Grado en ODONTOLOGÍA

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COMPARISON OF ZIRCONIUM AND SILICATE CERAMIC CROWN PROSTHESIS IN PATIENT AFFECTED BY BRUXISM: A SYSTEMATIC REVIEW

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Contents

1. Resumen

Introducción: El bruxismo es una patología que afecta del 10 al 30% de la población y muchas veces requiere rehabilitación mediante la colocación de prótesis fijas que pueden ser de circonio por sus propiedades mecánicas o cerámica de silicato ya que permite buenas propiedades ópticas. El objetivo principal de este estudio es comparar la supervivencia de la corona de cerámica de zirconio y silicato en pacientes con bruxismo y adicionalmente determinar las posibles complicaciones protésicas y su prevalencia.

Material y método: Se realizó una investigación en tres bases de datos: PubMed, Scopus, Web of Science sobre la supervivencia de coronas de zirconio y silicato en pacientes con bruxismo hasta diciembre de 2022.

Resultados: se encontraron 121 artículos y se seleccionaron 8 de los cuales 1 es un ensayo clínico aleatorizado, 2 son series de casos, 5 son estudios observacionales. Se encontró una tasa de supervivencia promedio de 98.54% en corona de zirconio y 97.19% en corona de silicato, además se encontró un hazard ratio de 2.4 en cerámica de silicato y 1.52 para coronas en general en pacientes con bruxismo. Se encontraron las siguientes complicaciones protésicas: astillado de porcelana (6,93% para corona de zirconio, 5,02% para corona de silicato), fractura de corona (0,6% para corona de zirconio), pérdida de retención (0,71% para corona de circonio), apertura de contacto interproximal (3,23 % para corona de zirconio), caries secundaria (0,83% para corona de circonio, 0,69% para corona de silicato), fractura del diente (0,98% para corona de circonio, 2,07% para corona de silicato), pulpitis irreversible (0,47% para corona de zirconio, 0,39 % para corona de silicato).

Conclusión: Las coronas de zirconio y cerámica de silicato tienen una tasa de supervivencia similar en pacientes con bruxismo. Se registraron las siguientes complicaciones: astillado de porcelana, fractura de corona, pérdida de retención, apertura de contacto interproximal, caries secundaria, fractura del diente, pulpitis irreversible. En general, ambos materiales tienen una baja prevalencia de complicaciones y un porcentaje similar a excepción de la fractura dental con mayor riesgo en la corona de cerámica de silicato.

2. Abstract

Introduction: Bruxism is a pathology affecting 10 to 30% of the population and often requires rehabilitation through the placement of fixed prosthesis that could be made of zirconia due to its mechanical properties or silicate ceramic as it allows good optical properties. The objective of this systematic review is to compare the survival of zirconia and silicate ceramic crown in patients with bruxism, in addition, to determine the possible prosthetic complications and its prevalence.

Material and method: A research was done in three databases: PubMed, Scopus, Web of science on the survival of zirconia and silicate crowns in patients with bruxism until December 2022.

Results: 121 articles were found and 8 were selected. An average survival rate of 98.54% was found in zirconia crown and 97.19% in silicate crown, in addition a hazard ratio of 2.4 was found in silicate ceramic and 1.52 for crowns in general in patients with bruxism. The following prosthetic complications were found: porcelain chipping (6.93% for zirconia crown, 5.02% for silicate crown), crown fracture (0.6% for zirconia crown), loss of retention (0.71% for zirconia crown), opening of interproximal contact (3.23% for zirconia crown), secondary caries (0.83% for zirconia crown, 0.69% for silicate crown), fracture of the tooth(0.98% for zirconia crown, 2.07% for silicate crown), irreversible pulpitis(0.47% for zirconia crown, 0.39% for silicate crown).

Conclusion: Zirconia and silicate ceramic crown have a similar survival rate in patients with bruxism. The following complication were recorded: porcelain chipping, crown fracture, loss of retention, opening of interproximal contact, secondary caries, fracture of the tooth, irreversible pulpitis. Overall, both material have a low prevalence of complication and similar percentage except for dental fracture with a higher risk in silicate ceramic crown.

1. Key words

The following key words were selected:

- Bruxism
- Teeth grinding
- Teeth clenching
- Prosthesis rehabilitation
- Zirconium
- Zirconia
- Zirconium rehabilitation
- Lithium disilicate
- Felspathic ceramic
- Ceramic
- Survival
- Survival rate
- Complication
- Failure

2. List of acronyms

- VDO: Vertical dimension in occlusion

3. Introduction

Currently oral rehabilitations are subjected to higher and stricter aesthetic demand from the patient thus the importance in identifying the need of the patient and finding the best material for the patient according to mechanical, biological, and optical properties of the material but also considering any pre-existing pathology. When the patient present generalized wear, multiple fractures, missing or decayed teeth, a full mouth rehabilitation is required in order to rehabilitate their function and several factors must be considered by the clinician such as: anatomical factors (crown-root ratio, periodontal ligament, root configuration), occlusion, biomechanical consideration, periodontium (1,2). Depending on the affectation of the teeth and its location, the prosthetic rehabilitation can be done under the form of a crown, inlay, onlay, overlay or veneer.

The presence of pre-existing occlusal pathology is a crucial factor to assess when planning any prosthetic treatment as it can impact its longevity on distinct levels.

3.1 Definition of bruxism

According to the glossary of prosthodontic terms, Bruxism can be defined as "*parafunctional grinding of the teeth or an oral habit consisting of involuntary rhythmic or spasmodic non-functional gnashing, grinding or clenching of teeth, in non-chewing movements of the mandible, that can lead to occlusal trauma*." (3). Bruxism can be classified in diverse types according to the period during which the contractions occur (day/sleep bruxism), or a combination of both, the way the muscles contract (toned, periodic, combined bruxism) or the types of movement made (eccentric/ centric). Bruxism is a disorder frequently found in the daily practice as it affects 10 to 31% of the population from a wide range of ages within children and adults with no predilection for female or male. Its incidence decreases with age having its peak during adolescence and younger adulthood (4).

There is no unique aetiology to bruxism however it has been linked to several factors that can be classified in 3 categories, such as: psychosocial factors, biological, and exogenous factors.

Psychosocial factors consist in all characteristics that influences an individual psychologically or socially. Stress, anxiety, poor coping skills are psychosocial factors that have shown to have a high impact in the development and worsening bruxism.

Moreover, biological risk factors have been linked to the occurrence of bruxism through the regulation of specific neurochemicals and neurotransmitters such as dopamine and serotonin; implying that genetics and epigenetics possess a role in the occurrence of bruxism (5). It has been found that bruxism is not peripherally driven (through the occlusion) but centrally through the regulation of dopamine and serotonin, it has been shown that some genes, responsible in the regulation of dopamine through its inhibition, have been associated with bruxism (particularly in children), giving genetics and epigenetics a role in the development of bruxism (5). In addition, the regulation of serotonin has shown a role through the link between selective 5-hydroxytryptamine reuptake inhibitors and adult bruxism. Dopamine and serotonin possess an inhibitory influence on bruxism through the inhibition of spontaneous masticatory muscles whereas adrenaline and noradrenaline are activators, loss of this inhibition interferes in the muscular control and lead to bruxism (4).

Exogenous factors have been associated bruxism through the presence of habits such as alcohol, smocking, caffeine, drug, or medication intake (SSRIs/SNRIs), but also in concurrent neurological condition such as ADHD, Parkinson’s, dementia, or epilepsy (4).

3.2 Oral complication of bruxism

Bruxism is a frequent disorder found in the population however not all individual affected by the pathology requires treatment as it can , in some cases, be asymptomatic. Nonetheless it can be a highly destructive disorder and if left untreated and can cause irreversible damage to the stomatognathic system (5). Complications can be categorized into hard tissue, soft tissue, and functional limitation which are shown in Table 1 of own elaboration.

Table 1 (in annex): Oral complication of bruxism

Hard tissue	Soft tissue	Functional limitation
- Abnormal tooth wear - Dental mobility - Exostosis - Pain - Coronal fractures - Tooth loss - Attrition - Pulp exposure	- Muscular atrophy - Pulp necrosis - Soft tissue trauma - Ulceration - Sensitivity - Pulp exposure - Parotid obstruction	- Occlusal instability - reduced movement of the ATM - Restauration failure - General loss of vertical dimension

One consequence of bruxism is the decrease of the vertical dimension in occlusion (VDO), VDO is defined as the distance measured between two points when the occluding members are in contact, a correct VDO is an important parameter to consider when doing a treatment plan. The loss of VDO can interfere in the proper function of the patient's mouth though an alteration of the phonation, compensatory, anterior guidance, eruption of the worn teeth, poor aesthetic, thus the importance of its rehabilitation (3).

No true treatment exists, and the treatment of the disorder focuses itself on the correction of the complication ensued by it and the prevention of those said complications.

3.3 Diagnosis

Bruxism is a complex pathology and does not always require treatment as it does not always cause oral complication however it is important to intervene in its early stage to prevent any irreversible damage to the stomatognathic system. Oftentimes the diagnosis of bruxism is subjective and relies on the presence of clinical signs and the anamnesis of the patient can be resumed in the presence of certain symptoms and signs such as: generalized tooth wear, enamel fracture, tension in the masticatory muscle, pain in the cheek.

However, this method of diagnosis is not always reliable as not all bruxer patients possess pain or oral manifestation but also the presence of those signs and symptoms does not always indicate bruxism as they can also be associated to other aetiology such as chemical erosion, TMJ disorder, nail biting, object biting, rendering its diagnosis more complex.

More objectives methods can be used to assess the contraction of the masticatory muscle and contact of teeth through the use of electromyography (EMG) or polysomnography (PSG) which is considered as the gold standard when diagnosing bruxism, however those tools do not give a final diagnosis of bruxism but only indicates the contraction of the masticatory muscle and are not realistic tools to use in the daily practice (5). Overall, there is a complexity in the diagnosis of bruxism making it more difficult in its care.

A clear diagnosis of bruxism is essential in the prevention of any irreversible damage to the hard and soft tissue.

3.4 Treatment of bruxism

Bruxism is a complex pathology to handle due to the complexity of its diagnosis and occasional absence of sign and symptoms. No treatment for bruxism exists and its care focuses on the treatment of the symptoms rather than the disease on itself, that is to say, the prevention of the appearance and/or worsening of oral complications and the treatment of tissue damage that issued.

Due to the uncertainty of the pathology, it is important for practitioner to clearly assess the degree of risk that the patient has and the need of intervention as not all patient with bruxism requires intervention (5). An assessment method has been created in order to determine the degree of need of the patient considering different risk factors, this method can be used as it has shown accurate support in the assessment process facilitating, enhancing, and rationalising the decision making of the practitioner.

The assessment method can be seen in the table 2 (5).

Table 2 (in annex): Assessment of the intervention need in patient with bruxism.

Risk factor	Score 1	Score 2	Score 3
Age	>40	-	<40
Bruxing history	N	-	
Present bruxing		-	
Disturbed sleep pattern	N	-	Y
Extent attrition/tooth wear	low	Medium	extensive
Fractures of teeth or restauration	N	-	Y
Number of fractures of posterior teeth. Restauration (only score if above=Y)	<3	-	>3
Soft tissue injury	N	-	Y
Gastro-oesophageal reflux disorder	N	-	Y
Psychological status	Low impact	-	High impact

SSRI.SNRI use	N	-	Y
Dietary influences	N	-	
smoking	N	-	Y
Total			
13-17	Low need		
18-21	Medium need		
>21	High need		

Since bruxism is associated to several other underlying pathologies and/or risk factors, it is important to identify those factors and to intervene at this level before continuing in the care of the symptoms. The symptomatology of bruxism can be treated by different approaches and the prior use of conservative methods is recommended, such as: counselling, cognitive-behavioural strategies, physiotherapy.

In the situation in which the conservative approaches do not show signs of improvement, then a more invasive treatment can be applied such as oral appliances (nightguards) or drugs.

3.5 Classification of ceramic

Due to the irreversible sequelae of bruxism on the teeth, it is the responsibility of the dentist to rehabilitate their anatomy and function. One way of treating generalized wear can be through the placement of fixed prosthesis, depending on the patient, the pattern of wear and the teeth affected, different fixed prosthesis can be used such as: crown, inlay, onlay, overlay or veneers, made from metal only, porcelain fused to metal or fully ceramic, with the increasing demand for an aesthetic treatment, full ceramic prosthesis is a treatment option that can be considered optimal to meet the requirement from the patient.

Diverse types of ceramic that are used in dentistry exists; they can be classified according to its composition in the following way (6):

- Silicate ceramic
  - Feldspathic
  - Glass ceramic
- Oxide ceramic
  - Polycrystalline ceramic
    - Aluminous oxide
    - Zirconium oxide
  - Glass infiltrated ceramic.

The classification of ceramic depending on the composition is illustrated in Figure 1 (of own elaboration) (6).

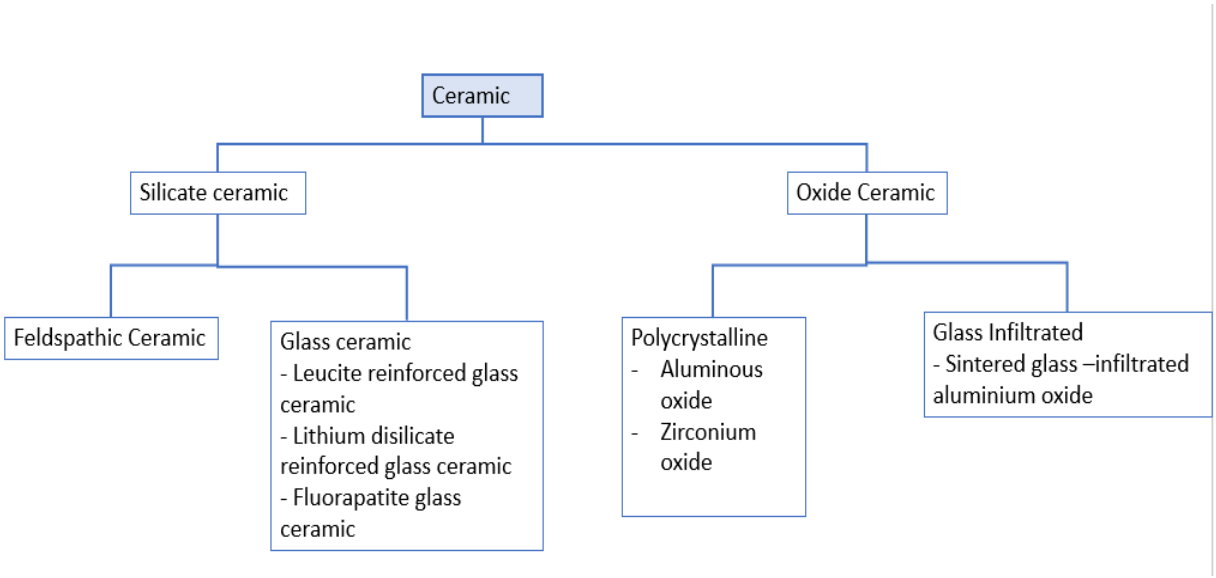

Figure 1 (in annex) : Classification of ceramic according to the composition

Silicate ceramic is a type of material which is usually favoured for prosthesis for their superior aesthetic properties, translucency, and similar properties to enamel. They are composed of feldspar, kaolin, and silica dioxide and can be classified in either feldspathic ceramic or aluminous ceramic. Felspathic ceramic is a type of ceramic composed of a higher percentages of quartz or silica dioxide (46 to 66%) in comparison to the aluminium percentage, two types of feldspathic ceramic exist: conventional or high resistance.

Feldspathic ceramic possesses excellent optical properties and good aesthetic results; however, it is considered fragile as it can only withstand 70 Mpa, hence it is usually used as a covering ceramic and needs an inner metallic structure to support the functional forces (7).

Glass ceramic are ceramic with similar composition to the conventional feldspathic ceramic however differs through the incorporation of specific elements in its ceramic mass to modify its mechanical properties, making it able to withstand higher forces (100-200Mpa). Several types of elements can be incorporated to the ceramic such as: leucite crystals; lithium disilicate or lithium orthophosphate.

One type of high resistance feldspathic ceramic is ceramic with incorporated microcrystals of leucite in the glass matrix making it more resistant, they can be found in the market under the name of: Optec-HSP® (Jeneric), Fortress® (Myron Int), Finesse® AllCeramic (Dentsply) e IPS Empress® I (Ivoclar) (7).

Another type is ceramic reinforced with disilicate, and orthophosphate of lithium also known as IPS Empress® II (Ivoclar), this ceramic has shown an increased resistance but also the opacity of the ceramic making it a less aesthetic option, in order to reach acceptable aesthetic results, it is necessary to cover it with a layer of conventional feldspathic ceramic.

