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Evaluating Full Cup Study, Numeric Pain Rating Scale, and Visual Analogue Scale in Assessing Pain after Surgical Removal of Lower Third Molar

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ABSTRACT

The objectives of this study is to evaluate the suitability of full cup test (FCT), numeric pain rating scale (NPRS), and visual analogue scale (VAS) to assess pain after surgical removal of lower third molar and to identify which of these three pain scales is the easiest to use. A total of 50 patients, age between 18 to 30 years who underwent minor oral surgery for removal of impacted third molar were sampled in Faculty of Dentistry, University of Malaya. The patients were provided with forms containing three pain scales and they were required to mark each pain scales – FCT, NPRS and VAS daily for three consecutive post-operative days. The forms were collected a week later when patients came back for review. The validity between NPRS with VAS, FCT with NPRS and FCT with VAS were tested using Spearman rank correlation coefficient. Results showed that the correlation coefficient values for each pair were very high and significant. The findings when comparing Day 1, Day 2 and Day 3 and the combination for those three days showed no significant differences. No evidences indicated that the findings for Day 1 were more superior in comparison with other days. In conclusion, FCT was as valid as NPRS and VAS. The pain scale which was claimed to be the easiest to use by patients was NPRS, followed by FCT and VAS. However, further studies are needed to investigate the reliability and sensitivity of FCT.

Keywords: Full cup test (FCT); Numeric pain rating scale (NPRS); Visual analogue scale (VAS); Validity; Spearman Rank Correlation Coefficient; Pain scales.

INTRODUCTION

An impacted tooth is one that fails to erupt into the dental arch within the usual range of expected time (1). The tooth becomes impacted because of adjacent teeth, dense overlying bone, excessive soft tissue or genetic abnormality which prevents eruption (1). Impacted third molar can be removed surgically as it is a common oral surgery procedure (2). This surgery usually causes post-surgical sequelae like pain, trismus and swelling as a result of postoperative inflammatory response (3). Among these sequelae, pain is thought to be the most crucial and essential for the patient, and pain intensity is one of the main factors which influence a person's sense of well-being (4).

International Association for the Study of Pain (IASP) has defined pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage"(5). Furthermore, the American Society of pain promoted the statement "pain as the fifth vital sign" mainly to increase and promote awareness of pain treatment among healthcare professionals. American Pain Society also stated that if pain is assessed with the same zeal as other vital signs, it would be treated more appropriately

(6). As such, doctors and nurses should be trained to treat pain as a vital sign to ensure better quality care (6).

Pain can be categorised into somatic pain and visceral pain. Somatic pain can be described as sharp, shooting, stinging pain which is localized and usually associated with surrounding discomfort and tenderness and patients are able to pinpoint the exact pain location (5). Hence, somatic pain would be the pain patients will be experiencing after the minor oral surgery removal of impacted third molar. On the other hand, visceral pain can be described as dull and cramping, which is often poorly localised and may be associated with tenderness locally or in the area of referred pain, or with symptoms such as nausea, sweating and cardiovascular changes (5).

It is important to emphasize that pain as the fifth vital sign is a screening mechanism for identifying unrelieved pain (4-5). Screening and assessment for pain can be applied immediately for most patients on a routine protocol. As with any other vital sign, a positive pain score should trigger further assessment of the pain, prompt intervention, and follow-up evaluation of the pain and the effectiveness of treatment so that appropriate pain management and treatment such as prescribing analgesic and its right dosage can be carried out instantly (6) so that a person's sense of well-being and quality of life will not be affected (4-6).

The ability of our body's somatosensory system to detect potentially tissue damaging and harmful stimuli is an important protective mechanism which involves both the body's peripheral and central mechanisms (5). Tissue damage such as inflammation from the surgery will activate peripheral nociceptors and results in secretion of inflammatory cells, enzymes, pro-inflammatory cytokines, anti-inflammatory cytokines and chemokines (5). Following peripheral activation, nociceptive afferent neurons will modulate, signal and conduct neuronal action potentials (5). These action potentials are then projected to multiple parallel ascending pathways from the spinal cord to the cortex, forebrain and midbrain, resulting in the formation of "pain sensation" (5).

