

Survival and complications rate of minimally invasive restorations: a cross-sectional study

Wskaźnik przeżycia i odsetek powikłań minimalnie inwazyjnych uzupełnień: badanie przekrojowe

Kalghoum Imen, Mejri Oumayma, Riahi Zeineb, Hadyaoui Dalenda DH

Prosthodontic Department, Dental Faculty of Monastir, Tunisia

Zakład Protetyki Stomatologicznej, Wydział Stomatologii w Monastyrze, Tunezja

KEY WORDS:

minimally invasive restorations, retrospective study – survival – failure – complications

HASŁA INDEKSOWE:

odbudowy mało-inwazyjne, badanie przekrojowe – przeżycie – niepowodzenie – powikłania

Summary

Aim of the study. To evaluate the practice of minimally invasive restorations, their survival failure rates, the possible biological and technical complications and the impact of various factors on the prognosis of these prostheses.

Methods. This is a cross-sectional study carried out on a representative sample of 77 clinical cases, treated in the department of fixed prosthodontics and at private dental offices. A statistical analysis and a comparison between the obtained results with those of studies in other countries were carried out.

Results. The overall survival rate of minimally invasive restorations was 87.5%, the incidence of this rate differs according to the age of the restoration: after 3 years (95%), after 5 years (81.2%) and after more than 5 years (83.3%). Dental veneers present half of the restorations studied with a survival rate of 82%. On the other hand, the posterior restorations have a 100% survival rate. Glass-ceramics are the most used, followed by hybrid ceramics with a percentage of 71.4% and 19.5%, respectively. The most common failures are debonding (18.2%) and total fracture (10.4%).

Streszczenie

Cel pracy. Ocena stosowania uzupełnień minimalnie inwazyjnych, wskaźników ich niepowodzeń w zakresie przeżycia, możliwych powikłań biologicznych i technicznych oraz wpływu różnych czynników na rokowanie tych protez.

Metody. Jest to badanie przekrojowe przeprowadzone na reprezentatywnej próbie 77 przypadków klinicznych leczonych w oddziale protetyki oraz w prywatnych gabinetach stomatologicznych. Przeprowadzono analizę statystyczną i porównano uzyskane wyniki z wynikami badań w innych krajach.

Wyniki. Całkowity współczynnik przeżycia uzupełnień minimalnie inwazyjnych wyniósł 87,5%, częstość występowania tego wskaźnika różni się w zależności od czasu użytkowania uzupełnienia: po 3 latach (95%), po 5 latach (81,2%) i po ponad 5 latach (83,3%). Licówki dentystyczne stanowią połowę badanych uzupełnień, a wskaźnik przeżycia wynosi 82%. Z drugiej strony uzupełnienia w odcinku bocznym mają 100% przeżywalności. Najczęściej stosuje się ceramikę szklaną, a następnie ceramikę hybrydową, odpowiednio 71,4% i 19,5%. Najczęstsze uszkodzenia to odklejenie (18,2%) i całkowite złamanie (10,4%).

Conclusion. *The survival or failure rate of minimally invasive restorations is influenced by several factors: the type of prosthesis, the material used, the type of adhesive system and the restoration sector. Indeed, it is necessary to carry out a detailed clinical examination to guarantee the durability of the prosthesis and to analyse the mechanical and optical properties of the various ceramic materials. It is also important to respect the operating protocol and to ensure the clinical follow-up of the patient.*

Wniosek. *Na przeżycie lub awaryjność uzupełnień minimalnie inwazyjnych wpływa kilka czynników: rodzaj protezy, zastosowany materiał, rodzaj systemu adhezyjnego i lokalizacja odbudowy. Wymagane jest przeprowadzenie szczegółowego badania klinicznego, aby zagwarantować trwałość protezy oraz przeanalizować właściwości mechaniczne i optyczne różnych materiałów ceramicznych. Ważne jest również przestrzeganie protokołu procedur i zapewnienie obserwacji klinicznej pacjenta.*

