Pain: a review of three commonly used pain rating scales

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Aims and objectives. This review aims to explore the research available relating to three commonly used pain rating scales, the Visual Analogue Scale, the Verbal Rating Scale and the Numerical Rating Scale. The review provides information needed to understand the main properties of the scales.

Background. Data generated from pain-rating scales can be easily misunderstood. This review can help clinicians to understand the main features of these tools and thus use them effectively.

Method. A MedLine review via PubMed was carried out with no restriction of age of papers retrieved. Papers were examined for methodological soundness before being included. The search terms initially included pain rating scales, pain measurement, Visual Analogue Scale, VAS, Verbal Rating Scale, VRS, Numerical/numeric Rating Scale, NRS. The reference lists of retrieved articles were used to generate more papers and search terms. Only English Language papers were examined.

Conclusions. All three pain-rating scales are valid, reliable and appropriate for use in clinical practice, although the Visual Analogue Scale has more practical difficulties than the Verbal Rating Scale or the Numerical Rating Scale. For general purposes the Numerical Rating Scale has good sensitivity and generates data that can be statistically analysed for audit purposes. Patients who seek a sensitive pain-rating scale would probably choose this one. For simplicity patients prefer the Verbal Rating Scale, but it lacks sensitivity and the data it produces can be misunderstood.

Relevance to clinical practice. In order to use pain-rating scales well clinicians need to appreciate the potential for error within the tools, and the potential they have to provide the required information. Interpretation of the data from a pain-rating scale is not as straightforward as it might first appear.

Key words: Numerical Rating Scale, pain, pain assessment, pain measurement, pain rating scales, Verbal Rating Scale, Visual Analogue Scale

Introduction

The Royal College of Surgeons and Royal College of Anaesthetists (1990) outlined a number of shortcomings in pain management. This led to an increase in the provision of acute pain services from prereport level of 2·8% in 1990 to 42·7% in 1994 (Windsor *et al.* 1996). In 2000 the number of NHS hospitals (Trusts) with an acute pain service was up to 200 (88%) (Spence 2000). Current guidelines for good pain management practice state that pain must be assessed and

documented on a regular basis (Royal College of Surgeons & Royal College of Anaesthetists 1990, Spence 2000). Trusts with acute pain services tend to standardize pain assessment tools across the Trust (Spence 2000), but there is little written about the decision-making processes employed by pain management services in the choice of these tools.

The aim of this review is to explore the properties of three commonly used pain-rating scales, the Visual Analogue Scale (VAS), the Numerical Rating Scale (NRS) and the Verbal Rating Scale (VRS). The review is divided into sections dealing with the key features of the pain rating scales, designed to provoke reflection.

Method

A Medline search was carried out via PubMed. The search strategy evolved throughout the process. Initial search terms included, pain rating scales, pain scales, Visual Analogue Scales, pain assessment tools, pain measurement, Verbal Rating Scales and Numerical Rating Scales. The reference lists of collected research articles were examined to create a further batch of research articles and to generate further search terms. A time-span was not imposed on the search. Only English language papers were retrieved. Each article was critiqued for methodological soundness and trustworthiness of data.

Findings

The complexity of pain

…intensity of pain, is, without a doubt, the most salient dimension of pain. (Turk & Melzack 1992, p. 6)

Intensity is not the only factor important in the experience of pain; pain occurs within a context. In cancer patients the sensory component of pain is less important than the evaluative-emotional aspect (Kremer *et al.* 1981, Clark *et al.* 1989). In the clinical setting, as well as in much published research, the reliance on pain intensity alone suggests that it is the only dimension of pain that is important to assess and record although this is not the case.

Pain intensity is influenced by the meaning of the pain to the patient and its expected duration (Turk & Melzack 1992). The environment also has an impact on the experience of pain, as do expectations, attitudes and beliefs. Pain is rarely caused by psychological factors but is associated with psychological and emotional effects such as fear, anxiety and depression. Acute or chronic pain can lead to varying degrees of altered behaviour, dysfunction or disability. A number of studies have demonstrated that pathology does not correlate well with pain; importantly, the absence of identifiable pathology does not mean the absence of pain (Wiesel *et al.* 1984, Boden *et al.* 1990, Turk & Melzack 1992).

