Evidence summary: The relationship between oral diseases and diabetes

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In brief

- Current evidence suggests a number of associations between oral diseases and diabetes mellitus (diabetes)
- There is evidence that oral health care/management of oral disease, most notably periodontal care, has a short term beneficial influence on diabetes outcomes but there is no evidence that this is sustained over the long-term and/or reduces the development of the complications of diabetes
- There is limited evidence to support major changes to medical or dental therapy in the case of diagnosis of diabetes; regular periodontal/oral care may benefit patients with periodontitis and diabetes
- At present, diabetes should not be considered a diagnosis that would require a change to dental therapy, such as restricting dental implants
- A diagnosis of diabetes should be considered and excluded in those who have severe periodontitis and vice versa

Abstract

This paper reports on one of four rapid reviews undertaken to explore the relationships between oral health and general medical conditions in order to support teams within Public Health England, health practitioners and policymakers. This review aimed to explore the nature of the association between poor oral health and diabetes when found in the same individuals or populations having reviewed the most contemporary evidence in the field. The reviews were undertaken by four groups each comprising consultant clinicians from medicine and dentistry, trainees, public health and academics. The methodology involved a streamlined rapid review process and synthesis of the data. The results identified a number of systematic reviews of low to high quality suggesting that management of oral diseases, most notably periodontal care, has a short term beneficial influence on diabetes metabolic outcomes but there is no evidence that this is sustained over the long-term and reduces the prevalence of the long-term complications of diabetes. The findings are discussed in relation to implications for service and future research.

Background

In England almost three million people have diabetes and many more are at risk of developing it. The estimated national spend by the NHS on diabetes is approximately 10 billion per year (1).

Diabetes mellitus is a long-term condition characterised by an inability to control the glucose levels in the blood due to an absolute or relative lack of the hormone insulin (International Classification of Diseases ICD-10 (E08-E13).

The majority of people with diabetes can be classified as having type 1 or type 2. Type 1 diabetes is an autoimmune disease, a group of diseases when the body's own immune system attacks the body's own host tissues rather than infections. It tends to occur at a younger age and it is essential to treat with insulin. Type 2 diabetes is 8-9 times more common than type 1. It occurs as a result of a combination of lack of response to insulin (insulin resistance) and lack of insulin production. It tends to occur at a later age and in the early stages can be treated with oral medications.

Elevated glucose levels are associated with a number of complications including blindness, kidney failure and minor and major leg amputation which can be prevented by maintaining low glucose levels with both lifestyle change and medication. Diabetes foot disease occurs as a result of diabetic peripheral neuropathy with high glucose levels associated with a wide range of both chronic and acute neuropathies that affect the full anatomic breadth of the peripheral nervous system from the nerve root to the skin, mirroring the spectrum of peripheral nerve diseases in general (2). In addition diabetes is associated with an increased risk of vascular complications such as myocardial infarction, stroke and peripheral vascular disease (3). Obesity is a strong risk factor for the development and progression of diabetes. Indeed the increased incidence of overweight and obesity worldwide explains the ever increasing number of people affected by type 2 diabetes (4).

It is preferable to view type 1 and 2 diabetes as separate conditions. Where evidence is in a particular type of diabetes this is indicated. For the purpose of this review we have used the term diabetes alone when the population studied is mixed, undifferentiated or not classified in the original article. In general, the majority of patients in the studies reviewed would be expected to have type 2 diabetes as it is more common.

The two most common diseases affecting oral health are dental caries and periodontitis. Dental caries (caries) is the localised destruction of susceptible dental hard tissues by acidic by-products from bacterial fermentation of dietary carbohydrates (5). Periodontitis is a chronic inflammatory disease caused by a dysbiosis of the sub-gingival microflora and resulting in the loss of the tissues surrounding the teeth (6). Approximately half of all adults in the UK are affected by some level of irreversible periodontitis, which increases with age, and almost a third of the same population have obvious dental decay (7).

Both type 1 and 2 diabetes have been associated with many oral diseases in the past. Observational studies have suggested diabetes links with periodontal diseases (including peri-implant disease), caries

(with its risks of tooth loss), oral mucosal disease (including oral infections), oral cancer, salivary dysfunction and oral dysesthesias including taste disturbances. Further clinical studies focused on the role of oral diseases and in particular periodontal status or therapy and their effect on hyperglycaemic control as well as the role of anti-diabetic medication in oral states.

However, with all the studies investigating these associations there has been little consensus with respect to the overall effect of diabetes mellitus on oral health and vice versa. This has made it difficult for both dental and medical clinicians alike to advise patients on these issues with great confidence. By pooling together the facts from high quality evidence-based research in one place, this paper should provide a source for clinicians to give this advice confidently.

Review methods

A rapid review of articles published between 2005 and 2015 investigating the relationship between diabetes and oral health was performed. A rapid review is a synthesis of the most current and best evidence to inform decision-makers (8). It combines elements of systematic reviews with a streamlined approach to summarise available evidence in a timely manner.

Search syntax was developed based on subject knowledge, MeSH terms and task group agreements (Figure 1); followed by duplicate systematic title and abstract searches of three electronic databases: Cochrane, PubMed, OVID (Embase, MEDLINE (R), and PsycINFO). Inclusion criteria were systematic reviews/meta-analyses involving diabetes and oral health, published in the 10-year period, involving human research and the full text being available in English. Exclusion criteria included animal studies and only systematic reviews and/or meta-analyses of observational and experimental studies were included in the final results.

Two independent searches were undertaken, screening papers by title and abstract for relevance and duplication. Each researcher reviewed their search results and excluded papers that were not systematic reviews/meta-analyses, were not related to diabetes and any aspect of oral health, and were not available in English despite contacting the authors. After the final selection the searches were combined and duplicates removed. Both researchers discussed included and excluded papers and a final agreement was made on the papers to be included for the rapid review. A flow diagram of the process is shown in Figure 2.

Figure 2

The following information was extracted from each paper: author, year, title, journal, population studied, oral disease/intervention, definitions used, methods, comparison/intervention and controls, outcomes, results, authors' conclusions, quality and quality justification; all shown in the data extraction table. From a total of 2,406 papers initially identified, there were 30 articles identified by the review for inclusion (Table 1). Key findings from the rapid review extracted from the information above are shown below, with examples of the papers that provide evidence for the results synthesis. Each of the relevant oral

health conditions, and relevant therapy, are considered in turn below starting with periodontitis and its management.

Table 1

Quality assessment was undertaken for each systematic review using the PRISMA and AMSTAR tools to ascertain risk of bias. An AMSTAR assessment was carried out on all papers with the methodological quality of the review being rated as “High” with a score between eleven and eight, “Moderate” between seven and four, and “Low” between four and zero. The quality of all papers was confirmed by group discussion.

The quality of the systematic reviews identified varied. Of the 30 systematic reviews, 12 were deemed to be of high quality, 15 of moderate quality and three were of low quality (Table 1). Common AMSTAR quality issues were a) lack of *a priori* design or question, b) no quality appraisal, c) missing tables, and d) no duplicate study selection.

Within the theme identified by this review, reviews related to investigation of i] glycaemic control and periodontal therapy and ii] the risk of oral cancer in patients with diabetes were of high quality, whilst articles on the association between dental implant therapy (9, 10), osseo-integration (11) and diabetic neuropathy (12), with oral diseases or therapy were of low quality.