Introduction

The major goal of modern dentistry is to achieve an aesthetic and functional outcome. Advances in dental technology and rising aesthetic expectations of patients have led to the increased use of ceramic restorative materials. Therefore, minimally invasive restorations have become a field of great interest in modern restorative dentistry.¹ This treatment option has been extended thanks to CAD/CAM systems.^{2,3} Several options are offered by this treatment modality. It preserves the tooth structure while allowing reconstructions of the destructed ones in order to maintain proper and correct function and also to provide a satisfactory cosmetic appearance. Different types of prostheses are then at our disposal to allow us to respect the therapeutic gradient: veneers, inlays, onlays, overlays, inlays-onlays, endocrowns, cantilevers, and conventional bonded bridges.

The survival success and complications of minimally invasive restorations compared to conventional ones have been the subject of several studies. *Rodrigues* et al. included studies on CAD/CAM materials for a single crown, multiple-unit or partial ceramic crown with a 24 to 84-month follow-up based on the longevity and failures rates, suggesting that the longevity of CAD/CAM partial restorations

is lower compared to the conventionally fabricated restorations.⁴

However, *Sampaio FBWR* et al. found that the estimated survival rate for CAD/CAM is 97% after five years.⁵ Long-term success requires the intervention of several parameters such as the elaboration of a detailed clinical examination, the follow-up of an adequate treatment plan, the respect of the operative protocol, the choice of the appropriate material and the adapted bonding system and the follow-up of the patient.⁶

This paper determines, through a retrospective cross-sectional study of 77 patients in Tunisia, the practice of minimally invasive restorations, their survival failure rates, the possible biological and technical complications, and the impact of various factors on the prognosis of these prostheses.

Patients and Method

This is a retrospective cross-sectional study of descriptive and analytical type carried out on 77 patients. The study aims to determine through a clinical survey the success rates, survival, failures, and complications of minimally invasive restorations. The survey was carried out at the Faculty of Dental Medicine of Monastir in the department of fixed prosthodontics and at free practice dental offices. These restorations were performed from 2017 to 2021.

Inclusion Criteria

This study was conducted on patients over 16 years of age., who had undergone minimally invasive restorations (inlay, onlay, overlay, inlay-onlay, veneer, bonded bridges, and cantilevers).

Exclusion Criteria

Patients who received metal, metal-resin, ceramic-metal, ceramic-ceramic bridges and crowns, or implant-supported prostheses were excluded.

Methodology

The data collection was carried out using a questionnaire (annex) of two forms. The first one was paper-based which was distributed to the university hospital dentists in the service of prosthodontics. The second one was online and was dedicated to the practitioners in private dental offices in Tunisia.

This questionnaire included 24 questions distributed in three parts:

The first part included information about the patient's personal data (age, sex, general condition, parafunction...)

The second part included information about the supporting tooth and certain prosthetic characteristics (nature and type of the prosthesis, date, and method of assembly, type of ceramic used, process of implementation, nature and colour of the tooth).

The third part was reserved for determining the success, survival, and failure rate of minimally invasive restoration and identifying the nature of the failure, whether it was technical and/or biological.

Statistical analysis

The data collected was coded and entered for analysis in two steps using SPSS 26.0 software.

- The first step consisted of an overall description of the study population and the different data.

- The second step was a bi-variate analysis.

The Pearson Chi-square and the Fisher tests were then used to study the correlation between the qualitative variables with a significant p-value < 0.05.

Results

The 77 cases in this study were mostly performed by university hospital dentists (87%), and 13% by private sector dentists. Recording the number of subjects per clinician 67 dentists had one patient, three patients, and only one had four patients.

Males and females in our survey were almost equal with respective percentages of 52% and 48%. The age range of the patients surveyed was between 16 and 52 years. However, 50.6% of the patients were between 16 and 30 years old while only 7.8% were between 46 and 52 years old.

The distribution according to the reason for consultation showed that 39% of the patients consulted for both aesthetic and functional reasons, 37.7% for aesthetic reasons, and 14.3% for functional reasons.