The interpretation, definition and explanation of pain underlie the complexity of its measurement and assessment. Pain is an individual and subjective experience modulated by physiological, psychological and environmental factors such as fear, anxiety, nature of treatment, prognosis of treatment, previous experiences and culture (5). Since there is no pain thermometer or ruler, measurement of pain must depend on inferences healthcare professionals can make based on patients behaviors or based on self-report (5-6).

The Visual Analogue Scale (VAS), Numerical Pain Rating Scale (NPRS), Verbal Rating Scale (VRS) are among the most commonly used measures of pain intensity in clinical and research settings (6-7). VAS has been proven to be reliable, valid and provides a high degree of resolution and is probably the most widely-used single-item measuring tool in clinical pain research (6, 8-9). On the other hand, NPRS is also commonly used because in adults. It has shown excellent psychometric properties, and it is often recommended over other measure because of its much strength and relatively few weaknesses (10-11).

Of late, a pain assessment scale called Full Cup Test (FCT) has been suggested for pain evaluation. It is claimed to be easy to use for the patient and it allows using parametric tests that are more powerful for statistical analysis (12). The FCT was also said to be more suitable to assess pain with patients who have lower educational backgrounds (13). The objectives for this study are (i) to verify whether FCT is a suitable pain scale to evaluate pain in comparison with the established NPRS and VAS after surgical removal of lower third molar and (ii) to rank which of these pain scales is the easiest to use by patients.

MATERIALS AND METHOD

This study was approved by the Ethical Committee of Faculty of Dentistry, University of Malaya. A total of 65 patients, age between 18 years to 30 years who will be undergoing minor oral surgery procedure for removal of impacted lower third molars in Department of Oro-Maxillofacial Surgical and Medical Sciences, Faculty of Dentistry, University of Malaya were sampled. The patients sample was demographically based on the capability of communicating in English, Malay and Mandarin languages so that the research information could be conveyed to them with ease. However, only 50 patients completed the study.

Before conducting this research, consent for both surgery and research participation was taken from patients. To standardise the procedure, the surgical removals of impacted third molars were performed under local anaesthesia by postgraduate surgical trainees in oral and maxillofacial surgery. The standard criteria for case selection involved moderate mesioangular impaction. In addition, standardised surgical protocols were adhered to, such as the use of two cartridges of local anaesthesia, ward or envelope incision, raising of the mucoperiosteal flap, creation of buccal bony gutter until tooth bifurcation can be visualized, tooth sectioning and elevation of sectioned tooth. The extraction sockets were debrided with normal saline and primary wound closure was done with two sutures. The patients

were prescribed with 1g of paracetamol tds and 500mg mefenamic acid bd in for pain control.

After the surgery, each patient will be given a form, with 3 pain scales, and an information sheet attached. Each of the three pain scale was also explained to every patient. The patients were required to mark the pain scales daily, for three postoperative days. Day 1 was considered as day of surgery. After Day 3, patients were then asked to choose which pain scale was the easiest to use and provide any reasons if any.

The forms contained three different pain scales, which were FCT, NPRS and VAS. FCT was represented by a "cup" drawing measuring 6 cm in height. The patients were told that the "cup" is full indicating the most severe pain experienced (13). And the cup is empty if there is no pain (12). Patients will then draw a horizontal line within the cup to indicate their pain level, as if the cup was filled with pain (13). Scores of FCT were calculated using this formula: height of cup/6cm x 10. The NPRS contained a scale of numbers, 0 – 10 on a simple horizontal line, with 0 being no pain at all and 10 being the most imaginable pain. Patients were then informed to circle or mark their numbers of choice to represent their pain level. The VAS on the other hand, consists of a simple 10 cm horizontal line with the word anchors of "no pain" at the left end and "worst imaginable pain" on the right end.

