

Bachelor's thesis

Degree program in Nursing

2018

Ilkka Pirhonen & Jemina Iiponen

PREVENTION AND CARE OF DIABETIC FOOT

– Patient instruction for Terveystietä

BACHELOR'S THESIS | ABSTRACT

TURKU UNIVERSITY OF APPLIED SCIENCES

Degree program in Nursing

2018 | number of pages, number of pages in appendices

likka Pirhonen & Jemina liponen

PREVENTION AND CARE OF DIABETIC FOOT

- Patient instructions for Terveystietä

Diabetes is a chronic illness that is becoming more common in Finland every year. If left untreated, it can have serious consequences. One of the biggest problems are chronic wounds caused by diabetes. Treating them is slow and expensive. Purpose of this thesis is to create English instructions for prevention and treatment of diabetic wounds, directed at patients suffering from diabetes.

This thesis was done using literature review, that concentrated on research done on treatment of diabetic wounds, and Käypä hoito –recommendations. The literature review indicated that most of the diabetic wounds are on feet, and their poor healing is often result of neuropathy, ischemia, or combination of both. The review also transpired that the most essential thing in prevention and treatment of diabetic wounds is regular follow-ups and good treatment balance.

KEYWORDS:

Wound care, Wound, Diabetes, Terveystietä, patient instruction

OPINNÄYTETYÖ (AMK / YAMK) | TIIVISTELMÄ

TURUN AMMATTIKORKEAKOULU

Degree Program in Nursing

2018 | xx sivua, xx liitesivua

likka Pirhonen & Jemina liponen

DIABETIKON JALAN EHKÄISY JA HOITO

- Potilasohjeet Terveysnettiin

Diabetes on Suomessa yhä yleistyvää kansantauti, jolla huonosti hoidettuna saattaa olla vakavia seuraamuksia. Yksi suurimmista ongelmista on diabeteksen aiheuttamat krooniset haavat, joiden hoitaminen on kallista ja pitkäaikaista. Tämän opinnäytetyön tarkoituksena on luoda englannin kieliset, diabetesta sairastaville suunnatut ohjeet haavojen ennaltaehkäisyyn ja hoitoon.

Menetelmänä on käytetty kirjallisuuskatsausta, jossa perehdytään diabetes haavojen hoitoon liittyviin tutkimuksiin, sekä Käypä hoito –suositukseen. Kirjallisuuskatsaus osoitti, että suurin osa diabeetikoiden haavoista on jaloissa, ja niiden heikko parantuminen johtuu useimmiten neuropatiasta, iskemiasta, tai näiden kahden yhdistelmästä. Katsauksessa kävi myös ilmi että, kaikkein olennaisinta diabetes haavojen ehkäisyssä ja hoidossa on säännöllinen seuranta ja hyvä hoitotasapaino.

ASIASANAT:

Haavan hoito, haava, diabetes, Terveysnetti, potilasohjeet

CONTENT

LIST OF ABBREVIATIONS	6
1 INTRODUCTION	6
2 PURPOSE AND RESEARCH QUESTIONS	8
3 DATA AND METHODS	9
4 RESULTS	10
4.1 What are the most common causes for diabetic ulcers?	10
4.1.1 Ischemia	10
4.1.2 Neuropathy	10
4.2 Effective prevention of diabetic foot ulcers	11
4.2.1 Assessment	12
4.2.2 Lifestyle management	14
4.2.3 Blood pressure control	15
4.2.4 Glycaemic control	15
4.2.5 Lipid management	15
4.2.6 Nail and skin care	16
4.3 How to classify the severity of diabetic ulcers?	17
4.4 How to promote healing in chronic diabetic ulcers?	19
5 ETHICS AND VALIDITY	22
6 DISCUSSION	23
7 CONCLUSIONS	24
REFERENCES	27
ATTACHMENT	30

LIST OF ABBREVIATIONS

Abbreviation	Explanation of abbreviation (Source)
DFU	Diabetic Foot Ulcer (Askari et al. 2013)
ABPI	Ankle Brachial Pressure Index (Armstrong et al. 2007)
DSME	Diabetes Self-Management Education (ADA 2017)
DSMS	Diabetes Self-Management Support (ADA 2017)
CVD	Cardio Vascular Disease (Jaiswal, Pop-Busui & Schinske 2014)

1 INTRODUCTION

Diabetes is one of the most common diseases in Finland and is counted as one of the so called "national diseases". According to Kela, Finnish Social Insurance Institution, in 2017 there were in total 336 401 patients diagnosed with diabetes, of which 183 788 were men and 152 613 were women. Of all the diabetics 6805 were under the age of 20. (Kela 2017.)

Diabetes is not just one disease, but a group of diseases that are connected by disturbance in pancreas' ability secrete insulin, and thus chronic elevated blood glucose (Ilanne-Parikka 2018). Insulin is a hormone secreted in the islets of Langerhans, in pancreas. It is essential for the metabolism of carbohydrates and the regulation of blood glucose levels in the blood. (Insulin 2018.) This insulin deficiency leads to all kinds of symptoms, of which the most common are fatigue and loss of weight. Other symptoms can be thirst, dehydration and polyuria. (Ilanne-Parikka 2018.)

From the several different types of diabetes, the most common are type 1 and type 2 as well as gestational diabetes. Type 1 is also known as childhood diabetes, since the disease is often diagnosed in the early childhood. Type 1 diabetes is caused by autoimmune disease, that slowly destroys the insulin secreting beta cells in pancreas. The inflammation has usually been in the pancreas for months, or even years, but the symptoms start rather quickly, within a week or two, when only fifth of the beta cells are working anymore. (Ilanne-Parikka 2018.)

Type 2 differs from the type 1 in way that instead not being able to produce insulin the body has developed resistance towards it and requires more insulin than the pancreas is able to produce. Abdominal obesity, fatty liver, elevated blood pressure, and imbalance in fatty acids and cholesterol are all indicators of type 2 diabetes. It is also often hereditary but if a person stays active and normal weight, genetic probability to develop diabetes is lessened significantly. (Ilanne-Parikka 2018.)

