Inter-rater reliability of the EPUAP pressure ulcer classification system using photographs

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Background. Many classification systems for grading pressure ulcers are discussed in the literature. Correct identification and classification of a pressure ulcer is important for accurate reporting of the magnitude of the problem, and for timely prevention. The reliability of pressure ulcer classification systems has rarely been tested.

Aims and objectives. The purpose of this paper is to examine the inter-rater reliability of classifying pressure ulcers according to the European Pressure Ulcer Advisory Panel classification system when using pressure ulcer photographs.

Design. Survey was among pressure ulcer experts.

Methods. Fifty-six photographs were presented to 44 pressure ulcer experts. The experts classified the lesions as normal skin, blanchable erythema, pressure ulcer (four grades) or incontinence lesion. Inter-rater reliability was calculated.

Results. The multirater-Kappa for the entire group of experts was 0.80 ($P < 0.001$). Various groups of experts obtained comparable results. Differences in classifications are mainly limited to 1 degree of difference. Incontinence lesions are most often confused with grade 2 (blisters) and grade 3 pressure ulcers (superficial pressure ulcers).

Conclusions. The inter-rater reliability of the European Pressure Ulcer Advisory Panel classification appears to be good for the assessment of photographs by experts. The difference between an incontinence lesion and a blister or a superficial pressure ulcer does not always seem clear.

Relevance to clinical practice. The ability to determine correctly whether a lesion is a pressure ulcer lesion is important to assess the effectiveness of preventive measures. In addition, the ability to make a correct distinction between pressure ulcers and incontinence lesions is important as they require different preventive measures. A faulty classification leads to mistaken measures and negative results. Photographs can be used as a practice instrument to learn to discern pressure ulcers from incontinence lesions and to get to know the different grades of pressure ulcers. The Pressure Ulcer Classification software package has been developed to facilitate learning.

Key words: classification, incontinence lesion, photographs, pressure ulcer, PUCLAS, reliability
Introduction

Pressure ulcers are amongst the most common tissue lesions. Recognizing the magnitude and importance of the problem, both the Agency for Healthcare Quality and Research (AHQR, formerly known as the Agency for Health Care Policy and Research) and the European Pressure Ulcer Advisory Panel (EPUAP) formulated pressure ulcer guidelines. The pressure ulcer classification formed an important part of those guidelines. The EPUAP (1999) defined pressure ulcers as areas of localized damage to the skin and underlying tissue caused by pressure, shear, friction and or a combination of these.

Classification systems

Many classification systems for staging or grading pressure ulcers are discussed in the literature. Shea (1975) published the first well-documented method of classifying pressure ulcers. His numeric classification system was pathology-based and each stage was defined by the anatomic limit of soft-tissue damage. Over the intervening years Shea’s classification system was modified and there has been a proliferation of many alternative pressure ulcer staging systems (Maklebust, 1995). Reid and Morison (1994a,b) described 14 classification systems for pressure ulcers within the UK. Minor variations on these scales were also made for local use.

In 1989 a four-stage system was developed by the National Pressure Ulcer Advisory Panel (NPUAP) and was adopted by the AHQR. (AHCPR, 1993; Cuddigan, 1997). In 1995 the NPUAP formulated an additional statement indicating that pressure ulcers do not necessarily progress from one stage to another in an orderly fashion and that staging systems are not to be used in reverse order to describe improvement in an ulcer (Ayello, 1997; Maklebust, 1997).

The EPUAP (1999, 2002) adopted the NPUAP classification system, with some minor textual adaptations. According to the EPUAP, the first grade is non-blanchable erythema of intact skin and is described as follows: a discolouration of the skin, warmth, oedema, induration or hardness may also be used as indicators, particularly on individuals with darker skin. The skin does not blush and become white with the light pressure of a finger or of a transparent pressure disc (Derre et al., 1999; Halfens et al., 2001; Vanderwee et al., 2002). This is the case with blanchable erythema, where the skin can be pushed into whiteness and where the microcirculation is still intact (Calianno, 2000). Blanchable erythema is not a pathophysiological reaction and is therefore also not deemed to be a pressure ulcer.