New reinforced feldspathic ceramics have been developed through the incorporation of lithium disilicate giving better resistance to fracture (resistance to flexion until 400 MPa) than previous reinforced feldspathic ceramic however a covering layer needs to be used in order to improve the aesthetic (7). They are found in the market under the name: IPS Empress® II, IPS e.max Press (Ivoclar). Lithium disilicate ceramic is a very popular ceramic in dental prosthesis due to its properties however it can be prone to crack and fracture and is highly dependent to the surface characteristics of the restoration and polishing (7).

The oxide ceramic is a family of ceramic composed of two sub-types: aluminous oxide and zirconium oxide, out which Oxide zirconium is a frequently used material to make prosthesis for the past 15 years. Oxide zirconium or zirconia is a white metallic material known for its good flexural strength and fracture toughness, it is composed of zirconium with stabilizing yttrium oxide filler, in which

the crystals can be arranged in specific pattern such as cubic (stable above 2370° with moderate mechanical properties) , tetragonal (stable between 1170° and 2370° with improved mechanical properties) or monoclinic (stable at room temperature to 1170° with reduced mechanical performance and density). Three generations of zirconia have been developed through the years, the first generation is composed of 0.25% of alumina and can sustain 1GPa, it presents a high opacity and is usually used in porcelain-veneered crowns, fixed dental prosthesis in posterior and anterior region, one of its disadvantages is its vulnerability to chipping (8). It was found that zirconia stabilize itself partially in a zone of high mechanic stress due to its transformation from the tetragonal phase to the monoclinic, increasing locally the resistance and stopping the propagation of crack and fissure (8).

First generation zirconia can be veneered using glass ceramic to improve its aesthetic, however due to the difference in coefficient of thermal expansion between the zirconia framework and the veneering ceramic inner tension occurs, which when added to the external tension of the mastication forces fracture can appear (9).

Second generation (3Y-TZP) possess improved translucency with a reduced alumina percentage and more homogenous repartition, improving its translucencies, however, is deemed insufficiently aesthetic to be used in anterior sector (9).

Third generation (5Y-TZP) is composed of a balance between the cubic and tetragonal phase and is considered as fully stabilized, the improvement of its transparent phase making it less opaque but also less strong and tough. However, it was found that it retains its strength with increasing wearing time (9).

Due to its opacity, zirconia crown can be used as a nucleus and be veneered by more aesthetic ceramic such as feldspathic ceramic in order to improve the aesthetic (8).

3.6 Aesthetic requirements

With the passing years aesthetic has become a significant requirement from the patient when doing a prosthodontic rehabilitation, however several factors intervene during the prosthodontic treatment influencing the final aesthetic results (10). Before doing an aesthetic prosthetic rehabilitation, it is necessary to proceed to an extensive evaluation and analysis of the patient on different scale such as: facial, soft tissue, dental, midline, proportion analysis, smile pattern. One important factor during the rehabilitation process is to establish a good communication with the patient, to understand well their expectation out of the prothesis and to explain to them the limitation of the process according to their situation.

4. Justification and Hypothesis

4.1 Justification

Due to the frequency of bruxism in the daily practice, it is common to observe patient with irreversible damage such as extreme vertical dimension loss or teeth fracture due to the wear or extreme force load occurring parafunctional use of the masticatory muscles (5). Oftentimes, those patients require dental prosthetic rehabilitation with the objective to restore the function and aesthetic of their teeth. This objective can be reached through the use of fixed prosthesis hence it is important as dentist to be able to rehabilitate the adverse effect of bruxism using the best material possible while considering the parafunctional habit and the increasing requirement for aesthetic, pushing practitioner to consider full ceramic prosthetic approach as a treatment option. Through the years, ceramic has been a material commonly used in dentistry that has been modified and improved causing the emergence of new type of ceramic with distinct properties (7). Consequently, dentist have a wide range of ceramic to choose when making crowns hence the importance in comparing the efficacy of the treatment between the different ceramic through the survival of the prosthesis on the long term, not only to encounter the best treatment plan for the patient's case but also to match the need and expectation of the patient.

Therefore, it is a disorder that can cause uncertainty from clinician when doing a prosthetic treatment due to presence of high parafunctional load, therefore it is important to include this factor when studying prosthodontic material to improve the dental care of patient affected by this parafunctional pathology. The goal of the study is to compare the survival rate of zirconium and silicate ceramic crowns in order to determine which one out of the two is more suitable for bruxer patient, those ceramic have been chosen as they are commonly used in prosthodontic. Out of the different type of ceramic existing within the silicate ceramic family, two ceramic in specific were selected for this study: feldspathic and lithium disilicate as they are more commonly used for dental prosthesis.

4.2 Hypothesis

The hypothesis of this study consists of that zirconium prosthesis has a better survival rate than silicate ceramic prosthesis in patient with bruxism.

5. Objectives

Primary objective: Compare the survival of zirconium crown and silicate crown in patient with bruxism.

Secondary objectives:

- Establish a list of the possible prosthetic complications occurring in patient wearing a silicate ceramic or zirconium fixed prosthesis.
- Determine the prevalence of those said complications in patient with bruxism.

6. Material and methods

This systemic review has been realized at Universidad Europea de Valencia from October 2022 to June 2023 following the guidelines of the PRISMA GUIDE.

6.1 Formulation of the PICO question

Three main data bases were used to do the research of the articles: PubMed, web of science, Scopus, to realise a research of indexed articles about prosthetic rehabilitation of patient with bruxism made of either zirconia or silicate ceramic.

To guide the research, a PICO question was formulated, and it states: In patient with bruxism wearing fixed prosthesis, “In patient with bruxism rehabilitated with crowns, does Zirconium have a better survival rate than silicate ceramic?”

This question can also be formulated like the following way:

P (population): Patient with bruxism rehabilitated with crowns

I (intervention): zirconium crown

C (comparison): Silicate ceramic (felspathic or lithium disilicate) crown

O (outcome): survival

O1: list of the complications

O2: Prevalence of the complications

6.2 Eligibility criteria

The following inclusion criteria were established:

- Study design: prospective/retrospective cohort studies, case -control studies, randomized clinical trials, case studies. No minimum of patient was set, publication in English, Spanish, French and German were included that were published since 2012.
- Type of Patient: patient affected by bruxism (i.e., Presenting uncontrolled clenching or grinding or contraction of the masticatory muscle) wearing tooth-supported fixed prosthesis (crown, veneers, bridge, inlay, onlay, overlay).
- Type of Intervention: fixed prosthetic rehabilitation made from oxide zirconium.
- Comparison: fixed prosthetic rehabilitation made from silicate ceramic
- Outcome:
    - Primary variables: survival
    - Secondary variables: complications

Later on, the following several exclusion criteria were chosen systemic review, meta-analysis, experimental studies on animals, ex-vivo studies. In addition, all studies including prosthetic rehabilitation on implants were excluded.

A limit of 10 years was chosen as restriction during the research process and articles in English, Spanish, French and German were included.

6.3 Strategy of research

As previously stated, 3 main data bases were chosen for the research of the articles: PubMed, web of science, Scopus.

The following key words were used: “bruxism”, “sleep bruxism”, “teeth clenching”, “teeth grinding”, “ zirconia”, “zirconia rehabilitation”, “zirconium”, “zirconium prosthesis”, “ceramic”, “ceramic rehabilitation”, “lithium disilicate”, “feldspathic ceramic”, “ceramic prosthesis”, “survival rate”,”survival”,”complications”,”failure”. Later on, the previous key words were combined using the Boolean operator AND, OR , mesh term in PubMed were also used in order to specify the research.

The research equations used in the three data bases for the research can be found in Table 3 (of own elaboration).

Table 3 (in annex): Research equation according to the data base

Data base	Key words	Filters	Number of articles	Date
PubMed	((bruxism[Mesh Terms]) OR (sleep bruxism[Mesh Terms]) OR (bruxism) OR (teeth GRINDING) OR (TEETH CLENCHING)) AND ((zirconium) OR (zirconia) OR (zirconium prosthesis) OR (zirconium rehabilitation) OR (zirconium[Mesh Terms]) OR (zirconium oxide)) OR ((ceramic) OR (ceramic rehabilitation) OR (lithium disilicate) OR (feldspathic ceramic) OR (ceramic prosthesis) OR (silicate ceramic)) AND ((complication) OR (failure) OR (survival) OR (survival rate))	article from 2012 to 2022, English, French, Spanish, German.	51 articles	12/2022
Scopus	(ALL (bruxism OR sleep AND bruxism OR teeth AND grinding OR teeth AND clenching) AND ALL (zirconia OR zirconium OR zirconium AND rehabilitation OR zirconium AND prosthesis) OR ALL (ceramic OR ceramic AND rehabilitation OR lithium AND disilicate OR feldspathic AND ceramic OR ceramic AND prosthesis) AND ALL (survival OR complication OR failure OR survival AND rate)) AND PUBYEAR > 2012 AND PUBYEAR < 2023 AND (LIMIT-TO (SUBJAREA , "DENT"))	article from 2012 to 2022, English, French, Spanish, German. Dentistry	18 articles	12/2022

Web of science	ALL=(bruxism) OR ALL=(sleep bruxism) OR ALL=(teeth grinding) AND ALL=(teeth clenching) AND (ALL=(Zirconium) OR ALL=(zirconia) OR ALL=(zirconium rehabilitation) OR ALL=(zirconium prosthesis) OR ALL=(ceramic) OR ALL=(ceramic rehabilitation) OR ALL=(lithium disilicate) OR ALL=(ceramic prosthesis) OR ALL=(feldspathic ceramic)) AND ALL=(survival) OR ALL=(survival rate) OR ALL=(complication) OR ALL=(failure)	article from 2012 to 2022, English, French, Spanish, German.	52 articles found	12/2022

The research in PubMed and Web of science was made following the process: First research (#1) was made using the key word of the population: Bruxism OR teeth grinding OR teeth clenching, second research (#2) was elaborated using the key word of the Intervention: Zirconium OR Zirconia OR Zirconium rehabilitation , third research (#3) was made using the key words for the Comparison: Lithium disilicate OR Felspathic ceramic OR Ceramic, fourth research (#4) was done using the key words for the Outcome: Survival rate OR Complication OR failure, a final research combining the four previous research such as: #1 AND #2 OR #3 AND #4.

Research in SCOPUS was elaborated by doing a unique research using the 4 distinct search field, each composed of our key words linked using the Boolean operator OR for the population AND intervention OR comparison AND outcome.

Later on, a crossed researched was made to select articles interesting for the study. In the case in which the articles were not freely available, authors were contacted to ask for access.

6.4 Selection of the articles

The selection of the articles was made through four phases. The first phase consisted in removing all doubles articles found, resulting in a total of 91 articles. Secondly, articles were excluded after reading the title to remove articles that were irrelevant. Thirdly, the selection was made after reading the abstract of the articles previously selected, then lastly the remaining articles were sorted through after reading the entirety of the article, excluding the articles that did not comply with our inclusion criteria.

6.5 Extraction of the data

After selecting the articles relevant to the study, the following information were extracted, those information can be seen in the tables and include the following parameters depending to name of the author, size of the sample, number of restauration, type of material used (zirconia or silicate ceramic),survival rate according to the Kaplan-Meier survival analyses (measured in %), hazard ration, prosthetic complications observed during the study, prevalence of the complications.

Primary variable:

- Survival:
    - Survival rate: the Kaplan-Meier survival analyses has been chosen in order to assess the prosthetic survival. It consists of the probability of surviving in a given length of time (11) and is measured in % following the equation:

$$S_t = \frac{\text{Number of subjects living at the start} - \text{Number of subjects died}}{\text{Number of subjects living at the start}}$$

    - Restorative failure: through specific requirements sets by the study an investigator proceed to a clinical examination to label the

restoration as success or failure, often restorative failure equivalent to the need to either extract the tooth or the full replacement of the restauration.

- Hazard ratio: Hazard ratio is a method of analysis of the survival and consists of ratio of the probability of occurrence of an event in a treatment group in comparison to the control group probability over a unit of time (12).

Secondary variable:

- Presence of any prosthetic complications: during the study and after the placement of fixed prosthesis in patient with bruxism some prosthetic complications can occurs, our secondary variable consists in recording the possible complication depending on the material used (zirconia or silicate ceramic), a list of prosthetic complication has been made and include the following: chipping, fracture, wear of the antagonist tooth.
- Prevalence of prosthetic complication: consist in the probability of occurrence of those previously mentioned complications in patient with bruxism.

6.6 Quality assessment

The risk of bias was assessed with the objective of analysing the methodological quality of the included articles. To evaluate the quality of the randomized controlled trial the Cochrane 5.1.0 (http://handbook.cochrane.org) was used, the articles were classified as low risk of bias when meeting all the criteria of the guide and high risk of bias when meeting one or more criteria were not met signifying that the study could represent a possible bias and weaken the reliability of the results of our study. For non-randomized observational studies, the Newcastle-Ottawa scale was used, the low risk of bias was assigned to the articles scoring more than 6 stars and high risk of bias in the case of equal or less than 6 stars. Case series studies were assessed using the MOGA scale.

6.7 Synthesis of data

In order to summarize and compare the outcome variables between the different studies, the pondered means of the values of the main variables were gathered according to the type of study.

7. Results

7.1 Selection of the studies. Flow chart

A total of 121 articles were found in the three data bases during the initial research, PubMed (n=51), Scopus (n=18), Web of science (n=52), after eliminating the doubles, 90 articles were encountered. In addition, 1 article was added through crossed research. Out of the 91 articles, 19 articles were identified as potentially eligible through the screening of their titles and abstracts. Later on, the full text of the previously selected articles was obtained and evaluated, as results of this screening 8 articles were selected and included for the systematic review. The information and reason of exclusion for the 83 articles can be found in the Table 3. Following the process previously described a flow chart was elaborated and is illustrated in figure 2.

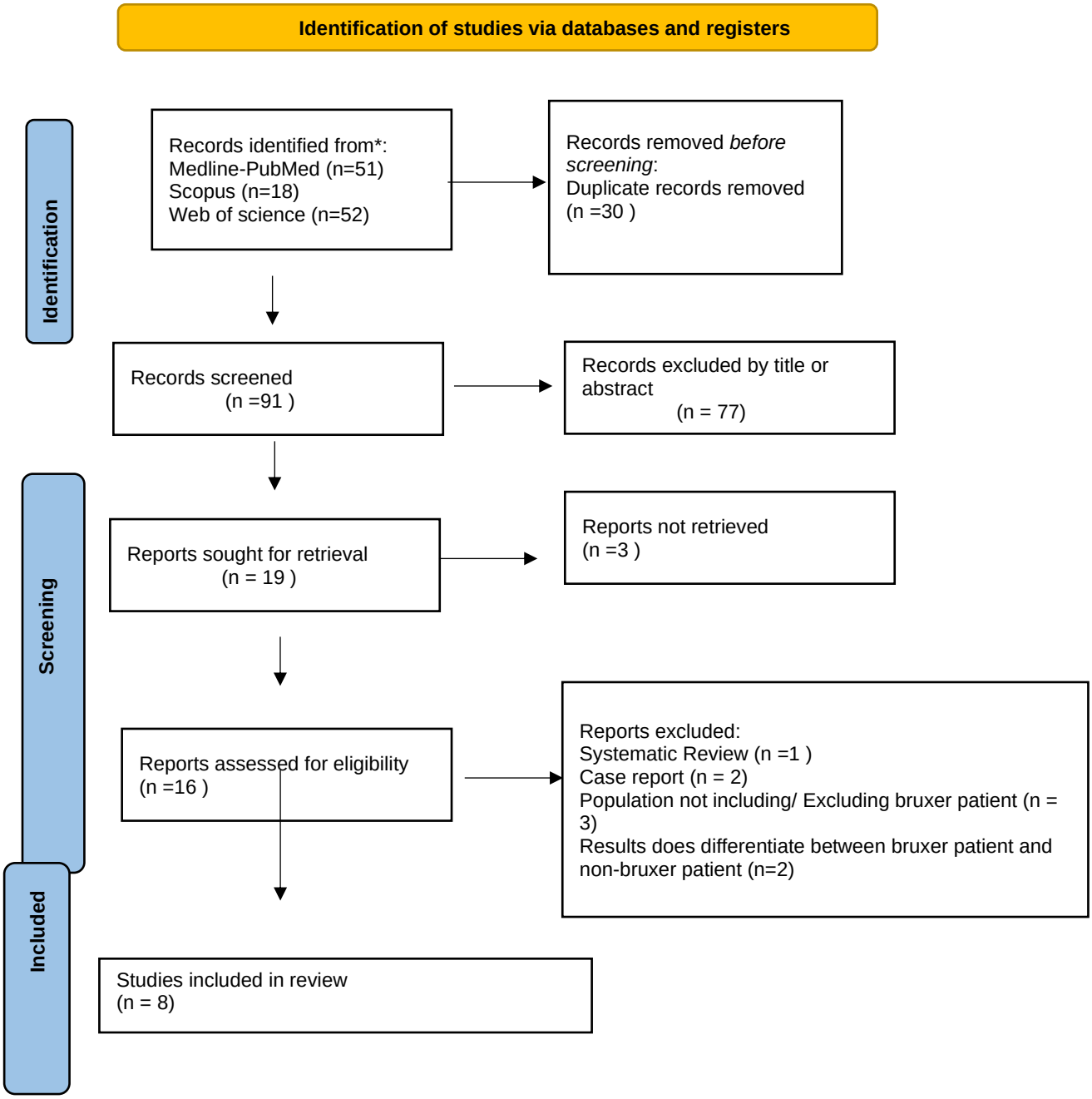

Figure 2: Flow chart (of own elaboration)

Table 4: Table with motives of exclusions (of own elaboration)

Author and year	Publication	Motive of exclusion
Monaco C et al. 2013 (13)	International Journal of Prosthodontics	Population studied did not include bruxer patient
Belleflamme M et al.2017 (14)	Journal of Dentistry	There was no information about the variable studied in patient with bruxism
Brignardello-Petersen R et al. 2018 (15)	Journal of the American Dental Association	Systematic review
Moreira A et al. 2019(16)	Case reports in dentistry	Case report
Simeone P et al. 2017(17)	The International Journal of Periodontics & Restorative Dentistry	Incomplete information about patient with bruxism in the results
Foutiadou C et al. 2021(18)	JOURNAL OF DENTISTRY	Population not bruxer
Moreira A et al.2018 (19)	JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH	Case report

7.2 Analysis of the characteristics of the reviewed studies

Out of the 8 articles selected, 1 article was a clinical randomized trial (20), 2 articles were case series (21–25), and 5 articles were observational prospective studies (21–25), out of which 7 were assessing the survival rate (20–26) and 5 the presence and prevalence of complication (20,21,23–25,27). A total of 2110 crowns were analysed out of which 1139 were made of Zr (veneered, non-veneered, or not specified) and 971 of silicate ceramic (lithium disilicate,

leucite reinforced ceramic or not specified). A summary of the characteristics of the selected articles can be found in the table 5 (of own elaboration).