Sometimes during pregnancy, a woman may develop gestational diabetes, which means rise of the blood glucose during pregnancy. This is because the need for insulin increases due to pregnancy hormones and weight gain. This may cause harm to the baby and the mother during the pregnancy. Gestational diabetes usually goes away after

delivery, but it increases the mother's chance to develop type 2 diabetes later in life. (Ilanne-Parikka 2018.)

Diabetes can be treated in several different ways, but in the end it all comes down to lifestyle changes. The aim of the treatment is to get the blood glucose levels close enough to normal (5.3 mmol/ml = 7,0%). Depending on the diabetes, sometimes just adjusting your diet and exercising regularly may be enough to keep the glucose levels in control, but sometimes that is not enough. Especially with type 1 diabetes, insulin injections are always necessary. There are also different kinds of tablet treatments available. What is common in all treatments is that all patients must follow their blood glucose levels by measuring their tissue glucose level regularly. (Ilanne-Parikka 2018.)

If left untreated diabetes can lead to severe consequences. The lack of insulin can lead to ketoacidosis, which can be life threatening. If the blood glucose is too low, it is called hypoglycemia and in worse case can lead to coma. The symptoms of hyperglycemia have been mentioned above. These are the short-term consequences, but if the blood glucose is in imbalance for a long time it can lead to long term complications, such as retinopathy, neuropathy, nephropathy or ischemia. The risk of cardiovascular diseases also grows two- or even four-fold. (Ilanne-Parikka 2018.)

2 PURPOSE AND RESEARCH QUESTIONS

The purpose of this thesis was to examine literature pertaining to diabetes and chronic diabetic wounds, and the existing guidelines on wound care of diabetic ulcers. The ultimate purpose of this research was to create quality and up-to-date instructions on how to treat the chronic wounds of a diabetic patient, that may be used by professionals and patients alike to educate themselves. The number of diabetic patients is growing worldwide and thus knowledge on care of the very common wounds that plague diabetic patients is critical for quality care. Ultimately, we aim to publish this thesis and the wound treatment guidelines on Theseus and Terveysnetti, respectively.

The research questions we aim to answer in this thesis were following:

1. What are the most common causes for diabetic ulcers?
2. How to effectively prevent diabetic ulcers?
3. How to classify the severity of diabetic ulcers?
4. How to best promote healing in chronic diabetic ulcers?

3 DATA AND METHODS

All data for this thesis will be pulled out via literature review of existing studies and treatment guidelines. According to Royal Literature Fund (2018) literature review is search and evaluation of the found literature in the chosen topic and it is meant to show the readers that the author has a good grasp of their subject, and that they understand where their own research fits into, and summarises the existing knowledge.

Both academic and professional sources were utilised in the research. Primary sources were the focus of research with allowances made for quality secondary sources such as Käypähoito. Data was collected from multiple academic databases, such as CINAHL Complete and PubMed.

The data was analysed through the lens of healthcare guidelines, but we will also be expanding on some of our main concept e.g. what is a diabetic ulcer? The main bulk of this written thesis is based on review of the found literature and research. In addition to this written work, found information was used to create up-to-date guidelines on wound care of diabetic ulcers, which has been uploaded to Terveysnetti.

The wound care guidelines for Terveysnetti is either a poster.

4 RESULTS

4.1 What are the most common causes for diabetic ulcers?

At the very basic level diabetic ulcers can be attributed to two causes; poor blood flow and neuropathy. With poor blood flow to the lower extremities caused by e.g. peripheral vascular disease, even a small, insignificant seeming wound can lead to an ischemic wound that will not heal. In the worst cases this can lead to a necrotic wound, and in time to amputation. Ischemia can also lead to neuropathy, which in turn can lead to greater risk of ulceration (Alavi et al 2014).

4.1.1 Ischemia

Kozier and Erb (2016, 1296) define ischemia as the “lack of blood supply due to obstructed circulation”. As the circulation is obstructed, the affected tissue becomes oxygen and nutrient starved. If any damage is caused to the limb, wound healing process is slower or possibly even completely inhibited. A slowly healing wound can also act as a gateway to infection, further exacerbating the situation. In time the tissue begins to die leading to ulceration and necrosis.

In the vast majority of cases ischemia does not appear by itself and occurs alongside neuropathy; most diabetic feet can be classified either as neuropathic foot if there are only signs of neuropathy or neuroischemic foot if both conditions are present (Edmonds, Foster & Sanders 2004, 12). That is not to say ischemia can be ignored; 90% of amputations have been attributed at least partially to ischemia. Furthermore, lessened blood flow to peripheral nerves due to atherogenesis itself can cause neuropathy. (Alavi et al 2014, 6.)

4.1.2 Neuropathy

Neuropathy in turn can be divided into three subtypes; motor, sensory, and autonomic. Sensory neuropathy causes loss of sensation in the lower extremities. Loss of protective sensation means that the patient cannot feel any damage being done to their feet. As such poorly fitting shoes, shearing, or an object in the shoe can cause mechanical damage which leads to a wound that the patient does not notice, or thinks is negligible. Quite often due to the lack of pain the wound keeps getting worse, especially if there are no regular and appropriate self-checks being done. (Edmonds, Foster & Sanders 2004.).

With motor neuropathy the nerves responsible for contraction of muscles damaged. The imbalance that is then caused by minor muscle loss in the flexor and extensor muscles leads to foot deformities (Wound Source 2010). Microfractures in the small bones of the foot account for deformities such as Charcot's foot or claw toes. As the foot becomes deformed, stress or pressure points of the foot change leading to uneven and unnatural weight distribution, which exacerbates the condition further. Calluses form on these pressure points leading to more pressure and thus further tissue damage when combined with other risk factors (Alavi et al 2014).

Autonomic neuropathy on the other hand appears as the drying of skin, which causes it to start cracking and swelling caused by arteriovenous shunts (Käypä hoito 2009). As with other forms of neuropathy, these can lead to worsening wounds. The cracked skin can also act as a gateway to infection.