Properties of the Visual Analogue Scale

The VAS is presented as a 10-cm line, anchored by verbal descriptors, usually 'no pain' and 'worst imaginable pain' (Fig. 1). The patient is asked to mark a 100 mm line to indicate pain intensity. The score is measured from the zero anchor to the patient's mark. Using a millimetre scale to measure the patient's score will provide 101 levels of pain intensity. One of the limitations of the VAS is that it must be administered on paper or electronically (Kremer *et al.* 1981, Dixon 1986, Jensen *et al.* 1986, Guyatt *et al.* 1987). Caution is required when photocopying the scale as this can lead to significant changes in its length (Jensen *et al.* 1986, Snow & Kirwan 1988).

The graphic orientation of the VAS can make a difference to the statistical distribution of the data obtained using it. Ogon *et al.* (1996) found that data were normally distributed when the VAS was used horizontally, but not when it was used vertically. Data obtained by horizontal and vertical VAS does correlate well (Scott & Huskisson 1979a, Hinchcliffe *et al.* 1985) but the level of agreement between the two is low (Dixon 1986).

In a study of Chinese patients (Aun *et al.* 1986) the vertical scale demonstrated less error than the horizontal scale. A similar study (Scott & Huskisson 1979b) exploring the use of the VAS by English language speakers found that there was a 7% failure rate for the VAS when it was presented vertically but less when presented horizontally. This suggests that the graphic orientation of the VAS should be decided according to the normal reading tradition of the population on which it is being used.

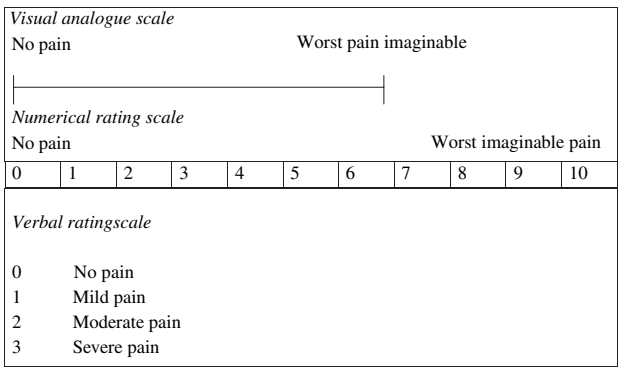

Figure 1 Common pain rating scales.

The VAS has ratio properties (Price *et al.* 1983, 1994) and is linear but not always normally distributed. The distribution of data influences the statistical test employed. Some authors advocate the use of non-parametric tests when scores obtained from VAS are not normally distributed (Ohnhaus & Adler 1975, McCormack *et al.* 1988, Dexter & Chestnut 1995, Ogon *et al.* 1996). If the distribution of data is normal the use of parametric statistical analysis, which is more powerful than non-parametric testing, is allowed.

The Numerical Rating Scale

The NRS is a 11, 21 or 101 point scale where the end points are the extremes of no pain and pain as bad as it could be, or worst pain. The NRS can be graphically or verbally delivered. When presented graphically the numbers are often enclosed in boxes and the scale is referred to as an 11 or 21 point box scale depending on the number of levels of discrimination offered to the patient. There is no published information about the distribution or error of data obtained using the NRS. However, the scale is interval level and can provide data for parametric analysis.

The Verbal Rating Scale

The VRS comprises a list of adjectives used to denote increasing pain intensities. The most common words used being: no pain; mild pain; moderate pain; and severe or intense pain. For ease of recording these adjectives are assigned numbers. These rank numbers can lead to the misapprehension that intervals between each descriptor are equal, but this is not the case (Jensen & Karoly 1992) and could be a source of error. The VRS is ordinal. There is no published evidence about the distribution of data obtained from the VRS. In most cases, data collected using a VRS can only be analysed using non-parametric statistics.

Test–retest reliability

In the acute pain setting the test–retest reliability of the VAS has been established. When a VAS is repeated within a short space of time, 90% of the scores are close together (Bijur *et al.* 2001). Patients with a cognitive impairment cannot reproduce VAS scores so consistently (DeLoach *et al.* 1998). The repeatability of the VAS is good as can be seen by correlation coefficients ranging from 0·97 to 0·99 (Bijur *et al.* 2001, Gallagher *et al.* 2002) (Table 1).

