



GRADUATION PROJECT

Degree in Dentistry

Comparison of the Longevity of Direct versus Indirect Dental Veneers

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RESUMEN:

Introducción: Impulsada por la creciente solicitud social de estética, la colocación de carillas directas (DVs) o Indirectas (IVs) como materiales de restauración ha aumentado. Aunque se comercializan como mínimamente invasivas, implican una alteración irreversible del esmalte; la preparación dental acumulativa durante los inevitables recambios plantea riesgos biológicos a largo plazo. La longevidad de las carillas es multifactorial incluyendo la selección del caso, la oclusión y tinción. Entre las DVs de composite estratificado y las IVs de disilicato de litio, no se ha identificado un único material superior que sea menos propenso a sufrir fracturas o alteraciones cromáticas. Ambos tipos demuestran supervivencia adecuadas, pero son susceptibles a complicaciones mecánicas o estéticas. Pese a su popularidad, es posible que dentistas y pacientes no comprendan las limitaciones de estos materiales. Consecuentemente, identificar un material con longevidad óptima resulta motivador. **Objetivo:** Comparar la longevidad de DVs e IVs evaluando diferencias en resistencia a la fracture y estabilidad cromática. **Materiales y Métodos:** se realizó una búsqueda bibliográfica utilizando Medline con una estrategia PICO. Se obtuvo un diagrama PRISMA; de un total inicial de 763 artículos, cuatro estudios cumplieron los criterios de inclusión. **Resultados y Conclusiones:** Tanto las DVs como las IVs proporcionan resultados de color aceptables a largo plazo y una mejora estética significativa. Las IVs requieren una mayor inversión inicial en costo y tiempo, pero menor mantenimiento y una estética superior. Las DVs son más vulnerables a la decoloración y requieren protocolos de pulido para mantener la estética. Debe considerarse primordialmente la selección del caso para prolongar el color. Aunque las DVs son más susceptibles al astillamiento por la técnica de aplicación, son resilientes bajo cargas masticatorias funcionales estándar. Las IVs proporcionan un mayor margen de seguridad contra la fracture. Finalmente, la oclusión y la selección del caso influyen más en la longevidad que la elección del material. Se requieren más investigaciones para determinar el material y método de fabricación más longevo.

Palabras Clave:

Lithium disilicate, composite resin, nano-hybrid composite, hybrid composite, direct veneers, indirect veneers, porcelain veneers, anterior veneers, longevity, durability, fracture resistance, colour stability, fracture strength, chipping, fracture

Abbreviations:

DVs: Direct Veneers

IVs: Indirect Veneers

LDS: Lithium Disilicate

CAD: Computer Aided Design

CAM: Computer Aided Manufacturing

USPHS: Uniter States Public Health Service

ABSTRACT:

Background: Driven by increasing societal demand for aesthetics, the placement of direct (DV) or indirect (IV) veneers as restorative materials has increased . While marketed as minimally invasive, veneers involve irreversible enamel alteration; cumulative tooth preparation during inevitable replacements poses long-term biological risks. Veneer longevity is multifactorial, involving case selection, occlusion, location, and staining influence. Between DVs composed of stratified composite and IVs composed of LDS, no single superior material has been identified less likely to undergo fracture or colour alterations. Both types demonstrate appropriate survival rates but remain susceptible to mechanical or aesthetic complications. Despite their popularity, clinicians and patients may not fully understand the limitations of these materials. Consequently, identifying a material with optimal longevity is motivating. **Objective:** To compare longevity of DVs and IVs by evaluating differences in fracture resistance and colour stability. **Materials and Methods;** a comprehensive literature search was conducted via Medline using a PICO-based strategy. Following PRISMA guidelines, four studies were selected from an initial 763 articles for qualitative synthesis. **Results and Conclusions:** Both DVs and IVs provide acceptable colour long-term outcomes and significant aesthetic improvement. IVs demonstrate a greater initial investment in cost and time but entail reduced maintenance and higher aesthetics. DVs are more prone to discoloration and require mandatory polishing protocols to maintain aesthetics. Perhaps what should be prioritised is the initial case selection to prolong colour longevity. No definitive mechanical superiority can be established. While DVs are more susceptible to chipping due to application technique, they remain resilient within standard functional masticatory loads. IVs provide a higher safety margin against fracture. Ultimately, patient occlusion and case selection influence longevity over material choice. Further investigations are required to find the most longaeval veneer material and fabrication method.

KEYWORDS

Lithium disilicate, composite resin, nano-hybrid composite, hybrid composite, direct veneers, indirect veneers, porcelain veneers, anterior veneers, longevity, durability, fracture resistance, colour stability, fracture strength, chipping, fracture

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LDS: Lithium Disilicate

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TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	Overview of dental veneers	1
1.2	An introduction to direct veneers	1
1.3	An introduction to indirect veneers	2
1.4	Longevity in the context of veneers	4
1.4.1	Colour stability	4
1.4.2	Fracture	5
2	JUSTIFICATION, HYPOTHESIS AND OBJETIVE	6
2.1	Justification	6
2.2	Hypothesis	6
2.3	Objective	7
3	MATERIAL AND METHODS	7
3.1	PICO question	7
3.2	Inclusion and exclusion criteria	7
4	RESULTS	8
4.1	Study selection and literature search strategy	8
4.2	Results of individual studies	9
4.2.1	DVs versus IVs and aesthetic longevity: Colour stability	10
4.2.2	DVs versus IVs and mechanical longevity: Fracture resistance	12
5	DISCUSSION	15
5.1	DVs versus IVs regarding aesthetic longevity: Colour stability	15
5.2	DVs versus IVs regarding mechanical longevity: Fracture resistance	17
6	LIMITATIONS	19
7	CONCLUSION	20
7.1	Conclusion to the PICO outcome 1: In patients receiving veneers, do DVs versus IVs provide greater colour stability?	20
7.2	Conclusion to the PICO outcome 2: In patients receiving veneers, do DVs versus IVs provide greater fracture resistance?	20
8	SUSTAINABILITY	20
9	REFERENCES	21
10	ANNEXES	25
10.1	Annex 1: USPSH criterion	25
10.2	Annex 2: Colour stability CIE formula	26

1 INTRODUCTION

Dentists more recently than ever face the growing challenge of competing with social medias portrayal of the “perfect smile”, when creating a patients treatment plan. A clear relationship is known between ideal facial images and smile dissatisfaction (1,2). The demand for aesthetics has indeed increased in society, driving the request of dental veneers by most patients within their first visit. Veneers are considered as partial restorative materials covering the outermost surface of mainly anterior teeth (3–5). Veneers are classified based on fabrication methods; direct or indirect, as well as based on materials utilised (6). The classifications being interconnected. Both fabricated veneers have statistically appropriate survival rates but are not exempt from mechanical or aesthetic complications (7). Amongst many, these include fracture or chipping and veneer discoloration, respectively.