Table 5: Characteristics of the selected studies

Variable of the characteristics of the studies			**Survival rate**	**Complication**	**Total**
Type of studies	Randomized clinical trial		1	1	2
	Cohort		5	5	10
	Case series		1	0	1
N° of patients			10-401	13-401	10-401
Type of crowns	Monolithic Zirconia (Zirkonzahn M1/M5, Zirkonzahn)	Non veneered	593	451	
		Veneered	391	283	
		NOT SPECIFIED	46	107	
	Silicate ceramic	Lithium disilicate: IPS e.max Press, Ivoclar vivadent, Schaan Lichtenstein, EMPRESS 2)	422	422	
		LEUCITE REINFORCED GLASS CERAMIC (EMPRESS)	21	21	
		Not specified	541	71	
N° of crowns			2014	1355	3369

In all studies selected, patient required the placement of crowns in order to rehabilitate the dentition.

Out of the 7 studies (20,22–26,28) assessing the survival rate, 3 studies studied zirconia (21,24,26) and 3 studies studied silicate ceramic (20,22,25) and 1

studied both material (23). 4 articles were assessing the survival rate and complication and 2 were assessing only the survival of crowns.

In the study of Schmitter et al. compared the survival of zirconia crown between patient with and without bruxism, Levartovsky et al. , Matalon et al. and Hansen et al. studied only a population of bruxer patient, Beier et al. studied a general population out of which 35.1% were bruxer, similar to Hawthan et al. which accounted for a percentage of bruxer patient of 32.9% (20,22–24,26,27). Additionally, the study of Klink et al. studied a population of patient affected by a decrease in the VDO due to either amelogenesis imperfect or parafunctional occlusion (25).

Out of the 6 studies (20,21,23–25,27) that were assessing the complications and its prevalence, 3 articles were studying zirconia (21,24,27), 2 silicate ceramic (20,25) and 1 both material (23,29).

It was uncovered that zirconia was the most common material used to rehabilitate the dentition in both studies that assessed the survival rate and the complication, accounting for 53.90% of the crowns studied. Not all studies indicated the type of material for silicate ceramic or the presence of veneered or not for zirconia crown.

7.3 Evaluation of methodological quality and the risk of bias

The Newcastle Ottawa scale was used in order to determine the bias risk for the 4 observational studies (19, 21,22,23) which can be seen in the Table 5, out of which 3 are considered low risk of bias (21,22,23) and one with a high risk (19). For the case series article, the MOGA scale was used, however those studies are considered high risk of bias due to nature of the study and its degree of scientific relevance. Besides, the Cochrane scale was used for the randomized clinical study (20) and it was determined to have a low risk of bias.

Table 6 : Scale of Newcastle-**Ottawa**

	Representative cohort	Selection unexposed cohort	Exposure check	Demonstration of the lack of the variable at the beginning of the study	comparability	comparability (other factors)	Measurement results	follow up sufficient	Rate of abandonment	Total
Beier et al. (22)	☆	☆	☆	☆	☆		☆	☆	☆	8
Matalon S et al. (24)		☆	☆	☆	☆		☆	☆		6
Hawthan M et al. (23)	☆	☆			☆	☆	☆	☆	☆	7
Heller H et al. (21)	☆	☆	☆		☆	☆	☆	☆	☆	8
Hawthan M et al. (30)	☆	☆	☆			☆		☆		5
Klink A et al. (28)		☆		☆	☆	☆		☆		

Table 7: Moga scale

Quality Appraisal Checklist for Case Series Studies	**Levartovsky S et al.** (26)	**Hansen T et al.**(27)
Study objective		
1- Was the hypothesis/aim/objective of the study clearly stated?	Yes	Yes
<u>Study design</u>		
2- Was the study conducted prospectively?	yes	No
3- Were the cases collected in more than one centre?	no	No

4- Were patients recruited consecutively?	yes	Yes
Study Population		
5- Were the characteristics of the patients included in the study described?	Yes	Yes
6- Were the eligibility criteria (i.e., inclusion and exclusion criteria) for entry into the study clearly stated?	Yes	Yes
7- Did patients enter the study at a similar point in the disease?	Yes	unclear
Intervention and co-intervention		
8- Was the intervention of interest clearly described?	Yes	Yes
Outcome measures		
9- Were relevant outcome measures established a priori?	Yes	Yes
10- Were outcome assessors blinded to the intervention that patients received?	no	no
11- Were the relevant outcomes measured using appropriate objective/subjective methods?	Yes	Yes
12- Were the relevant outcome measures made before and after the intervention?	Yes	Yes
Statistical analysis		
13- Were the statistical tests used to assess the relevant outcomes appropriate?	Yes	Yes
Results and conclusions		
14- Was follow-up long enough for important events and outcomes to occur?	Yes	No
15- Were losses to follow-up reported?	No	no
16- Did the study provided estimates of random variability in the data analysis of relevant outcomes?	Yes	yes
17- Were the adverse events reported?	No	No
18- Were the conclusions of the study supported by the results?	yes	Yes

Table 8 : Cochrane scale

	Random sequence (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personal (performance bias)	Blinding of outcome assessment (detection bias)	Selective reporting (reporting bias)	Other bias
Schmitter M et al. (20)	+	+	+	+	+	

7.4 Synthesis of the results

7.4.1 Survival of crowns

Out of the 8 articles selected 6 assess the survival of crowns in patient with bruxism, 4 of them assess it through the Kaplan Meier rate with 4 articles assessing zirconia crown and 1 silicate crown. The survival rate in zirconia crown varied from 96.30% to 99,60, the pondered average was calculated and resulted in a survival rate of 98.54%. As said by Schmitter et al. silicate crowns (more specifically lithium disilicate) had 100% survival rate whereases Klink et al. encountered an average survival rate over 10 years of 96.86% (20,25). The results summarizing the survival rate of zirconia crown and silicate crown in patient with bruxism can be seen in Table 9 (of own elaboration).

Table 9: survival rate (Kaplan-Meier rate) comparation in patient with bruxism between zirconia ceramic and silicate ceramic crown

	Zirconia ceramic	Silicate ceramic
Heller et al. (21)	99.20%	-
Levartovsky et al. (26)	99.60%	-
Schmitter et al. (20)	96.30%	100%
Matalon et al.(24)	97.60%	-
Klink et al.(28)	-	96.86%
Total pondered average	98.54%	97.19%

In addition, 2 articles assessed the prosthetic survival through the Hazard ratio, Hawthan et al. found a hazard ration of 1.52 for zirconia crown with no difference between zirconia and silicate ceramic and Beier et al. encountered a hazard ratio of 2.4 in silicate ceramic (22,23).

7.4.2 Complication

As previously stated, prosthetic complications can be classified in two categories: biological and technical, out of the articles selected 6 articles were assessing the presence of the complications and its prevalence. The complications found were secondary caries, fractured tooth, irreversible pulpitis, tooth loss, porcelain chipping, ceramic fracture, loss of retention and opening of interproximal contact.

Out of the biological complication,4 complications were found which are secondary caries, fractured tooth, tooth loss and irreversible pulpitis. The occurrence of secondary caries in zirconia crown was assessed by three articles and ranged from 0% to 1.75% with a pondered average of 0.83% (21,23,24). In addition, Hawthan et al. found secondary caries as the second most common complications in patient with bruxism (23). In the article by Matalon et al. two separate prevalence was found, one for veneered zirconia crown and one for non-veneered zirconia crown, the veneered crown no secondary caries was found whereas in the non-veneered group, secondary caries was found in 1.75%

of the crown (24). In addition, Klink et al. encountered a prevalence of 0.69% for secondary caries in silicate crown and lithium disilicate crowns (28).

Fracture of the teeth was found as the most common complication in zirconia crowns with a prevalence ranging from 0.9% to 4.34% and a pondered average of 0.98%. Matalon et al. found a fracture in 1.97% of veneered zirconia crown and 0% in the non-veneered zirconia crown (24). Klink et al. found 2.07% of teeth with silicate crowns encountered tooth fracture on a 10-year period observation (28).

Tooth loss is one of the complications that can occur after the placement of crowns, Hansen et al. found that patient with bruxism had a higher risk of tooth loss after placing zirconia crown due to the enhanced periodontal breakdown, in addition Hawthan et al. also found an increased risk of tooth loss in patient with bruxism independently to the material of the crown (23,27).

Irreversible pulpitis was a complication encountered in three articles and it was found overall in 0.47% of the zirconia crown ranging from 0.40% to 4.34% and from 0.23% to 3.45% of the silicate crowns, counting for a pondered average of 0.39% (20,24,28).

A summary of the prevalence of the biological complications can be seen in Table 10 (of own elaboration).

Table 10 : Prevalence of biological complication between zirconia ceramic and silicate ceramic in patient with bruxism

		Zirconia ceramic			Silicate ceramic		
		Secondary caries	Fractured tooth	Irreversible pulpitis	Secondary caries	Fractured tooth	Irreversible pulpitis
Hansen et al.(27)			1.30%	-	-	-	-
Schmitter et al. (20)		-	4.34% (root fracture)	4.34%	-	-	3.45%
Matalon et al.(24)	Veneered group	0%	1.97%	0%	-	-	-
	Non veneered group	1.75%	0%	0.4%			
Heller et al. (21)		0.60% 2	0.9% 3	-	-	-	-
Klink et al.(28)		-	-	-	0.69%	2.07%	0.23%
Pondered average		0.83%	0.98%	0.47%	0.69%	2.07%	0.39%

Technical complication is the second category of prosthetic complication, four main complications were encountered in the six articles assessing complications: porcelain chipping, crown fracture, loss of retention and opening of the proximal contact (20,21,23–25,27).

Porcelain chipping was the most common complication encountered in zirconia crown with a pondered average of 6.93% (ranging from 0% to 16.45%), Matalon et al. found a prevalence of 16.45% in the veneered group and 0% in the non-veneered group of zirconia crowns (24). In addition, Hawthan et al. found

that porcelain chipping was the least frequent complication in patient with bruxism independently to the material (23). Hansen et al. found a risk of crown chipping in zirconia crown 3 times higher in patient with bruxism (27). No porcelain chipping of silicate crowns was encountered in the study by Schmitter et al. whereas Klink et al. found a prevalence of 5.29% with half of the chipping occurring during the first two years, a pondered average was calculated, and porcelain chipping was seen in 5.02% of silicate crowns (28).

Crown fracture was encountered 0.6% (ranging from 0% to 0.87%) of the zirconia crown and 0% in silicate crown. Matalon et al. found no fracture in the veneered group but found 0.87% of the non-veneered crown fractured (24).

Loss of retention was encountered in 0.71% of the zirconia crowns (ranging from 0 to 1.31%) and 0% in silicate crown. Matalon et al. encountered a prevalence of 1.31% in the veneered group and 0% in the non-veneered group of the zirconia crown (24). Hawthan et al. found that loss of retention was the most common complications and main reason of prosthetic failure in patient with bruxism with no difference in between the material (23).

Open proximal contact was one of the technical complication encountered, it was found in 3.23% of zirconia crown (ranging from 0 to 4.37%) and 0% in silicate crowns. Matalon et al. noted a prevalence of 1.31% in the veneered group and 4.37% in the non-veneered group (24).

The quantitative results encountered can be seen summarized in Table 11 (of own elaboration).

Table 11: Prevalence of the technical complications of zirconia ceramic and silicate ceramic crowns in patient with bruxism

		Zirconia ceramic				Silicate ceramic			
		Porcelain chipping	Crown fracture (minor)	Loss of retention	Open proximal contact	Porcelain chipping	Crown fracture (minor)	Loss of retention	Open proximal contact
Hansen et al.(27)		5.20%	1.30%	-	-	-	-	-	-
Schmitter et al. (20)		0%	0%	0%	0%	0%	0%	0%	0%
Matalon et al.(24)	Veneered group	16.45%	0%	0%	1.31%	-	-	-	-
	Non veneered group	0%	0.87%	1.31%	4.37%				
Heller et al. (21)		3.00% 10	0.30% 1	0.30% 1	3.33% 11	-	-	-	-
Klink et al.(28)						5.29%			
Total pondered average		6.93%	0.6%	0.71%	3.23%	5.02%			

9. Discussion

The survival of a material when exposing it to specific condition is an important factor to take into consideration when planning a treatment, zirconia has long been the more commonly chosen material when rehabilitating a patient in need of an increase of VDO due to its ability to withstand the high occlusal forces however this type of ceramic does not allow good aesthetic and optic properties, hence the interest to study silicate ceramic as a treatment option for patient with bruxism, as it allows good aesthetic.

The present systematic review focused on fixed prosthesis in patient with bruxism, had as objective to determine and compare the survival between zirconia and silicate ceramic. Furthermore, to determine the possible complication in patient with bruxism and the prevalence of those said complications

9.1 Survival of the prosthesis

The overall survival rate of single crowns in patient with bruxism encountered in this systematic review is high for both zirconia and silicate crowns, ranging from 97.19 to 98.54 and it can be noted that both type of crowns has a similar survival rate, and no difference have been seen, refuting the hypothesis of the systematic review. In opposition, the study of Durrani S et al. which found that lithium disilicate crowns had a failure rate 5 times higher than zirconia crowns and were deemed unsuitable treatment options for patient with bruxism as it cannot withstand the stress (31).

In addition, the hazard ration was calculated, and it was found that patient with bruxism had a higher risk of crown failure overall for both material (hazard ratio from 1.52 to 2.4) that is to say, 52 to 240% more risk of prosthetic failure. This results concord with the article of Sousa N et al. that found a similar survival rate of silicate crown of 95% and also concluded that bruxism was a risk factor when placing crowns with a risk 8 times higher than patient without bruxism (32).

According to the study of Schmitter et al. ,which consists of a randomized clinical trial during which zirconia and silicate ceramic was assigned randomly to 2 groups: one bruxer and no bruxer that both needed dental rehabilitation through the placement of single crowns. It was observed that zirconia crown had 96.30% survival rate whereas silicate crown had 100% survival rate (20). However, those results can be limited by different factors such as the short period of observation (1 year) and also due to the small sample size (23 zirconia crowns and 29 silicate crowns) (20).

Klink A et al. proceeded to an observational study out of which patient were rehabilitated in order to increase the VDO either due to amelogenesis imperfecta or extensive tooth wear (bruxism) or attrition were evaluated. The authors decided to rehabilitate the patients using silicate ceramic, monolithic lithium disilicate crown were place in the posterior sector whereas Emax crown (lithium disilicate) with a veneer of felspathic ceramic were placed in the anterior sector to increase the aesthetic, in addition the patient were provided splint to wear at night (25).