A grade 2 pressure ulcer or an abrasion or blister is defined as a partial loss in the thickness of the skin involving epidermis, dermis, or both. The ulcer is superficial. A grade 3 pressure ulcer or a superficial ulcer is a full loss in the thickness of the skin involving damage necrosis of subcutaneous tissue that may extend down to, but not through, underlying fascia. A grade 4 or deep ulcer is an extensive destruction, tissue necrosis, or damage to muscle, bone, or supporting structures with or without full loss in the thickness of the skin. In all these cases it is understood that the causes of the lesions are pressure and shearing forces. The differences between the NPUAP classification and the EPUAP classification are limited. Whereas the NPUAP uses the term ‘stage’, the EPUAP uses ‘grade’. Some parts of sentences were not adopted by the EPUAP: the heralding lesion of skin ulceration (grade 1), shallow crater (grade 2), the ulcer presents clinically as a deep crater with or without undermining of adjacent tissue (grade 3), full thickness skin loss (grade 4). Elements of the position statement of the NPUAP with regard to non-blanchable erythema are included in grade 1, doing this with the exception of the observation points of coolness and sensation (pain, itching).

The NPUAP warned that the classification system should not be used to indicate pressure ulcer treatment success or failure and that other parameters should be used to determine progress towards pressure ulcer healing. (Maklebust & Margolis, 1995; Cuddigan, 1997).

Maklebust (1995) drew attention to the fact that some so-called grade 2 pressure ulcers are not caused by pressure but are related to chemical irritation and maceration. Incontinence lesions are located at the sacral and ischial area, but not necessarily on bony prominences. The colour of those lesions is purple rather than red. The surrounding tissue may be oedematous and swollen, the skin wet, and incontinence or diarrhoea is present.

Use of pressure ulcer classification systems

A single reliable grading scale is helpful for an accurate description of a pressure ulcer, useable by different disciplines to record without ambiguity, for the allocation of preventive equipment, and for the comparison of research results and clinical audits (Reid & Morison, 1994a; Healey, 1996; Banks, 1998). Quality improvement programmes have included pressure ulcer grades as an indicator that needs to be measured. Regulatory bodies and surveyors determine fines for licensed health care facilities based on the number of certain grade pressure ulcers (Maklebust, 1995). The Minimum Data Set (MDS) is used by American long-term care facilities to obtain
reimbursement from Medicare and Medicaid. In the skin condition section of the MDS, pressure ulcers have to be scored using the NPUAP classification system. Contradictory to the NPUAP recommendations, a healing ulcer has to be reverse graded. An eschar is graded as a grade 4 pressure ulcer, whereas the AHCPR classifies it as non-gradable. (NPUAP, 1995; Zuluowski et al., 2001) Health care facilities prescribe both treatment and preventive equipment on standard protocols per pressure ulcer grade (Maklebust, 1995).

James (1998) referred to the underreporting of the less severe grades of pressure ulcers. As the reason for this she referred to both the incorrect identification of these lesions and the lack of reporting of these lesions in the nursing and medical files.

The correct identification of the patients in danger of developing pressure ulcers is important to be able to start preventive measures in time. The current risk scales are only partially successful in this (Defloor et al., 2001; Schoonhoven et al., 2002). Many patients in danger of pressure ulcers are not identified as patients at risk and develop pressure ulcers. The identification of pressure ulcers in an early stage, and the ability to distinguish these lesions from other lesions, allows timely and effective ‘preventive’ measures to be taken and makes it possible to limit the likelihood of a more severe pressure ulcer lesion as much as possible.

Vanderwee et al. (2002) have shown that delaying preventive measures until non-blanchable erythema is present is an effective and efficient way of preventing pressure ulcers. The correct classification of pressure ulcers is also essential here.

Reliability of pressure ulcer classification systems

Pressure ulcer grading is based on the ability to assess or to recognize the predominant type of affected tissue, such as dermis, epidermis, subcutaneous fat, muscle or bone. Identification of different, affected body tissue layers is a complex skill that requires training and time to develop (Maklebust, 1995).