Variability in repeated measurements is also because of the perceptual stability of the stimulus itself. In other words, if the same stimulus is repeated a number of times, avoiding the effects of summation, the patient should recognize that the stimulus is the same on each occasion. In order to investigate this Rosier *et al.* (2002) assessed the repeatability of the VAS against perceptually stable visual stimuli. They found that actual experience of pain varies over time despite the fact that the physical stimulus remained the same. Variability was in the region of 20%, which is high enough to make a significant contribution to the clinically significant pain reduction of 28% that other studies support (Farrar *et al.* 2000, 2001).

Table 1 Correlation coefficients of the Visual Analogue Scale

Intra-class correlation coefficient	Confidence interval	References
0·99	95%, 0·989–0·992	Bijur *et al.* (2001)
0·97	95%, 0·96–0·98	Gallagher *et al.* (2002)

The Numeric Rating Scale has not been investigated as thoroughly but has been shown to have poor reproducibility (Van Tubergen *et al.* 2002). One of the possible reasons for poor reproducibility in this study may have been participant confusion because the verbal anchors used at each end of the scale changed according to the questions being asked.

The validity of the VRS has been established in a recent study (Lara-Munoz *et al.* 2004), which tested the VAS, VRS and NRS in experimental conditions using sound as the variable stimulus. All three tools were found to be reliable and valid and, although the VAS scored highest the researchers concluded that the VRS provided reliable scientific information.

Sensitivity of the pain rating scales

The sensitivity of a pain rating scales is the ability of the scale to detect change. The more levels a tool has the more sensitive it will be. A small change in pain is noticeable using a VAS but the small number of categories in the VRS demand that a much larger change in pain is required before the change shows up on the scale. The lack of sensitivity of the VRS can lead over or under-estimation of pain changes (Jensen *et al.* 1994). The VAS and the NRS are superior in this respect because they have greater sensitivity to change (Ohnhaus & Adler 1975, Jensen *et al.* 1986, Jamison *et al.* 2002).

Jensen *et al.* (1994) provide compelling evidence that 11 or 21 point scales are more than adequate for the assessment of pain. 101 point scales (such as the VAS and 101 point NRS) have more levels of discrimination than most patients use. Most of the patients in their study used multiples of 5 or 10 when using a 101-point scale. Approximately 75% of the patients used the 101-point scale as if it had 11 points. In a similar study Murphy *et al.* (1988) asked to patients to use a

0–10 scale and found that 17% of the patients spontaneously recorded their ratings between two whole numbers. Although there is relatively little published in relation to this question, the evidence suggests that 11-point scales are the most popular for patients when they are asked to quantify their pain.

The same does not follow when a VRS is being used. In a study by Rosier *et al.* (2002) patients were offered 15 adjectives to describe their pain. On average the patients used only six of the adjectives. Four of the adjectives accounted for 78% of the responses. This suggests that the patients felt able to communicate their pain using between 4 and 6 points of discrimination. However, it is not clear whether the patients felt comfortable and familiar with all the words available to them. Lack of familiarity might limit the choices they made.

How do changes in pain intensity scores relate to percentage changes in pain?

It is common to use percentage reduction in pain as a means to compare treatments or monitor progress. To work out the percentage pain reduction the following calculation is used:

$$100 \times \frac{\text{(Difference between pre- and postpain scores)}}{\text{Pretreatment intensity}}$$

Comparisons between pain changes using different scales cannot be made. A change from 51 to 48 mm on the VAS is a percentage change of approximately 6%. On an 11-point scale this could be represented as a change from 5 to 4; representing a change of 20%, suggesting a much greater response to treatment. Using raw scores to assess pain reduction can lead to some error. A change from 9/10 to 6/10 is a raw change of 3 and a percentage reduction of 33%. A change from 6/10 to 4/10 is a raw change of 2, but the percentage change is the same, 33%. The same calculation cannot be used with VRS where the numbers signify the rank and not the magnitude of the patient's pain.

Patients can be asked to provide percentage reduction scores directly. Cepeda *et al.* (2003) investigated the agreement between the calculated percentage pain reduction and the patient-reported percentage pain reduction in 430 patients with acute or cancer-related pain. They found that there was good agreement between the two, 95% of the differences not exceeding 17%. In an earlier study, Farrar *et al.* (2001) found near equivalence between raw scores and percentage scores.