Overall, a survival rate of 96,86% was found with no difference between both types of crowns. It is important to take into consideration the limitation of this article ,which first of all, studies a population of not only bruxer patient or patient with extensive tooth wear with the results generalized, but hence results could also be influence by the presence of amelogenesis imperfect and not bruxism. Also, the authors highlight the lack of data about the oral health of the patient with a full-mouth rehabilitation which could influence the results encountered (25).

Levartovsky. et al. observed the survival of zirconia crowns (non-veneered or veneered zirconia crown) in patient with bruxism needing an increase in the VDO through full mouth rehabilitation, in addition patient received occlusal splint to wear at night after the placement of the crowns (26). A survival rate of 99.6% was found, it is important to consider in the results the nature of the study which is an observational case-series study and the reduced size of the sample studies (10 patients) (26).

Beier et al. studied the survival of silicate crown in a general population out of which 35.1% were diagnosed with bruxism over a 4-month period, out of

which they assessed aesthetic match, porcelain surface, marginal discoloration, marginal integrity. In this study a hazard ratio was calculated, and it was found that bruxer patient had a significantly higher risk of prosthetic failure 2.3 times higher than non-bruxer patient (22).

As reported by Heller H et al. which examined patient rehabilitated with veneered or non-veneered zirconia crowns on teeth or implants in patient with and without bruxism. The author indicated the occlusion scheme as they set it set on maximum intercuspation in centric occlusion with either canine or group function in lateral excursion. Heller H et al. decided to place non veneered crown in the posterior sector and veneered with feldspathic ceramic for anterior teeth in order to better the aesthetic (21). The authors found a survival rate of 99.20% for zirconia crowns, however this results could be influence by the nature of the study which is a retrospective study meaning that each crown was placed in different setting and condition with varying clinical procedures. In addition, the authors highlighted that the study included a small sample size and a short follow up period, those factor could potentially limit the results encountered (21).

Matalon et al. studied the survival of monolithic zirconia crown (veneered or not veneered) in a sample of bruxer patient that needed increased VDO out of which only 7 out of the 16 patients evaluated were treated with a night guard. The authors detected a survival rate of 97.60% of the zirconia crown with overall a higher failure rate in veneered zirconia than non-veneered crowns. This Retrospective observational study is limited by several factors through its small sample size (16 patient), different clinical sequence when placing the crown, no polysomnography was used and has been assessed as a high-risk bias (24).

As stated by Hawthan M et al. which studied the installation of different type of crown (zirconia, alumina, lithium disilicate, leucite reinforced glass ceramic, felspathic ceramic) in a general population out of which 32.9% were bruxer over a period of 134.8 months. The author uncovered a hazard ratio of 1.52 in the group with bruxism for all type of ceramic and did not find a significant difference in the survival rate between the different type of ceramic which agrees with the results encountered in our systematic review (23). However, the results given by the study are not clearly mentioned for zirconia and silicate ceramic and

can therefore only be taken as a generalization. Furthermore, this study is a retrospective study during which treatment provider not calibrated, clinical procedure was not standardized or controlled. Also, the study was developed in a teaching institution, meaning that the sample selected is not necessary representative to the population in the general dental practice.

No standardized definition of prosthetic failure exists, and it is defined differently in the seven studies assessing the survival of crowns in patient with bruxism, this difference needs to be considered as some studies are stricter about their criteria of inclusion for prosthetic failure and others include more criteria hence account more crown as failed, this discrepancy in criteria could influence the results obtained. 3 studies out of the 7 included distinguished absolute to relative failure, that is to say absolute failure was defined as the presence of any complication that could only be solved through the replacement of the prosthesis or extraction of the tooth (tooth loss) whereas relative failure included all complication that could be resolve that were repairable (chipping); however, both failures were accounted in the survival rate calculated (20,24,25). Beier et al. defined the failure as the presence of any complication as prosthetic failure, whereas Hawthan et al. defined failure as the presence of extensive alveolar bone loss and or excessive tooth mobility rendering the tooth unable to retain crown and requiring extraction (22,23). Heller et al. is one of the studies that differed in its definition of failure as it made the distinction between prosthetic failure and complication, with prosthetic failure defined as the presence of any complication requiring either replacement or repair and complication as any problem that could be resolve through polishing (chipping) (21). This discrepancy in definition can influence the results uncounted in each article as some studies labelled more crowns as failed than others.

However, some limitations to the articles are to be considered. Firstly, most of the studies assessing the survival of crowns pointed that the method used to diagnose bruxism was through a questionnaire a clinical examination (presence of signs and symptoms) which can be a subjective method depending on the examiner, no studies used the gold standard of diagnosis for bruxism: the polysomnography, as it is time consuming and expensive (26). This factor could influence the results obtained as the presence of signs and symptoms does not

always signify the diagnosis of bruxism as the pathology shares similar signs and symptoms as other pathology (such as chemical erosion) and also it is a subjective method, hence some non-bruxer patient could have been included in the bruxer sample or some bruxer patient could have been left undiagnosed. A lack of the study of the type of bruxism is present in the majority of the studies, it is important to determine the nature of the bruxism with the type of movement occurring such as anterior grinding, canine grinding or clenching, statin clenching, rhythming clenching, in order to properly plan the reconstruction (33).

Another limitation to this systematic review is the sample size of the studies included 3 studies reported as a limitation of their study the small sample size and the interest in the future to organize studies with a bigger sample (20,21,24).

The type of studies is a factor that could also limit the validity of the results as most studies included are observational studies out which some are retrospective and case series which are at a lesser grade of scientific evidence than randomized clinical trial studies. Also, the unstandardized clinical procedure between crowns in retrospective study could influence the results as the crowns could have been placed in different conditions.

9.2 List of the complications

As previously stated, prosthetic complication can be classified in two categories: technical or biological. In this systemic review the following technical complication were encountered in zirconia crowns : porcelain chipping, minor crown fracture, loss of retention, opening of interproximal contact as seen in table 11 (20,21,24,27), whereas only porcelain chipping was encountered in silicate crown(25). Overall silicate crowns were less subjected to technical complications than zirconia crowns.

For the biological complications, the following have been found in zirconia and silicate crowns: such as secondary caries, fracture of the tooth, irreversible

pulpitis as seen in Table 10 (20,21,24,25,27). It was found that both zirconia and silicate crowns were affected by same type of biological complications.

Taking into consideration the previously cited limitation and the short observation time of some of the study it is possible that some complications were not recorded.

9.3 Prevalence of the complications

Knowing the prevalence of the possible complications when placing a crown in patient with bruxism is an important parameter in order to decide first the type of material to use and also to prevent those said complication. As previously listed, prosthetic complication can be categorized into biological and technical complications.

It was found that dental fracture was the most common biological complication in both zirconia and silicate crown however silicate crowns had twice more risk of dental fracture than zirconia crowns (2.07% for silicate crowns and 0.98% for zirconia crowns), this results could be due to the superior ability of the zirconia to withstand the higher occlusal loads. For secondary caries and irreversible pulpitis no difference was found between zirconia and silicate ceramic and overall, a low prevalence of the complication was found (pondered average ranging from 0.39% to 0.98% as seen in table 10). It is important to consider the limited number of studies available assessing prosthetic complications of silicate crowns in patient with bruxism, as only two studies were included in this systematic review (20,25). Furthermore, Klink et al. were the only authors assessing dental fracture and secondary caries in patient with bruxism, this limited data could influence the results obtained (25). Hence it is important in the future to organize more studies assessing complication of silicate crowns.

In addition, Matalon et al. compared the complication in veneered and non-veneered zirconia crowns, and it was found that veneered crowns were more prone to dental fracture whereas non veneered crown were more susceptible to secondary caries and irreversible pulpitis (24). Even though other studies also

assess zirconia crowns (veneered and non-veneered), Matalon et al. is the only study indicating the prevalence of the complication for each veneered or not veneered crowns whereas other studies generalized the results obtained for zirconia crowns (24). It is important to consider that the study of Matalon et al. was graded as high risk of bias due to abandonment rate, non-representativeness of the sample (as seen in table 5) .

As for the technical complications, the most common complication encountered was porcelain chipping in both type of ceramic with a prevalence of 6.93% in zirconia and 5.02% in silicate ceramic with no difference between both ceramic. In the study of Matalon et al. ,comparing veneered to non-veneered zirconia crown, porcelain chipping was more common in veneered crown (16.45%) whereas opening of the interproximal contact was more frequent in non-veneered (4.37%) (24). The results encountered opposes the results encountered by El Meshbahi N et al. As they have found that veneered zirconia is less subjected to Low temperature degradation and cracks as the zirconia core is not exposed to saliva (34).

Only three studies selected included the use of occlusal splint during their assessment, the use of an occlusal splint is an important parameter that needs to be considered when treating patient with bruxism as it is one of the treatment of the pathology (24–26). Matalon et al. highlighted the possibility of the use of occlusal splint to prevent the opening of contact points however little is known about it in the current literature (24). According to Teixeira F et al. the use of occlusal splint alleviates the stress load on which the prosthesis is subjected therefore protecting it (35).

9.4 Future line of investigation

Bruxism is a pathology commonly encountered in the clinical life of dentist and can cause irreversible effects on the soft and hard tissue of patients which could cause a loss in aesthetic and function, hence the importance for dentist to rehabilitate the dentition through fixed prosthesis. The selection of the material is a key point when treating patient with risk factors such as bruxism, the generally

accepted material ,when making crown, is zirconia due to its strength and ability to withstand high occlusal forces to the detriment of its optical and aesthetic property, in order to better the optic properties a veneer of silicate ceramic on the vestibular surface can be placed. In addition, silicate ceramic is that is frequently used when making crowns and is known for its good aesthetic and optical properties and similar properties to enamel. Hence the interest to compare both material in a population with bruxism in order to determine which material could allow the best treatment outcome.

As previously mentioned, the studies selected in this systematic review possess multiples limitation such as: small size of the sample, unstandardized clinical protocol, diagnosis of bruxism through presence of signs and symptoms, lack of randomized clinical trial. In addition, a limited number of studies assessing silicate ceramic in sample with bruxism was encountered, hence in the future it would be necessary to organize, and plan randomized clinical trial of big sized sample using a polysomnography as a diagnosis method and a specific standardized clinical protocol common to all crowns and specifically silicate crowns.

Throughout the years new materials are being created that are the results of the fusion of already existing material, such as zirconia-reinforced lithium silicate ceramic which combine the mechanical properties of the zirconia and the good aesthetic properties of silicate ceramic, it would be interesting studying this new emerging material in patient with bruxism (36).

10. Conclusion

1. Zirconia and silicate ceramic crown seem to have a similar survival rate in patient with bruxism, hence the hypothesis of this study is rejected.
2. Several complication can occur after the placement of crown, out of which the following were found in patients with bruxism: porcelain chipping, crown fracture, loss of retention, opening of interproximal contact, secondary caries, fracture of the tooth, irreversible pulpitis.
3. Overall, both material have a low prevalence of complication and similar percentage except for dental fracture, it was found that silicate ceramic crown has a higher risk of dental fracture.

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12. Annex

PRISMA GUIDE

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Front page
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	7-16
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	19

Section and Topic	Item #	Checklist item	Location where item is reported
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	21
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	20
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	22-26
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	28-30
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if	

Section and Topic	Item #	Checklist item	Location where item is reported
		not, the methods used to decide which results to collect.	
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	25.26
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	26
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	25-26
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	21
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	27
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	

Section and Topic	Item #	Checklist item	Location where item is reported
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	28-30
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they	30

Section and Topic	Item #	Checklist item	Location where item is reported
		were excluded.	
Study characteristics	17	Cite each included study and present its characteristics.	31-32
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	33-35
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	36,38,40
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	

Section and Topic	Item #	Checklist item	Location where item is reported
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	41-48
	23b	Discuss any limitations of the evidence included in the review.	41-48
	23c	Discuss any limitations of the review processes used.	41-48
	23d	Discuss implications of the results for practice, policy, and future research.	48
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	

Section and Topic	Item #	Checklist item	Location where item is reported
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

Figure 1: Classification of ceramic

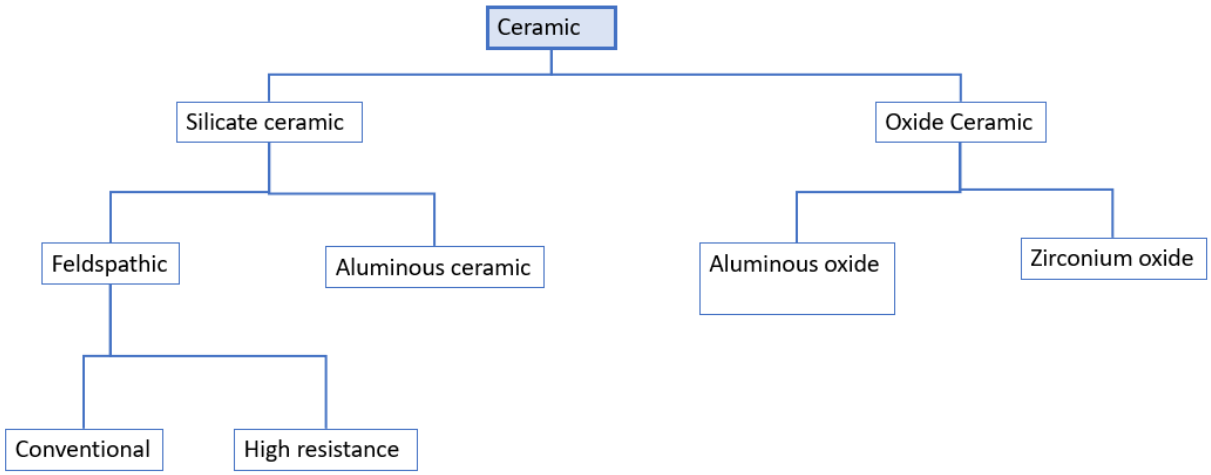

Table 3 : Oral complication of bruxism

Hard tissue	Soft tissue	Myalgia	Functional limitation
- Abnormal tooth wear - Dental mobility - Exostosis	- Muscular atrophy - Pulp necrosis - Soft tissue trauma - Ulceration - sensitivity	- Myalgia - Headache	- Occlusal instability - reduced movement of the ATM - Restauration failure - General loss of vertical dimension

Table 4 : Table describing assessment of the intervention need in patient with bruxism.

Risk factor	Score 1	Score 2	Score 3
Age	>40	-	<40
Bruxing history	N	-	
Present bruxing		-	
Disturbed sleep pattern	N	-	Y
Extent attrition/tooth wear	low	Medium	extensive
Fractures of teeth or restauration	N	-	Y
Number of fractures of posterior teeth. Restauration (only score if above=Y)	<3	-	>3
Soft tissue injury	N	-	Y
Gastro-oesophageal reflux disorder	N	-	Y
Psychological status	Low impact	-	High impact
SSRI.SNRI use	N	-	Y
Dietary influences	N	-	
smoking	N	-	Y
Total			
13-17	Low need		
18-21	Medium need		
>21	High need		

Table 3 : Table explaining the research equations used according to the data base.

Data base	Key words	Filters	Number of articles	Date
PubMed	((bruxism[Mesh Terms]) OR (sleep bruxism[Mesh Terms]) OR (bruxism)) OR (teeth GRINDING) OR (TEETH CLENCHING)) AND ((zirconium) OR (zirconia) OR (zirconium prosthesis) OR (zirconium rehabilitation) OR (zirconium[Mesh Terms]) OR (zirconium oxide)) OR ((ceramic) OR (ceramic rehabilitation) OR (lithium disilicate) OR (feldspathic ceramic) OR (ceramic prosthesis) OR (silicate ceramic)) AND ((complication) OR (failure) OR (survival) OR (survival rate))	article from 2012 to 2022, English, French, Spanish, German.	48 articles	11/2022
Scopus	(ALL (bruxism OR sleep AND bruxism OR teeth AND grinding OR teeth AND clenching) AND ALL (zirconia OR zirconium OR zirconium AND rehabilitation OR zirconium AND prosthesis) OR ALL (ceramic OR ceramic AND rehabilitation OR lithium AND disilicate OR feldspathic AND ceramic OR ceramic AND prosthesis) AND ALL (survival OR complication OR failure OR survival AND rate)) AND PUBYEAR	article from 2012 to 2022, English, French, Spanish, German. Dentistry	18 articles	12/2022

	> 2012 AND PUBYEAR < 2023 AND (LIMIT-TO (SUBJAREA , "DENT"))			
Web of science	ALL=(bruxism) OR ALL=(sleep bruxism) OR ALL=(teeth grinding) AND ALL=(teeth clenching) AND (ALL=(Zirconium) OR ALL=(zirconia) OR ALL=(zirconium rehabilitation) OR ALL=(zirconium prosthesis) OR ALL=(ceramic) OR ALL=(ceramic rehabilitation) OR ALL=(lithium disilicate) OR ALL=(ceramic prosthesis) OR ALL=(feldspathic ceramic)) AND ALL=(survival) OR ALL=(survival rate) OR ALL=(complication) OR ALL=(failure)	article from 2012 to 2022, English, French, Spanish, German. Dentistry	58 articles found	12/2022

Figure 2: Prisma Flow chart of searching and selection process of titles during systematic review.

