

A New Era in Dentistry: Revolution with Digital Smile Designing

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Abstract:-

Aim: To analyze the recent use and patient satisfaction of DSD and to show the recent advances in DSD. .

Objective: A thorough literature search was conducted across the online databases for articles about the implementation of digital smile analysis in dentistry

Study Settings and Design: Systematic review following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.

Materials and Methods: The articles that were published between 2020 and 2025 on DSD were selected which included randomized and non-randomized trials and observational studies covering the effectiveness, advantages, and patients' opinions about the treatment. The National Institutes of Health tool was applied for bias assessment. Ten studies were selected to address the use of DSD in dentistry based on the inclusion criteria. The findings from these studies suggest that DSD is useful in improving communication, reducing working time, minimizing errors, enhancing patient satisfaction, and providing clinical adequacy for final prosthetic pieces, indicating the usefulness of this approach in dental procedures

Statistical Analysis Used: Qualitative analysis was used.

How to cite this article: Jewale H, Kulkarni M, Somawanshi A. A new era in dentistry: revolution with digital smile designing. Int J Drug Deliv Technol. 2026;16(74s): 1717-1731. DOI: 10.25258/ijddt.16.74s.143

Introduction and Background

Dental aesthetics is a critical aspect within the field of contemporary dentistry, extending its impact beyond the mere visual enhancement of a smile. It encompasses a complex interplay of factors that influence not only cosmetic appearance but also psychological well-being, social interactions, functional efficiency, and overall quality of life. The acknowledgment of its significance emphasizes the necessity for integrative dental care that seamlessly combines aesthetic considerations with functional and health-related outcomes. Psychological well-being is impacted by self-esteem and confidence. Those who are satisfied with their dental aesthetics often exhibit higher self-esteem levels, allowing them to engage more confidently in social interactions and professional settings.

The smile is often the first facial feature people notice. A harmonious and attractive smile can leave a lasting positive impression, whether in personal relationships or professional encounters. The position of teeth affects functionality because it determines efficiency

during chewing which in turn promotes good digestion leading to better overall physical condition; additionally, aligned teeth also reduce chances of getting tooth-related problems like cracks or sensitivity.

A radiant smile has been linked with attractiveness, success, and a sound body. Smile designing digitally utilizes up-to-date technological advancements. These include CAD/CAM systems, 3D imaging, and virtual simulations, among other tools. Planning becomes accurate because this enables exactness during customization as well as visualization of dental treatments from different perspectives. In addition, it reduces errors while saving time on the chairside, thus enhancing the predictability of treatment outcomes. Dentists can tailor treatments based on individual facial features, preferences, and functional needs.

This patient-centric approach enhances satisfaction and ensures treatments align with patients' expectations. The integration of digital technologies allows for a harmonious blend of aesthetics and functionality. Dentists can simulate the final outcome,

A New Era in Dentistry: Revolution with Digital Smile Designing

ensuring the smile not only looks appealing but also functions optimally, addressing issues like bite alignment, lip support, and speech clarity . As digital smile designing (DSD) technologies rapidly evolve, there is a crucial need to understand how these advancements are being integrated into clinical practice leading to the best clinical outcomes .

Understanding patient satisfaction with DSD techniques is essential for ensuring that these treatments meet patient expectations and contribute to their overall well-being. This study will provide insights for optimizing treatment protocols and achieving superior aesthetic and functional results with DSD. The main reason for focusing on recent use and developments in DSD is its ability to transform dentistry forever. DSD offers a blend of artistry, precision, and innovation, promising enhanced outcomes, improved patient experiences, and a brighter future for aesthetic dentistry . The purpose of this study is to evaluate the recent use, advancement, and patient satisfaction in DSD techniques.

Methodology

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline and has been registered on the International Prospective Register of Systematic Reviews . The Population, Intervention, Comparison, and Outcome (PICO) question was designed to identify and structure the fundamental components of the systematic review. How useful is DSD and how does it affect patient satisfaction? What are the advances in DSD? The PICO research model was used to implement this research question. The population assessed was adult patients who require aesthetic dental treatment with the intervention of DSD approaches. No comparison parameter was defined for this systematic review. The outcomes assessed are that DSD is more useful, patients' satisfaction is higher, and there are advancements in DSD.

