文献紹介

カテゴリー：インプラント、エンド、ペリオ、移植・再植治療、補綴治療、その他（いずれか一つお選びください）

Key word：1（ジルコニア），2（ニケイ酸リチュウム），3（　） 三つお書きください。

タイトル：188695個のニケイ酸リチウムとジルコニアセラミックの最長7.5年間の臨床経過時の破損率：歯科技工所調べ

英文：Fracture rate of 188695 lithium disilicate and zirconia ceramic restorations after up to 7.5 years of clinical service: A dental laboratory survey

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目的：歯科技工所による調査では、最大7.5年間の臨床経過後における、レイヤードおよびモノリシックニケイ酸リチウムおよびジルコニア単冠および固定式補綴物（FPD）の破折率を評価した。

材料と方法：研究で使用したデータは、最長5年後に追加費用なしで保証サービス（修復物の作り直し）を提供する大手歯科技工所2社から収集した。データは2010年1月から2017年7月までの7.5年間収集された。不具合により破損した修復物のみを対象とし、適合不良、シェードマッチ、マージナルフィットが原因で破損した修復物は除外した。これらの技工所のデータベースシステムにより、再製するために技工所に戻された破損（破折）修復物の数と種類を特定することができた。対象とした修復物は、天然歯にセメントで固定されたもので、インプラント上部構造は除外した。ニケイ酸リチウム修復物のブランドはIPS e.max（Ivoclar Vivadent AG）であり、ジルコニア修復物のブランドはBruxzir（Glidewell Laboratories）、Katana HT（クラレノリタケ）、Zirlux（Henry Schein, Inc）、Zenostar（Ivoclar Vivadent AG）であった。データはニケイ酸リチウムとジルコニアに分類された。
修復物に分類した。ニケイ酸リチウム修復物は、モノリシック修復物とレイヤー修復物に分類され、修復物には、単冠、固定式補綴物（FPD）、ベニア、オンレーが含まれた。ジルコニア修復物もまた、モノリシック修復物とレイヤー修復物に分類され、修復物には単冠とFPDが含まれ、さらに前方と後方に分類された。修復物の部位（前歯部と臼歯部）、修復物の種類（クラウンとFDP）、製作方法（モノリシックとレイヤー）による修復物の破折率を比較し、カイ二乗検定（a=.05）を用いて分析した。

結果：合計188 695のニケイ酸リチウムおよびジルコニア修復物が分析され、7.5年間の全破損率は1.35%であった。このうち、51 751個がニケイ酸リチウム修復物であり、36 198個がモノリシック修復物（クラウン、FPD、ベニア、オン レー）、15 553個がレイヤー修復物（クラウン、FPD、ベニア）であった （表1）。モノリシッククラウンの破折率は0.96%で、レイヤードクラウンの破折率（1.26%）より有意に低かった（P<.05）。破折率に関しては、モノリシッククラウン（3.66%）とレイヤードクラウン（2.82%）の間に有意差は認められなかった（P=.151）。モノリシックベニア(1.15%)とレイヤーベニア(1.21%)においても同様に破折率に差は認められなかった(P=.866)。モノリシックオンレイの破折率は0.99%であった。異なるタイプの修復物（クラウン、FPD、ベニア、オンレー）を比較したところ、モノリシックFPDおよびレイヤーFPDの破折率は、他のものよりも有意に高かった（P<.001）。

本研究では、モノリシック・ジルコニアクラウンとレイヤード・ジルコニアクラウンおよびFPDの合計136944本を対象とした（表2）。モノリシックジルコニアクラウン（0.54%）はレイヤードクラウン（2.83%）よりも破折率が低かった（P<.05）。しかし、FPD（モノリシックまたはレイヤードクラウン）では差は認められなかった（P=.632）。さらに、モノリシッククラウン（0.54%）はモノリシックFPD（1.95%）よりも破折率が低かった（P<.001）；レイヤードクラウン（2.83%）はレイヤードFPD（1.93%）よりも破折率が高かった（P<.001）（表2）。