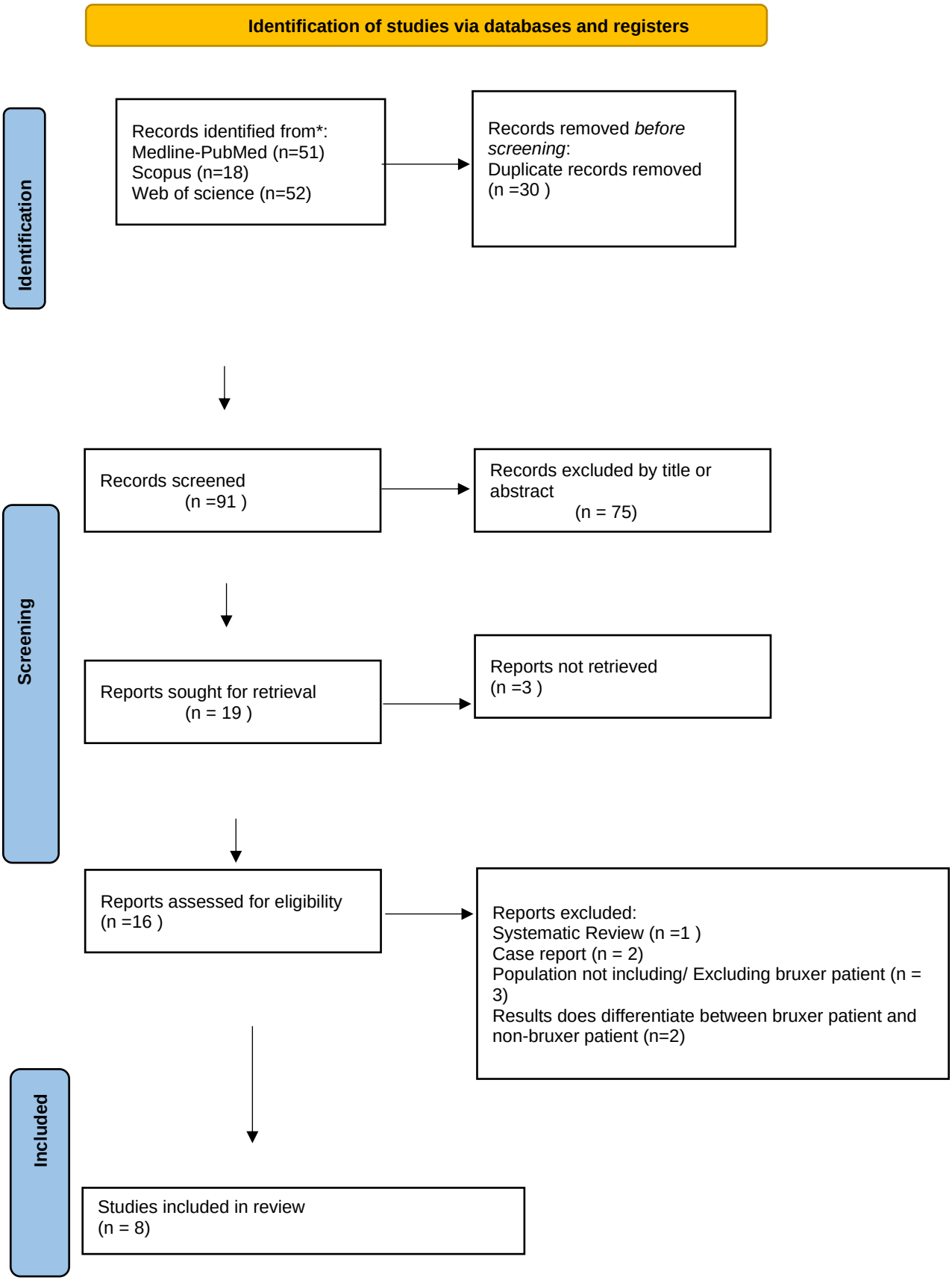

Table 4: Table describing the motives of exclusions.

Author and year	Publication	Motive of exclusion
Monaco C et al. 2013 (13)	International Journal of Prosthodontics	Population studied did not include bruxer patient
Belleflamme M et al.2017 (14)	Journal of Dentistry	There was no information about the variable studied in patient with bruxism
Brignardello-Petersen R et al. 2018 (15)	Journal of the American Dental Association	Systematic review
Moreira A et al. 2019(16)	Case reports in dentistry	Case report
Simeone P et al. 2017(17)	The International Journal of Periodontics & Restorative Dentistry	Incomplete information about patient with bruxism in the results
Foutiadou C et al. 2021(18)	JOURNAL OF DENTISTRY	Population not bruxer
Moreira A et al.2018 (19)	JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH	Case report

Table 5: Table describing the characteristics of the selected studies.

Variable of the characteristics of the studies			**Survival rate**	**Complication**	**Total**
Type of studies	Randomized clinical trial		1	1	2
	Cohort		5	5	10
	Case series		1	0	1
N° of patients			10-401	13-401	10-401
Type of crowns	Monolithic zirconia (Zirkonzahn M1/M5, Zirkonzahn)	Non veneered	593	451	
		Veneered	391	283	
		Not specified	46	107	
	Silicate ceramic	Lithium disilicate: IPS e.max Press, Ivoclar vivadent, Schaan Lichtenstein, EMPRESS 2)	422	422	
		Leucite reinforced glass ceramic (EMPRESS)	21	21	
		Not specified	541	71	
N° of crowns			2014	1355	3369

Table 6 : Evaluation of the bias risk of observational studies using the scale of Newcastle-Ottawa

	Representative cohort	**Selection unexposed cohort**	**Exposure check**	**Demonstration of the lack of the variable at the beginning of the study**	**comparability**	**comparability (other factors)**	**Measurement results**	**follow up sufficient**	**Rate of abandonment**	**Total**
Beier et al. (22)	☆	☆	☆	☆	☆		☆	☆	☆	8
Matalon S et al. (24)		☆	☆	☆	☆		☆	☆		6
Hawthan M et al. (23)	☆	☆			☆	☆	☆	☆	☆	7
Heller H et al. (21)	☆	☆	☆		☆	☆	☆	☆	☆	8
Hawthan M et al. (23)	☆	☆	☆			☆		☆		5
Klink A et al. (28)		☆		☆	☆	☆		☆		

Table 7: Evaluation of the bias risk of case series studies using Moga scale.

Quality Appraisal Checklist for Case Series Studies	**Levartovsky S et al.** (26)	**Hansen T et al.**(27)
Study objective		
1- Was the hypothesis/aim/objective of the study clearly stated?	Yes	Yes
Study design		
2- Was the study conducted prospectively?	yes	No
3- Were the cases collected in more than one centre?	no	No
4- Were patients recruited consecutively?	yes	Yes
Study Population		
5- Were the characteristics of the patients included in the study described?	Yes	Yes
6- Were the eligibility criteria (i.e., inclusion and exclusion criteria) for entry into the study clearly stated?	Yes	Yes
7- Did patients enter the study at a similar point in the disease?	Yes	unclear
Intervention and co-intervention		
8- Was the intervention of interest clearly described?	Yes	Yes
Outcome measures		
9- Were relevant outcome measures established a priori?	Yes	Yes
10- Were outcome assessors blinded to the intervention that patients received?	no	no
11- Were the relevant outcomes measured using appropriate objective/subjective methods?	Yes	Yes

12- Were the relevant outcome measures made before and after the intervention?	Yes	Yes
Statistical analysis		
13- Were the statistical tests used to assess the relevant outcomes appropriate?	Yes	Yes
Results and conclusions		
14- Was follow-up long enough for important events and outcomes to occur?	Yes	No
15- Were losses to follow-up reported?	No	no
16- Did the study provided estimates of random variability in the data analysis of relevant outcomes?	Yes	yes
17- Were the adverse events reported?	No	No
18- Were the conclusions of the study supported by the results?	yes	Yes

Table 8 :Evaluation of the bias risk of randomized clinical trial using the COCHRANE scale.

	Random sequence (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personal (performance bias)	Blinding of outcome assessment (detection bias)	Selective reporting (reporting bias)	Other bias
Schmitter M et al. (20)	+	+	+	+	+	

Table 9: Table comparing the survival rate (Kaplan-Meier rate) between zirconia ceramic and silicate ceramic crown in patient with bruxism.

	Zirconia ceramic	Silicate ceramic
Heller et al. (21)	99.20%	-
Levartovsky et al. (26)	99.60%	-
Schmitter et al. (20)	96.30%	100%
Matalon et al.(24)	97.60%	-
Klink et al.(28)	-	96.86%
Total pondered average	98.54%	97.19%

Table 10 : Results describing the prevalence of biological complication between zirconia ceramic and silicate ceramic in patient with bruxism.

		Zirconia ceramic			Silicate ceramic		
		Secondary caries	Fractured tooth	Irreversible pulpitis	Secondary caries	Fractured tooth	Irreversible pulpitis
Hansen et al. (27)			1.30%	-	-	-	-
Schmitter et al. (20)		-	4.34%	4.34%	-	-	3.45%
Matalon et al. (24)	Veneered group	0%	1.97%	0%	-	-	-

	Non veneered group	1.75%	0%	0.4%			
Heller et al. (21)		0.60% 2	0.9% 3	-	-	-	-
Klink et al. (28)		-	-	-	0.69%	2.07%	0.23%
Pondered average		0.83%	0.98%	0.47%	0.69%	2.07%	0.39%

Table 11: : Results describing the prevalence of the technical complications of zirconia ceramic and silicate ceramic crowns in patient with bruxism.

		Zirconia ceramic				Silicate ceramic			
		Porcelain chipping	CROWN fracture (minor)	Loss of retention	Open proximal contact	Porcelain chipping	fracture (minor)	Loss of retention	Open proximal contact
Hansen et al. (27)		5.20%	1.30%	-	-	-	-	-	-
Schmitter et al. (20)		0%	0%	0%	0%	0%	0%	0%	0%
Matalon et al.(24)	Veneered group	16.45%	0%	0%	1.31%	-	-	-	-
	Non veneered group	0%	0.87%	1.31%	4.37%				
Heller et al. (21)		3.00% 10	0.30% 1	0.30% 1	3.33% 11	-	-	-	-
Klink et al.(28)						5.29%			
Total pondered average		6.93%	0.6%	0.71%	3.23%	5.02%			

COMPARISON OF ZIRCONIUM AND SILICATE CERAMIC PROSTHESIS IN PATIENT AFFECTED BY BRUXISM: A SYSTEMATIC REVIEW

Running title: COMPARISON OF ZIRCONIUM AND SILICATE CERAMIC PROSTHESIS IN PATIENT AFFECTED BY BRUXISM

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Abstract

Introduction: Bruxism is a pathology affecting 10 to 30% of the population and often requires rehabilitation through the placement of crowns that could be made of zirconia or silicate ceramic. **Aim:** The primary objective of this study is to compare the survival of zirconia and silicate ceramic crown in patients with bruxism and additionally to determine the possible prosthetic complications and its prevalence.

Material and method: A research was done in three databases: PubMed, Scopus, Web of science on the survival of zirconia and silicate crowns in patients with bruxism until December 2022.

Results: 121 articles were encountered and 8 were selected out of which 1 is a randomized clinical trial, 2 are case series, 5 are observational studies. An average survival rate of 98.54% was found in zirconia crown and 97.19% in silicate crown, in addition a hazard ratio of 2.4 was found in silicate ceramic and 1.52 for crowns in general in patients with bruxism. The following prosthetic complications were found: porcelain chipping (6.93% for zirconia crown, 5.02% for silicate crown), crown fracture (0.6% for zirconia crown), loss of retention (0.71% for zirconia crown), opening of interproximal contact (3.23% for zirconia crown), secondary caries (0.83% for zirconia crown, 0.69% for silicate crown), fracture of the tooth(0.98% for zirconia crown, 2.07% for silicate crown), irreversible pulpitis(0.47% for zirconia crown, 0.39% for silicate crown).

Conclusion: Zirconia and silicate ceramic crown have a similar survival rate in patients with bruxism. The following complication were recorded: porcelain chipping, crown fracture, loss of retention, opening of interproximal contact, secondary caries, fracture of the tooth, irreversible pulpitis. Overall, both material have a low prevalence of complication and similar percentage except for dental fracture with a higher risk in silicate ceramic crown.

Key words: Bruxism , Teeth grinding, Teeth clenching, Prosthesis rehabilitation, Zirconium, Zirconia, Zirconium rehabilitation, Lithium disilicate, Felspathic ceramic, Ceramic, Survival , Survival rate, Complication, Failure

Introduction

Currently oral rehabilitations are subjected to higher and stricter aesthetic demand from the patient thus the importance in identifying the need of the patient and finding the best material for the patient according to mechanical, biological, and optical properties of the material but also considering any pre-existing pathology. The presence of pre-existing occlusal pathology such as bruxism is a factor to consider when planning any prosthetic treatment. Bruxism can be defined as “parafunctional grinding of the teeth or an oral habit consisting of involuntary rhythmic or spasmodic non-functional gnashing, grinding or clenching of teeth, in non-chewing movements of the mandible, that can lead to occlusal trauma.” (1). Bruxism is a disorder frequently found in the daily practice as it affects 10 to 31% of the population and can be a highly destructive disorder causing irreversible damage to the stomatognathic system such as general tooth wear, decrease in vertical dimension in occlusion (VDO), alteration of function and aesthetic (2). Oftentimes the diagnosis of bruxism relies on the presence of clinical signs and the anamnesis of the patient however tools such as electromyography (EMG) or polysomnography can be used and are considered as the gold standard of diagnosis. Full coverage crowns can be used to treat the generalized tooth wear due to bruxism that can be made out of silicate ceramic or Oxide Ceramic. Different type of silicate ceramic exists such as feldspathic, lithium disilicate, these type of ceramic are commonly used in the making of crowns and are known for their good aesthetic even though they withstand less forces. Out of the oxide ceramic, zirconia is a ceramic commonly used in patient with altered occlusal forces as it can withstand more occlusal forces than silicate ceramic; however, it does not provide good aesthetic.

The aim of the present systematic review was to systematically review the following question: In patient with bruxism treated with crowns, does Zirconium have a better survival rate than silicate ceramic?”

This was done by firstly assessing the survival between zirconia and silicate crowns then determining the possible prosthetic complication and its prevalence.

Material and methods

This systematic review complies with the PRISMA statement (Preferred Reporting Items for Systematic reviews and Meta-Analyses)

Focus question: The focus question was established according ot the PICO structure:

- P (population): Patient with bruxism rehabilitated with crowns
- I (intervention): zirconium crown
- C (comparison): Silicate ceramic (felspathic or lithium disilicate) crown
- O (outcome):
- O1survival
- O2: list of the complications
- O3: Prevalence of the complications

Eligibility criteria : the following inclusion criteria were used:

- Study design: prospective/retrospective cohort studies, case -control studies, randomized clinical trials, case studies, publication in English, Spanish, French and German were included that were published since 2012.
- Type of Patient: bruxer patient rehabilitated with tooth-supported crowns.
- Type of Intervention: placement of crowns made from oxide zirconium.
- Comparison: crowns made from silicate ceramic.
- Outcome: Primary variables: survival and as secondary variables: list the possible complications and determine its prevalences.

The following several exclusion criteria were chosen systemic review, meta-analysis, case reports, experimental studies on animals, ex-vivo studies, crowns on implants, A limit of 10 years.

Information sources and data search: 3 main data bases were chosen for the research of the articles: PubMed, web of science, Scopus, in addition a manual research was carried out. The following key words were used: “bruxism”, “sleep bruxism”, “teeth clenching”, “teeth grinding”, “ zirconia”, “zirconia rehabilitation”, “zirconium”, “zirconium prosthesis”, “ceramic”, “ceramic rehabilitation”, “lithium disilicate”,“feldspathic ceramic”, “ceramic prosthesis”,“survival rate”,”survival”,”complications”,”failure”. Later on, the previous key words were

combined using the Boolean operator AND, OR , mesh term in PubMed were also used in order to specify the research.