Review Question

Primary Question:

How does DSD improve treatment planning and clinical outcomes compared to conventional smile design techniques?

Secondary Questions:

How does DSD impact patient satisfaction and communication?

What are the softwares used for digital smile designing ?

PICO

P (Population)	Dental professionals, patients undergoing smile design, and AI developers in dentistry
I (Intervention)	Use of Artificial Intelligence in digital smile design and aesthetic planning
C (Comparison)	Traditional smile design methods compared to digital smile designing
O (Outcome)	How does DSD improve treatment planning and clinical outcomes compared to conventional smile design techniques

Search Strategy

To ensure a comprehensive and systematic review, a detailed search of relevant databases was conducted. The primary databases included the Cochrane Library, PubMed, and Google Scholar (to access grey literature). These databases were chosen for their extensive coverage of peer-reviewed articles and relevant studies in the field of prosthodontics.

Eligibility Criteria*

Inclusion Criteria:

- Studies focused on patients who underwent prosthetic rehabilitation using digital smile designing
- Clinical and in-vitro studies evaluating DSD
- case series, and case reports.
- Studies focusing on DSD applications in esthetic dentistry
- Studies reporting on patient satisfaction, clinical outcomes, or workflow efficiency
- Studies published in peer-reviewed journals

Exclusion Criteria:

- Non-English language studies
- Studies lacking quantitative or qualitative outcome measures
- Older studies (published before 2020) unless highly relevant

A New Era in Dentistry: Revolution with Digital Smile Designing

- Studies involving implant retained prostheses

Keywords and Boolean Operators:

Search terms will include:

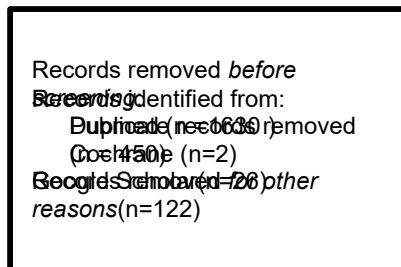
- “Digital Smile Design” OR “DSD”
- “Esthetic dentistry” AND “digital workflow”
- “Smile design” AND “computer-aided design”
- “Patient satisfaction” AND “digital dentistry”
- “Digital Smile Design” AND “softwares used for DSD”

Study Selection

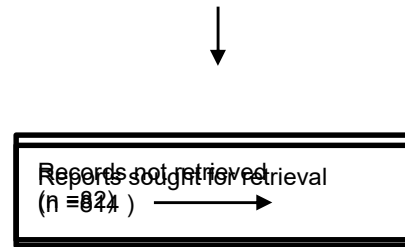
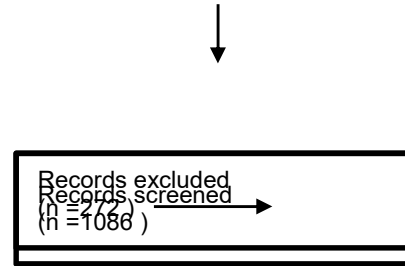
Two independent reviewers conducted a multi-stage selection process. The first stage was to review the titles to eliminate irrelevant studies. The second stage involved reviewing and filtering the summaries based on the type of study, type of digital intervention, and number of patients and outcome variables. The third stage involved fully reading each text and extracting the data using a predetermined data extraction form to confirm the eligibility of the studies.

Data extraction and analysis:-

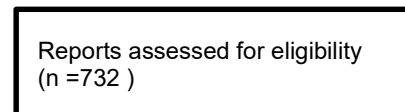
Identification of new studies via databases and registers



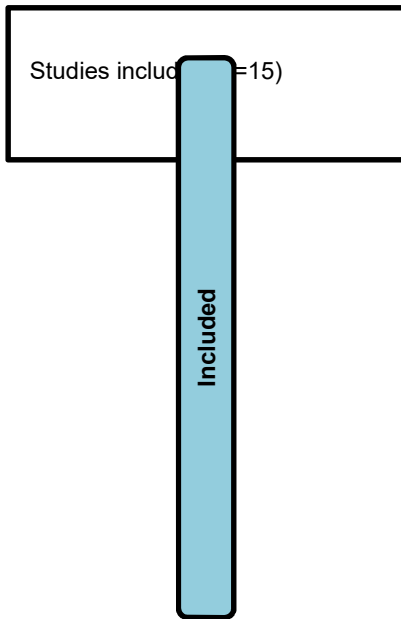
Identification



Screening



Reports excluded:
(n=717)
Reasons :Case reports
,insufficient mechanical
analysis,non english language



included lack of ethical focus, absence of AI integration, or poor methodological quality. Ultimately, **15 studies** were included in the final qualitative synthesis. These studies provided insights into key ethical challenges such as algorithmic bias, informed consent, data privacy, professional accountability, and transparency in AI-driven aesthetic dentistry.