前歯部の層状修復物は、前歯部のモノリシック修復物（1.23%）よりも破折率が高く（2.09%）、後歯部の層状修復物の破折率は2.98%であったのに対し、モノリシック修復物は0.75%であった（P<.001）。前方修復物と後方修復物（モノリシック）を比較すると、後方修復物は前方修復物よりも破折率が有意に低かった（P<.001）が、層状ジルコニアでは、後方修復物は前方層状ジルコニア修復物よりも破折率が有意に高かった（P<.001）（表3）。

Table 1. Monolithic and layered lithium disilicate (e.max) single crown and fixed partial denture fracture rates up to 7.5 years (January 2010 to July 2017)

e.max Restorations	Monolithic	Units Fractured	% Fracture	Layered	Units Fractured	% Fracture
Crown	27 346	262	0.96^{a,A}	11 683	171	1.26^{b,A}
FPD	3337	122	3.66^{a,B}	1382	39	2.82^{a,B}
Veneer	2170	25	1.15^{a,A}	2488	30	1.21^{a,A}
Onlay	3345	33	0.99	—	—	—
Total units	36 198	442	1.22	15 553	240	1.54

FPD, fixed partial denture. Different lowercase letters indicate significant differences among groups in same row (*P*<.05). Different uppercase letters indicate significant differences among groups in same column (*P*<.05).

Table 2. Monolithic and layered zirconia single crown and fixed partial denture fracture rates up to 7.5 years (January 2010 to July 2017)

Zirconia	Monolithic	Units Fractured	% Fracture	Layered	Units Fractured	% Fracture
Crown	77 411	416	0.54^{a,A}	30 036	849	2.83^{b,A}
FPD	16 437	320	1.95^{a,B}	13 060	252	1.93^{a,B}
Total units	93 848	736	0.78	43 096	1101	2.55

FPD, fixed partial denture. Different lowercase letters indicate significant differences among groups in same row (*P*<.05). Different uppercase letters indicate significant differences among groups in same column (*P*<.05).

Table 3. Monolithic and layered zirconia anterior and posterior restoration fracture rates up to 7.5 years (January 2010 to July 2017)

Zirconia	Monolithic	Units Fractured	% Fracture	Layered	Units Fractured	% Fracture
Anterior	5854	72	1.23^{a,A}	20 712	433	2.09^{b,A}
Posterior	87 994	664	0.75^{a,B}	22 384	668	2.98^{b,B}
Total units	93 848	736	0.78	43 096	1101	2.55

Different lowercase letters indicate significant differences among groups in same row (*P*<.05). Different uppercase letters indicate significant differences among groups in same column (*P*<.05).

文献紹介

考察：歯科技工所のデータから二ケイ酸リチウムおよびジルコニアセラミック修復物の破折率を評価することで、短期間で有用な情報を得ることができた。これは、人気のあるセラミックシステムが破折によって早期に破損してしまう場合に重要な情報となる。データの収集と分析に要した時間は数ヶ月であった。このことは、最近導入されたセラミック・システムの懸念に対処するために、研究者やメーカーにとって貴重な情報となり得た。さらに、現在では、臨床試験ができておらず良くない状況が、人気のあるセラミック・システムに重大な問題があるかどうかを判断するための、現在の方法論の価値を上げています。

このアプローチは、実施済みの臨床試験の必要性に取って代わるものではありません。しかし、最近導入されたセラミックシステムの性能の初期指標と考えることはできます。現代のセラミックは、その成功に関する臨床的エビデンスが乏しいまま、大量に販売され、臨床で用いられている。臨床試験は通常、採用される患者のタイプ、研究を行う臨床医の質、および全体的な臨床環境に関して選択的であり、それが良好な結果をもたらす可能性がある。歯科技工所のデータは、様々な患者に修復処置を行う様々な臨床医を代表している。