4.2 Effective prevention of diabetic foot ulcers

Treating diabetic foot ulcers (DFU) is often difficult, expensive, and time consuming, and at least quarter of DFUs don't heal. That is why it is important to take actions to prevent that kind of wounds from forming in the first place. (Askari et al. 2013.) Preventative measures have been known to decrease patient morbidity, usage of expensive resources, and risk for amputations (Armstrong et al. 2007).

Preventing foot ulcers is good start immediately when the diabetes diagnosis is given, the corner stone being good patient guidance. The purpose, by giving appropriate guidance to the diabetic patient, is to motivate the patient to independently monitor and treat their own feet. (Hietanen & Juutilainen 2016, 343-345.)

4.2.1 Assessment

First step in preventing DFUs is to evaluate the patient's wound risk factors (see table1). The evaluation is simple: you check the protective sensation of the feet, whether you feel the pulse in the lower extremities or not, if there are any deformities, and ask of previous wounds in the feet, or amputations. (Hietanen & Juutilainen 2016, 343-345.) This evaluation should be done regularly by a professional once a year (Liukkonen, Saarikoski & Stolt 2012)

Table 1 Diabetic foot risk classification (Diabeetikon jalkaongelmat: Käypä hoito -suositus, 2009)

Risk classification	Protective sensation	Foot deformity	Lack of pulse	Earlier wound or amputation	Actions
0	NO	NO	NO	NO	Check up and risk classification annually. Basic guidance.
1 Wound risk doubled	YES 1	NO	NO	NO	Check up at a clinic at least annually. Basic guidance and self inspection of the feet. Footwear guidance.
2 Wound risk increased over fivefold	YES	YES OR NO At least one of these 2		NO	Regular visits at a podiatrist. Intensifying self care. Check up at a clinic. Examining circulation.
3 Wound risk increased over tenfold	NOT RELEVANT			YES 3	Regular visits at a podiatrist. Preparedness to treat problems. Check up on every visit at a clinic.

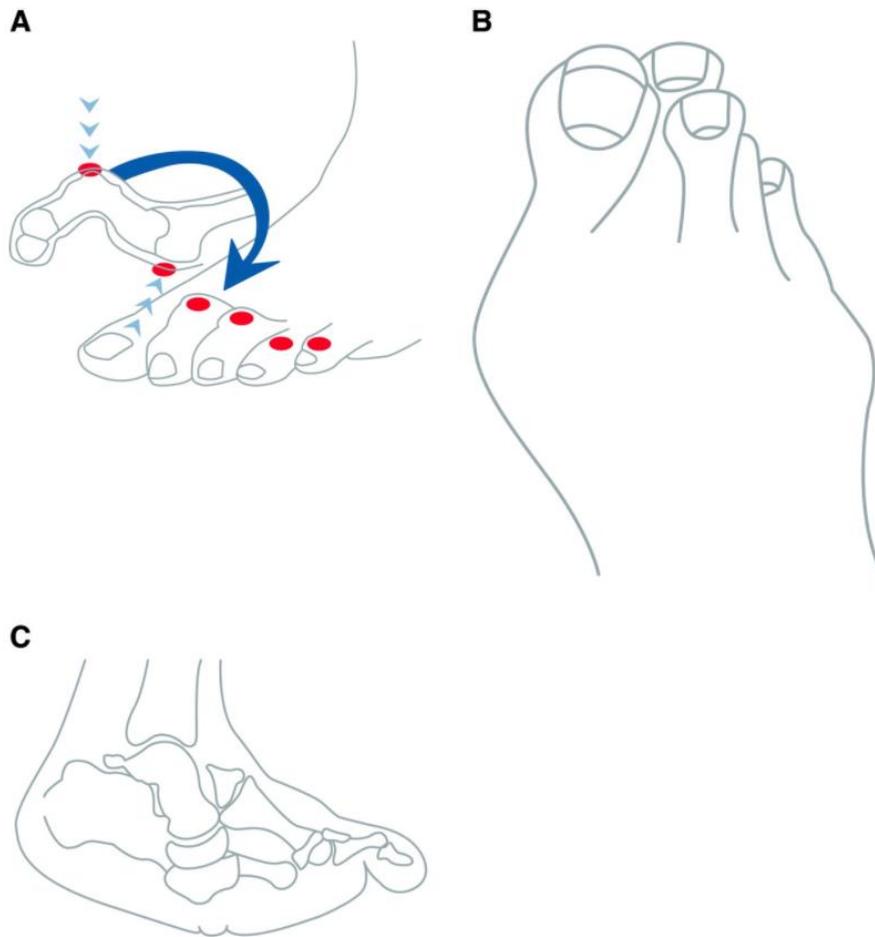
Protective sensation, as explained in the previous heading 3.1, can be tested easily with one or several of the following devices: 128 Hz tuning fork, Semmes Weinstein monofilament and Biothesiometer (VPT meter). The tuning fork is placed over a bony part of the foot, such as tip of the first metatarsal. The test is considered positive, when the patient can't feel any vibration from the tuning fork. The Semmes Weinstein monofilament is a very thin nylon filament, which is pushed against the sole of the patient's foot until it bends or buckles from the pressure and is then left in place for about a second and then released. The patient is sitting supine on an examination table, eyes closed, and responds "yes" every time they feel the pressure from the monofilament. A

little less used device is the VPT meter. It is a hand-held device with vibrating rubber tractor which is connected to a base unit that sends a voltage, ranging from 0 to 100 v, that makes the device vibrate at 100Hz. The device is used so that the rubber tractor is held on top of the big toe and the voltage is increased until the patient can feel it. (Armstrong et al. 2007.)

