CHAPTER 7

Summary and general discussion
Introduction

This thesis focuses on the epidemiology, treatment and psychosocial impact of facial burns. The **first part** consists of a retrospective, observational study on the epidemiology of facial burns in the Netherlands, including not only burn centre admissions but also general hospital admissions and visits to an emergency department (ED). In addition, predictors of facial burns, facial surgery and facial reconstructive surgery were identified. The **second part** consists of two Cochrane systematic reviews that summarise the best evidence available on topical treatment for facial burns and early excision and grafting for burns. The **third part** focuses on the perceived quality of facial scars and its relation with self-esteem and depressive symptoms. This final chapter consists of a summary of the main findings, a general discussion and describes directions for future developments for each part of this thesis, and finishes with a general conclusion and future directions of the complete thesis.

**Part I: Scope**

The first part of this thesis was used to frame the possible impact of a facial burn in a broader picture than a physical event alone (Chapter 1) and to provide a general overview of the magnitude of the problem (Chapter 2). We used a grounded theory based model that was developed in cancer patients with facial disfigurements to frame and understand the possible psychosocial transition in burn survivors. This model distinguishes three stages, that is, ‘becoming disfigured’, ‘being a disfigured person’ and ‘becoming a person with a disfigurement’. A similar trajectory was assumed to play a role in people with facial burns. An evident first step, according to the first stage of the model, was to examine the epidemiology of facial burns in the Netherlands (Chapter 2). We conducted a retrospective, observational study including people with burns admitted to a burn centre, admitted to a general hospital or those that visited an ED from 2003 to 2007. In this 5-year period, on average annually 12,000 people applied for burn-related treatment at an ED, 1900 people had a burn-related hospital admission of which approximately 540 were admitted to a Dutch burn centre. The percentage of people with facial burns in each healthcare setting were 21, 11 and 41, respectively. Unfortunately, analyses for EDs and general hospital admissions were restricted to descriptive statistics due to the limited access to the actual data, whereas the registration of the three burn centres was much more extensive and accessible.

Further analyses of the burn centre admissions showed a higher male-female ratio in the group with facial burns (2.7) compared to the group without facial burns (1.7). Besides the male gender, other predictors of facial burns were a younger age, a larger percentage TBSA burned, work-related burns and fire/flame burns, whereas contact burns reduced the risk of facial burns. The average length of hospital stay was significantly longer (5.9 days) in the facial burns group compared to the group without facial burns. Although the frequency of all
surgery was lower in the facial burns group, one in five patients received facial surgery and one in twenty received facial reconstructive surgery in a 2- to 7-year follow-up. Analysis showed an increased risk for facial surgery in women, burns located to the scalp, ears or ventral side of the neck, fire/flame burns and a larger percentage of facial TBSA burned, whereas an older age, burns located on the front of the face and work-related burns decreased the risk of facial surgery. Predictors for reconstructive facial surgery were burns to the ventral side of the neck, fire/flame burns and number of facial surgeries in the acute phase of the burn.

Our study identified the people at risk for severe facial burns and therefore the group that is ‘becoming disfigured’. The methodological strength of our study design is that we used three repositories in order to include burn casualties from three different healthcare settings. However, the National Hospital Discharge Register (NHDR) for general hospital admissions and the Dutch Injury Surveillance System (LJS) for ED visits provided limited detail on burn injuries and the actual data were not accessible. Nonetheless, the descriptive statistics provided a general overview of the characteristics of burn patients that require medical attention in the Netherlands. Our findings on risk factors on the other hand, might be applicable for burn centre admission only and possibly cannot be generalised to the entire Dutch burn population. In order to provide more reliable data on the complete burn population, we would need one extensive repository for all healthcare settings, preferably based on the extensive repository of the three Dutch burn centres (R3). This is probably not realistic since a repository is always a trade-off between the level of detail and the applicability.

An extensive registration requires a considerable effort of personnel maintaining the register, which will increase the risk of a repository with a vast number of missing variables. Therefore, a first step is to reach consensus on a minimum dataset necessary for a practicable repository. A next step could be to investigate whether an existing repository matches this minimum dataset or can easily be expanded with burn-related items, like percentage TBSA burned, aetiology and injury mechanisms. The Dutch Trauma Registry (LTR) might be such a repository for admitted patients. One should be aware that a change in repository might provoke a temporary decline in completeness of registration, as shown in a recent Finnish study[3]. That same study showed an increase in completeness of coding after the initial decline, but also an increase in the use of ‘unspecific’ codes for external causes, that provide limited information. Especially these external causes should be included in the repository in order to be of added value for future prevention campaigns.