The following research equation was carried out in Pubmed: ((bruxism[Mesh Terms]) OR (sleep bruxism[Mesh Terms]) OR (bruxism) OR (teeth GRINDING) OR (TEETH CLENCHING)) AND ((zirconium) OR (zirconia) OR (zirconium prosthesis) OR (zirconium rehabilitation) OR (zirconium[Mesh Terms]) OR (zirconium oxide)) OR ((ceramic) OR (ceramic rehabilitation) OR (lithium disilicate) OR (feldspathic ceramic) OR (ceramic prosthesis) OR (silicate ceramic)) AND ((complication) OR (failure) OR (survival) OR (survival rate)).

Search strategy: The selection of the articles was made through four phases. The first phase consisted in removing all doubles articles found, resulting in a total of 91 articles. Secondly, articles were excluded after reading the title to remove articles that were irrelevant. Thirdly, the selection was made after reading the abstract of the articles previously selected, then lastly the remaining articles were sorted through after reading the entirety of the article, excluding the articles that did not comply with our inclusion criteria.

Extraction data: The following data were extracted from the studies selected and arranged in tables: name of the author, size of the sample, number of restauration, type of material used (zirconia or silicate ceramic),survival rate according to the Kaplan-Meier survival analyses (measured in %), hazard ratio, prosthetic complications observed during the study, prevalence of the complications.

Quality and risk of bias assessment: To evaluate the quality of the randomized controlled trial the Cochrane 5.1.0 (http://handbook.cochrane.org) was used, the articles were classified as low risk of bias when meeting all the criteria of the guide and high risk of bias when meeting one or more criteria were not met signifying that the study could represent a possible bias and weaken the reliability of the results of our study. For non-randomized observational studies, the Newcastle-Ottawa scale was used, the low risk of bias for a score more than 6 stars and high risk of bias for a score of equal or less than 6 stars. Case series studies were assessed using the MOGA scale.

Synthesis of data: In order to summarize and compare the outcome variables, the pondered means of the values of the main variables were gathered according to the type of study.

Results

Study selection : A total of 121 articles were found in the three data bases during the initial research, PubMed (n=51), Scopus (n=18), Web of science (n=52), 1 articles from the manual research after eliminating the doubles, 91 articles were encountered. 19 articles were identified as potentially eligible through the screening of their titles and abstracts. After evaluating the full text of the articles, a total of 8 articles were included (figure 1).

Study characteristics: Out of the 8 articles selected, 1 article was a clinical randomized trial (3), 2 articles were case series (4–8), and 5 articles were observational prospective studies (4–8), out of which 7 were assessing the survival rate (3–9) and 5 the presence and prevalence of complication (3,4,6–8,10), the characteristics of the articles can be seen in table 1. A total of 1139 zirconia and 971 of silicate ceramic crown were assessed.

Risk of bias: For the randomized study a low risk of bias was considered (table 7) (3), additionally for the observational studies 3 are considered low risk of bias (table 5) (21,22,23) and one with a high risk (19). The case -series studies were considered high risk of bias due to nature of the study and its degree of scientific relevance (table 6).

Synthesis of results:

Survival : The survival rate in zirconia crown varied from 96.30% to 99,60, the pondered average was calculated and resulted in a survival rate of 98.54% (table 2). In addition, 2 articles assessed the prosthetic survival through the Hazard ratio, Hawthan et al. found a hazard ration of 1.52 for zirconia crown with no difference between zirconia and silicate ceramic and Beier et al. encountered a hazard ratio of 2.4 in silicate ceramic (5,6). The results are shown in table 2.

Complication : The complications found were secondary caries, fractured tooth, irreversible pulpitis, tooth loss, porcelain chipping, ceramic fracture, loss of retention

and opening of interproximal contact.

Prevalence of the complications: Out of the biological complication,4 complications were found which are secondary caries, fractured tooth, tooth loss and irreversible pulpitis (table 3). The occurrence of secondary caries in zirconia crown accumulated a pondered average of 0.83% (4,6,7). Fracture of the teeth was found as the most common complication in zirconia crowns with a prevalence ranging from 0.9% to 4.34% and a pondered average of 0.98%. Tooth loss is one of the complications that can occur after the placement of crowns, Hansen et al. found that patient with bruxism had a higher risk of tooth loss after placing zirconia crown due to the enhanced periodontal breakdown, in addition Hawthan et al. also found an increased risk of tooth loss in patient with bruxism independently to the material of the crown (6,10). Irreversible pulpitis was a complication encountered in three articles and it was found overall in 0.47% of the zirconia crown ranging from 0.40% to 4.34% and from 0.23% to 3.45% of the silicate crowns, counting for a pondered average of 0.39% (3,7,11). Technical complication is the second category of prosthetic complication, four main complications were encountered in the six articles assessing complications: porcelain chipping, crown fracture, loss of retention and opening of the proximal contact (table 4) (3,4,6–8,10). Porcelain chipping was the most common complication encountered in zirconia crown with a pondered average of 6.93% (ranging from 0% to 16.45%). Crown fracture was encountered 0.6% (ranging from 0% to 0.87%). Loss of retention was encountered in 0.71% of the zirconia crowns (ranging from 0 to 1.31%) and 0% in silicate crown. Open proximal contact was one of the technical complication encountered, it was found in 3.23% of zirconia crown (ranging from 0 to 4.37%) and 0% in silicate crowns.

Discussion

Survival: The results of this study has found a similar survival rate of single crowns in patient with bruxism for both zirconia and silicate crowns, ranging from 97.19 to 98.54 and it can be noted that both type of crowns has a similar survival rate, and no difference have been seen, refuting the hypothesis of the systematic review. In opposition, the study of Durrani S et al. which found that lithium disilicate crowns had

a failure rate 5 times higher than zirconia crowns and were deemed unsuitable treatment options for patient with bruxism as it cannot withstand the stress (12). In addition, it was found that patient with bruxism had a higher risk of crown failure overall for both material (hazard ratio from 1.52 to 2.4) that is to say, 52 to 240% more risk of prosthetic failure. This results concord with the article of Sousa N et al. that found a similar survival rate of silicate crown of 95% and also concluded that bruxism was a risk factor when placing crowns with a risk 8 times higher than patient without bruxism (13).

However, some limitations to the articles are to be considered. Firstly, no standardized definition of prosthetic failure exists, this difference needs to be considered as some studies are stricter about their criteria of inclusion for prosthetic failure and others include more criteria hence account more crown as failed. This discrepancy in definition can influence the results uncounted in each article as some studies labelled more crowns as failed than others.

Additionally, the main diagnosis method used was through a questionnaire a clinical examination (presence of signs and symptoms) which can be a subjective and depend on the examiner, no studies used the gold standard of diagnosis for bruxism: the polysomnography, as it is time consuming and expensive (9). This factor could influence the results obtained as the presence of signs and symptoms does not always signify the diagnosis of bruxism as the pathology shares similar signs and symptoms as other pathology (such as chemical erosion) and also it is a subjective method, hence some non-bruxer patient could have been included in the bruxer sample or some bruxer patient could have been left undiagnosed. Another limitation to this systematic review is the sample size of the studies included 3 studies reported as a limitation of their study the small sample size and the interest in the future to organize studies with a bigger sample (3,4,7). The type of studies is a factor that could also limit the validity of the results as most studies included are observational studies out which some are retrospective and case series which are at a lesser grade of scientific evidence than randomized clinical trial studies. Also, the unstandardized clinical procedure between crowns in retrospective study could influence the results as the crowns could have

been placed in different conditions.

List of the complications: The following technical complications were encountered in irconia crowns : porcelain chipping, minor crown fracture, loss of retention, opening of interproximal contact as seen in table 4 (20,21,24,27), whereas only porcelain chipping was encountered in silicate crown (25). Overall silicate crowns were less subjected to technical complications than zirconia crowns. For the biological complications, the following have been found in both types of crowns: secondary caries, fracture of the tooth, irreversible pulpitis as seen in Table 10 (20,21,24,25,27). It was found that both zirconia and silicate crowns were affected by same type of biological complications. Taking into consideration the previously cited limitation and the short observation time of some of the study it is possible that some complications were not recorded.

Prevalence of the complications: It was found that dental fracture was the most common biological complication in both zirconia and silicate crown however silicate crowns had twice more risk of dental fracture than zirconia crowns (2.07% for silicate crowns and 0.98% for zirconia crowns), this results could be due to the superior ability of the zirconia to withstand the higher occlusal loads. For secondary caries and irreversible pulpitis no difference was found between zirconia and silicate ceramic and overall, a low prevalence of the complication was found (from 0.39% to 0.98%). It is important to consider the limited number of studies available assessing the biological complication of silicate crowns in patient with bruxism as only two studies were used in this systematic review, this limited data could influence the results obtained (3,8).

As for the technical complications, the most common complication encountered was porcelain chipping in both type of ceramic with no difference between both ceramic. The results encountered opposes the results encountered by El Meshbahi N et al. As they have found that veneered zirconia is less subjected to Low temperature degradation and cracks as the zirconia core is not exposed to saliva (15).

Only three studies selected included the use of occlusal splint during their assessment. Matalon et al. highlighted the possibility of the use of occlusal splint to prevent the opening of contact points however little is known about it in the current literature (7). In

agreement to Teixeira F et al. that states that the use of occlusal splint alleviates the stress load on which the prosthesis is subjected therefore protecting it (16).

Future line of investigation : As previously mentioned, the studies selected in this systematic review possess multiples limitation such as: small size of the sample, unstandardized clinical protocol, diagnosis of bruxism through presence of signs and symptoms, lack of randomized clinical trial, lack of study of silicate ceramic in bruxer. Henceforth, in the future it would be necessary to organize, and plan randomized clinical trial of big sized sample using a polysomnography as a diagnosis method and a specific standardized clinical protocol common to all crowns and specifically silicate crowns.

Additionally, it would be interesting to study new emerging materials in bruxer, such as zirconia-reinforced lithium silicate ceramic as it combines the mechanical properties of the zirconia and the good aesthetic properties of silicate ceramic (17).

Conclusion

Within the limitation of this systematic review, zirconia and silicate ceramic crown have a similar survival rate in patient with bruxism, hence the hypothesis of this study is rejected. Several complication can occur after the placement of crown, out of which the following were found in patients with bruxism: porcelain chipping, crown fracture, loss of retention, opening of interproximal contact, secondary caries, fracture of the tooth, irreversible pulpitis. Overall, both material have a low prevalence of complication and similar percentage except for dental fracture, it was found that silicate ceramic crown has a higher risk of dental fracture.

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Table 1: Table describing the characteristics of the selected studies.

Variable of the characteristics of the studies			Survival rate	Complication	Total
Type of studies	Randomized clinical trial		1	1	2
	Cohort		5	5	10
	Case series		1	0	1
N° of patients			10-401	13-401	10-401
Type of crowns	Monolithic Zirconia (Zirkonzahn M1/M5, Zirkonzahn)	Non veneered	593	451	
		Veneered	391	283	
		Not specified	46	107	
	Silicate ceramic	Lithium disilicate: IPS e.max Press, Ivoclar vivadent, Schaan Lichtenstein, EMPRESS 2)	422	422	
		Leucite reinforced glass reinforced ceramic (EMPRESS)	21	21	
		Not specified	541	71	
N° of crowns			2014	1355	3369

Table 2: Table comparing the survival rate (Kaplan-Meier rate) between zirconia ceramic and silicate ceramic crown in patient with bruxism.

	Zirconia ceramic	Silicate ceramic
Heller et al. (4)	99.20%	-
Levartovsky et al. (9)	99.60%	-
Schmitter et al. (3)	96.30%	100%
Matalon et al. (7)	97.60%	-
Klink et al. (11)	-	96.86%
Total pondered average	98.54%	97.19%

Table 3 : Results describing the prevalence of biological complication between zirconia ceramic and Silicate ceramic in patient with bruxism.

		Zirconia ceramic			Silicate ceramic		
		Secondary caries	Fractured tooth	Irreversible pulpitis	Secondary caries	Fractured tooth	Irreversible pulpitis
Hansen et al. (10) 84			1.30%	-	-	-	-
Schmitter et al. (3)		-	4.34%	4.34%	-	-	3.45%
Matalon et al. (7)	Veneered group	0%	1.97%	0%	-	-	-
	Non veneered group	1.75%	0%	0.4%			
Heller et al. (4)		0.60% 2	0.9% 3	-	-	-	-
Klink et al. (11)		-	-	-	0.69%	2.07%	0.23%
Pondered average		0.83%	0.98%	0.47%	0.69%	2.07%	0.39%

Table 4: : Results describing the prevalence of the technical complications of zirconia ceramic and silicate ceramic crowns in patient with bruxism.

		Zirconia ceramic				Silicate ceramic			
		Porcelain chipping	CROWN fracture (minor)	Loss of retention	Open proximal contact	Porcelain chipping	fracture (minor)	Loss of retention	Open proximal contact
Hansen et al. (10)		5.20%	1.30%	-	-	-	-	-	-
Schmitter et al. (3)		0%	0%	0%	0%	0%	0%	0%	0%
Matalon et al. (7)	Veneered group	16.45%	0%	0%	1.31%	-	-	-	-
	Non veneered group	0%	0.87%	1.31%	4.37%				
Heller et al. (4)		3.00% 10	0.30% 1	0.30% 1	3.33% 11	-	-	-	-
Klink et al. (11)						5.29%			
Total pondered average		6.93%	0.6%	0.71%	3.23%	5.02%			

Figure 1: Prisma Flow chart of searching and selection process of titles during systematic review.

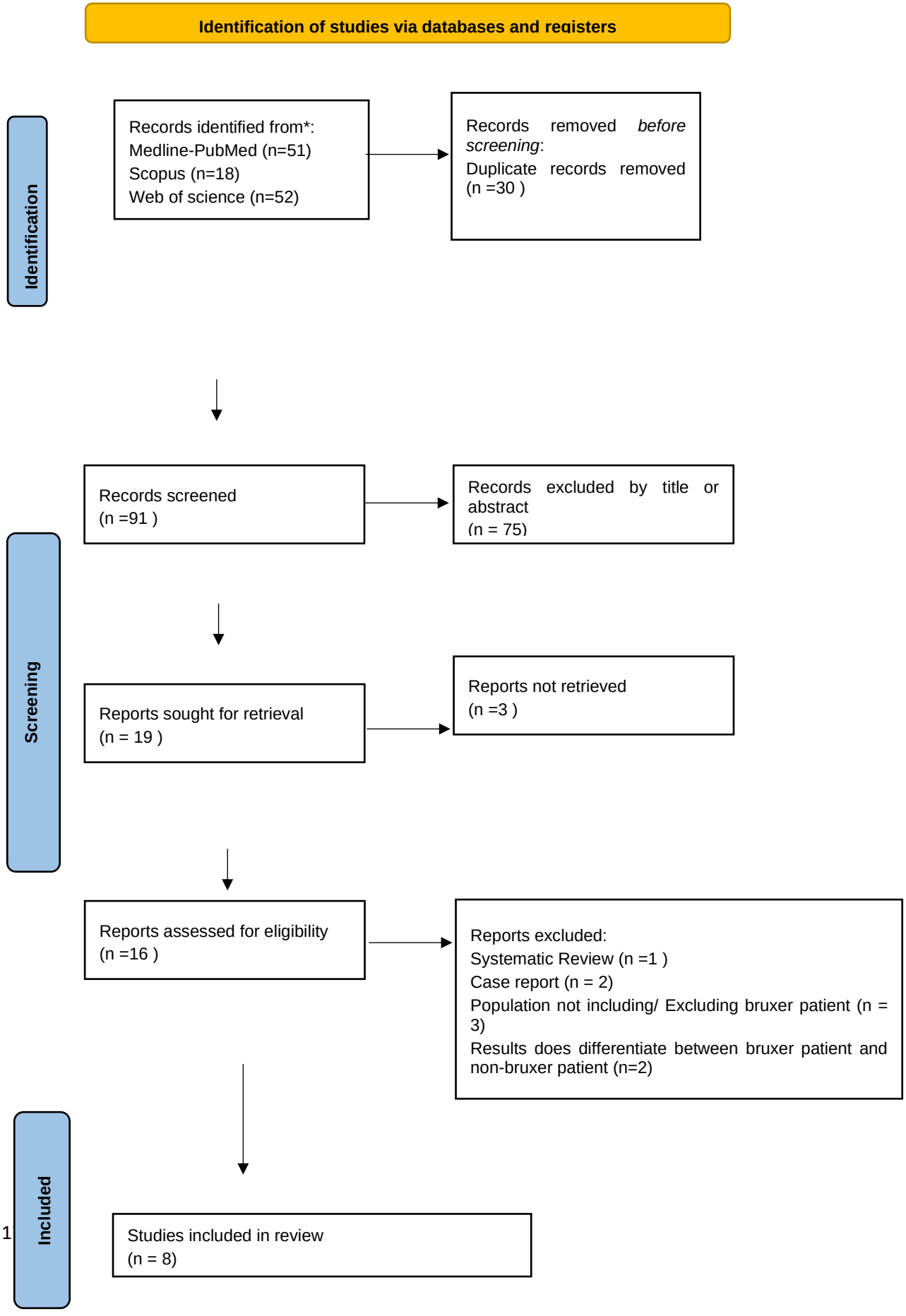

Table 5 : Evaluation of the bias risk of observational studies using the scale of Newcastle-Ottawa

	Representative cohort	Selection unexposed cohort	Exposure check	Demonstration of the lack of the variable at the beginning of the study	comparability	comparability (other factors)	Measurement results	follow up sufficient	Rate of abandonment	Total
Beier et al. (22)	☆	☆	☆	☆	☆		☆	☆	☆	8
Matalon S et al. (24)		☆	☆	☆	☆		☆	☆		6
Hawthan M et al. (23)	☆	☆			☆	☆	☆	☆	☆	7
Heller H et al. (21)	☆	☆	☆		☆	☆	☆	☆	☆	8
Hawthan M et al. (23)	☆	☆	☆			☆		☆		5
Klink A et al. (28)		☆		☆	☆	☆		☆		

Table 6: Evaluation of the bias risk of case series studies using Moga scale.