セラミック修復物の中には、研磨の際の少しのチッピングもある。このようなセラミック修復物は、ラボで再製されたものではないため、本試験では失敗とはみなされなかった。その結果、失敗率は臨床試験と比較して過少に報告された。データ選択プロセスに含まれた技工所では、5年間の保証が提供されていた。このことは、臨床医にとって、破折した修復物を他の技工所に再製してもらうのとは対照的に、無料で再製してもらうために返送する動機付けとなるはずである。しかし、破折の原因にかかわらず、修復物は保証期間内であったため、破折の内容や理由は記録されなかった。破折の理由としては、固定式補綴物(FPD)のセラミック材料の厚さ、コネクター部分の寸法、ポンティックスパン、セメントの種類、合着前のセラミック表面の処理などが考えられる。このような情報が報告されていれば、破折の原因についてもっと貴重な指針が得られたであろう。

全体的な破折率（1.35%）は、二ケイ酸リチウムとジルコニア修復物（クラウンとFPD）ともに7.5年までと比較的低く、Scharerの基準内であった。一般的に、クラウンの破折率はFPDよりも3倍低く、モノリシック修復物の破折率はいずれのセラミックタイプでもレイヤー修復物よりも低かった。ジルコニアFPDは二ケイ酸リチウムFPDよりも破折が少なく、二ケイ酸リチウムよりもジルコニア材料をFPDに選択することを確信させた。これらの知見は、5～10年の中期的な生存率がクラウンと比較して低いため、FPDに二ケイ酸リチウムを選択することを推奨する臨床研究の知見と一致している。

歯科用ジルコニアは現在、さまざまなイットリア濃度がある。本研究で評価したFPD用ジルコニア材料は3mol%イットリアで、曲げ強度が400～600MPaである最近の半透明の5mol%イットリアキュービックジルコニアよりも曲げ強度が高い（1000～1200MPa）。臨床医や歯科技工士とのコミュニケーションから、5mol%のジルコニアFPDの早期破折率が高いことが示唆されている。この半透明のジルコニアは正方晶ではなく立方晶である。そのため、亀裂の伝播を抑制する相変態が起こらず、強度が低下する。

モノリシックな二ケイ酸リチウムのクラウン、ベニア、およびオンレーは、それらのレイヤーが約1.2%であるのに対して、約1%という低い破折率を示した。このことは、二ケイ酸リチウムを単体の信頼できるセラミック材料として推奨した臨床研究と一致している。二ケイ酸リチウム修復物が歯質に接着する能力は、このセラミックの成功に不可欠な役割を果たしてきた。現在では、咬頭が欠損した歯を二ケイ酸リチウムのオンレーまたは部分被覆修復物で修復するのが一般的な臨床方法であり、歯質を保存し、耐久性と審美性に優れたセラミックで歯を修復することができます。二ケイ酸リチウムオンレーの破折率は33/3345と低く、このような臨床応用が可能である。

レイヤージルコニア修復物の破折率(クラウン2.83%、FPD1.93%)は、過去に報告された5年間の破折率(3.25%、3.47%)よりも低かった。この改善は、ベニアリング陶材を支持するための下部構造の設計の最適化や、焼結時の冷却速度の低減など、加工プロトコルの改善に関連していると思われる。このような加工プロトコールが開発された後、レイヤージルコニア修復物が市販されなかったことは残念です。臨床家と患者の双方にとって時間と費用の節約になり、レイヤージルコニア修復物におけるポーセレンが欠けるを避けることができたはずだからである。

臨床に基づくエビデンスの最高ランクであるランダム化臨床試験からプロスペクティブな臨床データを収集するには、時間と労力がかかる。歯科技工データは、大きなサンプル数を精査し、短期間で有用な情報を提供することができる。Belliらは、あるミリングセンターで3.5年間に得られた34911個のミリングされたセラミック修復物の破折率を分析した。彼らの報告によると、全体の破折率は1.4%であった。二ケイ酸リチウムFPDはジルコニアベースのFPDよりも破折率が高く、レイヤー修復物(クラウンおよびFPD)はモノリシック修復物よりも破折率が高かった。この研究の結論は、二ケイ酸リチウムおよびジルコニアセラミック材料から作製された修復物は比較的破折率が低く、臨床的および技術的詳細に細心の注意を払えば、有望な臨床結果をもたらすという本研究の結論と一致していた。

結論

この歯科技工所調査の結果に基づき、以下の結論が導き出された:

