# Long-term clinical outcomes and complications of lithium (di)silicate based fixed prosthodontic restorations: protocol for an overview of systematic reviews

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*Contributions:*

MR is the guarantor. HL and KS drafted the manuscript. All authors contributed to the development of the selection criteria, the risk of bias assessment strategy and data extraction criteria. HL and HK developed the search strategy. All authors read, provided feedback and approved the final manuscript.


*Declaration of interests:*

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.


## Introduction

The first glass ceramic with lithium (di)silicate ($LiSi_{(2)}$) as the main component of the crystalline phase was introduced to the market in 1998. In 2005 modified versions with improved optical properties [1,2] were launched. In 2013 a reinforced lithium silicate glass-ceramic with a 10% zirconium dioxide content was introduced [3,4]. The zirconia particles are incorporated to strengthen the ceramic structure by stopping crack propagation [5]. This composition is intended to combine the positive mechanical properties of zirconium oxide with the glass-ceramic aesthetics [6–8]. Further $LiSi_{(2)}$ variations are co-crystallized ceramics e.g. with $Al_2O_3$ ($LiAlSi_2O_6$).

Due to their aesthetic and mechanical properties, as well as the possibility of chairside production, LiSi$_{(2)}$ restorations are very popular. According to a survey among 1.000 dentists in Germany, LiSi$_{(2)}$ had a share of 20% across all types of restorations in 2017 and 25% of those surveyed expect a further increase. LiSi$_{(2)}$ has thereby largely replaced other glass ceramics due to its higher strength and extended range of indications [9].

LiSi$_{(2)}$ have proven to be very durable. In a long-term study over 16.9 years with 2392 restorations made of IPS e.max Press by Malament et al., no further failures could be observed after 8 years [10]. During this long-term use under functional conditions in the oral cavity, both the restorations and their antagonists are constantly exposed to tribological, thermical and chemical stress. Reported clinical failures are restoration fracture, chipping, abrasion, discoloration, or biological failure as secondary caries. The question arises how the interaction of LiSi$_{(2)}$ with less hard and abrasion- and attrition-resistant natural teeth after years in use leads to complications and possibly even changes in the masticatory system on the anatomical and functional level [11,12].


## Review objectives

The intended overview of systematic reviews shall point out long-term clinical outcome and complications of tooth- or implant supported multi- and single-unit lithium (di)silicate restorations and discuss whether the conceivable range of possible complications and effects on the stomatognathic system is documented in the literature.

## Methods

The overview follows the pilot checklist with Preferred Reporting Items for overviews of systematic reviews (PRIO-harms) [13]. The protocol was developed according to the PRISMA-P reporting guideline [14]. It will be registered and published prospectively.

*Eligibility criteria*
Systematic reviews reporting on clinical outcomes and complications of tooth- or implant-supported lithium (di)silicate based fixed prosthodontic restorations in humans will be included. To achieve high sensitivity, no other restrictions will be applied. PICOS is defined as depicted in *table 1*. For updated reviews that were carried out at different points in time only the most recent publication will be included. When publications are available in multiple languages, only the English version will be included.

*Search strategy*
We will search MEDLINE via OVID, Embase via OVID, Trip Pro Medical Database, Epistemonikos Database and Cochrane Database of Systematic Reviews (via Cochrane Library/Wiley). Date of publication or language will not be restricted. An initial search strategy aiming at high sensitivity will be developed for MEDLINE using text words and MESH subject headings. Once it is finalized this strategy will be adapted to the syntax and controlled vocabulary of the other databases. We are not aware of recent comparative evaluations of search filters for systematic reviews. Therefore, for MEDLINE and Embase we will use the sensitive filter of Canada's Agency for Drugs and Technologies in Health (CADTH) [15]. A draft search strategy for MEDLINE is listed in *Appendix 1*. This strategy builds upon those by Poggio et al.

[16] and Laumbacher et al. [17]. The electronic searches will be complemented by searches of the bibliographies of all included reviews for additional relevant articles and forward snowballing using PubMed functions "Cited by" and "Similar articles" [18,19]. Results will be transferred to Citavi (Swiss Academic Software GmbH Wädenswil, Switzerland) and duplicates removed.