Much of the existing literature on veneer longevity is largely outdated and there remains limited contemporary research evaluating the performance of direct versus indirect veneers. Considering the aforementioned, this review aims to provide an updated assessment of the longevity of dental veneers in terms of aesthetics and mechanical considerations according to manufacturing technique. Overall, targeting the awareness of dentists desiring clinical excellence and optimal outcomes for their patients (8,9).

1.1 Overview of dental veneers

The concept of dental veneers came about through Dr Charles Pincus in 1928 (4). This led to advances in the world of cosmetic dentistry as veneers are partial restorative materials placed on the buccal side of anterior teeth for aesthetic purposes (3–5). Veneers have the capacity of solutioning teeth with morphological issues, discolorations, diastemas and worn anterior teeth (4,5,10,11). As mentioned above, veneers can be classified by manufacturing technique and by material (6). Material selection depends on various factors comprising social economic status, patient baseline and treatment duration (10).

1.2 An introduction to direct veneers

Direct veneers (DVs) can be made from composite resin and can be placed in one single session, optimising time and costs (12). Following a minimal tooth preparation, various techniques can be applied including a freehanded application of thin layers of hybrid composite and curing each layer. While it allows the incorporation of different shades and opacities, as the

veneer will be stratified, it is more prone to undergo mechanical failure. It is also a process requiring considerable skill and artistic expertise from the clinician, often resulting in unpredictable outcomes (13,14). Alternatively, with the aid of a prefabricated tooth mould, hybrid composite application can more simply reproduce tooth structure. In the late 1990's a more flowable injectable composite was introduced. Characterised by a lower filler content 37-53% when compared to hybrid composite containing 50-70%, this composite facilitated handling, contributed to greater mechanical properties and polishing capacities (15). Lower and smaller filler content allows for less infiltration of stains overtime (16). The use of a mould permits a more consistent outcome, however prospective studies comparing injectable versus free hand application are limited with some apparently reporting no statistical or clinical discrepancies (15,17,18). Though mechanical longevity is increased with this technique, aesthetics is compromised; only one shade of composite is applied, therefore in complex cases of teeth discoloration this technique may not achieve acceptable aesthetic outcomes (18). To overcome these limitations, an innovative "cut back" technique was introduced and explored by few clinicians (18,19). This recent advancement involves an initial application of composite layering, followed by an injectable composite layer and a minimal cut back of it, to achieve the aesthetic anatomy of the tooth. Due to its novelty, it indicates the need for research of long-term clinical follow-up data, as this technique could address the shortcomings of layering and injectable composite veneers (18,19).

1.3 An introduction to indirect veneers

Indirect veneer (IV) fabrication following a tooth preparation of 0.5mm-1mm, requires a two-step process involving the laboratory, making it inherently more time-consuming compared to DV manufacturing (12,20,21). However, with the progression of computer aided design and computer aided manufacturing (CAD-CAM), a chairside working approach has evolved. In office design programmes such as CEREC and Plan CAD Easy, allow clinicians to design and fabricate the veneer in a single visit, eliminating the laboratory (22,23). Therefore, although fabricated indirectly, chairside veneers share the same time efficiency as DV fabrication. Nevertheless, adoption of chairside systems remains limited due to their high cost and the need for digital training to ensure competency with the CAD-CAM system. While this approach reduces treatment time, the practical limitations must be considered when evaluating its feasibility in regular clinics. Additionally, long-term clinical performances of chairside CAD-CAM materials is limited and should be investigated further (23). Notable IV and CAD-CAM materials practitioners

can select from include Lithium disilicate (LDS) ceramics (IPS-Emax-CAD), feldspathic porcelain as well as resin composites.

LDS is a glass ceramic, first introduced in 1988 as IPS-Empress-2 and has now evolved into IPS-Emax-CAD and IPS-Emax-Press (4,11,24). The composition of LDS veneers includes; a glass matrix filled with lithium silicate along with the incorporation of LDS crystals (25). The strength of this type of restoration is provided by its high crystalline composition offering great restorative mechanical properties. LDS veneers can either be formed by a process called “pressing” or via CAD-CAM techniques (26).

- LDS IPS-Emax-Press: This technique employs a conventional workflow. This entails; hot pressing an ingot of LDS onto the working cast of the patients arch (27). In turn, enabling the fabrication of restorations through a thermal process.
- LDS IPS-Emax-CAD: Representing the latest advancement in LDS, this method incorporates a digital workflow via CAD-CAM technology. The controlled process involves the milling of a prefabricated LDS block, which in essence is cutting it into the shape of the restoration required (27).

Both pressing and milling techniques for LDS veneers are frequently used. Certainly, articles assessing IVs should distinguish the fabrication mode. Research has identified that milled LDS has a higher flexural strength when compared to pressed, which may influence the mechanical longevity of the restoration (26,28).

Much like DVs, IVs can be applied using a “cut back technique”. To achieve superior optical biomimicry, an LDS core can be made and then hand layers of IPS-Emax-Ceram can be layered on top. Briefly, it can be considered as a technique achieving high aesthetic results but increasing the risk of fracture and chipping (12,28).

Similar to LDS, feldspathic porcelain is a glass matrix ceramic (27). It’s a porcelain that exhibits a flexural strength of 60-70MPa whilst LDS has a markedly higher value of 320-450MPa. Flexural strength is a critical parameter, as it indicates the susceptibility to fracture. LDS behaves superiorly under mechanical strain, suggesting that the duration of these veneers may possess greater longevity compared to those made from feldspathic (29). Further, in a metanalysis, after 10.4 years, LDS veneers reported lower fracture and discoloration when compared to feldspathic

veneers; 6.1% compared to 41.48% and 1.9%, compared to 19.64% respectively (30). Hence, in this systematic review the focus will remain with articles discussing LDS veneer longevity.