The clinical implications of our epidemiological study focus around the admittance of facial burn patients. The risk profiles identified in this study can be used to prepare the burn team responsible for the admittance prior to the admission, as most referrers provide information on those risk factors in advance. For instance, the risk factors gender, age, aetiology, percentage TBSA burned, location of the burn and whether the burn occurred in an enclosed space are
all included in the referral form provided by the Dutch Burns Foundation. In addition, the limited capacity of specialised burn care might force the burn specialist to make a decision which patient is referred to the burn centre for admission in the last available bed and which patient is admitted to a general hospital, solely based on information from the clinicians in the referring hospitals. Although a facial burn is one of the criteria for referral to a Dutch burn centre \[4\], other burn patients, with or without facial burns, might be in more need for specialised burn care. Our risk profiles provide burn specialists with additional information on the possible severity of the facial burn that can help them decide in this situation. After admission, burn specialists can use the risk profiles in addition to their clinical findings and use both in their treatment decision-making and help them inform the patient about the choice of treatment and prognosis.

Besides clinical advantages, risk factors are especially interesting for prevention purposes because prevention strategies can now be focused on the group with an increased risk for a severe facial burn. Although our findings identified the risk population, our study was not designed to identify risk behaviour. This information is crucial to start a successful prevention campaign. Therefore, future research should aim at identifying those risk behaviours, for instance through extensive interviews focused on injury mechanisms in patients with facial burns.

In conclusion, our study provides healthcare professionals with the risk profiles for facial burns, facial surgery and facial reconstructive surgery that can be used in treatment decision-making and help determining the patient's prognosis. Although men are more at risk for facial burns, young women with a large percentage TBSA burned, including their ears, scalp or ventral side of the neck, caused by flames are particularly at risk for facial surgery. In addition, if they require facial surgery in the acute phase of the burn, they have an increased risk for facial reconstructive surgery in later life. Furthermore, the risk profiles can be used to develop prevention campaigns aimed at specific high risk populations.

**Part II: Evidence of treatment**

The second part of this thesis continued to focus on the stage of ‘becoming disfigured’. While the first part focused on predictors of ‘who is becoming disfigured’, this part elaborates on the treatment of the burn and subsequently the outcome of ‘becoming disfigured’. Unfortunately, there is still no treatment that cures all burns instantly without leaving visual markings, and no remaining physical and psychosocial consequences. Nonetheless, the development of new treatments is an ongoing process aimed at wound healing without scars with optimum patient comfort and patient satisfaction. Treatment in burns can roughly be divided in topical treatment and surgical treatment. In this part of the thesis we summarised the best evidence available for topical treatment for facial burns (Chapter 3) \[5\] and for early excision and grafting for burns (Chapter 4) \[6\] in two Cochrane systematic reviews.
We conducted a Cochrane systematic review to assess the effects of topical interventions on wound healing in people with facial burns of any depth (Chapter 3)\(^5\). Topical treatment for facial burns comprised any remedy, agent, substance, device or skin substitute that was placed on the face as a therapy for burn wounds. We included five randomised controlled trials (RCTs), comprising a total of 119 patients, that investigated antimicrobial agents, bio-engineered (TransCyte\(^\text{®}\)) or biological (allograft) dressings. All studies were at high risk of bias and heterogeneity of interventions prevented pooling of data. With regard to time to complete wound healing, one study reported similar healing rates between two antimicrobial agents and three studies showed shorter healing time in the patients that received skin substitutes compared to the patients that received an antibacterial agent. Unfortunately those studies used inappropriate analytical methods and therefore we had to conclude that there was insufficient evidence of a difference in facial burn wound healing between the antimicrobials studied and either alternative antimicrobials or skin substitutes. Results of additional outcome measures (wound infection, need for (reconstructive) surgery, scar quality, pain, adverse effect of treatment and length of stay) were inconclusive as well, due to wide 95% confidence intervals and lack of sufficient data. Nevertheless, two studies\(^7\text{–}^9\) reported significantly less pain with the use of skin substitutes that could stay on the wound for several days compared to daily application of antibacterial ointments. This finding is especially of interest in relation to patient comfort and therefore deserves further attention. Overall, there was insufficient high quality research and evidence to recommend a specific topical intervention for wound healing in people with facial burns.

