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Improved outcomes in patients with diabetic foot ulcers despite of differences in baseline characteristics

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Abstract

The incidence of diabetes is increasing worldwide with concomitant raising number of patients with diabetic foot disease. Diabetic foot disease treatment has received more attention in the past decades, culminating in the creation of multidisciplinary outpatient clinics, but at the same time, complexity of patients seems to have increased. The aim of this article is to study differences in patient characteristics and outcomes (ulcer healing and ulcer-free survival days) in patients with a diabetic foot ulcer in two prospective cohorts with 15 years in between. Prospective cohort study of all patients in one diabetic foot centre of expertise in 2003–2004 and 2014–2018. Clinical outcomes were determined after a follow-up period of 12 months. Outcomes were differences in baseline characteristics and comorbidities, and differences in ulcer-related outcomes between both cohorts. We included all consecutive diabetic foot ulcer patients from our centre for the period 2003–2004 ($n = 79$) and 2014–2018 ($n = 271$). Age (67.0 ± 14.3 vs. 71.6 ± 11.5, $p = 0.003$) and prevalence of end-stage renal disease (1.3% vs. 7.7%, $p = 0.036$) were significantly higher in the more recent population. The more recent population had higher healing rate (53.2% vs. 76.4%, $p < 0.001$), higher median ulcer-free survival days once an ulcer had healed [173 days (IQR 85.3–295.5) vs. 257.0 (IQR 157.0–318.0), $p = 0.026$], and fewer minor amputations (20.3% vs. 8.1%, $p = 0.002$). People with diabetic foot ulcers treated in 2014–2018 were older and more frequently diagnosed with ESRD, compared to this population in 2003–2004, while other characteristics were similar; ulcer-related outcomes were better.

KEYWORDS
amputations, diabetes, diabetic foot ulcers, ulcer free survival days

1 | INTRODUCTION

Diabetic foot ulcers are a threatening and common complication of diabetes mellitus.[1] Treatment of diabetic foot ulcers is complex, and requires frequent outpatient visits to multidisciplinary teams, frequent surgical and medical interventions, and long-term hospital admissions.[2] At the same time, patients experience loss of mobility that comes with a high socio-economic impact.[3–9] The yearly incidence of diabetic foot ulcers is estimated to be around 2%, with a lifetime prevalence of 19%–34%.[10] The burden of diabetic foot disease is already ranked in the top-10 of all diseases and with an expected continuation of the increase of diabetes worldwide, this burden will likely increase even more.[11,12]

The field of expertise including diabetic foot disease has seen major changes over the past decades. Towards the end of the last

century, the first international guidelines were released.[13] These, among others, have led to a widespread development of multidisciplinary clinics, aiming to implement guidelines and provide secondary and tertiary care for these complex patients.[14–17] The multidisciplinary treatments have led to an improvement in potential outcomes including better ulcer healing, fewer amputations and a reduced ulcer recurrence.[14–17] However, during the same period of time, the population of people with diabetes has become more complex, for example because people with diabetes now live longer and the disease develops at a younger age, leading to a higher risk of developing complications.[14,18] Consequently, the characteristics of the population of people with diabetic foot disease may have changed over the past decades as well.

A change in population characteristics has an impact on the implementation of guidelines, the generalisability of scientific evidence from older studies, and, most importantly, it may have an impact on treatment outcomes. Unfortunately, long-term epidemiological studies on population and ulcer characteristics or ulcer outcomes in people with diabetic foot disease are scarce. Only recently, one study conducted in a medical centre in Copenhagen, Denmark was published related to this topic. It found no changes in foot ulcer healing between 1999/2000 and 2011/2012. The study showed a median healing time of 6 and 6.6 months, respectively.[19] However, in this study, ulcer characteristics and comorbidities were only analysed in relation to their respective risk for ulcer healing in both periods; no comparison was reported concerning the presence of these variables in both populations. It therefore remains unknown whether the population of people with diabetic foot ulcers has increased in complexity over the past decades, and whether such changes may have impacted ulcer outcomes.

The aim of this study is therefore to research the differences in characteristics and outcomes (ulcer healing and ulcer-free survival days) in patients that have a diabetic foot ulcer and were treated between 2003 and 2004 and between 2014 and 2018.