Correlation between pain rating scales

Using percentage pain scores rather than raw changes can help in understanding the magnitude of pain changes that a patient has experienced. Intuitively, it might be expected that scores obtained using a VAS and scores obtained using a NRS would broadly agree with one another because of the similarities of the two scales. Bijur *et al.* (2003) found a significant correlation between the VAS and the NRS ($r = 0{\cdot}94$, 95% CI = 0·93–0·95). They also found that the slope of the regression line was 1·01 (95% CI = 0·97–1·06) indicating a strong level of agreement between the two tools. DeLoach *et al.* (1998) also identified high correlation in postoperative patients between the VAS and the NRS. However, the regression line slopes were 0·86 and 0·95 suggesting that the two scales do not agree. This tells us that at best the VAS and the NRS provide similar information about pain, but a direct conversion cannot be made between one and the other. In other words, a score of 40 mm on the VAS cannot be translated into a score of 4/10 using the NRS.

Correlation between the VRS and the VAS has been demonstrated in groups of patients (Woodforde & Merskey 1972, Ohnhaus & Adler 1975, Reading 1980, Littman *et al.* 1985, DeLoach *et al.* 1998, Briggs & Closs 1999) but this correlation is reduced when patients results are examined individually (Linton & Gotestam 1983). The correlation coefficients vary widely and change over the course of the VAS range. This means that although there might be a good correlation between VRS and VAS scores at the lower end of the scale the association between the two deteriorates as the patient's pain increases. DeLoach *et al.* (1998) identified a group of patients whose VRS and VAS scores moved in opposite directions rather than both increasing or decreasing together. Littman *et al.* (1985) identified a group of patients who gave a pain score of 0 (no pain) using the VRS and yet scored >0 on the VAS. Lack of information about the slope of the regression line means that the degree of agreement between the VRS and the VAS cannot be established from the data presented in these papers.

What is a clinically meaningful change in the level of pain intensity?

Pain is often described as the fifth vital sign and health care professionals are encouraged to regularly document the patient's pain alongside other regular measurements that chart the patient's course. Scientific papers have used 50% pain reduction as a statistically significant reduction (Rowbotham 2001). Farrar *et al.* (2001) defined a clinically important change in pain as 'much improved' or 'very much improved' using the Global Rating Scale, and that related to a 30% reduction in pain. An earlier study using data from a trial of transmucosal fentanyl for cancer pain, Farrar *et al.* (2000) equated a 33% pain reduction with moderate or

better pain relief in 130 patients. Although a 33% reduction may be significant to the patient it is interesting to note that serial VAS measurements can have a variability of up to 20% (Rosier *et al.* 2002).

How bad is moderate or severe pain?

The VRS is often used in clinical practice. Tempting though it may be to quantify the patient's pain as a linear scale, the rank scores on the VRS are used for ease of recording. Three studies have examined the use of the VRS in order to quantify the adjectives commonly used (Serlin *et al.* 1995, Collins *et al.* 1997, Briggs & Closs 1999). Serlin *et al.* (1995) found that cancer pain patients quantified mild pain as between 1 and 4 on an 11-point scale, moderate pain related to scores between 5 and 6, and severe pain was represented by a score of seven and above. Using a different approach with acute pain patients Collins *et al.* (1997) found that a score of approximately 30 mm on a 100 mm VAS corresponded with moderate pain and a score of 54 mm or more corresponded with severe pain. Briggs and Closs (1999) found that cancer patients quantified severe pain as being 35 mm or more on the VAS.

Patients need access to their score history

Without access to the 'score history' the patient is unlikely to be able to place their current score accurately (Scott & Huskisson 1979a, Farrar *et al.* 2000). If one was concerned with identifying the patients opinion of their absolute pain score at a particular point in time it would be appropriate to ask them to score without reference to previous scores; there is an argument that this is more accurate (Jacobsen 1965). Scott and Huskisson (1979b) identify a problem; the patient's score produced without reference to their score history produces data that is not in agreement with other measures of their disease progress. Given that repeated measures using the VAS produces errors of approximately 20 mm (DeLoach *et al.* 1998) or 20% (Rosier *et al.* 2002) it is appropriate to reduce error by showing the patient their previous score. The ratio of patient preference for seeing their previous score or not is 3:1 (Joyce *et al.* 1975). The reason for this choice is unclear.