In the second Cochrane systematic review we assessed the effects of early excision and grafting on scar quality in people with burns of all depths (Chapter 4)\(^6\). Early excision was defined as surgical excision within a week post-burn and we considered any type of graft. Comparator interventions could include any other intervention, no intervention or a placebo intervention on condition that timing of excision was different compared to the intervention. We included 10 RCTs comprising a total of 416 patients and studies varied from low to limited risk of bias. Two studies were considered sufficiently similar to pool for the outcome mortality and two other studies for the outcome proportion of patients requiring surgery, whereas the variety in control interventions and differences in outcome measures between studies prevented pooling of data for other outcomes. Three studies addressed our primary outcome scar quality but differed in outcome measurement. The results of two studies indicated better scar quality in the early excision group\(^10,11\) while one study was in favour of conservative treatment\(^12\), however, overall there was insufficient data to support any definite conclusions. With regard to wound infection, two studies used clinical signs to measure wound infection and found no statistically significant difference\(^13,14\), whereas two of the three studies that used positive wound swabs favoured early excision\(^10,11\). The third study did not allow meaningful data extraction\(^15\). Our conclusion was that early
excision might reduce the number of positive wound swabs but that there appears to be no clinically significant reduction in wound infection. Four studies addressed mortality as an outcome; two studies were sufficiently similar to pool and favoured the early excision group \[^{14,16}\]. However, these studies might have an overlap in patients, reducing the body of evidence, and are relatively old, which makes it questionable whether the results can be generalised to modern burn care. The other two studies reported non-significant higher or lower proportions of deaths in the early excision group \[^{11,15}\]. Overall, there was insufficient data to support any definite conclusions.

Three of the secondary outcomes were addressed by more than one study and indicated that early excision might reduce the length of hospital stay, whereas conservative treatment might reduce the proportion of patients that receives a surgical intervention and reduce blood loss as a result of the operation. Especially interesting were the results of the four studies that addressed the proportion of patients requiring surgery. The nature of the intervention prescribed that all patients in the early excision group received surgery, but all four studies showed that significantly less patients in the control group required surgery. Overall results showed that 52\% (37 out of 71) of the patients in the control group required surgery. Consequently, 48\% of the patients had wounds that healed without surgery. Since the patients were randomised, we can state that approximately half of the patients in the early excision group had wounds that would have healed if surgery was postponed and therefore received unnecessary surgery from a wound healing perspective. Consequently, those patients were unnecessary exposed to narcosis and suffered from additional blood loss during the surgery.

Cochrane systematic reviews are regarded as the gold standard of systematic reviews, however, the body of evidence is depending upon the quality of the included studies. The “garbage in, is garbage out” principle also applies to systematic reviews, therefore, inclusion of RCTs of high methodological quality strengthens the recommendations of the review. Both our Cochrane reviews showed that only a limited number of studies were eligible for inclusion and that all included studies had some methodological limitations, most often with regard to the description of randomisation procedure. Luckily, the advantage of a Cochrane review is that it is updated regularly, keeping the evidence up-to-date and increasing the number of included studies with time. This is especially visible in the review on topical treatment, in which six additional studies are identified and awaiting assessment \[^{17-21}\]. This would potentially increase the number of studies to 11. Although this increase in studies is essential, it is even more important to include studies of high quality. Of the six identified eligible studies, one study properly described the randomisation procedure \[^{21}\], whereas three others did not \[^{17,20,22}\], one study is still recruiting patients \[^{19}\] and one study is still unpublished \[^{18}\]. This is in line with a recent study that showed a significant increase in published RCTs in burn care over time, but the methodological quality of those studies did not increase \[^{23}\]. Nonetheless, a
preliminary assessment of the four published studies \cite{17,20-22}, indicates that conclusions of the next update of the Cochrane review will change substantially. For instance, the overall results of those studies show a minimal difference between topical interventions in wound healing and wound infection indicating that all those interventions could be applied with regard to this specific subject. Furthermore, studies that compared dressings and other skin substitutes that could stay on the burn wound for a longer period of time to creams and ointments that require daily removal and application indicate less pain and more patient comfort in the groups that received dressings. On the other hand, creams that could stay on the burn wound for a longer period of time, for instance cerium nitrate-silver sulfadiazine, might have similar advantages and have the additional advantage of a relatively easy application on a face with its curvatures compared to dressings. As a result, dressings and creams that could stay on the burn wound for a longer period of time are most likely a more favourable intervention for facial burns.