Poor blood circulation in diabetic patient's extremities (peripheral vascular disease, also known as ischemia) is very common problem, that also effects the healing process of wounds (Armstrong et al. 2007.) It is also known to be the cause in one third of foot ulcers and is considerable risk factor with recurring wounds (Albert et al. 2008). Assessing the vascularity of a diabetic patient's feet includes palpation of all lower extremity pulses, ankle brachial pressure index (ABPI), a device called doppler, and pulse oximetry. One should also examine the general look of the foot; things like pallor, absence of hair growth, dystrophic toenails and cool, dry, fissured skin can also be indicators of poor blood circulation in the feet. (Armstrong et al. 2007.) If these examinations are not conclusive there is foot oxygen partial pressure test, magnetic artery imaging, or arterial angiography (Hietanen & Juutilainen 2016, 343).

Evaluation of any deformities is an important part of diabetic foot assessment since the sites of the deformities are the most common places for foot ulceration. This is due to increased pressure to the deformed and plantar areas. The most common deformities are claw toe, almost similar hammer toe, bunion with overlapping toes, and rocker-bottom deformity, which is associated with Charcot's Foot. (Albert et al. 2008)

Figure 1 Types of foot deformation. A: claw toe, B: bunion, C: rocker –bottom deformity. (Albert et al. 2008)



Old wounds and amputations sites are a serious risk for new wounds. When a wound heals the new skin is never as strong as the old, and thus the skin is more prone to break again. (Berman, Frandsen and Snyder 2016, 835)

4.2.2 Lifestyle management

When the wound risk has been assessed it is time for lifestyle change. Lifestyle management is essential part of treating diabetes and thus preventing diabetic wounds. Lifestyle management consists of things such as self-management education and support (DSME and DSMS), nutrition therapy, physical activity, smoking cessation, and psychosocial care. (American Diabetes Association [ADA] 2017.)

According to an article written by American Diabetes Association (2017) the general idea of DSME and DSMS is “to support informed decision making, self-care behaviour, to

support informed decision making, self-care behaviours, problem solving, and active collaboration with the health care team to improve clinical outcomes, health status, and quality of life in a cost-effective manner.”

4.2.3 Blood pressure control

High blood pressure, hypertension, is often accompanied with other risk factors, such as dyslipidaemia, impaired glycaemic tolerance and diabetes (Špínar 2012, e433-e438). Hypertension is defined by blood pressure that is higher than 140/90 mmHg (Edmonds, Foster & Sanders 2004, 30). It is one of the risk factors for cardiovascular disease (CVD) and is known to have significant role in the development of atherosclerosis. (Špínar 2012, e433-e438.)

Microvascular complications caused by hypertension can cause problems in peripheral capillaries and lead to complications, such as retinopathy and ischemia (Edmonds, Foster & Sanders 2004, 30).

4.2.4 Glycaemic control

Increased blood glucose level in the cells weakens the blood flow to the wound by causing the cell walls of the blood vessels to become rigid and thus preventing the wound from getting important oxygen and nutrients. (Collins & Toiba 2010, 18)

Glycooxidation can lead to cellular damage. When arterogenesis of the capillaries prevents the blood flow to the peripheral nerves, it can contribute to development of neuropathy. (Alavi et al 2014, 1.e4).

4.2.5 Lipid management

Lipids, with carbohydrates and proteins, constitute the basic key components of living cells. Lipids are fats, waxes, phosphatides, cerebrosides, and other similar compounds. (Lipid 2018.) Dyslipidaemia often correlated with diabetes and is, according to Merriam-

Webster Dictionary (2018), "a condition marked by abnormal concentrations of lipids or lipoproteins in the blood".

CVD is very common among diabetic patients and is known as the leading cause of death among adult diabetic patients. Especially in association with dyslipidaemia, diabetics have heightened risk of CVD compared to other risk factors. Abnormalities in lipid metabolism play significant part in atherogenesis and its progression. (Jaiswal, Pop-Busui & Schinske 2014.) Atherogenesis means thickening of the blood vessel walls (Agius & Ross 1992) which, due to lessened elasticity of the peripheral capillaries, may lead to ischemia (Alavi et al 2014, 1.e6).

4.2.6 Nail and skin care

And last, but not least: nail and skin care. It is perhaps the most important part of the prevention of foot ulcers. The situation should be evaluated by a professional at least once a year. (Liukkonen, Saarikoski & Stolt 2012a.)

In nail and skin care most of the responsibility falls on the patient themselves. They should examine their feet daily, especially between the toes for any maceration, which could be a sign of fungal infection. If the patient can't see their feet, a mirror can be used to observe the plantar areas of the feet. If the patient's vision is compromised due to retinopathy, or they are unable to perform the daily examination, a person who is trained to do the examination should do it. This can be a nurse, or a family member or a friend who has been trained to examine diabetic feet. (Askari et al 2013, 373–376.)

The feet should be washed daily and dry carefully afterwards, especially between the toes to avoid maceration. Before washing, one should try the water using the elbow or forearm to estimate the water temperature, which shouldn't be more than 37 °C. This helps to prevent accidental burns, that may occur due to neuropathy. Diabetic patients should refrain from using heating pads, and they should not put their feet too close to heaters or fireplace. (Askari et al 2013, 373–376.)

Nails should be cut every two weeks. Nails should not be cut too short; there should be about 1mm left of the white part of the nail (Mustajoki 2018). Instead of cutting the nails in rounded shape, they should be cut straight across (Askari et al 2013, 373–376). The patient should always find professional help, if the nails are thickened, there is

discoloration, ingrown toenails, or poor vision or other reason prevents the cutting of the nails (Liukkonen, Saarikoski & Stolt 2012b). Sometimes nails grow so thick that it may be difficult for the patient to cut them themselves. Thickening of the nail may result of several different things: injury, constant pressure to the nail in too small shoes, decline of blood flow in extremities, or some illnesses may be the cause of thickened toe nails. If just one nail is thickened, the reason is usually external, e.g. injury, but if all the nails are thickened the reason is most likely internal, e.g. aging or diabetes. (Liukkonen, Saarikoski & Stolt 2012b.)