Quality Appraisal Checklist for Case Series Studies	**Levartovsky S et al.** (26)	**Hansen T et al.** (27)
Study objective		
1- Was the hypothesis/aim/objective of the study clearly stated?	Yes	Yes
Study design		
2- Was the study conducted prospectively?	yes	No
3- Were the cases collected in more than one centre?	no	No
4- Were patients recruited consecutively?	yes	Yes
Study Population		
5- Were the characteristics of the patients included in the study described?	Yes	Yes
6- Were the eligibility criteria (i.e., inclusion and exclusion criteria) for entry into the study clearly stated?	Yes	Yes
7- Did patients enter the study at a similar point in the disease?	Yes	unclear
Intervention and co-intervention		
8- Was the intervention of interest clearly described?	Yes	Yes
Outcome measures		
9- Were relevant outcome measures established a priori?	Yes	Yes
10- Were outcome assessors blinded to the intervention that patients received?	no	no
11- Were the relevant outcomes measured using appropriate objective/subjective methods?	Yes	Yes

12- Were the relevant outcome measures made before and after the intervention?	Yes	Yes
Statistical analysis		
13- Were the statistical tests used to assess the relevant outcomes appropriate?	Yes	Yes
Results and conclusions		
14- Was follow-up long enough for important events and outcomes to occur?	Yes	No
15- Were losses to follow-up reported?	No	no
16- Did the study provided estimates of random variability in the data analysis of relevant outcomes?	Yes	yes
17- Were the adverse events reported?	No	No
18- Were the conclusions of the study supported by the results?	yes	Yes

Table 7:Evaluation of the bias risk of randomized clinical trial using the COCHRANE scale.

	Random sequence (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personal (performance bias)	Blinding of outcome assessment (dection bias)	Deselective reporting (reporting bias)	Other bias
Schmitter M et al. (20)	+	+	+	+	+	

COMPARACIÓN DE PRÓTESIS DE CERÁMICA DE ZIRCONIO Y SILICATO EN PACIENTES BRUXISTAS: UNA REVISIÓN SISTEMÁTICA

Título corriente: COMPARACIÓN DE PRÓTESIS DE CERÁMICA DE ZIRCONIO Y SILICATO EN PACIENTES BRUXISTAS

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Resumen

Introducción: El bruxismo es una patología que afecta del 10 al 30% de la población y muchas veces requiere rehabilitación mediante la colocación de coronas fabricadas de zirconio o de silicato. **Objetivo:** El objetivo principal de este estudio es comparar la supervivencia de las coronas cerámicas de zirconio y silicato en pacientes con bruxismo y ,adicionalmente, determinar las posibles complicaciones protésicas y su prevalencia.

Material y método: Se realizó una investigación en tres bases de datos: PubMed, Scopus y Web of science sobre la supervivencia de coronas de zirconio y silicato en pacientes con bruxismo hasta diciembre de 2022.

Resultados: Se encontraron 121 artículos y se seleccionaron 8 de los cuales 1 ensayo clínico aleatorizado, 2 series de casos, 5 estudios observacionales. Se encontró una tasa de supervivencia promedio de 98.54% en corona de zirconio y 97.19% en corona de silicato, además se encontró un hazard ratio de 2.4 en cerámica de silicato y 1.52 para coronas en general en pacientes con bruxismo. Se encontraron las siguientes complicaciones protésicas: astillado de porcelana (6,93% para corona de zirconio, 5,02% para corona de silicato), fractura de corona (0,6% para corona de zirconio), pérdida de retención (0,71% para corona de zirconio), apertura de contacto interproximal (3,23 % para corona de zirconio), caries secundaria (0,83% para corona de zirconio, 0,69% para corona de silicato), fractura del diente (0,98% para corona de zirconio, 2,07% para corona de silicato), pulpitis irreversible (0,47% para corona de zirconio, 0,39 % para corona de silicato).

Conclusión: Las coronas de zirconio y cerámica de silicato tienen una tasa de supervivencia similar en pacientes con bruxismo. Se registraron las siguientes complicaciones: astillado de porcelana, fractura de corona, pérdida de retención, apertura de contacto interproximal, caries secundaria, fractura del diente, pulpitis irreversible. En general, ambos materiales tienen una baja prevalencia de complicaciones y un porcentaje similar excepto la fractura dental con mayor riesgo en la corona de cerámica de silicato. **Palabras clave:** bruxismo, rechinamiento, apretamiento, rehabilitación, zirconio, zirconio, rehabilitación con zirconio, disilicato de litio, cerámica felspática, cerámica, supervivencia, tasa de supervivencia, complicación, fracaso

Introducción

Actualmente, las rehabilitaciones orales están sujetas a una demanda estética más alta y estricta por parte del paciente, de ahí la importancia de identificar la necesidad del paciente y encontrar el mejor material para el paciente de acuerdo con las propiedades mecánicas, biológicas y ópticas del material, pero también considerando cualquier pre- patología existente. El bruxismo es un factor para tener en cuenta a la hora de planificar cualquier tratamiento protésico. El bruxismo se puede definir como "el rechinar parafuncional de los dientes o un hábito oral que consiste en rechinar, rechinar o apretar los dientes de manera involuntaria, rítmica o espasmódica, no funcional, en movimientos no masticatorios de la mandíbula, que puede conducir a un trauma oclusal" (1). El bruxismo es un trastorno que se encuentra con frecuencia en la práctica diaria ya que afecta del 10 al 31% de la población y puede ser un trastorno altamente destructivo causando daños irreversibles como desgaste dental general, disminución de la dimensión vertical en oclusión (VDO), alteración de la función y estética (2). A menudo, el diagnóstico de bruxismo se basa en la presencia de signos clínicos y la anamnesis del paciente, se pueden utilizar herramientas como la electromiografía (EMG) o la polisomnografía y se consideran el estándar de oro del diagnóstico. Para el tratamiento del desgaste dental generalizado por bruxismo se pueden utilizar coronas de cobertura total que pueden ser de cerámica de silicato o de Cerámica de Óxido. Existen diferentes tipos de cerámicas de silicato como el feldespático, el disilicato de litio, este tipo de cerámicas son comúnmente utilizadas en la elaboración de coronas y son conocidas por su buena estética, aunque soportan menos fuerzas. Fuera de la cerámica de óxido, zirconio es una cerámica de uso común en pacientes con fuerzas oclusales alteradas, ya que puede soportar más fuerzas oclusales que la cerámica de silicato; sin embargo, no proporciona una buena estética. El objetivo de la presente revisión sistemática fue revisar sistemáticamente la siguiente pregunta: ¿En pacientes con bruxismo tratados con coronas, el circonio tiene una mejor tasa de supervivencia que la cerámica de silicato?" Esto se hizo evaluando en primer lugar la supervivencia entre las coronas de zirconio y las de silicato y luego determinando la posible complicación protésica y su prevalencia.

Material y métodos

Esta revisión sistemática cumple con la declaración PRISMA (Preferred Reporting Items for Systematic reviews and Met-Analyses).

Pregunta de enfoque: La pregunta de enfoque se estableció de acuerdo con la estructura PICO:

- P (población): Paciente con bruxismo rehabilitado con coronas
- I (intervención): corona de circonio
- C (comparación): corona de cerámica de silicato (felspático o disilicato de litio)
- O (resultado):
    - O1 Supervivencia
    - O2: lista de las complicaciones
    - O3: Prevalencia de las complicaciones

Criterios de elegibilidad: se utilizaron los siguientes criterios de inclusión:

- Diseño del estudio: se incluyeron estudios de cohortes prospectivos/retrospectivos, estudios de casos y controles, ensayos clínicos aleatorizados, estudios de casos, publicación en inglés, español, francés y alemán que se publicaron desde 2012.
- Tipo de Paciente: Paciente bruxista rehabilitado con coronas diente soportadas.
- Tipo de Intervención: colocación de coronas de óxido de zirconio.
- Comparación: coronas de cerámica de silicato.
- Resultado: Variables primarias: supervivencia y como variables secundarias: enumerar las posibles complicaciones y determinar sus prevalencias.

Se eligieron los siguientes varios criterios de exclusión: revisión sistémica, metaanálisis, informes de casos, estudios experimentales en animales, estudios ex vivo, coronas sobre implantes, un límite de 10 años.

Fuentes de información y búsqueda de datos: Para la búsqueda de los artículos se escogieron 3 bases de datos principales: PubMed, web of science, Scopus, además se realizó una búsqueda manual. Se utilizaron las siguientes palabras clave: “bruxismo”, “bruxismo del sueño”, “apretar los dientes”, “rechinar los dientes”, “zirconio”, “rehabilitación de zirconio”, “zirconio”, “prótesis de zirconio”,

“cerámica”, “cerámica rehabilitación”, “disilicato de litio”, “cerámica feldespática”, “prótesis cerámica”, “tasa de supervivencia”, “supervivencia”, “complicaciones”, “fracaso”. Posteriormente, las palabras clave anteriores se combinaron utilizando el operador booleano AND, OR, término de malla en PubMed para especificar la investigación. La siguiente ecuación de investigación se llevó a cabo en Pubmed: ((bruxismo[Mesh Terms]) OR (dormir bruxismo[Mesh Terms]) OR (bruxismo) OR (dientes rechinando) OR (DIENTES APRETAR)) AND ((zirconio) OR (zirconia) OR (prótesis de zirconio) OR (rehabilitación de zirconio) OR (zirconio[Mesh Terms]) OR (óxido de zirconio)) OR ((cerámica) OR (rehabilitación de cerámica) OR (disilicato de litio) OR (cerámica feldespática) OR (prótesis de cerámica) O (cerámica de silicato)) Y ((complicación) O (fracaso) O (supervivencia) O (tasa de supervivencia)).

Estrategia de búsqueda: La selección de los artículos se realizó a través de cuatro fases. La primera fase consistió en la eliminación de todos los artículos dobles encontrados, dando como resultado un total de 91 artículos. En segundo lugar, los artículos se excluyeron después de leer el título para eliminar los artículos que eran irrelevantes. En tercer lugar, la selección se realizó tras la lectura del resumen de los artículos previamente seleccionados, y, por último, el resto de los artículos se clasificaron tras la lectura del artículo completo, excluyendo los artículos que no cumplían con nuestros criterios de inclusión.

Datos de extracción: Los siguientes datos fueron extraídos de los estudios seleccionados y ordenados en tablas: nombre del autor, tamaño de la muestra, número de restauraciones, tipo de material utilizado (zirconio o cerámica de silicato), tasa de supervivencia según los análisis de supervivencia de Kaplan-Meier (medida en %), razón de riesgo, complicaciones protésicas observadas durante el estudio, prevalencia de las complicaciones.

Evaluación de la calidad y el riesgo de sesgo: El riesgo de sesgo se evaluó con el objetivo de analizar la calidad metodológica de los artículos incluidos. Para evaluar la calidad del ensayo controlado aleatorizado se utilizó el Cochrane 5.1.0 (http://handbook.cochrane.org), los artículos se clasificaron como de bajo riesgo de sesgo al cumplir con todos los criterios de la guía y alto riesgo de sesgo cuando el

cumplimiento de uno o más criterios no se cumplieron, lo que significa que el estudio podría representar un posible sesgo y debilitar la confiabilidad de los resultados de nuestro estudio. Para los estudios observacionales no aleatorizados se utilizó la escala Newcastle-Ottawa, asignándose bajo riesgo de sesgo a los artículos con puntuación superior a 6 estrellas y alto riesgo de sesgo a los artículos con puntuación igual o inferior a 6 estrellas. Los estudios de series de casos se evaluaron mediante la escala MOGA.

Síntesis de datos: Para resumir y comparar las variables de resultado entre los diferentes estudios se recogieron las medias ponderadas de los valores de las principales variables según el tipo de estudio.

Resultados

Selección de estudios: Se encontraron un total de 121 artículos en las tres bases de datos durante la investigación inicial, PubMed (n=51), Scopus (n=18), Web of Science (n=52), 1 artículo de la búsqueda manual después de eliminar los dobles , se encontraron 91 artículos. 19 artículos fueron identificados como potencialmente elegibles a través de la selección de sus títulos y resúmenes. Después de la lectura del texto completo se seleccionaron 8 artículos que se incluyeron para la revisión sistemática (figura 1).

Características del estudio: De los 8 artículos seleccionados, 1 artículo era un ensayo clínico aleatorizado (3), 2 artículos eran series de casos (4–8) y 5 artículos eran estudios observacionales prospectivos (4–8), de los cuales 7 evaluaban la supervivencia tasa (3-9) y 5 la presencia y prevalencia de complicación (3,4,6-8,10). Se analizaron un total de 3369 coronas de las cuales 1114 fueron de Zr (revestidas, sin revestir o sin especificar) y 985 de cerámica de silicato (tabla 1).

Riesgo de sesgo: Para el estudio aleatorizado se consideró bajo riesgo de sesgo (tabla 7) (3), adicionalmente para los estudios observacionales 3 se consideran de bajo riesgo de sesgo (21,22,23) y uno de alto riesgo (tabla 5) (19). Los estudios de serie de casos se consideraron de alto riesgo de sesgo debido a la naturaleza del estudio y su grado de relevancia científica (tabla 6).

Síntesis de resultados:

Supervivencia: La tasa de supervivencia en corona de zirconio varió de 96,30% a 99,60, se calculó el promedio ponderado y resultó una tasa de supervivencia de 98,54% (tabla 2). Además, 2 artículos evaluaron la supervivencia protésica a través del Hazard ratio, Hawthan et al. encontró una relación de riesgo de 1,52 para la corona de zirconio sin diferencia entre la cerámica de zirconio y la de silicato y Beier et al. encontró una relación de riesgo de 2,4 en cerámica de silicato (5,6). Resultados se muestran en la tabla 2.

Complicación: Las complicaciones encontradas fueron caries secundaria, diente fracturado, pulpitis irreversible, pérdida dentaria, astillado de porcelana, fractura de cerámica, pérdida de retención y apertura de contacto interproximal.

Prevalencia de las complicaciones: De la complicación biológica se encontraron 4 complicaciones que son caries secundaria, diente fracturado, pérdida dentaria y pulpitis irreversible (tabla 3). La ocurrencia de caries secundaria en corona de zirconio fue evaluada por tres artículos y varió de 0% a 1,75% con un promedio ponderado de 0,83% (4,6,7). La fractura de los dientes se encontró como la complicación más común en las coronas de zirconio con una prevalencia que va de 0,9% a 4,34% y un promedio ponderado de 0,98%. La pérdida de dientes es una de las complicaciones que se pueden presentar luego de la colocación de coronas, Hansen et al. encontraron que los pacientes con bruxismo tenían un mayor riesgo de pérdida de dientes después de colocar una corona de zirconio debido a la mayor degradación periodontal, además Hawthan et al. también encontraron un mayor riesgo de pérdida dentaria en pacientes con bruxismo independientemente del material de la corona (6,10). La pulpitis irreversible fue una complicación encontrada en tres artículos y se encontró en general en el 0,47% de la corona de zirconio variando de 0,40% a 4,34% y de 0,23% a 3,45% de las coronas de silicato, contando para un promedio ponderado de 0,39% (3 ,7,11). La complicación técnica es la segunda categoría de complicación protésica, se encontraron cuatro complicaciones principales en los seis artículos que evaluaron las complicaciones: astillado de porcelana, fractura de corona, pérdida de retención y apertura del contacto proximal (tabla 4) (3,4,6–8, 10). El astillado de porcelana fue la complicación más común encontrada en la corona de zirconio con un promedio

ponderado de 6,93 % (rango de 0 % a 16,45%). La fractura de la corona se encontró en un 0,6 % (con un rango de 0 % a 0,87 %) en la corona de zirconio y en un 0 % en la corona de silicato. El contacto proximal abierto fue una de las complicaciones técnicas encontradas, se encontró en el 3,23% de las coronas de zirconio (rango de 0 a 4,37%) y en el 0% de las coronas de silicato.