2 | MATERIAL AND METHODS

2.1 | Study design and setting

We have used data from two observational, prospective, time-interrupted cohort studies from a single specialist diabetic foot centre that treats one geographical area in the East of the Netherlands. In this region, there is only one hospital. For the first cohort we prospectively included all patients with a diabetic foot ulcer that were recruited in this hospital as part of the Eurodiale study (2003–2004).[20] For the second cohort, we prospectively included all patients from December 2014 to August 2018 that were treated by the same multidisciplinary team as the patients in the 2003–2004 cohort.[21] For both cohorts, patients were excluded if they had an ulcer 1 year prior to their treatment. From 2003 until now, we have served as a specialist clinic regarding diabetic foot care, and referral agreements have remained similar during this period. Regarding the 2003–2004 cohort, the local ethics committee has approved the study protocol and all patients have given their written informed consent.[22] According to Dutch law, the second cohort (2014–2018) was exempt from any ethical questions as all observations and registrations were part of normal care.

Patients with diabetic foot ulcers have been treated by a multidisciplinary team in our centre since 1995. The team consists of vascular surgeons, podiatrists, wound care nurses, casting technicians, specialists in internal medicine, rehabilitation doctors, radiologists and orthopaedic shoe technicians. Our key staff members were the same during both study periods. All patients were treated according to protocols based on the Dutch Guidelines[23] and the International Working Group on the Diabetic Foot Guidelines.[24] For the 2003–2004 cohort, patients were treated according to the international consensus of that time.[25] Treatment included, among others, off-loading using irremovable or removable knee-high and ankle-high casts, regular wound debridement and wound dressings, the treatment of infection, the treatment of peripheral artery disease (PAD) and education. Regular interval checks were conducted according to the guidelines, between treatments at the outpatient clinic, once per week or every other week.[26] Ulcer prevention treatment would start when patients were close to healing and consisted of regular outpatient clinic checks, podiatric treatment, the prescription of orthopaedic footwear when required and education. Once the ulcer was healed, patients were referred to their podiatrist and, when necessary, their rehabilitation doctor and orthopaedic shoe technician for further preventative treatment.

2.2 | Participants

The criteria for recruitment and inclusion in the Eurodiale study have been extensively described elsewhere.[20,22,27] People with diabetes and a new foot ulcer which developed for the first time in 12 months were included. Patients that had received ulcer treatment on the ipsilateral foot during the past 12 months, and patients with a life expectancy of <1 year, were excluded.[22] For the current analysis we included all 79 patients recruited from our centre and followed them for 12 months or until the patient passed away.

For the second cohort, we prospectively registered all patients with diabetes that presented a new foot ulcer between December 2014 and August 2018, as part of standard care.[21] For our current analysis, we have excluded patients if they were only referred for a second opinion, when they were lost to follow up before an outcome or the end of the research was reached. In order to create a cohort similar to the Eurodiale study, we excluded patients that received treatment for an ulcer on the ipsilateral foot within the past 12 months.[22] The prospective inclusion was capped for the current study to ensure a 12-month follow-up for all participants. The follow-up for all participants ended after 12 months or after the participant passed away. The follow-up was guaranteed through regular visits to the outpatient clinic. An additional phone call was made to the patient after 12 months to enquire about their status (ulcer-free, amputation-free and alive).

2.3 | Variables

2.3.1 | Patient demographics

We obtained our demographic data on comorbidities such as cardiovascular disease, cerebrovascular disease, end-stage renal disease (ESRD: defined as eGFR <15 or dialysis treatment), and peripheral neuropathy (defined as loss of protective sensation based on 10-gram monofilament tests[24]) during the first presentation. Peripheral Artery Disease (PAD) was defined as an Ankle-Brachial-Index (ABI) ≤0.9 and PAD with chronic limb-threatening ischemia if a patient had a toe pressure <30 mmHg. In the cohort of 2003–2004, no toe pressures were performed. Cardiovascular disease was defined as a history of percutaneous coronary intervention of one or more of the coronary arteries or a coronary artery bypass graft and a history of myocardial infarction. HbA1c was determined within 3 months after referral or 3 months prior to referral.