It is recommended, that every diabetic, but especially those with neuropathy, should wear shoes also indoors. Also, it is advised to change clean socks every day, and to wear the seam on the outside (Askari et al 2013, 373–376.). In prevention of foot ulcers, choosing the right kind of shoes is essential. All shoes, also dress shoes, should be spacious enough; the length of the shoe is appropriate if the insole is 1-1½ cm longer than the foot, shoes should be wide enough to spread the toes, and the sole should be about 2 cm thick and slightly flexible, heel is not higher than 1-2 cm. (Mustajoki 2018.) The frontal part of the shoe should be closed, to prevent any minor trauma to the fore foot. The inside of the shoes should be examined always before putting the shoe on. This is done to detect any external objects, like small stones, that may cause harm, especially to patients with sensory neuropathy. It is not advised to wear shoes without socks. (Askari et al 2013, 373–376.)

4.3 How to classify the severity of diabetic ulcers?

There are multiple scales or classification systems for ulcers and diabetic foot such as the Wagner-Meggitt classification and the University of Texas classification system. The use Wagner-Meggitt system is widespread but it is not perfect. This scale focuses on the ulcers alone, not the foot as a whole. The first stages look at whether there is an ulcer and then the depth of the ulcer. The last two stages look at gangrene, which is necrosis due to or related to an infection. This system is useful for classifying any ulcer, not just ones due to diabetes, but does not take into account any risk factors or causes for ulceration. The University of Texas classification system does so by having four grades based on the severity of the wound and each of these grades can be further classified based on whether there is a present infection, ischemia, or both. (Käypä hoito 2009.)

The four grades used in the University of Texas classification system (see Table 2) ranging from 0-3, with zero be "a pre- or postulcerative site" and 3 representing an ulcer that has reached bone or penetrated a joint (Alavi et al 2014, 14). In between grade one is a superficial ulcer and grade two one that has reached the tendon. Further modifiers, or stages, are based on the presence of ischemia or infection. Stage A is a non-infected, non-ischemic wound, B is infected, C is ischemic, and D is both infected and ischemic (Alavi et al 2014). Therefore, in practice a D3 classified ulcer would be an infected and ischemic ulcer that has penetrated bone and a B1 would be a superficial but infected ulcer.

A Practical Manual of Diabetic Foot Care by Edmonds, Foster and Sanders (2004) classifies diabetic foot into six stages: normal foot, high-risk foot, ulcerated foot, infected foot, necrotic foot and unsalvageable foot. This classification system covers the progress of a diabetic foot, not just ulceration like some other classification systems used in healthcare (Edmonds, Foster & Sanders 2004, 13). It is relatively easy for a layman to understand and as such has been highlighted here.

In normal foot there are no risk factors such as foot deformities or neuropathy present and the foot is asymptomatic. At the second stage the foot is being affected by one or more of the potential risk factors for diabetic foot. At this point there are no current ulcers, but the risk of one developing is high. Treatment should be focused on treating the risk factors to prevent ulceration, be the factors ischemia, neuropathy, or foot deformities. Furthermore, if the patient has a history of previous ulcers they should be considered at risk of further ulceration. (Edmonds, Foster & Sanders 2004, 13.)

The third stage is considered the turning point. This is where the foot has become damaged. While this can range from a fully formed non-infected ulcer to small skin abrasions, it should be restated that with the presence of risk factors mentioned in previous segments of this thesis even small breakages in the affected area can rapidly lead to a serious diabetic ulcer. (Edmonds, Foster & Sanders 2004, 13.)

Stage four is an infected foot. Infection present in the foot further worsens the condition and increases the risk of amputation severely. The second-to-last stage is the necrotic foot where necrosis of the tissues has begun. More often than not this is a direct result of the previous stage where infection has taken hold. However, it should be mentioned that in rare cases ischemia alone can lead to necrosis in a diabetic foot (Edmonds, Foster & Sanders 2004.) When the foot becomes unsalvageable it has reached the sixth and

final stage. The foot needs to be amputated for possibly several reasons. The limb itself could be destroyed, the infection could risk the life of the patient, or the pain in the limb has become unmanageable and thus needs to be removed. (Edmonds, Foster & Sanders 2004, 13.)

Table 2 Wound classification. The depth classification is done after revision. (Diabeetikon jalkaongelmat: Käypä hoito -suositus, 2009)

Depth of the wound	Wagner's classification	Etiological grouping of a wound according to University of Texas classification			
		Clean wound	Infection of the wound	Ischemia of the wound	Infection and ischemia of the wound
Skin and hypodermis	1	A1	B1	C1	D1
Tendon or articular capsule	2	A2	B2	C2	D2
Bone or synovial joint	3	A3	B3	C3	D3
Partial gangrene	4				
Whole foot gangrene	5				

4.4 How to promote healing in chronic diabetic ulcers?

Treatment of a diabetic foot often requires a multidisciplinary team as several factors can be involved in the cause of the condition and others can inhibit treatment severely. Treatment may include localised wound treatment, surgical intervention, treatment of infection, pressure-relieving therapy, and indirect treatment of risk factors leading to diabetic foot. Prevention however is the most efficient treatment available. Treatment options depend on the nature of the wound and its causes. (Käypä hoito 2009.)

Tsekkatko lähteen?

To prevent formation of ulcers and to encourage existing wounds to heal, relieving pressure can be done via special shoes or other mobility aids such as crutches. With pressure off the ulcer healing can be promoted. Furthermore, if the stress points of the

foot have changed due to foot deformities and micro fractures, these shoes will help prevent rubbing and abrasions that may occur with ill-fitting shoes. (Käypä hoito 2009.)

Tsekkaatko lähteen?

Localised wound treatment also depends on the cause of the wound. Treatment of a neuropathic ulcer is standard. Any infected or necrotic tissue should be debrided along with hardened calluses to allow the wound to heal. Wound dressing should not dry out the wound bed nor should it allow the wound to fester. An ischemic or neuroischemic ulcer should not be debrided without consulting a vascular surgeon and undertaking appropriate procedures (Käypä hoito 2009). Wound dressing should always be comfortable, and it should not be able to get stuck to or damage the wound bed. Frequent check-ups along with self-evaluation are important to keep an eye on the healing process and to be watchful of infections or other complications (Käypä hoito 2009).