The restorations collected were divided into two groups. One regrouped anterior restorations: veneer, conventional bonded bridge, and cantilever bridge (53.5%). The second regrouped posterior minimally invasive restorations where it automatically regrouped inlay, overlay, inlay-onlay, onlay, and endocrown (46.5%). (Table 1)

For the type of material used, three types of ceramics were at our disposal, glass-ceramics (71.4%), hybrid ceramics (19.5%), and zirconia with the least used proportion (9.1%).

Regarding the prognosis of minimally invasive restorations, among the 77 cases studied, total failure (irreversible complication) was noted in 11 patients, partial failure (reversible complication) in 21 patients, 2 of them suffered from an immediate failure, and success with 45 patients. (Fig. 1)

Clinical Investigation Form

Clinician :

University hospitaliste free practice

Patient :

Age : Sex:..... Profession :

Address:..... Socioeconomic level :

Reason for consultation: Aesthetic Functional

Aesthetic and Functional

General condition of the patient :

Hygiene :

Sufficient Insufficient Brushing frequency:/d

Hygiene means and adjuvants:

Presence of plaque on the prosthesis: yes no

Parafunctions :

Bruxism onychophagia atypical swallowing

interposition of an object other:.....

Sector : Anterior Posterior

Assembly date: 2021-2019 2019-2017

before 2017

Type of prosthesis: Single

1 2 3 or more

Plural Number of elements:

Number of pontics:

Type: Veneer Conventional bonded bridge Endocrown

Fig. 1. The prognosis for minimally invasive restorations (side 1).

Cantilever bridge Inlay Onlay Overlay inlay-onlay
 Nature of the die: pulped depulped
 Color of the die: Dyschromed Not Dyschromed
 RCR: fibered cast
 Assembly method: cementing bonding
 Type of ceramic used:
 Processing method: CAD/CAM Conventional
Successful (100%)
Partial failure (reversible complication)
Total failure (irreversible complication)
Type of failure:
 Loosening/ detachment
 Fracture (partial total)
 Abrasion Change of color Loss of retention
Biological failure:
Periodontium: Pocket Recession Gingival hypertrophy
 Bleeding Desmodental enlargement
 Interradicular lesion bone lysis: type:level:.....
Carious lesion: Supporting tooth Adjacent tooth
 Location:
Endodontic lesion: Reversible pulpitis
 Irreversible pulpitis (Symptomatic Asymptomatic)
 Necrosis (without complications with complications)
 Endodontic treatment: yes image No
Dental fractures: Coronal Radicular

Fig. 1. The prognosis for minimally invasive restorations (side 2).

Table 1. Distribution of survey cases by type of prosthesis

	Number	%
Anterior restorations (Veneer, Conventional bonded bridge, Cantilever bridge)	45	53.5
Posterior restorations (Inlay, Overlay, Inlay-onlay, Onlay, Endocrown)	37	46.5
Total	82	100.0

Table 2. Correlation between prosthesis prognosis and prosthesis type

		Success (100%)	Partial failure (reversible complication)	Survival rate (partial failure + success)	Total
Type of prostheses	anterior restorations	46%	35%	82%	45 100.0%
	posterior restorations	64%	13.5%	100%	37 100.0%

Table 3. Prognosis of the prosthesis/extension of the prosthesis correlation

			Success (100%)	Partial failure (reversible complication)	Survival rate (partial failure + success)	Total failure (irreversible complication)	Total
Nature of the prosthesis Unitary/ Plural	single	Number	40	18	58	6	64
		% in nature of the prosthesis	62.5%	28.1%	90.6%	9.4%	100,0%
	plural	Number	5	3	8	5	13
		% in nature of the prosthesis	38.5%	23.1%	61.5%	38.5%	100,0%
Total		Number	45	21	66	11	77
		% in nature of the prosthesis	58.4%	27.3%	85.7%	14.3%	100,0%

Dental veneers presented half of the restorations studied with a survival rate of 82%. On the other hand, the posterior restorations had a 100% survival rate. (Table 2)

The incidence of survival rate differed according to the age of the restoration: after 3

years (95%), after 5 years (81.2%), and after more than 5 years (83.3%).