Results: evidence synthesis

The results are reported in nine sections, each relating to an oral disease or condition investigated. Each section contains evidence of any association between the oral disorder and diabetes and also on the impact of oral therapy on diabetes and diabetes management on oral health.

I] Periodontitis and diabetes

There is high quality evidence that diabetes (type 2) is a risk factor for periodontitis (13). There is some moderate quality evidence that whilst the extent of periodontitis, i.e. percentage of surfaces/sites affected is similar between patients with or without diabetes, measures of severity including greater clinical attachment loss and pocket probing depths are greater in patients with diabetes (14). Patients with diabetic complications, most specifically diabetic neuropathy, appear to have poorer oral health, *including* periodontitis, than those without neuropathy (12). However, there is scant evidence from two reviews of variable quality that diagnosis of periodontitis a) promotes development of type 2 diabetes and b) adversely affects glycaemic control and diabetes complications in patients with diabetes (12, 15).

In summary, whilst there is strong evidence that diabetes is a recognized risk factor for periodontitis, more research is needed to ascertain the impact of periodontitis on the development and progression of diabetes.

II] Periodontal therapy and glycaemic control

One high quality systematic review provides evidence that in patients with type 2 diabetes, intensive periodontal therapy involving scaling and root planning reduced HbA1c (a marker of glycaemic control) by 0.29% [3-4 mmol/l] for up to three months; however, after six months there was no evidence that this reduction was sustained (16). Modest improvements in glycaemic control, as demonstrated by a reduction in Hb1Ac, are supported by seven other moderate quality systematic reviews (15, 17-22); whilst one was equivocal (23). In one of the reviews by Wang et al 2014, after three months follow-up, periodontal treatment substantially lowered HbA1c compared with no treatment (–0.36%, 95%CI, 0.52% to 0.19%, P < 0.0001). These findings were accompanied by substantial and statistically significant reductions in PPD and CAL between study groups (PPD 0.42 mm, 95%CI: 0.60 to 0.23, P<0.00001; CAL 0.34 mm, 95%CI: 0.52 to 0.16, P = 0.0002). Consistent with the 2015 Cochrane review, there was no substantial change of HbA1c levels after 6 months (21).

In summary, there is merit in performing periodontal therapy in patients with type 2 diabetes with regards to a short term improvement in metabolic control. Further research is needed to demonstrate that this benefit is sustained over longer follow-up and it translates into reduction of diabetes complications. Results from a recently completed trial (ISRCTN83229304) might provide some evidence in favour or against the association.

III] Periodontal therapy and systemic/surrogate markers

One high quality review suggests that periodontal treatment (SRP) reduced markers of systemic inflammation in patients with diabetes: serum levels of TNF- α and CRP (24). Sgolastra et al, 2013 (19) reported no significant improvements in lipid fractions (total cholesterol, triglycerides and high and low density lipoprotein cholesterol [TC, TG, HDL, or LDL]) in patients with diabetes and chronic periodontitis who received scaling and root planning (19).

Lastly, five different reviews suggest that different types of periodontal treatment; surgical or non-surgical, with or without the use of adjunctive antibiotics, antiseptics, or oral hygiene instructions do *not* appear to produce different effects on glycaemic control in patients with diabetes (16, 17, 20, 21, 25).

IV] Tooth loss and diabetes

Patients with diabetic complications, most specifically diabetic neuropathy, appear to have more tooth loss than those without neuropathy (12). This finding is consistent with the view that diabetes and its complications are associated with poorer oral health.

V] Caries and diabetes

Conflicting evidence on the association between diabetes and increased prevalence of caries was found. Greater levels of dental plaque were noted in patients with diabetes and this may have implications for future risk of caries (26). Furthermore, children with type 1 diabetes are at increased

risk of periodontal diseases as evidenced by greater dental plaque levels, gingival inflammation and bleeding.

VI] Dental Implants and diabetes

There is limited evidence that poor metabolic control is associated with peri-implant disease (27, 28), and weak evidence of higher marginal bone loss around dental implants in patients with diabetes with unspecified metabolic control (9). There is equivocal evidence that patients with diabetes have higher failure rates of dental implants and no evidence that diabetes is a contraindication to dental implant placement (10, 11, 29); however, some evidence for delay in implant osteo-integration based on glycaemic control was identified (Oates et al., 2013).

VII] Oral surgery and diabetes

Whilst there is evidence that people with diabetes are more likely to suffer complications of surgery in other areas, specific evidence that diabetes is associated with post-operative complications in the oral cavity is lacking (30).

VIII] Oral squamous cell carcinoma and diabetes

A high quality systematic review suggests that type 2 diabetes is associated with an elevated risk of oral cancer and precancerous lesions (31). Patients with type 2 diabetes have a higher case mortality on diagnosis of oral cancer, independent of tobacco, alcohol and obesity factors with a relative risk of 1.41(95%CI: 1.16–1.72) when comparing patients with diabetes to people without diabetes, with no evident heterogeneity among studies (31).

IX] Saliva and diabetes

Patients with diabetic complications, most specifically diabetic neuropathy, appear to have greater mouth dryness than controls (12). There is limited evidence on the role of diabetes in increasing the risk of salivary dysfunction (32). There is some recent, limited and weak evidence that salivary protein markers may be used to monitor glycaemic control accurately as a less painful alternative to capillary blood glucose measurements (33).

Summary

The evidence reviewed to form the conclusions for this rapid review demonstrates that there are oral manifestations of diabetes, including effects on oral health, periodontitis, oral cancer risk, and that diabetes may have an effect on dental implants success. More evidence is required before advising clinicians of any contraindications to perform implants in diabetic patients. There is strong evidence of type 2 diabetes being a risk factor for periodontal diseases and weak evidence in relation to type 1. There is weak evidence in relation to dental caries experience in children. Limited evidence exists of periodontitis being a risk factor for diabetes; however, there is a growing body of evidence that professional periodontal treatment (i.e. scaling and root planning as a minimum) results in modest improvement in glycaemic control in the short-term but this is not sustained beyond three months.

Furthermore, the average reduction in glycated haemoglobin observed following periodontal therapy (0.3%/3-4 mmol/l) could translate into long-term clinical benefits but further research is needed.

Overall, there is some evidence of a bidirectional relationship between diabetes and oral health and the management of conditions, most notably for periodontitis on diabetes. This is a very important area for further interdisciplinary patient care and research, particularly as health professionals care for an ageing population with multiple co-morbidities. As dental professionals we need to keep abreast of the emerging evidence of associations between non-communicable diseases. Whilst there is no evidence to support a major change in patient management we should be aware that regular periodontal care may benefit patients with periodontitis and diabetes. However, patients with periodontitis need help with regular self-care and professional periodontal treatment.

The rapid nature of the review is a potential limitation especially with the large scope of the topic reviewed. However, the methodology used has been proven successful previously in work by Khangura et al., (8, 34).This rapid review was limited by the quality of the systematic reviews and meta-analyses appraised. These limitations are well summarised in the Cochrane review studies by Simpson et al (2010 and updated in 2015) (16, 35), and highlighted in Table 1. Overall the quality of the reviews in this field was mixed whilst the research on the topic was generally judged to be of low quality.

