient evidence regarding the OccluSense's repeatability and validity. From present review it can be discerned that OccluSense demonstrates substantial potential to fill the current diagnostic gaps in occlusal assessment tools, particularly for clinicians moving towards digital platforms.

REFERENCES

[1] Reich KM, Tatzber V, Skolka A, Piehslinger E, Lettner S, Kundi M, et al. A comparative study of digital and conventional occlusal indicators: Accuracy and reliability of the T-Scan Novus, wax occlusogram, and articulating silk in clinical application. J Dent. 2025;156:105695. Doi: 10.1016/j.jdent.2025.105695.

[2] Basson E, Kerstein RB, Radke J. Ability to correctly select high force occlusal contacts from articulating paper markings. Adv Dent Technol Tech. 2020;2(1):101-04.

[3] Qadeer S, Kerstein RB, Kim RJY, Huh JB, Shin SW. Relationship between articulation paper mark size and percentage of force measured with computerized occlusal analysis. J Adv Prosthodont. 2012;4(1):07-12

[4] Elboraey AN, Dehis WM, Eissa SM, El-Hotieby MM, Abdelkader OK. Occlusal equilibration and muscle activity in fixed versus removable mandibular implant-supported overdenture. Clin Oral Investig. 2024;28(3):160.

[5] Lila-Krasniqi ZD, Shala KS, Dula LJ, Pustina-Krasniqi T, Bicaj T, Ahmedi EF. Differences between centric relation and maximum intercuspation as possible cause for development of temporomandibular disorder analyzed with T-Scan III. European Journal of Dentistry. 2015;9(4):573-79.

[6] Manziuc MM, Savu MM, Almăşan O, Leucuţa DC, Tăuţ M, Ifrim C, et al. Insights into occlusal analysis: Articulating paper versus digital devices. J Clin Med. 2024;13(15):4506. Doi: 10.3390/jcm13154506.

[7] Bozhkova T, Musurlieva N, Slavchev D, Dimitrova M, Rimalovska S. Occlusal indicators used in dental practice: A survey study. Biomed Res Int. 2021;2021:2177385. Doi: 10.1155/2021/2177385.

[8] Sutter B. Digital occlusion analyzers: A product review of T-Scan 10 and occlusense. Adv Dent Tech Technol. 2019;2(1):2-31.

[9] Bathiya A, Pisulkar SK. Digital occlusal analysis using T-scan: Its role, mechanism, accuracy and application. Med Sci. 2020;24(105):2826-34.

[10] Gade JR, Agrawal MJ, Dandekar SG, Soni MN, Jaiswal KV, Ingole A. Digital occlusal analyser T-Scan: A review. J Res Med Dent Sci. 2021;9(11):187-93.

[11] Dizayee WM, Ikram FS. Comparison between digital and conventional occlusal indicators. Erbil Dent J. 2023;6(1):10-19. Doi: 10.15218/edj.2023.02

[12] Popa S, Ahlers MO. Contact point marking with the OccluSense system- an in vitro study on reliability and validity. J Oral Rehabil. 2024;51(9):1662-74.

[13] Chan H, Alimujiang A, Fong SL, Wu ML, Liang R, Lai PY, et al. Use of T-Scan III in analyzing occlusal changes in molar fixed denture placement. BMC Oral Health. 2024;24(1):257. Doi: 10.1186/s12903-024-04014-1.

[14] Jauregi M, Amezua X, Iturrate M, Solaberrieta E. Repeatability and reproducibility of 2 digital occlusal analyzers for measuring the right- and left-side balance of occlusal contact forces: An in vitro study. J Prosthet Dent. 2024;132(1):179-87.

[15] Popa AD, Vlăduţu DE, Turcu AA, Târtea DA, Ionescu M, Păunescu C, et al. Aspects of occlusal recordings performed with the T-scan system and with the medit intraoral scanner. Diagnostics (Basel). 2024;14(13):1457.

[16] Aung MH, Nyan M. Clinical application of a digital occlusal analyzer in occlusal equilibration: A case report. Med Connect Dent. 2022;2:40-44.

[17] Cao R, Xu H, Lin J, Liu W. Evaluation of the accuracy of T-scan system and Cerec Omnicam system used in occlusal contact assessment. Heliyon. 2023;9(2):e13476.

[18] Kerstein RB, Radke J. Average chewing pattern improvements following Disclusion Time reduction. Cranio. 2017;35(3):135-51.

[19] Sapkota B, Gupta A. Pattern of occlusal contacts in lateral excursions (canine protection or group function). Kathmandu Univ Med J (KUMJ). 2014;12(45):43-47.
[20] Mohamed MH, Soliman SI. Computerized assessment of articulating paper occlusal adjustment for implant crowns restoring modification spaces of Kennedy Class II cases. Adv Dent J. 2023;5(3):639-50. Doi: 10.21608/ADJC.2023.199811.1290.
[21] Gözen M, Güntekin N. Comparison of occlusal force distribution and digital occlusal analysis methods of single posterior implant restorations: An in-vivo study. BMC Oral Health. 2025;25:795. Doi: 10.1186/s12903-025-06205-w.
[22] Ayuso-Montero R, Mariano-Hernandez Y, Khoury-Ribas L, Rovira-Lastra B, Willaert E, Martinez-Gomis J. Reliability and validity of T-scan and 3D intraoral scanning for measuring the occlusal contact area. J Prosthodont. 2020;29(1):19-25. Doi: 10.1111/jopr.13096.

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