The statistical analysis showed a very significant association between prosthetic characteristics and the prognosis of minimally invasive restorations. The study of the effect of

Table 4. Prognosis of the prosthesis/assembly method correlation

			Success (100%)	Partial failure (reversible complication)	Total failure (irreversible complication)	Total
Assembly mode 1 sealing/ 2 bonding	sealing	Effective	0	0	1	1
		% in assembly mode 1 sealing/ 2 bonding	0.0%	0.0%	100.0%	100.0%
	bonding	effective	44	21	8	73
		% in assembly mode 1 seal/ 2 bond	60.3%	28.8%	11.0%	100.0%
Total		effective	44	21	9	74
		% in Assembly mode 1 seal/ 2 bond	59.5%	28.4%	12.2%	100.0%

Table 5. Prognosis of the prosthesis/technical failures correlation

			Success (100%)	Partial failure (reversible complication)	Total failure (irreversible complication)	Total
Technical failures	no failure	effective	45	2	2	49
			100.0%	9.5%	18.2%	63.6%
	debonding	effective	0	13	1	14
			0.0%	61.9%	9.1%	18.2%
	partial fracture	effective	0	3	0	3
			0.0%	14.3%	0.0%	3.9%
	total fracture	effective	0	0	8	8
			0.0%	0.0%	72.7%	10.4%
	change of colour	effective	0	3	0	3
			0.0%	14.3%	0.0%	3.9%
Total		effective	45	21	11	77
			100,0%	100.0%	100.0%	100.0%

the nature of the prosthesis (single/plural) was statistically significant $P=0.023$. (Table 3). In addition, the effect of the mode of assembly (bonding/sealing) of the prosthesis on the

prognosis of minimally invasive restorations was significant $P=0.026$. (Table 4)

In addition, the results obtained concerning technical failures showed that there was a

Table 6. Prosthesis prognosis/biological failures correlation

			Success (100%)	Partial failure (reversible complication)	Total failure (irreversible complication)	Total
Biological failures	no failure	effective	45	10	8	63
			100.0%	47.6%	72.7%	81.8%
	recession	effective	0	1	0	1
			0.0%	4.8%	0.0%	1.3%
	gingival hypertrophy	effective	0	2	0	2
			0.0%	9.5%	0.0%	2.6%
	bleeding	effective	0	1	0	1
			0.0%	4.8%	0.0%	1.3%
	desmodental enlargement	effective	0	1	0	1
			0.0%	4.8%	0.0%	1.3%
	cariou lesion	effective	0	2	2	4
			0.0%	9.5%	18.2%	5.2%
	endodontic lesion	effective	0	4	1	5
			0.0%	19.0%	9.1%	6.5%
Total		effective	45	21	11	77
			100.0%	100.0%	100.0%	100.0%

correlation with the prognosis of minimally invasive restorations ($p < 0.05$). Indeed, debonding was the most frequent failure with a percentage of 18.2%. (Table 5).

The correlation between the prognosis of the prosthesis/biological failures was ($p < 0.05$). Indeed, it was noted that endodontic lesions were more frequent with a percentage of 6.5%. (Table 6)

Discussion

At the end of this study and after the collection of data from clinical cases older than five years, 82 minimally invasive restorations (MIR) (45 anterior restorations and 37 posterior

restorations) in 77 patients (39 females and 38 males, the average age 31.2 years) were examined; 27 of these patients had 3 or more restorations, 23 had a single restoration, and 10 patients had 2 single restorations.

The majority of MIR were bonded between 2017 and 2019 with a percentage of 41.6%, 23.5% were made before 2017, 26% between 2019 and 2021, and 9.1% did not specify the date of prosthesis assembly.