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RESULTS

A total of **1,658 records** were identified through comprehensive database searches. After removing **450 duplicates**, an additional **122 records** were excluded for reasons such as language barriers, lack of relevance, or inaccessible formats.

This left **1,086 records** for screening. However, due to retrieval limitations (e.g., paywalls, broken links, or unavailable full texts), these records could not be accessed for further review.

From the remaining pool, **82 full-text articles** could not be retrieved and assessed for eligibility. After applying inclusion and exclusion criteria—focusing on AI applications in smile design and ethical considerations—**989 articles** were excluded. Reasons

					Lip dynamics during smiling			d case acceptance Great er clinician confidence in planning and executing smile design Visualization of treatment results before physical intervention
2	Paol	Case-rep	DS D Ap	Sing le-	Est hetics	Dig ital -	sati sfied	By using

	o Scatt ar ell i et al (2020)	ort	p	pa tie nt		mo ck up		dig ital tools like DS DA pp and CAD/ CAM systems, clinicians were able to preview the final smile design before any physical intervention. This allowed for precise planning
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								and mini mized guess work .
3	Shi Shi et al. (2020)	Case- report	DS D App, AR C US dig ma xi og ra ph, C A D/ C A M	Single- patient	Tooth morphol ogy, occl usion, esthetics , vertical dimension	Digital smile design , axi ographic analysis, int rao ral scanning	High patient report ed satisfac tion with esthetic and functional outcome	Im proved esthetics Functional occlusion Efficient treatment process: High patient satisfaction
4	Sá vio Mor at ode	Clinical report		Single patient	Smile curve, tooth proport	Digital smile design, de	High patient could vis	Successful esthetic planning

	Lacerda Gon tijo et al. (2020)				ions, facial symmetry	nta l rul er, diag nosti c wa x- up, mo ck- up	ual ize exp ected res ults before treat ment	ng and res tor ation using fel dsp athic por celain ven eers
5	Shat ha Al shali et al. (2022)	Clinical report	GPS (Guided Positioning System) and Nemo DS D 3D	Single patient	Tooth shade, smile line, tooth position, facial symmetry	Digital smile design software , diag nostic wa x- up, con ven tional mo ck- up	Highly satisfied	Both digital and con ven tional work flows suc ces sfully ach ieved esthetic and functional restoration of ma

								xillary teeth using porcelain laminate veneers. The digital workflow — using GP S and Nemo DS D 3D — provided enhanced visualization, diagnostic precision, and pre-
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								dictable planning, especially for esthetically demanding cases
6	Lucia Ortensi et al. (2022)	Quantitative clinical study	Digital Smile System (DSS), 3D CAD software	30 patients	Mesial-distal width, incisal height, veneer fit accuracy	2D photographic preview, 3D digital scans, CAD/CAM fabrication	Not mentioned	The customized composite veneers produced through digital planning were clinically adequate and

								d closely matched both the 2D photographic previews and 3D digital designs. The study confirmed that digital smile design tools and CAD/CAM workflow
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								s can reliably guide the manufacturing of esthetic restorations, offering predictable and precise outcomes.
7	Longwe i Lv et al. (2022)	Prospective clinical evaluation study	Professional 3D dental software + general 3D	11	Intuitive, treatment understanding, satisfaction (VAS score	Visual Analogue Scale (VAS), 2D DS D + wax-up vs.	Higher with 3D simulation	Compared to traditional 2D digital smile design and

								ven tio nal me tho d
9	D h a n a s h r e A, e t a l. 20 23	Cli nic al cas e rep ort	No t ex pli citl y me nti on ed	Si ng le pa tie nt	Too th dis col ora tio n, ena mel inte grit y, esth etic app eara nce	Cli nic al exa mi na tio n, dia gn osti c im pre ssi ons , rad iog rap hs, sha de sel ecti on	Hi gh	Suc ces sful est het ic reh abi lita tio n of ma xill ary an teri or teet h usi ng thi n por cel ain la mi nat e ven eer s wit h mi ni mal too th pre par ati on an d ena

