

# Dentistry For

# Diabetes\*



The Impact Of Diabetes On Dental Health And Treatments Available.

\*This Guide is intended as an introductory overview only, and is not a substitute for your doctor's advice.



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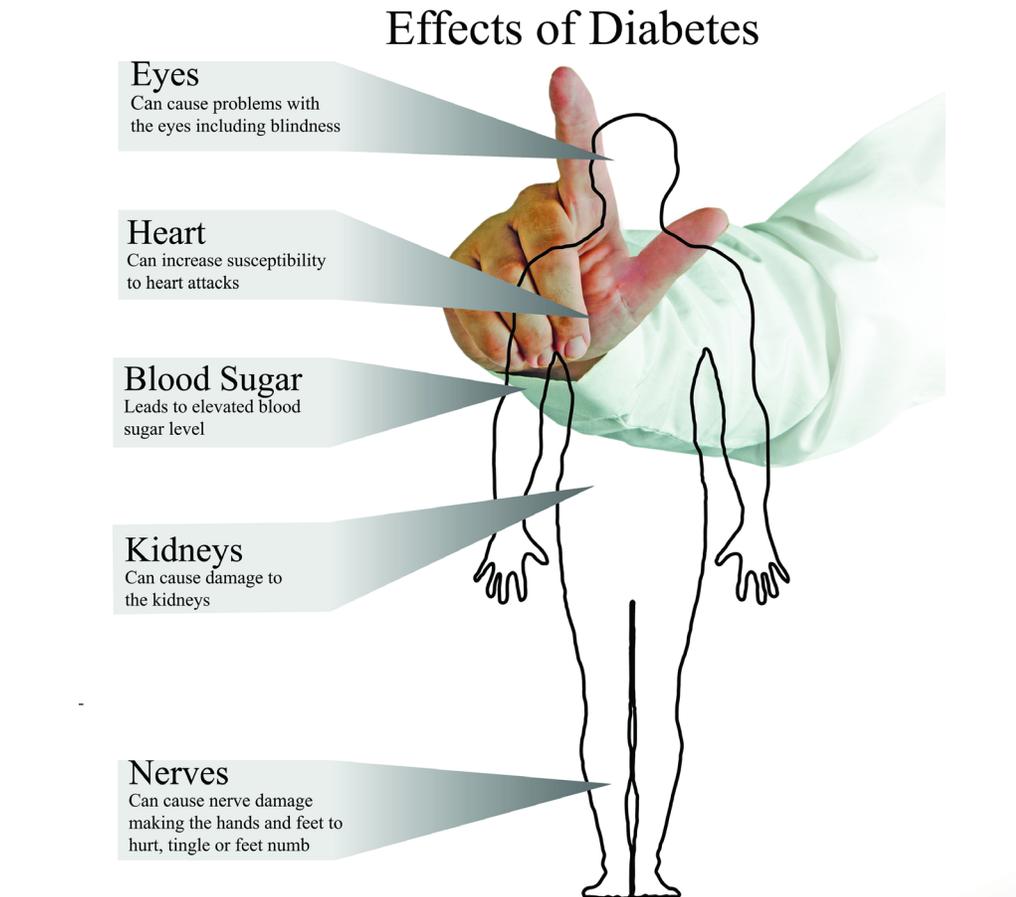


## Introduction by Dr. Yamen Ghamian & Dr. Habib Khoury

Diabetes is one of the fastest growing diseases on a global scale. It affects over 400 million people worldwide and the rates are steadily increasing. A few decades ago, diabetes wasn't such a common diagnosis and it hadn't yet become nearly as well-known as it is today. Now, it's so common that the term is a mainstay in our vocabulary and medical facilities have had to make accommodations to handle the number of people in need of treatment for diabetes and related complications. As the number of patients with diabetes increases, our understanding of the underlying issues and complications associated with the disease has been forced to increase as well.

The term 'diabetes' covers two different metabolic disorders: Type 1 and Type 2. Both types have the same end result of excessive blood glucose levels and they affect the body in a similar fashion despite their different origin.

Type 1 diabetes, once known as Juvenile Diabetes, begins during childhood and is often influenced by genetic issues involving alterations to genes that determine immune system function. The disorder results from the body's immune system attacking and destroying the beta cells in the pancreas that are responsible for producing insulin. Without any insulin, glucose cannot be broken down and utilized. This type of diabetes makes up only 5% of all diabetes cases.



Type 2 diabetes often affects adults, although it becoming increasingly common in children as well. There are many factors that contribute to the onset of Type 2 diabetes but the most common causative factor is lifestyle, with genetics playing a more minor role. With this type, the pancreas is producing insulin normally but the cells within the body become insulin resistant and this hinders the metabolism of glucose. Since the insulin is not able to convert glucose into usable energy, the glucose remains in the bloodstream. The pancreas attempts to accommodate by producing more insulin but

eventually, it is unable to keep up and insulin production decreases.

Within both types of diabetes, the dangers come from the resulting high glucose levels. The mechanism with which high glucose levels can damage the body is not understood in its entirety yet. It has been theorized that since glucose is "rough" in shape, it is abrasive to the pathways of the cardiovascular system and the linings of the internal organs involved, leaving small scrapes as it goes along. Research within the last decade has indicated that the more damaging and likely factor is that high glucose levels

result in the formation of nitric oxide in the bloodstream, which causes the arteries and blood vessels to dilate. Although the dilation is mild and does not cause an immediate issue, the chronic presence of it and the increased blood pressure can damage the cardiovascular system over an extended period. Regardless of which type of diabetes is present, the long-term damage from glucose levels is ultimately the same. Neither type of diabetes can be cured, but they can be managed and with proper treatment, and therefore dangerous complications of diabetes can usually be avoided or greatly delayed.