It is important to note that the publications do not use standard definitions and classification of periodontitis as used by the American guidelines (6); this should be standardised in future to facilitate comparability between studies.

There is evidence that management of oral disease, most notably periodontal care, has a short term beneficial influence on diabetes but no evidence that this is sustained over the long-term and reduces diabetes complications. The vast majority of the articles described define diabetes only by its presence or absence and many do not even classify which type of diabetes was present. There was no information regarding the effect of different levels of glucose control on either the absence or presence of an association or whether the association has a glucose exposure “dose effect”. Testing the association of HbA1c and dental outcomes would therefore be useful for future research. Ideally, type 1 and 2 diabetes should be studied separately given the above. More high quality multidisciplinary research is needed to investigate relations between the non-communicable diseases and their management as shown in Table 2.

Table 2

In summary, the current evidence suggests a number of associations between oral diseases and diabetes. There is limited evidence to support major changes to medical or dental therapy; however, regular periodontal/oral care may benefit glycaemic control in patients with periodontitis and diabetes. At present, diagnosis of diabetes should not require a change to dental therapy, such as restricting use of dental implants. Greater awareness of the impact of diabetes on oral health and vice versa is needed among medical and dental health professionals.

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Figure 1 Search terms

oral health and hba1c /ifcc /glycaemic index
mouth and diabetes mellitus
gingival or gingivitis and diabetes mellitus
head and neck complications and diabetes mellitus
salivary gland disease and diabetes mellitus
oral dysaesthesia and diabetes mellitus
oral ulcers or oral ulceration and dm
oral lichen planus and diabetes mellitus
oral scc and dm
streptococcus viridans and dm
oral tuberculosis and diabetes mellitus
oral syphillis and diabetes mellitus
oral infections and diabetes mellitus
oral streptococcus and diabetes mellitus
oral staphylococcal/ staphylococcus aureus and dm
mouth disease and diabetes mellitus
(mouth or oral or dent$).
(plaque or biofilm).
(mouthwash or mouth wash or chlorohexidine or chx).
(tooth loss or edentulous or shortened dental arch).
(loose tooth or loose teeth).
dentures.
(dry socket or alveolar osteitis or non healing socket or non-healing socket).
(xerostomia or dry mouth or hyposalivation).
hypersalivation.mp.
(bms or burning mouth syndrome or oral dysasthesia or burning sensation).
(minor oral surgery or tooth extraction or dental extraction).
(((oral or dent$ or mouth or recurrent apthous) and (ulcer$ or stomatitis)) or ras).
(angular chelitis or angular stomatitis).
dental implant$.
gum inflammation.mp.
((oral or dental or socket) and (healing or non healing or non-healing)).
(diabetes or diabetes mellitus or oral diabetes or non insulin dependent diabetes or insulin dependent diabetes or niddm or iddm or type 1 diabetes or type 2 diabetes).
(blood glucose or glycemic control or glycaemic control or blood glucose levels or hypoglycaemia or hyperglycaemia or glycemic index or glycaemic index).
(ifcc or hba1 or hba1c or a1c). insulin resista$.
bleeding gums.mp.
(oral thrush or candidia$ or fung$).
(tongue or mouth or lips or swallowing or pharynx or oropharynx or throat or teeth).
(lichen planus or lichenoid).
(calculus or tartar).
(chronic inflammation or acute inflammation).
resistance to infection.mp. (toothache or tooth ache or tooth pain or dental pain).
(bad breath or halitosis)
(oral and (white or red)).
saliv$ gluc$ level$.
(antifungal$ or antibacterial$).
((tooth or dental) and eruption). (systematic review$ or (meta ana$ or meta-ana$)).
saliva
(("oral health" or dental or dentist or "burning mouth syndrome" or periodont* or ging* or calculus or decay or caries or edentulous or tooth loss or dry socket or alveolar osteitis or xerostomia or dry mouth or saliva* or lichen planus or halitosis or tooth eruption or dental implant or oral thrush or oral

oral disease hba1c /ifcc /glycaemic index
oral manifestations and diabetes mellitus
oral surgery complications and diabetes mellitus
hyposalivation / xerostomia / dry mouth and diabetes mellitus
taste disturbance / dysguesia and diabetes mellitus
halitosis and diabetes mellitus
recurrent aphthous stomatitis and dm
oral cancer and dm
oral actinomycosis and dm
oral mycobacterial or oral mycobacterium) and diabetes mellitus
oral viral / virus and diabetes mellitus
oral hsv or oral herpes simplex or type 1 hsv or type 1 herpes simplex) and diabetes mellitus
oral candida or oral candidosis or oral candidiasis and diabetes mellitus
oral hpv or oral human papilloma virus) and diabetes mellitus
angular cheilitis and diabetes mellitus
oral protozoa and diabetes mellitus
(periodont$ or gum$ or ging$). (decay or caries or cavity).
(toothbrushing or tooth brushing).