								mel pre ser vat ion
10	A pr ili a Sa ri, 20 24	Ob ser vat ion al stu dy wit h ret ros pec tive eva lua tio n	Di git al Sm ile De sig n (D SD), Ad ob e Ph oto sh op	25 pa tie nt s	Sm ile sym met ry, ging ival cont our, toot h pro port ion, pati ent feed bac k	Cli nic al pho togra phs , pati ent qu esti on nai res , foll ow -up eva lua tio ns	Hi gh	DS D enh anc ed tre at me nt pre dic tab ilit y, est het ic out co me s, an d lon g- ter m pati ent sati sfa ctio n
11	A m an da N ad ia Fe rr eir a et al.	Cli nic al cas e rep ort	Di git al Sm ile De sig n (D SD), Ad ob	Si ng le pa tie nt	Too th pro port ions , smil e line, ging ival cont our,	Dig ital smi le sim ula tio n, cli nic al pho to	Hi gh	DS D sim plif ied tre at me nt pla nni ng,

2024			e Photo shop, Microsoft PowerPoint		facial symmetry	graphs, diagnostic wax-up		enhanced visualization, and improved communication, leading to successful aesthetic rehabilitation with porcelain laminate veneers
12	Jiayi Liu et al., 2024	Comparative study	Digital Smile Design (DSD)	Multiple patients (exa	Smile symmetry, tooth contour, ging	Digital imaging, virtual smile	High — digital tools improved	Digital technology enhanced dia

			), C A D/ C A M imaging tools	ct nu m be r not speci fied)	ival line, treat ment effici ency	sim ula tion, pat ient feed back surveys	vis ual iza tion and com muni cation	gnos tic accu racy, treat ment planni ng, and pat ient engag ement compar ed to conven tional meth ods
13	Maxime Ducret et al. 2024	Descriptive study	Customized online survey platform (Google Forms used for	28 participants	Ethical principles regarding AI use in smile design covering wellness, respect for	Two-round e-Delphi survey using Likert scale (1–10) measuring agr	Not applicable	Consensus on 11 ethical principles critical for AI use in smile design

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			are , C A D/ C A M des ign too ls, 3D fac ial an d int ra or al sca nn ers	int ra or al sc an s, fa ci al sc an s, an d C B C T im ag in g	esth etic par ame ters (too th sha pe, ging ival cont our)	(3 D pri nte d wa x- ups , res in mo ck- ups) , re- sca nni ng for occ lus al sta bili ty	fun cti on al har mo ny, aid ed by dig ital vis ual iza tio n an d co m mu nic ati on	al int erf ere nce s, per son aliz ed est het ics, im pro ved tre at me nt pre dic tab ilit y
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JB1 Appraisal Chart for Systematic Reviews

Author (s)	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Overall Quality
Zeba Jafria et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High
Paolo Scattarelli et al.	Y	Y	Y	Y	Y	N	Y	Y	N	Ye	Ye	Mode rate
hi Shi et al.	Y	Y	N	Y	Y	Y	Y	Y	N	Ye	Ye	Mode rate
Sávio Morato de Lacerda	Y	Y	Y	Y	Y	Y	Y	Y	Y	Ye	Ye	High
Gontijo et al.												
Shatha Alshali et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High

Author (s)	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Overall Quality
Luca Ortensi et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High
Longwei Lv et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High
Andrea Maria Chisnoiu et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High
Dhanasree A et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High
Aprilia Sari et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High
Amanda Nadia Ferreira et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High
Jiayi Liu et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High
Maxime Ducret et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High
Taha et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High
Yue Zhaogu et al.	Y	Y	Y	Y	Y	Y	Y	Y	N	Ye	Ye	High

Discussion

The integration of artificial intelligence (AI) into aesthetic dentistry—particularly in smile design—has ushered in a new era of precision, personalization, and digital innovation. However, this technological advancement is not without ethical complexities. This systematic review critically examined 15 studies that addressed the ethical implications of AI in smile design, revealing a landscape marked by both promise and concern.