Surgical intervention can range from correcting foot deformities to revision surgery to even amputation. Infected and necrotic tissue can be removed easily in order to promote wound healing and in many cases can be done just under local anaesthesia outside of an operating theatre (Käypä hoito 2009). Major surgical intervention should be considered if the wound has not healed within two months or if the depth of the ulcer is significant. Prior to any major surgery the wound should not have an untreated infection, body glucose levels should be appropriately balanced, vascular function should be evaluated, and any underlying disorders should not be left unaccounted for or untreated. Appropriate post-operative treatment and patient education are also paramount. Amputation is only done in extreme situations such as when the patient's life is threatened or the pain in the limb is untreatable. (Käypä hoito 2009.)

Infections present should always be concerning. To classify the wound as infected there should either be pus secreting from the wound, or two of the following signs: redness, tissue warmth, swelling, pain, slowed wound healing, or a strong odour (Käypä hoito 2009). Antibiotics and debridement along with indirect treatment of risk factors are all utilised.

As ischemia can lead both directly and indirectly to foot ulceration, vascular function should be assessed and taken into consideration when discussing treatment options. Lowered vascular function inhibits wound healing and can directly cause necrosis and ulceration. With revascularization it is possible to pre-empt unnecessary amputation and upkeep quality of life. Primarily internal treatment is preferred rather than vascular surgery when the blockage is short or is arterial in nature. This can be done via peripheral

angioplasty. Larger blockages are in turn treated via bypass surgery, however if there are significant risks involved these blockages can also be treated internally. Vascular surgery when compared to amputation increases a patient's possibility for independent living and quality of life significantly. Lifestyle changes such as quitting smoking can also increase vascular function beneficially. (Käypä hoito 2009.)

Amputation is done as a last resort. It is an option in extreme cases such as when the patient's life is in immediate danger due to infection or necrosis, other treatment options have been determined nonviable, or the life expectancy of the patient is less than one year. Prior to the procedure the possible need for prosthesis should be considered, along with the realistic estimation of remobilization and rehabilitation. The extent of amputation is determined by the viability of the limb, the future treatment plans and the presence of risk factor such as vascular complications. Amputation is always done as conservatively as possible, with minor amputation starting from the toes to preserve as much of the foot as possible. If the prognosis for wound healing is good, above-the-ankle amputations are not recommended. If the foot itself cannot be salvaged, more extensive or major amputation should be considered. Exarticulation of the knee or amputation done at the shin are done with prosthesis in mind. Above the knee amputations are done when lower-limb amputation is not viable due to vascular reasons and/or if the patient has no chance of remobilization. (Käypä hoito 2009.)

5 ETHICS AND VALIDITY

This Bachelor's Thesis aimed to follow the ethical principles of scientific research; integrity, meticulousness, and accuracy. The thesis intended to make sure that the data acquisition, research, and evaluation conform to scientific criteria and were ethically sustainable; the authors did not present their own opinions as research results. The works and achievements of other researchers were respected by citing and referencing their work appropriately. Since this thesis was a literature review, it did not require any permits nor funding. (Finnish Advisory Board on Research Integrity 2012)

Our subject is valid in today's medical field, since diabetes is one of the most common illnesses in Finland. It is important that we bring most up to date information on the care of diabetic wounds to the patients suffering from the illness.

6 DISCUSSION

The whole process has been interesting and educative. When we started this bachelor thesis, we knew that there would not be shortage of references. There is a lot of high quality and up-to-date material and information available on the subject of diabetes and diabetic wounds. However, sometimes the information went too deep for BA level thesis and it was difficult to discern the information that would be relevant to our thesis. At times the process felt also overwhelming and it was difficult to find our focus. Some of the sources had different areas of focus which also lead to confusion.

Working with a partner in such big project was effortless. Our collaboration worked, because we knew each other's strengths and weaknesses and they complimented each other. During the process we both were reminded of things we had studied before and learned many new things.

This process started with the idea to create good, easy, and up-to-date instructions for English speaking diabetic patients. We think we managed to compile a pile of very good information that was then summarised into a small hand-out poster

7 CONCLUSIONS

1. Diabetic foot is very common problem in Finland and treatment of diabetic wounds takes lots of resources
2. Ischemia and neuropathy are the most common causes for diabetic foot ulcers.
3. Prevention is the best treatment of diabetic foot
4. The patient needs to be dedicated to the prevention and treatment process, , otherwise it won't work.
5. Having the diabetes in good treatment balance goes a long way when it comes to the prevention the wounds.
6. Diabetic wounds can be classified by the cause, depth, cleanness, and infection level.
7. Promotion of the healing of a diabetic foot ulcer includes localised wound treatment, surgical intervention, treatment of infection, pressure-relieving therapy, and indirect treatment of riskfactors.