Failure rate of pain rating scales

The failure rate of the VAS is between 4 and 11% (Kremer *et al.* 1981, Jensen *et al.* 1994) but this can be reduced if the tool is carefully explained to the patient (Joyce *et al.* 1975, Ogon *et al.* 1996). The teaching time for the VRS is often shorter than that for the VAS (Guyatt *et al.* 1987).

Patients with cognitive impairment are less likely to report pain and less likely to be able to use the VAS (Kremer *et al.* 1981, Price *et al.* 1999, Allen *et al.* 2002, Gabre & Sjoquist 2002). Kremer *et al.* (1981) found that there was a significant age difference between the patients able to complete the VAS and those who were not (mean age 75·3 years vs. 54·4 years, $P < 0{\cdot}01$). They explained this as deterioration in abstract ability with increasing age.

Failure rates with the NRS and VRS are lower than failure rates with the VAS. In a study of 56 chronic pain patients the failure rates of the NRS and VRS was 2% ($n = 1$) and 0 respectively (Kremer *et al.* 1981).

Patient preferences

Some patients prefer the VAS for its sensitivity, while others prefer the VRS or the NRS for simplicity (Joyce *et al.* 1975, Van Tubergen *et al.* 2002). Older adults and children who have less abstract ability, find a categorical scale such as the VRS easier to use (Kremer *et al.* 1981, Fanurik *et al.* 1998, Radbruch *et al.* 2000). However, there is no evidence to suggest that these groups cannot use the NRS.

Conclusion

Pain rating scales have a fundamental place in clinical practice. The evidence suggests that patients are able to use them to communicate their pain experience and their response to treatment. The interpretation of pain scores is not straightforward. The key to successful pain management hinges upon the ability of the patient to use the tools made available, and the careful interpretation of the scores by the health care professionals.

Pain intensity is probably the easiest dimension of pain to assess, but it is not so easy to interpret the intricacies of the results. Patients communicate far more information about their pain than just intensity when using a pain rating scale.

All three of the pain-rating scales explored in this review are reliable and valid. The VAS is statistically the most robust as it can provides ratio level data. However, the data are not always normally distributed, and patients do not always use all of the scale. Repeated scores using the VAS can vary by as much as 20%. This could contribute to the clinically significant reduction in pain, suggested to be approximately 30–33%. The VAS is the most difficult of the three scales to use in clinical practice and has the highest failure rate.

The VRS is the least sensitive tool of the three, but it is easy to use. One of the biggest concerns about this tool is that the rank numbers assigned for ease of recording can mislead the clinician about the level of data that the tool provides.

The VRS has not been extensively researched, but it is probably reliable and valid.

The NRS provides interval level data and is as sensitive as the VAS. The scale is easy to administer, record, and allows patients to use either 11 or 21 points of intensity.

Patients prefer the NRS when they want sensitivity and the VRS for simplicity but the evidence is not conclusive. The least favourite tool is the VAS, which is also the hardest tool to use and has the highest failure rate. In clinical practice the NRS or the VRS are both appropriate. As a tool for pain assessment as well as for audit and research the NRS is probably more useful than the VRS or the VAS.

Pain is entirely subjective and its links with pathology are indirect, the only way to successfully assess pain is to believe the patient. Pain is what the patient says it is (McCaffrey & Beebe 1989).

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Contributions

Study design: AW; data analysis: AW and manuscript preparation: AW and BH.

References

Allen RS, Haley WE, Small BJ & McMillan SC (2002) Pain reports by older hospice cancer patients and family caregivers: the role of cognitive functioning. *Gerontologist* **42**, 507–514.

Aun C, Lam YM & Collett B (1986) Evaluation of the use of visual analogue scale in Chinese patients. *Pain* **25**, 215–221.

Bijur PE, Silver W & Gallagher EJ (2001) Reliability of the visual analog scale for measurement of acute pain. *Academic Emergency Medicine* **8**, 1153–1157.

Bijur PE, Latimer CT & Gallagher EJ (2003) Validation of a verbally administered numerical rating scale of acute pain for use in the emergency department. *Academic Emergency Medicine* **10**, 390–392.

Boden SD, McCowin PR, Davis DO, Dina TS, Mark AS & Wiesel S (1990) Abnormal magnetic-resonance scans of the cervical spine in asymptomatic subjects. A prospective investigation. *Journal of Bone and Joint Surgery (America)* **72**, 1178–1184.