2.3.2 | Ulcer-related outcomes

An ulcer was defined as a full-thickness lesion of the skin.[28] In case a patient had multiple ulcers, we chose and classified the most severe ulcer. Each ulcer was classified following the University of Texas Ulcer Classification (UT) during the first meeting.[29] The ulcer grade, according to the UT classification, classifies the depth of the ulcer while the ulcer stage classifies the presence of any infections or ischemia. The size of the ulcer was not reported in several patients and therefore was not

TABLE 1 Baseline characteristics

		Population 2003–2004 (*N* = 79)	Population 2014–2018 (*N* = 271)	*p*-value
Age in years		67.0 (14.3)	71.6 (11.5)	0.003
Gender	Male	50 (63.3)	154 (56.8)	0.305
	Female	29 (36.7)	117 (43.2)	
Type Diabetes	Type 1	9 (12.5)	11 (4.1)	0.019
	Type 2	63 (87.5)	260 (95.9)	
HbA1C mmol/mol	<58	39 (58.2)	117 (49.8)	0.423
	58–68	14 (20.9)	53 (22.6)	
	69–85	12 (17.9)	46 (19.6)	
	>86	2 (3.0)	19 (8.1)	
Diabetes duration	<5 years	13 (16.7)	35 (15.0)	0.569
	5–10 years	17 (21.8)	65 (27.9)	
	>10 years	48 (61.5)	133 (57.1)	
PAD		26 (32.9)	106 (39.1)	0.317
Ulcer history	No	30 (44.1)	193 (71.2)	<0.001
	Yes	38 (55.9)	78 (28.8)	
Comorbidity	Cerebrovascular disease	10 (12.7)	41 (15.1)	0.584
	Cardiovascular disease	18 (23.4)	85 (31.4)	0.175
	End stage renal disease	1 (1.3)	21 (7.7)	0.036
	Neuropathy	71 (89.9)	225 (83.0)	0.138
Infected ulcers		30 (38.0)	104 (38.4)	0.948
Ulcer Stage *	A	33 (41.8)	100 (36.9)	0.473
	B	20 (25.3)	61 (22.5)	
	C	16 (20.3)	55 (20.3)	
	D	10 (12.7)	55 (20.3)	
Ulcer Grade *	1	38 (48.1)	151 (55.7)	0.026
	2	16 (20.3)	72 (26.6)	
	3	25 (31.6)	48 (17.7)	
Ulcer localisation	Hindfoot	8 (10.1)	35 (12.9)	0.506
	Forefoot	71 (89.9)	236 (87.1)	

Note: Values are *n* (%) or mean ± *SD*. *: Ulcer stage and grade according to University of Texas Ulcer Classification.[30] Number of missing values: Type diabetes; 8 in 2003–2004; HbA1c; 12 in 2003–2004, 36 in 2014–2018; Diabetes duration; 1 in 2003–2004, 38 in 2014–2018; Ulcer history; 11 in 2003–2004; Cardiovascular disease; 2 in 2003–2004; End stage renal disease; 1 in 2003–2004.

included in the analysis. An ulcer was considered healed if the skin was intact for a minimum of 2 weeks (with or without prior minor amputation). If an amputation was necessary and the wound of the amputation was healed, this patient was registered as 'healed with amputation'. The time to heal was defined as the difference (in weeks) between the date the patient, and their new ulcer, was first registered, and the date on which the ulcer was considered healed. The cutoff points were 12 weeks, 20 weeks, and 12 months. Ulcer-free survival days were considered to be all the days a patient was alive and ulcer-free (i.e.: all ulcers healed) during the 12-month follow-up.[28] A minor amputation was defined as an amputation below the ankle joint (this included toe, ray, forefoot and midfoot amputations), a major amputation was defined as an amputation above the ankle (transtibial, through-knee or trans-femoral; no amputations above the trans-femoral level were performed).[28] The observation period for all these variables was 12 months after the first visit to the clinic.