1. 現代の二ケイ酸リチウムおよびジルコニアセラミックスは、モノリシックおよびレイヤードタイプともに、7.5年という中期に至るまで破折率は低かった。レイヤー修復物はモノリシック修復物よりも破折率が高かった。
2. ジルコニアFPDは二ケイ酸リチウムFPDよりも破折率が低く、二ケイ酸リチウムよりもジルコニアがFPDに使用されることが確認された。
3. 歯科技工所のデータをレトロスペクティブに分析することにより、臨床家、研究者、メーカーに貴重な情報を迅速に提供することができる。

報告の考察
以前より、二ケイ酸リチウムとジルコニアの修復物破折率に関する結果に興味がありました。結局、どちらの修復物を使用すれば良いのか？また、これに今後は、IOSなのか一般的な印象なのかでも結果が違ってくると思う。また、今回の研究では、臨床結果ではなく歯科技工所のデータベースという内容がユニークだと思いました。通常、なんらかの臨床医のバイアスが入ると思いますが、セラミック保証のために歯科技工所に再生で送られてきた物をデータとしてカウントしているので、信憑性が高いと感じました。

報告者：田中健久

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RESEARCH AND EDUCATION

Fracture rate of 188695 lithium disilicate and zirconia ceramic restorations after up to 7.5 years of clinical service: A dental laboratory survey

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ABSTRACT

Statement of problem. The use of ceramic materials has increased significantly because of high esthetic demands, low costs, and ease of fabrication. Long-term, clinically based evidence is scarce, and laboratory studies have limited relevance in determining clinical durability.

Purpose. The purpose of this dental laboratory survey was to evaluate the fracture rate of layered and monolithic lithium disilicate and zirconia single crowns and fixed partial dentures after up to 7.5 years of clinical service.

Material and methods. Two commercial dental laboratories with a database system that was able to track the number of remakes because of fracture only were identified. Lithium disilicate restorations (monolithic and layered) were categorized according to restoration type (single crown, fixed partial denture, veneer, and onlay). Zirconia restorations (monolithic and layered) were categorized according to type (single crown, fixed partial denture) and then into anterior or posterior restoration. Restoration remakes due to poor fit, shade, or marginal integrity were excluded from the evaluation. Data were analyzed, and statistical significance was evaluated with chi-square tests (α=.05).

Results. A total of 188 695 (51 751 lithium disilicate and 136 944 zirconia) restorations were included in the analysis, with an overall fracture rate of 1.35%. Lithium disilicate monolithic single crowns had a fracture rate of 0.96%, which was significantly lower than that of layered single crowns at 1.26% (P<.05). When the different types of lithium disilicate restorations were compared, fixed partial denture (monolithic and layered) fracture rates were significantly higher than those of single crowns (P<.001). Monolithic zirconia single crowns (0.54%) fractured at a lower rate than layered zirconia single crowns (2.83%) and monolithic fixed partial dentures (1.83%) (P<.001), while layered single crowns (2.83%) had a higher fracture rate than that of layered fixed partial dentures (1.93%) (P<.001). Monolithic anterior and posterior zirconia restorations fractured at a lower rate than layered anterior and posterior zirconia restorations (P<.05). Posterior monolithic zirconia restorations fractured at a lower rate than anterior restorations, while posterior layered zirconia restorations fractured at a higher rate than anterior zirconia restorations (P<.05).

Conclusions. Within the 7.5-year period, restorations fabricated with lithium disilicate and zirconia restorations had relatively low fracture rates. Monolithic restorations fractured at a lower rate than layered restorations. (J Prosthet Dent 2020;123:807-10)

Ceramic materials, especially lithium disilicate and zirconia, are being used extensively for the fabrication of crowns and fixed partial dentures (FPDs). In the past, the performance of ceramic crowns and FPDs was limited by premature fracture failure.[1,2] In 1991, Scharer[3] proposed that clinicians should demand 3- to 5-year data from independent clinical trials, indicating a survival rate of 95%, before adopting a new ceramic material. While these criteria are arbitrary, they seem to provide appropriate protection. However, properly conducted clinical trials are both expensive and time-consuming, and it takes approximately 10 years after