Records will be screened in a first round by titles and abstracts followed by a second round of study selection based on the full text. In each round selection will be done by two authors independently and blinded using the collaboration tool Rayyan [20]. Conflicting votes found after unblinding will be resolved by discussion. Cohen's kappa will be calculated. Full texts, which do not meet the eligibility criteria will be excluded. The process for selecting studies will be outlined in a *PRISMA* flow diagram *(Fig. 1).*

*Outcomes*

Outcomes, which are considered are clinical survival rate and incidence of technical, aesthetical and/or biological complications. Survival is defined as the restoration being clinically acceptable in situ for the follow-up time without refabrication. Complication is defined as one or more events affecting function and/or aesthetics negatively and/or resulting in biological pathologies [21].

*Methodological quality*

To assess the methodological quality and risk of bias of included systematic reviews, the AMSTAR 2 critical appraisal tool for systematic reviews will be used [22].

*Data collection process and data items*

Data will be collected using Excel spreadsheets (Microsoft). The following information will be extracted from systematic reviews: first author, title, year of publication, PMID, DOI, objective, included studies, types of studies, period of studies, type of restoration, region of restoration (anterior/posterior), reporting items, materials, fabrication (CAD/CAM or pressed), luting procedure, luting material, number of patients, number of restorations, follow up time, survival, technical complications, biological complications, aesthetic complications. Complications will be noted solely for lithium (di)silicate restorations if possible. All primary studies on lithium (di)silicate included in the systematic reviews will be retrieved if possible and the following information extracted: first author, year of publication, PMID, DOI, study design, type of restoration, veneered or monolithic restorations, material, surface treatment (polished or glazed), number of patients, number of restorations, follow-up, survival, success, and complications. When different numbers of patients or restorations at baseline and follow-up are provided, numbers at latest follow-up are selected. Data extraction will be done by one author and overseen by two additional reviewers.
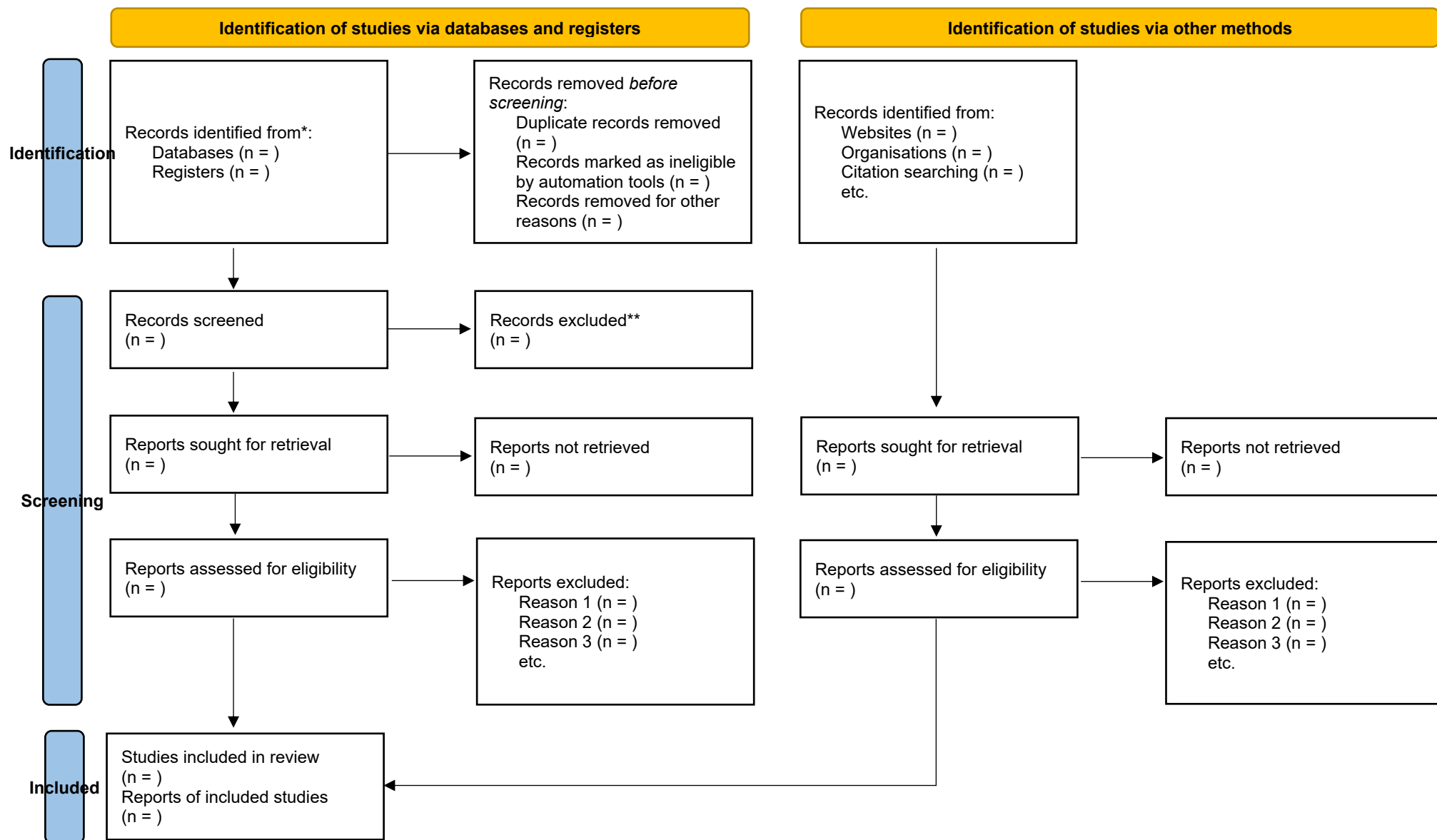
*Data analysis*