2.4 | Statistical methods

Descriptive statistics were used to analyse the baseline patient and ulcer characteristics, and ulcer outcomes. Continuous variables were presented as a mean with a SD (in case of normal distribution) or a median with an interquartile range (IQR; in case of non-normal distribution). Categorical data was presented as a number (percentage). Differences in baseline characteristics between groups were tested using Chi-square tests, Student t-tests or Mann–Whitney *U* tests, depending on the characteristics of the variables. A Kaplan–Meier survival curve was calculated to analyse the time it took for the ulcer to heal in months, and log rank tests were used to analyse the differences between the groups. The differences between the groups regarding healing and time to heal were corrected for confounders in a multivariate logistic and a Cox regression analysis, respectively. Baseline variables associated with the groups that have a *p*-value <0.15 in the univariate analysis were subsequently tested for an association with the outcome (healing or time to heal), and considered as potential confounders when the *p*-value was <0.15. They were then entered in the multivariate model.

Statistical significance was set at a *p*-value <0.05. Statistical analysis was performed using SPSS Statistics for Windows, version 24.0 (IBM Corp, Armonk, NY, USA).

3 | RESULTS

We included the 79 patients that were consecutively treated between 2003 and 2004, and the 271 patients that were consecutively treated between 2014 and 2018.

3.1 | Baseline characteristics

The baseline characteristics of both cohorts are shown in Table 1. Age (67.0 ± 14.3 vs. 71.6 ± 11.5, $p = 0.003$) and end-stage renal disease (1.3% vs. 7.7%, $p = 0.036$) were significantly higher in the more recent cohort. On the contrary, the patients that were treated between 2003 and 2004 more frequently had type 1 diabetes (12.5% vs. 4.1%, $p = 0.019$), an ulcer grade 3 (31.6% vs. 17.7%, $p = 0.026$), and more patients in this cohort had a history of previous ulceration at inclusion (71.2% vs. 55.9%, $p < 0.001$) compared to the cohort of 2014–2018.

3.2 | Ulcer-related outcomes

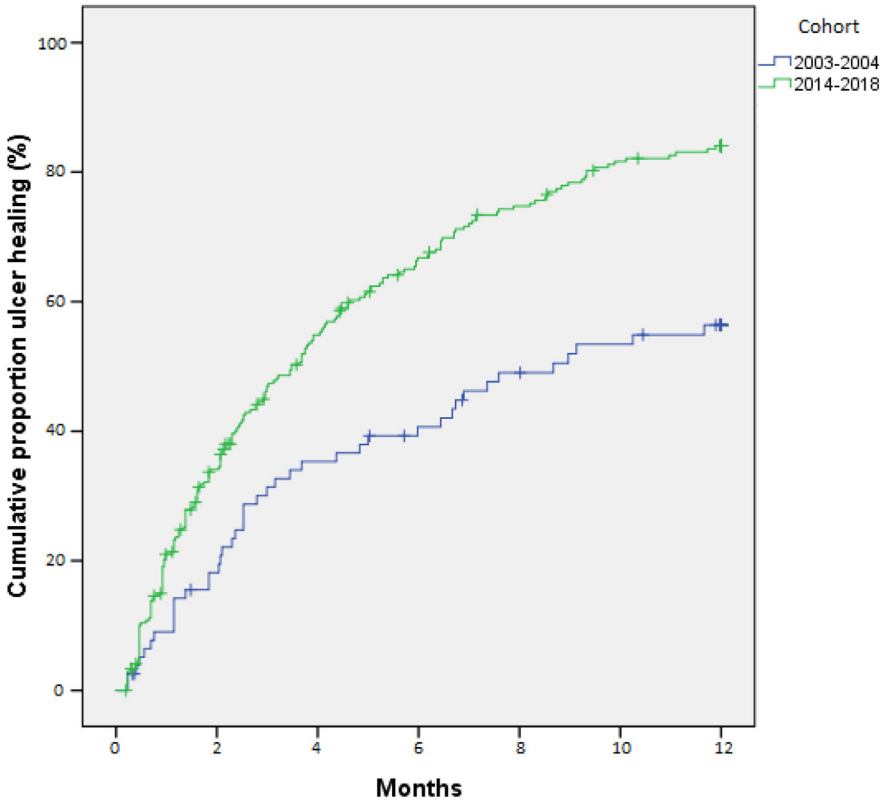
The majority of the ulcers in both cohorts were superficial ulcers (UT stage A) with 41.8% in the 2003–2004 cohort and 36.9% in the more recent cohort.