The treatment for Type 1 diabetes involves daily insulin injections. Since the body can't produce insulin on its own, it needs to get it from an outside source. There is a long list of options for the type of injections that can be used and the injection scheduling differs by patient but it's often a lifelong necessity. Maintaining a regular exercise routine and eating healthy are also vital parts of treating the disease and making sure glucose levels remain within a healthy range.

Type 2 diabetes treatment differs greatly depending on the severity of the disease. In many cases, making changes to lifestyle, such as eating a healthier diet or starting a regular exercise routine, can be all the treatment that is needed. In more severe cases, insulin injections and other medication may have to be added into the treatment plan to prevent hyperglycemia. Medications to manage the common diabetes complications of high blood pressure and kidney issues may also be needed.

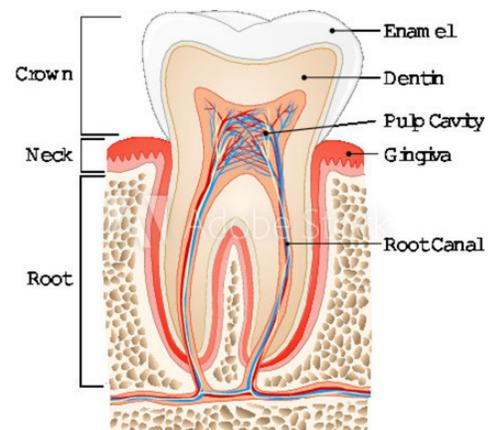
For both types of diabetes, regular visits to the doctor are recommended to check glucose levels and monitor the status of the disease. However, there's an aspect of diabetes treatment that tends to be overlooked and forgotten. As our understanding of diabetes grows, it is becoming apparent that doctor's visits are only one half of the solution. The other half involves a different type of doctor: a dentist.

Suggesting an oral exam as part of diabetes treatment regimen can come as a surprise to many. We usually don't associate diabetes with oral health. At least, we don't associate it as something that would influence diabetes. No one could be blamed for immediately wondering "What do my teeth have to do with diabetes?" The majority of public information about the disease doesn't put much of a focus on oral health except with respect to dental issues being a symptom. Yet, research now shows a strong and complex connection between oral health and diabetes.

## Impact of Oral Health on Diabetes.

The surprise of hearing that maintaining good oral health is important to the treatment of diabetes stems from the misconception that oral health is only about teeth. While teeth are the most noticeable feature in the mouth, the gum tissue that surrounds them

and the bone they are anchored into are just as vital. Any part of the mouth can become infected, and all infections affect the entire body. Tooth abscesses are not uncommon, but a more prevalent type of oral infection stems from periodontal disease. Most people will experience some stage of periodontal disease within their lifetime. Gum disease is most common between the ages of 40 and 50 although it's also common in those young enough to be in their high school and early college years. In fact, the American Dental Association



(ADA) states that 75% of people have some form of periodontal disease at some point in their lives.

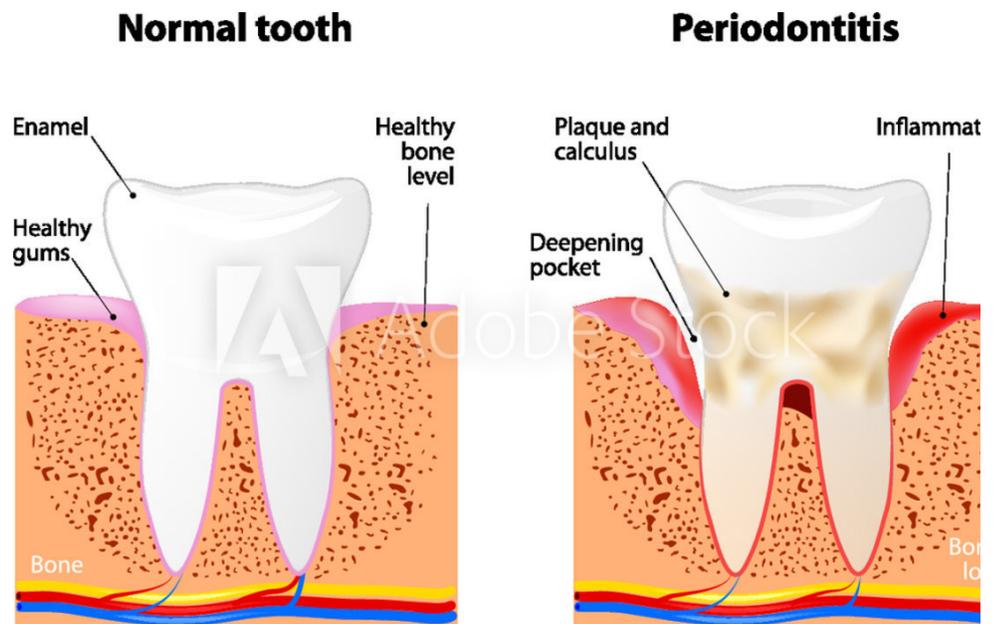
Periodontal disease targets the periodontium. The periodontium refers to four parts the tooth-supporting structure that work together to keep teeth firmly rooted in the mouth: the gingivae (the gums), the periodontal ligament, the cementum and the alveolar bone.