Contrasting with DVs, indirect resin composite veneers are made using CAD-CAM systems, allowing for easier manipulation of the resin outside of the mouth (31). While they are considered a comparable alternative to ceramics, they also have a similar therapeutic outcome as to DVs (10). For this reason, the focus of this review will remain on indirect ceramics but nonetheless wanted to comment its existence.

1.4 Longevity in the context of veneers

The assessment of the longevity of veneers in studies is often determined by the Outline of The United States Public Health Service (USPSH) criteria. A category such as fracture is selected and the veneer at the time of assessment is then given a score based on the criteria that it matches. Contextually, the higher the score the less longevity the restoration has in terms of that specific category (refer to **Annex 1, Table 5**). Further assessment of colour may be evaluated by applying the Commission Internationale De L'éclairage (CIE) colour system. This essentially compares how the restoration can change colour (ΔE) or may degrade overtime (refer to **Annex 2, Equation 1**). ΔE values between 1-3.3 are considered acceptable value changes while >3.3 values indicate a significant difference between original colour and final changes concluding an unacceptable clinical result (32).

This review will refer to the categories of colour discoloration and fracture resistance, due to research reporting majority of failures in longevity in this regard (6,7,31,33). Additionally, it considered pertinent to include both aesthetic stability and mechanical integrity rather than observing a single failure modality as otherwise it would fail to apprehend the multifactorial concept of veneer longevity.

1.4.1 Colour stability

Colour changes in dental veneers can be due intrinsic or extrinsic staining. Intrinsic staining refers to colour changes within the restorative material that may be attributed to changes over time in structural composition (6). The intrinsic colour stability of restorative materials can be assessed under controlled conditions such as *in vitro* studies, providing a baseline for predicting initial aesthetic outcomes. However, the appearance of veneers is also subject to external factors (extrinsic staining), such as the intake of specific dietary products and

habits. Consumption of coffee, Coca-Cola, wine and habits such as smoking or daily chlorhexidine mouth washes, are known to facilitate staining of dental materials (6,16). Therefore, while the material itself may uphold its colour, these environmental and behavioural factors can compromise the overall longevity of the restoration's appearance. Patients should therefore be informed of both the inherent strengths of the material and the potential impact of external factors in the long-term.

Studies have shown that the composite used in DVs can undergo structural changes in their amine components due to oxidation, resulting in intrinsic colour alterations. Moreover, the presence of an organic resin matrix renders these materials particularly susceptible to extrinsic factors (16). These changes in colour can compromise the long-term aesthetic appearance of DVs. However, regular polishing techniques can be carried out to try and improve the colour of the veneer, but does require regular appointments that might drive patient dissatisfaction and, in some cases, a move to porcelain-based IVs (13). Porcelain veneers have in fact shown more colour stability over time when compared to DVs (9,12,13,34,35). This is not to say that porcelain is not exempt from colour changes over time. Apparently there is a correlation between underlining cement used to place the porcelain veneers and a change in colour of the veneer with time (36,37). Also noteworthy, is the vitality of a tooth, which can influence the clinical outcome of the veneers; a non-vital tooth has supposedly less adhesive capacity, less structural stability and less colour stability (33).

1.4.2 Fracture

Mechanical failure such as fracture of veneers is a scenario patients must be made aware of (35,36,38). Depending on the baseline issue and motivation of veneer placement, different materials should be selected for the veneer to be long lasting. For instance, initial cases of large diastema closure, peg laterals, bruxism patients, require materials with a high flexural strength to be placed. In these instances, placement of composite with low flexural strength, may lead to anticipated fracture of the veneer (36). Additionally, the consumption of cold or warm foods and drinks contribute to varying temperature within the oral cavity. These temperature changes may lead to thermally induced material changes or cementation issues, resulting in fractures (31,39). Importantly, in the eventuality of fractures of DVs, patients can request a repair within the clinic the same day. Contrarily, IVs require the laboratory to be repaired, clearly highlighting a disadvantage of IVs (14).

Overall, the performance of veneers is due to numerous contributing factors including preparation and design as well as magnitude of occlusal loads. A lack of occlusal assessment may be a highly important factor when considering fracture resistance. The mouth is subject to differing occlusal loads; maxillary canines are required for correct anterior guidance necessary for mouth opening and lateral movements. Without the removal of excessive loads and correct material selection, the longevity of the veneer is shortened (7,39). Clinicians need to understand the location and material selection most appropriate for the placement of veneers.

Considering the aforesaid, DVs and IVs apport different beneficial properties. Longevity of a veneer according to material and technique selected, is a complex assessment to carry out.

2 JUSTIFICATION, HYPOTHESIS AND OBJETIVE

2.1 Justification

With the recent rise in dubious veneer treatment plans coupled with the growing demand for high aesthetics and long restorative duration, concerns about the marketing surrounding veneer placements have been raised (33). These concerns extend to patients as well as clinicians, who may not fully understand the capabilities and limitations of dental veneers. While it is true that veneers are often promoted as requiring minimal tooth preparation, they do in fact involve irreversible alteration of tooth structure. Even minor removal of enamel has long-term consequences, especially when veneer replacement becomes necessary as materials reach the end of their lifespan. Each subsequent replacement of a veneer typically requires additional tooth preparation, and the cumulative removal of tooth structure over time may render the treatment more invasive than beneficial (9,27,33,40). This is why research surrounding the ideal veneer material with the greatest longevity is motivating. Unfortunately, there is a lack of consensus in the dental world as to which fabrication is favoured; DVs or IVs as well as a standard protocol assessing the multifactorial determinants of colour stability and susceptibility to fracture (7,9,39). This review aims to critically evaluate available studies and provide updated research on the longevity of DVs versus IVs as well as indicating any future research recommendations.

2.2 Hypothesis

The hypothesis of this review is that IVs have a longer longevity in terms of colour and fracture resistance when compared to DVs.

2.3 Objective

To compare the clinical longevity of DVs (Composite) and IVs (LDS) veneers by evaluating differences in fracture resistance and colour stability.

3 MATERIAL AND METHODS

3.1 PICO question

In patients receiving veneers, do DVs versus IVs provide greater fracture resistance and colour stability?