All ulcer-related outcomes are shown in Table 2. The healing rate was lower in the cohort of 2003–2004 compared to the 2014–2018 cohort at both 12 weeks (27.8% vs. 42.4%, $p = 0.019$), 20 weeks

TABLE 2 Ulcer-related characteristics and outcomes

		Population 2003–2004 (*N* = 79)	Population 2014–2018 (*N* = 271)	*p*-value
Healing rate	12 weeks	22 (27.8)	115 (42.4)	0.019
	20 weeks	28 (35.4)	153 (56.5)	0.001
	12 months	42 (53.2)	207 (76.4)	<0.001
Ulcer-free survival days, median (IQR)	All patients	14.0 (0.0–180.0)	189.0 (12.0–301.0)	<0.001
	Patients with a healed ulcer	173.0 (85.3–295.5)	257.0 (157.0–318.0)	0.016
Time to healing in months, median (95% CI)		8.7 (3.8–13.5)	3.5 (2.8–4.1)	<0.001
Ulcer recurrence		19 (24.1)	62 (22.9)	0.828
Lower-extremity amputation	Minor	16 (20.3)	22 (8.1)	0.002
	Major	4 (5.1)	8 (3.0)	0.479
12-month mortality rate		12 (15.2)	37 (13.7)	0.729

Note: Values are *n* (%) unless stated otherwise.



	Number patients at risk												
2003-2004	79	70	62	52	49	46	43	38	36	33	32	30	22
2014-2018	271	208	168	129	109	90	76	63	56	47	39	36	33
Time	0	1	2	3	4	5	6	7	8	9	10	11	12

FIGURE 1 Time to ulcer healing

(35.4% vs. 56.5%, $p = 0.001$) and the 12-month follow up (53.2% vs. 76.4%, $p < 0.001$). The crude odds ratio (OR) for ulcer healing was 2.85 in favour of the 2014–2018 cohort compared to the 2003–2004 cohort (95% confidence interval [CI] 1.69–4.81, $p < 0.001$). The OR corrected for confounders (in which only age and ulcer grade remained in multivariate analysis) was 3.59 in favour of the 2014–2018 cohort compared to the 2003–2004 cohort (95% CI 2.03–6.34, $p < 0.001$).

The median time to heal in months was longer for the cohort of 2003–2004 in comparison to the 2014–2018 cohort: 8.7 (95% CI 3.8–13.5) versus 3.5 (95% CI 2.8–4.1) months respectively ($p < 0.001$). The Kaplan–Meier curve is presented in Figure 1. The crude Hazard Ratio (HR) for healing was 2.10 (95% CI 1.50–2.93, $p < 0.001$). The HR corrected for confounders (i.e. ulcer grade) was 2.10 (95% CI 1.50–2.94, $p < 0.001$).

The minor amputation rate was higher in the 2003–2004 cohort compared to the 2014–2018 cohort (20.3% vs. 8.1%, $p = 0.002$), whereas the major amputation rate was similar in both cohorts (5.1% vs. 3.0%, respectively, $p = 0.479$).

In the cohort of 2003–2004, the median ulcer-free survival days in all patients was lower than in the cohort of 2014–2018: 14.0 days (IQR 0.0–180.0) versus 189.0 days (IQR 12.0–301.0; $p < 0.001$). The median ulcer-free survival days in the patients with an ulcer that healed during the observation period was also lower in the cohort of 2003–2004 compared to the 2014–2018 cohort: 173.0 days (IQR 85.3–296.5) versus 257.0 (157.0–318.0; $p = 0.016$).

The ulcer recurrence rate within 12 months after the first presentation using the ulcer index was similar in both cohorts, with 24.1% for the 2003–2004 cohort versus 22.9% for the 2014–2018 cohort ($p = 0.828$).

The 12-month mortality rates were similar in both cohorts: 12 for the 2003–2004 cohort and 37 for the 2014–2018 cohort ($p = 0.729$). Out of the 12 patients that died in the 2003–2004 cohort, 9 patients had no healing of the ulcer. This was 25 out of 37 for the 2014–2018 cohort.