The reliability of pressure ulcer classification systems has rarely been tested (Healey, 1996). A Medline search with the search terms ‘pressure ulcer(s)’, or ‘pressure sore(s)’ or ‘decubitus’, and ‘inter-rater’ or ‘reliability’ for the period from 1993–2003 only supplied four studies on pressure ulcer classification systems. Moreover, in many studies on the prevalence or incidence of pressure ulcers, the reliability of the observation of pressure ulcers is seldom considered an issue.

Alcocock et al. (1994) presented six photographs to nurses and asked them to assess them with a classification system with six stages. The number of ‘correct’ responses ranged from 32 to 49%. They did not describe how they defined ‘correct’ and how many nurses participated in their study. When they reduced the six stages to three, the reliability varied between 68 and 98%.

Healey (1996) made use of 10 photographs to study the inter-rater reliability of three classification systems (Stirling scale, Torrance scale and Surrey scale). For each of the scales, the photographs were presented to a different group of 35 to 37 nurses. The Kappas measured were very low and varied between 0.15 and 0.37, indicating a low degree of agreement. The more categories in the scale, the lower the reliability.

Lorentzen et al. (1999) studied a three-stage classification system that used the colours red, yellow and black. They presented 120 photographs of non-healing ulcers with various causes to 21 observers and reported a moderate agreement (observer agreement = 0.65; \( \kappa = 0.47 \)).

Bours et al. (1999) had pairs of nurses assess the skin at the pressure points on 23 hospital patients and 45 nursing home patients using the EPUAP classification. Observers did not score independently of each other. The inter-rater reliability was high (Kappa 0.97 and 0.81). The pairs observed 90 outpatients independently of each other. Here the inter-rater reliability was much lower (\( \kappa = 0.49 \)).

Aim of the study

The purpose of this paper is to examine the inter-rater reliability of classifying pressure ulcers according to the EPUAP classification system when using pressure ulcer photographs. In this, different groups of experts were asked to classify a set of photographs.

Methods

Sixty-seven photographs of normal skin, blanchable erythema, pressure ulcers and incontinence lesions were selected based on their clarity. These photographs came from the personal collection of the authors and from those of other EPUAP trustees. If erythema was visible on the photograph – this could be the case for pressure ulcer photographs, incontinence lesion or blanchable erythema photographs – a second photograph was also shown. On this photograph a transparent pressure disk was pressed onto the erythema so the extent to which the erythema was blanchable was visible.

In a first phase the clarity of the 67 photographs was assessed by nine EPUAP trustees. The photographs where more than one EPUAP trustee was of the opinion that they were insufficiently clear were eliminated from the photographic series (Lynn, 1986). The remaining photographs were
placed in a two-part website presentation, in a random order. A first part contained a theoretical overview concerning the classification and observation of pressure ulcers. The different grades and the observation of blanchable and non-blanchable erythema were described. There was further expansion on the points of attention in the observation of pressure ulcers and incontinence lesions (AHCPR, 1993; EPUAP, 1999, 2002). In a second part it was requested that the different photographs be classified as normal skin, blanchable erythema, non-blanchable erythema (grade 1 pressure ulcer), blister (grade 2 pressure ulcer), superficial pressure ulcer (grade 3), deep pressure ulcer (grade 4) or incontinence lesion. This presentation was placed on the Internet in English and Dutch.

Nine EPUAP trustees were asked to run through this programme, to assess the photographs and to return the assessment form. The trustees were pressure ulcer researchers delegated from the UK, Italy, the Netherlands, Denmark, Belgium, and Ireland. The same was requested of seven pressure ulcer researchers, 20 staff nurses and 17 pressure ulcer nurses. The seven researchers were conducting pressure ulcer research at university level in the Netherlands and Belgium. The 20 staff members were Belgian hospital hygienists who were responsible for the pressure ulcer policy in their hospital. The 17 pressure ulcer nurses were active in Dutch and Belgian hospitals as reference nurses for pressure ulcers. All experts were familiar with the EPUAP classification.

Analytic procedure

The Cohens’ Kappa (κ) was used to evaluate the inter-rater reliability between two experts. The Kappa coefficient measures the proportion of agreement that occurs beyond that expected by chance.