Figure 2 Flow diagram

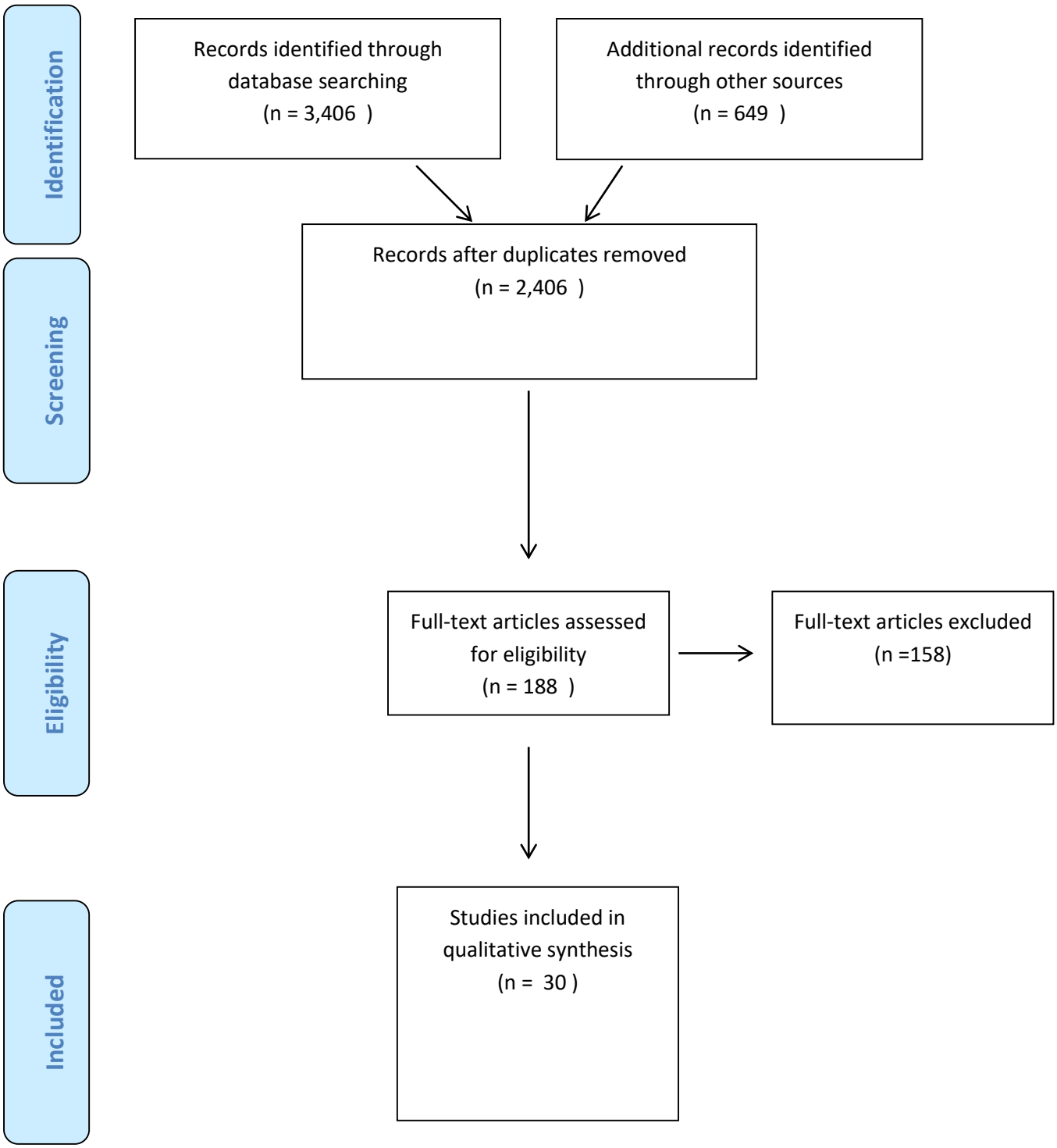

Table 1 – Included papers

Author, year and paper title	**Study types in the review**	**Characteristic of populations**	**Oral disease and diagnostic criteria or Oral disease intervention and description**	**Intervention/ comparison including** *Covariates adjusted*	**Results**	**Authors Conclusions**	**AMSTAR rating and justification**
Artese et al 2015 (24) Periodontal therapy and systematic inflammation in type 2 diabetes mellitus	9 studies -6 RCTs -2CCTs	- Participants with type 2 diabetes according to the WHO criteria - Participants having received PT with at least 3 months of follow-up - assessment of serum inflammatory biomarkers related to insulin resistance; and - At least 30 individuals included in the type 2 diabetes group.	**Periodontitis:** any periodontitis diagnosis definition proposed by Authors: Includes attachment level and probing depths **Periodontal interventions** oral hygiene instructions; full-mouth scaling and root planing (supra/subgingival biofilm and calculus removal) (SRP); surgical procedures (i.e., periodontal flap surgery) and SRP plus local or systemic antimicrobial.	Effect of periodontal therapy (PT) on serum levels of inflammatory markers (TNF- α and CRP) in people with type 2 diabetes mellitus Periodontal interventions were compared with the passive option (no periodontal treatment) **Covariates adjusted** N/A	- Periodontal Therapy reduces serum levels of inflammatory markers (TNF- α and CRP) in Type 2 diabetic individuals. The meta-analysis showed a significant mean difference for TNF-Alpha(-1.33pg/ml, 95%CI: -2.10; -0.56,p<0.001) and CRP (-1.28 mg/l, 95%CI; -0.48, p<0.001) favouring periodontal intervention versus control) - None of the studies reported adverse effects	The results of this meta-analysis support the hypothesis that PT reduces serum levels of TNF- α and CRP in T2DM individuals. The decrease of inflammatory burden has important implications for metabolic control and can, in part, explain the mechanisms linking periodontitis and increased risk for complications in people with T2DM.	High (11) Met all Amstar criteria

Barasch et al 2008 (30) Risk factors for oral postoperative infection in patients with diabetes	-11 cross sectional - 5 retrospective -6 prospective studies	- All diabetic patients undergoing dental surgery	Post -operative oral infections and wound healing- no specific definitions given	**Oral surgery** Frequency of post-operative infections in patients undergoing oral surgery procedures **Covariates adjusted** None specifically. Although Individual articles within the review did note antimicrobial use, age, gender, smoking status and other medical conditions as confounders but it is not mentioned if or how these were adjusted for in the review	1.Incidence of postoperative infections is between 0.5-4% , however poor quality studies to back this up 2. potential risk factors for post-operative infections include age, gender, medical conditions, position of the tooth, impaction, difficulty of the surgery and experience of the surgeon. 3. there is strong evidence diabetes , perioperative and long-term glycaemic control in general and surgery - 4. there is scant evidence this is the same for oral surgical procedures	1.Evidence that diabetes is an independent risk factor for postoperative infection in general and thoracic surgery is strong; however, data on infections following dental osseous surgery are scant at best. 2. diabetes, evidence suggests that micro vascular complications may play an important role in elevating risk for infection, as could perioperative and longer term glycaemic control. Given the increasing prevalence in general dental practices of patients who are diabetic, many of whom require dental osseous surgery, the level of uncertainty and the lack of high quality evidence suggest that well-designed studies should be performed to accurately quantify the incidence and risk of infectious complications in dental patients who have diabetes.	High (9) 1.Looked at relevant topic, that few others did 2.Articles included were of reasonable quality Amstar not met : No full search strategy, no summary measures, no method for synthesis
Borgannakke et al 2015 (12) Is There a Relationship Between Oral Health and Diabetic Neuropathy	53 references given. Type of each not mentioned	Diabetic patients with neuropathy	1.Periodontal disease in patients with diabetic neuropathy 2.Burning mouth syndrome . 3.Dry mouth 4. taste disturbance 5.trigeminal pain 6.temperomandibular joint disorder - no criteria or definitions provided	Patients simultaneous occurrence of diabetic neuropathy and oral diseases listed. **Covariates adjusted** None presented	1. high prevalence of the various oral conditions in people with diabetic neuropathy, 2. this will negatively influence the quality of life 3. increased susceptibility to gingivitis, periodontitis, tooth loss, mouth dryness, and other oral health conditions 4. Periodontal infection is shown to adversely affect blood glucose levels 5. Routine, non-surgical periodontal therapy is shown to be effective in decreasing glycated haemoglobin levels by about 0.5 percentage point glycated haemoglobin, which is moderate, but clinically and statistically significant	1.There is a lack of awareness by people with diabetes of increased oral risks 2. periodontal infection adversely affects blood glucose levels 3.periodontal therapy reduces blood glucose levels by 0.5% 4. inter-professional management of diabetes is required 5. Further exploration of this relationship is required 5.Whether improvement of periodontal health will benefit various forms of neuropathy still remains to be explored 6. propose that further exploration of the relationship between diabetic neuropathy and oral health may result in a potentially important opportunity for patient-centred, inter-professional collaboration for the benefit of the health of the patients	Low (3) Amstar: No duplicate study selection, Status publication not n inclusion criteria, No comprehensive literature , search, no status of publication, no scientific quality appraisal , no synthesis, no comment on bias