After one week, patients were called back for review and their resorbable sutures removed if requested. The pain scale forms were then collected from the patients. Data were tabulated and analysed using IBM SPSS (Statistical Package for the Social Sciences) Statistics software version 12.0.1. The correlation and agreement between a pair of pain scales were evaluated using Spearman rank coefficient (12).

RESULTS

A total of 65 patients who had undergone minor oral surgery to remove impacted third molars were given the pain scale forms. Out of 65 patients, 50 patients came back for review and had their resorbable sutures removed. They did not experience any post-operative complications after the minor oral surgery. The forms were collected and the results were analysed. The pain scales correlation and agreement were done between NPRS with VAS, FCT with NPRS and FCT with VAS.

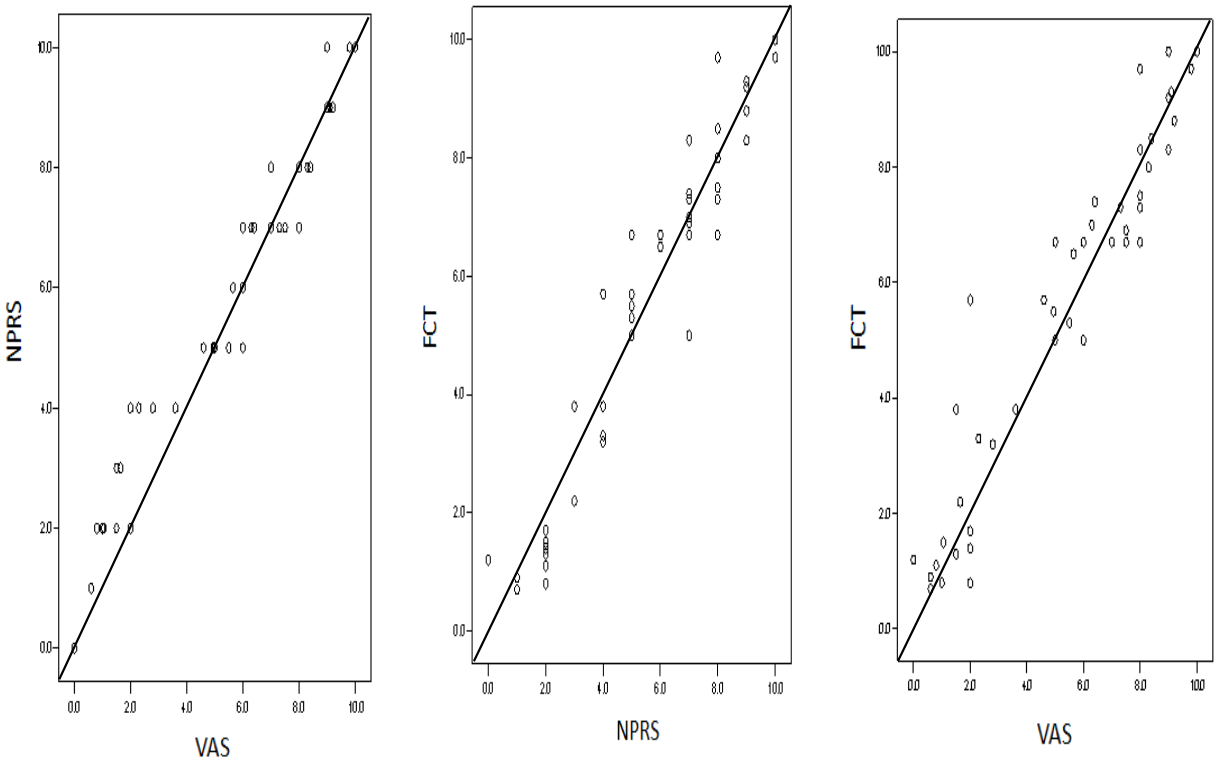

Figure 1A: Relationships between 3 pairs of pain scales on Day 1