The question was formulated based on the subsequent organization:

- **P (population):** Adult patients receiving veneers
- **I (intervention):** Longevity of IVs made from LDS
- **C (comparison):** Longevity of DVs made from composite resin
- **O (outcome):**
 - O1: Colour stability performance
 - O2: Fracture resistance performance

3.2 Inclusion and exclusion criteria

This review considered the following inclusion and exclusion criteria in its research (refer to Table 1).

Inclusion Criteria	Exclusion Criteria
- Human studies - <i>Ex vivo</i> studies	- <i>In vitro</i> studies - Animal studies
- Randomised and non-randomised control trials - Cohort studies - Prospective or retrospective studies	- Systematic reviews - Meta-analysis - Case reports
- Studies including adult patients (above 18) receiving direct veneers made from composite and indirect veneers made from feldspathic or LDS porcelain	- Studies that provide insufficient information on longevity of veneers regarding colour or fracture resistance - Studies that don't compare both types of veneers
- Studies that provide information regarding this review's objectives	- Studies including patients under 18
- Peer reviewed articles	- Studies published before 2016
- Maxillary veneers	- Studies in other languages other than the English language

Table 1: Inclusion and exclusion criteria selected for this review

4 RESULTS

4.1 Study selection and literature search strategy

To obtain a reproducible and effective search, complete Medline search engine was used. Based on the PICO question of this review, specific Boolean operator combinations and filters were chosen and can be referred to in **Table 2**.

	PICO	Input Function	Filters Added
Search Strategy	Population: Adult patients receiving veneers	(Dental Veneers OR veneer OR dental veneer OR Esthetics, Dental)	Studies 2016-2026 English Peer reviewed
	Intervention: Indirect veneers (LDS)	AND (Indirect veneer OR ceramic veneer OR porcelain veneer OR Lithium Disilicate OR lithium disilicate OR LDS OR Emax)	AND NOT (Crown OR posterior veneer OR Occlusal veneer OR systemic review OR metanalysis)
	Comparison: Direct composite veneers	AND (Direct veneer OR direct composite veneer OR composite veneer OR resin veneer OR composite resin veneer OR Composite Resins)	
	Outcome: Colour stability, fracture resistance	AND (Color stability OR color stability OR discoloration OR color changes OR shade stability OR fracture OR fractures OR chipping OR crack OR fracture resistance OR mechanical performance OR failure)	

Table 2: Boolean operators and filters used according to the PICO question

Following the Boolean operators and filter application on the 23/02/2026 the following Prisma Flow chart was the outcome see **Figure 1**:

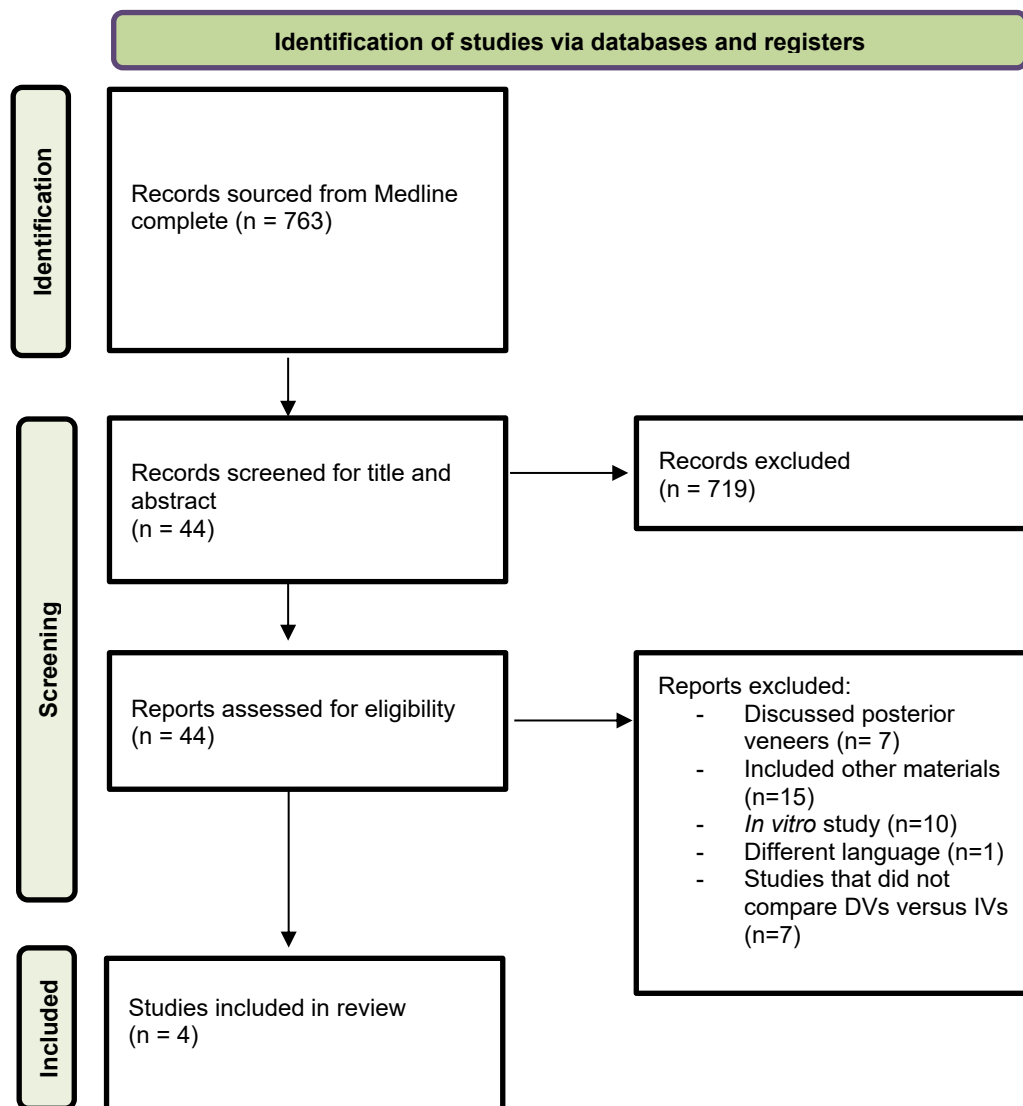


Figure 1: Modified Prisma 2020 flow diagram for new systematic reviews outlining the study identification process and results from the literature search through Medline complete database (38)

4.2 Results of individual studies

Following the search within Medline, the articles sampled were summarised according to PICO outcome (colour stability or fracture resistance) see **Table 3** and **Table 4**.