8

9

REFERENCES

- Agius, L., Ross, R. 1992. *The Process of Atherogenesis – Cellular and Molecular Interactions: From Experimental Animal Models to Humans*. *Diabetologia* 35(2): 34-40. PMID: 1478376
- Alavi, Afsaneh; Armstrong, David G.; Ayello, Elizabeth A.; Boeni, Thomas; Botros, Mariam; Goodman, Laurie; Kirsner, Robert S.; Sibbald, Gary R.; Woo, Kevin. 2014. *Diabetic foot ulcers: Part I. Pathophysiology and prevention*. *Journal of the American Academy of Dermatology* 70(1): 1.e1-1.e18. doi: 10.1016/j.jaad.2013.06.055. [Accessed on 2018-04-21]
- Albert, Stephen F.; Armstrong, David G.; Boulton, Andrew J.M.; Frykberg, Robert G.; Hellman, Richard; Kirkman, M. Sue; Lavery, Lawrence A.; LeMaster, Joseph W.; Mills, Sr., Joseph L.; Mueller, Michael J.; Sheehan, Peter and Wukich, Dane K. 2008. *Comprehensive Foot Examination and Risk Assessment*. *Diabetes Care* 31(8): 1679-1685. doi: 10.2337/dc08-9021
- American Diabetes Association. 2017. *4. Lifestyle Management*. *Diabetes Care* 40(Supplement 1): 33-43. doi: 10.2337/dc17-S007
- Armstrong, D.G., Driver, V.R., Wu, S.C. and Wrobel, J.S. 2007. *Foot ulcers in the diabetic patient, prevention, and treatment*. Dove Medical Press Limited 3(1): 65–76. PMID: PMC1994045
- Askari, G., Ebnesahidi, A., Iraj, B. and Khorvash, F. 2013. *Prevention of Diabetic Foot Ulcer*. *International Journal of Preventative Medicine* 4(3): 373–376. PMID: PMC3634178
- Berman, A., Frandsen, G., Snyder, S. 2016. *Kozier & Erb's Fundamentals of Nursing: Concepts, Process, and Practice*. 10th ed. Pearson
- Boucher, Jackie L., Cypress, Marjorie, Dunbar, Stephanie A., Evert, Alison B., Franz, Marion J., Mayer-Davis, Elizabeth J., Neumiller, Joshua J., Nwankwo, Robin, Urbanski, Patti, Verdi, Cassandra L. and Yancy Jr., William S. 2014. *Nutrition Therapy Recommendations for the Management of Adults with Diabetes*. *Diabetes Care* 37 (Supplement 1): 120-143. doi: 10.2337/dc14-S120
- Crestodina, Lea R. 2015. *Understanding Neuropathic Wounds*. *Journal of Wound Ostomy & Continence Nursing* 42(1): 100-101. doi: 10.1097/WON.000000000000108. [Accessed 2018-01-31]
- Collins, N., Toiba, R. 2010. *Nutrition -411: The importance of glycaemic control in wound healing*. *Ostomy Wound Management* 56(9): 18-23. Available at <http://www.o-wm.com/content/importance-glycemic-control-wound-healing> [Accessed 2018-05-24]
- Daniel, M.J. 2011. *Lipid Management in Patients with Type 2 Diabetes*. *American Health & Drug Benefits* 4(5): 312-322. PMID: PMC4105726
- Dyslipidaemia. 2018. *Merriam-Webster Dictionary*. Available at <https://www.merriam-webster.com/medical/dyslipidemia> [Accessed 2018-05-20]
- Edmonds, Michael E., Foster, Alethea V.M., Sanders, Lee J. 2004. *A Practical Manual of Diabetic Footcare*. Blackwell Publishing Ltd, Malden, Massachusetts. ISBN 1-4051-0715-4. [Accessed on 2018-05-13]

Finnish Advisory Board on Research Integrity. 2012. *Responsible conduct of research and procedures for handling allegations of misconduct in Finland*. Available at http://www.tenk.fi/sites/tenk.fi/files/HTK_ohje_2012.pdf [Accessed 2018-02-15]

Hietanen, H. and Juutilainen, V. (eds.). 2016. *Haavanhoidon periaatteet*. 1st-3rd ed. Helsinki: Sanoma Pro Oy.

Ilanne-Parikka, P. 2018. *Diabetes ("sokeritauti")*. Lääkärikirja Duodecim. doi: dlk00011 (015.004)

Insulin. 2018. *Merriam-Webster Dictionary*. Available at <https://www.merriam-webster.com/dictionary/insulin> [Accessed 2018-05-21]

Jain, Amit K.C.. 2012. *A New Classification of Diabetic Foot Complications: A Simple and Effective Teaching Tool*. The Journal of Diabetic Foot Complications, 2012; Volume 4, Issue 1, Pages 1-5. <http://jdfc.org/wp-content/uploads/2012/01/v4-i1-a1.pdf>. [Accessed on 2018-05-19]

Jaiswal, M., Pop-Busui, R., Schinske, A. 2014. *Lipids and lipid management in diabetes*. Best Practise & Research Clinical Endocrinology & Metabolism 28(3): 325-338. doi: 10.1016/j.beem.2013.12.001

Kela. 2017. *Voimassa olevat ja päättyneet lääkekorvausoikeudet*. Kelasto-raportit. Available at http://raportit.kela.fi/ibi_apps/WFServlet [Accessed 2018-05-21]

Käypä hoito. 2009. *Diabeetikon jalkaongelmat*. Available at <http://www.kaypahoito.fi/web/kh/suosituksset/suositus?id=hoi50079#s19> [Accessed 2018-01-31]

Käypä hoito. 2016. *Diabetes*. Available at <http://www.kaypahoito.fi/web/kh/suosituksset/suositus?id=hoi50056> [Accessed 2018-01-31]

Lipid. 2018. *Merriam-Webster Dictionary*. Available at <https://www.merriam-webster.com/dictionary/lipids?src=search-dict-hed> [Accessed 2018-05-20]

Liukkonen, I., Saarikoski, R., Stolt, M. 2012a. *Diabeetikon jalkojen hoito*. Duodecim Terveyskirjasto. doi: jal00137 (012.045)

Liukkonen, I., Saarikoski, R., Stolt, M. 2012b. *Paksuntunut kynsi*. Duodecim Terveyskirjasto. doi: jal00095 (009.065)

Mustajoki, Pertti. 2018. *Diabeteksen jalkaongelmat ja niiden ehkäisy*. Lääkärikirja Duodecim. doi: dlk00768 (014.368) [Accessed 2018-05-16]

Patient Education. 2012 *Medical Dictionary for the Health Professions and Nursing*. <https://medical-dictionary.thefreedictionary.com/patient+education> [Accessed 2018-02-15]

Royal Literature Fund. 2018. *What is a literature review?*. Available at <https://www.rlf.org.uk/resources/what-is-a-literature-review/> [Accessed 2018-02-15]

Špinar, J. 2012. *Hypertension and ischemic heart disease*. Cor et Vasa 54(6): e433-e438. doi: 10.1016/j.crvasa.2012.11.002

Wound. 2018. *Merriam-Webster Dictionary*. Available at <https://www.merriam-webster.com/dictionary/wound> [Accessed 2018-01-31]

WoundSource Editors. 2010. *Neuropathic Ulcers and Wound Care: Symptoms, Causes, and Treatments*. WoundSource. <http://www.woundsource.com/blog/neuropathic-ulcers-and-wound-care-symptoms-causes-and-treatments> [Accessed 2018-03-18]

ATTACHMENT

Prevention and care of di

Patient education poster based on bachelor thesis of Iikka Pirhonen and Jemina Liponen

What is diabetic foot?