The gums are the outside, pink, tissue that surrounds the teeth and provides protection to the structures

underneath. Healthy gums are tightly wrapped around the tooth so that no bacteria or food particles can slip in between them and the teeth. Cementum is a hard tissue that covers the root of the tooth, creating a surface layer, and attaches the root to the periodontal ligament. Surrounding the tooth below the gum line, the periodontal ligament is a thin tissue that anchors the tooth to bone socket and is responsible for absorbing the light shock caused by biting down and chewing. Lastly, the alveolar bone is the bony ridge that extends from the maxilla (the upper jaw) or the mandible (the lower jaw) and bears the sockets that teeth sit in.

Caused by plaque buildup around the gum line, periodontal disease slowly destroys the structures of the periodontium. The first stage of the disease is gingivitis. This is when the gums become irritated and inflamed, appearing red and puffy around the tooth. Gums affected by gingivitis will bleed easily during brushing and flossing and can sometimes be tender. At this stage, the condition can be easily treated by improving oral hygiene, getting regular dental cleanings, and removing the built-up plaque and bacteria that is irritating the gums. It can take a few months for gingivitis to clear up but the gums usually don't experience any long-term damage after the condition is reversed.

If gingivitis is left untreated and it progresses in severity, the gums begin to pull away from the teeth and a pocket is formed between the



gum and the tooth. This is referred to as a 'periodontal pocket'. Food, plaque, and bacteria get into the pocket and are close to impossible to remove with regular brushing or flossing because they are too far down below the gum line to be reached. Unable to be cleaned out, the pockets soon become infected by the trapped bacteria. Over time, the infection causes the gums to recede as it breaks down the periodontium and begins eating away at the alveolar bone. As the periodontium is diminished, the teeth become loose and eventually fall out because there's no longer anything anchoring them in place.

The first stages of periodontal disease are typically painless but as the gums recede, the root of the tooth is exposed. The root is covered by cementum rather than the same protective enamel that covers the crown of the tooth so it's more sensitive and prone to decay, causing

tooth aches and increased sensitivity. Infections within the periodontal pocket can begin to work their way outwards through the gum tissue and a visible abscess that resembles a pimple will form. These can be extremely painful and make eating or brushing an unpleasant experience. Once the disease reaches more advanced stages, teeth can begin shifting and making it uncomfortable to chew. At that point, treatment is needed immediately to preserve the remaining periodontium and prevent tooth loss. Even healthy teeth that don't have a single cavity can simply fall out. Attempting to save the teeth after periodontal disease has become advanced enough to affect the bone can be very difficult, so it's important to have the issue addressed once the first symptoms appear, like gums that bleed when you brush.

While tooth loss is a major concern when it comes to periodontal disease, the spread of the infection

is also a cause for serious concern. An infection that takes root in one part of the body can travel once it hits the bloodstream and go on to impact other parts of the body. A constant presence of infection also influences the immune system. When the immune system detects an infection or the presence of a foreign pathogen that's not supposed to be there, it immediately works to fight it off and as part of that process, inflammation occurs.

In many ways, inflammation is good. It's one of the mechanisms that the body uses to promote healing and repair the tissues that have been damaged, either by an injury or illness. Without inflammation, the body would have a hard time healing itself or fighting off any type of infection. Yet, despite the necessity of it, inflammation has a potent dark side. When inflammation becomes chronic, it does more bad than good. Cells that were originally healthy can become damaged by the frequent inflammation, the immune system can get worn down and compromised to the point that it no longer functions as it should which puts a strain on the entire body.

One of the ways chronic inflammation negatively affects the body is by altering glucose tolerance. There have been studies that suggest chronic inflammation promotes insulin resistance.<sup>1</sup> Since periodontal disease causes chronic inflammation, it can contribute to the risks of developing insulin resistance that will lead to the formation of Type 2 diabetes.<sup>13</sup> This makes periodontal disease a strong concern for those

with prediabetes or are predisposed to developing metabolic disorders. While prediabetes can be reversed, a continued increase of insulin resistance caused by infection and the resulting chronic inflammation can throw a huge wrench into the efforts of preventing the progression of prediabetes to Type 2 diabetes.<sup>2</sup> A patient could be doing everything they are told to but if there is an underlying factor that's not being addressed, they will have a much harder time regaining and maintaining their health.

Maintaining steady glucose levels is



the fundamental principle of both preventing and managing both forms of diabetes. Even when diabetes has already developed, many of the complications can be avoided if glucose levels are kept under control and the disease is not allowed to progress. Untreated high glucose levels result in complications that affect multiple systems of the body and in severe cases, they can become life threatening.

The heart and vascular system are particularly in danger of experiencing complications. High blood pressure,

heart disease, and stroke are all seen with higher frequency within diabetic patients. Damage to veins and blood vessels from an abnormally high amount of glucose traveling through the bloodstream causes problems with circulation. The disrupted blood flow starves the affected area of nutrients and oxygen, which causes tissue and nerve death, as well as hindering the body's ability to heal any injuries to the area.

Periodontal disease, on its own, is strongly linked to heart disease.<sup>10,15</sup> A 2003 meta-analysis showed that those with periodontal disease had a 19% increase in the risk of developing cardiovascular conditions, even without any other health issues factored in.<sup>3,6</sup> While 19% may not sound like an alarming percentage, when you take into consideration that heart disease kills roughly 17 million people per year, a 19% decrease in the risk of heart disease translates into a significant impact.

The link between periodontal disease and heart disease is believed to be the result of a combination of chronic inflammation promoted by the infections that are the main staple of periodontal disease and the bacteria that causes them.<sup>8</sup> *Porphyromonas gingivalis* is a strain of bacteria that is highly associated with periodontal disease and known to colonize in periodontal pockets. It's not a normal part of the oral bacteria environment but once present and allowed to multiply, it becomes the main contributor to infection within the gums.