4.2.1 DVs versus IVs and aesthetic longevity: Colour stability

Author/Year	Elkaffas <i>et al</i> (2024) (34)
Study Design	Randomised clinical trial
Sample	N= 28 patients total 120 veneers 19 females, 9 males Mean average age of 26 years - Group 1: DV (nano-filled composite), n= 14 patients, total 60 veneers - Group 2: IV LDS IPS-Emax-Press, n= 14 patients, total 60 veneers
Follow-up Time	2 years with every 6 months evaluation
Longevity factor assessed	Colour stability according to the USPSH criteria
Outcomes	Minor discoloration USPHS score of 2 in both DV and IV (not statistically significant) No significant difference in survival rate $p > 0.05$. IVs survival rate of 95% and DVs of 93% More surface control was needed in DVs
Author/Year	Patel <i>et al</i> (2025) (10)
Study Design	Prospective controlled non-randomised cohort study
Sample	N= 90 patients 90 veneers Each patient received 1 veneer - Group 1: DVs (nano-hybrid composite), total 30 veneers - Group 2: IVs LDS IPS-Emax-CAD, total 30 veneers **Group 3: IVs, total 30 veneers made from composite, excluded from this review
Follow-up Time	3 months, 6 months and 1 year evaluation
Longevity factor assessed	Colour stability according to the USPSH criteria
Outcomes	Marginal discoloration: - After 12months DV: 13 cases of USPSH criteria score 1, 10 reports of score 2 and 5 reports of score 3. - After 12 months IV: no discoloration reported. ($p < 0.001$)
Author/Year	Mazzetti <i>et al</i> (2022) (2)
Study Design	Longitudinal, retrospective clinical study
Sample	N= 341 patients 1459 veneers assessed Mean patient age: 47.8 Mean veneers per patient 4.3 - Group 1: DVs (micro-hybrid composite)

	○ n= patients not specified ○ Total 1043 veneers (71.5%) ○ 799 females and 244 males ○ n Central incisor = 417 ○ n Lateral incisor = 372 ○ n Canine = 252 - Group 2: IV LDS IPS-Emax-Press ○ n= patients not specified ○ Total 416 veneers (28.5%) ○ 274 females and 142 males ○ n Central incisor = 175 ○ n Lateral incisor = 130 ○ n Canine = 111
Follow-up Time	10 years follow up (2008-2014) with every 6 months evaluation
Longevity factor assessed	Colour stability
Outcomes	N= 957 veneers were successful (65.6%) N=250 veneers required replacement (17.1%) Success annual failure rate: - DV: every 1 year about 10% of veneers need some repair. - IV: every year only 2.8% of veneers need repair Survival annual failure rate: - DV: every year 4.1% of DV need to be completely replaced - IV: every year 1.2% of IV need to be completely replaced In 10 years DV frequently required colour or fracture repair only 35% remained in original state: 65% required maintenance. In 10 years IV rarely needed colour or fracture repair, 75% remained in original state. Colour stability: significant concerns regarding DV that tend to lose colour over time. IV are more colour stable. IV have superior longevity compared to DV. DV have four to five times higher risk of failure Males had significantly higher survival failure (requiring replacement) compared to females. Key limitation: a significant difference between veneer material is noted, there is a lack for failure reason.

Table 3: Including a summary of articles sampled from the Medline complete search that discuss DVs versus IV regarding aesthetic stability specifically colour stability

4.2.2 DVs versus IVs and mechanical longevity: Fracture resistance

Author/Year	Elkaffas <i>et al</i> (2024) (34)
Study Design	Randomised clinical trial
Sample	N= 28 patients total 120 veneers 19 females, 9 males Mean average age of 26 years - Group 1: DV (nano-filled composite), n= 14 patients, total 60 veneers - Group 2: IV LDS IPS-Emax-Press, n= 14 patients, total 60 veneers
Follow-up Time	2 years with every 6 months evaluation
Longevity factor assessed	Fracture according to the USPSH criteria
Outcomes	DV: - n= 4 chipping and cracks IV LDS veneers: - n= 3 complete failures - n= 2 fracture - n= 1 debonding Survival rates did not differ significantly $p > 0.05$. IVs survival rate of 95% and DVs of 93%
Author/Year	Patel <i>et al</i> (2025) (10)
Study Design	Prospective controlled non-randomised cohort study
Sample	N= 90 patients 90 veneers Each patient received 1 veneer - Group 1: DVs (nano-hybrid composite), total 30 veneers - Group 2: IV LDS IPS-Emax-CAD, total 30 veneers **Group 3: IVs, total 30 veneers made from composite, excluded from this review
Follow-up Time	3 months, 6 months and 1 year evaluation
Longevity factor assessed	Fracture according to the USPSH criteria
Outcomes	At 3 and 6 months: no significant difference At 12 months: Statistically significant difference where DV had 11 events of fracture and IV had 1 event. ($P = 0.02$)
Author/Year	Gresnigt <i>et al</i> (2021) (12)
Study Design	<i>Ex vivo</i> study
Sample	40 extracted maxillary central incisors - Group 1: control group, no veneers (n=10) - Group 2: IPS Emax Ceram veneers (n = 10)

	**Group 3: Partial veneers (n=10), excluded from this review - Group 4: DVs (nano-hybrid composite), (n=10) Subjected to thermocycling: 20,000 cycles consisting each of moving the samples between two water baths: one at 5°C and one at 55°C Fracture strength assessed through applied load with a universal testing machine (Zwick/Roel Z020 Germany) from the incisal direction. Applied to each group after thermocycling.
Follow-up Time	No follow up period Aging was determined through thermocycling
Longevity factor assessed	Fracture strength
Outcomes	After thermocycling: - 1 IV was eliminated resulting in (n=9) prior to fracture test - 3 DV had cracks but still underwent fracture assessment. - Control group was intact Fracture resistance between veneers did not statistically differ ($p>0.05$): - DV: 385 ± 225 N (greatest mean fracture load), main failure due to chipping, debonding - IV LDS IPS-Emax: 264 ± 66 N, main failure due to root fracture - Control: 271 ± 100 N Conclusion: normal intraoral force 150N therefore both veneers had good fracture resistance.
Author/Year	Mazzetti <i>et al</i> (2022) (2)
Study Design	Longitudinal, retrospective clinical study
Sample	N= 341 patients 1459 veneers assessed Mean patient age: 47.8 Mean veneers per patient 4.3 - Group 1: DVs (micro-hybrid composite) - o n= patients not specified - o Total 1043 veneers (71.5%) - o 799 females and 244 males - o n Central incisor = 417 - o n Lateral incisor = 372 - o n Canine = 252 - Group 2: IV LDS IPS-Emax-Press - o n= patients not specified - o Total 416 veneers (28.5%)