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Clinical Implications

Two of the most common indirect ceramic systems used by clinicians show relatively low fracture rates after up to 7.5 years of clinical service.

product inception before a 5-year clinical trial will reach publication.[4]

An alternative approach to clinical trials has been the use of dental laboratory surveys of fractured ceramic restorations.[4-8] Such surveys provide clinicians with relatively accurate and timely information to help guide them in their choice of ceramic materials. Successful use of these surveys requires 3 assumptions: that the surveyed dental laboratories provide a 5-year warranty and will replace fractured ceramic restorations free of charge; that patients with fractured restorations will return to the treating dentist; and that the treating dentist will take advantage of the warranty and remake the fractured restoration with the original laboratory.

Contemporary dental laboratories have excellent computer-based records to track returns, and access to these data provides timely feedback on the clinical performance of the restorations they provide. Previous laboratory surveys[4-8] have provided information on the fracture rates of lithium disilicate restorations up to 4 years after placement and zirconia-based restorations up to 5 years of service. In general, these surveys have demonstrated relatively low fracture rates well below those advocated by Scharer. The purpose of the present study was to determine fracture rates of lithium disilicate and zirconia-based restorations up to 7.5 years after placement.

MATERIAL AND METHODS

The data used in this study were collected from 2 major dental laboratories that offered a warranty service (remake of the restoration) at no additional cost after up to 5 years. The data were gathered for a period of 7.5 years between January 2010 and July 2017. Only restorations that failed due to catastrophic failure (fracture) were included, while restorations that failed because of poor contour, shade match, or marginal fit were excluded. The database systems of these laboratories allowed for identifying the number and type of failed (fractured) restorations that were returned to the laboratory for a remake. The restorations included were cemented on natural teeth, and implant-supported restorations were excluded. The brand of lithium disilicate restorations was IPS e.max (Ivoclar Vivadent AG), and the brands of zirconia restorations were Bruxzir (Glidewell Laboratories), Katana HT (Kuraray Noritake), Zirlux (Henry Schein, Inc), and Zenostar (Ivoclar Vivadent AG). The data were categorized into lithium disilicate and zirconia restorations. The lithium disilicate restorations were classified into monolithic and layered restorations, and the restorations included complete-coverage single crowns, fixed dental prostheses (FPDs), veneers, and onlays. The zirconia restorations were also classified into monolithic and layered restorations, and the restorations included single crowns and FPDs that were further classified into anterior and posterior. The fracture rates of the restorations according to the location of the restoration (anterior versus posterior), type of restoration (crown versus FDP), and fabrication method (monolithic versus layered) were compared and analyzed with chi-squared test (α=.05).

RESULTS

A total of 188 695 lithium disilicate and zirconia restorations were analyzed with an overall fracture rate of 1.35% over a 7.5-year period. Of these, 51 751 were lithium disilicate restorations, of which 36 198 were monolithic restorations (crowns, FPDs, veneers, and onlays) and 15 553 were layered restorations (crowns, FPDs, and veneers) (Table 1). The monolithic crowns had a fracture rate of 0.96%, which was significantly lower than that for the layered crowns (1.26%) (P<.05). No significant difference was found between the monolithic (3.66%) and the layered (2.82%) FPDs regarding the fracture rate (P=.151). The same was observed for the monolithic veneers (1.15%) compared with the layered veneers (1.21%), for which no difference in the fracture rate was observed (P=.866). Only monolithic onlays were placed with a fracture rate of 0.99%. When the different types of restorations (crowns, FPDs, veneers, and onlays) were compared, the fracture rates of the monolithic and layered FPDs were significantly higher than those of the others (P<.001).

A total of 136 944 monolithic and layered zirconia crowns and FPDs were included in the present study (Table 2). Monolithic zirconia crowns (0.54%) had a lower fracture rate than that of layered crowns (2.83%) (P<.05). However, no difference was observed for FPDs (monolithic or layered) (P=.632). Moreover, the monolithic crowns (0.54%) had a lower fracture rate than the monolithic FPDs (1.95%) (P<.001); the layered crowns (2.83%) had a higher fracture rate than the layered FPDs (1.93%) (P<.001) (Table 2).