We will provide matrix of evidence tables listing the references/studies included in each of the systematic reviews and assess the extent of primary study overlap. Data will be grouped according to type of restoration and material. It will not be statistically analyzed because of expected heterogeneity.

**Table 1.** PICOS framework

| P (Population) | Subjects who received single or multi-unit fixed prosthodontic restorations |
|---|---|
| I (Intervention) | Lithium (di)silicate based restorations |
| C (Comparison) | Other types of restorative material or no comparison |
| O (Outcome) | Clinical survival and technical, biological or aesthetic complications |
| S (Studies) | Systematic reviews |

**Figure 1.** PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources

| Identification of studies via databases and registers | | Identification of studies via other methods |
|---|---|---|

**Identification**

Records identified from*:
Databases (n = )
Registers (n = )

→

Records removed *before screening*:
Duplicate records removed (n = )
Records marked as ineligible by automation tools (n = )
Records removed for other reasons (n = )

Records identified from:
Websites (n = )
Organisations (n = )
Citation searching (n = )
etc.

**Screening**

Records screened
(n = )

→

Records excluded**
(n = )

Reports sought for retrieval
(n = )

→

Reports not retrieved
(n = )

Reports sought for retrieval
(n = )

→

Reports not retrieved
(n = )

Reports assessed for eligibility
(n = )

→

Reports excluded:
Reason 1 (n = )
Reason 2 (n = )
Reason 3 (n = )
etc.

Reports assessed for eligibility
(n = )

→

Reports excluded:
Reason 1 (n = )
Reason 2 (n = )
Reason 3 (n = )
etc.

**Included**

Studies included in review
(n = )
Reports of included studies
(n = )

*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).
**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

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**Appendix 1.** Draft search strategy for MEDLINE (Ovid)