	○ 274 females and 142 males ○ n Central incisor = 175 ○ n Lateral incisor = 130 ○ n Canine = 111
Follow-up Time	10 years follow up (2008-2014) with every 6 months evaluation
Longevity factor assessed	Fracture
Outcomes	N= 957 veneers were successful (65.6%) N=250 veneers required replacement (17.1%) Success annual failure rate: - DV: every 1 year about 10% of veneers need some repair. - IV: every year only 2.8% of veneers need repair Survival annual failure rate: - DV: every year 4.1% of DV need to be completely replaces - IV: every year 1.2% of IV need to be completely replaced In 10 years DV frequently required fracture repair only 35% remained in original state: 65% required maintenance. In 10 years IV rarely needed fracture repair, 75% remained in original state. Higher risk of fracture DV. Lower risk of fracture in IV but if fractures replacement required. IV have superior longevity compared to DV. DV have four to five times higher risk of failure Males had significantly higher survival failure (requiring replacement) compared to females. Key limitation: a significant difference between veneer material is noted, but there is a lack for failure reason.

Table 4: Including a summary of articles sampled from the Medline complete search that discuss DVs versus IVs regarding mechanical longevity specifically fracture resistance

5 DISCUSSION

5.1 DVs versus IVs regarding aesthetic longevity: Colour stability

With colour and aesthetics playing an important role in restorative dentistry, and particularly patient satisfaction, veneers that remain colour stable the longest should be favored. As can be seen in **Table 3**, in the study conducted by Elkaffas *et al* (2024)(34), observing 60 nano-filled DVs and 60 LDS IPS-Emax-Press IVs, after 2 years there was statistical negligence ($p>0.05$) between veneer materials. While this score is considered minor, the study rather emphasized that IVs are also susceptible to colour changes as both veneers reported a USPSH score of 2. This counters the notion that IVs are more colour stable compared to DVs, identified in current literature (9,12,13,35). In a longer study, Panayong *et al* (2025)(41), reported similar findings whereby, out of 163 veneers, 112 had no colour change and 50 had slight colour change. The study was conducted over a period of 10.2 years and considered extrinsic staining, providing more population representative and realistic results. Out of the sample 14 patients drank regular coffee and tea. However, due to the organic matrix of DVs, the material is considered more susceptible to infiltration of extrinsic factors. In fact, a cohort study conducted by Patel *et al* (2025), demonstrated that after 12 months LDS IPS-Emax-CAD IVs, had no statistical USPSH discoloration ($p<0.001$) while DVs showed more colour instability where ten veneers reported USPSH score 2 and five cases of score 3 (10)(see **Table 3**). Importantly, differing results of IVs between Elkaffas *et al* (2024)(34) and Patel *et al* (2025)(10) may be due to differing LDS IVs placement; LDS IPS-Emax-Press and LDS IPS-Emax-CAD were placed respectively. A systematic review has shown that CAD/CAM LDS have better tooth marginal fits contributing to less likely marginal discoloration, therefore more colour stability compared to pressed LDS (28). Therefore, results should be interpreted with caution. While in these studies, IV material were different, DV material was consistent with the use of nano-hybrid composite. Both studies concluded that DVs are impacted by colour stability overtime. Importantly, in the study by Patel *et al* (2025)(10), patients received only one veneer while patients received roughly 4 veneers in the study by Elkaffas *et al* (2024)(33). Aesthetics wise, it is not recommended to place only one veneer, as colour change may be more noted when comparing adjacent unprepared teeth. This could explain why in less time, higher USPSH scores were reported in DVs in the study by Patel *et al* (2025)(10). Similarly, this might explain why there was no discoloration reported in the IVs (10). Although in the study, composite was applied with the multilayered stratification technique providing high aesthetics capabilities, it is an approach that relies heavily on the clinician. It requires considerable skill and artistic expertise from the dentist, often with unpredictable outcomes (13,14). Contrastingly, CAD-CAM veneers have a more controlled and

predictable production processes. Moreover, since patients only received one veneer, the clinical challenge was magnified: any practical inconsistency in the multilayering of the composite, was enhanced by the “naturalness” of the adjacent teeth. Equally, patients receiving IVs benefited from the standardized CAD-CAM process, making them less likely to exhibit the perceived colour instability that was more prevailing in the DVs.

While it is true that in recent years new techniques as well as well as new composites have been developed, it seems that DVs can still be susceptible to colour changes. The question lies in whether the change is acceptable to continue their placement compared to perhaps moving directly to IVs. In a split mouth trial of 44 veneers with two different DV composites, indicated that colour stability was impacted after 18 months (32). Interestingly, even if a multi-shade composite was applied with assumed higher aesthetics capabilities, changes towards a yellow, red brown tone according to the CIE criterion were reported regardless (see **Annex 2, Equation 1**). While colour changes were noted, the changes were seemingly within the acceptable threshold criteria of aesthetics of 1-3.3 ΔE . This highlights that while colour stability may be a limitation for DV longevity, it underlines that they are still considered to maintain enough stability overtime. In the study conducted by Mazetti *et al* (2022)(2), a total of 1043 micro-hybrid DVs confirmed the need for maintenance of 65% of the veneers within 10 years boundary (see **Table 3**). In comparison to the 416 IVs made from LDS IPS-Emax-Press, which in 10 years, 75% of cases remained in their original status. While this study also assessed fracture and failed to specify the requirement of veneer failure, the higher need for maintenance of DV could be a result of the usage of micro-hybrid composite. This composite has bigger filler size compared to nano-hybrid composite utilized in previously mentioned studies. Research has evidenced that bigger filler size allows for greater infiltration of staining factors hence more polishing maintenance requirements (16).