The inflammation caused by these infections may contribute to atherosclerosis, which is the hardening of the major arteries and the leading cause of heart attack and stroke.<sup>4</sup> Bacteria from the infections of periodontal disease that have entered into the bloodstream can reach the arteries and the heart, contributing to plaque buildup on the artery walls or causing dangerous secondary infections such as endocarditis.<sup>6</sup>

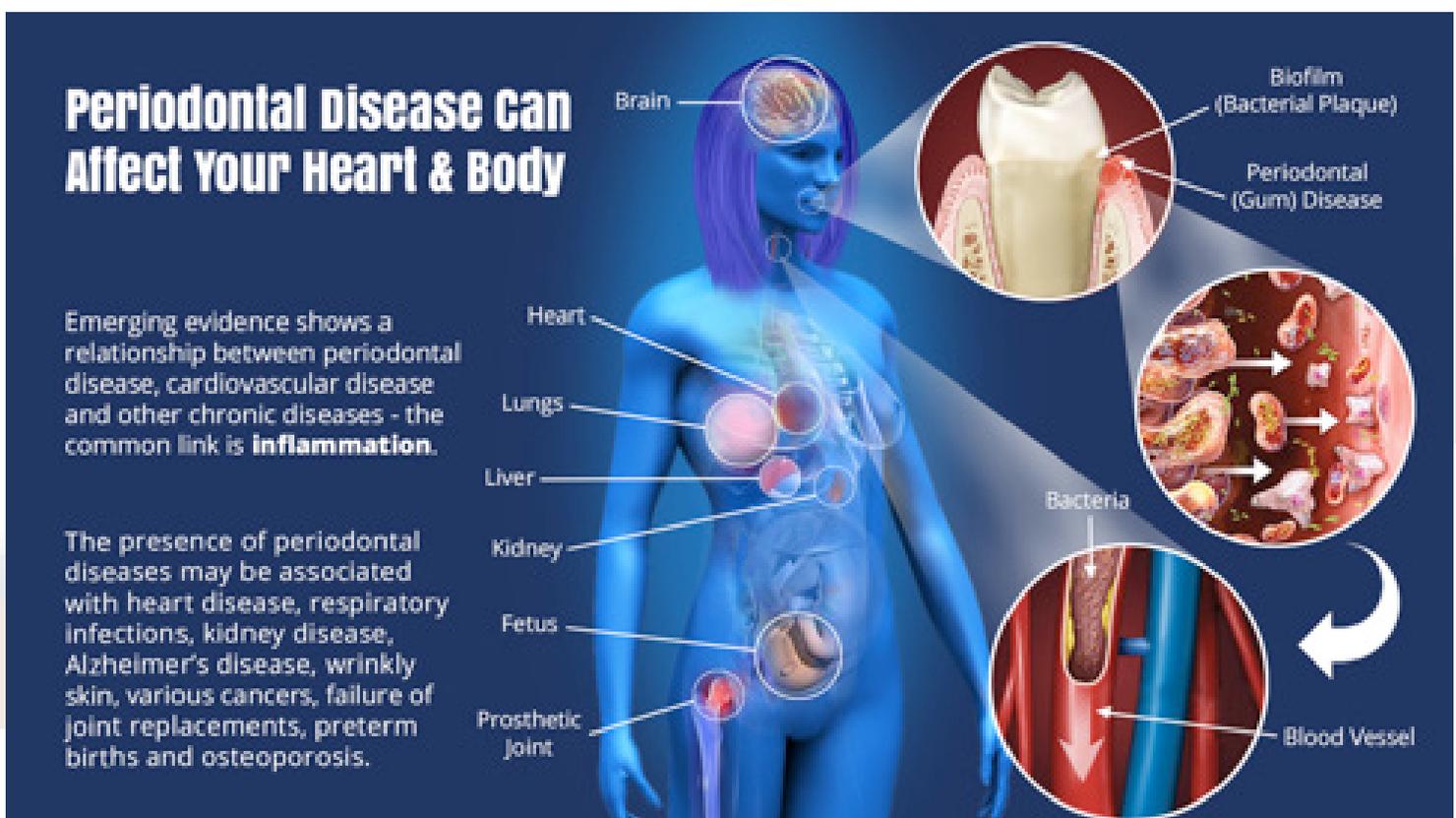
Diabetes and periodontal disease together is the mixture of two diseases that are linked to heart and vascular issues. When these are combined, it creates the perfect storm. It's two destructive forces merging in one stronger force that can wreak havoc on the cardiovascular system and raise the risks of the serious complications

associated with both diseases. On their own, both diabetes and periodontal disease have a negative impact on heart health but when combined, that impact is more likely to be life threatening.

The dangers that a combination of diabetes and periodontal disease pose to cardiovascular system was highlighted in a Swedish study conducted in 1996.<sup>5</sup> Within the group of diabetics that participated in the study, those with periodontal disease showed a significant increase in the rate of cardiovascular issues. 82% of the periodontal group experienced at least one major cardiac event over the course of the study. In comparison, within the group that did not have periodontal disease, only 21% experienced a major cardiac event. A major cardiac

event is defined as any event that causes extensive damage to the heart muscles but the term is most often used to refer to a heart attack so it's a serious situation that's not easy to recover from. The large difference between the results within the two groups shows that the impact of diabetes combined with periodontal disease on risk of experiencing one of these devastating events is neither small nor insignificant.