Anterior layered restorations had a higher fracture rate (2.09%) than anterior monolithic restorations (1.23%), and layered posterior restorations had a fracture rate of 2.98% compared with 0.75% for monolithic restorations (P<.001). When anterior and posterior (monolithic) restorations were compared, the posterior restorations had a significantly lower fracture rate than the anterior restorations (P<.001), while for layered zirconia, the posterior restorations had a significantly higher fracture rate (P<.001) than anterior layered zirconia restorations (Table 3).

Table 1. Monolithic and layered lithium disilicate (e.max) single crown and fixed partial denture fracture rates up to 7.5 years (January 2010 to July 2017)

e.max Restorations	Monolithic	Units Fractured	% Fracture	Layered	Units Fractured	% Fracture
Crown	27 346	262	0.96[a,A]	11 683	171	1.26[b,A]
FPD	3337	122	3.66[a,B]	1382	39	2.82[a,B]
Veneer	2170	25	1.15[a,A]	2488	30	1.21[a,A]
Onlay	3345	33	0.99	—	—	—
Total units	36 198	442	1.22	15 553	240	1.54

FPD, fixed partial denture. Different lowercase letters indicate significant differences among groups in same row ($P<.05$). Different uppercase letters indicate significant differences among groups in same column ($P<.05$).

Table 2. Monolithic and layered zirconia single crown and fixed partial denture fracture rates up to 7.5 years (January 2010 to July 2017)

Zirconia	Monolithic	Units Fractured	% Fracture	Layered	Units Fractured	% Fracture
Crown	77 411	416	0.54[a,A]	30 036	849	2.83[b,A]
FPD	16 437	320	1.95[a,B]	13 060	252	1.93[a,B]
Total units	93 848	736	0.78	43 096	1101	2.55

FPD, fixed partial denture. Different lowercase letters indicate significant differences among groups in same row ($P<.05$). Different uppercase letters indicate significant differences among groups in same column ($P<.05$).

Table 3. Monolithic and layered zirconia anterior and posterior restoration fracture rates up to 7.5 years (January 2010 to July 2017)

Zirconia	Monolithic	Units Fractured	% Fracture	Layered	Units Fractured	% Fracture
Anterior	5854	72	1.23[a,A]	20 712	433	2.09[b,A]
Posterior	87 994	664	0.75[a,B]	22 384	668	2.98[b,B]
Total units	93 848	736	0.78	43 096	1101	2.55

Different lowercase letters indicate significant differences among groups in same row ($P<.05$). Different uppercase letters indicate significant differences among groups in same column ($P<.05$).

DISCUSSION

Assessing the fracture rates of lithium disilicate and zirconia ceramic restorations from data from dental laboratories can provide useful information in a short time. This could be important if a popular ceramic system was failing prematurely from fracture. The time required to collect and analyze the data was a few months. This can be valuable to researchers and manufacturers to address concerns of a recently introduced ceramic system. Moreover, the unfortunate circumstances of declined clinical trials nowadays enhances the value of the current methodology to determine if there is a major issue concerning a popular ceramic system.

This approach does not replace the need for randomized clinical trials. However, it may be considered as an early indicator of the performance of a recently introduced ceramic system. Contemporary ceramics have been marketed and adopted by clinicians in large numbers with limited clinical evidence of their success. Clinical trials are usually selective concerning the type of patients recruited, the quality of clinicians conducting the research, and the overall clinical environment, which may lead to favorable outcomes. Data from dental laboratories represent a wide range of clinicians performing restorative procedures on a wide range of patients.

Some ceramic restorations may have had minor chipping that was smoothed and polished, which would not show up as a failure in the present study as these restorations were not remade by the laboratory. As a result, the failure rate would be underreported compared with clinical trials. The laboratories included in the data-selection process provided a 5-year warranty, which should incentivize the clinician to return a fractured restoration to be remade at no charge as opposed to having another laboratory provide the remake. However, the nature or reason for fracture was not recorded because the restoration was under warranty regardless of the cause of fracture. Reasons for fracture maybe the thickness of the ceramic material, connector area dimensions, and pontic span of the fixed prosthesis; type of cement; and treatment of the ceramic surface before luting. Such information, if reported, would have provided valuable guidance as to the cause of fracture.