If it is assumed that the numeric ranking of the different grades of pressure ulcers also mean a worsening in seriousness, the inter-rater reliability of lesions that were not classified as incontinence lesions can be evaluated by way of a weighted Kappa. With the weighted Kappa coefficient a correction is not only made for the degree of agreement between assessors that can be expected due to simple coincidence, but account is also taken of the degree of deviation. To be able to pronounce a general assessment on the inter-rater reliability, the multitater Kappa as discussed by Siegel and Castellan (1988) was applied.

A $\kappa = 0.60$ can be seen as a minimum in order to speak of an acceptable assessors agreement, while a Kappa of 0.80 or higher is characterized as ‘good’ or ‘satisfactory’ (Popping, 1983). Landis and Koch (1977) mean the following interpretation: $< 0$ ‘poor’, 0–0.20 ‘slight’, 0.21–0.40 ‘fair’, 0.41–0.60 ‘moderate’, 0.61–0.80 ‘substantial’, 0.81–1.00 ‘almost perfect’.

The Cohen’s Kappa and the multitater-Kappa (using the mkappasc procedure) were calculated with SPSS 10 (SPSS Inc., Chicago, IL, USA). The linear weighted Kappa was calculated with the program Agree 7.002 (Popping, RUG, Groningen, the Netherlands). An $\alpha$ of 0.05 was used as level of significance.

Results

The 67 photographs selected were assessed on their clarity by nine EPUAP trustees (Table 1). More than one EPUAP trustee was of the opinion that 11 photographs were insufficiently clear. These 11 photographs were submitted by the authors as three photographs of normal skin, a photograph of blanchable erythema, two photographs of a blister, four photographs of superficial pressure ulcers and a photograph of an incontinence lesion. The 11 photographs were removed from the set.

To determine the correct classification of the photographs, the assessments of the EPUAP trustees were used as the gold

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Based on Lynn (1986), the accordance of at least seven of nine EPUAP trustees would suffice. For each photograph at least eight of nine EPUAP trustees were in agreement on the classification (Table 2).

The remaining 56 photographs were presented to seven researchers, 20 staff members and 17 pressure ulcer nurses (Table 1). The multirater-Kappa for the entire group of experts amounted to 0.80 ($P < 0.001$) (Table 3). Comparable figures were found in the group of the researchers, the staff nurses and the pressure ulcer nurses. The average Kappas varied between 0.75 for the staff nurses and pressure ulcer nurses and 0.64 for the researchers.

Table 3 shows the weighted Kappas were almost identical (0.78–0.79). When experts have deviating scores (5.9% of the scores), it appears that in 33.3% of those deviant assessments there is only one grade of difference from the gold standard. In 3.2% of the cases the deviation is more than two grades and in 7.3% of the cases the lesion is classified as an incontinence lesion. The difference between the grades is not always clear-cut. In 51.6% of the deviant assessments the experts classify the photograph as unclear. The sensitivity of the classification of photographs with blanchable erythema and with non-blanchable erythema is 0.99 (95% CI: 0.978–0.995) and the specificity is 0.97 (95% CI: 0.953–0.981).

Incontinence lesions are sometimes classified as pressure ulcers (Table 4), but pressure ulcer photographs are sometimes also wrongfully labelled as incontinence lesions (Table 5). Incontinence lesions are mostly confused with superficial pressure ulcers, to some extent with blisters and to a lesser extent with erythema. Seventeen times it is stated that the photograph is unclear. The set with photographs was randomly split up per grade into two groups. The multirater-Kappa remains comparable ($\kappa = 0.81$; $\kappa = 0.78$; $P < 0.001$).

### Discussion

The inter-rater reliability of the EPUAP classification appears to be good for the assessment of photographs and based on Landis and Koch (1977) even ‘substantial’ to ‘almost perfect’. There was no difference between the different groups of experts. All experts appeared to be in a high degree of agreement in the assessment of the EPUAP trustees. For blisters and incontinence lesions the observation agreement was somewhat lower, but still amply above 85%.