Diabetic foot is one of the most common problems among diabetic patients. Secondary illnesses caused by diabetes, especially ischemia and neuropathy, can cause wounds, or prevent wounds caused by external object, from healing.

Sensory neuropathy causes loss of sensation in the lower extremities. Lack of protective sensation prevents you from noticing the damage done to your feet.

Lack of blood circulation (ischemia) in the feet causes the tissue to become oxygen and nutrient starved. This hinders the healing process and opens a way to infections.

Risk classification	Protective sensation	Foot deformity	Lack of pulse
0	NO	NO	NO
1 Wound risk doubled	YES 1	NO	NO
2 Wound risk increased over fivefold	YES	YES OR NO At least one of these 2	
3 Wound risk increased over tenfold	NOT RELEVANT		

Diabetic foot risk classification (Diabeetikon jalkaongelma)

Key terms:

- Diabetes Mellitus
- Diabetic foot
- Ulceration
- Neuropathy
- Ischemia
- Preventative treatment

Prevention

- Risk assessment at least once a year
- Changes in lifestyle, such as quitting smoking and increasing exercise
- Keep your blood pressure in check
- And your blood sugar levels as well
- Take care of your nails and skin
- Check and wash your feet daily
- Well fitting shoes are very important

Depth of the wound	Wagner's classification	Etiological grouping of a wound according to University of Texas classification			
		Clean wound	Infection of the wound	Ischemia of the wound	Infection and ischemia of the wound
Skin and	1	A1	B1	C1	D1

Treatment

Prevention is the best treatment and you should act immediately when the wound is formed, even if it is small. There are several ways to treat it. Relieving pressure is one of the most important. This can be done by using orthopedic shoes or orthopedic insoles. Pressure relief can be achieved, such as crutches. Pressure relief can be achieved, such as crutches.

Prevention and care of diabetic foot

Patient education poster based on bachelor thesis of Iikka Pirhonen and Jemina Iiponen

#Excellence In Action

What is diabetic foot?

Diabetic foot is one of the most common problems among diabetic patients. Secondary illnesses caused by diabetes, especially ischemia and neuropathy, can cause wounds, or prevent wounds caused by external object, from healing.

Sensory neuropathy causes loss of sensation in the lower extremities. Lack of protective sensation prevents you from noticing the damage done to your feet.

Lack of blood circulation (ischemia) in the feet causes the tissue to become oxygen and nutrient starved. This hinders the healing process and opens a way to infections.

Key terms:

- Diabetes Mellitus
- Diabetic foot
- Ulceration
- Neuropathy
- Ischemia
- Preventative treatment

Risk classification	Protective sensation	Foot deformity	Lack of pulse	Earlier wound or amputation	Actions
0	NO	NO	NO	NO	Check up and risk classification annually. Basic guidance.
1 Wound risk doubled	YES 1	NO	NO	NO	Check up at a clinic at least annually. Basic guidance and self inspection of the feet. Footwear guidance.
2 Wound risk increased over fivefold	YES	YES OR NO At least one of these 2		NO	Regular visits at a podiatrist. Intensifying self care. Check up at a clinic. Examining circulation.
3 Wound risk increased over tenfold	NOT RELEVANT			YES 3	Regular visits at a podiatrist. Preparedness to treat problems. Check up on every visit at a clinic.

Diabetic foot risk classification (Diabeetikon jalkaongelmat: Käypä hoito -suositus, 2009)

Prevention

- Risk assessment at least once a year
- Changes in lifestyle, such as quitting smoking and increasing exercise
- Keep your blood pressure in check
- And your blood sugar levels as well
- Take care of your nails and skin
- Check and wash your feet daily
- Well fitting shoes are very important

How to pick the right shoes?

- The insole should be 1-1½ cm longer than your foot
- You should be able to spread your toes in the shoe
- The sole should be about 2 cm thick and slightly flexible, no more than 2 cm heels
- The frontal part of the shoe should be closed

Depth of the wound	Wagner's classification	Etiological grouping of a wound according to University of Texas classification			
		Clean wound	Infection of the wound	Ischemia of the wound	Infection and ischemia of the wound
Skin and hypodermis	1	A1	B1	C1	D1
Tendon or articular capsule	2	A2	B2	C2	D2
Bone or synovial joint	3	A3	B3	C3	D3
Partial gangrene	4				
Whole foot gangrene	5				

Wound classification. The depth classification is done after revision. (Diabeetikon jalkaongelmat: Käypä hoito -suositus, 2009)

Treatment

Prevention is the best treatment and you should be quick to see a professional immediately when the wound is formed, even a small one. If the wound already exists there are several ways to treat it. Relieving the pressure on the wound is important. This can be done by using orthopedic shoes or insoles, or different kinds of mobility aids, such as crutches. Pressure relief combined with localised wound treatment is often the most efficient way. All this requires frequent check ups along with self-evaluation to keep an eye on the healing process and to avoid infection.

Surgical intervention is usually considered if there is need for correcting deformities, the wound hasn't healed in two months, or the depth of the wound is significant. Amputations are done only in extreme cases when the wound is untreatable, or it threatens the patient's life.

For more information on diabetes

In Finnish: Diabetesliitto <https://www.diabetes.fi/>
In English: Diabetes UK <https://www.diabetes.org.uk/>



Do you want to know more about the thesis?

Contact via email
Jemina Iiponen: jemina.iiponen@edu.turkuamk.fi
Iikka Pirhonen: iikka.pirhonen@edu.turkuamk.fi