The overall fracture rate (1.35%) for both lithium disilicate and zirconia restorations (crowns and FPDs) was relatively low up to 7.5 years, well within Scharer's criteria.[3] Generally, crowns fractured 3 times less than FPDs, and monolithic restorations fractured less than layered restorations for both ceramic types. Zirconia FPDs fractured less than lithium disilicate FPDs, confirming the selection of zirconia material for FPDs over lithium disilicate, and required less tooth reduction and connector dimensions than lithium disilicate FPDs. These findings are consistent with those of clinical studies discouraging the selection of lithium disilicate for FPDs because of a poor survival rate compared with crowns in the medium term of 5 to 10 years.[9]

Dental zirconia is now available with different yttria concentrations. The zirconia material for FPDs evaluated in this study was 3 mol% yttria, which has a higher flexural strength (1000 to 1200 MPa) than the more recent and translucent 5 mol% yttria cubic zirconia, which has a flexural strength of 400 to 600 MPa.[10] Clinicians should specify the optimal type of zirconia with the work authorization. Communication with clinicians and dental technicians suggests an early high fracture rate for 5 mol% zirconia FPDs. This translucent zirconia has cubic rather than tetragonal crystals. Therefore, the phase transformation responsible for inhibiting crack propagation does not occur, resulting in lower strength.[10]

Monolithic lithium disilicate crowns, veneers, and onlays displayed low fracture rates of around 1% compared with around 1.2% for their layered counterparts. This is consistent with clinical studies that recommended lithium disilicate as a reliable ceramic material for single units.[7] Lithium disilicate ceramics, in their pressed and milled versions, have been increasingly used because of their desirable mechanical and optical properties. The ability of lithium disilicate restorations to adhesively bond to tooth structure has played an integral part in the success of this ceramic. It is now common clinical practice to restore teeth with missing cusps with a lithium disilicate onlay or partial coverage restoration, preserving tooth structure and restoring the tooth with a ceramic that is durable and esthetically pleasing. The low fracture rate of lithium disilicate onlays (33/3345) supports this clinical application.

The fracture rate of layered zirconia restorations (crowns 2.83% and FPDs 1.93%) was lower than a previously reported 5-year fracture rate (3.25% and 3.47%).[8] This improvement is likely related to improved fabrication protocols, including optimizing the substructure design to support the veneering porcelain and a reduced cooling rate during sintering.[11] It is unfortunate that layered zirconia restorations were not marketed after these processing protocols had been developed as it would have saved time and money for both the clinician and the patient and avoided the plague of porcelain chipping on layered zirconia restorations.

Collecting prospective clinical data from randomized clinical trials, the highest rank of clinically based evidence, can be time- and labor-intensive. Dental laboratory data can scrutinize a large sample size and provide useful information in a short time. Belli et al[6] analyzed the fracture rate of 34 911 milled ceramic restorations obtained from a milling center over a 3.5-year period. They reported an overall fracture rate of 1.4%. Lithium disilicate FPDs had higher fracture rates than zirconia-based FPDs, and layered restorations (crowns and FPDs) had higher fracture rates than monolithic restorations. The conclusion of this study was consistent with the present one that restorations fabricated from lithium disilicate and zirconia ceramic material have relatively low fracture rates and have promising clinical outcomes when clinical and technical details are meticulously followed.

CONCLUSIONS

Based on the findings of this dental laboratory survey, the following conclusions were drawn:

1. Contemporary lithium disilicate and zirconia ceramics in their monolithic and layered forms displayed low fracture rates up to the medium term of 7.5 years. Layered restorations had higher fracture rates than monolithic restorations.
2. Zirconia FPDs displayed a lower fracture rate than lithium disilicate FPDs, confirming the use of zirconia for FPDs over lithium disilicate.
3. The retrospective analysis of data from dental laboratories can provide valuable and rapid information to clinicians, researchers, and manufacturers.

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