This means that selected photographs can be assessed in a reliable way based on the EPUAP classification. In this, account should be taken that it concerned experts with years of experience in the observation and classification of pressure ulcers and who – insofar as this was necessary – received prior information on the classification. It is to be expected that carers with less experience will also score less reliably. This seems to be indicated by a small study on distinguishing between different forms of redness of the skin by untrained nurses. The inter-rater reliability in this study was small (Pel-Littel, 2003). Further research is required as to whether,
and to what extent, training can adjust this. This is important because, in practice, not only experts, but also all nurses, observe the skin for the presence of pressure ulcers. If a pressure ulcer is not identified, or identified too late, pressure relieving or pressure reducing measures will not be performed in time and this can lead to the creation of a much more serious pressure ulcer lesion.

What the experts looked for, what they took into consideration and weighed up with each other, what elements were decisive in the classification of the lesion, were not studied. Making the observation points and the decision-making used more explicit would allow the definitions of the varying grades to be completed and, especially, better describe the clinical presentation. Now the emphasis already lies heavily on the identification of the different layers of tissue and their degree of damage. A better description of the clinical presentation could be used to train carers with a more limited expertise in the observation and classification of pressure ulcers.

The EPUAP classification is a diagnostic instrument and is not intended to describe the healing of pressure ulcers. Other instruments were developed for this such as the Sessing Tool, the Pressure Sore Status Tool or the Pressure Ulcer Scale for Healing, where among other things the amount of exudate and the presence of necrotic tissue, slough, granulation or epithelial tissue are evaluated (Bates Jensen, 1997; Ferrell, 1997; Stotts & Rodeheaver, 1997; Thomas et al., 1997). The distinction between blanchable and non-blanchable erythema on the one hand and non-blanchable erythema on the other must allow the start of preventive measures at the correct moment (Vanderwee et al., 2002). Starting measures too late leads to the development of more severe lesions, and starting too early results in the unnecessary deployment of expensive means and measures. A correct identification of non-blanchable erythema is essential in this approach and photographs may be used as a practice instrument to learn to make correct identification. Both the sensitivity and the specificity of the classification of photographs with blanchable erythema and with non-blanchable erythema was high. There was only limited doubt about the difference between blanchable and non-blanchable erythema. On three occasions a photograph of blanchable erythema was assessed by an expert to be non-blanchable erythema and on one occasion the contrary was the case. The use of a photograph of erythema in combination with a photograph where a transparent pressure disk is pressed on the erythema appears to be a good method for distinguishing between blanchable and non-blanchable erythema.

The ability to determine correctly whether a lesion is a pressure ulcer lesion (pressure ulcer grades 2, 3 or 4) is important as a measure of outcome to assess the effectiveness of preventive measures. This was estimated correctly to a high degree. In 94.1% of the observations a pressure ulcer lesion was correctly identified as a pressure ulcer lesion. In 3.0% the photograph was classified as unclear, but this also includes situations where experts doubted between grades 2, 3 or 4. Only in 0.4% of the observations was a lesion wrongly classified as not a pressure ulcer.

| Table 4 Number of times that a pressure ulcer photograph is classified as an incontinence lesion |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Normal skin three photographs  | Blanchable erythema eight photographs | Non-blanchable erythema 12 photographs | Blister five photographs | Superficial pressure ulcer 11 photographs | Deep pressure ulcer nine photographs |
| Researchers (n = 7) | 0 | 0 | 0 | 1 | 2 | 0 | 2 |
| Staff (n = 20) | 0 | 0 | 1 | 4 | 4 | 0 | 7 |
| Nurses (n = 17) | 0 | 0 | 1 | 1 | 8 | 0 | 5 |
| Total (n = 44) | 0 | 0 | 0 | 1 | 14 | 0 | 14 |