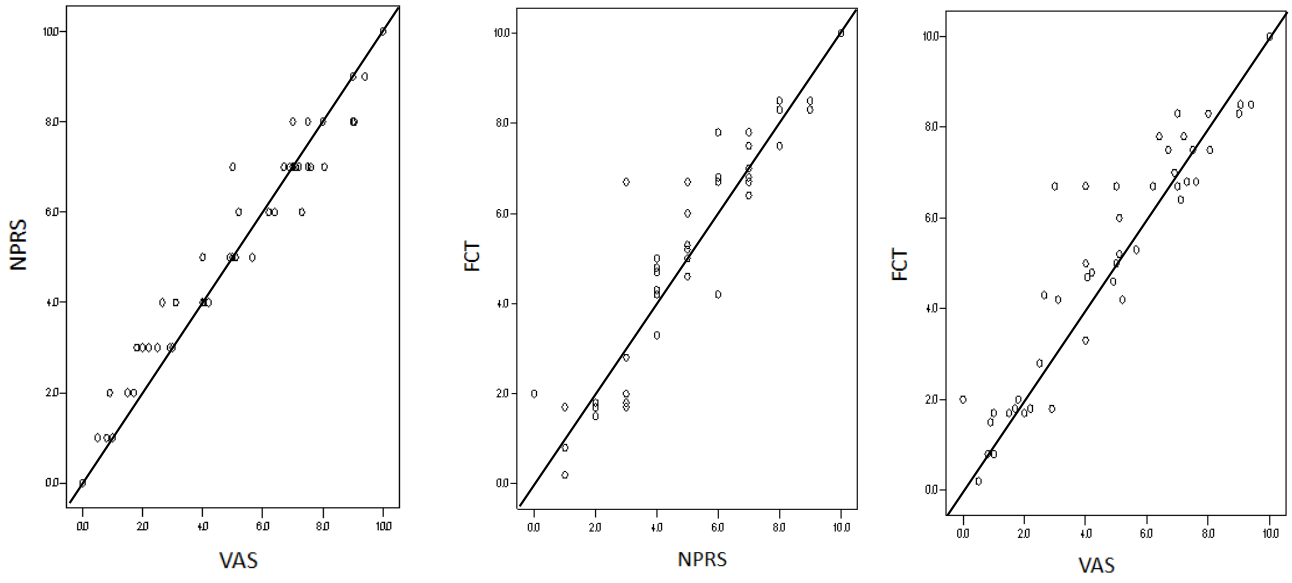

Figure 1B: Relationships between 3 pairs of pain scales on Day 2

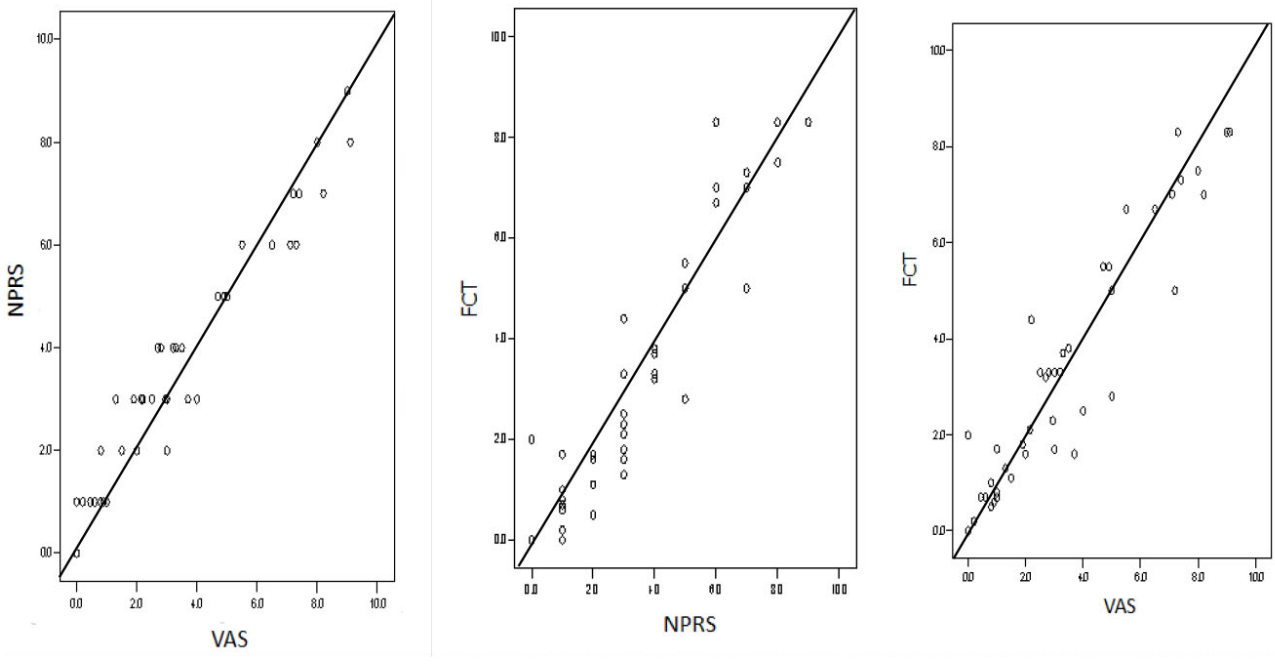

Figure 1C: Relationships between 3 pairs of pain scales on Day 3

The relationships between NPRS and VAS, FCT and NPRS as well as FCT and VAS on Day 1 increase monotonically, indicating that Spearman rank coefficient can be applied (Figure 1). Correlations among the three pain scales on Day 1 were very high and significant (2-tailed) where $P < 0.01$ (Table 1) indicating a strong linear relationship between each pair of pain scales.

Table 1: Correlation coefficients between 3 pairs on pain scales on Day 1

Scales	Correlation coefficient		
	Day 1	Day 2	Day 3
NPRS and VAS	0.978	0.969	0.959
FCT and NPRS	0.956	0.938	0.920
FCT and VAS	0.948	0.935	0.924

The relationships between NPRS and VAS, FCT and NPRS as well as FCT and VAS on Day 2 increase monotonically, indicating that Spearman rank coefficient can be applied (Figure 1B). Correlations among the three pain scales on Day 2 were very high and significant (2-tailed) where $P < 0.01$ (Table 1) indicating a strong linear relationship between each pair of pain scales.

The relationships between NPRS and VAS, FCT and NPRS as well as FCT and VAS on Day 3 increase monotonically, indicating that Spearman rank coefficient can be applied (Figure1C). Correlations among the three pain scales on Day 3 were very high and significant (2-tailed) where $P < 0.01$ (Table 1) indicating a strong linear relationship between each pair of pain scales.

The average relationships between NPRS and VAS, FCT and NPRS as well as FCT and VAS for the combined 3 days increase monotonically too, indicating that Spearman rank coefficient can be applied (Figure 2). Correlations among the average three pain scales on were also very high and significant (2-tailed) where $P < 0.01$ (Table 2) indicating a strong linear relationship between each pair of pain scales.