The combined results of both reviews and the studies awaiting assessment provide directions for clinical practice. The results indicate that postponing surgery could reduce the number of patients requiring surgery by half. In the meantime, dressings (that could stay on the wound for a longer period of time) decrease the number of painful procedures without hampering the wound’s healing potential. On the other hand, early excision and grafting might reduce wound infection rates and the length of hospital stay, which is the largest contributor to hospital costs per patient \cite{24}.

It is generally understood, that time to wound healing is an important factor in scarring, with an increased risk of hypertrophic scarring when time to wound closure takes more than 21 days \cite{25-27}. Consequently, early identification of those burns that take more than 21 days to heal is important in order to accelerate wound closure with surgical treatment. Nowadays, the healing potential of a burn wound can be predicted with the laser Doppler imager (lDi) with a 95 to 100% accuracy \cite{28-33}, whereas even a trained burn specialist has only a 60 to 75% accuracy in burn depth assessment and the most reported error is overestimation of depth \cite{34}. This device can help preventing surgery on wounds that have a healing potential of up to 14 days with usually no or limited scarring. Furthermore, the lDi indicates which parts of a burn wound of indeterminate depth require surgery and therefore potentially decrease the grafting area. Nonetheless, the question remains whether wounds with a healing potential between 14 and 21 days are best treated with early excision and grafting or conservative treatment with regard to scar quality. In the near future we will start a pilot study on scar quality in patients from an earlier trial that had well documented burn wounds with a broad range of healing potential in order to gain knowledge on this topic.

In order to be of added value for burn specialists and assist them in their decision-making, systematic reviews should ideally be based on high quality research and evidence. Therefore,
future studies should be designed in conjunction with a trials expert and a statistician in order to warrant the methodological quality of the trial and increase the body of evidence in burn care. The protocols of these well-designed studies should be published in advance and trialists should conduct their studies according to those protocols. In addition, it might be worthwhile, or even necessary, to seek international collaboration in order to gain sufficient statistical power and enable firm conclusions. This might be especially relevant for research in burn care, because the diversity in both patient and wound conditions, as well as restrictions in allowing trials involving children, leave a relatively small number of patients eligible for trials in this field. Furthermore, trialists should report more thoroughly as most of the RCTs in our reviews had an incomplete description of the randomisation procedure, leading to a lower assessment of the methodological quality. Trialists are strongly encouraged to report according to the CONSORT statement guideline [35] (www.consort-statement.org), as for instance only stating that patients were randomised is not sufficient anymore. Since an increasing number of scientific journals nowadays demand that authors of RCTs provide the CONSORT checklist at manuscript submission, this and other methodological limitations will diminish over time. Nonetheless, even systematic reviews with limited underlying evidence are of value in health decision-making, as those reviews identify the gaps in knowledge. When there is a scarcity of scientific evidence on a certain topic, health care professionals should incorporate more information from other types of research (cohort studies, case-control studies or case reports), consider the applicability of an intervention in their local setting and rely on their expert opinion. Carefully considering all these elements lead to evidence based practice, which in turn could be converted into evidence based guidelines. Although the development of a guideline is a time-consuming process, it eventually summarises the best evidence relevant for health care professionals in one document that saves time, improves quality of care and uncovers directions for research necessary to reduce the gaps in knowledge. Both our Cochrane reviews considered several outcomes, including three patient reported outcomes (PROs), that is, scar quality, patient satisfaction and quality of life. In recent years, the focus on PROs has increased in various health related domains. Nevertheless, none of the included studies in both reviews addressed patient satisfaction or quality of life. With regard to scar quality, one study [36] in the review on topical treatment for facial burns and three studies [10-12] in the review on early excision and grafting addressed this outcome. However, only one study [10] used a PRO measure for scar quality, which was a non-validated tool that measured the patient-rated cosmetic appearance of the scar on a 4-point scale (1 represents normal appearance and 4 represents unsatisfactory appearance). Nowadays, a widely used and validated patient-reported scar assessment tool is available for burn scar assessment, that is the Patient and Observer Scar Assessment Scale (POSAS) [37] (www.posas.org). The advantage of using such a tool in future studies is that it enables comparisons between
studies and pooling of data for a more precise overall estimate of effect size. In general, our reviews indicate a scarcity in studies that use validated PRO measures in burn care. Since the use of PROs could provide valuable insight into the needs of patients, future studies should incorporate PROs as an outcome measure.