Borgannake et al 2013 (15) Effect of periodontal disease on diabetes: systematic review of epidemiologic observational evidence	17 papers: 4 cohort 3 case controlled not presented rest	People with diabetes with periodontal disease undergoing periodontal therapy	Periodontal disease and therapy. No specific definition in selection criteria. Definitions listed for individual studies	Periodontal therapy on glycaemic control **Covariates adjusted**: None by reviewers. Reported covariates adjusted for in each individual study which varies. Includes age, gender, smoking , BMI, boneloss and clinical attachment loss duration, baseline HBa1C etc	1.A small body of evidence supports significant, adverse effects of periodontal disease on glycaemic control, diabetes complications, and development of type 2 (and possibly gestational) diabetes 2.Compared to periodontally healthy individuals, people with poor periodontal health and: type 2 diabetes, or no diabetes, have greater risk of developing poorer glycaemic control type 1 or type 2 diabetes: have greater risk for diabetes related complications no diabetes: have greater risk of developing manifest diabetes studies on the effect of periodontal disease on gestational diabetes are inconclusive.	1.Scant current evidence suggests that periodontal disease adversely affects glycaemic control and diabetes com-plications or promotes development of type 2 diabetes. 2. Large-scale, definitive studies of long duration and in multiple different population groups in many different countries are needed in all the areas this review explored	High (9) Amstar not met: No synthesis, no conflict interest declared
Bornstein et al 2009 (10) Systemic conditions and treatments as risks for implant therapy	18 studies: case controlled matched chart survey, cohort and case series	Patients with and without diabetes, type 1 or type 2 and other risk systemic and local risk factors also	Dental implants failure: no definition of this	Dental implant failure rates in systemic conditions including diabetes **Covariates adjusted** None presented	1.There was a large heterogeneity in papers in a review of one database 2. There is unequivocal evidence that patients with diabetes have higher dental implant failure rates. 3. diabetic patients tend to have early failure	1.it is not possible to distinguish between subtypes of systemic diseases such as diabetes type 1 and 2 or primary and secondary osteoporosis 2.The supposition that subjects with diabetes tend to have higher failure rates is equivocal	Low (3) Amstar not met: No comprehensive literature search, no tables included, no study characteristics, no synthesis, no scientific quality assessed, no bias

Carramollino-cuellar et al 2014 (35) Relationship between the oral cavity and cardiovascular diseases and metabolic syndrome	40 studies-Type of studies not include.	Diabetic or CHS sufferers with periodontal disease.	Periodontal disease. No definition.	Bidirectional relationship of metabolic syndrome (including DM) and periodontal disease **Covariates adjusted** None presented	Evidence suggests that there is a moderate association between obesity, and particularly diabetes mellitus, could be related to an increased susceptibility to periodontitis. However, it is not clear whether periodontal treatment could improve the systemic conditions of such patients.	The existing scientific evidence suggests that obesity, and particularly diabetes mellitus, could be related to an increased susceptibility to periodontitis. However, it is not clear whether periodontal treatment could improve the systemic conditions of such patients	High (8) Amstar not met: No study selection, no process data collection, no synthesis no bias
Chavarry et al 2009 (13) The relationship between diabetes mellitus and destructive periodontitis: a meta- analysis	57 papers: 49 cross sectional studies, others logitudinal studies	Patients with periodontal disease and diabetes (type 1 and 2) and people without diabetes	Periodontal disease: clinical measures (PPD or CAL) radiographic evidence of alveolar bone loss	Mean differences in PPD and CAL **Covariates adjusted** None in selection criteria. However variable covariates for each paper presented including age, gender, duration of diabetes, HIV, pregnancy, smoking, number of teeth	Random effect model showed a significant association with clinical attachment level (mean difference = 1.00 [CI 95% = 0.15 to 1.84]) and periodontal pocket depth (mean difference = 0.46 [CI 95% =0.01 to 0.91]) between type 2 diabetics and non-diabetics. Type 2 diabetes mellitus can be considered a risk factor for periodontitis	1. There is enough evidence to consider type 2 DM as a risk factor for destructive periodontal disease. 2. More studies are needed to assess if type 1 DM is a true risk factor for periodontal disease. 3. In future studies on type 1 DM the inclusion of population aged 25 years and above is recommended.	High (8) Amstar not met: no study selection criteria, no excluded table, no synthesis no conflict of interest
Chen et al 2013 (29) Smoking, Radiotherapy, Diabetes and Osteoporosis as Risk Factors for Dental Implant Failure: A Meta-Analysis	58 studies 5 in relation to diabetes. 3 prospective and 2 retrospective observational studies	Patients with dental implants who had diabetes and other systemic conditions	Dental implant failure: no definition given	Comparison of Implant failure rates in people with different risk factors **Covariates adjusted** None presented	For diabetes: No inverse impact of diabetes (n = 5; RR = 0.90; 95% CI, 0.62–1.32) on the risk of dental implant failure was found	1. Smoking and radiotherapy were associated with an increased risk of dental implant failure. 2.The relationship between diabetes and osteoporosis and the risk of implant failure warrant further study.	High (7) Amstar not met: No prioiri design, no characteristics, no status in selection, no table excluded, no quality assessed

Chrcanovic et al 2014 (36) Diabetes and oral implant failure: a systematic review	14 studies -7 controlled clinical trials -7 retrospecti ve analyses	Type 2 diabetics with dental implants and healthy controls with dental implants	Dental implant loss	effects of diabetes mellitus on implant failure rates, postoperative infections, and marginal bone loss **Covariates adjusted** None set in selection criteria and not mentioned any set by individual papers	1.a statistically significant difference (*p* =0 .001; mean difference = 0.20, 95% confidence interval =0.08, 0.31) between diabetic and non-diabetic patients concerning marginal bone loss, favouring non-diabetic patients 2. for postoperative infections. The difference did not significantly affect implant failure rates (*p* = .65), with a risk ratio of 1.07(95% confidence interval = 0.80, 1.44)	The results of the present systematic review should be inter - preted with caution because of the presence of uncontrolled confounding factors in the included studies. Within the limits of the existing investigations, the difference between the insertion of dental implants in non-diabetic and diabetic patients did not statistically affect the implant failure rates. However, the studies in the review show heterogeneity in eligibility criteria for implantation in different diabetic populations. Studies are lack - ing that include both patient types, with larger sample sizes, and that report outcome data separately for each group.	High (10) Amstar not met: No exclusion table