Considering the results of the Swedish study, it's not much of a surprise that mortality rates from cardiovascular complications in patients with the dangerous periodontal disease and diabetes combination are double the mortality rates from cardiovascular complications seen with diabetics without periodontal disease. An observation of Type 2 diabetic



patients has shown there is a 2.3 times higher rate of death from heart disease when periodontal disease is present.<sup>7</sup> These increased rates of mortality are not only seen with heart disease but are also noted in other common diabetes complications, sometimes to a greater degree.

A major concern for diabetic patients is renal (kidney) disease and it's a common complication of chronic high glucose levels. Since the kidneys are responsible for filtering out the blood, they are heavily impacted by glucose levels. When there is a high amount of glucose, the kidneys must work overtime to filter it all out and that puts a large strain on them. A continual strain ages the organ rapidly and its ability to function steadily declines. The small filters in the kidney, called glomeruli, gradually become damaged from the strain and begin to scar. The scar tissue begins to take up more space and results in a condition called glomerulosclerosis. Once this condition is present, the kidneys are increasingly rendered unable to do the job they were meant to do, leading to waste and toxins not being filtered out and building up in the bloodstream.

Diabetic renal disease is generally not serious enough to need dialysis. The treatment usually consists of medications and improving glucose levels. End-stage renal disease is not common with diabetes but when periodontal disease is added in, the risk for diabetic renal disease progressing to the terminal stages is 8.2 times higher than in those without periodontal issues.<sup>7</sup>

Periodontal disease has been observed to exaggerate the risk that diabetic patients already face when it comes to kidney failure. In one analysis, the presence of periodontal disease could actually predict the onset of kidney disease in diabetic patients. Those with periodontal disease were seen to be far more likely to experience renal complications than those who had good oral health.<sup>16</sup> When the oral disease was present in the Type 2 diabetes study participants, the researchers were able to conclude, with high accuracy, that kidney disease would form.<sup>9</sup> With research studies, it's rare to find such a decisive conclusion and the results of that analysis display how strong the link between periodontal disease and diabetes complications really is. Another observation that highlights this connection is the comparison of the mortality rates of diabetes influenced kidney failure between those with periodontal disease and those without it. Diabetic patients with periodontal disease were seen to have an 8.2 times higher chance of dying from renal complications than the diabetic patients that had general good oral health.<sup>7</sup>

The reason periodontal disease has such a devastating impact on diabetes is due to the negative affect it has on glucose levels. The risks of diabetes complications worsen with the presence of periodontal disease mainly due to the hindrance it causes with maintaining healthy glucose levels.<sup>9</sup> The cycle of chronic inflammation and the altering of glucose tolerance caused by oral infections adds another

destructive layer to an already destructive disease, building onto and accelerating the dangers that diabetes poses while on its own.

When periodontal disease is taken out of the equation, glucose levels tend to improve significantly with standard diabetes treatment. In many of the observed cases, the reversal of gingivitis or even mild cases of periodontal disease lead to an improvement in glucose tolerance.<sup>11</sup> It's not only the severe cases that can become a systemic issue. The earliest stages of failing oral health still make a large impact on the risk of diabetes complications and should not be overlooked. At face value, the figures of improvement seen in the studies appear small. The majority published literature on the topic only cite improvement percentages below 50%. There is rarely a 100% improvement because once the damage is done, it cannot always be entirely repaired or reversed. However, even a small percentage



of improvement in the control of glucose levels leads to a substantial decrease in the risk for diabetes complications.

## Impact of Diabetes on Oral Health.

With the amount of research and clinical observations available, there can be little doubt that diabetes is heavily impacted by poor oral health.<sup>12</sup> Yet, the negative impact is far from being one sided. Oral health and diabetes interact with each other in a clear cycle.

Periodontal disease is seen in higher rates among diabetes patients. This is true for both Type 1 and Type 2 diabetes.<sup>14</sup> The severity of periodontal disease is also seen to be much higher than the average. In one study of children with Type 1 diabetes, a higher rate of inflammation and bleeding of the gums was observed. The amount of plaque formation didn't appear to make a difference in the observations.<sup>7</sup> Increased inflammation was also seen in Type 2 patients. These indicate that diabetes alters that inflammatory response in a way that promotes a greater than average amount of inflammation to the gums, regardless of whether the patient has a good oral hygiene routine.<sup>14</sup> Even with brushing and flossing to routinely remove plaque above the gum line, the inflammation still occurred.

The “how” and “why” aspects of the effect diabetes has on oral health

are not completely known but there are a few theories. The theory that is cited the most often and has the most weight leans on the fact that diabetes leads to an altered immune system. Chronic high glucose levels change the way the immune system responds, making it act differently than it would for someone without a metabolic disorder. While a small amount of unavoidable plaque formation may not cause periodontal disease in someone that has good oral hygiene and receives regular dental cleanings, the altered immune system of a diabetic could cause a more aggressive inflammatory response and promote the formation of periodontal disease at the smallest amount of irritation. All studies on the issue have indicated that when it comes to gum tissue, a diabetes-influenced immune system is hyper-inflammatory.<sup>7,14</sup>

