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Original Research Article

Construction and Validation of a Visual Instrument for the Evaluation of Pain Intensity and Location of Pain in Traumatic Brachial Plexopathy in Adults

Celia Maria Oliveira[1], Jose Augusto Malheiros[2]*, Marcelo Magaldi de Oliveira[3], Dacle Vilma Carvalho[4], Selme Silqueira de Matos[5] and Cassia Maria de Oliveira Mercadante[6]

[1]Federal University of Minas Gerais (UFMG), Nursing Faculty, Belo Horizonte/MG, Brazil.
[2]Federal University of Minas Gerais (UFMG), Neurosurgery Department, Belo Horizonte/MG, Brazil.
[3]Federal University of Minas Gerais (UFMG), Neurosurgery Department, Belo Horizonte/MG, Brazil.
[4]Federal University of Minas Gerais (UFMG), Nursing Faculty, Belo Horizonte/MG, Brazil.
[5]Federal University of Minas Gerais (UFMG), Nursing Faculty, Belo Horizonte/MG, Brazil.
[6]University Center of Brasilia (UNICEUB), Psychology Department, Brasilia/DF, Brazil.

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Background: **In brachial plexus injury, pain is a prevalent symptom and requires careful handling. Existing scales to evaluate such pain are inaccurate and difficult to apply.** ***Objective:*** **To construct a visual instrument with a color scale for the location and measurement of pain intensity in adults with brachial plexopathy.** ***Methods and results:*** **A total of 53 patients were evaluated between December 2010 and December 2011 at the Felicio Rocho Hospital (Hospital Felicio Rocho) and Clinical Hospital, Federal University of Minas Gerais (Universidade Federal de Minas Gerais – UFMG). Forty-seven patients (88.7%) had pain and agreed to participate. The 47 diagrams colored by patients were evaluated and compared by three peripheral nerve specialists. After examining and defining the patients' injuries, the diagrams were compared to evaluate their reliability. The reliability index was 98.6%, and the Kappa index agreements were as follows: k = 0.677 for upper trunk (substantial agreement); k = 0.709 for middle trunk (substantial agreement); k = 0.884 for lower trunk (excellent agreement); and k = 0.500 for full injury (moderate agreement).** ***Conclusion:*** **The visual instrument was useful in locating and measuring pain intensity in patients with brachial plexopathy.**

Keywords: Brachial Plexopathy, Pain, Pain Intensity, Visual Instrument Scale.

INTRODUCTION

Traumatic brachial plexus injury is a complex problem and has a significant prevalence in big cities. In addition to the potential sequela of neurological dysfunction, neuropathic pain is a frequent complaint and is difficult to manage. One of the difficulties in the approach to brachial plexus pain is the systematization and quantification for monitoring and management.

Pain evaluation methods are scarce, and indirect evaluations are often performed using resources such as case reports and behavioral measures. There is a lack of systematization and quantification of the various tables. The most commonly used scales are the Visual Numerical Scale, Verbal Quantification Scale, Faces Pain Scale and Color Analogue Scale (JENSEN; KAROLY; BRAVER, 1986). Therefore, there is a gap in the literature with regard to an instrument that can precisely identify pain in brachial plexopathy, be easily applied, represent intensity and location along the plexular path, and be used in the clinical management of these patients.

OBJECTIVE

To construct a visual instrument with a color scale for the location and measurement of pain intensity in adults with brachial plexopathy that can be used when monitoring these patients.

**Corresponding Author: Jose Augusto Malheiros, Ph.D. Federal University of Minas Gerais (UFMG), Neurosurgery Department. Belo Horizonte/MG, Brazil. Tel: +55 31 98899 8039 Fax: +55 31 3295 2434 Email: joseaugustomalheiros@gmail.com*

METHODS AND RESULTS

First stage

Application of visual instrument

Data collection was prospectively performed from December 2010 to December 2011 at the Felicio Rocho Hospital and Clinical Hospital, Federal University of Minas Gerais (Universidade Federal de Minas Gerais – UFMG), with a total of 53 patients. Of these patients, 47 (88.7%) patients presented pain and agreed to participate in the study. All patients accepted and signed the terms of free and informed consent and underwent a pain evaluation.

After the collection of personal and clinical data, the patient was introduced to the pain intensity level scale and body diagram. Data collected on personal and clinical characteristics were entered into an Excel spreadsheet and analyzed using R software, version 2.15.0. In the data collection process for color scale validation, 4 different colored pencils (black, yellow, red and orange) were presented to the patient. The patient was then asked to relate the colors to the pain intensity levels and to color each scale level with one color, according to their perception.