4 | DISCUSSION

Changes in population characteristics and treatment outcomes of people with diabetic foot ulcers over the past decades are largely unknown.[14,18] However, these changes can affect both clinical practice and research via an interpretation and generalisation of the findings. To investigate population and treatment outcome changes over time, we have compared two diabetic foot ulcer patient cohorts in one geographical region with 15 years in

between the cohorts. Our key finding was that the population in the 2014–2018 cohort was older with more ESRD compared to the population of the 2003–2004 cohort, while the ulcer-related outcomes were better.

The gender distribution and ulcer stage at inclusion were similar in both cohorts, but patients were older and more frequently had ESRD in the more recent cohort. This is in line with the increase of diabetes-associated ESRD, ranging from 40%–700%, as reported by Harding et al.[14] However, the reviewed studies included people with diabetes in general and did not specifically target patients with a diabetic foot ulcer. These numbers were also incidence numbers of mainly countries with an income classed as 'low' or 'middle'. In the Netherlands, the number of patients with renal replacement therapy increased from 11,221 in 2004 to 17,494 in 2018, and the number of patients with diabetes (type 1 and type 2) with renal replacement therapy increased from 1189 in 2004 to 2336 in 2018.[31] As ESRD increases among diabetes patients, and ESRD is an independent risk factor for foot ulceration, it can be expected that the number of ulcer patients with ESRD has risen as well.[30,32,33] As patients with ESRD and a diabetic foot ulcer have poorer prospects regarding healing and survival, this is an important finding for clinical practice because it implies an increased care burden and suggests a specific focus on improving the outcomes for this subpopulation is warranted.[32,34–36] In addition, we have observed an increase in elderly patients in our cohorts. This may be due to the consequences of an ageing population in our region (from 14% aged >65 to 20% >65), of developing an ulcer later in life due to better diabetes care over the years prior, of developing diabetes later in life in general, or a combination of all the above.[37,38] Furthermore, the rate of diabetes type 1 in the more recent cohort was significantly lower compared to the cohort of 2003–2004. Type 2 diabetes is much more likely to develop in patients later in life, as it mostly develops due to behavioural factors such as lack of exercise or obesity, and is often diagnosed several years after the onset of complications such as neuropathy or a foot ulcer.[39] The increase of diabetes type 2 patients in the more recent cohort can be seen as a result of the older age of the population in this cohort and the fact they have presented more complications due to their diabetes.

Concerning ulcer-related outcomes, we have observed two to three times higher odds for healing (both when expressed as healing rates and as time to heal) in our 2014–2018 cohort after correcting for confounders in a multivariate analysis. Furthermore, we have had a more or less similar ulcer recurrence rate in both cohorts (24.1% vs. 22.9%) but a significantly lower amount of ulcer free survival days in healed patients in the 2003–2004 cohort compared to 2014–2018 (173.0 vs. 257 days). This was primarily due to the patients treated between 2003 and 2004 taking a longer time for their ulcer to heal, resulting in less ulcer free days. Over the past two decades, the implementation of guidelines, knowledge of and experience with treatment, and treatment options (such as endovascular treatments of PAD, etc.) have all improved significantly. This may have resulted in a more aggressive treatment of patients with diabetic foot ulcers, and may explain the finding of better outcomes. Furthermore, studies in the past have shown a better outcome for patients that were treated in a multidisciplinary outpatient clinic.[40,41] We have a multidisciplinary team working together for >20 years in more or less the same formation, with the key employees (vascular surgeon, casting technician, wound care nurse, podiatrist, and shoe technician) remaining largely the same and providing extensive training for new members of the team. The combination of this longstanding collaboration, the continuous updates and improvements of the protocols of this team, and the continued implementation of renewed (inter)national guidelines may have contributed to improved outcomes. However, some caution is required for causal interpretations as multiple (unmeasured) factors may have also changed over the years. To the best of our knowledge, we can only compare our data with one other study, that of Sorensen et al., in which two cohorts with more than 10 years in between were compared.[19] Healing rates were not statistically different between both cohorts (1999–2000 vs. 2011–2012) being 33% versus 30%, respectively. With the limited amount of details reported in this study, it is unclear why no improvement was observed as was the case in our study.