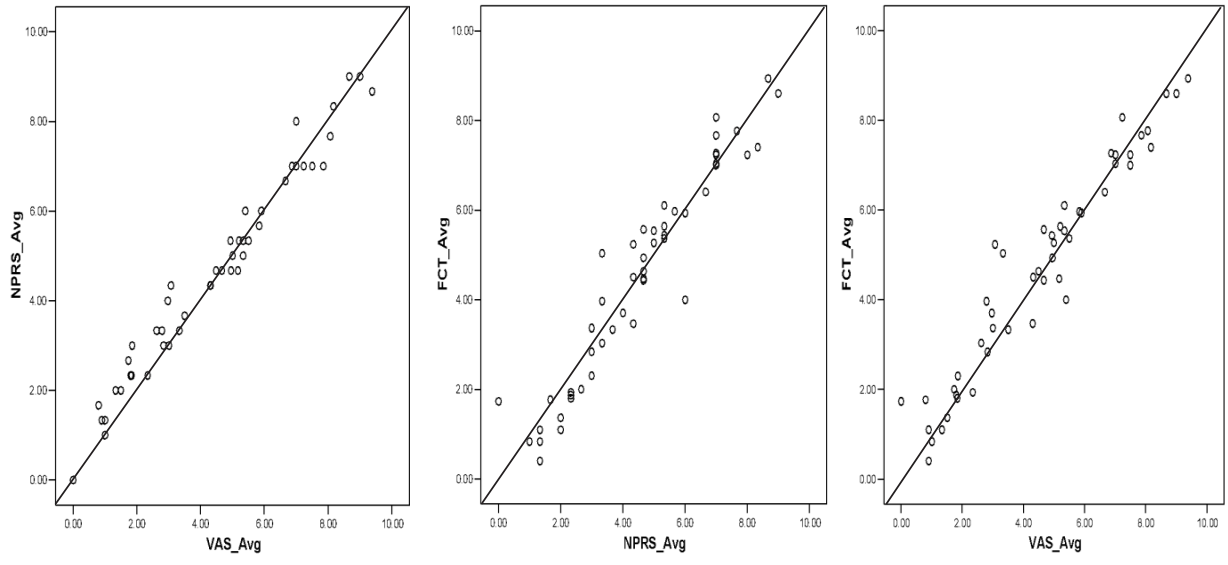

Figure 2: Average (Avg) relationships between 3 pairs of pain scales

Table 2: Average correlation coefficient between 3 pairs of pain scales

Scales	Correlation Coefficient
NPRS and VAS	0.987
FCT and NPRS	0.967
FCT and VAS	0.963

The findings when comparing Day 1, Day 2 and Day 3 showed no significant differences. No evidences indicated that the findings for Day 1 were more superior in comparison with other days.

28 patients out of 50 chose NPRS as the easiest pain scale to use followed by FCT chosen by 13 patients and VAS chosen by 9 patients (Figure 3).

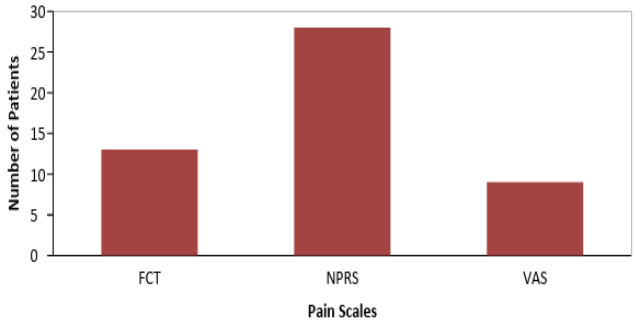

Figure 3: Patients' opinion on which pain scale is the easiest to use

Out of the 50 respondents, only 7 patients provided reasons for their choice - 4 for NPRS, 2 for FCT and 1 for VAS (Table 3). NPRS was the easiest

to them mainly because its simplicity and familiarity. However, 2 out of 13 patients who chose FCT mentioned they preferred FCT because they were able to express and imagine their pain better using an imaginary cup.

Table 3: Patients' reasons for their choice of pain scale

Pain Scales	Reasons
NPRS	Easy and clear Used to Numeric pain rating scale Simple to use Faster compared to VAS and FCT
FCT	Expresses pain better Able to imagine better using a cup
VAS	Simple and Easy

DISCUSSION

Pain after minor oral surgery is categorized as somatic pain (3, 5). Somatic pain may be portrayed as localized sharp and stinging pain, associated with localized tenderness and swelling and patients are able to pinpoint the exact location of pain (5). Accurate and reliable pain assessment is essential to ensure that patients experience safe, effective and individualised pain management (5). Moreover, pain assessment is needed to monitor or to predict the course of a disease state, to test hypothesis concerning the impact of pain on other outcomes or measures of functioning, or to place patients into specific diagnostic groups (14). In addition, regular and repeated pain assessment is necessary to assess the adequacy of analgesic prescription so that healthcare professionals are able to control and treat pain more appropriately (5, 17). Inadequate pain management will lead to adverse psychological and physiological deterioration for individual patients and their families.