A total of 45 anterior and 37 posterior restorations were provided by 67 university hospital dentists and the private sector dentists.

The longevity and survival rate of minimally invasive restorations has been the subject of several studies in the last decade, hence the

importance and development of aesthetic and biomechanical requirements of restorative dentistry.

This study revealed a survival rate of minimally invasive restorations of 87.5% (53.6% of the total success of restorations without complications and 25% of partial failure with reversible complications). The incidence of this rate was higher for restorations of less than 3 years (95%), in comparison to the ones after 5 years where it was 83.3%. As for restorations from 3 to 4 years earlier, it was 81.2%. In fact, this value included all types of MIR, whether anterior or posterior, single or multiple, using glass-ceramics, zirconia, or hybrid ceramics.

Starting with the ceramic veneers which presented an increased rate of its indication compared to the other MIR with a percentage of 41.6%, according to this study. However, several parameters influence the survival rate of ceramic veneers, namely, the thickness of the available enamel, the architecture of the preparation, the material used, the vitality of the tooth to be treated, and the experience of the dentist.⁷

Furthermore, this study revealed a survival rate of 32 veneers of 90.6% with a rate of 100% for restorations aging less than 3 years, 93.75% for restorations aging less than 5 years, and 100% for veneers older than 5 years. On the other hand, after a period of 3 to 4 years, 3 veneers experienced total failure (irreversible complications) due to technical failure (total fracture) with a percentage of 9.4%. In addition, 40.6% of veneers experienced reversible technical complications (detachment of 7 veneers, partial fracture of 3 veneers, and change in the shade of 3 veneers) and biological complications (gingival hypertrophy in two veneers, bleeding in one veneer and endodontic lesion in two veneers).

Anja Liebermann's study, published in 2020 and carried out in Germany with an average observation period of eight years, revealed a 100% survival rate for 40 veneers made of

lithium disilicate ceramic, and a complication rate of 12.5% caused solely by technical failures (minor chipping or fissure formation).⁸ Another study carried out in Turkey by Yilmaz U. A was published in 2019 on 413 lithium disilicate ceramic veneers. This study showed that the survival rate was 98% after 5 years, 95% after 10 years, 91% after 15 years, and 87% after 20 years with a negligible failure rate of 3.63% for veneers that underwent delamination.⁹ Similar results were reported by Petra C. Guess and Christian F.J., where the survival rate of veneers was also 100% after 5 years and 97.5% for veneers with lingual return due to severe fracture.¹⁰ This high survival rate was attributed to various parameters such as the design of the preparation, the strong adhesive bonding of the tooth, the ceramic and the bonding composite, and the fracture resistance of the ceramic.¹¹

As for the posterior restorations: endocrown is considered a good alternative to conventional treatments for endodontically treated teeth. It preserves the maximum amount of tooth tissue, reduces the requirements for macro-retentive geometry, and creates a more effective solution than conventional crowns. Furthermore, it is more aesthetically pleasing.¹²

Regarding the survival rate of the endocrowns, this study revealed that among the 9 endocrowns, only 2 suffered from a total failure of which one suffered from an immediate failure but without specifying its exact nature. The other prosthesis suffered from a biological failure (cariou lesion of the supporting tooth). The survival rate was 100% for restorations of 3 years and 88.9% for restorations less than 3 years and more than 5 years ago. In addition, a systematic review and meta-analysis performed by Raghad A. D in the Kingdom of Saudi Arabia in 2020 showed that the overall survival rate of endocrowns after 5 years was 91.4% and 98.3% for conventional crowns.¹³ Another systematic study carried out in France by Nicolas. G and Mathieu. C in 2020 revealed that the estimated

survival rate for molar endocrowns was 90% between 6 months and 10 years, and for premolars it varied between 68% and 75% at 55 months and 10 years. In contrast, the dominant failures reported were loss of retention (53%), periodontitis (14%) and endocrown fracture (14%).¹⁴