Corbella et al 2013 (25) Effect of periodontal treatment on glycaemic control of patients with diabetes: a systematic and meta- analysis	15 studies were included. -were RCTs or interventio nal studies	People undergoing non-surgical periodontal therapy with diabetes	Periodontal disease: no definition in selection criteria but data collected on individual papers definitions of periodontal disease	Effect of periodontal treatment on Hba1C **Covariates adjusted** None presented	1.A reduction of -0.38% (95% confidence interval [CI] -0.23 to -0.53) after 3–4 months (P < 0.001) And -0.31% (95% CI 0.11 to -0.74) after 6 months (P = 0.15) of follow-up was found for HbA1c, favoring the treatment group. 2. in treated patients, a significantly greater decrease in FPG was observed in respect to control participants. 3.Such difference amounted to -9.01 mg/dL (95% CI -2.24 to -15.78) after 3–4 months (P = 0.009) and -13.62 mg/dL (95% CI 0.45 to -27.69) after 6 months (P = 0.06) from treatment, respectively. 4.In participants treated with adjunctive antimicrobials, a non-significant increase of HbA1c was observed 3 months after treatment, whereas FPG decreased by 0.27 mg/dL (95% CI 39.56 to -40.11; P = 0.99).	1. periodontal treatment might be effective in improving metabolic control in terms of reduction of HbA1c and FPG concentrations in patients with diabetes. 2. However, the significance of this improvement is questionable and should be further investigated. 3. Periodontal non-surgical treatment is important in periodontal patients affected by diabetes because, in addition to the negligible side-effects, it leads to the reduction of one potential factor impairing glycaemic control, while preserving dental and periodontal health.	Medium (6) Amstar not met: no priori design, no duplicate study selection, no exclusion, no synthesis, no bias assessed
Darre et al 2008** (37) Efficacy of periodontal treatment on glycaemic control in diabetes mellitus: meta - analysis of interventional studies	25 studies 9 RCTs 16 non-controlled trials	Diabetic patients with periodontal disease undergoing and not undergoing periodontal therapy	Periodontitis: a common chronic gram-negative anaerobic infection of the periodontium that causes destruction of periodontal tissues and loss of alveolar bone (CAL,BOP,PPD,PI,GI) Periodontal treatment: Root planing scaling,OHI and antimicrobial therapy	Effect of periodontal disease and treatment on glycaemic control **Covariates adjusted** Noted from individual papers, although all did not account for these. Covariates adjusted by paper include age, BMI, duration of diabetes, and number of teeth. Also looked at if studies reported ethnicity, gender, diabetic treatment, type of diabetes and its treatment and smoking	The standardized mean difference in HbA1c with the treatment of periodontal disease was 0.46 (95% CI: 0.11, 0.82). These findings suggest that periodontal treatment could lead to a significant 0.79% (95% CI: 0.19, 1.40) reduction in HbA1c level	Periodontal treatment could improve glycaemic control. These results need to be viewed with caution because of a lack of robustness, and deficiencies in the design of some of the studies included	High (8) Amstar not met: No priori design, no, exclusion table, synthesis

Engbrettson and Koecher 2013** (17) Evidence that periodontal treatment improves diabetes outcomes: a Systematic Review and Meta-analysis	9 RCT studies	Individuals with periodontal disease and diabetes over the age of 18	Periodontal treatment: periodontal therapy, either surgical or non-surgical, with or without the use of adjunctive antibiotics, antiseptics, or oral hygiene instruction	the effect of periodontal treatment on diabetes outcomes **Covariates adjusted** None presented	1. mean treatment effect of −0.36% HbA1c (CI −0.54, −0.19) compared to no treatment after periodontal therapy ($p<0.0001$). 2. heterogeneity – low bias (i2) 3. however poor sample sizes of studies included	The modest reduction in HbA1c observed as a result of periodontal therapy in subjects with type 2 diabetes is consistent with previous systematic reviews. Despite this finding, multi-centre trials of sufficient sample size are lacking.	Moderate (7) Amstar not met: No duplicate study selection, no comprehensive literature search, no publication status in selection, no, no synthesis
Morais de Freitas 2013 (32) Factors related to dry mouth and low salivary flow rates in diabetic elderly: a systematic literature review	5 studies 4 cross sectional 1 longitudinal	Elderly with diabetes with or without a sensation of dry mouth	Salivary dysfunction xerostomia	factors related to xerostomia and/or hyposalivation in elderly patients with diabetes **Covariates adjusted** Age, gender, patient health, medications use, disease stage, socioeconomic status, presence of neuropathy	Hyposalivation in elderly people with diabetes may occur in terms of stimulated response in those with poor glycaemic control. e,g, due to drugs/ anxiety etc. more studies needed to confirm this	Cannot draw definitive conclusions about the factors that cause xerostomia and/or hyposalivation in elderly patients with DM. more longitudinal studies needed	Moderate (5) Amstar not met: No priori design, no duplicate selection, no publication status in selection, no excluded, no bias assesses, no conflict of interest
Gong et al 2015 (31) Type 2 diabetes mellitus and risk of oral cancer and precancerous lesions: A meta-analysis of observational studies	13 studies included: 4 case control 9 cohort	Patients with type 2 diabetes mellitus	Oral cancer and precancerous lesions	Associations between type 2 diabetes mellitus (type 2 DM) and risk of oral cancer and precancerous Lesions **Covariates adjusted** covariates adjusted or by matching, and the effect estimates with 95% Cis were only included in the study. Though variations in which were adjusted for between studies. These included age, gender, smoking, alcohol, duration of chewing, BMI physical activity, education, diet, family history of cancer, health status, marital status	1.type 2 DM had a significantly elevated incidence of oral cancer (SRR = 1.15, 95% CI: 1.02–1.29; Pheterogeneity = 0.277, I2 = 15.4%; 10 studies) 2. Type 2 DM was associated with increased oral cancer mortality (SRR = 1.41, 95% CI: 1.16–1.72; 4 studies) 3. positive association between type 2 DM and risk of oral precancerous lesions (SRR = 1.85, 95%CI: 1.23–2.80; Pheterogeneity = 0.038, I2 = 57.5% 4. no bias	These findings of this meta-analysis indicate that compared with non-diabetic individuals, individuals with type 2 DM have an elevated risk of oral cancer and precancerous lesions development	Very high (11) Amstar: All met

Ismail et al 2015 (26) Oral health of children with type 1 diabetes mellitus: A systematic review	37 studies 7 longitudinal Rest case controlled	Children with type 1 diabetes	Caries DMFT Periodontal health	Oral health status of children with type 1 diabetes. **Covariates adjusted** none presented	1.conflicting evidence regarding the caries experience of children with type 1 diabetes 2.exhibit poorer periodontal health status 3.greater plaque accumulation 3. Further studies are warranted	There is conflicting evidence regarding the caries experience of children with type 1 diabetes, but they exhibit poorer periodontal health status with greater plaque accumulation compared to healthy children. Further studies are warranted to assess the oral health status of children with type 1 diabetes.	Moderate (6) Amstar not met: No publication status in selection, no exclusion table, no quality assessed, no synthesis, no bias assessed
Janket et al 2005 (38) Does periodontal treatment improve glycaemic control in diabetic patients? A Meta-analysis of Intervention Studies	10 studies all interventional	Type 2 Diabetics patients undergoing periodontal treatment	Periodontal treatment. No definition	Periodontal treatment effect on Hba1C **Covariates adjusted** none presented	1.a non-significant 0.38% reduction in actual value of HbA1c, and 0.71% among 5 studies conducted among patients with type 2 diabetes 2. a non-significant 0.38% reduction in actual value of HbA1c, and 0.71% among 5 studies conducted among patients with type 2 diabetes 3. further studies with a larger sample size are needed (246)	1.future study needed 2.smoking, BMI, and diet, as well as baseline characteristics affecting glycemic control—should be adjusted 3. needed participants should be limited to type 2 diabetic patients on oral hypoglycemic agents or diet regimen only, etc	Moderate (7) Amstar not met: No priori, no status of publications in selection, no synthesis, no conflict of interest