Discusión: Los resultados de este estudio han encontrado una tasa de supervivencia similar de coronas en pacientes con bruxismo tanto para coronas de zirconio como de silicato, que van desde 97,19% a 98,54% y se puede observar que ambos tipos de coronas tienen una tasa de supervivencia similar, y no se puede observar ninguna diferencia significativa, refutando la hipótesis de la revisión sistemática. En oposición, el estudio de Durrani S et al. que encontró que las coronas de disilicato de litio tenían una tasa de fracaso 5 veces mayor que las coronas de zirconio y se consideraron opciones de tratamiento inadecuadas para pacientes con bruxismo, ya que no pueden soportar el estrés (12). Además, se calculó el hazard ratio y se encontró que los pacientes con bruxismo tenían mayor riesgo de fallo coronario en general para ambos materiales (hazard ratio de 1.52 a 2.4) es decir, 52 a 240% más riesgo de fallo protésico . Esto resulta en concordancia con el artículo de Sousa N et al. que encontró una tasa de supervivencia similar de corona de silicato del 95% y también concluyó que el bruxismo era un factor de riesgo al colocar coronas con un riesgo 8 veces mayor que el paciente sin bruxismo (13).

Sin embargo, se deben considerar algunas limitaciones a los artículos. En primer lugar, no existe una definición estandarizada de fallo protésico, esta diferencia debe ser considerada ya que algunos estudios son más estrictos en cuanto a sus criterios de inclusión para fallo protésico y otros incluyen más. Por tanto, los criterios dan cuenta de más coronas como fallidas, esta discrepancia de criterios podría influir en los resultados obtenidos. Además, el método principalmente utilizado para diagnosticar el bruxismo fue a través de un cuestionario y un examen clínico (presencia de signos y síntomas) que puede ser subjetivo y dependiendo del examinador, ningún estudio utilizó el estándar de oro de diagnóstico: la polisomnografía, ya que es lenta y costosa (9). Este factor podría influir en los

resultados obtenidos ya que la presencia de signos y síntomas no siempre significa el diagnóstico de bruxismo, ya que la patología comparte signos y síntomas similares a otras patologías (como la erosión química) y además es un método subjetivo, por lo que algunos paciente sin bruxismo podría haber sido incluido en la muestra de bruxistas o algún paciente con bruxismo podría haber quedado no diagnosticado. El tipo de estudios es un factor que podría limitar la validez de los resultados ya que la mayoría de los estudios incluidos son estudios observacionales retrospectivos y series de casos que tienen un grado de evidencia científica menor que los estudios de ensayos clínicos aleatorizados. Además, el procedimiento clínico no estandarizado en el estudio retrospectivo podría influir en los resultados ya que las coronas podrían haber sido colocadas en diferentes condiciones.

Lista de las complicaciones: Se encontraron las siguientes complicaciones técnicas en coronas de zirconio: astillado de porcelana, fractura menor de la corona, pérdida de retención, apertura del contacto interproximal como se ve en la tabla 4 (20,21,24,27), mientras que solo se encontró astillado de porcelana en la corona de silicato (25). En general las coronas de silicato estuvieron menos sujetas a complicaciones técnicas que las coronas de zirconio. En cuanto a las complicaciones biológicas se han encontrado en ambos tipos de coronas: caries secundaria, fractura del diente, pulpitis irreversible como se ve en la Tabla 10 (20,21,24 ,25,27). Se encontró que tanto las coronas de zirconio como las de silicato se vieron afectadas por el mismo tipo de complicaciones biológicas. Teniendo en cuenta la limitación mencionada anteriormente y el corto tiempo de observación de algunos de los estudios, es posible que algunas complicaciones no se hayan registrado.

Prevalencia de las complicaciones: Se encontró que la fractura dental era la complicación biológica más común tanto en la corona de zirconio como en la de silicato, sin embargo, las coronas de silicato tenían el doble de riesgo de fractura dental que las coronas de zirconio (2.07% para las coronas de silicato y 0.98% para las coronas de zirconio), estos resultados podrían deberse a la capacidad superior del zirconio para soportar las cargas oclusales más altas. Para caries secundaria y pulpitis irreversible no se encontró diferencia entre zirconio y cerámica de silicato y en

general se encontró una baja prevalencia de la complicación (de 0,39% a 0,98%). Es importante considerar el número limitado de estudios disponibles que evalúan la complicación biológica de las coronas de silicato en pacientes con bruxismo, ya que solo se utilizaron dos estudios en esta revisión sistemática, estos datos limitados podrían influir en los resultados obtenidos (3,8).

En cuanto a las complicaciones técnicas, la complicación más común encontrada fue el desconchado de porcelana en ambos tipos de cerámica con un predominio del 6,93% en cerámica de zirconio y del 5,02% en cerámica de silicato sin diferencia entre ambas cerámicas. Los resultados encontrados se oponen a los resultados encontrados por El Meshbahi N et al. que han descubierto que el zirconio revestido está menos sujeto a la degradación a baja temperatura y a las grietas, ya que el núcleo de zirconio no está expuesto a la saliva (15). Solo tres estudios seleccionados incluyeron el uso de férula oclusal durante su evaluación (7–9). Matalón et al. destacó la posibilidad del uso de férula oclusal para prevenir la apertura de los puntos de contacto, sin embargo, poco se sabe al respecto en la literatura actual (7). De acuerdo con Teixeira F et al. que establece que el uso de férula oclusal alivia la carga de estrés a la que se somete la prótesis protegiéndola (16).

Futura línea de investigación: Los estudios seleccionados en esta revisión sistemática poseen múltiples limitaciones tales como: tamaño pequeño de la muestra, protocolo clínico no estandarizado, diagnóstico de bruxismo por presencia de signos y síntomas, falta de ensayo clínico aleatorizado, falta de estudio de cerámica de silicato en bruxista En adelante, en un futuro sería necesario organizar y planificar ensayos clínicos aleatorizados de gran tamaño de muestra utilizando como método de diagnóstico la polisomnografía y un protocolo clínico estandarizado específico común a todas las coronas y en concreto a las coronas de silicato. Adicionalmente, sería interesante estudiar nuevos materiales emergentes, como la cerámica de silicato de litio reforzada con zirconio, ya que combina las propiedades mecánicas de la zirconio y las buenas propiedades estéticas de la cerámica de silicato (17).

Conclusiones: Dentro de las limitaciones de esta revisión sistemática, las coronas de zirconio y cerámica de silicato tienen una tasa de supervivencia similar en pacientes

con bruxismo, por lo que se rechaza la hipótesis de este estudio. Varias complicaciones pueden ocurrir después de la colocación de la corona, de las cuales se encontraron las siguientes en pacientes con bruxismo: astillado de porcelana, fractura de corona, pérdida de retención, apertura de contacto interproximal, caries secundaria, fractura del diente, pulpitis irreversible. En general, ambos materiales tienen una baja prevalencia de complicaciones y un porcentaje similar a excepción de la fractura dental, se encontró que la corona de cerámica de silicato tiene un mayor riesgo de fractura dental.

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Table 1: Table describing the characteristics of the selected studies.

Variable of the characteristics of the studies			**Survival rate**	**Complication**	**Total**
Type of studies	Randomized clinical trial		1	1	2
	Cohort		5	5	10
	Case series		1	0	1
N° of patients			10-401	13-401	10-401
Type of crowns	Monolithic Zirconia (Zirkonzahn M1/M5, Zirkonzahn)	Non veneered	593	451	
		Veneered	391	283	
		Not specified	46	107	
	Silicate ceramic	Lithium disilicate: IPS e.max Press, Ivoclar vivadent, Schaan Lichtenstein, EMPRESS 2)	422	422	
		Leucite reinforced glass ceramic (EMPRESS)	21	21	
		Not specified	541	71	
N° of crowns			2014	1355	3369

Table 2: Table comparing the survival rate (Kaplan-Meier rate) between zirconia ceramic and silicate ceramic crown in patient with bruxism.

	Zirconia ceramic	Silicate ceramic
Heller et al. (4)	99.20%	-
Levartovsky et al. (9)	99.60%	-
Schmitter et al. (3)	96.30%	100%
Matalon et al. (7)	97.60%	-
Klink et al. (11)	-	96.86%
Total pondered average	98.54%	97.19%

Table 3 : Results describing the prevalence of biological complication between zirconia ceramic and Silicate ceramic in patient with bruxism.

		Zirconia ceramic			Silicate ceramic		
		Secondary caries	Fractured tooth	Irreversible pulpitis	Secondary caries	Fractured tooth	Irreversible pulpitis
Hansen et al. (10)			1.30%	-	-	-	-
Schmitter et al. (3)		-	4.34%	4.34%	-	-	3.45%
Matalon et al. (7)	Veneered group	0%	1.97%	0%	-	-	-
	Non veneered group	1.75%	0%	0.4%			
Heller et al. (4)		0.60% 2	0.9% 3	-	-	-	-
Klink et al. (11)		-	-	-	0.69%	2.07%	0.23%
Pondered average		0.83%	0.98%	0.47%	0.69%	2.07%	0.39%

Table 4: : Results describing the prevalence of the technical complications of zirconia ceramic and silicate ceramic crowns in patient with bruxism.

		Zirconia ceramic				Silicate ceramic			
		Porcelain chipping	CROWN fracture (minor)	Loss of retention	Open proximal contact	Porcelain chipping	fracture (minor)	Loss of retention	Open proximal contact
Hansen et al. (10)		5.20%	1.30%	-	-	-	-	-	-
Schmitter et al. (3)		0%	0%	0%	0%	0%	0%	0%	0%
Matalon et al. (7)	Veneered group	16.45%	0%	0%	1.31%	-	-	-	-
	Non veneered group	0%	0.87%	1.31%	4.37%				
Heller et al. (4)		3.00% 10	0.30% 1	0.30% 1	3.33% 11	-	-	-	-
Klink et al. (11)						5.29%			
Total pondered average		6.93%	0.6%	0.71%	3.23%	5.02%			

Figure 1: Prisma Flow chart of searching and selection process of titles during systematic review.

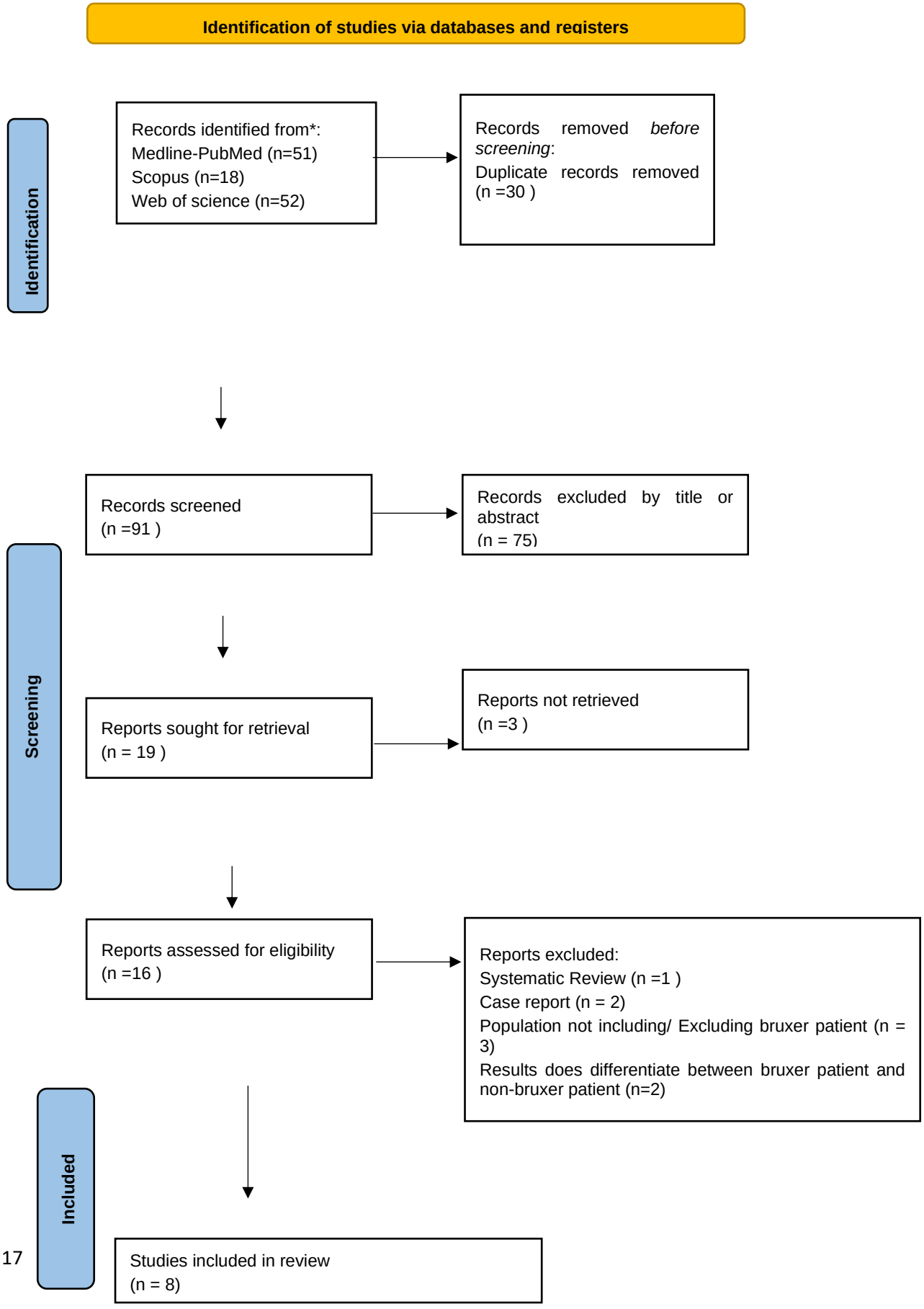

Table 5 : Evaluation of the bias risk of observational studies using the scale of Newcastle-Ottawa

	Representative cohort	Selection unexposed cohort	Exposure check	Demonstration of the lack of the variable at the beginning of the study	comparability	comparability (other factors)	Measurement results	follow up sufficient	Rate of abandonment	Total
Beier et al. (22)	☆	☆	☆	☆	☆		☆	☆	☆	**8**
Matalon S et al. (24)		☆	☆	☆	☆		☆	☆		**6**
Hawthan M et al. (23)	☆	☆			☆	☆	☆	☆	☆	**7**
Heller H et al. (21)	☆	☆	☆		☆	☆	☆	☆	☆	**8**
Hawthan M et al. (23)	☆	☆	☆			☆		☆		**5**
Klink A et al. (28)		☆		☆	☆	☆		☆		

Table 6: Evaluation of the bias risk of case series studies using Moga scale.

Quality Appraisal Checklist for Case Series Studies	**Levartovsky S et al.** (26)	**Hansen T et al.** (27)
Study objective		
1- Was the hypothesis/aim/objective of the study clearly stated?	Yes	Yes
Study design		
2- Was the study conducted prospectively?	yes	No
3- Were the cases collected in more than one centre?	no	No
4- Were patients recruited consecutively?	yes	Yes
Study Population		
5- Were the characteristics of the patients included in the study described?	Yes	Yes
6- Were the eligibility criteria (i.e., inclusion and exclusion criteria) for entry into the study clearly stated?	Yes	Yes
7- Did patients enter the study at a similar point in the disease?	Yes	unclear
Intervention and co-intervention		
8- Was the intervention of interest clearly described?	Yes	Yes
Outcome measures		
9- Were relevant outcome measures established a priori?	Yes	Yes
10- Were outcome assessors blinded to the intervention that patients received?	no	no
11- Were the relevant outcomes measured using appropriate objective/subjective methods?	Yes	Yes

12- Were the relevant outcome measures made before and after the intervention?	Yes	Yes
Statistical analysis		
13- Were the statistical tests used to assess the relevant outcomes appropriate?	Yes	Yes
Results and conclusions		
14- Was follow-up long enough for important events and outcomes to occur?	Yes	No
15- Were losses to follow-up reported?	No	no
16- Did the study provided estimates of random variability in the data analysis of relevant outcomes?	Yes	yes
17- Were the adverse events reported?	No	No
18- Were the conclusions of the study supported by the results?	yes	Yes

Table 7:Evaluation of the bias risk of randomized clinical trial using the COCHRANE scale.

	Random sequence (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personal (performance bias)	Blinding of outcome assessment (dection bias)	Deselective reporting (reporting bias)	Other bias
Schmitter M et al. (20)	+	+	+	+	+	