Overall, the difficulty with interpreting results of this systematic review, lies in the involvement of an interplay of factors contributing to changes in colour of a veneer; the lack of hygiene instructions or increased consumption of coffee and other products that are known to causes staining could have increased the propensity of the colour shift (6). In an *in vitro* study where, different veneers were immersed in coffee, Coca-Cola or tea for 10 minutes twice daily for 30 days, coffee was the solution that most affected colour instability (6). After immersion of DV and LDS veneers in differing solutions, this study reported DVs to have higher discoloration 9.53 ΔE compared to 7.29 ΔE for LDS (6). In this context, it is understandable as to why the research behind the most aesthetically stable veneer material is confounding and difficult to interpret.

5.2 DVs versus IVs regarding mechanical longevity: Fracture resistance

Clinical evidence reports that mechanical failure of veneers is a frequent reason for patient complaint, emphasizing the need for careful pre-operative case selection and proactive patient education on the potential matter (28,35,36,38). Previous literature has found that DVs are more susceptible to fracture cases due to their application technique, however still report good outcomes, hence their continued use (10,13,14,34). Patel *et al* (2025)(10) confirms this statistical significant difference in his findings where in 12-months, nano-hybrid DVs had 11 events of fracture compared to 1 event for IV LDS-Emax-CAD. According to the USPSH criteria (see **Annex 1, Table 5**) DVs reported eight cases of score 2, one case of score 3 and two cases of score 4. Whereas IVs reported once case of score 2. Contrastingly, Elkaffas *et al* (2024)(34) in 2-years, found that survival rates between nano-hybrid DV and IV LDS IPS-Emax-Press did not differ ($p>0.05$). Interestingly, it reported four chipping cases in DVs and two fracture and three complete failure cases in IVs. The differences between the two studies could be due to IV LDS-Emax-CAD having more controlled production process therefore a more innate fabrication strength when compared to pressed LDS which instead shows more susceptibility to fracture (28). Regardless LDS-Emax-Press has a reporting of a >99.7% cumulative survival rate in 10-years in 254 veneers (42) and 89.3% in 233 veneers in 10.2-years (41). Emphasising a high success rate despite the use of pressing technique. In the study conducted by Mazetti *et al* (2022)(2)(see **Table 4**), between DVs (micro-hybrid composite) and IVs (LDS IPS-Emax-Press), DVs reported higher risk of fracture. This study holds heavy weight in this systematic review as it is the longest retrospective study comparing IVs and DVs, following a period of 10-years. However, as previously mentioned, (**section 5.1**), a conservative analysis is advised when interpreting this article's conclusion of DVs having a fivefold risk of failure when compared to IVs. This is because both colour and fracture analysis are carried out in the study and an absence of veneer failure reason is present. Although the study nonetheless indicates that DVs undergo shorter mechanical longevity. Supporting this notion is a *ex vivo* study assessing only DVs, where fracture strength of DVs without artificial aging resulted in minor chippings ($n=10$ veneers) whilst post artificial aging, fracture strength was reduced, resulting in veneer fracture: a shift towards greater failure. Although conducted in extracted maxillary teeth which may not accurately replicate the oral environment, the study regardless demonstrates that the total force withstood after artificial aging was 47N less when compared to DVs that did not undergo artificial aging. Highlighting that overtime fractures in DVs are a potential limiting factor in their longevity (31).

Importantly, when assessing fracture resistance, the force that each tooth typically receives should be considered as not every tooth has the same occlusal load. Therefore, a noteworthy question to be asked is whether depending on location, DVs or IVs are more mechanically longeval? A limitation of this systematic review is that while veneer location in most of the studies is reported, the location of following failure is not highlighted (see **Table 4**). This reinforces the need for greater investigations in this regard as future studies may indicate the most favorable and longeval material according to location. The *ex vivo* study conducted by Gresnigt *et al* (2021)(12) attempts to discuss the question by assessing only maxillary central incisors, examining fracture resistance between nano-hybrid DVs and LDS IPS-Emax-Ceram post thermocycling aging and applied load with a universal testing machine. While Emax-Ceram is a layered IV technique being more susceptible to fracture, it showed comparable fracture resistance to DVs, concluding no significant difference between the veneers ($p>0.05$). Interestingly, it reported DVs to have a fracture strength of 385N compared to IVs at 264N (see **Table 4**). However, the main failure mode of DVs was chipping whilst more severe complications of root fracture were reported in IVs. While results should be interpreted with caution due to the artificiality of the study, it can illustrate that IVs in central incisors are less susceptible to “simple” mechanical failures. Fundamentally, both veneers can withstand appropriate fracture force given that intraoral forces are typically 150N. Supporting that maxillary incisors are less likely to be affected by mechanical failure, is the study conducted by Sen *et al* (2024)(7) which observed IVs made from LDS CAD-CAM as well as feldspathic veneers over a 10-year period. With 36 veneers allocated in central incisors, 29 lateral incisors and 31 canines, higher fracture reporting’s were noticed in canines. It is well known that maxillary canines are required for correct anterior guidance necessary for mouth opening and lateral movements. Without a clear occlusal assessment and removal of excessive forces, the veneer is more likely to undergo mechanical failure (36).

Moreover, with respects to parafunctional habits such as bruxism, Elkaffas *et al* (2024)(34) and Patel *et al* (2025)(10) excluded these patients whilst Mazetti *et al* (2022)(2) merely checked if the patient had “stable occlusion”. The difficulty in assessing longevity in veneers is the multifactorial mode of failure; the material might be able to withstand normal oral forces but to what extent should they be capable of withstanding abnormal forces? In a large systematic review, it was found that there was double the risk of veneer fracture in patients with bruxism compared to those without this habit. Additionally, many patients with bruxism are prescribed with a splint, indeed individuals not wearing a splint run a seven time higher risk of veneer fracture (30). Then in these instances, placement of composite with low flexural strength, may

lead to anticipated fracture of the veneer (36). In this context, it is imperative that clinicians understand their patients' habits prior to placing veneers as well as prescribing a splint if one is required. This is in the interest of the patient as well because while veneers are promoted as minimally invasive, they involve irreversible tooth alteration. If careful case assessment is not carried out at each subsequent veneer replacement, additional tooth structure is removed, resulting in worse mechanical stability and overall limiting long-term success of a subsequent restoration placement (9,27,33,40).