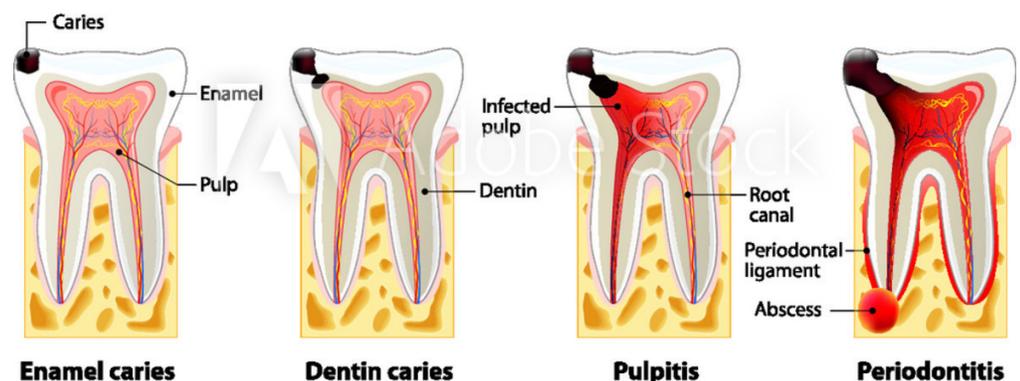
This would explain why periodontal disease appears to be more aggressive in diabetic patients. In an analysis of 18 studies and 2 clinical trials, greater pocket depth and tooth attachment loss was observed in diabetic patients.<sup>17</sup> Loss of the

bone structure was also seen to occur much sooner after the onset of periodontal disease. The rates are remarkably higher than what is typically seen with periodontal disease in non-diabetic patients.

An altered immune system can also change the balance of bacteria within the mouth.<sup>5,17</sup> Bacteria are always present but when in balance, many types of bacteria aren't harmful and actually have a beneficial role. Yet, it only takes a slight shift in that balance for bacteria to go from harmless to overgrown and blossoming into an infection. Alterations to the immune system could cause it to kill off 'good' bacteria or not kill off enough 'bad' bacteria to prevent an infection from taking root. This combined with a periodontal pocket, where bacteria can easily get trapped and there's an opening that leads to the inner structures of the periodontium, greatly increases the risk of periodontal disease progressing and a stronger infection forming.

Unchecked bacterial growth can also be damaging to teeth. Bacteria can eat away at the enamel and cause cavities (dental caries). Once a

## THE STAGES OF CARIES DEVELOPMENT



cavity is formed and there is enough rotting of the tooth for the dental pulp to become exposed, the risk of infection spikes. If there's already an issue with bacteria overgrowth, an infection is no longer a risk but a high probability. An infection with a tooth can spread into the bone structure and soft tissue around it, which not only causes damage to those areas but also has systemic affects. If untreated, the infection is aggressive, or the immune system is compromised, the infection can also work its way into the bloodstream and in the worst-case lead to a life-threatening condition called septicemia. In fact, it is not uncommon for bacteria associated with gum disease to cause infections elsewhere in the body.

Bacteria isn't the only thing in the mouth that can grow out of control. *Candida albicans* is a type of fungus. In some ways, it's essential to the body and it's always there but when it grows out of control, it leads to a very irritating infection, most commonly known as a "yeast infection". While not life threatening, it's a painful and aggravating oral condition to have. It's rare in healthy adults but is common in diabetic patients<sup>18</sup> for two reasons: an altered immune system that upsets the microbe environment of the mouth, and xerostomia.

Xerostomia is chronic dry mouth. The salivary glands, usually the parotid glands, can become enlarged by diabetes and unable to secrete an adequate amount of saliva. A 1992 study found that 42% of diabetic

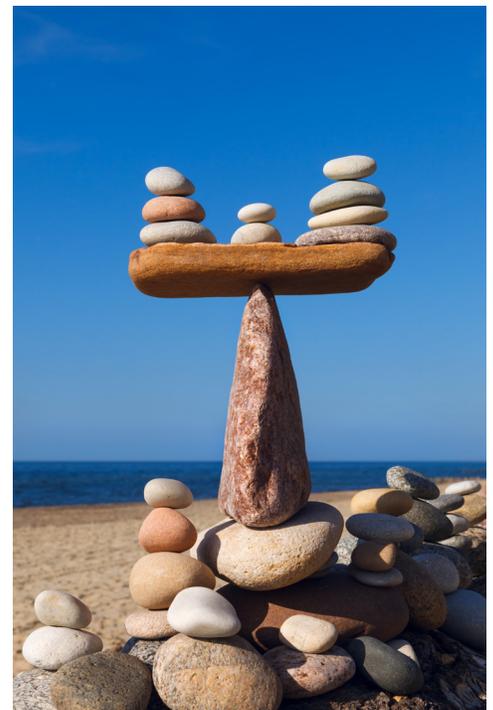
patients experience dry mouth, with women making up 82% of that. It's prevalent in both types of diabetes and it's one of the multiple factors that causes diabetic patients to experience oral health issues.<sup>19,21</sup> The number of cavities formed and the rates of candida infections are much higher in those with xerostomia. This complication of diabetes also contributes to increased periodontal disease.

Even when xerostomia is not an issue, saliva is still impacted by diabetes. A small amount of saliva can contain a significant amount of glucose when overall levels of glucose are high in the bloodstream. The correlation between glucose in the bloodstream and the glucose in saliva is reliable enough that glucose levels can be checked through saliva alone (although blood readings are most accurate).

*Streptococcus mutans* is a constant resident of the oral microbe environment. In small amounts, it doesn't cause an issue but its preferred diet of sugar and starches makes a bit of worry when there is an abundance of glucose present.<sup>18</sup> As with any other organism, having a steady food supply allows it to grow and multiply rapidly. This strain of bacteria has been linked to endocarditis and a few other systemic diseases. The effect on oral health alone is due to the corrosive acid that is emitted as a by-product of the bacteria feeding off sugar and starches. The acid is particularly damaging to tooth enamel and eats away at it, leading to tooth decay.