In conclusion, the combined results of both Cochrane reviews and the studies awaiting assessment indicate that early excision could reduce wound contamination, whereas postponing surgery could reduce the number of patients requiring surgery by half. In the meantime, dressings and creams that could stay on the wound for a longer period of time could decrease the number of painful procedures without hampering the wound’s healing potential in facial burns. Therefore, a conservative start of burn wound treatment in combination with adequate bacterial control seems to be the most favourable treatment at present.

Part III: Psychosocial impact

The third part of this thesis focused on psychosocial aspects of facial burns related to the transition from ‘being a disfigured person’ to ‘being a person with a disfigurement’. While the first two parts were largely confined to the protected area of a hospital, this part focused on the return to everyday life and the later psychosocial consequences of facial burns. In this ‘new’ everyday life with facial burns and scarring, burn survivors are exposed to reactions of others as a result of their facial disfigurements. Both the severity of scarring and psychosocial aspects were assumed to play a role in how a burn survivor copes with these reactions and subsequently influence the transition to ‘being a person with a disfigurement’. In order to further elucidate the interplay between scar severity and psychosocial well-being, we investigated the level of agreement between patient and observer rated facial scar assessment with the aim to unravel some underlying mechanisms that possibly influence the patient’s rating, that is whether scar assessment is related to the patients’ self-esteem (Chapter 5). Furthermore, we investigated the relations between patient’s self-reported facial scar severity, self-esteem and depressive symptoms in one model, taking into account all relations in the same analyses (Chapter 6).

In a prospective multicentre cohort study, we assessed the level of agreement between patient and observer rated facial scar assessment (Chapter 5). Results showed that the majority of patients (70%) evaluated the individual scar characteristics (colour, thickness, surface roughness and pliability) identical or similar (plus or minus one point on a 10-point scale) compared to the professional’s evaluation. A group of patients scored some scar characteristics more severe than the observer (26 to 54% for individual scar characteristics). When using these discrepancy scores in a multiple regression analyses, higher discrepancy scores on surface roughness showed to be significantly associated with a lower self-esteem. This association remained significant when controlled for age, gender and percentage TBSA burned, although the explained proportions of variance were modest (16%).
Further analyses of the same cohort using Structural Equation Modeling included depressive symptoms six months post-burn (Chapter 6). The investigated model showed that patient-rated facial scar severity did not directly predict self-esteem three months post-burn and depressive symptoms six months post-burn. There was, however, a significant relationship between early depressive symptoms and both patient-rated facial scar severity and self-esteem, indicating that patients with early depressive symptoms rated their facial scars more severe and had a lower self-esteem. Additional analyses showed that self-esteem acted as a mediator between early and late depressive symptoms. The model provided a moderately well-fitting representation of the data and the variables in the model accounted for 12% of the variance in perceived facial scar severity, 43% of the variance in self-esteem and 37% of the variance in depressive symptoms six months post-burn.

One of the methodological strengths of our studies is that by investigating the professional’s scar evaluation in relation to PROs, that is patient’s scar evaluation and a psychological construct, we were able to reveal some of the dynamics that account for the different views between patient and professional on scar severity. Up to now, this difference in individual scar characteristics measured with the POSAS had not been investigated in relation to a psychological outcome measure. Another methodological strength of our study is the use of advanced analytical methods that investigate all relations in one model and allow the identification of relations between multiple variables. This type of research increases the possibility of discovering new relations, especially when Structural Equation Modeling (SEM) is used. In addition, the use of SEM in Chapter 6 enabled us to identify self-esteem as mediator between early and late depressive symptoms. These analyses extend our knowledge regarding underlying mechanisms of patient reported outcomes that gain increasing importance in quality of care and quality of life assessments. Moreover, it also adds to the literature that investigates influencing factors of psychosocial well-being in the aftermath of a burn injury showing that the process of adaptation partly depends on both pre-burn history of depression and early post-burn depressive symptoms assumed to originate in reaction to the injury.