Briggs M & Closs JS (1999) A descriptive study of the use of visual analogue scales and verbal rating scales for the assessment of postoperative pain in orthopedic patients. *Journal of Pain and Symptom Management* **18**, 438–446.

Cepeda MS, Africano JM, Polo R, Alcala R & Carr DB (2003) Agreement between percentage pain reductions calculated from numeric rating scores of pain intensity and those reported by patients with acute or cancer pain. *Pain* **106**, 439–442.

Clark WC, Ferrer-Brechner T, Janal MN, Carroll JD & Yang JC (1989) The dimensions of pain: a multidimensional scaling comparison of cancer patients and healthy volunteers. *Pain* **37**, 23–32.

Collins SL, Moore RA & McQuay HJ (1997) The visual analogue pain intensity scale: what is moderate pain in millimetres? *Pain* **72**, 95–97.

DeLoach LJ, Higgins MS, Caplan AB & Stiff JL (1998) The visual analog scale in the immediate postoperative period: intrasubject variability and correlation with a numeric scale. *Anesthesia and Analgesia* **86**, 102–106.

Dexter F & Chestnut DH (1995) Analysis of statistical tests to compare visual analog scale measurements among groups. *Anesthesiology* **82**, 896–902.

Dixon JS (1986) Agreement between horizontal and vertical visual analogue scales. *British Journal of Rheumatology* **25**, 415–416.

Fanurik D, Koh JL, Harrison RD, Conrad TM & Tomerlin C (1998) Pain assessment in children with cognitive impairment. An exploration of self-report skills. *Clinical Nursing Research* **7**, 103–119.

Farrar JT, Portenoy RK, Berlin JA, Kinman JL & Strom BL (2000) Defining the clinically important difference in pain outcome measures. *Pain* **88**, 287–294.

Farrar JT, Young JP Jr, LaMoreaux L, Werth JL & Poole RM (2001) Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. *Pain* **94**, 149–158.

Gabre P & Sjoquist K (2002) Experience and assessment of pain in individuals with cognitive impairments. *Special Care Dentistry* **22**, 174–180.

Gallagher EJ, Bijur PE, Latimer C & Silver W (2002) Reliability and validity of a visual analog scale for acute abdominal pain in the ED. *American Journal of Emergency Medicine* **20**, 287–290.

Guyatt GH, Townsend M, Berman LB & Keller JL (1987) A comparison of likert and visual analogue scales for measuring change in function. *Journal of Chronic Diseases* **40**, 1129–1133.

Hinchcliffe KP, Surrall KE & Dixon JS (1985) Reproducibility of pain measurements in rheumatoid arthritis by patients using visual analogue scales. *Phamaceutical Medicine* **1**, 99–103.

Jacobsen M (1965) The use of pain rating scales in clinical research. *British Journal of Psychiatry* **111**, 545–546.

Jamison RN, Gracely RH, Raymond SA, Levine JG, Marino B, Herrmann TJ, Daly M, Fram D & Katz NP (2002) Comparative study of electronic vs. paper VAS ratings: a randomized, crossover trial using healthy volunteers. *Pain* **99**, 341–347.

Jensen TS & Karoly P (1992) Self-report scales and procedures for assessing pain in adults. In *The Handbook of Pain Assessment* (Turk DC & Melzack R eds). The Guildford Press, New York, pp. 135–151.

Jensen MP, Karoly P & Braver S (1986) The measurement of clinical pain intensity: a comparison of six methods. *Pain* **27**, 117–126.

Jensen MP, Turner JA & Romano JM (1994) What is the maximum number of levels needed in pain intensity measurement? *Pain* **58**, 387–392.

Joyce CR, Zutshi DW, Hrubes V & Mason RM (1975) Comparison of fixed interval and visual analogue scales for rating chronic pain. *European Journal of Clinical Phamacology* **8**, 415–420.

Kremer E, Atkinson JH & Ignelzi RJ (1981) Measurement of pain: patient preference does not confound pain measurement. *Pain* **10**, 241–248.

Lara-Munoz C, De Leon SP, Feinstein AR, Puente A & Wells CK (2004) Comparison of three rating scales for measuring subjective phenomena in clinical research. I. Use of experimentally controlled auditory stimuli. *Archives of Medical Research* **35**, 43–48.

Linton SJ & Gotestam KG (1983) A clinical comparison of two pain scales: correlation, remembering chronic pain, and a measure of compliance. *Pain* **17**, 57–65.