Glucose allows bacteria to thrive and promotes the growth of it. That's the exact reason that dentists recommend brushing teeth immediately after eating something sugary or to limit sugary treats. When the glucose in saliva is always high due to uncontrolled blood glucose levels, the promotion of bacterial growth is a constant. This heavily contributes to an increase of tooth decay, abscesses, periodontal disease, and candida infections.<sup>20</sup>

Diabetes negatively affects oral health in multiple ways and through



a few different pathways but it's all interconnected and stems from a lack of control with glucose levels. It'd be easy to jump to the conclusion that simply fixing the glucose levels would solve the entire problem but, sadly, the solution is not as clear cut and there's isn't a quick, easy

fix. When there's already a chronic infection in mouth, getting glucose levels back to a healthy range is not as easy as it otherwise would be. On the other hand, if glucose levels are not controlled, treating and preventing oral infections is not as easy as it normally would be.

Periodontal disease worsens diabetes and diabetes worsens periodontal disease, as well as overall oral health.

The two of conditions feed on, and play off each other. They are interwoven in such a way that treating one independently while neglecting the other makes the treatment inadequate for solving the entire problem. A doctor may prescribe everything needed to treat diabetes but the influence of poor oral health will hinder the treatment. A dentist could treat periodontal disease or other oral conditions but if the hyperglycemia isn't being treated as well, those conditions are likely to return or progress.

## Treatment

Due to the cycle of interaction between periodontal disease and diabetes, periodontal disease cannot be looked at as merely a complication or a symptom. Instead, it must be acknowledged as a major factor in diabetes. Rather than treating periodontal disease after the effect of diabetes progresses the severity, it should be treated at the first signs.

The link between periodontal disease and diabetes can also offer

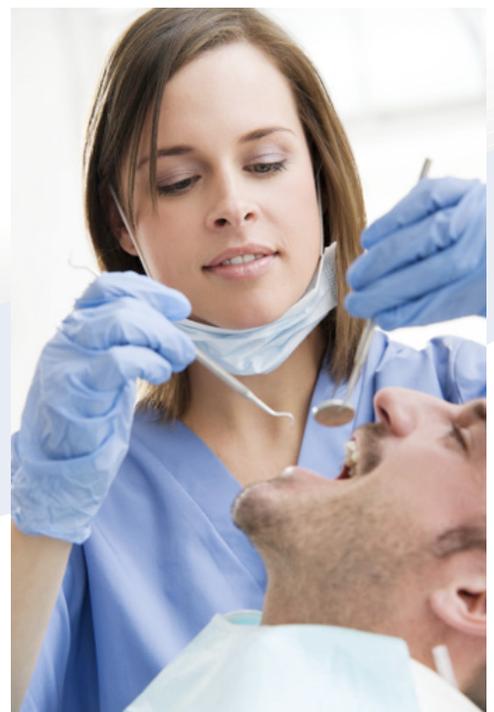
a method of screening for diabetes.<sup>7</sup> Many cases of metabolic disorders are not diagnosed until they reach a moderate stage because the early symptoms can often be mistakenly contributed to common, harmless things or are just not noticeable enough to raise alarm. The presence of periodontal disease and the severity of it could be a warning sign of building insulin resistance, helping to detect prediabetes and early stage diabetes before the disease takes hold or can cause irreversible damage.

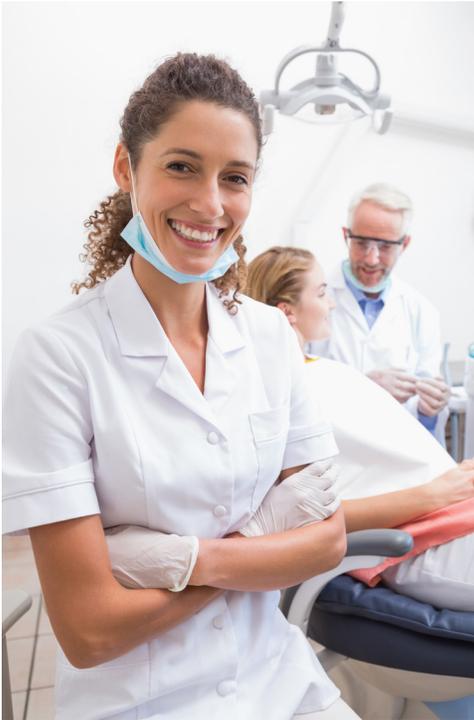
Since periodontal disease has been observed to increase insulin resistance and alter glucose tolerance, early treatment may prove to be a useful preventative method for those who are predisposed to developing a metabolic disorder. By taking away that contributor to poor glucose metabolism, it can make other efforts of changing diet and lifestyle more effective at keeping diabetes at bay.

A noticeable improvement in glucose levels has been seen within studies that compared the diabetes status of those that received treatment for periodontal disease against the severity of the diabetes in those who did not get treatment and continued to have failing oral health.<sup>22</sup> It was found that treating periodontal disease in all levels of severity led to more easily managed glucose levels. The removal of *Porphyromonas gingivalis*, in particular, resulted in improved glycemic control. Regaining oral health resulted in regaining or maintaining overall health.

The treatments for periodontal disease can vary depending on the severity. The most common treatment is called 'scaling and root planing'. This is a non-surgical method that works the best with mild or moderate stages of the disease. During the scaling portion of the method, the hardened plaque buildup, called tartar, is removed from below the gum line in the periodontal pockets. The root planing portion consists of the tooth roots being smoothed out to help the gums reattach to the tooth and close the pocket. The process often takes multiple sessions, especially the scaling, to make sure tartar doesn't build up in the pockets again and hinder the gums from reattaching and healing.