The number of amputations in both our cohorts are comparable to the results of other studies. The annual major amputation rate has decreased in patients with diabetes (i.e. with and without a foot ulcer) in the cohorts of Schmidt et al. (comparing 2000–2005 to 2010–2015) from 0.004% to 0.002%, and in patients with a diabetic foot ulcer in the cohorts of Sorenson et al. (comparing 1999–2000 to 2011–2012) from 4% to 3%.[19,42] Harding et al. also reported a reduction of lower extremity amputations between 1982 and 2011 in their review.[14] Over our two cohorts, major amputations decreased from 5.1% to 3.0%. This was not statistically significant and the number of events was too low to draw a meaningful conclusions. We did, however, observe a significant decrease in minor amputations from 20.3% to 8.1%, whereas minor amputations rates in both the studies from Schmidt et al. and Sorensen et al. remained more or less the same with rates of 0.005% and 13% versus 11%, respectively.[19,42] On the other hand, the review of Harding et al. did show a decrease in minor amputations as well as.[14] However, one must notice that the data reported by Sorensen et al. and Schmidt et al. are centre data, and the results from Harding et al. are concluded from a review of data reported over several countries and might therefore be hard to compare to our results.

One of the limitations of our research is the classification of the ulcers using the University of Texas classification instead of a more extensive classification such as PEDIS.[43] Because the data of the second cohort was collected as part of clinical care, a limited amount of time was available for more extensive data entry. However, the data have only been entered by two full-time and well-trained employees, and it has been checked for accuracy via Electronic Patient Files and by asking the practitioners directly. Unfortunately, the data entry being part of clinical care did result in a non-consistent registering of ulcer sizes in all patients. While ulcer size is associated with ulcer healing, we could not research this as a potential explanation for our findings.[20,44] Another limitation is the imbalance in the size of the two cohorts with the 2003–2004 cohort having a smaller sample size. The

inclusion period of the Eurodiale study was 1 year, which meant any data from 2005 onwards was unavailable. However, it is unlikely that a larger cohort would have resulted in different findings, as no major changes were implemented over the years directly following the Eurodiale study, and an imbalance between the two cohorts is more likely to result in loss of statistical power when analysing differences between the two cohorts. Furthermore, a selection bias could be present as participation was actively requested for the study in 2003–2004 whereas this was not the case in 2014–2018. Also, in the 2003–2004 cohort, patients with a life expectancy of less than 1 year were excluded, whereas in 2014–2018 these patients were not excluded which could lead to higher mortality rates in the more recent cohort. However, since the mortality rates were similar, the effect of this difference was most likely very small. Furthermore, in the 2003–2004 cohort, no toe pressures were performed. In our opinion, this could result in more patients in this cohort that are underdiagnosed with PAD. The percentage of patients with PAD in the 2014–2018 cohort is now slightly higher but statistical not significant. Our expectation is that even if there were more patients with PAD in the 2003–2004 cohort, this would still not differ statistical significantly. A strength in our research is that we have studied differences in patient characteristics and ulcer related outcomes between two prospective cohorts with 15 years in between, conducted in a specialist centre with similar (and mostly the same) personnel during both time periods, and in a clearly defined and unchanged regional catchment area.

With the ongoing increase of people with diabetes worldwide, and the further increase of better diabetes-related treatment modalities potentially ensuring that people with diabetes live longer, we expect the number of more complex patients with diabetic foot disease to increase even further over the years to come. Our patients with diabetic foot ulcers were older and had more ESRD compared to 15 years ago. We expect this increase to continue. Despite this increase in patient complexity, ulcer healing has improved over this period which suggests that caring for even more complex patients with diabetic foot ulcers can still result in clinically positive outcomes. This older population with more frequent ESRD will need more complex care to which the teams will increasingly have to respond, for example, by involving geriatricians and nephrologists. Furthermore, more longitudinal studies must be performed to place our findings in the perspective of other centres and health care systems.

5 | CONCLUSION

Compared to 15 years prior, patients with diabetic foot ulcers now presented more renal disease and were older, while simultaneously ulcer-related outcomes improved over this period.

CONFLICT OF INTEREST

The authors declare no conflict of interest in writing this manuscript.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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