Javed and Ramanos 2009 (28) Impact of Diabetes Mellitus and Glycaemic Control on the Osseo-integration of Dental Implants: A Systematic Literature Review	18 studies: 10 clinical 8 experimental	Humans with diabetes with dental implants	conventional dental implants and/or immediate loading of dental implants	Can patients with diabetes be good candidates for dental implant therapy? And how does hyperglycaemia and glycaemic control influence osseo-integration? **Covariates adjusted** none presented	1.poorly controlled diabetes negatively affects implant osseo-integration; however, under optimal serum glycaemic control, osseo-integration can successfully occur in patients with diabetes. 2. use of antiseptic mouth rinses and oral-hygiene maintenance helps in achieving a successful dental implant osseo-integration in subjects with diabetes 3. A successful dental implant osseo-integration can be accomplished in subjects with diabetes with good metabolic control (serum glycaemic level and haemoglobin A1c in normal range) in a similar manner as in subjects without diabetes. 4. dental implant therapy in diabetics without good glycaemic control remains contraindicated	A successful dental implant osseo-integration can be accomplished in subjects with diabetes with good metabolic control (serum glycemic level and hemoglobin A1c in normal range) in a similar manner as in subjects without diabetes	Moderate (5) Amstar not met: No excluded table, no characteristics, no quality assessment, no synthesis, no bias assessed
Khader et al 2005 (14) Periodontal status of diabetics compared with non- diabetics: a meta-analysis	23 studies 18 comparative cross sectional, 3prospective cohort and 2 trials	Diabetics and non- diabetics with periodontitis	Periodontal status. PI,GI, PPD, CAL	Oral hygiene and periodontal disease **Covariates adjusted** none presented	1.The severity of oral hygiene and POD was worse in diabetics. 2.The extent of POD was similar in diabetics and non-diabetics 3. heterogeneity a problem	Diabetics had a significantly higher severity but the same extent of periodontal disease than non-diabetics.	Moderate (6) Amstar not met: no comprehensive literature search, no excluded, no quality assessed, no conflict of interest
Kudiyirickal 2014 (39) Diabetes mellitus and oral health	78 studies	People with diabetes	Periodontal disease, pulp, dry mouth, root caries, wound healing Oral candidiasis No definitions	Oral health status **Covariates adjusted** none presented	Diabetes can worsen oral infections and vice versa. In the literature, periodontitis and diabetes in the young to middle-aged adults have been the most widely researched area	Several studies have shown the inter-link between oral health diabetes, thereby highlighting the importance of proper management of orofacial infections in the reduction of the disease-related morbidity from diabetes and vice versa.	Moderate (4) Amstar not met: No priori, no characteristics, no duplicate selection no publication status in selection, no quality assessed

Li et al 2015 (18) Effect of non-surgical periodontal treatment on glycaemic control of patients with diabetes: a meta-analysis of RCTs	9 RCT's	Type 2 diabetics with periodontal disease	Periodontal therapy : none defined by reviewers. SRP, SRP + mouthwash variably in individual studies	whether non-surgical periodontal treatment can reduce the Haemoglobin A1c (HbA1c) % level in type 2 diabetic patients **Covariates adjusted** none presented	pooled analysis (n=1082) showed −0.27 % (95 % CI:-0.46 % to −0.07 %, p= 0.007) absolute difference in HbA1c % with treatment while studies with sufficient sample size had HbA1c % change of −0.014 % (95 % CI:-0.18 % to 0.16 %, p= 0.87)	The moderate reduction in HbA1c after the non-surgical therapy in patients with type 2 diabetes is consistent with previous systematic reviews. However, more large scale and high-quality RCTs are necessitated to confirm these results.	Moderate (5) Amstar not met: No priori design, no duplicate selection, no public status selection, , no quality assessed, no conflict of interest
Masceranhas 2014 (33) Effect of Diabetes Mellitus Type 2 on Salivary Glucose – A Systematic Review and Meta-Analysis of Observational Studies	10 observational studies	Type 2 Diabetic patients	Saliva glucose content	the effectiveness of salivary glucose to estimate glycaemia and HbA1c. **Covariates adjusted** none presented	1. Type 2 DM leads to a consistent increase in salivary glucose that remains detectable in spite of food contamination, variations in salivary flow rate or presence of local autonomic neuropathy. 2.Our review also reports a significant overall relationship between salivary glucose concentration and associated glycaemia/HbA1c values, with the correlation strength increasing as we move to higher glycaemia/HbA1c values 3.will allow a less painful and invasive method for type 2 DM screening or diabetic glucose monitoring	significant overall relationship between salivary glucose concentration and associated glycemia/HbA1c values, with the correlation strength increasing as we move to higher glycemia/HbA1c values	Moderate (6) Amstar not met: No duplicate selection, no status of publication in selection, no excluded table, no bias assessment, no conflict of interest
Mombelli and Cicone 2006 (11) Systemic diseases affecting osseo-integration therapy	15: studieseight case series six cross-sectional, longitudinal or retrospective one matched control retrospective chart survey	Patients with dental implant with systemic conditions and including diabetes	Dental implants. None described	impact of systemic diseases and their treatment on the success of osseo-integration therapy **Covariates adjusted** none presented	1.No unequivocal tendency for subjects with diabetes to have higher failure rates emerged, 2.a significant increase in the relative risk of implant failure with diabetes	The tendency for subjects with diabetes to have higher failure rates is equivocal	Low (3) Amstar not met: No comprehensive literature sear, no status publication in selection, no excluded table, no quality assessed, no synthesis, no bias assesses, no conflict of interest

Oates et al 2013 (9) A critical review of diabetes, glycaemic control, and dental implant therapy	16 papers	Patients with diabetes and dental implants	Dental implants	implant therapy relative to glycaemic control for patients with diabetes **Covariates adjusted** none presented	1. Reported implant failures rates for diabetic patients ranged from 0–14.3% 2. identification and reporting of glycaemic control was insufficient or lacking in 13 of the 16 studies 3. failed to demonstrate a significant relationship between glycaemic control and implant failure, with failure rates ranging from 0–2.9%	Clinical evidence is lacking for the association of glycemic control with implant failure while support is emerging for implant therapy in diabetes patients with appropriate accommodations for delays in implant integration based on glycemic control	Low (3) Amstar not met: No priori design, no excluded table, no characteristics, no comprehensive literature search, no quality assessed, no synthesis, no bias assessed
Mauri-Obradors et al 2015 (23) Effect of nonsurgical periodontal treatment on glycosylated haemoglobin in diabetic patients: a systematic review -	21: 13 RCT And 8 non RCT	Type 1 diabetics undergoing periodontal therapy	Periodontitis: none specified by authors. Collected definitions based on CAL, PPD, BOP, PI and number of remaining teeth	Effect of non- surgical periodontal therapy in reducing hba1c in type 1 diabetics **Covariates adjusted** none presented	1. A significant decrease in HbA1c ($p<0.05$) was found in only 14 (66 %) of the studies: 69 % of the RCTs articles and 62 % of the non-RCT articles 2. after 3-4 or 6/12 follow up 66.7 % of the studies, a significant decrease in HbA1c after periodontal treatment was reported 3. Only five of the 21 studies (23.8 %) were of high methodological quality and reported significant improve-ments in the metabolic control of DM types 1 and 2	Published literature is insufficient and inconclusive to clearly support periodontal treatment as a means to improve serum HbA1c levels in patients with type 1 DM	Moderate (7) Amstar not met: no publication status in selection, no quality used conclusions, o synthesis, no bias
Renvert et al 2008 (40) Non-surgical treatment of peri-implant mucositis and peri-implantitis: a literature review -	24 papers	Patients with peri-implant disease	Dental peri-implant mucositis perimplantitis	Peri- implantitis risk factors and methods of treating these **Covariates adjusted** none presented	potential risk indicators for peri-implant disease including poor oral hygiene, smoking, history of periodontitis, diabetes, genetic traits, alcohol consumption and implant surface	Strong evidence that poor oral hygiene, a history of periodontitis and cigarette smoking, are risk indicators for peri-implant disease potential risk indicators for peri-implant disease including poor oral hygiene, smoking, history of periodontitis, diabetes, genetic traits, alcohol consumption and implant surface	High (8) Amstar not met: no comprehensive search strategy, no bias assessed, no synthesis