With severe cases of periodontal disease, surgery may be the best option. If the periodontal pocket is deep or there is significant bone loss,





scaling and root planing is not enough to promote rapid healing or fully treat the disease. When the periodontal pocket is so deep that the entirety of it cannot be reached during scaling, flap surgery may be performed. In this surgery, the gum tissue is opened for access. This allows the teeth to be fully cleaned of tartar that has accumulated far below the gum line. After the teeth are cleaned, the gums are put back in place and sutured tightly around the teeth to prevent any food or bacteria from getting into the gums and creating a new pocket.

Another type of surgery that can be performed to fix the damage of periodontal disease is grafting. If there is a large amount of bone damage, grafting may be an option to fix that as well. It can be done to preserve the support of remaining teeth or to promote enough bone growth that a dental implant can be securely anchored in to replace teeth

that were lost due to loss of the bone structure. Both the flap surgery and the grafting surgeries are usually a onetime deal and do not need to be repeated.

Antibiotics may also be included in the treatment of periodontal disease, in combination with either the scaling and root planing or surgical options. There are multiple forms of antibiotic that can be used. Pills are commonly prescribed if the infection is aggressive and at high risk of spreading or has penetrated the bone structure. However, antibiotics can also be administered during the time of treatment. The dentist can insert small, slowly dissolving capsules of antibiotics into the periodontal pocket after scaling to help kill off any remaining bacteria. An antibiotic mouthwash is another option and fights off the overgrowth at bacteria in the mouth to prevent it from furthering an infection or to help kill the infection in the gums that is already existing. The form of antibiotics prescribed depends heavily on the specifics of each patient's case and the dentist will decide which form of antibiotic to prescribe based on which is the best and most effective for each individual patient.

The impact of periodontal treatment on glycemic levels varies and the amount of improvement obtained can fall anywhere on the scale of meager to astounding. Some studies show a noticeable improvement while the results of other studies show only a minor difference. The conflicting results may be dependent on the

severity of both the periodontal disease and the diabetes. In cases where the periodontal pocket is very deep or the infection has infiltrated the bone structure, the scaling and root planing may not eliminate all the infection or the resulting inflammation and a surgical option is needed.

The addition of antibiotics to periodontal treatment lead to more positive results, especially in cases of advanced periodontal disease where the infection has spread outside of the periodontal pocket.<sup>2,16</sup> However, the results of this study indicate that antibiotics are not needed for gingivitis or mild periodontal disease and an improvement of glycemic levels was observed with a change in oral hygiene or scaling treatments alone.

The re-occurrence rate of periodontal disease after treatment, with maintained oral hygiene routine and regular cleanings, is low.<sup>8</sup> The presence of porphomonas gingivalis was not commonly detected after treatment and its absence plays a large role in preventing reoccurring incidents of infection in the periodontium, although this is dependent on the level of routine oral care received after the treatment for periodontal disease was completed. Regular brushing, flossing, and dental cleanings continually remove the bacteria before it can take hold, preventing the infection from reoccurring. A large part of the long-term effect on glucose control could be determined by how effective the patient's oral hygiene routine is and

whether they keep appointments for dental cleaning and check-ups. In patients who do not actively maintain improvements in oral hygiene, the improvement in glucose control is likely to be on a more diminished scale because the periodontal irritation and inflammation will continue be an ongoing issue.

Another factor for the differing results could be due to how well the diabetes was being treated or whether the patient was sticking to the treatment guidelines. Not monitoring glucose levels, failing to stay within the dietary restrictions, or continuing a smoking habit can worsen glucose levels and diminish any improvement that might otherwise be seen after scaling and root planing treatments. Since the severity of periodontal disease and diabetes is a two-way street, they have to be treated together or it is unlikely that there will be a noticeable improvement with either independent condition.

## Conclusion

Diabetes and periodontal disease are two very common conditions in the modern world. Most adults will experience at least the early stages of periodontal disease at some point within their lifetime and the rate of new diabetes diagnoses per year is steadily rising. The chances of someone having both conditions at the same time is getting higher and that leads to a problematic situation that requires a multifaceted treatment.

Periodontal disease enhances the risk of experiencing complications from diabetes. On its own, it is linked to a few serious conditions that affect the heart. Since diabetes has complications that affect the same organ, the combination of the two diseases raises the risk of those complications becoming life threatening. Mortality rates of cardiovascular and renal complications is increased when diabetes and periodontal disease are both present. Diabetes affects oral health by increasing the severity of periodontal disease, promoting tooth decay, and disrupting the microbe environment of the mouth so that infection is more prone to taking hold.

The impact that both conditions play on glycemic control is the factor that makes them so dangerous together. Diabetes is characterized by a difficulty with breaking down and utilization glucose, resulting in high level of glucose within the bloodstream. Periodontal disease triggers inflammatory responses

that can alter the way the body metabolizes glucose, making it difficult to get glycemic levels under control. With two diseases influencing glucose metabolism, the result of poor glycemic control is more likely to be heightened.

Although it seems like diabetes and an oral disease are worlds apart, they are tightly linked. It is not uncommon for them to be found together. Periodontal disease and diabetes creates a two-way street where the conditions build off each other, each worsening the other, and combine to contributed to increased failing health.

Research has provided evidence that treating periodontal disease makes diabetes treatment more effective by improving the ability to control glycemic levels and discourage hyperglycemia. However, periodontal disease is not simply a symptom of diabetes but rather, it is a major contributing factor in disease severity. The presence of oral disease may even be able to predict the onset of diabetes. Eliminating periodontal disease at the first signs could be a both a preventive method or a vital part of the treatment for diabetes.



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