After coloring the color scale according to the pain intensity levels, the patients were asked to rate the intensity of their pain in the upper limb and to color the area or areas where they felt pain using the color or colors that corresponded to the pain intensity. The patients were involved in the activity and showed no difficulty in completing the instrument (FIGURE 1).

Second stage

After data collection, each diagrammatic pain representation was analyzed, and the correlations of the colored area(s) with the dermatomes and the corresponding nerve trunk were recorded. As there is no "gold standard" test for diagnosing the types of brachial plexus injury, it was decided to use the clinical neurological analysis of three peripheral nerve specialists. After the neurological evaluation, the specialists recorded their diagnostic impression and the intensity (mild, moderate or severe) of the top, middle and bottom trunk involvement, as well as that of all trunks.

The 47 body diagrams completed by the patients were presented to the specialists, along with the diagrammatic interpretations. The specialists were asked to analyze each diagrammatic pain representation, correlating the colored area(s) with the dermatomes and the corresponding nerve trunk. They were then asked to indicate on record whether they did not agree, fully agreed or partially agreed with the analysis. If they did not agree or partially agreed, then they were asked to describe their evaluation.

Each specialist evaluated 47 body diagrams, producing a total of 141 evaluations. Two specialists fully agreed with all the evaluations made by the researcher, and one specialist partially agreed with two evaluations and fully agreed with the rest of the evaluations (45). There was, therefore, consensus on 139 of the 141 ratings, achieving a Reliability Index (RI) of 98.6%.

Validation of the instrument regarding pain location

The criterion of validity was used to validate the instrument regarding pain location. Only patients who underwent a surgical procedure were considered for this validation, for a total of 35 patients (74.5%). It should be noted that this standard was chosen to serve as a reference for the analysis of the pain representation locations on the body diagram and was not used to diagnose injured nerve trunks.

The kappa coefficient (COHEN, 1960) was used to verify the existence and intensity of correlations between the representation on the body diagram and the specialist's evaluation reports for each nerve trunk (upper, middle, lower and all trunks). Performance measures such as sensitivity and specificity were also calculated (TABLE 1).

A significant correlation was thus found between the pain representation in the diagram and the neurological examination, for all nerve trunks. According to the Kappa indices, the agreement found for each trunk was classified as follows:

- upper trunk (k = 0.677) substantial agreement,
- middle trunk (k = 0.709) substantial agreement,
- lower trunk (k = 0.884) excellent agreement, and
- all trunks (k = 0.50) moderate agreement.

DISCUSSION

Brachial plexus injuries generally cause limitations that range from mild to severe, with socioeconomic repercussions for the person and family and high costs for the health system (FLORES, 2006). In addition to the limitations imposed by the neurological deficit itself (ranging from tingling to "flail arm" monoplegia), most of these patients experience refractory pain that is difficult to manage and that contributes to a worsening of the dysfunction imposed by traumatic brachial plexopathy.

Pain management in these patients, as well as correct evaluation using body diagrams, is therefore, necessary to complement motor and sensory neurological evaluations. To locate pain, the authors recommend the use of body diagrams, wherein the patient shows or indicates the painful area or areas (PEPPER; CRUZ; SANTOS, 1998). However, when addressing pain due to peripheral nerve injury, such as in the case of the brachial plexus, where pain is characterized as diffuse, radiated and in shock, this type of identification does not cover the extent of plexopathic pain. The instrument constructed in the present study allows the patient to locate, measure the intensity of and portray the extent of his pain on the body diagram. In addition, there was a correlation between pain severity and brachial plexus injury.

Regarding the distribution of pain locations on the body diagram, it was observed that the majority (85.1%) of patients located their pain in more than one upper limb region, but all such representations included the extremity of the limb. Given that 8.5% of the patients located their pain only in the extremity of the limb, 93.6% presented pain in the extremity of the upper limb. This result is in agreement with the study by Teixeira (1999) regarding the involvement of nerve roots, which is usually characterized by the occurrence of pain in the extremities and intermediate portions of the upper limbs.

The sensitivity index for pain location on the body diagram was moderate for the upper trunk, low for the middle and lower trunks and high when the injury reached all the nerve trunks. With regard to instrument sensitivity, these results show that the patients' pain representation was wider spread than the injured area of the trunk, i.e., there was retracted pain in other regions in addition to the injured locations identified by surgery. This result may be related to the characteristics of neuropathic pain identified by Teixeira and Yeng (2006) as diffuse, radiated, in shock, burning, tingling, and pricking.