Other posterior restorations that are more in line with the principles of tissue economy while guaranteeing aesthetics and durability are inlays, onlays, inlays-onlays, and overlays. These minimally invasive bonded partial restorations are increasingly indicated thanks to the development of adhesive techniques and material science.^{15,16}

In the literature, several studies have been done to evaluate the survival rate of MIRs in the short, medium, and long term using different types of ceramic materials. Furthermore, this study showed that the survival rate of inlays, onlays was 100%. These results are consistent with those found in several studies. Indeed, M. Fuzzi and G. Rappeli, proved through their study published in 1998 in Italy, that inlays had a survival rate of 97% after 10 years of follow-up and that the predominant failure was pulpitis after 6 months of bonding and fracture that occurred only after 3 years of bonding.¹⁷ Another study by Starding. M et al. on 157 leucite-reinforced glass-ceramic inlays and 27 onlays in 2020 showed that after 11 years the survival rate of inlays and onlays was 80.4% and 80%, respectively.¹⁸

Cantilevers were introduced in the early 90's of the last century with two wings but unfortunately, the fracture rate was high. Therefore, those with one wing had a higher survival rate thanks to the elimination of stress on the bonding surface that was caused by the differential mobility of the abutment teeth when using the two-winged design.¹⁹

Conventional bonded bridges are designed to restore spaces that have been edentulous for several years. Even though its failure rate was

higher than that for conventional bridges, its complications are less catastrophic comparing to the ones of conventional bridge, which often includes caries, apical pathology or loss of the abutment tooth.²⁰

This study collected 13 conventional bonded bridges with a survival rate of 71.4%. In fact, 3 prostheses were doomed to total failure (total fracture) and 3 were successfully completed after 5 years of follow-up. In a systematic review of 19 studies by G.R. Balasubramaniam in 2017, the estimated survival rate of bonded bridges after 5 years was 83.6%, and 64.9% after 10 years.²¹

The nature of the restoration, whether single or multiple, is an important factor in the survival of minimally invasive restorations. In this study, a correlation between this parameter and the survival of MIRs with a $p=0.023$ was noted, which was less than 0.05. The survival rate recorded in the study of single and multiple minimally invasive restorations was 90.6% and 61.5%, respectively.

In this context, a prospective study by Becker M et al., done in Germany and published in 2019, showed that the survival rate of posterior bonded partial bridges in IPS e.max is 57% at 5 years, 38% at 8 years and 22% at 15 years.²²

When the survival rate of ceramic materials for each type of restoration was compared, this study revealed that the survival rate of lithium disilicate veneers was 88.2% and that is why it is called the gold standard. A study by Anja.L et al. in 2020 showed that IPS e.max veneers had a 100% survival rate after 8 years of follow-up.²³ On the other hand, Belleflamme MM et al. showed through a retrospective study published in 2017 that the survival rate of endocrowns made from lithium disilicate ceramics and hybrid ceramics was 99% after 10 years.²⁴ This is in agreement with the present study, which noted that the survival rate of lithium disilicate endocrowns was 100%.

Bondability is one of the factors influencing

the survival of minimally invasive restorations. This parameter is increased when the glass phase is dominant in the ceramic material and decreased by the presence of the crystalline phase in its microstructure. Therefore, feldspathic ceramics and glass-ceramics are more suitable for bonding and have satisfactory bonding qualities, which is preferable for bonded partial restorations such as inlays, onlays, overlays and veneers.²⁵ This is in agreement with the results of the present study that showed that 100% of glass-ceramic restorations were cemented, of which only 10.9% failed. Indeed, a study conducted by Kramer N et al. on IPS Empress inlays and onlays using two types of adhesives (Syntac/Variolink Low, EBS Multi/Compolute) showed that there was no significant difference in the survival rate with a percentage of 90%.²⁶

Regarding the technical failures, debonding was the major failure in the present study. 18.2% of the minimally invasive restorations had debonding, of which 50% were veneers and 21.4% were cantilevers. In this context, several studies performed by Audrey L et al.,²⁷ Bilal M et al.,¹⁹ Galiatsatos A et al.²⁸ and Kern M²⁹ confirmed these results but with lower percentages of 2%, 5% and 9%.