Sgolgostra et al 2012 (41) Effectiveness of Periodontal Treatment to Improve Metabolic Control in Patients With Chronic Periodontitis and Type 2 Diabetes: A Meta-Analysis of Randomized Clinical Trials	5 RCTs	Patients with type 2 diabetes and chronic periodontitis undergoing scaling and root planing	Chronic periodontitis: a complex disease that develops from intra-oral biofilms harbouring periodontal pathogenic micro-organisms. -Individual studies varied- some American European consensus criteria	Effectiveness of SRP in improving glycaemic and metabolic control in patients with CP and DM2 **Covariates adjusted** n/a	SRP was effective in the reduction of HbA1c (MD = 0.65; 95% CI 0.43 to 0.88; P <0.05) and FPG (MD =9.04; 95% CI 2.17 to 15.9; P <0.05), but no significant differences were found in the reduction of TC, TG, HDL, or LDL	Supports the effectiveness of SRP in the improvement of glycaemic control in patients with CP and DM2; however, future studies are needed to confirm these results	High (9) Amstar Amstar not met: no priori design no scientific quality in used in conclusion

Simpson et al 2015 (16) Cochrane review Treatment of periodontal disease for glycaemic control in people with diabetes	35 Parallel RCT studies (33=T2DM only)	Patients with diabetes, periodontitis undergoing scaling and root planning above age 16	Periodontal disease is the inflammation and destruction of the underlying supporting tissues of the teeth	periodontal therapy (SRP +/- adjunctives- surgery, antimicrobials, other med) on glycaemic control in people with diabetes mellitus **Covariates adjusted** n/a	1.(83%) as being at high risk of bias, two studies (6%) as being at low risk of bias, and four studies (11%) as unclear. 2. Comparison 1: low quality evidence from 14 studies (1499 participants) comparing periodontal therapy with no active intervention/ usual care demonstrated that mean HbA1c was 0.29% lower (95% confidence interval (CI) 0.48% to 0.10% lower) 3 to 4 months post-treatment, and 0.02% lower after 6 months (five studies, 826 participants; 95% CI 0.20% lower to 0.16% higher). 3. Comparison 2: 21 studies (920 participants) compared different periodontal therapies with each other. There was only very low quality evidence for the multiple head-to-head comparisons. specific comparison between scaling and root planing (SRP) plus antimicrobial versus SRP and there was no consistent evidence that the addition of antimicrobials to SRP was of any benefit to delivering SRP alone (mean HbA1c 0.00% lower: 12 studies, 450 participants; 95% CI 0.22% lower to 0.22% higher) at 3-4 months post-treatment, or after 6 months (meanHbA1c 0.04%lower: five studies, 206 patients; 95%CI 0.41% lower to 0.32% higher). 4.The evidence was insufficient to conclude whether any of the treatments were associated with harm. 5. Studies showed varying degrees of success with regards to achieving periodontal health, with some showing high levels of residual inflammation following treatment.	Statistically significant improvements were shown for all periodontal indices (BOP, CAL, GI, PI and PPD) at 3-4 and 6 months in comparison 1; however, this was less clear for individual comparisons within the broad category of comparison 2.	High (11) Amstar all criteria met

Sun Q et al 2014 (22) Effects of periodontal treatment on glycaemic control in type 2diabetes mellitus patients: a meta-analysis of RCTs	8 RCT studies involving 515 participants	Type 2 diabetics having periodontal therapy	Periodontal disease : no specific definitions presented	periodontal treatment (SRP,OHI, +/-antimicrobials) on glycaemic control in t2dm pts **Covariates adjusted** none presented	1.1.03% (95% confidence interval: 0.31% to 1.70%, *P* = 0.003) from baseline to 3 months, and 1.18% (95% confidence interval: 0.72% to 1.64%, *P* < 0.001) from baseline to 6 months 2. indicated that periodontal treatment could improve glycaemic control in type 2 diabetic patients with periodontal diseases	Our analysis indicated that periodontal treatment could improve glycaemic control in type 2 diabetic patients with periodontal diseases	Moderate (5) Amstar not met: No priori design, no excluded table, no publication status in selection, no quality used in conclusion, no bias assessed, no conflict of interest
Teew et al 2010* (20) The effect of periodontal treatment on glycaemic control of DM pts: a systematic review and meta-analysis -	5 controlled trial studies	Diabetic patients undergoing periodontal treatment	Periodontitis: a chronic multifactorial infectious disease of the sup-porting tissues of the teeth -Individual studies had variable defintions periodontitis presented	Periodontal therapy (SRP +OHI +/- adjunctive **Covariates adjusted** none presented	1. Favouring periodontal intervention in type 2 diabetic patients. Nevertheless, this improvement in %HbA1C must be interpreted with care due to limited robustness as evidenced by heterogeneity among studies 3. periodontal treatment leads to an improvement of glycaemic control in type 2 diabetic patients for at least 3 months	Suggest that periodontal treatment leads to an improvement of glycaemic control in type 2 diabetic patients for at least 3 months	Moderate (5) Amstar not met: No duplicate study selection, no quality assessed, no exclusion table, no bias assessed no quality used in conclusion
Wang et al 2014** (21) Effects of Periodontal Therapy on Metabolic Control in Patients With Type 2 Diabetes Mellitus and Periodontal Disease A Meta-Analysis	10 trials of 1135 patients	Patients with periodontitis and diabetes undergoing periodontal therapy	Periodontal disease: is a multi-factorial infectious disease of the soft tissues and bone that support the teeth. Individual studies clinical parameters presented	periodontal therapies on metabolic control in T2DM patients with PD **Covariates adjusted** none presented	1. After the follow-up of 3 months, treatment substantially lowered HbA1c compared with no treatment after periodontal therapy (–0.36%, 95%CI, 0.52% to 0.19%, P<0.0001) 2. Clinically substantial and statistically significant reduction of PPD and CAL were found between subjects with and without treatment after periodontal therapy (PPD 0.42 mm, 95%CI: 0.60 to 0.23, P<0.00001; CAL 0.34 mm, 95%CI: 0.52 to 0.16, P = 0.0002). 3. And there is no significant change of the level of HbA1c at the 6-month comparing with no treatment (–0.30%, 95%CI, 20.69% to 0.09%, P = 0.13).	Periodontal treatment leads to the modest reduction in HbA1c along with the improvement of periodontal status in diabetic patients for 3 months, and this result is consistent with previous systematic reviews. And the effect of periodontal treatment on HbA1c cannot be observed at 6-month after treatment.	Moderate (7) Amstar not met: No priori design, no duplicate study selection, No status of publication in selection, no exclusion table, no quality used in conclusion

Figure 2 Flow diagram