6 LIMITATIONS

The research for this review principally found meta-analysis and systemic reviews which forced a greater expansion of study selection including *ex vivo* studies and case control studies, which are considered lower in the pyramid of research. This is not only a limitation to this review but also a stress for a need of more retrospective and prospective studies comparing differing materials. Overall, only four studies out of 763 articles answered directly the PICO question of this review. Longevity implies a parameter that requires an assessment considering a certain amount of time, most articles in this systematic review observed a short span of time. This is a limitation within this review but also within literature. Many articles fail to have retrospective analysis of cases beyond 10 years as patient compliance is difficult and often impossible to obtain. Other systematic reviews, much like this one, attempt to form conclusions as to what material is best however no decisive data has been determined. This is partially due to the difficulty of failure mode of veneers as they have a multifactorial failure nature, making it hard to pinpoint the main causal factor. Furthermore, there's the difficulty of cross-analysis between articles due to a lack of standard protocol and inherent clinician dependency associated to applying veneers, particularly DVs (7,9,39). These differences are crucial when assessing longevity of a material. Another clear limitation is the narrowed selection of veneer material focusing on only two materials; new materials are currently explored such as zirconia, leucite reinforced porcelain and "cut back" technique of DV. These novelty materials should be studied further. While not explored in this systematic review, the vitality of the tooth should be considered in any forthcoming investigation to establish a holistic conclusion as to whether it affects the structural and colour stability of any restoration covering it (33).

7 CONCLUSION

7.1 Conclusion to the PICO outcome 1: In patients receiving veneers, do DVs versus IVs provide greater colour stability?

Clinically from the four articles found in this systematic review, it can be accepted that statistically speaking both DVs and IVs have acceptable colour outcomes overtime and overall report significant aesthetic improvement. Both veneers have the capacity of being influenced by colour instability. However, it is also true that patients have reported greater investment in time, higher costs but reduced maintenance and higher aesthetics with IVs (14). For this reason, the hypothesis that IVs have greater colour stability compared to DVs can be accepted with caution. Perhaps what should be considered more is the initial case selection. For instance, to prolong aesthetic longevity of DVs some instructions should be mentioned mandatorily, including the regular visit for polishing and appropriate hygiene technique recommendations (13). Cases with only one veneer placement should be emphasized with clear limitations of higher chances of magnified colour discrepancies.

7.2 Conclusion to the PICO outcome 2: In patients receiving veneers, do DVs versus IVs provide greater fracture resistance?

From this systematic analysis, a clear conclusion as to which material is more mechanically stable cannot be made. Both materials provide acceptable outcomes. One could tentatively accept that DVs are more susceptible to chipping due to application technique and that IVs provide a higher safety margin against fracture (10). Despite this, DVs still exhibit resilience within standard functional masticatory loads of 150N (12,34). Location of veneer placement and patient occlusion may be the more concerning factors influencing veneer longevity rather than the material choice (7,30,36). This should be investigated further in future studies in the attempts to find the most longeval veneer material.

8 SUSTAINABILITY

Balancing clinical outcomes with the United Nations Sustainable Development Goals (SDGs) is at the core of sustainable dentistry. SDG 3 (good health and well-being) along with SDG 12 (responsible consumption and production) are essential (43). From an economical and environmental perspective (SDG 12), DV application are highly efficient as they require fewer resources and avoid the laboratory step in essence reducing waste and energy consumption (12,20,21). The introduction of CAD-CAM chairside systems have attempted to shorten the

duration of IV fabrication, however are not feasible in the grand scheme of things as they consume large amounts of energy and are costly (22,23).

In a social context of sustainability (SDG 3) the priority lies in long-term well-being and resource conservation (43). Despite a costly initial production, IVs necessitate less maintenance requiring patients to return less to the clinic and reducing materials used over the veneer's lifespan (14). Importantly, DVs are better for the environment because they can be repaired. If a DV fractures, it can be repaired in the clinic. Whereas if IV undergo fracture they must be completely replaced or sent to the laboratory (14).

The aforementioned should be considered to support environmental and social sustainability through clear application of minimal intervention dentistry by the clinician. Incorporating a case base treatment plan when selecting veneer material focusing on assessing cost as well as ensuring that patients fully understand the difference repairability and replacement of future veneers (9,27,33,40). Matching veneer material to the patient, can help reduce the environmental tax of repeated restorative cycles while maintaining high standards of oral health.

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10 ANNEXES

10.1 Annex 1: USPSH criterion

Reference	Category	Score	Criteria
(7,10,11,34,41,42)	Marginal discoloration	0	No discoloration is evident
		1	Slight staining can be polished away
		2	Obvious staining, cannot be polished away
		3	Gross staining
	Surface roughness	0	Smooth surface
		1	Slight rough or pitted
		2	Rough, cannot be refinished
		3	Surface deeply pitted, irregular grooves
	Fracture of restoration	0	No fracture
		1	Minor crack lines over restoration
		2	Minor chippings of restoration (1/4 of restoration)
		3	Moderate chippings of restoration (1/2 of restoration)
		4	Severe chippings (3/4 restoration)
		5	Debonding of restoration
	Fracture of tooth	0	No fracture of tooth
		1	Minor crack lines in tooth
		2	Minor chipping of tooth (1/4 crown)
		3	Moderate chipping of tooth (1/2 crown)
		4	Crown fracture near cementum enamel line
		5	Crown-root fracture (extraction)
	Wear of restoration	0	No wear
		1	Wear
		0	No wear

	Wear of antagonist	1	Wear of antagonist
	Caries	0	No evidence of caries continuous along the margin of the restoration
		1	Caries evident continuous with the margin of the restoration
	Post-operative sensitivity	0	No symptoms
		1	Slight sensitivity
		2	Moderate sensitivity
		3	Severe pain

Table 5: Studies selected in research that refer to the Outline of the United States Public Health Service (USPSH) criteria

10.2 Annex 2: Colour stability CIE formula

$$\text{Change of colour} = \Delta E = [(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{\frac{1}{2}}$$

Equation 1: Colour stability CIE formula where: L* = brightness (0%-100%), a* = redness (positive direction) or greenness (negative direction) and b* = yellowness (positive direction) or blueness (negative direction). Referred to in section 5.1 with reference to Abd El Ghany *et al* (2025)(32).