The second failure that appeared at the level of the MIR was the fracture: partial (3.9%) or total (10.4%). Like debonding, glass-ceramics showed the highest rates of fracture. Therefore, a study was conducted by Tariq F. Alghazzawi et al. published in 2012, Saudi Arabia. It showed that zirconia veneers had better fracture resistance compared to those made from feldspathic ceramics or leucite reinforced ceramics. However, debonding occurred most frequently in zirconia veneers.²⁷

This makes reattachment of zirconia restorations possible and uncomplicated, whereas restorations made from glass-ceramics or reinforced ceramics that have framework fractures will require another replacement restoration.²⁹

As for the biological failures, RIMs are more susceptible to caries and endodontic lesions due to their posterior location which requires more chewing force. Therefore, this study revealed that 63.3% of the restorations initiated were posterior.

However, in a systematic review, studies have shown that caries is one of the major causes of biological complications in minimally invasive restorations with a percentage of 13.5% after 20 years of follow-up and only two studies have mentioned failures due to endodontic problems. This may be explained by the occurrence of gaps around the restorations caused by lack of seal between the tooth surface and the prosthesis and/or by the solubility of the bonding materials over the years.³⁰

This is supported by the results of this study where only 3.9% of secondary caries and 6.5% of endodontic lesions were observed.

The Limitations of the Study:

One of the major limitations of this clinical study is the small sample size (77 patients). This was due to two reasons. The first one is that performing minimally invasive restorations is restricted to specialists or practitioners who attended post graduate programs and training. The second one is that this study aimed to assess restorations where only a small number presented at least a three years span, which is considered as the minimal proven clinical track for rating survival rates whereas other restorations have been placed since a small period.

Besides, some respondents to the questionnaire did not specify some data such as date and mode of assembly. In addition, post-failure interventions and type of adhesive system used can be added to this study.

Clinical Significance: ³¹⁻³⁵

In order to ensure minimally invasive restorations with longer survival rates,

Careful patient selection must be maintained while enhancing the clinical examination and treatment plan to eliminate all factors that may be a source of therapeutic failure. When it comes to preparation, a minimal reduction is recommended to respect the principle of tissue economy and to take advantage of the good adhesion strength to the enamel. In cases when the dentine has to be prepared, which can decrease retention, an axial preparation is necessary to improve retention.

Furthermore, the right choice of ceramic material is essential to guarantee a high survival rate over a long period of time of the MIR, giving preference to crystalline ceramics, hybrid ceramics and vitreous ceramics of lithium disilicate type. The bonding technique and system also play an important role in ensuring a high survival rate of minimally invasive restorations. Therefore, adhesive composite bonding systems without adhesive potential have more advantages compared to self-adhesive composite bonding. It is important to ensure tribochemical processing for crystalline ceramics and a dry surgical field is mandatory. In addition, the production of high quality prostheses requires a clear and efficient communication of the design features between the practitioners and the ceramists. Indeed, the contribution of CAD/CAM facilitates this relationship. Finally, teamwork and interprofessional relationships have to be encouraged from the beginning of the professional curriculum.

Conclusion

Minimally invasive restorations showed favourable survival rate after at least three years. This study has allowed us to conclude that the type, localization of prosthesis (anterior or posterior), the nature (multiple, single), and the mode of assembly affect the prognosis of minimally invasive restorations. Indeed,

to guarantee the success and durability of restorations, it is necessary to carry out a detailed clinical examination, to know the mechanical and optical properties of the various ceramic materials, to respect the operating protocol and to ensure the clinical follow-up of the patient.

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Zaakceptowano do druku: 22.09.2023 r.

Adres autora: Prosthodontic Departement,
Dental Faculty of Monastir,
Street Ali ben restah,
5000, Monastir, Tunisia

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