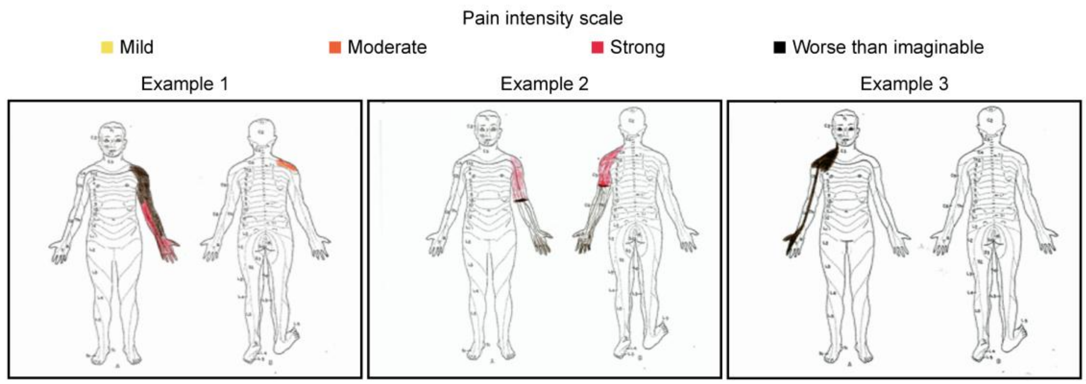

Figure 1: Three examples of the brachial plexus pain in three different patients. The patients were asked to rate the intensity of their pain and to color in this dermatome diagram.

Table 1: Contingency and Kappa Coefficient between Test and Diagnosis for each nerve trunk.

Upper Trunk Body diagram	Surgical report: No N	No %	Surgical report: Yes N	Yes %	Total N	Total %	Kappa	P-value
No	18	85.7	7	50.0	25	71.4	0.6774	<0.001
Yes	3	14.3	7	50.0	10	28.6		
Total	21	100.0	14	100.0	35	100.0		

Middle Trunk Body diagram	Surgical report: No N	No %	Surgical report: Yes N	Yes %	Total N	Total %	Kappa	P-value
No	24	96.0	9	90.0	33	94.3	0.709	<0.001
Yes	1	4.0	1	10.0	2	5.7		
Total	25	100.0	10	100.0	35	100.0		

Lower Trunk Body diagram	Surgical report: No N	No %	Surgical report: Yes N	Yes %	Total N	Total %	Kappa	P-value
No	30	93.8	2	66.7	32	91.4	0.8848	<0.001
Yes	2	6.3	1	33.3	3	8.6		
Total	32	100.0	3	100.0	35	100.0		

All trunks Body diagram	Surgical report: No N	No %	Surgical report: Yes N	Yes %	Total N	Total %	Kappa	P-value
No	8	47.1	2	11.1	10	28.6	0.503	<0.001
Yes	9	52.9	16	88.9	25	71.4		
Total	17	100.0	18	100.0	35	100.0		

- upper trunk - specificity of 85.7%, sensitivity of 50% and positive predictive value (PPV) of 70%.
- middle trunk - specificity of 96.1%, sensitivity of 10% and positive predictive value (PPV) of 50%.
- lower trunk - specificity of 93.8%, sensitivity of 33.3% and positive predictive value (PPV) of 33.3%.
- all trunks - specificity of 47.1%, sensitivity of 88.9% and positive predictive value (PPV) of 64%.

Another factor that may be related to the aforementioned results is that central mechanisms also participate in peripheral neuropathies, as pain often reaches regions that are distant from the damaged nerve structures (BASBAUM, 1974). It should be emphasized that there may be microinjuries in brachial plexus traumas that are not detected in surgery. This factor may also have contributed to the low sensitivity of the instrument, i.e., the patient reported more painful areas than those corresponding to the injuries detected by neurological examination.

The specificity index was high for the upper, middle and lower trunk and moderate for all nerve trunks. These results show that pain identification on the body diagram is highly correlated with the presence of injury, that is, when pain was not represented in a specific region of the upper limb, there was no detected injury in the corresponding nerve trunk.

This visual instrument allowed us to view the patient's pain in a simple and objective way. Furthermore, we observed a correlation between pain intensity and injury severity that was not previously described in the literature. These characteristics can help both in the initial evaluation and in potential use as an instrument for long-term monitoring and management of pain in these patients, thereby optimizing the treatment of pain that is often not handled in a satisfactory manner.

CONCLUSION

The studied visual instrument is useful for locating and measuring pain intensity in patients with brachial plexopathy.

CONFLICT OF INTEREST STATEMENT

All the authors declare no conflicts of interest.

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