1      exp Crowns/
2      exp Denture, Partial, Fixed/
3      exp Inlays/
4      exp Dental Veneers/
5      Dental Abutments/
6      exp Dental Implants/
7      Dental Prosthesis, Implant-Supported/
8      ((dent$ or oral$ or t??th) adj5 crown$).ti,ab,kf.
9      ((dent$ or oral$ or t??th) and (implant$ or abutment$)).ti,ab,kf.
10     veneer$.ti,ab,kf.
11     dental laminate$.ti,ab,kf.
12     (indirect adj5 restor$).ti,ab,kf.
13     (Onlay$ or inlay$ or overlay$ or partialcrown$ or tabletop$ or (partial$ adj3 crown$)).ti,ab,kf.14 "fixed partial denture$".ti,ab,kf.
15     "fixed dental prosthes$".ti,ab,kf.
16     ((dent$ or t??th or fixed or resin or maryland or rochette) adj5 (bridge$ or pontic$)).ti,ab,kf.
17     (prosthodontic adj3 fix$ adj3 restor$).ti,ab,kf.
18     ((monolithic or anatomic) adj3 restor$).ti,ab,kf.
19     ((FPD$ or FDP$) and (dental or t??th)).ti,ab,kf.
20     or/1-19 [Population: Fixed prosthodontic restorations]
21     exp Ceramics/
22     Silicates/
23     Aluminum Silicates/
24     Lithium Compounds/
25     (lithia disilicate or Lithium disilicate or UNII-PDM70D5IQL or PDM70D5IQL or "E max cad" or "OPC 3G" or Lithium silicate or Li2Si2O5 or Silicic acid H2Si2O5 dilithium salt or Silicic acid H2Si2O5 lithium salt or "13568-46-2").rn,nm. [fields Registry Number/Name of Substance (Word); synonyms from PubChem]
26     "66402-68-4".rn. [CAS registry number]
27     "266-340-9".rn. [EC number]
28     "101943115".rn. [PubChem CID]
29     (ceramic$ or allceramic$ or porcelain$).ti,ab,kf.
30     (lithi$ or sili$ or disili$ or LiSi or LiAlSi or Li2Si2O5).ti,ab,kf.
31     (metal-free or metalfree or non-metal or nonmetal).ti,ab,kf.
32     ("e max" or emax or celtra or tessera or suprinity or zls).ti,ab,kf.
33     (empress2$ or "empress 2").ti,ab,kf.
34     or/21-33 [Intervention: Lithium (di)silicate based restorations]
35     (systematic review or meta-analysis).pt. or (meta-analysis/ or systematic review/ or systematic reviews as topic/ or meta-analysis as topic/ or "meta analysis (topic)"/ or "systematic review (topic)"/ or exp technology assessment, biomedical/ or network meta-analysis/) or ((systematic* adj3 (review* or overview*)) or (methodologic* adj3 (review* or overview*))).ti,ab,kf,kw. or ((quantitative adj3 (review* or overview* or synthes*)) or (research adj3 (integrati* or overview*))).ti,ab,kf,kw. or ((integrative adj3 (review* or overview*)) or (collaborative adj3 (review* or overview*)) or (pool* adj3 analy*)).ti,ab,kf,kw. or (data synthes* or data extraction* or data abstraction*).ti,ab,kf,kw. or (handsearch* or hand search*).ti,ab,kf,kw. or (mantel haenszel or peto or der simonian or dersimonian or fixed effect* or latin square*).ti,ab,kf,kw. or (met analy* or metanaly* or technology assessment* or HTA or HTAs or technology overview* or technology appraisal*).ti,ab,kf,kw. or (meta regression* or metaregression*).ti,ab,kf,kw. or (meta-analy* or metaanaly* or systematic review* or biomedical technology assessment* or bio-medical technology assessment*).mp,hw. or (medline or cochrane or pubmed or medlars or embase or cinahl).ti,ab,hw. or (cochrane or (health adj2 technology assessment) or evidence report).jw. or (comparative adj3 (efficacy or effectiveness)).ti,ab,kf,kw. or (outcomes research or relative effectiveness).ti,ab,kf,kw. or ((indirect or indirect treatment or mixed-treatment or bayesian) adj3 comparison*).ti,ab,kf,kw. or (multi* adj3 treatment adj3 comparison*).ti,ab,kf,kw. or (mixed adj3 treatment adj3 (meta-analy* or metaanaly*)).ti,ab,kf,kw. or umbrella review*.ti,ab,kf,kw. or (multi* adj2 paramet* adj2 evidence adj2 synthesis).ti,ab,kw,kf. or (multiparamet* adj2 evidence adj2 synthesis).ti,ab,kw,kf. or (multi-paramet* adj2 evidence adj2

synthesis).ti,ab,kw,kf. [Filter for Systematic Reviews/Meta-Analysis/Health Technology Assessment  OVID Medline, Embase, PsycINFO. Statement 17 with a PsycINFO-specific field code deleted. Source: Strings attached: CADTH database search filters (Internet). Ottawa: CADTH; 2021. Available from: https://www.cadth.ca/resources/finding-evidence/strings-attached-cadths-database-search-filters#syst (Cited 2021-11-03).]

36      20 and 34 [Population AND Intervention]
37      35 and 36 [Population AND Intervention AND Study Type]

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