| Table 5 Number of times that an incontinence lesion (eight photographs) receives another classification |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Eight photographs | Normal skin three photographs | Blanchable erythema twelve photographs | Non-blanchable erythema twelve photographs | Blister five photographs | Superficial pressure ulcer eleven photographs | Deep pressure ulcer nine photographs |
| Researchers (n = 7) | 0 | 0 | 0 | 1 | 2 | 0 | 2 |
| Staff (n = 20) | 0 | 0 | 1 | 4 | 4 | 0 | 7 |
| Nurses (n = 17) | 0 | 0 | 1 | 1 | 8 | 0 | 5 |
| Total (n = 44) | 0 | 0 | 0 | 1 | 14 | 0 | 14 |
Expert opinions especially diverge when it comes to incontinence lesions. The awareness that this type of lesions differs from pressure ulcers is relatively recent and it is not so simple to make a distinction with pressure ulcers (Defloor, 2000). It is not the presence of erythema that causes experts to confuse pressure ulcers with incontinence lesions, but the presence of small lesions to the skin. The difference between an incontinence lesion and a blister (grade 2) or a superficial pressure ulcer (grade 3) does not always seem clear. It is possibly the lack of information on the extent of urinary and/or faecal incontinence, the degree of transpiration, the presence of moist skin, and information on the evolution of the lesion that makes a correct classification more difficult. Being able to make a correct distinction between pressure ulcers and incontinence lesions is important. They each have a different cause mechanism and therefore require different preventive measures. A pressure ulcer is caused by pressure and shearing forces and can be prevented by pressure-reducing and pressure-relieving measures. Incontinence lesions originate through maceration caused by lengthy contact with humidity and through chemical irritation as a result of the levels of acidity of the urine and faeces. Incontinence training, hygienic care, absorbing incontinence material and skin care are measures that can prevent incontinence lesions. A faulty classification of a lesion leads to mistaken measures and negative results.

Comparable results were also gained with fewer photographs. The set with photographs was randomly split up per grade into two groups and the multirater-Kappas of both groups remained comparable and high. This allows subsets to be used in a pretest–post-test design to study the inter-rater reliability of the handling effect of an intervention or training. With live situations the reliability is more difficult to assess because the lower incidence of grade 3 and grade 4 pressure ulcers leads to an unequal distribution of the various grades. If insufficient attention is paid to this, then this can lead to an overly positive picture.

Photographs can be used as a practice instrument to learn to discern pressure ulcers from incontinence lesions and to get to know the different grades of pressure ulcers. The set of photographs and instructions used in this research were built into the PUCLAS software package (Nursing Science, Ghent University, Gent, Belgium). This self-study package allows one to practice the correct classification of pressure ulcers. The package is distributed by the EPUAP in nine languages.

Limitations

Photographs were used in this study. They give a static image of a lesion. However, to make it possible to assess whether the erythema was blanchable or not, double photographs were used that represented several moments. Video recordings could possibly offer a better alternative here. Photographs only show a two-dimensional image. This can make the assessment of the extent of a wound and of the damage to the different layers of tissue more difficult. Yet it does not seem to be a problem for experts.

The research carried out here is only a first step in the assessment of the reliability of the EPUAP classification. The inter-rater reliability of experts and inter-rater and intrarater reliability of nurses and other carers without special expertise on pressure ulcers would have to be researched further. In addition, the difference in reliability between in vivo and in vitro situations for non-experts needs to be studied more closely.

Whether photographs are harder or easier to assess than practical situations is hard to say. Qualitatively poor photographs can make observation more difficult and classification impossible. In practical situations many more elements can be taken into account, such as whether or not incontinence and transpiration are present, frictional movements of the patient, skin condition, bandaging. However, sometimes the abundance of information is difficult to process, especially when information is conflicting. Classifying lesions takes training and experience. Further research should also show to what degree carers who were trained with photographs are better at correctly classifying pressure ulcers at the bedside.

Conclusions

The inter-rater reliability of experts in the assessment of pressure ulcer photographs using the EPUAP classification is high. Non-blanchable erythema is only mistakenly classified to a limited degree. This is also the case for pressure ulcer lesions (grades 2–4). Incontinence lesions and pressure ulcer grade 2 (blister) and grade 3 (superficial pressure ulcer) are sometimes confused.

Contributions

Study design: TD, LS; data analysis: TD; manuscript preparation: TD, LS.

References

Pressure ulcers