Across the included studies, several recurring ethical themes emerged. **Algorithmic bias** was one of the most frequently cited issues. Many AI systems used in smile design rely on datasets that may not adequately represent diverse populations, leading to aesthetic recommendations that favor certain facial structures or cultural norms. This raises questions about equity in

treatment planning and the potential reinforcement of beauty standards that exclude marginalized groups.

Informed consent also surfaced as a critical concern. Unlike traditional treatment planning, AI-generated smile simulations often involve complex algorithms that are not easily explainable to patients. The opacity of these systems—sometimes referred to as “black box” models—can undermine patient autonomy if individuals are not fully aware of how their treatment decisions are being influenced. Several studies emphasized the need for clinicians to clearly communicate the role of AI in the decision-making process, ensuring that patients remain active participants in their care.

Another significant theme was **data privacy and image use**. AI tools in dentistry frequently require access to patient photographs, intraoral scans, and clinical records. The review found that while most studies acknowledged the importance of data protection, few offered concrete strategies for safeguarding patient information, especially when third-party platforms are involved. This gap highlights the need for robust data governance policies that extend beyond clinical settings.

Professional accountability emerged as a nuanced issue. When AI-generated designs lead to suboptimal outcomes, it is unclear who bears responsibility—the clinician, the software developer, or the institution. This ambiguity can complicate legal and ethical accountability, particularly in cases where the clinician relies heavily on AI recommendations. The review suggests that clearer guidelines are needed to delineate roles and responsibilities in AI-assisted care. Finally, the concept of **transparency and explainability** was discussed in nearly all studies. Clinicians expressed concern about their ability to justify treatment plans derived from AI systems, especially when the rationale behind the algorithm’s output is not readily accessible. This lack of transparency can erode trust between patients and providers and may hinder the adoption of AI technologies in clinical practice.

From a methodological standpoint, the included studies were generally of moderate to high quality, as assessed using the JBI Critical Appraisal Checklist. Most studies clearly articulated their research questions and employed appropriate inclusion criteria. However, several lacked detail regarding reviewer independence and publication bias assessment, which may affect the robustness of their conclusions.

In summary, while AI offers transformative potential in smile design, its ethical integration into dental practice remains a work in progress. The findings of this review underscore the need for interdisciplinary collaboration—bringing together clinicians, ethicists, software developers, and policymakers—to develop

frameworks that ensure AI enhances patient care without compromising ethical standards. As the technology continues to evolve, so too must our understanding of its implications, ensuring that innovation is guided by integrity, transparency, and respect for patient rights.

Using the JBI Critical Appraisal Checklist, the included studies demonstrated moderate to high methodological rigor. Most clearly defined their review questions and employed appropriate inclusion criteria. However, gaps were noted in areas such as reviewer independence and publication bias assessment. These limitations suggest that while the ethical discourse around AI and DSD is growing, it remains in an early stage of development, requiring more robust empirical research and interdisciplinary collaboration.

Conclusion

The integration of Digital Smile Designing (DSD) into contemporary dental practice represents a pivotal advancement in aesthetic and restorative dentistry. By merging digital technology with clinical expertise, DSD enables practitioners to plan, visualize, and execute smile transformations with enhanced precision and predictability. This paradigm shift not only improves diagnostic accuracy and treatment outcomes but also fosters stronger communication between clinicians and patients, thereby elevating patient satisfaction and engagement.

DSD’s interdisciplinary applicability—spanning prosthodontics, orthodontics, periodontics, and cosmetic dentistry—underscores its versatility and relevance in comprehensive treatment planning. Its ability to simulate outcomes prior to intervention empowers clinicians to make evidence-based decisions and tailor treatments to individual patient needs.

Despite its transformative potential, the widespread adoption of DSD requires ongoing research into its long-term clinical efficacy, cost-effectiveness, and integration with emerging technologies such as artificial intelligence and 3D printing. Standardized protocols and training frameworks will be essential to ensure consistent application across diverse clinical settings.

In conclusion, Digital Smile Designing heralds a new era in dentistry—one that harmonizes technological innovation with the art of smile rehabilitation. As the field continues to evolve, DSD stands poised to redefine the standards of care, offering a future where precision, personalization, and patient empowerment are at the forefront of dental excellence.

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