Patients experience pain in various ways and they may become anxious and depress and some may resort to suicide. Moreover, pain causes stress and their endocrine system reacts by releasing exaggerated amount of hormone, excessive proteins, carbohydrates and glucose breakdowns as well as releasing other harmful, noxious and toxic substances to the body (17). Furthermore, continuous untreated pain may put healthcare professionals at risk for legal actions and hospitals may lose their reputation and profits (17). In this study, an effective and valid pain scale is imperative for clinical purposes. Therefore, we asked patients to mark the pain scales for three consecutive post-operative days using there different pain scale namely: NPRS, FCT and VAS (5).

The NPRS and VAS are the two most extensively used pain measuring tools in research projects investigating pain (6, 7, 14, 16). The FCT, on the other hand, has been introduced to establish a self-reported pain evaluation (12). In our study, these pain scales were compared to this efficiency.

NPRS is a versatile and well-validated tool (6, 16). A large number of researches had supported the reliability and validity of NPRS as a single index of pain intensity or severity, and it compares favourably to other commonly employed pain scales like VAS (6). Slightly more than 50% of patients from this study chose NPRS as the easiest pain scale to be used in comparison to both VAS and FCT and this statement had been supported by Jaywant *et al.* (2003) (18). Two respondents also stated that NPRS was simple to use, easy and clear. Furthermore, the NPRS is straightforward and quick to use and the results are simple to record (5, 16). This is in agreement with one of the respondents who wrote that marking NPRS was faster compared to VAS and FCT. Another advantage of NPRS is that it is simple for practitioners to describe and can be administered orally without requiring any instrumentations (visual aids) unlike the VAS and FCT (6, 16). However, the drawback of NPRS is that, some patients have difficulty visualizing their pain in numerical terms and cannot complete the pain assessment due to their confusion and thus, they are more suited to a categorical scale such as the verbal rating scale (5, 16). As a research tool, the metrics for NPRS have not been fully characterized as the VAS, but in clinical use the thresholds are consistent with those of VAS (16).

The VAS scale is well described in research and has been proven valid and reliable (7, 16) as well as a sensitive clinical measure of pain that is amenable to statistical analysis (16). In terms of sensitivity, both NPRS and VAS are equally sensitive and no one scale shows greater sensitivity than the other (14). Like NPRS, VAS is also relatively simple, easy and quick to use (5, 16), although more than half of the sample chose NPRS as the easiest pain scale to be marked. VAS allows a wide choice of ratings and avoids imprecise descriptive terms (5). As proven by the correlation coefficient values between NPRS and VAS for Day 1, Day 2, Day 3 and combination for those 3 days, both pain scales showed positive correlation and were highly valid. One of the drawbacks of VAS is that VAS is a one-dimensional measure of pain intensity and it cannot represent all aspects of pain perception such as measuring severe pain situations, sensation immediately after local anaesthesia (16) and acute pain in cancer patients (14). Unlike NPRS which can be relayed verbally as discussed previously, conventional VAS has no visual aid and can only be utilized by patients marking the scales themselves, which may pose a problem

in physically disabled patients. Additionally, VAS requires patients to equate the level of pain they are experiencing with the length of the pain scale line (12).