Littman GS, Walker BR & Schneider BE (1985) Reassessment of verbal and visual analog ratings in analgesic studies. *Clinical and Pharmacological Therapy* **38**, 16–23.

McCaffrey M & Beebe A (1989) Giving narcotics for pain. *Nursing* **19**, 161–165.

McCormack HM, Horne DJ & Sheather S (1988) Clinical applications of visual analogue scales: a critical review. *Psychological Medicine* **18**, 1007–1019.

Murphy DF, McDonald A, Power C, Unwin A & MacSullivan R (1988) Measurement of pain: a comparison of the visual analogue with a non-visual analogue scale. *Clinical Journal of Pain* **3**, 197–199.

Ogon M, Krismer M, Sollner W, Kantner-Rumplmair W & Lampe A (1996) Chronic low back pain measurement with visual analogue scales in different settings. *Pain* **64**, 425–428.

Ohnhaus EE & Adler R (1975) Methodological problems in the measurement of pain: a comparison between the verbal rating scale and the visual analogue scale. *Pain* **1**, 379–384.

Price DD, McGrath PA, Rafii A & Buckingham B (1983) The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. *Pain* **17**, 45–56.

Price DD, Bush FM, Long S & Harkins SW (1994) A comparison of pain measurement characteristics of mechanical visual analogue and simple numerical rating scales. *Pain* **56**, 217–226.

Price CI, Curless RH & Rodgers H (1999) Can stroke patients use visual analogue scales? *Stroke* **30**, 1357–1361.

Radbruch L, Sabatowski R, Loick G, Jonen-Thielemann I, Kasper M, Gondek B, Lehmann KA & Thielemann I (2000) Cognitive impairment and its influence on pain and symptom assessment in a palliative care unit: development of a Minimal Documentation System. *Palliative Medicine* **14**, 266–276.

Reading AE (1980) A comparison of pain rating scales. *Journal of Psychosomatic Research* **24**, 119–124.

Rosier EM, Iadarola MJ & Coghill RC (2002) Reproducibility of pain measurement and pain perception. *Pain* **98**, 205–216.

Rowbotham MC (2001) What is a 'clinically meaningful' reduction in pain? *Pain* **94**, 131–132.

Royal College of Surgeons & Royal College of Anaesthetists (1990) *Commission on the Provision of Surgical Services: Report of the Working Party on Pain After Surgery*. Royal College of Surgeons and Royal College of Anaesthetists, London.

Scott J & Huskisson EC (1979a) Accuracy of subjective measurements made with or without previous scores: an important source of error in serial measurement of subjective states. *Annals of the Rheumatic Diseases* **38**, 558–559.

Scott J & Huskisson EC (1979b) Vertical or horizontal visual analogue scales. *Annals of the Rheumatic Diseases* **38**, 560.

Serlin RC, Mendoza TR, Nakamura Y, Edwards KR & Cleeland CS (1995) When is cancer pain mild, moderate or severe? Grading pain severity by its interference with function. *Pain* **61**, 277–284.

Snow S & Kirwan JR (1988) Visual analogue scales: a source of error. *Annals of the Rheumatic Diseases* **47**, 526.

Spence A (2000) *Services for Patients with Pain; Report of a CSAG Committee*. Department of Health, London.

Turk DC & Melzack R (1992) The measurement and assessment of people in pain. In *Handbook of Pain Assessment* (Turk DC & Melzack R eds). The Guildford Press, New York, pp. 3–12.

Van Tubergen A, Debats I, Ryser L, Londono J, Burgos-Vargas R, Cardiel MH, Landewe R, Stucki G & Van Der HD (2002) Use of a numerical rating scale as an answer modality in ankylosing spondylitis-specific questionnaires. *Arthritis and Rheumatism (Arthritis Care and Research)* **47**, 242–248.

Wiesel SW, Tsourmas N, Feffer HL, Citrin CM & Patronas N (1984) A study of computer-assisted tomography. I. The incidence of positive CAT scans in an asymptomatic group of patients. *Spine* **9**, 549–551.

Windsor AM, Glynn CJ & Mason DG (1996) National provision of acute pain services. *Anaesthesia* **51**, 228–231.

Woodforde JM & Merskey H (1972) Some relationships between subjective measures of pain. *Journal of Psychosomatic Research* **16**, 173–178.