Overall, the results of both our studies concerning facial scar assessment and psychosocial aspects provide directions for the professional with regard to which patients should be considered to receive psychological screening in the aftermath of a facial burn injury. Our findings in Chapter 5 contrasted with an earlier study by Brown et al. Based on that study, the scar assessment of the patient and the professional were expected to match poorly, whereas our results indicated that the majority of patients assess their facial scars similar to the professionals assessment and only a subgroup of patients deviated from the professional. Furthermore, our study suggests that using both patients’ and professionals’ scar assessments provides more useful information regarding the patients’ well-being relative to focussing on the separate assessments. Particularly an overestimation of the scar characteristic surface...
roughness relative to the professional may be an indicator of underlying psychological difficulties and a call for further clinical attention. However, the explained variance was modest, indicating that also other factors are likely to contribute to the patient’s self-esteem in addition to the patient’s perceived scar severity. Possible contributors could be burn-related, like surgical procedures or painful wound management, but could also relate to pre-burn vulnerability, like having a history of depression or highly value appearance. Therefore we included more of such variables in chapter 6.

Chapter 6 focussed on the relations between patient-rated facial scar assessments, self-esteem and both early and late depressive symptoms. Findings in this study suggested that both early depressive symptoms and lower self-esteem were indicative for later depressive symptoms in patients with facial burns, regardless of the patients’ perceived facial scar severity. The counter-intuitive result that we were not able to find a direct relationship between facial scar severity and both self-esteem and later depressive symptoms suggested that scar severity played a relatively minor role in these relations. Due to sample characteristics such as an overall mildly affected population in terms of facial scar severity and a predominantly male population, we cannot exclude that in certain subgroups facial scar severity directly affects self-esteem and depressive symptoms. This study may have suffered from a lack of statistical power to detect subgroups in which facial scar severity would have been important in predicting the psychosocial outcomes of interest. More research in larger samples that both include pre-burn functioning and post-burn factors is recommended to elucidate this issue. Nevertheless, anticipating further research we recommend routine psychological screening during hospitalisation on depressive symptoms, self-esteem and pre-burn psychological functioning in order to identify patients at risk and to optimise their treatment.

A letter to the editor by Kamolz et al. in response to our publication as described in chapter 5 shows that measuring facial scar severity is a topic of interest. Kamolz et al. argued that also objective measurements of facial movements should be included in future research. Although measuring facial movements could be of interest, in our response we emphasised that the added value of our findings is that it provides more insight in underlying dynamics in the patient’s scar evaluation. Both the letter and our response are included in the addendum of this thesis.

Our findings should be confirmed in future studies in order to gain more knowledge on these underlying dynamics. Ideally, those studies would include also patients with more severe facial scarring. Although the mean percentage facial TBSA burned in our study (3.3%) was higher compared to a recent retrospective study in the United Kingdom (1.2%) [45], the mean scar severity scores in our study (2.1) were lower compared to an extensive Dutch observational study (4.9) [46] that included scars on any body part. Inclusion of patients with more severe facial scarring is necessary to investigate if the relationships identified in our studies also hold
for patients with severe facial disfigurements. However, our epidemiological study already indicated that burn survivors with facial burns are generally less severely burned compared to burn survivors without facial involvement, as the proportion of burn survivors requiring surgery is lower, (39% compared to 52%, respectively) \[2\]. In addition, only one in five burn survivors with facial burns require a facial operation in the acute phase of the burn. A method to include patients with more severe facial scarring in future research is to focus on patients with facial burns that have been treated surgically. In addition, those patients are more likely to have several follow-up visits to the outpatient clinic in order to receive further treatment, like pressure garments, silicone therapy and reconstructive surgery \[47-53\]. At those visits, scar severity and scar maturation can be monitored in time. Incorporating these measurements as standard care in follow-up minimises additional follow-up visits for research purposes only and consequently reduces the burden for the patient. Meanwhile, these standard scar measurements add to available data, enabling analyses that could provide additional insight in scar maturation and its relation to the patients psychosocial well-being, as well as add to the hospital’s quality control measures.