From this study and other various studies, NPRS and VAS have been proven valid through their correlation coefficient values (5, 14, 16). Hence, FCT was compared with both NPRS and VAS and the results showed that all correlation coefficients values were close to +1, indicating very strong correlation between FCT with NPRS and FCT with VAS. This proved that FCT was also as valid in comparison to NPRS and VAS. FCT which is a newer self pain assessment tool was claimed to have the advantages of VAS without its practical difficulties and the "cup" metaphor eliminates the conceptual complexity of VAS (12). From our study, more patients chose FCT (13 patients) over VAS (9 patients) as the easier pain scale to be used. However, NPRS was still the most preferable pain scale to be used when compared with VAS and FCT.

Ergün *et al.* (2007) stated that FCT is useful for different types of pain, sensitive to change and also useful in patients with low education because the average number of times required explaining VAS was approximately two times more in contrast to FCT as it does not need any numerical or word skills, and is easy to understand and to complete (13). As with VAS, the data obtained from FCT can be used for parametric test (12). Furthermore, FCT has the self-report component on pain which is usually the best indicator for the pain level an individual is experiencing and this is in agreement with Katz (19). From our study, two out of nine patients who chose FCT as the easiest pain scale stated that FCT was able to express pain better and pain can be better imagined using a "cup".

Recording pain as the fifth vital sign aims to increase and elevate awareness among healthcare professionals as well as utilization of pain assessment tool to improve pain management among patients (5, 6, 17). In order to so, pain assessments have to be implemented because controlling and treating pain, including type of analgesia and dosage are based on pain intensity (17). Hence, implementing pain assessment tools in clinical or healthcare settings as well as making clinicians to practice and document pain assessment protocol on a routine basis would be good suggestions (6, 17). Enforcing pain assessment tools can be achieved by: i. providing education for healthcare providers by incorporating pain assessment into initial orientation and ongoing education of all appropriate staff, ii. providing routine documentation and pain scales for assessment, iii. identifying educational resources such as published material or information which can be readily adapted for use among healthcare providers, and iv. educating patients and their family about pain assessment, screening and the responsibilities of healthcare providers (5).

During post-operative period in a surgical or non-surgical setting, pain assessment must be made simple and brief for clinicians to explain and patients to complete. Therefore, pain scales such as NPRS, VAS and FCT which have been proven valid and easy to use in this study, especially NPRS can be implemented and practiced by healthcare professionals. For patients with lower educational level, FCT would be suitable choice for pain assessment instead (12). And for patients with limited cognitive ability, scales with drawings or pictures such as the Wong-Baker FACES scale can be implemented (17). Selecting a pain assessment tool between a clinician and patient should be synergistic and collaborative decision and it should be done before surgical procedures so that patients will be familiarised with the pain assessment tool (17).

There were a few limitations to this study. The sample size targeted for this study was 60 patients because in Spearman rank correlation, the tables of critical values have a limited range of possible sample size, and in the Companion to Advance Mathematics and Statistics, the sample size has a maximum of 60 samples (20). During the conduct of this study, a total of 65 patients were sampled to reach our target sample size. However, only 50 patients came back for review and submitted their forms. Even though patients were reminded a day before their review appointment via text messages and phone calls, they still failed to show up. Hence, we were not able to collect the forms. Text-messages and phone calls are increasingly being used as reminders to help and improve patient's compliance and this is in agreement with Marissa (21). Both patient and the healthcare provider affect compliance. Thus, a positive physician-patient relationship is the most important factor in improving compliance (22).

Nonetheless, additional studies incorporating larger samples are indispensable in justifying the findings of this study. Pain rating scales have a fundamental place in clinical practice. For instance, result from this study suggested that patients were able to express their pain experience more easily through FCT. 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 health care professionals (16). Thus, it is suggested that either NPRS or FCT should be used in the Faculty of Dentistry, University of Malaya as pain assessment tools because both NPRS and FCT were proven valid in assessing pain.

CONCLUSION

FCT, similar like the much established NPRS and VAS, is suitable method to measure pain. However, the easiest pain scale to be used was NPRS, followed by FCT and VAS. Further studies are needed to investigate the reliability and sensitivity of FCT.

DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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