Furthermore, future research should take into account our findings in Chapter 6 that pre-burn and early post-burn depressive symptoms influence the patient-reported scar evaluation \[39\]. Although the incorporation of subjective PROs in research is a great step forward, our study indicates that these measurements may be influenced by the patients’ mental state. Therefore, these influencing factors should also be included in the data analyses in order to elucidate the underlying pathways and provide a more complete picture of the relations of interest. Ideally, future studies would use advanced analytical methods in order to investigate the relations between all variables in the same model.

Our findings should be regarded as a first step in understanding the underlying pathways between scar severity and psychosocial aspects in patients with facial burns. A next step might be to incorporate the patients’ view on importance of appearance in the model, as a prior study showed that the persons view on importance of appearance predicted body image dissatisfaction \[42\]. This finding indicates that patients who highly value their personal appearance have more difficulties accepting their scars and therefore might asses their scars more severe. This subgroup might develop more psychological problems in the aftermath of a burn, regardless of the objective severity of their scars. In addition, pre-burn psychosocial vulnerability has been shown to be common among burn patients and may predispose to burns \[54\] while our results show that psychosocial factors predict later psychosocial functioning. Therefore, incorporating pre-burn psychosocial functioning in future research would be of interest.

In conclusion, our studies show that a patient’s facial scar assessment that deviates from the observer's scar assessment can be used as an early indication of the patient’s psychosocial well-being. Especially a discrepancy on the scar characteristic surface roughness relates to the
patient’s self-esteem. Furthermore, both early post-burn depressive symptoms and pre-burn functioning play a role in the patient’s facial scar assessment, self-esteem and later depressive symptoms. Therefore, we recommend routine psychological screening during hospitalisation on depressive symptoms, self-esteem and pre-burn psychological functioning in order to identify patients at risk and to optimise their treatment.

**General conclusions and future directions**

This thesis contains an extensive overview of the trajectory of facial burns, from risk factors to treatment modalities and psychosocial consequences after a facial burn. We provided healthcare professionals with the risk profiles for facial burns, facial surgery and facial reconstructive surgery that can be used in treatment decision-making and help determining the patient’s prognosis. We showed that men are more at risk for facial burns, but young women with a large percentage TBSA burned, including their ears, scalp or ventral side of the neck, caused by flames are particularly at risk for facial surgery. In addition, if they require facial surgery in the acute phase of the burn, they have an increased risk for facial reconstructive surgery in later life.

With regard to the state of the art evidence in topical and surgical treatment for facial burns we showed that early excision could reduce wound contamination, whereas postponing surgery could reduce the number of patients requiring surgery by half. In the meantime, dressings and creams that could stay on the wound for a longer period of time could decrease the number of painful procedures without hampering the wound’s healing potential in facial burns. Therefore, a conservative start of burn wound treatment in combination with adequate bacterial control seems to be the most favourable treatment at present. Furthermore, we investigated perceived facial scar severity and the relationships with self-esteem and depressive symptoms. We showed that patients generally assess their facial scars similar to the professionals’ assessment, but that a deviating patient’s scar assessment relative to the observer’s scar assessment can be used as an early indication of the patient’s psychosocial well-being. Especially a discrepancy on the scar characteristic surface roughness relates to the patient’s self-esteem. Furthermore, both early post-burn depressive symptoms and pre-burn functioning play a role in the patient’s facial scar assessment, self-esteem and later depressive symptoms. Therefore, we recommend routine psychological screening during hospitalisation on depressive symptoms, self-esteem and pre-burn psychological functioning in order to identify patients at risk and to optimise their treatment.

Future research is necessary and should be aimed at identifying injury mechanisms of facial burns, identifying the optimum timing of excision and wound treatment, and investigate underlying psychosocial pathways that possibly affect the burn survivors psychosocial well-being. The trialists should incorporate PROs in their outcome assessments and consult a trial
expert and a statistician to warrant the methodological quality of their studies. Furthermore, findings of studies should be summarised in systematic reviews and guidelines in order to have an overview of the body of evidence on a certain topic, which can help healthcare professionals in their treatment decision-making.
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